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The
Measure of
Reality

QUANTIFICATION
AND WESTERN
SOCIETY,
1250–1600

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Take away number in all things and all things perish. Take
calculation from the world and all is enveloped in dark igno-
rance, nor can he who does not know the way to reckon be
distinguished from the rest of the animals.

St. Isidore of Seville (c. 600)

And still they come, new from those nations to which the
study of that which can be weighed and measured is a con-
suming love.

W. H. Auden (1935)

word *appreciate*, with its many phonemes) or, in accordance with the musical effect required, to any fractional division of these. Neumatic notation was *not* quantitative.

Let us consider the matter of notational pitch first, as did the monks, before we go on to our central interest, note duration or time. Neumes at first and often thereafter were written *in campo aperto*, “in the open field,” that is, without staff lines. Their position, high or low, offered a hint as to whether a given note or phrase was higher or lower than the one preceding or following. After a while the monks lightly traced one and then two and more horizontal lines across the page to make the highs and lows easier to recognize. They were on their way to the musical staff, originally four and then five horizontal lines. The lines and the spaces between them, with a few additional markings, enabled the scribe to indicate and the performer to read all legitimate pitches in relation to each other.¹³

The musical staff was Europe’s first graph. It measures the passage of time from left to right, and pitch according to position from top to bottom. The Schoolmen and the majority of everyone else who received formal education got, along with the alphabet and the abacus, this musical graph. Oresme’s geometrical depiction of motion (see Figure 3, Chapter 3) just might be an adaptation of the staff. (Europeans, however, waited till the eighteenth

Hughes (Oxford: Oxford University Press, 1955), 106; Carl Parrish, *The Notation of Medieval Music* (London: Faber & Faber, 1957), 4–6; James McKinnon, “The Emergence of Gregorian Chant in the Carolingian Era,” in *Antiquity and the Middle Ages: From Ancient Greece to the 15th Century*, ed. James McKinnon (Englewood Cliffs, N.J.: Prentice-Hall, 1990), 94; David Hiley, “Plainchant Transfigured: Innovation and Reformation through the Ages,” in *ibid.*, 123–4; *The Cambridge Encyclopedia of Language*, ed. David Crystal (Cambridge University Press, 1987), 404.

¹³ Murray, *Gregorian Chant*, 6.

century to fully exploit this means of representing physical phenomena, a delay that one historian of mathematics has called “incomprehensible” and even “inexcusable.”¹⁴

The invention of the staff is traditionally credited to an eleventh century Benedictine choirmaster, Guido of Arezzo, who lamented that in singing the divine offices “we often seem not to praise God but to struggle among ourselves.”¹⁵ Neither he nor any single individual invented the staff, but he does seem to have been the first to standardize it and give it wide circulation. He and others even color-coded the lines of the staff to minimize confusion about intervals.¹⁶

A singer with a good ear could be trained to identify specific intervals with a monochord by sliding the bridge back and forth and lining it up with marks on the sounding board representing the several pitches. That, however, took a long time and did not always work. The resourceful Guido noticed that the ascending tones represented on his staff matched, in order, those of the first syllables of the phrases of one of the most familiar of hymns, the 400-year-old “*Ut queant laxis*,” sung for the feasts of John the Baptist:

Ut queant laxis Resonare fibris
Mira gestorum Famuli tuorum
Solve polluti Labii reatum
Sancte Iohannes.

Anyone who knew the hymn melody would know the notes for *ut*, *re*, *mi*, *fa*, *sol*, and *la* (in italics above), which meant that now

¹⁴ Salomon Bochner, *The Role of Mathematics in the Rise of Science* (Princeton, N.J.: Princeton University Press, 1966), 40.

¹⁵ Charles M. Radding, *A World Made by Men: Cognition and Society, 400–1200* (Chapel Hill: University of North Carolina Press, 1985), 188.

¹⁶ *Source Readings in Music History*, 1: 117, 118–19.