
Compàs nàutic

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The mariner's compass is a navigational instrument utilized by various seafarers from at least the Middle Ages up until the mass reception of navigational radar in the mid-20th century. In its most rudimentary form, it consists of a magnetic needle attached to a wind rose or compass card in such a manner that when placed on a pivot in a box fastened in line with the keel of a ship the card would turn as the ship changed directions, indicating always what course the ship was on in relation to North, since the needle would point in that direction, at least in the European version.

Functionally, the compass did not remain in the water, used only by a specialized class of navigators; it slowly moved landward, later developed as the pocket compass for hiking and camping. Though there has been much historical contention regarding the origins of the compass, it remains clear that it is one of the first technologies to harness and instrumentalize magnetic energy.

In addition, the mariner's compass also serves as the beginnings of the rise of secularity and empirical science (especially experimentation through the figure of Franciscan monk Roger Bacon), in particular a certain form of mathematical knowledge: geometric and trigonometric. Socio-historically, the compass, as Frederic Lane rightly notes, constitutes one node of the conditions of possibility for the colonial Europeanization of the non-Western world, allowing for ships and navigators to venture farther into what was then "uncharted waters." Though the compass would be remediated into various forms after the Middle Ages, most recently radar and GPS (global positioning system), this dossier will be concerned mostly on the specific developments during the Middle Ages (though this historical period itself is fraught with ontological and epistemological slippages).

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"The Compass"(1920)by Man Ray

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The Early Compass

The (Ur-) Compass' Chinese Roots

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South-Pointing Needle

The compass, as it is conceived of today, has its immediate roots in the Middle Ages. Yet, for medieval historians of technology, it has been fodder for debate, especially as its “true” origins have been quite difficult to verify with historical evidence. Yet, almost all medievalists understand the compass to have Chinese roots. By 83 AD, the Han Dynasty had been utilizing magnetism for geomancy—the divination of land and topography, with a technology referred to as the “the south-pointing spoon.” The process of magnetizing metals was simply to rub the metal with a lodestone, a variation of magnetite. And by 8th century AD, various textual sources suggest that Chinese sailors and navigators were utilizing the earliest version of the compass for navigation, what the scholar Barbara Kruetz calls the “ur-compass,” which consisted of a magnetized needle, floating in a bowl of water or hanging from a thread (Gies and Gies). And perhaps, most significantly, unlike the compasses of today, that finds its technological ancestors in Europe, the magnetized needle on this version of the compass pointed south.

Arrival in Europe

As mentioned above, there have been various claims made about the geographic origins of the compass. Though tentative, there is one fact that medievalists do agree on: the ur-compass originates in China. What was up for debate was how the compass had arrived in Europe. Did it come over water from European or Chinese sailors? Did it come from intermediary Arab sailors who had brought the technology from the Far East? It is now agreed upon that the compass arrived in Europe through the Silk Road in its prototypical Chinese form, which primarily served an astronomical-astrological function.

One of the first mentions of the mariner's compass in Western literature is Alexander Neckham's *De Naturis Rerum* (On the natures of things) written in 1190 (Gies and Gies). In 1205, Guyot de Provins, a monk, mentions a magnetized needle in a satirical poem called *La Bible de Guyot de Provins*. Yet, it is not until the writings of Franciscan friar and philosopher Roger Bacon's friend Peter Peregrinus of Maricourt's 1269 monograph *Epistola Petri Peregrini de*

Maricourt ad Sygerum de Foucaucourt, militem, de magnete (better known as Epistola de magnete) that we see the mariner's compass represented in its "dry" form; that is, a step beyond the water in the bowl beginnings.

Design and Description

The mariner's compass cannot be said to have a singular crucial technical element since its history of development shows an assemblaging of various technologies which preceded its coming-together. With the ur-compass (needle in the bowl), the directional information provided to the navigator was almost null and void since there was very little frame of reference for the navigator to orient the ship. Hence, there were various transformations to the design and development of the compass from the ur-compass to the mariner's compass, which not only delineates North but also helps locate the ship's position. As significant the harnessing of magnetic energy was, the magnetic needle itself would have no informational value without the addition of the compass-card. The mariner's compass is not so much then a technology as it is a multiplicity of technologies.

Frederic Lane suggests a 4-stage developmental model of the compass:

- (1) Posing of the problem
- (2) Assemblage of the elements of a solution
- (3) The "break through"
- (4) Critical revision and solution

stages 3 and 4 usually go hand in hand

Using this model, he explains the development of the compass as follows:

- (1) magnetized needle in a bowl
- (2) the division of the horizon into thirty-two or more points and various ways of mounting the needle so that it could swing freely and yet come to rest, even on the deck of a ship at sea
- (3) the attachment of the compass rose to the needle, which may have already been in practice at sea
- (4) the form taken by the break through—(3)—which related in a practical way the direction of a free-swinging needle, the wind rose with thirty-two or sixty-four points, and the course of the ship

Though Lane's model is useful, it posits a linear teleology that does not take into account the various divergences and conflicts that went into the formation of the compass. Additionally, Lane privileges functionality over various other properties of the compass. For example, Lane would consider the azimuth a "crucial revision and solution" – (4) —since the earliest navigators who used the compass found out very quickly that the magnetic needle could not always reliably point north due to the fact that there is magnetic variation throughout the Earth's surface; hence the innovation of the azimuth compass which allowed for checking the ship's bearing.

But another development in the compass, such as that of the self-contained compass, cannot readily be explained by Lane's model, since so much of the historiography of the compass is through medieval texts, whose publishing dates are unreliable since some manuscripts were not published decades after their completion. Furthermore, because of its pre-Gutenberg galaxy, medieval texts cannot for certain be assumed to be widely distributed or even read, and hence influential among navigators. A self-contained compass was available by 1300, documented in Francesco da Barberino's Documenta d'Amore (1300), which distinguishes two categories of compass—the needle and bowl and the pyx.

The pyx is described by Barberino as a "small round box of the sort that has a needle under glass; then, in case of shipwreck, you can tell even under water which way is north, and thus find your way to the shore" (Kreutz, 374). Despite Barberino's mentioning of a self-contained compass in 1300, the text mentioned above by Peter Peregrinus of Maricourt had an accompanying diagram with 360 degrees, and both a pivoted transparent rule with upright spikes at either end and a magnetized, transverse needle-like wire stretched across its face. Lastly, a major improvement in the functioning of the compass came in the form of what is called the Cardan or "dry" suspension, which kept the magnetic needle in horizontal equilibrium (Gies and Gies).

The Compass' Impact on Navigation Or, Solving the Self-Location Problem

As E.G.R. Taylor suggests, the compass had ramifications for navigation, which in turn would have major impact socially (scroll down to Social/Political Processes section). For him, the compass represents a shift from one method of navigation to another, that is, from "improper" to "proper." By the former, Taylor means the "method of navigation employed in conducting a vessel, with no other helps than the sounding lead and the familiar landmarks coupled with Master's knowledge of wind and sky." Hence, by the latter, he means "instrumental navigation, navigation by the chart, navigation across vast oceans."

Improper Navigation

Improper navigation was in many ways an astronomical science, as Draper argues.

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A dramatization of primitive navigation

It was based on a Ptolemaic worldmap that considered the universe as a set of concentric spheres, with earth at its center. However wrong this was, the Ptolemaic map did have cross-hatches that were earliest forms of what we would consider longitude and latitude, though these lines were not curvilinear as yet the spherical nature of the earth did not emerge. Draper describes the process as such:

"In effect, the stars were found to act as points in a knowable space located at a great distance from the earth. The sun, the moon, and the planets did not appear to be fixed in this space, but followed paths that reduced their usefulness for the purposes of guidance. On clear nights, the star Polaris showed the direction of north and provided information on latitude by its angle above the horizon. Other stars with known positions in the pattern of the celestial sphere were also used, but celestial navigation remained an incomplete art for many centuries. The principal reason for this imperfection was the earth's rotation, which made it impossible to determine the angular position of the earth with respect to the stars. Without good information on this position, estimates of longitude necessarily remained of low quality." (Draper, 113-114).

Proper (Instrumental) Navigation

Furthermore, Taylor notes that instrumental navigation necessarily includes technical interoperability. Not only did mariner's compass comprise of various preceding technologies, in adherence to McLuhan's dictum regarding old and new media, but also operated in concert with various other, exogenous technologies. Perhaps it is unwise to even speak in such a register of inside/outside or endo-/exogeneous in reference to the mariner's compass since it was a single fold in a vast assemblage of navigational technologies, with certain properties remediating while others are left to become dead media. Standing figures in this ecology of the technologies of instrumental navigation included the compass-card (or wind-rose), the maritime chart (portolan), the astrolabe, the quadrant and the cross-staff. Below is a

brief description of each:

The astrolabe was a brass ring used to measure angles and degrees that would hang from a rope to determine the ship's angle of direction.

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Celestial Navigation

The quadrant (or Davis quadrant) was a mapping instrument that allowed navigators to measure the altitude of certain astronomical objects.

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Quadrant

The cross-staff was a related instrument that allowed for the navigator to measure latitude through the altitude of either the North Star or Sun, obtained via the quadrant.

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Cross Staff

As mentioned already, the portolan or maritime chart is most likely to have been adopted widely by mariners in the

13th-14th centuries, mostly in the Mediterranean. As many scholars note, Fernand Braudel being the most noteworthy, the Mediterranean was where the most navigational developments—technological and technical—occurred as it was where strategically the most mercantile activity occurred. Hence, the portolans acted as a proto-open source log, whereby “experienced sailors compile[d] sailing directions that described coastlines and specified bearings and distances between points so that skippers unfamiliar with a given shipping route could benefit. In the late 13th or early 14th century, someone had an insight: such information imposed on the whole Mediterranean, one with a center just west of Sardinia, the other with a center on the Ionian coast north of Rhodes” (Gies and Gies, 223-224).

The compass-card or wind-rose was first incorporated by the sailors of Amalfi, remediating the ancient fleur-de-lis—“The Rose of the Winds.” It is “a circular card furnished with 32 points of the compass and positioned directly beneath the free-swinging magnetized needle on a dry-pivot, allowing the helmsman to read the ship’s course—in points, not degrees, since 32 point system was incompatible with the 360 degrees of astronomer’s circle” (Gies and Gies).

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The Coppa Tarantina

According to Barbara Kreutz, the wind-rose has its roots in divination. She argues that the earliest compass-rose is said to have had 16 directional divisions. This is curious because the Rose of Winds reflects the traditional wind system, which had only 12 divisions. Following Bacchisio Motzo, Kreutz argues that the ur-compass (needle and bowl) was not used as a navigational instrument but rather as a conjurer’s trick (Kreutz, 378). She makes this argument with using Motzo’s observation that Etruscans in the early-Middle Ages divided the horizon into 16 divisions. The Coppa Tarantina, as pictured here, is the iconographic merging of the Ptolemaic world-map (see Marine Chronometer ; hence the compass-rose is demonstrative of the wedding of the Greek and Egyptian mythology.

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Ptolemaic Map

The Problem of Self-Location

What weaves together the improper and proper navigational modalities is that the compass is necessarily an interface of self-location. More simply, the compass comes about to solve the problematic of what Niklas Luhmann refers to as “self-reference” or reflexivity. Or perhaps to put it yet another way, it is the beginnings of perspective as understood in the concept of worldview [Weltanschauung], which would notably emerge centuries later. Worldview is not simply an outlook but a wide world view or a global view. Despite the elementary school poems regarding Columbus having to prove that world was indeed not flat, the compass tells us that “the global” was not a concept that emerged in the wake

of World War II as many commentators have recently suggested.

But in fact the compass was a medieval global interface, a crude feedback technology that allowed for the voyaging of a “known unknown” as Kant would put it. From this perspective though Heidegger may seem to have too strongly periodized the “opening of spheres” with the emergence of modern physics, it seems as if his point regarding the world-picture is nevertheless valid when looking at the compass and medieval navigation in general. In an ever expanding universe (to which the development of science played a major role), the world needed to be constituted through the primary perspective of man. And in this way we may wish to correct or amend Heidegger’s dictum: “Man becomes the relational center of that which is as such” to “European man becomes the relational center of that which is as such.”

The Ramon Lull System

Whether the compass-rose was indeed a remnant of tribal European cultures, the technical assemblage of the mariner’s compass by the mid-14th century was influencing a new method of navigation that emphasized the use of instruments and scientific, astronomical knowledge as opposed to some sort of metaphysical “mastery” by the seaman. The system refers to Ramon Lull, a 13th century Catalan scholar, who in his *Introductorium Mange Artis Generalis: Arbor Scientiae* describes “a ship’s navigator establishing his position in relation to his course through the use of the needle in conjunction with charts and mathematical tables—far more sophisticated use for the needle than mere orientation” (Kreutz, 371).

The Lull system, as instrumental navigation is usually referred to, is also an early instance of technical interoperability, much as the World Wide Web is the condition of interoperability for various media devices today. By late 15th century, magnetic compass is developed fully matured navigational instrument. Many of the “bugs and kinks” had been already worked out. For example, the fact that the needle did not point exactly north (caused by magnetic variation in different geological environments) had been duly noted and allowed for. Simplified versions of the astrolabe and its variant, the quadrant, measured the angles of the two Guardians in relation to the North Star; the resulting data used in conjunction with tables gave latitude within about twenty-five miles (Gies and Gies 278).

The King John II System

In 1484, King John II of Portugal appointed a commission of astronomers, geographers, mathematicians and mapmakers to, as John Law describes, “of finding a method for navigating outside European waters” (Law, 9). Hence the group studied the problem of declination of the sun and made tables to be used at sea in conjunction with the astrolabe and quadrant; by determining the sun’s height at midday and consulting the tables, sailors could ascertain latitude. The findings of the group were compiled in the *Regimento do Astralbio et do Quadrante* (1495). A new navigation technique was born: the skipper first sought the correct latitude for a certain port or point of land, then ran along the line of latitude to his target destination.

“This new navigation hinged around the determination of the latitude by means of solar or stellar observation, a method particularly appropriate for journeys that were mainly in a northerly or southerly direction, such as those undertaken by the Portuguese. This was because it depended upon sailing north or south until the vessel reached the same latitude as its destination” (Law, 9). The King John II Commission, by Law’s estimation, is “one of the earliest successful practical applications of scientific knowledge” (Ibid.).

Standing-Reserve

The compass is not simply a neutral innovation of navigation but demonstrative of the pre-history of instrumentalization of nature, which Heidegger later dubs as “standing-reserve” [Bestand]. The transformation of nature into energy is demonstrated on several levels with the compass. First, magnetic energy is converted for human use even in the ur-compass, as the magnetic needle was the result of rubbing iron with lodestone. Secondly (though perhaps primary in its significance for the navigational enterprise), the compass was the means by which winds and tides could be measured, predicted and ultimately harnessed for the purposes of transport. As many recovered portolan charts—navigation charts made of animal skin containing notes of past voyages and maps developed in the 13th and 14th centuries—would indicate, one of the major hindrances to sea travel was unpredictability of winds.

Additionally, for many medieval navigators the shortness of the sailing season allowed for roughly one voyage a year. The short days and generally poor visibility of the winter months made for short, infrequent voyages. As the historian Frederic Lane suggests, the chief “economic meaning” of the compass was the extension of the sailing season in the Mediterranean, venturing so far as to say that the compass was “initially a means of countering overcast” (Lane, 607).

Whether this is true or not, the compass did facilitate more voyages per year in the Mediterranean. Lane writes: “In transportation between Venice and the Levant, for example, being at sea in winter months made all the difference between two voyages a year instead of one. It enabled ships to transport twice as much each year and keep crews

more continually employed. In regard to the Levantine voyages in general, it may be said that starting the spring voyages before winter was over and letting the fall voyages run into December gave sailors more favorable winds. That same schedule was selected again when convoys were established late in the seventeenth century" (Lane, 608-609).

Regimentation

Interestingly, Law emphasizes one major element of the King John II Commission—that of the regimentation or training of mariners. After the commission's *Regimento* was published, there emerged a "discipline" of navigation founded on three sets of rules (Law, 10):

(1) Regiment of the North, which tells how to measure the altitude of the Pole Star and then convert this into the latitude

(2) Rule for Raising the Pole, which told the navigator how far he had to sail on any course in order to raise one degree, and how far east or west he had sailed in doing so. This rule was the product of elementary trigonometry.

(3) Regiment of the Sun, which tackled the difficult problem of guiding the navigator through a solar fix to a determination of the latitude. This was complicated, or at least it was more complicated than the analogous Regiment of the North, because of the daily variation of the declination of the sun and the consequent necessity to consult tables in order to determine the latter.

For Law, these sets of rules are indicative of a new regime of navigational knowledge that prefigures the specialization of modern labor processes. "The new navigation," he writes, "did not depend upon the mariner being able to 'pick it up' by himself. The simple rules, the simple data and the simple instruments were supplemented by systematic training, at least from the turn of the sixteenth century" (Law, 10). Specifically, the parallel development of the regimentation of navigational knowledge and technical innovation resulted in the Portuguese imperial domination of the 15th and 16th centuries, which Law calls "long-distance control," the very pre-condition for European colonial expansion.

European Expansion

In following Charles Draper, the Ramon Lull and King John II Commission systems of navigation were early moves towards a revolution in "knowable space" (Draper, 113). Knowable space has dual meaning. On one hand, it signals a movement away from the strict theological dogma. On the other, or more precisely in turn, it demonstrated a move towards another type of modality of specifically Western knowledge—that of the non-Western world. Hence, Law's concern is not so much about "social control" in the traditional sociological sense but in "managing long-distance control," (Law, 2) in which navigational technologies like the compass figured quite prominently.

"During that medieval millennium, Europe left the world of Rome far behind, while overtaking China and India. The rising technological level of medieval Europe is reflected in the improvement of daily life and work: from slave labor to free labor, from human drudgery to animal power and waterpower; from luxury handicrafts to mass production for mass markets." (Gies and Gies, 286-287)

The Compass in Secularity

Philosopher Charles Taylor in *A Secular Age* offers a tri-partite typology of secularity, breaking them down as "secularity 1" (retreat of religion in public life); "secularity 2" (decline in belief and practice) and "secularity 3" (the change in the conditions of belief) (Taylor, 423). If we are to use Taylor's model, then the compass comes as coincident with secularity 2 and 3, as it was representative of a transformation of knowledge and knowledge-production during the *longue duree* of the Middle Ages. To be sure, the common-sense understanding of medieval religious life projects an image of utmost piety and belief (for the late-Middle Ages) and alchemistic magic (for the early-Middle Ages). To say the least, this view is limited in its conceptualization of both belief and piety (See WC Smith).

This multitextured reality of social life in the Middle Ages is demonstrated by the development of the compass, which, according to Gies and Gies, represents the shift from magic to science. Interestingly enough, the famous case of Galileo, for example, who was attacked viciously by the Church, is not wholly representative of the medieval Church's relationship to science. Gies and Gies give an alternative account of Catholic theology as supportive of technological advancement. Certain technologies that produced Nature "at-hand" was well in line with the theological view of God and humans as sharing transcendence.

There are images of God as steward or mason, during these times. And even in the 6th century, the Benedictine rule created a convergence of heretofore separate theological concepts—labor and piety. (This of course finds a more fervent articulation in radical Protestant reform movements such as Calvinism later.) What this represents, George Ovitt argues, is an "ethic of appropriation" that emerges in a cluster of theologians that emphasize the post-lapsarian view of man as holding power over the natural world. He names Tertullian, Augustine, Bede and Aquinas as representative

thinkers in this movement; but the persona classicus of this line of thought is Roger Bacon who argued that the "practical arts" [Kraft] gave man power over the world.

Rise of Mathematical Knowledge

The compass and instrumental navigation more generally was active in the waning of medieval "science" for a proto-Enlightenment empirical science. Bacon was of course one of the first proponents of the experimental method. But more to the point, the regimentation of navigational knowledge that Law speaks of is at once the rise of mathematical knowledge (specifically geometry and trigonometry) and the "massification" of it as well. It is worth repeating the point that the new form of navigation instantiated by the King John II commission wrought a new regime of navigational training.

Instrumental navigation meant that pilots must master some mathematics, including the degrees of the circle instead of merely the compass points. This is best seen in the transformation of the compass-card, which were marked out by points before they were marked out in degrees. The "point" to "degree" shift is the actualization of the waning of astronomic knowledge to trigonometric knowledge. As Gies and Gies note, by mid-14th century new navigation is widely used and trigonometry is being developed in universities and being applied to navigation, giving the possibility of global voyages and unlimited voyagers. We not only exhibit the rise of scientific knowledge but the beginnings of its institutionalization as practical arts, what we now call "applied sciences."

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