Chapter 1: Measuring Philadelphia

Novelist John Wideman describes standing on the steps of the Philadelphia Art Museum at night overlooking the Benjamin Franklin Parkway and the streets below:

 "I belong to you, the city says. You can grasp the pattern. Make sense of me. Connect the dots. I was constructed for you. Like a field of stars, I need you to bring me to life."

But, he warns, beware. The city catches you up, fools you, captures you:

"Love you. Love you not."

From higher on the hill, he reads larger figures:

"Would you believe in the magic pinwheel of lights, straight lines, exact proportions, symmetry of spheres within spheres, gears meshing, turning, spinning to the perpetual music of their motion?"

He marvels that someone somehow conceived the city that way, imagined the city as he sees it. Wideman suddenly finds himself an occupant of someone else's dream.   At that moment, he steps back and resolves to keep his distance, to think of himself as a reporter covering a story in a foreign country:

"Stay on his toes, take nothing for granted. What he sees is not what the natives see… At best he can write the story of someone in his shoes passing through."[1]

The dimensions of Philadelphia carry the dreams of its makers into the habitual motions of its citizens. The measures of architects and of building tradesmen order the rhythmic pattern of streets, houses, shop windows, and parking stalls, giving scale to each stride.[2] A walk or a drive through the streets, as Wideman observes, enacts the pattern, as a dance enacts music, playing over and through the measures of the city.   The walker, like the dancer, moves freely in real time, supported by and anticipating the rhythm underfoot, yet only outside the motion does the larger structure of music and city appear.

Philadelphia's urban pattern, woven in the rhythm of the streets, is scarcely visible at ground level. Yet all citizens can summon a mental version of it, combining maps, habitual routes and familiar landmarks into an imagined city that carries the geometric dream of its architects.[3] From that image, Wideman makes the next mental leap from geometric form and proportion to a music of the spheres that orders the motions of earth and planets. The ease of his transition evokes a classical analogy between architecture and cosmology that was built into the tradition of design and familiar to educated citizens until the twentieth century.   At that metaphoric precipice however, Wideman halts. The dream he sees must belong to someone else. He is a stranger and does not share the vision that made the city, so he must remain on guard lest the patterned web that he sees

before him carry him away. The distance that he reminds himself to maintain as a reporter and novelist is also that of the architect who interprets the urban patterns in order to make one more modification to the city.

The built patterns of Philadelphia that impressed Wideman were platted, built, modified and rebuilt over several generations by architects and city planners who considered their dimensions both systematically and symbolically, even when they promoted vastly different schemes. In the seventeenth century, Philadelphia's founder, William Penn established the city as a designed artifact in an authoritative plan that laid down a geometry and scale, which architects continue to recognize. Perhaps more than in other cities, Philadelphia's citizens as well as its planners recognize the city's form and its history.

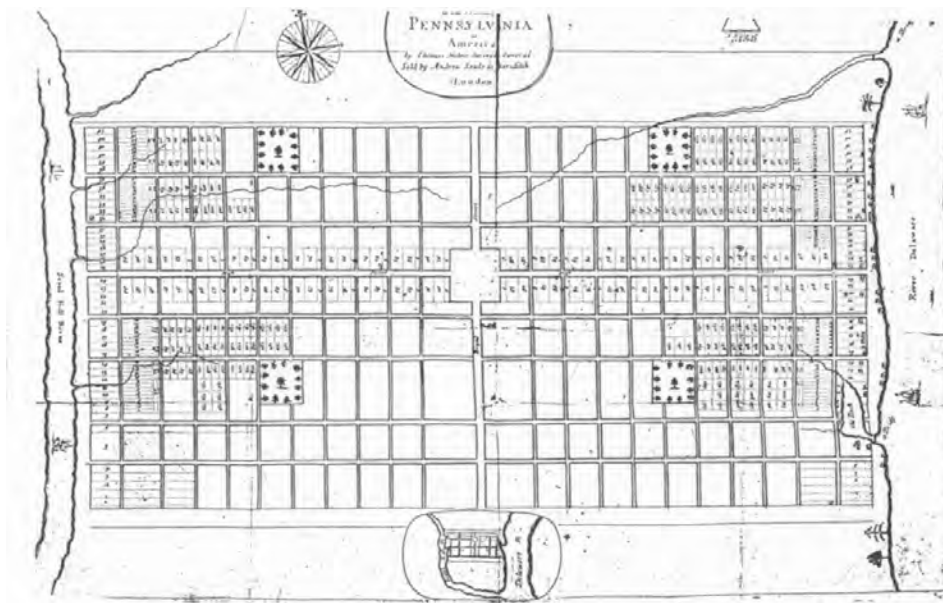**William Penn's Symbolic Measures: the Quincunx**

Figure 1 Plan for Philadelphia drawn by Thomas Holme 1683. (Library Company of Philadelphia)

In 1683, William Penn founded the city of Philadelphia between two rivers, the navigable Delaware River and the freshwater Schuylkill. Penn's surveyor, Thomas Holme, drew a map of the peninsula, then overlaid a city plan with grid of streets in a traditional pattern descended from ancient Roman military encampments. Holme scribed an east-west street, High Street, at a narrow point between the rivers and an intersecting north-south street, Broad Street, to define the city's axes, its *cardo* and *decumanus* (fig. 1).[4] At the center crossroads, he drew a city square to anchor Philadelphia to the compass. In Roman cities, the center was marked by a *mundus*, or hell's mouth that symbolically opened a vertical connection between the heavens above and underworld below. The mundus, meaning world or universe, was the city's pivot that modeled in miniature the axis of the world, linking large and small. In Holme's plan for Philadelphia, the center square is an open plaza designated for civic use, an instruction that was finally fulfilled in the nineteenth century with the construction of City Hall. It occupies high ground

between watersheds to the two rivers. Three parallel streets to the north of High Street and five to the south, ten streets to the east of Broad Street and ten to the west completed a plan for the city that has changed only slightly since it was first laid out in the woods.

In Philadelphia, Penn added to the Roman grid and interpreted it according to a set of symbolic numbers. Holme's plan shows four additional squares surrounding the central square in a quincunx arrangement, like the pattern of five on a playing card. He centered each on a quadrant of the city and drew trees to indicate that the squares were to be planted like English residential parks. The layout resembled a scheme for the rebuilding of London drawn by Richard Newcourt following the Great Fire of 1666 and perhaps an earlier plan for Londonderry, Ireland by Thomas Raven.[5]   However, Holme's quincunx of squares was ordered by a compelling set of dimensions in fives and tens that correspond with numbers Penn specified elsewhere in written instructions for subdividing his land in Pennsylvania.

In Holme's plan, the central square, where city hall now stands was laid out to contain ten acres, one furlong per side. High and Broad Streets are 100 feet wide. An acquaintance of Penn's father, John Evelyn, had recommended rebuilding the main thoroughfares in London to 100 feet wide, yet that dimension was far larger than any streets yet built.[6]   All other principal streets in Philadelphia measure 50 feet. Penn specified in instructions to his agents in Philadelphia that urban plots be allotted to settlers as a bonus in a proportion of 1/50 of the land that they purchased.[7]   He also envisioned rural settlements for 10 families who each owned 500 acres, 50 of which were clustered together into a town. A country town configuration would contain 5000 acres with a 500-acre domestic center. [8]   Through these numbers, Penn specified a proportional harmony between the city and countryside based on the numbers five and ten and a provision that each landowner would invest in both.

The specific origin of Penn's numerology is not known, however the number five was the subject of a contemporary treatise by Sir Thomas Browne, a Scottish physician and philosopher. Browne traced the appearance of fives in the Bible, ancient literature, and natural history to build the case that it represented the underlying order of the natural world, and the human body. He argued that five was the union of the first female number, two, and the first male number, three, and therefore was the numerical origin of human procreation. Five appeared in the

Quid Quincunce speciosius, qui, in quam cunq; partem spectaueris,
rectus est. Quintilian.

Figure 2 Illustration of quincunx in Cyrus Browne treatise.

star-like pattern of many flowers and seeds, marking their productivity as well. In particular, Browne extolled the quincunx, a geometric form of five elements that was a traditional pattern for planting orchard trees (Fig. 2). Browne argued that the quincunx
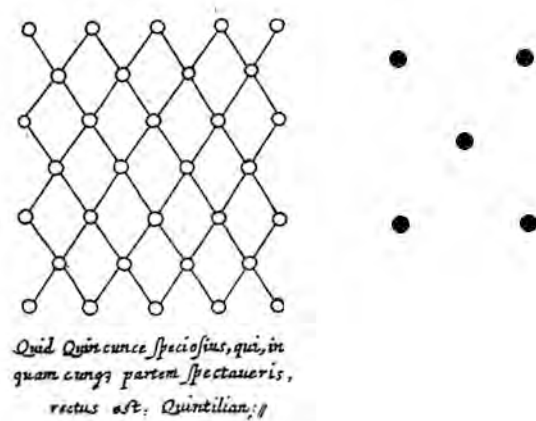
and the diamond lattice formed by extending the figure into a pattern were used in the Hanging Gardens of King Cyrus in Babylon, in Noah's orchards, and even in Adam's first garden in Paradise.[9] Browne discovered "several commodities, mysteries, parallelisms and resemblances, both in Art and Nature," that arose out of the quincunx to give it power to engender fertility and growth.

A friend Penn's father, Samuel Pepys remarked that the plan of Philadelphia resembled "Penn's favorite rhomboid"-- suggesting that Penn was fond of the quincunx and familiar with at least some of its symbolic implications.[10] The four squares surrounding Center Square in Philadelphia were to be planted squares in the English tradition as opposed to paved plazas. Penn also named the principal streets after trees (Chestnut, Walnut, Spruce and Pine) and praised the city as a "greene countrie town."[11] He wrote of a desire that Philadelphia grow more as a garden than a city in which native trees, and native peoples remained and orchards might thrive in the generous lots he gave to the first proprietors.

Penn's division of land in 1683 according to a decimal-based scheme followed closely on the 1670 proposal of a metric system in France.[12] Penn used feet and acres, but divided the land in proportions of 1:5, 5:10, and 1:50. The preference for decimal increments argued that measure defer to arithmetic and count on the fingers of the hand rather than traditional units that increased by factors of sixty, often sixes and twelves. Penn's measures engaged a contemporary effort to rationalize measuring systems, ironically by evoking symbolic numerology and its magic.

Sexagesimal System of Measures

Classical metrology was based on the dream that the cosmos was a rational geometric order that governed both the stars and our bodies, humming in harmony. In its most ancient derivation, our word measure descends from Latin, 'modus' and the Indo-European root 'me-' meaning month or moon from which we get commensurate and menstruation. The moon measured the cycles of women's bodies like the tides, mediating between cosmic and bodily rhythms to count time.   Plato wrote that the moon was the first measure, waxing in fifteen days from new moon to full then waning in another fifteen, so the moon first taught even the slowest among us to count.[13] He preferred to count the moon's cycle as an inaccurate thirty days rather than twenty-eight in order to produce twelve months to the year, 360 days, plus five.[14] This broadly used accounting glosses over the irreconcilability of lunar and solar cycles to offer easily divisible numbers, even at the cost of five days left over at the end of the year. In the ancient Egyptian calendar, the extra days were a time outside of time, the birthdays of the gods, marked by festivals and ritual.

The same numbers, twelve and thirty linked the body and the cosmos in spatial dimensions within classical measures of foot, yard, and fathom.[15] Both are factors of sixty at the base of an ancient system of measure that supported a broad trading network among Greek, Egyptian and Sumerian traders throughout the Mediterranean as early as 2000BC.   Sexagesimal numbers survive in radial measures of 360 degrees in a circle and in a linear foot of twelve inches and yard of 36. This system, based in the cosmological movement of the moon, has always stood in tension with a body-based

decimal system at the root of numbers (base 10). An ancient debate over whether the body should be known in terms of the cosmos or the cosmos in terms of the body emerges in the details of measuring systems. Plato sided with the cosmos, writing that he distrusted a Pythagorean belief in man as the measure of all things. He argued that men should not to depend on the frailty of their bodies or senses and must look for certainty in the universe and in mathematics itself, "the qualities of number apparently lead toward truth."[16]

The numbers that order measuring systems posit mathematical correspondences at the base of a well-functioning universe, so that the affairs of men, from movements of armies to diseases of the body, might correlate with movements of the zodiac. The United States adopted the survivors of the ancient sexagesimal system, eroded by the vagaries of use and uncooperative facts. As early as 1821, John Quincy Adams argued that the old English measures had been so debased that they were no longer meaningful and proposed that as a new and rational country, the US should adopt the French decimal-based metric system.[17]

In the seventeenth century, William Penn received classical metrology intact as well as its nascent French challenger. He owned a 1670 atlas or "Chorography" of the world that measured the circumference of the earth as 21,600 miles (nautical miles in current terms). Each degree of the circle measured 60 miles, such that "an able footman going constantly at 24 miles a day would compass it in 900 days."[18]   The measure of a mile survives from Roman tradition as 1000 paces (even though a nautical mile is longer than a Roman mile, the association remains), so taken together, these numbers mark the earth as a divine timepiece gracefully in tune with human dimension: 24 miles/ 24 hours per day, 120 miles or two degrees in 5 days. To walk the full 21,600 mile circuit around the world would take 900 days or 30^2 in total. Each mile measured 1000 paces, so the journey would be completed in 600^2 x 60 paces. Such elegance ruled the created universe.

William Penn gave land in measures that were meditations on the city as an organism of both people and landscape, a creature, in the sense of something created, that might be fertile and procreate.[19] Philadelphia's grid of streets possessed the site, turning land into property, but modifications of the grid give the city bodily contours. Center Square constitutes a navel or *mundus* at the narrow waistline between two rivers around which Penn located the city's meetinghouse, town hall and school, institutions that would nurture the city as head and heart. Allusions to the city as a body evoke a renaissance analogy that was widely used in architectural treatises. In the fifteenth century, Italian architect Filarete described an ideal city with three plazas: for government, the church, and the market, that corresponded to head, heart, and belly of a healthy body.[20] His extended
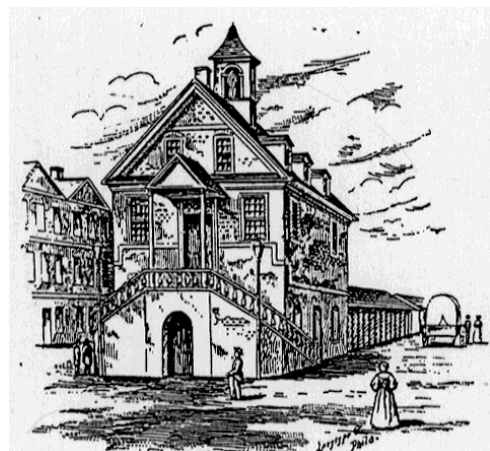

Figure 3 High Street "Great House," 1707-1735 (engraving from Joyce, History of Phila.)

analogy simply detailed an embedded tradition of thought in both the design and description of cities.[21]

Philadelphia's architects have repeatedly built the city in bodily form although not always in accordance with Penn's plan. The city's first market extended along the center of High Street from the Delaware River inland. Atop the market shambles in accordance with English tradition, the city's first town hall or 'Greate House," presided as a sensible head above a possibly unruly belly (figure 3). In English market towns of the sixteenth and seventeenth centuries market halls often had headhouses which contained courts of law to preside over disputes within. Such buildings also held the standard measures of the market such as a bushel basket or weighing stone that insured fair transactions. Philadelphia's Statehouse remained over the market until 1735 when a new Statehouse (now Independence Hall) was built at 6th and Chestnut Streets, weakening the old metaphor. The current city hall, built for the nation's centennial in 1876, was located on Center Square, returning to Penn's original plan and reinforcing the city's founding order.

The Measures of the Market at Headhouse Square in the Eighteenth Century

By 1735 when the new Statehouse was built, Philadelphia had grown both north and south from the center along the Delaware waterfront. A pair of new markets was planned for North and South Second Street, above Coats Street and below Pine Street respectively. Their symmetry respected the body metaphor of urban form by extending paired extremities, like arms that reached outward from the center. The shambles structures of both markets followed the model of High Street market, "after the same Modell as the present Stalls in the West Side of the Court house of this City."[22] Both remained without headhouses until the nineteenth century, reinforcing their role as limbs without an independent head, yet both were geographically and administratively independent of the city's main market on High Street, marking a significant turning point in the city's growth. The market on South Second Street, now Headhouse Square, was built by Joseph Wharton and Edward Shippen, then mayor of the town, for their own profit. They induced the city to acquire land for widening the street to allow a 30' wide market to be flanked by 50' streets, demolished one standing house, and built the first shambles of sixteen market stalls.[23] The market for North Second Street was also built, although it remained smaller and less prosperous than its mate.

South Second Street Market proved profitable, running as a quasi-public space governed by privately paid officers who monitored market scales, confiscated bad meat, and chased shoplifters. The affairs of the market were governed by a spatial and temporal order that reflected the geometry of the urban body. Wholesale purchases were

Figure 4 Butcher's stall in Second Street Market c. 1940 (Photographic file, Philadelphia Historical Commission)

Figure 5: Procession of Victuallers, High Street Philadelphia, 15 March, 1821 (engraving by John Kimmel)

prohibited before ten o'clock and no transactions at all were allowed before daylight when the market officially opened or after closing at three, rules that evoked both celestial and clock time.[24] Market vendors were given specific places to display their wares. In 1800 the city ruled that fishmongers were to "stand in a single row on each side of the market place" beginning at Pine Street and continuing 40 feet southward. Next were vendors of "roots, herbs and vegetable provisions" raised on their own farms and gardens. Butter, eggs and country produce were sold from stands under the eaves on the west side of the north shambles, while fruit and garden seeds were sold on the east side of the south shambles. Butchers occupied the stalls in the center of the market house (figure 4).[25] This structure protects comestibles in accordance with their perishability. Fish, vegetables and meat were sold under roof, while butter and eggs took the west side, which was shaded by the market structure until afternoon. The structure also reflects a body metaphor, holding the rawest and bloodiest food inside the central core, while processed or clean commodities flanked the outside.

Streets and markets were the city's public arena and took hard use on market days, usually Tuesdays and Saturdays. On festival days, they served as parade grounds strutted by the same people who had hawked their wares the day before (Figure 5 & 6). By the 1790s, South Second Street Market had 68 stalls and was a thriving
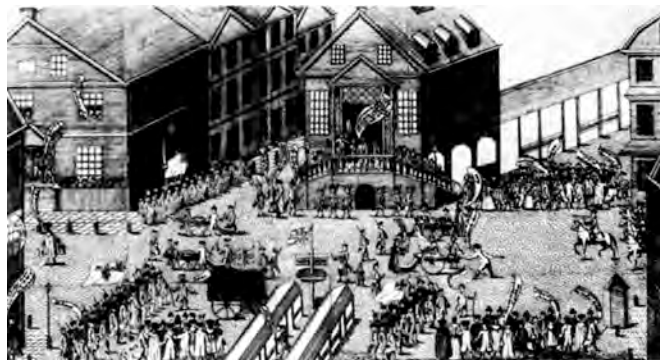

Figure 6 High Street Market. Cartoon by Henry Dawkins of The Paxton Expedition, 1764. (The Library Company Philadelphia).

center surrounded by inns, taverns, and other businesses. The finest and largest building on Headhouse Square was built by John Ross, merchant, on the southeast corner of Second and Pine Streets, which still stands.[26] The Harper Houses at 419 and 421 South Second Street were built in 1788 with an arched walkway between them to serve commercial structures in the rear such as a bake house later used as a forge. The balance of the houses built in the 18th and 19th centuries were single properties with a shop on the ground floor, typically selling groceries or liquor, and residence above. Several were used as hotels or boarding houses with a tavern on the street and some were shops for tradesmen such as cigar makers, milliners or tailors.

In 1795, fifty years after the market was established, a wooden firehouse was constructed on the southern end of the market to serve as headquarters for the Southwark Hose Company. Architecturally, it established Second Street market as an independent entity, a body with an ordering head, separate from the central High Street market. In 1805 the standing brick firehouse was built at the north end for Hope Hose Co. #6 and the Fellowship Engine Co. #29.[27] In the early nineteenth century, Philadelphia had hundreds of quasi-public volunteer fire companies that acted as neighborhood social clubs, competing with one another sometimes to the point of violence.[28] The architectural language of the fire company buildings was contrived to convey their dignified side as a public service.

Figure 7 Second Street Market Headhouse

The brick firehouse straddles Second Street, presenting a trim façade to a long view. The classical octagonal cupola rises above the shambles in the old tradition, giving architectural order to the square and correct measure (figure 7). A clock, added in 1820, meters the time, a weathervane the wind, and a bell in the cupola once struck the opening and closing hours of the market or called citizens from their sleep when property was threatened by fire.

Harmonic Proportions in Philadelphia

As the city grew in the eighteenth and nineteenth centuries, builders subdivided Penn's city blocks, using dimensions ordered by a classical system of proportions. First, Penn's grid of fifty-foot wide streets was interlaced with smaller streets and alleys laid out in round numbers, 10', 20', 30' 40,' which reproduce in their relationships an ancient Greek system of musical harmonies, 1:2:3:4. These street dimensions insure that wherever two intersect, they create a rectangular space with classically resonant proportions.[29]
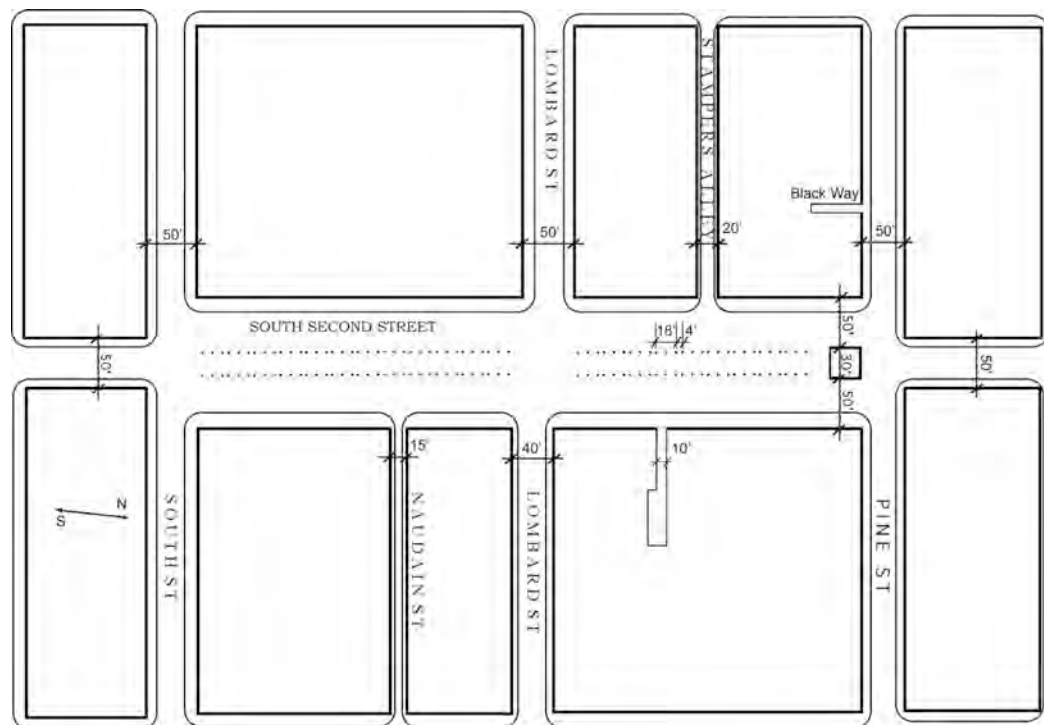
Figure 8 Plan of Second Street Market with street dimensions and original spacing of shambles piers.

Throughout the city, many secondary streets and alleys wove the city grid into a complex plaid pattern. Grand houses on large streets and humble houses on small streets were built in close proximity to each other to accommodate diverse uses and people in each district, rather than separating them among districts. Each street has a clear character defined by a correspondence between the width of the street and the height of buildings that line it.[30] Named streets that run east and west are particularly consistent, so buildings along Pine Street, at fifty feet in width as laid out by Penn, are generally three stories high with an attic and raised basement, housing prosperous families and businesses (figure 8). Parallel to Pine Street, forty-foot wide Lombard Street is lined with two to three-story houses that were less expensive. Between them, Stamper's Alley at twenty feet wide once contained small workshops and stables, often one-story with a loft that might house stablemen or apprentices. A ten-foot walkway between buildings led to a small courtyard with workshops and houses only one room deep, which might be leased to working class families. Running north and south, Second Street market crosses all of these streets to define a public urban space within the grid that serves both rich and poor. Over two hundred years, the market area housed a diverse population of English, Swedish, German and free black families augmented with waves of newcomers from Ireland, Italy, Russia and the American South.[31] Philadelphia's urban structure, weaving small and large streets and houses together, could accommodate change with grace and has been praised as fundamental to the city's resilience and long-term social stability.[32] In the 1960s, city planner Edmond Bacon redefined several of the alleys in the Society Hill area as walking paths with small parks inserted at intervals within the blocks. By reinterpreting the pre-existing pattern, he could improve public space to make smaller houses more desirable and promote private investment.[33]

The traditional proportional measures that ordered Philadelphia's streets and houses implicitly refer to the body. In the first century AD, Vitruvius described the derivation of building proportions (primarily the orders of the columns) from correspondences between parts of the body. In his canonical *The Ten Books of Architecture*, Vitruvius explained that the hand, from its heel to the tip of the middle finger, is the same dimension as the face from chin to hairline, folding them together along a line of measure. As a pair, hand and face may conjure other terms of their relationship, perhaps as the expressive parts of the body that complement one another in words and deeds. Vitruvius goes on to compare the foot and body as 1:6, where body complements foot and foot body, in the act of walking.[34] The body is dissected into parts and folded together again in the same manner that an architect should fold dissimilar but interdependent parts of a building together to create a plan. He argued that the exact proportions chosen to govern a building determine its character: slender and graceful as a maiden, or stocky and strong as a man. Through this analogy, measures fold a portrait of the body into architectural construction so they are interlaced and interdependent.[35]

Proportions of Philadelphia Vernacular

In 1805, an architectural geometry for Philadelphia was set in print by house carpenter Owen Biddle, who gave lessons in architectural drawing under the auspices of the Philadelphia Carpenter's Company, a craftsman's guild.[36] In *Young Carpenter's Assistant*, Biddle compiled what he considered the useful parts of widely-used British books on architectural design, specifically William Paine on column proportion and Peter Nicholson on geometrical figures, both of whom drew on the Vitruvian text. Biddle repeats their geometric rules of design as received wisdom without introductory promises of beauty, truth, or music, for proportions were so deeply embedded in building practice that they needed no justification. Biddle then demonstrates how a Philadelphia architect might use proportional geometry within the logic of the city.

As an example, Biddle illustrated a house, apparently of his own design, based on a
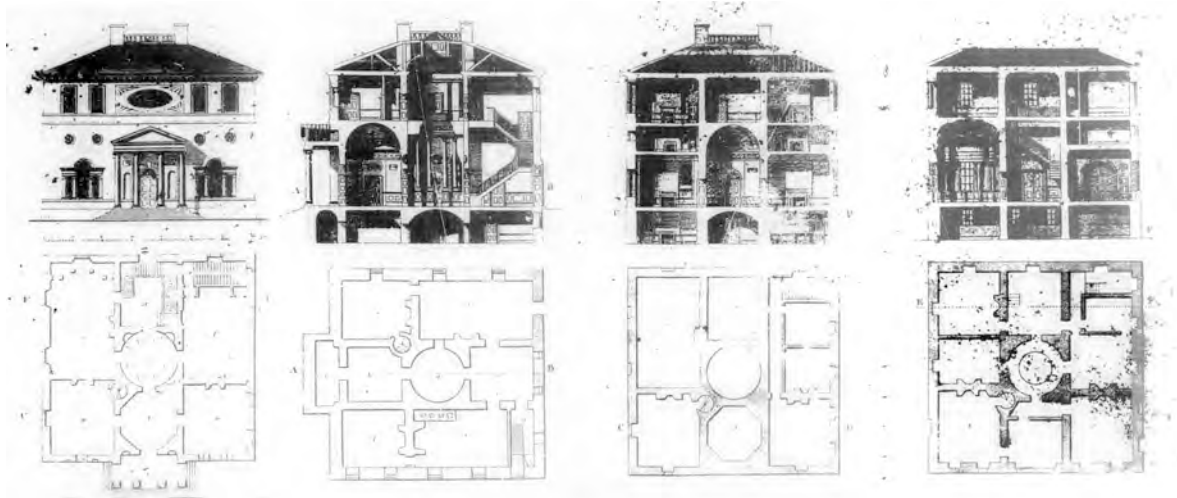
1. Elevation & Ground Plan 2. Section & Cellar (rotated plan) 3. Section & Mezzanine   4. Section & 2nd Floor

Figure 9 Owen Biddle, design for a house in Young Carpenter's Assistant, 1805. (Plates 37-40)

classical nine-square plan (Figure 9).[37] Geometry and proportions govern the design throughout. A circular room with a hemispherical dome at the center of the plan is flanked by square rooms proportioned 4:5, height to width. Two rectangular rooms behind them are 3:5 in plan, rising to different, yet proportional heights. The difference in height between the two symmetrical rooms allowed Biddle to insert a low mezzanine between the ground floor salons and the upper chambers. He notes that the interleaving of large and small rooms affords convenient chambers for servants in immediate communication with the formal rooms. "Were it not for this, in very large buildings, the Servants would frequently be unavoidably lodged at a considerable distance from the heads of the Family."[38] His domestic logic parallels that of the street system in Philadelphia, weaving grand and humble together in a working fabric based on proportional dimensions.

Following his description of the house, Biddle includes drawings for three structures recently built in Philadelphia: a bridge over the Schuylkill River begun in 1799, façade drawings for the Bank of Pennsylvania by Benjamin Latrobe, 1799, and the Bank of the United States by Samuel Blodget, 1795. He ends with a drawing of the 1755 steeple of Christ's Church designed by Robert Smith, "which for the justness of its proportions, simplicity and symmetry of its parts, is allowed by good judges to be equal if not superior in beauty to any Steeple of the spire kind, either in Europe or America" (Figure 10).[39] The proportions were particularly meritorious, Biddle noted, for they knit disparate architectural elements together into a harmonious composition.   At the last, the steeple anchors Biddle's book, including examples of recent work, his house design as well as lessons in draftsmanship, to a classical tradition of proportional, geometric design grounded in Philadelphia.

Buildings in Headhouse Square demonstrate a proportional logic in the ordinary construction of the city. The dimensions of the early market building were described in a resolution of the Common Council of the City of Philadelphia in 1745. The market was to be "in height ten ffoot to the Joice, the Length of two Stalls Joining to be Eighteen ffoot, to have an alley of ffour ffeet betwixt them & the next two Stalls".[40] This scheme
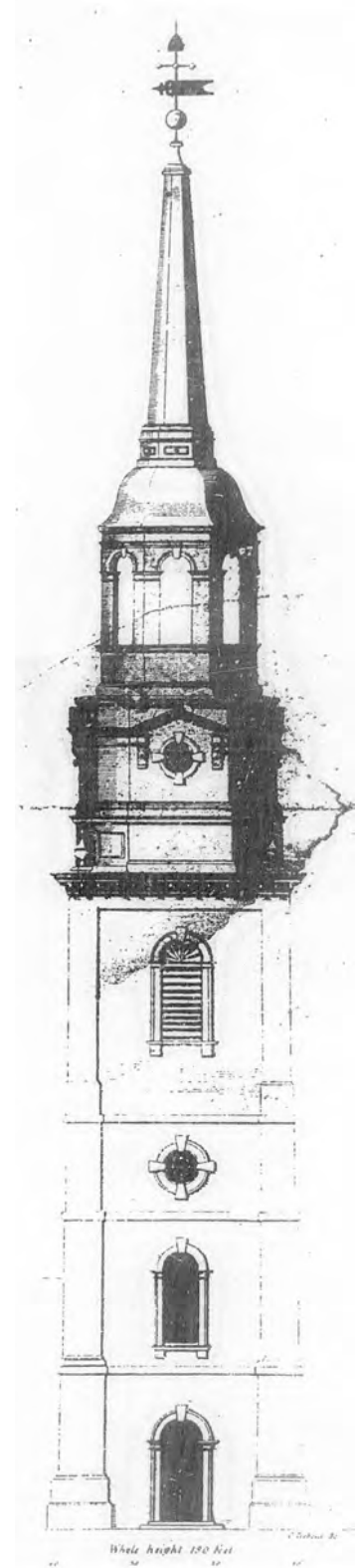
Figure 10 Biddle, Drawing of Christ's Church Steeple, 1755

grouped the market stalls and openings within the city street grid: four stalls to a section, and 12 sections under one roof. A vendor could be located within the group without counting stalls, the foodstuffs on sale could be separated by section, and the whole scheme locked into the street grid. The buildings of Second Street are likewise ordered by proportional dimensions. For example, the Headhouse facade is thirty feet wide with three openings centered on ten-foot intervals (Figure 11). The dimensions are set from the outside rather than inside, so the façade presents a well-ordered face to the long view from Second Street. The intervals that order the façade in a 4:5 rectangle are repeated in the cupola yet halved.

Symbolic Lines and Material Architecture

The system of classical proportions and Penn's symbolic numbers are dimension games that combine symbolism and calculation in lines and numbers independent of material construction. Like a geometer's figures on the blackboard, the marks are actually there yet, as phenomenologist Edmond Husserl writes, the geometer's experience of what he produces is not of its materiality but of "a science of essences that is not fantasy but neither is it of this perceived world."[41] Philadelphia's geometric measures were lodged in brick and stone by its designers to be perceived not as material but as essence, reduced in the mind of later citizens to the immaterial lines from which they came. However, the material measures of the building only approximate the ideal lines, compromised by the vagaries of substance and construction.[42]

Conversely, Husserl describes a circle as an idea derived out of many things from heads to soccer balls to worlds. From this perspective, a circle is an approximation, grounded in the sediment of experience, which approaches a horizon of abstraction.[43] Ideal and real approximate each other across the unbridgeable threshold.

Vitruvius faces the same dilemma in a famous passage describing how a man's body would fit within both the circle and the square to mediate between two perfect yet irreconcilable figures. He injected the material body of a man into the realm of geometry to resolve the dilemma of squaring the circle that had plagued ancient mathematicians, as if only the vagueness of flesh could reconcile irreconcilable numbers. Leonardo da Vinci interpreted Vitruvius' words in an iconic drawing, yet many others drew similar images, each interpreting the body differently (Figure 12). For example,
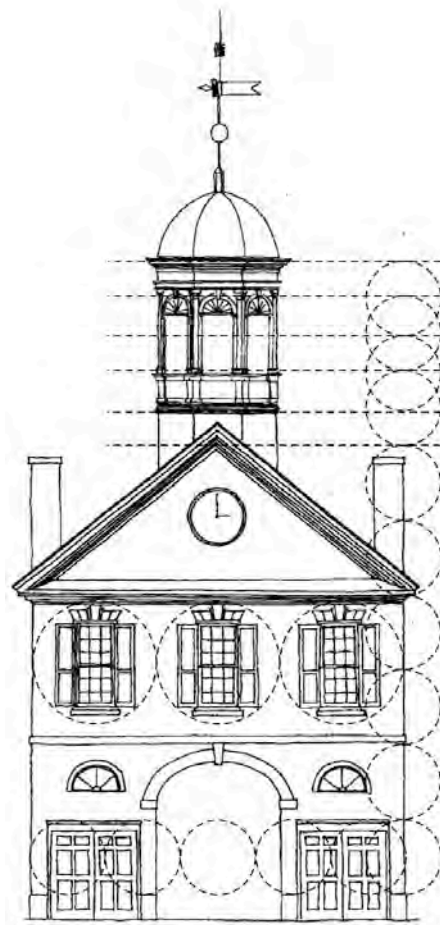

**Figure 11 Headhouse façade proportions**

Cesariano stretched the body almost painfully to fit it into place, approximating both the body and the Vitruvian ideal.[44] His image feigns precision by placing the body on a grid, yet exploits vagueness to turn the trick.

Deleuze and Guattari reject Husserl's definition of abstraction as an horizon or limit to ask why essences are necessary to geometric explanation?[45] They prefer to place the circle too on the side of material reality as a figure that represents a plethora of heads, soccer balls and worlds. Leonardo's drawing then brings all things circular into a relationship with many real bodies represented in the figure of the man, summoning viewers' own experiences of roundness and men. The drawing is an action in the real world like architectural contract drawings that are instructions to build.[46]

Following this line of thought, buildings are neither more perfect nor more vague than the drawings that represent them. Both embody wishes sent forth to modify a real world circumstance by changing the movements and/or the ideas of others, leaving questions of perfection or essence beside the point. The fives and tens embedded in Penn's plan for Philadelphia are not manifest in the minds of citizens but in the rhythm and scale of their motions. Citizens ignorant of Penn's vision of an urban orchard navigate with reference to the two rivers, cardinal axes and quincunx of green squares. Likewise, those innocent of proportion still move in accordance with a building's proportional dimensions. Philadelphia is recognized as a "walking city" because the dimensions of its streets and buildings still carry the physical
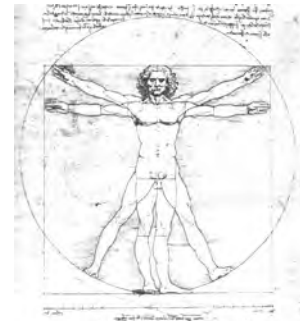
Vitruvian man, Leonardo DaVinci, c.1489
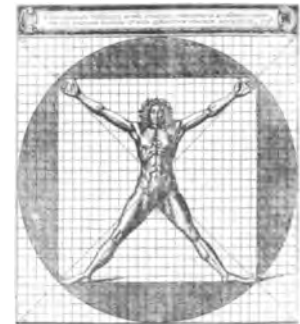
Vitruvian man after Cesare Cesariano, De Architectura, 1527

Figure 12 Vitruvian men.

Figure 13: The Measurers, c. 1600, oil painting by Hendrick van Balen (Museum of the history of Science, Oxford)

memory of the body. Trained by the city, Philadelphians walk, measuring their daily actions by eye and foot.

Material Measures of Building Trades

Within proportional dimensions borrowed from drawings, buildings were constructed in all too material brick and remeasured by incremental dimensions arising out of the traditions of the building trades (Figure 13). By the end of the 18th century, the large urban lots that Penn gave to settlers had been subdivided into row house dimensions, set not by proportional numbers but by the span of wood joists and the depth of purchasers pockets. 16'-4" is a common lot width in Philadelphia that allows standard 16' joists to be cut at the mill and laid in 4" pockets in a party wall three bricks wide.[47] If joists are staggered on either side, the party wall maintains a full brick width barrier throughout and no materials must be cut on site. The 16' bay is a habit brought to this country from England and is still a dimension of choice. Traditional building practices tended to use easily divisible multiples of 2: 4, 8, 16, 32, rather than either the factors of 60 or harmonic proportions.   Lot increments thus rest on a different logic than that of the city's founder or of classical traditions.

Each building material has its own measures, which evolved within their separate trades based in the motions of work. In medieval practice, measures were so local and so specific to each trade that in an effort to unify England under law, the Magna Carta decreed that throughout the country there would be one governing standard for each commodity -- one wine gallon, one beer gallon and one oil gallon. American measures of building materials continue in that tradition only slightly rationalized. In Philadelphia, the Carpenters Company developed a proprietary price book that assigned a rate per dimension for the elements of a construction job. Most builders in the city agreed to the rates listed to avoid undercutting each other and devaluing their work. Upon the completion of a job, a member of the Carpenter's Company "measured" the work to calculate a fair price for both owner and artisan.[48] With this system, the Carpenter's Company maintained control of the quality and value of construction in Philadelphia until the late 19th century and insured themselves a living as measurers. The dimensions they calculated were specific to each trade. Stonemasonry was measured by the perch (a cubic measure equal to one rod or 16.5 feet x 1 foot x 1.5 feet), bricklaying by the number of bricks (a price per thousand), framing carpentry by the square foot of floor area, and finish carpentry by the linear foot of molding installed, glazing by the number and size of window panes, and plasterwork by the square foot of wall surface and linear foot of molding.

These traditions of measure still inform construction. On a building site, earth is measured by cubic yard, concrete by cubic foot. Structural steel is coded by weight per linear foot, except reinforcing bars which, are measured in gauges like wire that descend in number as the diameter increases. Nails (also steel and round) are sold by pennyweight. A wood 2x4 isn't, yet dimensions along the grain are true. Wood intended for finish carpentry is measured in 1/4" nominal width, 5/4 "or 7/4", yet those dimensions are memories of its depth as rough stock. Sheet copper is specified by ounce per square foot, sheet steel by gauge, and sheet aluminum by decimals of the inch. Roofing is sold

in 10' x10' squares, whether metal, wood, slate, shingle or rubber and bricks by the pallet, although brick dimensions vary widely. Each of these measures is embedded in daily practice as numbers pervade speech in negotiation. Calculations, comparisons, and tallies meter the process of manufacture and building practice as well as the motions of work. Process is embedded in product. Measure also reveals hand of workman and tools in the increments of materials.   For example, bricks are molded in forms, fired in clamps, sold in 100 count pallets, and laid in courses one by one, in the hand of the mason; each of these measures implies certain tools, a rhythm and motion in time that orders and drives the work, like the measures of music drive a dance. The motions of making are recalled in maintenance chores such as cleaning and painting. How much can be covered in a day's work? How many gallons of paint? How far can one reach from a ladder? How many windows to wash? The job is sized up.

The measures of construction are incremental, proceeding by addition according to the repetitive motions of work and cannot be reconciled with a proportional system. For example, the brick headhouse with its clock and cupola was built as a terminus to end the market structure at the end of the block. As a result, the headhouse displays two elevations, a proportional and composed facade that faces Second Street and a non-proportional flank that takes a residual dimension in between the repetitive sequence of the market shambles and that of the city streets.

The incremental measures of Headhouse Square are many: streets, piers, party walls, doorways and shop window bays. When the shambles south of Lombard Street was demolished, the space was remeasured in new increments, this time parking stalls, a nominal dimension of 10' x 20' to accommodate a car.   New buildings, such as the parking garage north of Lombard and "Abbott's Square," a condominium just south, answer the dimensions of modern construction technology. Measured not by the hand or strength of workman, building material dimensions speak of the machines that transport them, forklifts, flatbed trucks and cranes. Each machine has its own scale, pace and extension that appears in the dimensions of finished buildings.

Abbott's Square condominium in Headhouse Square conceals a 20-foot structural bay behind 12-foot shop windows so interior spaces do not align with the facade. Twentieth-century architecture has shed even the habit of proportional measure so all dimensions are repetitive and each tends to be considered functionally or as part of the pictorial composition of a façade, not within a mathematical sequence. Abbott's Square, built in the 1980s embeds a layer of parking above ground floor commercial space and below its residential units so the vertical sequence of the facade reads not as a progression but as a series of discrete layers.   Its façade is detached from the rhythm of its supporting structure, yet tied to layers of floor levels, like a tapestry with a defining warp and a variable weft hung from a hidden scaffold. The facade is flat and the roofline seems to interrupt the repetitive series arbitrarily, as if cutting off yard goods.
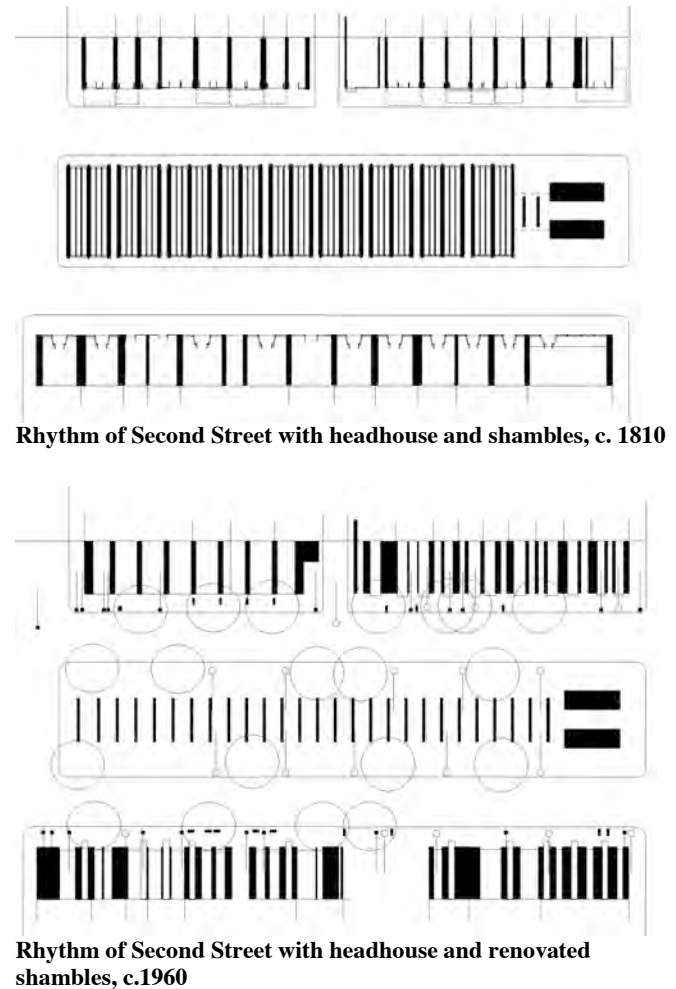
The Body's Motion as a Meter: Experiential Measures
Running meters are to proportional systems like running verse or ballads are to internally structured poetry such as the sestina or sonnet. Ballads give measure to popular stories in

easy and repetitive meters that invite linear narrative. At a given stride, the rhythms of speech or the structural bays of a building can continue indefinitely until reaching a barrier that cuts them off arbitrarily. Rhythmic measures of buildings in a colonnade or a row of houses define the body's motion in a continuous beat, rather than in cycles, or as part of a larger whole. Running meters virtually never mesh with proportional spaces, leaving gaps where they meet another system. Philadelphia's repetitive row houses along a block always create a special condition at the corner, usually a larger dimension used for a duplex or corner store. These gaps in a repetitive fabric, such as the Headhouse at the end of the market hall, are places of pause or emphasis, like punctuation marks that modulate the motions of the city.

Rhythm of Second Street with headhouse and shambles, c. 1810

Rhythm of Second Street with headhouse and renovated shambles, c.1960

F;g. 14 Rhythmanalysis of Second Street between Pine Street and Lombard before and after renovation

Penn's fives, proportional dimensions and the incremental measures of construction that meter distances in the city overlay temporal rhythms of walking and driving, which are metered by a person's stride and the cycles of traffic lights. The time required to cross a 50' street or traverse the length of a block is a unit of body, time and space, traffic and speed. Urban dimensions imply increments of time, the time to shop, the time to walk past, or to pause. So a five minute radius around Headhouse looks different by foot, by car or by bus. The walking city of Philadelphia, overlaid with railroads and streetcars, with pavement and parking for cars, and with interstate highways has changed scale. New construction has brought larger stores, (outlets for national chains) that extend for half a block with facades measured in units of plate glass limited by what two men can carry. New dimensions overlay old in a moiré, sometimes aligning, often not (Fig 14).

Theoretician Henri Lefebvre proposed a rhythm analysis of Mediterranean cities in "all their magnitude from particles to galaxies." He took measure of the timing of daily life on a street, from the footfall of pedestrians to bus roar, from morning errands to night stalking created a stable polyrhythm characteristic of the place. In urban polyrhythms, Lefebvre noted that cyclical rhythms differed from linear progression according to

measure. Cycles of day and night, seasons, years, and even dozens of eggs and oysters and other natural phenomena were habitually measured in twelves or sixties according to sexagesimal calculations. Linear rhythms, like the beating of a hammer or drum, including complex intervals, pauses, and repeats generated by the body in work or social activity are usually counted in twos and powers of two or in decimal units.[49] Lefebvre's distinction between cyclical rhythms of

Figure 15 The Quincunx extended: location of green squares outside of Penn's original plan.

the earth and linear, decimal measures of the body is, of course, ancient.   Rituals marking the cycle of the year intersect linear work to define increments, so work pauses for weekends and holidays set by a cyclical calendar. The additive time of production generally proceeds in binary rhythms. Traffic lights meter the flow of stop and go. Machines hum in binary rhythms without rest as background noise. Subways roll back and forth under the street to compress space along their axes. Commuter trains link up the suburbs and the airport makes conduits to cities across the country.

Persistent Measures in Philadelphia

William Penn's poignant fives and tens, sexagesimal factors of 60, 1:2:3:4 harmonic proportions, the powers of 2 sequence: 2,4,8, 16, the decimal system, and the binary rhythms are all present in the fabric of the city, overlaid and integrated with one another. For example, the current plan of Philadelphia shows a series of parks in areas beyond the limits of the original city that extend the diamond pattern of Penn's quinqunx, albeit sporadically (Figure 15). In South Philadelphia, green squares such as Passyunk, Jefferson, and Dickenson were laid out in the nineteenth century in imitation of Penn's four neighborhood parks. Broad and Market streets have no squares, green or otherwise, yet the interval at which they would have appeared
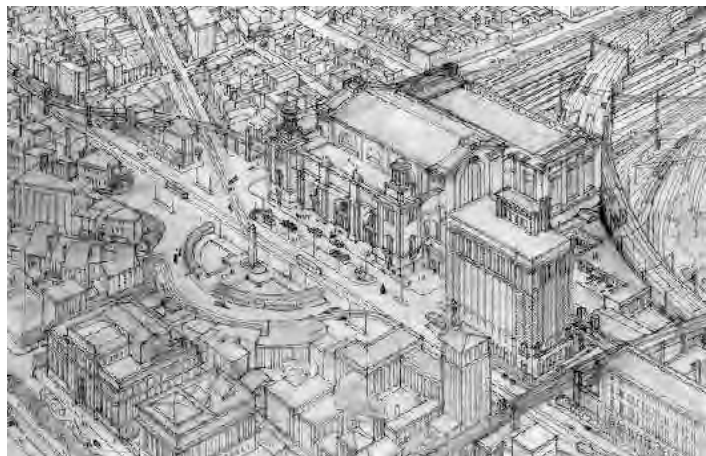

Figure 16 Paul Philippe Cret, proposal for a railroad station and plaza at Market and 32nd Streets, 1924 (Philadelphia Athenaeum Archives)

coincides with the interval of subway stops, about 1/3 of a mile, 100 rods, or a 10-minute walk. In 1924, architect Paul Philippe Cret proposed a large railroad station and urban plaza at Market and 32nd streets, west of the Schuylkill River, to mark the intersection of two diagonal avenues, Lancaster and Woodland. His scheme reflected classical planning principles of the École des Beaux Arts and the City Beautiful movement, while it recognized the logic of Penn's original geometry. In 1932, a station and a post office were built at 30th street facing one another across Market Street to make an architectural entrance to West Philadelphia, but without a plaza. Similarly, in the 1960s, Edmond Bacon focused attention on the Market Street (formerly High Street) axis of Philadelphia to modernize the business district.[50]

Philadelphia's walkable, habitable scale has emerged from the confluences of such dimensions that span generations of building. Architects who have interpreted patterns already present in Philadelphia such as Cret and Bacon engage past practice in an architectural dialogue that reflects on the city through measured modification.   They capture habits already in place, adding another gloss that reflects on the large, patterns of Philadelphia.

[1] John Edgar Wideman, Philadelphia Fire (NY: Vintage, 1990), 44.

[2] Michel de Certeau, The Practice of Everyday Life, trans. Steven Randall (Berkeley, CA: Univ of Calif., 1984), 100. 100. Sami-Ali, Le banal (Paris: Gallimard, 1980), 10.

[3] Kevin Lynch's classic study of mental maps in Boston, Image of the City (Cambridge Technology Press, 1960), identifies "nodes," "edges," and "landmarks" as features most recognized.

[4] Joseph Rykwert, The Idea of a Town: the anthropology of urban form in Rome, Italy and the ancient world (Cambridge, Mass: MIT Press, 1988), 99.

[5] Gary B. Nash, "City Planning and Political Tension in the Seventeenth Century: The Case of Philadelphia," Proceedings of the American Philosophical Society 112, no. 1 (1968): 61. For discussion of Richard Newcourt's plan for London see John Reps, The Making of Urban America (Princeton, NJ: Princeton Univ. Press, 1965), 163.
For discussion of Thomas Raven's plan for Londonderry see Anthony Garvan, "Proprietary Philadelphia as Artifact," in The Historian and the City, ed. Oscar Handlin and John Burchard (Cambridge, Mass: 1963), 191-93.

[6] John Evelyn, London Revived: Considered for its Rebuilding in 1666, ed. E.S. deBeer (Oxford: Oxford Univ. Press, 1938), 37.

[7] In the actual allotment of land, purchasers received a building lot in the city and a larger estate close by to total 1/50 of their entire holdings in Pennsylvania. See Nash, "City Planning and Political Tension in the Seventeenth Century: The Case of Philadelphia," 61.

[8] Richard and Mary Dunn, William Penn Papers, v.2 1680-84 (Philadelphia, PA: Univ. of Pennsylvania Press, 1982), note p.130.

[9] Sir Thomas Browne, "The Garden of Cyrus or The Quincuncial Lozenge or Net-work Plantations of the Ancients, Artificially, Naturally, Mystically Considered (1658)," in Sir Thomas Browne: Selected Writings, ed. Sir Geoffrey Keynes (Chicago: Univ. of Chicago, 1968), 159.

[10] Quoted in Edwin Blaine Bronner, William Penn's Holy Experiment (NY: Temple Univ. Publications, 1962).

[11] Penn declined to name streets after landowners or prominent families, rather after "things that grow spontaneously in the country." See Nash, "City Planning and Political Tension in the Seventeenth Century: The Case of Philadelphia," 70.

[12] Vicar Gabriel Mouton is credited with inventing the first metric system c.1670. He argued that measures of length be based on an arc of the meridian. In 1795, France adopted a metric system in which the meter was 1/10,000 of a measured quarter of the earth's circumference.

[13] Plato, "The Republic," in The Collected Dialogues, ed. Edith Hamilton and Huntington Cairns (Princeton, NJ: Princeton Univ. Press, 1961), 978e (p.1521).

[14] Daniel McLean McDonald, The Origins of Metrology (Cambridge: McDonald Institute for Archaeological Research, 1992), 5. A year was counted in an ancient Egyptian calendar as 12 lunar months of 30 days plus five days uncounted which were birthdays of the gods.

[15] Joseph Rykwert, The Dancing Column (Cambridge, MA: MIT Press, 1996), 84. Rykwert refers to the Pythagorean link between body and building throughout but explains the origin. Pythagoras asserted that 'man is the measure of all things,' based on an mathematical correspondence in which God is the Macrocosm, the World is the Mediocosmos, and Man is the Microcosm. See also pp.99-101 for discussion of perfect numbers, measure and the body.

[16] Plato, "The Republic," 7:525b (p.757) quoted in Henry Richardson, "Measurement in Plato's Protagoras," Journal of History of Philosophy 28, no. 1 (1990): 29.

[17] John Quincy Adams, "Report of Weights and Measures," American State Papers, Class X 2 (1834): 656-704.

[18] Peter Heylyn, Cosmography in Four Books containing the Chorography and History of the Whole World (London: 1670).Held by the Library Company of Philadelphia.

[19] Diana Agrest points out the transsexual ambiguities of the classical body/building/city metaphor particularly apparent in work of Filarete and Francesco di Giorgio Diana Agrest, "Body, Logic and Sex," Assemblage 7 (1988).

[20] Filarete, Treatise on Architecture (New Haven: Yale Univ. Press, 1965 (1465)). See Rykwert, The Dancing Column, 63-4.

[21] Parks as lungs, streets as arteries and sewer discharge as cloaca have long use in the description of urban structure.

[22] "Minutes of the Common Council of the City of Philadelphia", 1704 to 1776 (Philadelphia, 1847): 446 quoted in Margaret Tinkcom, "The New Market in Second Street," Pennsylvania Magazine of History and Biography 82 (1958): 380.

[23]Ibid.: 383.

[24]James Mease, Picture of Philadelphia: giving account of its origin, increase and improvements (Philadelphia, PA: Robert Desilver, 1831), 118.

[25] Philadelphia Codes of Ordinances and Acts of Assembly, (Philadelphia: Microfilm 02884, 1800), 166.

[26] John L Cotter, Daniel Roberts, and Michael Parrington, The Buried Past, Barra Foundation Book (Phila.: Univ. of Penna. Press, 1992), 155. The Ross House was restored once in the early nineteenth-century by John Haviland and again in 1976 by local architect, Charles Broudy

[27]John Paxton "New Map of Phila" for list of Firemen 1820, (Historical Society of Philadelphia) The wooden firehouse was gone by 1860. Philadelphia Historical Commission Files for South 2nd Street

[28] Nineteenth century fire companies were split between those that owned the pumpers and those that owned the hose, so two companies had to answer any alarm and cooperate with one another. Fire stations however did not uphold their promise as civic institutions. By the mid-nineteenth century under the press of immigration, the area surrounding Headhouse had become more ethnically diverse and poorer. Fire companies proliferated as competitive social groups, many of which were no more than street gangs. In Southwark, just south of Headhouse Square, a fire was as often an occasion for ethnic confrontation and violence as for fire fighting. See Bruce Laurie, "Fire Companies and Gangs in Southwark: The 1840s," in The Peoples of Philadelphia, ed. Allen Davis and Mark Haller (Phila: Temple Univ. Press, 1973), 77. see also Andrew Neilly, "The Violent Volunteers: A History of the Volunteer Fire Department of Philadelphia, 1736-1871" (dissertation., University of Pennsylvania, 1959).

[29]Rudolf Wittkower, Architectural Principles in the Age of Humanism (London: Tiranti, 1952), 91.

[30] Accepted practice rather than law governed the relationship between the height of buildings and the width of streets. Philadelphia has many exceptions to the general rule.

[31] Extensive work has been done to document Philadelphia's changing population, supported by the Philadelphia Social History Project based at Temple University. See Susan E. Klepp, Philadelphia in Transition: a demographic history of the city and its occupational groups, 1720-1830, Garland Studies in Historical Demography (NY: Garland Press, 1989), Bruce Laurie, Working People of Philadelphia, 1800-1850 (Philadelphia: Temple University Press, 1980).

[32] Although by 1900, Headhouse Square had become an enclave for Eastern European Jewish immigrants, and by the 1930s, the population was largely poor and black, many from the American South.

[33] Edmund N. Bacon, Design of Cities (NY: Viking Press, 1967), 264.

[34] Vitruvius, The Ten Books on Architecture, trans. Morris Hicky Morgan (New York: Dover, 1960), Book III, Chapter 1, paragraph 2 (p.72).

[35] Dalibor Vesely, "The Architectonics of Embodiment," in Body and Building, ed. George Dodds and Robert Tavernor (Cambridge, MA: MIT Press, 2002), 37.

[36] Owen Biddle, Young Carpenter's Assistant or a System of Architecture, Adapted to the Style of Building in the United States Early American Imprints, Series 2 (Lancaster, PA: Benjamin Warner, 1817).Biddle addressed the carpenters of the US, explaining how to build columns from staves of wood glued together and a dome from wooden ribs.

[37] Jeffrey Cohen, "Building a Discipline: Early Institutional Settings for Architectural Education in Philadelphia, 1804-1890," Journal of the Society of Architectural Historians, 53, no. 2 (1994).140-142.

[38] Biddle, Young Carpenter's Assistant or a System of Architecture, Adapted to the Style of Building in the United States 49 (Plate 39).

[39] Ibid., 56.

[40] Minutes of the Common Council of Philadelphia, July 4, 1745 quoted in Edwin Brumbaugh, "Report of Research and Investigations Relevant to the Restoration of the New Market in Second Street south of Pine Street," (Philadelphia, PA: Philadelphia Historical Commission, 1958), 3.   Brumbaugh found archaeological evidence for original piers, which confirm the Council description. Brumbaugh, Plan of Headhouse Square, (Philadelphia Athenaeum). In 1804, shortly after the headhouse was built, the overcrowded market was widened and half of the market's 64 piers were removed. Two eighteenth century maps survive showing the market piers with stalls and cross aisles, yet they do not agree with one another in dimension.

[41]Edmond Husserl, Ideas I, section 7, p.55, quoted in Jacques Derrida, Husserl's Origin of Geometry, trans. John Leavey (NY: Nicolas Hays, 1978), 44.

[42] Derrida described writing as constituting "the other as other in itself and the same as same in the other" quoted by John Leavey in introduction to Ibid., 15.

[43] Ibid., 178.

[44] Marco Frascari, Monsters of Architecture (Savage, MD: Rowman & Littlefield, 1991), 35,55, and 111.

[45]Gilles Deleuze and Felix Guattari, A Thousand Plateaus: Capitalism and Schizophrenia, trans. Brian Massumi (Minneapolis: Univ. of Minnesota, 1987), 367.

[46] Elaine Scarry makes a parallel argument, crediting language with real consequences like sentences handed down by a judge that can imprison a body Elaine Scarry, Resisting Representation (NY: Oxford Univ. Press, 1994). also Dan Rose, "Worldly Discourses: Reflections on Pragmatic Utterances and on the Culture of Capital," Public Culture 4 (1991).

[47] Donna J. Rilling, Making Houses, Crafting Capitalism: Builders in Philadelphia, 1790-1850, ed. Daniel K. Richter, Early American Studies (Philadelphia: University of Pennsylvania Press, 2001), 98. notes that timber was stacked in 12 or 16 foot lengths to be rafted to market. House widths and lot widths varied but dimensions of 12 and 16 feet turn up regularly.

[48] Ibid., 85.

[49] "Rhythmanalysis of Mediterranean Cities" by Henri Lefebvre and Catherine Régulier first published in Peuples Méditerranéens 37 (1986) Henri Lefebvre, Writings on Cities, trans. Elenore Kofman and Elizabeth Lebas (Oxford: Blackwell, 1996), 228-31.

[50] Bacon, Design of Cities, 301.