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978-0-521-55427-5 - The Measure of Reality: Quantification and Western Society, 1250-1600

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Excerpt

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PART ONE

Pantometry Achieved

Pantometry [f. Gr. *παντο*- Panto-, all + Gr. *-μετρία* measurement.]

1. Universal measurement: see quotes. *Obs.* [1571 Diggs (*title*) A Geometrical Practice, named Pantometria, divided into three Bookes, Longimetra, Planimetra, and Steriometria.]

Oxford English Dictionary

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CHAPTER ONE

Pantometry: An Introduction

Every culture lives within its dream.

Lewis Mumford (1934)¹

In the mid-ninth century A.D. Ibn Khurradadbeh described Western Europe as a source of “eunuchs, slave girls and boys, brocade, beaver skins, glue, sables, and swords,” and not much more. A century later another Muslim geographer, the great Masudi, wrote that Europeans were dull in mind and heavy in speech, and the “farther they are to the north the more stupid, gross, and brutish they are.”² This was what any Muslim sophisticate would have expected of Christians, particularly the “Franks,” as Western Europeans were known in the Islamic world, because these people, barbarians most of them, lived at the remote Atlantic margin of Eurasia, far from the hearthlands of its high cultures.

¹ Lewis Mumford, *Technics and Civilization* (New York: Harcourt, Brace & World, 1962), 28.

² Bernard Lewis, *The Muslim Discovery of Europe* (New York: Norton, 1982), 138–9.

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Six centuries later the Franks were at least equal to, and even ahead of, the Muslims and everyone else in the world in certain kinds of mathematics and mechanical innovation. They were in the first stage of developing science-cum-technology that would be the glory of their civilization and the edged weapon of their imperialistic expansion. How, between the ninth and the sixteenth centuries, had these bumpkins managed all that?

What was the nature of the change in what would be called in French their *mentalité*? As a necessary preliminary to any attempt to answer that, we should examine that *mentalité* in the 1500s. It is the effect, and knowing it, we will know better what to look for in the way of causes.

Kitsch is a peephole through which we may see samples if not always of a society's bromides, then of what it is thinking about with freshest intensity and even of *how* it is thinking. I offer in evidence Pieter Bruegel the Elder's 1560 print of Temperance³ (Figure 1), then the most prestigious of the ancient Virtues. A Latin motto printed below the original is bromidic ("We must look to it that we do not give ourselves over to empty pleasures, extravagance, or lustful living; but also that we do not, because of miserly greed, live in filth and ignorance")⁴ but the artist, aiming for sales, made sure that just about everything else in the print was

³ My interpretation of this print is drawn largely from H. Arthur Klein and Mina C. Klein, *Peter Bruegel the Elder, Artist* (New York: Macmillan, 1968), 112–16.

⁴ H. Arthur Klein, *Graphic Worlds of Peter Bruegel the Elder* (New York: Dover, 1963), 243–5.

Figure 1. Pieter Bruegel the Elder, *Temperance*, 1560. H. Arthur Klein, *Graphic Worlds of Peter Bruegel the Elder* (New York: Dover Publications, Inc., 1963), 245.

new or at least newly applauded. No one would or could have created such a picture five hundred years before or, in its entirety, even a hundred years before, no more than a map of America.

Progressive Westerners ply their crafts around the figure of Temperance. The sixteenth was a great century for astronomy and cartography – it was the century of Nicolaus Copernicus and Gerhardus Mercator – and so at the top and center a daredevil astronomer teetering on the North Pole measures the angular distance between the moon and some neighboring star. A colleague below takes a similar measurement of the distance between two locations on earth. Just below and to the right is a clutter of measuring devices – compasses, a mason's square, a plumb bob, among other things – and people using them. Bruegel obviously assumed that his contemporaries and prospective customers took pride in their ability to measure, to oblige a fluid reality to stand still and submit to the application of the quadrant and T square.

The upper right of the print is devoted to violence. There the people and devices – musket, crossbow, and artillery – are all associated with war, arguably the central occupation of Europeans in Bruegel's century. In the Middle Ages battles had been settled by the collision of aristocrats on horseback, but military technology had changed and now battles were dominated by the confrontations of great blocks of plebeian pedestrians armed with “stand-off” weapons like pikes, crossbows, harquebuses, muskets, and artillery. Leading the new armies required more than courage and a solid seat on your charger.

Sixteenth century military textbooks commonly included tables of squares and square roots to guide officers in arranging hundreds and even thousands of men in the new battle formations of the Renaissance West: squares, triangles, shears, bastard squares, broad squares, and so on.⁵ Officers, the good ones, now

⁵ Bernabe Rich, *Path-Way to Military Practise* (London 1587) (Amsterdam: Da Capo Press, 1969).

had “to wade in the large sea of Algebra & numbers”⁶ or to recruit mathematicians to help them. Iago, the old soldier and villain of Shakespeare’s *Othello*, dismisses Cassio as an “Arithmetician,” who had “never set a squadron in the field,”⁷ but such number-smiths had become a military necessity.

The new kind of war had reduced foot soldiers to quanta. They, even more than the men of the Greek phalanx and Roman legion, learned to perform like automatons. They began to do something that we have considered characteristic of soldiers ever since: to march in step. Niccolò Machiavelli, military as well as political theorist, declared that “as a man that is dancing, and keeps time with the music, cannot make a false step; so an army that properly observes the beat of its drums cannot easily be disordered.”⁸ Textbooks and drillmasters reduced the foot soldiers’ complicated manipulations of pike and firearm to series of distinct motions – twenty, thirty, forty – all requiring approximately the same concentration and duration. François Rabelais laughed at soldiers who performed like “a perfect clockwork mechanism,”⁹ a kind of machinery of which we will hear much more in Chapter 4.

In Bruegel’s print, just below the two cannons at the upper right, are five men, probably arguing about the contents of the large book beside them, most likely the Bible. It was such disputes that drove men to cast cannons and to turn foot soldiers into escapements and cogs. Below the debaters a teacher instructs chil-

⁶ Thomas Digges, *An Arithmetical Militaire Treatise Named Stratioticos* (London 1571) (Amsterdam: Da Capo Press, 1968), 70.

⁷ William Shakespeare, *Othello*, act I, scene 1, lines 18–30.

⁸ Niccolò Machiavelli, *The Art of War*, in *The Works of Nicholas Machiavel* (London: Thomas Davies et al., 1762), 44, 47, 54. See also William H. McNeill, *The Pursuit of Power: Technology, Armed Force, and Society since A.D. 1000* (Chicago: University of Chicago Press, 1982), 128–34.

⁹ François Rabelais, *The Histories of Gargantua and Pantagruel*, trans. J. M. Cohen (Harmondsworth: Penguin Books, 1955), 141.

dren in reading letters. Literacy was increasingly important for the ambitious. Even sergeants needed to be literate, “for it is harde by Memorie to discharge so many things wel as he shal be charged withall.”¹⁰

Johannes Gutenberg a century before had standardized Gothic letters, casting them onto the faces of small metal cubes of uniform dimensions, excepting width (“M” being, after all, wider than “I”). He lined these up on a block like ranks of soldiers on parade, wedged them tight, and then pressed the block on paper, printing a whole page at a time. His most famous product was the Mazarin Bible: forty-two lines to the page of about 2,750 letters each, with left and right margins justified.¹¹

The lower left of the print is devoted to a tempest of calculation. A merchant counts his money, with which we measure all things. An accountant calculates in Hindu-Arabic numerals, and someone – a peasant? – seems to be jotting calculations on the back of an old lute or bellows. What is the mark by his hand? It looks like a drawn version of a tally stick, a piece of wood notched to indicate numerical values: a broad notch for a guilder, a narrower one for divisions thereof.¹²

Next, moving clockwise, is a painter (Bruegel himself?), his back turned to us, possibly in embarrassment. In this print Bruegel violated the primary diktat of Renaissance perspective that a picture should be geometrically consistent and should include no more than one point of view. He jammed several scenes together, each with its own point of view. The people and objects on the right side are spatially (if vaguely) related to steps that indicate

¹⁰ Digges, *Stratiticos*, 87.

¹¹ Michael Clapham, “Printing,” in *A History of Technology*, eds. Charles Singer et al. (Oxford: Clarendon Press, 1957), 3: 386–8; Gutenberg Bible, Humanities Research Center, University of Texas, Austin.

¹² Karl Menninger, *Number Words and Number Symbols: A Cultural History of Numbers*, trans. Paul Broneer (Cambridge, Mass.: MIT Press, 1969), 251.

third dimension by rising, that is, receding, toward the back (the top). In contrast, the lines of the organ on the left stretch straight back from the viewer toward an unseen but obviously lower horizon. The astronomer and cartographer bob autonomously in surrealistic space.

The effect is disjointed, but Bruegel knew full well what he was doing. He and his customers were familiar with the geometrical rules of Renaissance perspective, and by breaking them he was able to indicate the independence of the otherwise contiguous scenes by giving each an independent perspective. (Much more about Renaissance perspective in Chapter 9.)

Immediately above the artist are a number of musicians and one drudge pumping an organ. The singers are performing music from texts. They are children and adults of several ages, hence of several vocal ranges, and they are accompanied by the organ, a sackbut, a cornett, and other instruments. The likelihood is that they are singing polyphonically, and if so, they certainly need texts. The sixteenth was the century of Josquin de Prés and Thomas Tallis, the golden age of church polyphony, a kind of music so complicated that it could be performed best – perhaps can be performed only – with the aid of written notation. Renaissance music notation, like ours, its descendant, consisted of lines indicating, from top to bottom, the pitch of notes, and figures thereon indicating the order of the notes and rests, which in duration were all equal or exact multiples or fractions of each other. Tallis, one of Bruegel's contemporaries, will compose *Spem in alium*, in forty separate parts, possibly for Queen Elizabeth's fortieth birthday in 1573.¹³ This motet is the ne plus ultra of the quantum approach to sound, not surpassed as a bravura display of counterpoint from that day to this.

To show that his age was not all war, work, and tricky tech-

¹³ Paul Doe, "Tallis, Thomas," in *The New Grove Dictionary of Music and Musicians*, ed. Stanley Sadie (London: Macmillan, 1980), 18: 544.

nique, Bruegel included a reference to the contemporary theater, jester and all, in the upper left corner. This painter seems to have had a nose not only for current but for future trends as well. Lope de Vega will be born two years after Bruegel finishes this drawing, and Shakespeare two years after that.

Temperance herself occupies the center of the picture. In her left hand she holds spectacles, a symbol of sagacity, and in her right hand are reins that lead to a bit in her mouth, representing self-restraint. She wears spurs on her heels (control over great power) and a snake knotted around her waist as a belt (evil passions under control?). She stands on the vane of a post wind-mill, medieval Europe's greatest single contribution to power technology. At the dead center of the picture – surely not by accident – she wears on her head what was then the most distinctively Western of all contrivances for measuring quantity: the mechanical clock, whose titanic *TICK-TOCK* had already been thundering in Europe's ears for 250 years.¹⁴

Bruegel's print is a sort of potpourri of what quickened the attention of urban Western Europeans circa 1560, of what we might call the West's Renaissance dream. The collection is such a miscellany that it is not easy to put a name to that dream. No one was concerned with its internal consistency or even thought of it as a whole. It was a yearning, a demand, for order. Many of the people in Bruegel's picture are engaged in one way or another in visualizing the stuff of reality as aggregates of uniform units, as quanta: leagues, miles, degrees of angle, letters, guldens, hours, minutes, musical notes. The West was making up its mind (most of its mind, at least) to treat the universe in terms of quanta uniform in one or more characteristics, quanta that are often thought of as arranged in lines, squares, circles, and other symmetrical forms: music staves, platoons, ledger columns, planetary or-

¹⁴ Klein, *Graphic Worlds of Peter Bruegel the Elder*, 243–5.