Chapter 8
These Are Not Your Mother's Sundials: Or, Time and Astronomy's Authority

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Abstract Drawing upon the exquisite collection of sundials and time-finding instruments at the Adler Planetarium in Chicago—currently being catalogued by the author—this essay offers examples of sundials made of silver, gilt brass, ivory, wood, and stone between 1500 and 1900. They were designed to be portable or fixed, pocket-sized, or monumental, but all did more than tell the time. By critically examining them, we can see the influence of the cultures in which they were made and used. These material objects tell stories of race, empire, labor, religion, fashion, and politics. And by so doing, the sundials exhibit the relationship of time in these concerns.

Keywords Astronomy • Sundials • Time finding instruments • Politics • Religion • Culture • Labor

When most people think about sundials today, they picture a horizontal surface with a triangular sail skimming over a spray of hour lines tipped by Roman numerals. Normally they imagine it cast in bronze and set on a concrete pedestal in a garden. They also believe that this ornamental thing is a better perch for birds than an accurate time finder. Who can blame them? The bulk of sundials sold by garden centers are badly designed, poorly constructed, and capriciously installed. Many simply will not work.

It is hoped that the sundials discussed in this paper will delight and surprise readers who hold dials in such low esteem.[1] They may even rehabilitate dials for them. These sundials were handcrafted by skilled artisans in silver, gilt brass, ivory, wood, and stone between 1500 and 1900. Some were pocket-sized and portable;

[1]This paper draws upon the extraordinary collection of more than 400 sundials and time-finding instruments at the Adler Planetarium in Chicago. The author has been documenting the collection, and a catalogue is forthcoming (Schechner 2017). Particular instruments will be cited using the museum's accession numbers preceded by AP. Please consult Schechner (2017) for additional documentation.

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others were garden sculpture. Some were humble; others, princely treasure. They exemplify the many forms and styles on which people of different social classes depended to find the time. Their accuracy suited their users' needs, and many could have been employed to set local clocks.

Every one of these sundials is also an astronomical instrument. Each embodies one or more mathematical projections of the celestial sphere and shows the sun's daily motion traced by shadows moving across its various surfaces. They are fitting subjects for a symposium devoted to the science of time. Nonetheless, their production and use as scientific instruments are merely starting points for understanding their historical significance as tangible objects. Like other material culture, sundials are made and employed by human beings and so influenced by cultural milieu and entangled with historical events. To quote Shakespeare, their "nature is subdu'd/To what it workes in, like the Dyer's hand" (Shakespeare 1609, Sonnet 111, ll. 6–7). This means that we can examine the objects in order to discover the impact of sociocultural issues such as race, gender, class, politics, religion, education, and economics (Ulrich et al. 2015; Schechner 2014). Sundials have already been shown to be material evidence of the roles that astronomy has played in people's daily lives (Schechner 2001a, b), and they have been examined as embodiments of cosmological beliefs (Schechner 2007, 2009a). This essay will offer examples of sundials that speak to different aspects of authority.

Authority is a noun of action and force: It is a power to give orders, to make decisions, to enforce, and to control. It implies a recipient upon which action is taken and a vehicle for the action. There are many different ways that sundials as astronomical instruments can be entangled with authority: They can embody edicts of political power or religious order; they can produce and spread astronomical and calendrical information; they can translate and adjudicate between time-telling conventions and can regulate clocks; they can be slaves to fashion or markers of their owners' taste and wealth; they can demonstrate mathematical learning and academic achievement; and they can discipline workers and order lives. The sundials selected to illustrate these points are all part of a remarkable collection at the Adler Planetarium in Chicago.

Political Power

Let us begin with three sundials that evoke political power: an instrument devised by a prince elector, a heraldic crest that found the time, and a travel document carried in the pocket of a lord, diplomat, and military commander.

All that survives of the string-gnomon dial (Fig. 8.1) made in 1547 by Ott-Heinrich, Count Palatine of the Rhine, is an engraved, gilt brass plate, but it bespeaks more than the time. It is a badge of privilege and power. In the center is an elaborate coat of arms emblazoned with four crowned lions, one flanked by buffalo horns and another by wings. The initials "M D Z/O H P" engraved below the coat of arms near 12 o'clock stand for the count's personal motto, *Mit der Zeit* (All in good

Fig. 8.1 A badge of political power and privilege. String-gnomon sundial by Ott-Heinrich, Count Palatine of the Rhine, Palatinate-Neuburg, Southern Germany, 1547. Adler Planetarium, Chicago, M-237

time), and his name and title, *Ott-Heinrich Pfalzgraf*. A member of the Bavarian royal family of Wittelsbach, Ott-Heinrich (1502–1559) was a man to be reckoned with. He was a prince practitioner who made some of his own scientific instruments, a patron of the arts, a book collector, a trustee of Heidelberg University, and a major figure in the Protestant Reformation. From 1505 until his death, he was the Count Palatine of the duchy of Palatinate-Neuburg, a territory in the Holy Roman Empire. In 1556 he added the title of Prince Elector of the Palatinate. Ott-Heinrich, however, was a member of the Schmalkaldic League, a defensive alliance organized by two powerful Lutherans, Philip I, Landgrave of Hesse, and Johann Friedrich I, Elector of Saxony, in response to Charles V's efforts to suppress Protestantism by force in the Catholic Holy Roman Empire. At the time that Ott-Heinrich devised this sundial, his castle at Neuburg an der Donau was under siege by imperial troops. He waited it out. Charles V was victorious in this Schmalkaldic War, but in less than 10 years, he would recognize Lutheranism officially in the Peace of Passau (1552). As Ott-Heinrich's motto affirmed, it was "all in good time" (Schechner 2017, AP: M-237).

The garden dial shown in Fig. 8.2 is a mark of power at the junction of politics and religion. Dating to the seventeenth century and designed for about 44° N, this sundial consists of a slab of polished brown marble that has been sculpted into a

Fig. 8.2 A mark of religious and political authority. Garden dial with heraldic imagery, Italian or South German, seventeenth century. Adler Planetarium, Chicago, M-276

shield with heraldic devices and hour lines for three pin-gnomon dials and one horizontal dial. Lines cut into the wings and tail feathers of the double-headed eagle measure time according to three independent systems of equal hours—the Babylonian (which counted 1–24 from sunrise), the Italian (which counted 1–24 from sunset), and the common (which counted 1–12 twice with starting points at midday and midnight). More will be said about these hour systems below, but here it should be understood that they were appropriate for civil and business purposes. Unequal, planetary hours (which counted 1–12 from sunrise and again from sunset) are incised into the coronet that tops the eagle. This system was used by Catholics to regulate the hours for prayers. That a dial showing unequal hours was placed literally in a crowning position above the heraldic eagle tells us much about the owner's beliefs and alliances. Indeed, one of the two small coats of arms on this instrument belongs to a senior official of the curia or protonotary apostolic (Schechner 2017, AP: M-276).

Political power is also writ large on a gilt brass pocket sundial (Fig. 8.3) made by J. J. Schört of Paris in 1638 for Jacques de Stavay-Molondin (1601–1664), the lord of Molondin, Switzerland, and a French diplomat and military commander. This sundial is a diplomatic pass. The universal equatorial dial is engraved with a gazetteer of 90 cities, providing its owner with the geographic information he needed to set the sundial for any latitude in Europe. The underside of the dial has Stavay-Molondin's coat of arms and a secret code: *Anagramma/Oculus Domini is videt/INDE AMABO DANOS* (Anagram: That eye of God sees, thence I will love the Danes). The meaning of this cipher remains a mystery (Schechner 2017, AP: M-294).

Fig. 8.3 A diplomat's sundial with a secret code. Universal equatorial dial by J. J. Schört, Paris, 1638, owned by Jacques de Stavay, lord of Molondin, Switzerland. Views of the pocket dial with a detail of the underside of the compass box, showing the cipher. Adler Planetarium, Chicago, M-294

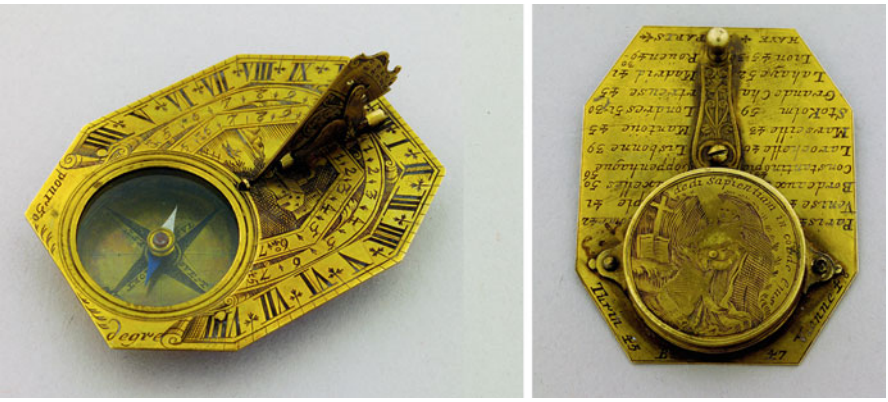

Fig. 8.4 A time regulator for a Carthusian monk. Butterfield-type dial by Thomas Haye, Paris, circa 1720, showing St. Bruno praying in the wilderness. Adler Planetarium, Chicago, A-3

Religious Order

The authority of religion is evident in many pocket sundials, and the five discussed here offer diverse examples. Let us consider first a brass, Butterfield-type dial made by Thomas Haye in Paris, circa 1720 (Fig. 8.4). It is a devotional object to humble a monk. On the underside of the compass box, Haye has engraved an image of a man in monastic robes praying on bent knee before a book and a cross in the wilderness. It is St. Bruno. Aspiring to an eremitic life in the desert, Bruno and six companions ventured in 1084 to a rocky, snowy spot in the Chartreuse Mountains of the French

Alps. There Bruno established an ascetic community of contemplative hermits, which became known as the Carthusian Order. The hermitage and "mother house" of the Carthusian Order, Grande Chartreuse, is listed on the sundial's gazetteer (Schechner 2017, AP: A-3). With very little change, Carthusian monks have followed the statutes of their order for more than 900 years. It is said that they live and die by the clock, since their hours are rigorously measured into periods of prayer, spiritual meditation, and manual work, mostly carried out in the solitude of the monks' cells (The Carthusian Order 2016; Merton 1957, pp. 127–144). Table 8.1 shows a typical day for a Carthusian monk. A sundial would be a fitting emblem for them.

Table 8.1 Time discipline typical of a Carthusian monk

11:30 pm	Rise
11:45 pm	Matins of Our Lady
12:15 am	**In church: Night Office (Matins followed by Lauds), lasting 2–3 h depending on the day or the feast**
2:15 or 3:15 am	Lauds of Our Lady. Then back to sleep
6:30 am	Rise
6:45 am	Prime of Our Lady and Canonical Prime. Mental prayer or spiritual reading
7:45 am	To church: Angelus
7:45 am	**In church: Community mass, followed by private masses**
9:00 or 9:30 am	Free time. Mental prayer or *Lectio Divina* (meditative reading of the Bible)
10:00 am	Terce of Our Lady and Canonical Terce
10:45 am	Study and manual work
11:45 am	Angelus, Sext of Our Lady, and Canonical Sext Dinner (always meatless; on Friday, bread and water only) Recreation (reading, working, gardening, enjoying sunshine)
2:00 pm	None of Our Lady and Canonical None. Study
3:15 pm	Manual work
4:00 pm	Vespers of Our Lady
4:15 pm	In church once a week: Office of the Dead
4:45 pm	Free time
5:00 pm	**In church: Canonical Vespers**
5:30 pm	Light evening meal. Time for reading and prayer
7:00 pm	Angelus. Examination of conscience. Canonical Compline and Compline of Our Lady
8:00 pm	Bedtime

This is the typical time schedule for a cloister monk, although there are slight variations between charterhouses, monks, and days. The day is punctuated by the recitation of the Divine Office and the Little Office of Our Lady. Also known as the Liturgy of the Hours and the Little Hours of the Blessed Virgin Mary, they consist of a daily cycle of prayers, psalms, and scriptural readings recited at particular hours. The offices are named Matins, Lauds, Prime, Terce, Sext, None, Vespers, and Compline. The Angelus is a prayer of devotion commemorating the Incarnation and is often announced by a bell. All activities are done in solitude by the monks in their cells, except for communal prayers in the church (shown in bold). (Adapted from the Carthusian Order's official website)

Even in a monastery, daily schedules are subject to shaping by weekly patterns, monthly routines, and the annual cycle of religious festivals and saints' days. For those living outside of religious orders, secular distractions abound. Perpetual calendars help individuals in both communities recall these cycles and are often sundial accessories (Schechner 2014, pp. 52–59). A superb example (Fig. 8.5) is found on the exterior of a silver case that houses an Augsburg-type dial made by Johann Martin between 1671 and 1719 in Augsburg. The case top has a calendar volvelle (a stack of pierced, rotating disks), which aligns days of the week with dates of the month. Apertures reveal the number of days per month, the sun's zodiacal position, the lengths of day and night, and the major saints' days. A lunar volvelle on the case bottom shows lunar phases and the separation of the sun and moon in hours and minutes (Schechner 2017, AP: A-98).

Form and function can also be married in sundials for the devout. Take, for instance, a gilt sundial-reliquary made by the workshop of Ulrich Schniep in Munich, circa 1560 (Fig. 8.6). The cross-shaped hollow box holds the bones of Saints Sabina, Ursula, Ignatius of Antioch, and Walburga, plus a tiny piece of the True Cross clad in gold. The top and bottom faces of the box are engraved with images of a bishop, the Virgin Mary, and assorted Jesuit and Marian symbols. But flip the reliquary over, and the hinged lid becomes the base of an inclining cruciform sundial. The sides and edges of the cross become sundial surfaces and gnomons. The fine quality and imagery suggest that this remarkable sundial probably belonged to a German bishop, who wore it as a pectoral cross or suspended it from his belt (Schechner 2001a, 2017, AP: M-253).

Christianity is not the only religion in which adherents have found time-finding instruments useful in regulating work and prayers. Muslims, for instance, have used sundials and astrolabes to determine the correct times for their daily prayers. During their rituals, Muslims must also orient themselves according to the *qibla*, the direction of Mecca, and, more specifically, that of the *Ka'abah* in Mecca. Given as a compass bearing, the *qibla* varies from place to place on the Earth. Therefore, geographical tables on Muslim instruments give the latitude, longitude, and *qibla* of each city. Specialized devices known as *qibla* indicators attach this information to a magnetic compass with an index that can be set to the right bearing. A sundial may also be included, as in the *qibla* indicator pictured in Fig. 8.7. It was made in England between 1750 and 1800 for the Turkish market (Schechner 2017, AP: A-148).

Religious pilgrims, moreover, must find their way to holy shrines. Figure 8.8 shows an astronomical compendium made of wood in 1513 by Erhard Etzlaub of Nuremberg. In addition to a magnetic compass, the instrument has an incised map of Europe and North Africa complete with latitude scales. Other surfaces have sundials and horary quadrants to find time and available daylight at latitudes 54°, 51°, 49°, 45°, 42°, 37°, 31°, and 24°. Etzlaub created the wooden compendium in order to guide pilgrims to Rome, Jerusalem, and Sinai (Schechner 2001a, 2017, AP: DPW-22).

Fig. 8.5 A perpetual calendar to keep track of religious festivals and lunar phases, engraved on the silver case of an Augsburg-type dial by Johann Martin, Augsburg, 1671–1719. Adler Planetarium, Chicago, A-98

Time-Telling Conventions

In Europe, different countries had different conventions for time telling, and travelers needed to negotiate these changes at the borders. Italians counted their hours 1–24 from sunset, while Bohemians started from sunrise (using a system often called Babylonian hours). In the Nuremberg region, Germans divided the day into two sets of equal hours with the first hour of the day counted at sunrise and the first hour of the night counted at sunset. The French and English, however, preferred the system of common hours in which the day was divided into two groups of 12 equal hours starting at noon and midnight. By displaying plural hour systems, portable dials enabled their users to convert between them (Schechner 2014, Chap. 5).

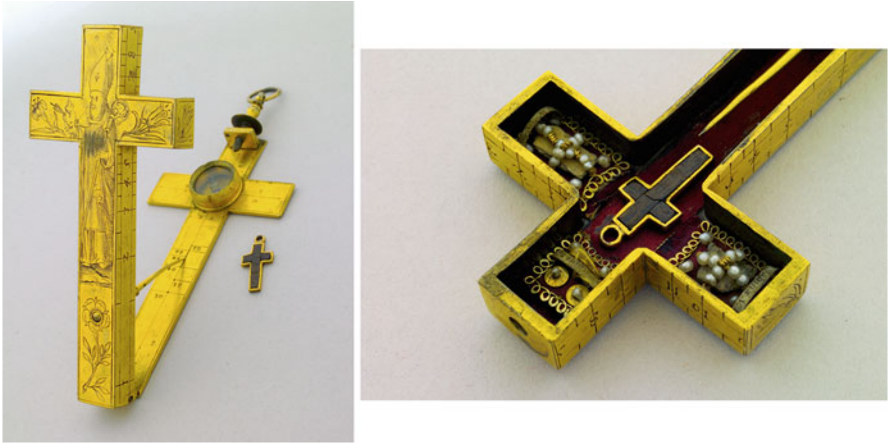

Fig. 8.6 A bishop's reliquary in the form of a cruciform sundial, made in the workshop of Ulrich Schniep, Munich, circa 1560. Adler Planetarium, Chicago, M-253

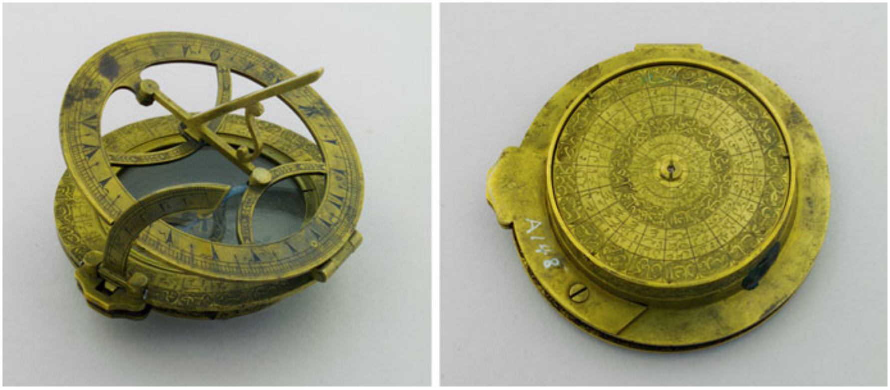

Fig. 8.7 A means to find the direction of Mecca and hours of prayer. Qibla indicator and inclining dial, probably made in England for the Turkish market between 1750 and 1800. Adler Planetarium, Chicago, A-148

Figure 8.9 illustrates the bundling of hour systems on an ivory diptych dial by Thomas Tucher of Nuremberg, circa 1610–1620. A string, now missing, once stretched between the inner faces of the lower and upper leaves and served as a gnomon for four sundials. These all read common hours. Four pin-gnomon dials on the vertical and horizontal faces show Italian hours, Babylonian hours, and the length of daylight at different times of the year. In the daytime, a person wanting to read Nuremberg hours can use the Babylonian-hour dial, which is labeled "Nirenperger Uhr." At night, the Italian-hour dial will serve him by moonlight if he corrects the shadow reading for the number of hours that the moon is behind the sun. To get this right, he would take advantage of the lunar volvelle on the outer

Fig. 8.8 A guide for pilgrims on the way to Rome, Jerusalem, or Sinai. Wooden compendium by Erhard Etzlaub, Nuremberg, 1513. Adler Planetarium, Chicago, DPW-22

face of the lower leaf. Note that the Italian-hour dials are labeled “Welsche Uhr” (foreign hours), highlighting the perspective of the maker in Nuremberg (Schechner 2017, AP: T-10).

Another example is the ivory diptych by Johann Gebhart, Nuremberg, 1546 (Fig. 8.10). This instrument has an equatorial dial on its top leaf showing common hours. In its center is a lunar volvelle. Instructions incised into the ivory remind the user how to convert the sundial into a moon dial. The lower leaf has a pin-gnomon dial whose crisscrossing lines indicate both Italian and Babylonian hours (Schechner 2017, AP: DPW-21).

Sundials like these examples were treaties on time zones.

Slaves to Fashion

Like stylish clothing and cooking, sundial designs followed fashion trends, particularly in major cities of production. It was not enough to simply find the time. Consumers wanted to show off their good taste when they pulled a sundial from their purse or pocket. Each city had its special style. In late-seventeenth- and eighteenth-century London, compass dials were popular (Fig. 8.11), whereas in Paris, Butterfield-type dials with their cute bird-gnomons were all the rage (Figs. 8.4 and 8.12). In Augsburg, individuals purchased universal equatorial dials in a form that became synonymous with the city (Figs. 8.5 and 8.13), while

Fig. 8.9 Plural hour systems for use by travelers. Ivory diptych dial by Thomas Tucher, Nuremberg, 1610–1620. Adler Planetarium, Chicago, T-10

the Nuremberg compass makers produced diptych dials (Figs. 8.9 and 8.10). Dials purchased by the wealthy were fashioned of silver, gilt brass, or ivory. Those of lesser means bought cruder instruments of brass or wood (Schechner 2001a, 2017, AP: A-95, A-243, W-237).

Luxurious goods also existed. Exquisite crescent dials of silver and gilt brass were imported from Augsburg to London. An example by Johann Martin (Fig. 8.14) is signed by Masig, an import agent in the early eighteenth century (Schechner 2017, AP: M-301). Butterfield-type dials by the inventor, Michael Butterfield, were so desirable that they were counterfeited (Schechner 2001a, 2009b, 2017, AP: N-5). Instruments such as the polyhedral dial fashioned by Ulrich Schniep of Munich in 1577 (Fig. 8.15) had the status of *haute couture*. Shaped as a gilt tower, this windowsill instrument has sundials on every face, a magnetic compass on the underside of the domed roof, and a level within its chamber. Schniep had many noble clients, including Duke Albrecht and Emperor Maximilian II. This polyhedral dial was made for a member of the von Stadion family of Augsburg, whose coat of arms appears on the instrument (Schechner 2017, AP: M-304).

Fig. 8.10 A treaty on time zones. Ivory diptych sun and moon dial by Johan Gebhart, Nuremberg, 1546. Adler Planetarium, Chicago, DPW-21

Fig. 8.11 London fashion. Compass dial, Samuel Rolfe, London, 1742. Adler Planetarium, Chicago, W-237

Fig. 8.12 Paris fashion. Butterfield-type dial, Michael Butterfield, Paris, 1681–1684. Adler Planetarium, Chicago, A-243

Fig. 8.13 Augsburg fashion. Augsburg-type dial, Johann Mathias Willebrand, Augsburg, 1700–1725. Adler Planetarium, Chicago, A-95

Authority of Learning

Complexity in polyhedral and multiple-faced instruments such as the Schniep tower-shaped sundial offered owners the opportunity to show off not only their breeding and good taste but also their learning. Such dials also establish their makers' virtuosity. As the sun travels across the sky, the sundials on one face hand off the job of finding time to those on the next.

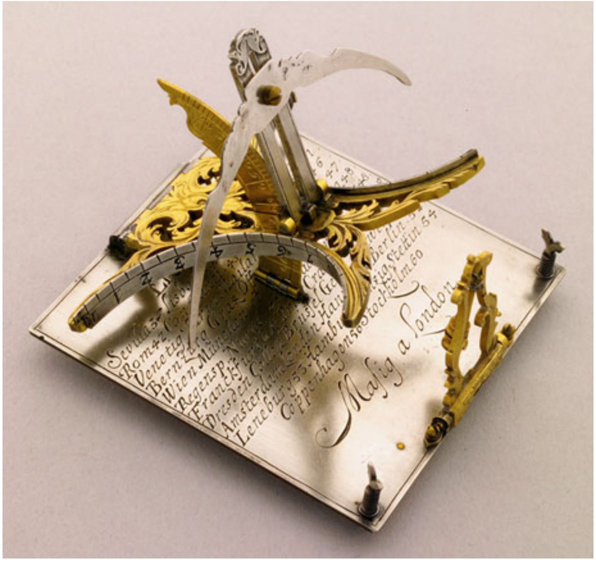

Fig. 8.14 A stylish import. Crescent dial by Johan Martin, Augsburg, imported to London by Masig in the early eighteenth century. Adler Planetarium, Chicago, M-301

Fig. 8.15 Haute couture. Tower-shaped polyhedral dial by Ulrich Schniep, Munich, 1577, for a member of the von Stadion family of Augsburg. Adler Planetarium, Chicago, M-304

The silver polyhedral dial, built in Germany about 1620 (Fig. 8.16), is deliberately overengineered to be a spectacle. Based upon a design published by Oronce Fine in his *Protomathesis* (Paris, 1532) and again in *De solaribus horologiis et quadrantibus* (Paris, 1560), this object is a conglomeration of planes, cavities, rings, and spheres. It has 29 distinct dials on its various surfaces. This is not a sundial; it is a dissertation in mathematical astronomy! (Schechner 2001a, b; Schechner 2017, AP: M-324).

Labor Relationships

Modern societies are characterized by a division of labor, a hierarchical structure of workers, and schedules for particular types of work. Sundials have exhibited all of these labor relationships.

First and foremost, as time-finding devices, sundials have always encouraged time discipline (Schechner 2001a, 2014). Even the simplest ones show the passage of time and can admonish the onlooker to use his or her time more wisely. But sundials that provide information on the lengths of days versus nights during the course of the year have a greater capacity for time management, since they enable the user to plan ahead. For example, the table-sized dial by Ulrich Schniep of Munich, 1572 (Fig. 8.17), has declination arcs showing the sun's place in the ecliptic. These are divided into zodiacal signs in the order of day duration increasing or decreasing. Along the meridian line of the hour plate are numbers indicating the hours of daylight depending on the sun's position (Schechner 2017, AP: M-243). Such a sundial would have made a very wealthy merchant, banker, or senior administrative official mindful of his business.

Sundials could also be attached to the tools of people who worked with their hands as well as heads. A late-seventeenth-century example is the sundial mounted over a surveyor's plane-table compass (Fig. 8.18). This special type of magnetic compass has a square base with straight edges. A surveyor employs it on top of a portable flat surface, called a plane table, when drawing charts and maps in the field. A sundial accessory would have helped the surveyor keep track of the time. This example was made by Thomas Haye, Paris, 1690–1700 (Schechner 2017, AP: DPW-2).

As manufactured goods, sundial production followed the rules of local guilds, which concerned the economic and training relationships between masters, journeymen, and apprentices. Sundials also expressed relationships between patrons and clients with the craftsmen that served them. To this end, the carved limestone, garden dial (Fig. 8.19) made in 1719 by Franz Xaver Josef Bovius in Eichstätt, a town in upper Bavaria, is not just a sundial; it's a job application. Bovius was a Catholic priest, who is known to have made sundials for many nobles in his chapter. This particular dial was made for Casimir Ferdinand Adolf von Waldbott of Bassenheim, a nobleman and choir bishop in Mainz and Trier. A dedication to Waldbott, which includes all his titles and distinctions, is carved into a banner

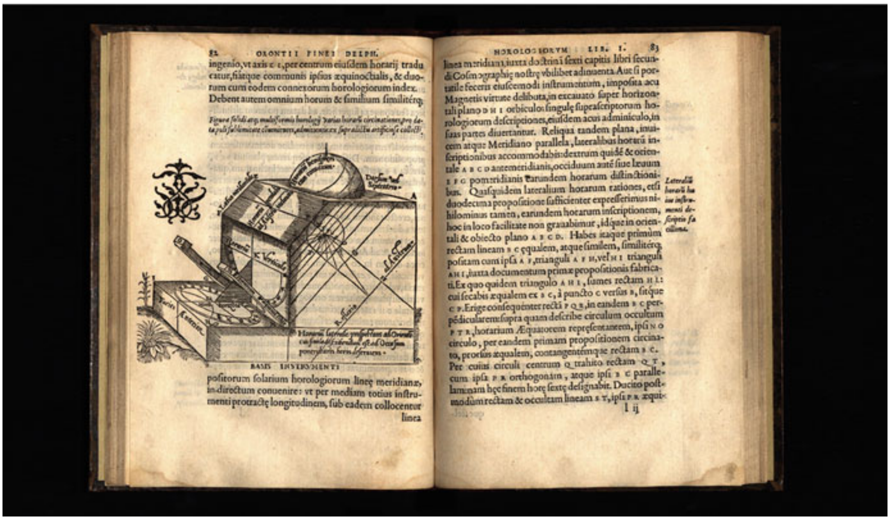

Fig. 8.16 A mathematical thesis. A German polyhedral dial, circa 1620, based on a design published by Oronce Fine in *De solaribus horologiis, et quadrantibus* (Paris, 1560). Adler Planetarium, Chicago, M-324

Fig. 8.17 A work planner. String-gnomon dial by Ulrich Schniep, Munich, 1572, showing the hours of daylight available each month. Adler Planetarium, Chicago, M-243

above Waldbott's coat of arms. The arms are also engraved four times onto the brass gnomon. A central element of Waldbott's heraldic crest is the swan, and Father Bovius has carved swan motifs no less than 35 times in emblems that encircle the sundial. Mottos with the emblems suggest Waldbott's attributes (fortitude, prudence, temperance, justice, brightness unimpeded, trusting, not weakened, touched but not shaped, looking to the heavens, following God, and so forth). Others are fawning affirmations such as "Scribe Beati" (Write of the happy), "Latior in Senio" (I am brought forth in old age), and "Excelsa Peto" (I demand the heights). Three chronograms[2] on the sundial also reference the red and white colors of Waldbott's coat of arms, and one enjoins, "IVgIter soL nobIs ConserVabIt aDoLphVM" (The sun will perpetually preserve our Adolf). By copying and rearranging the capital letters, we get MDCLLVVVIIII, the year 1719 in which

[2]Chronograms are sentences or phrases in which specific letters are interpreted as Roman numerals, which stand for a particular date when pulled out of the sentence and rearranged.

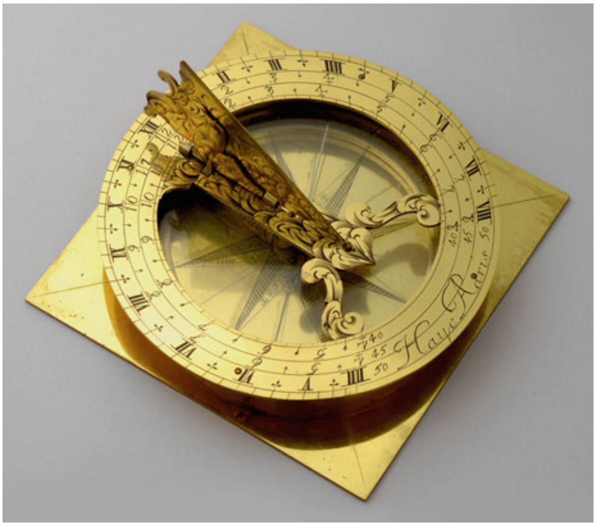

Fig. 8.18 A task master. Surveyor's plane-table compass with a built-in sundial, by Thomas Haye, Paris, 1690–1700. Adler Planetarium, Chicago, DPW-2

the dial was made. No sundial has more flattery of its patron than this. Father Bovius's signature reminds the recipient that he has been examined, approved a candidate of canon law, and served as priest in the diocese of Eichstatt (Schechner 2017, AP: M-286).

A very fine sundial by Christoph Schissler, Augsburg, circa 1562 (Fig. 8.20), offers another perspective on labor relations. The gnomon (now missing) was a string attached to a staff held by the turbaned figure of a Moor. The exotic black African represents a slave at a royal court or in the household of a European nobleman. He symbolizes his owner's power at home and abroad. He is at his master's beck and call at all hours (Schechner 2017, AP: M-240).

Empire

The mention of slave labor brings us to the topic of imperialism and how sundials served colonial administrators and military officers. Figures 8.21 and 8.22 show two examples of brass pocket sundials carried by French military officers across Canada and down the Mississippi in the mid-eighteenth century. Both were made in Paris by Pierre le Maire II between 1730 and 1760 and are among six extant examples (Schechner 2016). The underside of each carries a gazetteer for New France listing colonial capitals (e.g., Quebec, Port Royal, and New Orleans), forts large and small (e.g., the Fortress of Louisbourg and Fort Louis), fur trading posts (e.g., Green Bay, Montreal, Fort St. Anne, and Michipicoten), and Native American tribes (e.g., the Iroquois, Abenaki, Wabash, Missouri, Illinois, Quapaw, Natchez, Pensacola, and others). The sundials are evidence of the transmission of cartographic and ethnographic knowledge gathered by missionaries, explorers, soldiers,

Fig. 8.19 A job application. Garden dial designed to impress the recipient and include the maker's resume, carved by Father Franz Xaver Josef Bovius of Eichstätt, Germany, 1719, for Casimir Ferdinand Adolf von Waldbott of Bassenheim, a choir bishop in Mainz and Trier. Adler Planetarium, Chicago, M-286

and colonial merchants. These wilderness sites were bitterly contested by France and England in numerous battles and proxy wars involving Indian tribes. The sundials, however, made these Indian nations seem smaller by confining their ranges to very specific latitudes. It is also sobering to see the city of La Rochelle on one sundial. This French port was central to France's triangle trade, which transported slaves from Africa to the West Indies and Louisiana, and sugar from plantations there back to France (Schechner 2016, AP: T-58, W-57).

Similar sundials were made for use in New Spain (Fig. 8.23). An equatorial dial by Juan Andres, La Paz, 1699 (A-263), is made from the silver being mined nearby and exported to Spain. Its gazetteer lists locations in the northern part of the Viceroyalty of Peru, including Potosí, known for its great silver lodes; Lima, the capital of the viceroyalty and hub for the export of silver and import of

Fig. 8.20 Slave labor. A black African Moor once held the string-gnomon on this lavish sundial by Christoph Schissler the Elder, Augsburg, circa 1562. Adler Planetarium, Chicago, M-240

Fig. 8.21 A colonial administrator. Butterfield-type sundial made in Paris by Pierre le Maire II, 1730–1760, for use in New France. The gazetteer lists fur trading posts, forts, and Native American tribes across Canada. Adler Planetarium, Chicago, T-58

manufactured goods; Cusco and Quito, producers of cotton and woolen textiles; and Arequipa and Nazca, producers of wine. The gazetteer also includes indigenous people. The only ornamentation on this sundial is a simple *globus cruciger* (cross-on-orb), symbolizing the dominion of Christianity over the globe. The decoration

Fig. 8.22 A dial for conquerors. Butterfield-type dial by Pierre le Maire II, Paris, circa 1750, for use in French possessions down the Mississippi River and its tributaries and east along the Gulf of Mexico. The gazetteer lists indigenous peoples to be governed: the Wabash, Missouri, Illinois, Arkansas (Quapaw), Natchez, Pensacola, and Tohomé. La Rochelle, a coastal city in France, is also included. The port was involved in France’s trade of slaves from Africa and sugar from plantations in the West Indies and Louisiana. Adler Planetarium, Chicago, W-57

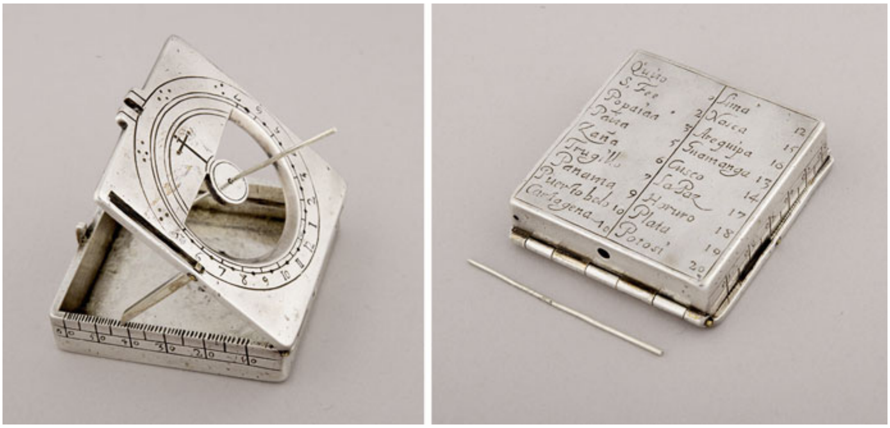

Fig. 8.23 On a mission in New Spain to import Catholicism and export silver. Equatorial sundial by Juan Andres, La Paz, Bolivia, 1699. Adler Planetarium, Chicago, A-263

suggests that this sundial was made for missionaries, but the locations were also mining, textile, and agricultural centers with European- and colonial-born Spanish administrators and landowners, who oversaw a labor force of enslaved Indians and some Africans.

Clock Regulation

The last section of this paper examines the tug-of-war between apparent solar time and mean time as represented by the material culture. Clocks play such an outsized role in modern life that it is easy to forget that sundials had the upper hand in accuracy and affordability well into the nineteenth century. Sundials capable of distinguishing minutes were produced a century before minute hands became common on clocks. Clocks, moreover, could only keep mean time from an arbitrary starting point, whereas sundials and other time-finding instruments found the time directly from the sun or stars. Therefore, every clock user needed a good time-finding instrument to set his or her timekeeper. One early solution was to buy a clock or watch with a sundial attached. Another took advantage of specialized sundials that were noon markers. The most popular noon markers throughout the nineteenth century were cannon dials set up in public parks (Figs. 8.24 and 8.25). Sunlight focused by a lens on the touch hole of a small cannon announced noon with a blast that delighted onlookers (Schechner 2017, AP: W-104).

As watches and clocks became more accurate, people cared about the discrepancy between apparent solar time (read by a sundial) and mean solar time (measured out by a clock) and began to favor mean time. To convert between the two, tables for the equation of time were printed in almanacs and on paper disks that were pasted inside the cases of pocket watches and sundials. With the familiar phrases, “Watch Fast” and “Watch Slow,” the tables informed users whether to add or subtract minutes from the time read off their sundials in order to set their clocks to mean time. By the late eighteenth century, those who found this too tedious could purchase a heliochronometer, a sundial that found mean solar time directly. Johann Jakob Sauter II of Stockholm, 1802–1811, produced the fine example shown in Fig. 8.26, which mechanically corrects for the equation of time (Schechner 2017, AP: M-302).

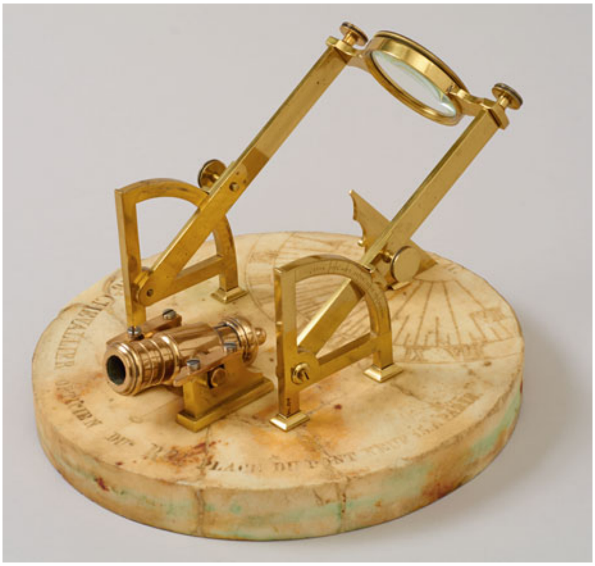

Fig. 8.24 An acoustic sundial to regulate clocks. Cannon dial by Jean-Gabriel-Augustin Chevallier, Paris, circa 1820. Adler Planetarium, Chicago, W-104

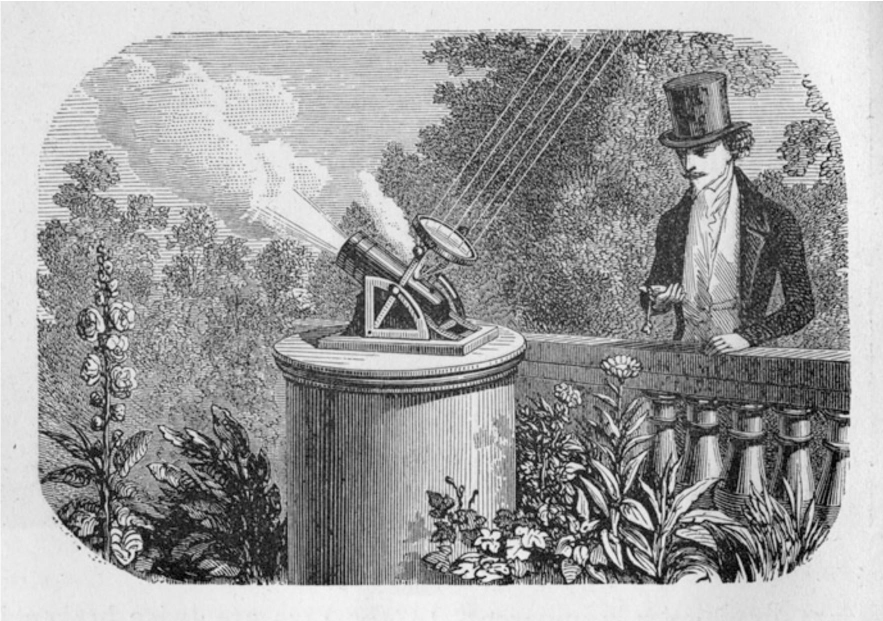

Fig. 8.25 Man setting his watch by the noon blast of a cannon sundial. Adolphe Ganot, *Natural Philosophy for General Readers and Young Persons* (New York, 1872)

Fig. 8.26 A slave to the clock. Heliochronometer by Johann Jakob Sauter II, Stockholm, 1802–1811, which mechanically corrects for the equation of time. Adler Planetarium, Chicago, M-302

Fig. 8.27 Authority of mean time. Heliochronometer by Pilkington and Gibbs, Preston, Lancashire, England, as sold by Ross Ltd., London, circa 1910, along with a promotional booklet. Adler Planetarium, Chicago, W-276

The tables were turned with the advent of the railroads, which required a standard time zone along the tracks, and telegraph lines that could send time signals from precise clocks set up in astronomical observatories to central locations. Mean time won out. Sundials became slaves to clocks. Although Pilkington & Gibbs, England, used pastoral images to advertise its heliochronometers in 1910 (Fig. 8.27), they were often to be found at railroad stations. The firm's slogan—"Tis Always Morning Somewhere"—and model names such as "Empire" underscored belief in the British Empire as an "empire on which the sun never sets." (Schechner 2017, AP: W-276).

Conclusion

The foregoing examples make it clear that sundials tell us much more than the time of day. They tell us about the times in which their makers and users lived. As material culture, the instruments embody social norms, cultural differences, and aspirations related to race, empire, labor, education, fashion, religion, and politics. They show how astronomy's authority was culturally bounded when it came to knowing what the hour was from the sun, moon, and stars.

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