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Knowing Nature by Its Surface: Butchers, Barbers, Surgeons, Gardeners, and Physicians in Early Modern Italy

▼ **ARTICLE**

▼ **ABSTRACT** This article draws attention to several different practices of observation, manipulation, and experimentation with the surface of natural things. Beginning from the observation that the surfaces of natural things invited observation, manipulation, measurement, and re-configuration, with the promise to unveil the knowledge of depths, this article explores how practical knowledge about the surface of things and bodies led to new conceptions of nature and matter as composed of layers, corpuscles, and artificially reproducible solid parts in early modern Europe. This article explores issues of knowledge production, and studies the ways in which material knowledge-making practices contributed to the habits of observing and experimenting with the surface of nature. By discussing three groups of cases in which nature was known by its surface and practice was mixed with theoretical appraisals of matter—surgeons, butchers, and food-cutters; gardeners and agronomists; and physicians—this article argues that "cognitive models" focusing on the description as well as the manipulation of natural surfaces informed both artisanal practices and natural philosophy, bridging the "high" and the "low" in the age of the "scientific revolution."

▼ **KEYWORDS** Artisanal Epistemology, Early Modern Science, Historiography of Science, History of Medicine, History of the Body, Surfaces

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BREPOLS

Introduction: Surface Knowledge

Gaston Bachelard's 1938 *Formation of the Scientific Mind* contains a pointed critique of "depth" as the supposed substance of science. Depth is described there as the quintessential "epistemological obstacle" that scientific practice overcomes in its historical development. Looking for depth was for the French historian a fundamental error, due to the fact that "envelopes appear less precious and less substantial than the matter they envelop," while the "bark [*écorce*], so essential from a functional point of view, is thought of merely as a protective layer of the wood." This "intuitive valorization of interiority," or "myth of the interior," leads to the so-called obstacle of the substance, namely the idea that nature has a substance, which is depth, that needs to be penetrated and extracted. Bachelard believed that this was a fundamental mistake of the "pre-scientific" early modern mind.[1] As Carolyn Merchant and Katharine Park (among others) have shown, the language of penetration and extraction is emblematic of the gendered language of the secrets of nature.[2] This article returns to the surface of natural things. The surface represents another way of dealing with nature in the early modern period, an inversion or revaluation of what counts as important in natural inquiry and manipulation: for some early moderns, what held the key to understanding the secrets of nature was its surface.

This article describes the knowledge and practice related to the surfaces of several kinds of bodies in early modern Italy from the point of view of the intersections between some branches of "high" and "low" culture, or intellectual and artisanal ways of knowing. It discusses areas of overlap in the expertise of physicians, surgeons, cooks, butchers, barbers, anatomists, earth scientists, and naturalists. Experts in such areas shared both specific sets of practical skills in manipulating natural surfaces, and observational and epistemic techniques for understanding natural bodies via their surface. This article discusses three groups of cases in which nature was known by its surface and practice was mixed with theoretical appraisals of matter, focusing on the knowledge of individual bodies of humans, plants, and animals: surgeons, butchers, and food-cutters; gardeners and agronomists; and physicians. Similar semantic areas connect the peel of fruits, the skin of animals and humans, the bark of trees, and the fur of animals, and such semantic areas are linked to shared cognitive models related to surface knowledge.

"Cognitive model"—which I adapt from the more intellectualistic "mental model" recently used in the history of mechanics to describe the relationships between practical experience and conceptual systems—is a useful tool to account for similarities in knowing and practicing nature that straddle the boundaries among disciplines and levels of literacy, and it allows to factor in personal contact and exchange of information.[3] As I treat them here, cognitive models link together theoretical frameworks, attention to specific features of objects, and practical engagement with bodies and

1 Bachelard (1993, p. 99).
2 Merchant (1980); Park (2006).
3 Renn (2015); Renn, Damerow, Schemmel, Lehner, & Valleriani (2018, pp. 3–28).

materials. In this formulation, attention to the surface is the "model" followed by different early modern actors to produce practical or theoretical knowledge from an engagement with nature (hence the "cognitive"). Surface-centered cognitive models help to understand how information and practical know-how were exchanged among different actors, or simply shared as models for looking at nature and extracting practical or theoretical knowledge from nature. For example, as we shall see below, a learned anatomist with a university degree like Andreas Vesalius (1514–1564) could share a cognitive model with a butcher skinning a pig and a cook slicing the peel off an apple. In these cases, practice and theoretical frameworks were mutually integrated in the production of new knowledge. Moreover, the cognitive models discussed in this article belong to the family of the "evidentiary paradigm," famously proposed by Carlo Ginzburg to describe a kind of knowledge linked to qualitative evaluation, comparison, and analysis of individual features of—in this case—the superficial qualities of matter.[4] Cognitive models focusing on the description as well as the manipulation of natural surfaces informed artisanal practices and natural philosophy as well. Thinking about, practicing with, and observing surfaces can be thought of in terms of shared cognitive models to make sense of practice, experience, and eventually experiment.

This article has an exploratory nature and by no means claims the final word on the issue of knowing surfaces in early modernity. Art historians, anthropologists, and literary scholars have done important work on the links between surface and knowledge.[5] However, this article explores the topic of surface from the point of view of the history of science. It builds on attempts at getting past the dichotomy between quantitative and qualitative knowledge, as well as between natural philosophy and the arts. It explores the many different ways "modern science" has emerged, as well as the contribution non-mathematical sciences—what Thomas Kuhn once called "non-mechanical arts" only to relegate them to the so-called Baconian strand of early modern science—have made to the habits of observing, collecting, experimenting with, and manipulating natural matter.[6]

Historians of early modern science who have been attentive to its relationship with forms of popular knowledge and metaphors have described the knowledge of nature as a process of "penetration" of its secrets. William Eamon, building on

4 Ginzburg (1979).

5 For recent examples, see Fend (2017); Amato (2003). Additionally, there is a network of scholars involved in "surface studies," based in the UK (https://www.surfacestudies.org).

6 Kuhn (1976, pp. 1–31). The early modern "scientific revolution" is known for being characterized by an exchange between humanist erudition and a passion for practice. To mention only a few recent works: Smith (2004); Shapin (1989, pp. 554–563); Cook (2008); Gooday (2008, pp. 783–795); Struhal (2017, pp. 501–513); Opitz, Bergwik, & Van Tiggelen (2016, pp. 1–15); Leong (2018, pp. 4–10); Long (2011, p. 7); Rankin (2013); Whaley (2011); Di Meo & Pennell (2013); Barker (2016, pp. 101–116); Snook (2017, pp. 1–21). On the traditions of mixed mathematics and alchemy see, for example, Bennett (1986, pp. 1–28); Newman (2006). On more qualitative "disciplines," see Spary & Zilberstein (2020, pp. 1–19). On the history of the interactions between popular and learned actors in early modern science, see Daston (2017, pp. 134–142); Östling, Larsson Heidenblad, Sandmo, Nilsson Hammar, & Nordberg (2018, pp. 9–33); Dupré & Somsen (2020). On the problems of "popular culture," see Burke (1978); Ginzburg (1980); Chartier (1982).

Ginzburg's work, insisted on the conception and metaphor of science as a hunt for the secrets of nature, which moved from the realm of popular knowledge to discussions of natural philosophy. This epistemology of *venatio* and of penetrating the interiority of nature was, for Eamon, one of the most relevant origins of the "new philosophy" of the 17th century, epitomized by Bacon's use of the metaphor of Pan's hunt and by his elaboration of a methodology for a "learned experience." Nature's secrets became more than a metaphor: they became the label for the belief that the true mechanisms of nature were hidden beneath the exterior and superficial appearance of things.[7]

While these accounts are still relevant in explaining some of the features of the new sciences of the 17th century, this article argues that the idea of going deep into nature and explaining the true nature of matter are not necessarily at odds with cognitive models linking together the manipulation and observation of the surface of individual bodies and their natures. Different bodies of nature could be worked out by different actors with different expertise, all sharing a special attention to their surfaces. Ultimately, this article proposes to explore how practical knowledge about the surface of things and bodies led to conceptions of nature and matter as composed of layers, corpuscles, and artificially reproducible solid parts, and how such a framework contributed to the demise of traditional Galenic and Aristotelian views on the nature of the body.[8]

Cutters

Surgeons and anatomists knew that they could learn from butchers something about cutting and treating the human body. Andreas Vesalius, the canonical hero of the anatomical revolution of the 16th century, in the section of his *De humani corporis fabrica* (1543) where he described how to dissect skin and flesh and how to separate skin from the membrane which lays below it, declared:

> This is something we learn from butchers as well, when they try to remove the skin beneath the axillae of cattle and leave the fleshy membrane attached to the body to avoid removing too much meat. These are not the only matters that are well known among butchers; they also know the nature of cuticle, when the scrape pigs that have been singed, or rather when the dip them in hot water and scrape of the bristles together with the cuticle.[9]

It is true that "empirical" surgeons—those surgeons who practiced without a formal university degree—compared anatomists and butchers with mocking intentions. However, the comparison touched on a deeper layer of contiguities between the two professions, having to do with how manual skills could provide an access to knowledge. For example, the famous "empiric" Leonardo Fioravanti (ca. 1517–1583)

7 Eamon (1994).
8 Close (1969, pp. 467–486); Lenoble (1969); Daston & Vidal (2003).
9 Vesalius (2014, Vol. 2, p. 47).

wrote: "No art in the whole world is more similar to the anatomist's than the art of butchers; both arts in fact are based on cutting, flaying, and dismembering bodies." He went on to explain that in both medicine and butchery a certain "science" was connected to "manual operations," and therefore that they were both to be called "arts" rather than "sciences." Interestingly, the practical knowledge of butchers included, besides a specific ability to recognize and evaluate animals at first sight, being able to properly flay animals "in order not to waste their skin," and being able to bleed animals out "so that the meat will not be too reddish."[10] Less than a century later, in 1639, another hero of the scientific revolution, René Descartes (1596–1650), wrote to Marin Mersenne (1588–1648) that he had his practical training in anatomy at a "butcher's yard" in Amsterdam.[11] Another eminent surgeon of the late 16th century, the Venetian Giovanni Andrea Della Croce (1509–1575), underlined that techniques for sewing up wounded intestines were to be learned from tailors and furriers: "some rightly sew together separate parts of the intestines the way furriers sew together their fur and bags."[12]

Surgeons and anatomists could indeed learn a great deal from butchers and barbers in matters of cutting the surface of the body. In the 17th century, Neapolitan barber-surgeon Cinzio D'Amato opened his book on phlebotomy and cupping with a chapter on how to embalm human bodies. He gave two recipes, one for an embalming powder and one for a balm. According to those recipes, the practitioner had to empty out the viscera of the cadaver; fill them with perfumed stoop and balms; and smooth, anoint, perfume, and soften the skin. The solemn art of the embalmer had something to do with the art of lower kinds of artisans. In his two recipes and brief description of the technique, D'Amato explained that once the internal organs were removed the embalmer had to apply his powder "just like we do when we put salt on pig's flesh"—typically something butchers and meat sellers would do.[13] In all of these cases, the art of manipulating skin and flesh—the surface of human and non-human bodies—was the way to access the knowledge of the inner parts of the body, with no trace of the Galenic jargon of complexions and humors.

In the early modern period, the city of Norcia in central Italy (now Umbria) became famous for breeding skilled artists in the cutting of the skin and flesh of animals and humans, and in manipulating the interior and exterior of dead as well as living bodies. The word *norcini* was tellingly polysemic in the early modern period, as it could mean at the same time "butcher," "castrator," and "surgeon." Already famous as butchers in the Roman empire, by the middle ages *norcini* "acquired a special skill in cutting, eviscerating, dissecting animals [pigs above all], and their knowledge of human anatomy was perfect."[14] By the 16th century, *norcini* were regularly employed as castrators of young boys whose life was to be devoted to singing, and as "empir-

10 Fioravanti (1583, pp. 52–53).
11 Beaude, Costabel, Gabbey, & Rochot (1964–1974, Vol. 2, p. 621).
12 Dalla Croce (1583, Vol. 2, p. 96). On the shared expertise of butchers and physicians in pre-modern times, see Ferrières (2002, pp. 21–65).
13 D'Amato (1669).
14 Pappalardo (1963, p. 46).

ical" surgeons in Italian hospitals and towns as specialists in hernias, stones, and cataracts.[15] While *norcini* are well known among historians of medieval and early modern medicine, it is worth considering this loose professional group in light of the cognitive models they shared with other artisans and professionals dealing with the surface of natural bodies.

When Pope Paul IV (1555–1559) prohibited women to sing in churches for both religious and secular purposes, Italy became the land of castratos (boys singing as girls). These boys had their testicles removed at a young age, roughly between 7 and 12 years old. This was a delicate operation, requiring both precision in cutting and knowledge of human anatomy. Many early modern sources indicate the *norcini* as specialists of castration, especially in the big cities, and in Rome above all. Eminent physician Gabriele Falloppio (1523–1562) praised the special technique of the *norcini* in his 1561 book on surgery:

> This procedure can be carried on in different ways, and it is actually made in several different ways, since some, like the *norcini*, make a cut: truly there is no better way to remove the testicles, and this is why I praise this method above all others …. Others pass a ring or a golden thread around the testicles to remove them, but none of these procedures is as safe as the *norcini*'s.[16]

It is not difficult to understand why *norcini* became famous as specialists of inguinal hernias and the removal of bladder stones—among the most painful and disabling affections for early modern patients—procedures involving special abilities in cutting the parts around the genital area. But as empiric surgeons they also acquired a semi-official status as eye and teeth surgeons, forming the majority of the surgical staff in Italian hospitals until the 18th century.[17] Regarding the extraction of bladder stones, skin diseases specialist Girolamo Mercuriale (1530–1606) wrote in 1583 that "for this procedure you need to pick the best surgeons … this treatment is to be performed by the right surgeon, precise and experienced …. In these times, such surgeons are the so-called *norcini*, the most excellent in this art."[18]

The status of *norcini* as surgeons is embodied by the figure of Durante Scacchi (b. 1540). Scacchi was born in Preci near Norcia, and studied medicine in Rome under the guidance of famous physician and anatomist Realdo Colombo (1516–1559). He practiced as a surgeon and physician in several cities in Umbria and Marche, and was finally nominated as civic surgeon in Fabriano in 1567, a post he held until 1609. In 1596, he published a *Subsidium medicinae*, translated into Italian in 1609 by his brother Cesare (b. 1555), himself a *norcino*. The structure of the book is noteworthy, because it is different both from learned surgical books and from barbers' manuals. It is divided into four parts. Book 1 is on the eye conditions and the removal of the cataract in particular; Book 2 is on the extraction of bladder stones and other issues

15 Cruciani (2001).
16 Falloppio (1647, p. 198).
17 Park (1998, pp. 110–130).
18 Mercuriale (1590, p. 32).

related to the bladder; Book 3 is on surgical operations including anal fistula, hernias, hare-lips, polyps, and eye-fistulas; and Book 4 is a compendium of surgery: tumours, ulcers, aposteme, wounds, fractures, cancers, gunshot wounds, and so forth. In other words, the book reflects the knowledge of the *norcini* and places it in the context of learned surgery, the kind of surgery that was written about in Latin.[19] *Norcini* are the perfect example of what anthropologists and historians of science call "trading zones," namely bi-directional exchanges among different groups of professionals and experts.[20] In this case, exchanges took place both between different experts, and between practical men and men of learning. Moreover, these trading zones could cross species.

In his 1581 manual for professional food-cutters, titled *Ragionamento sopra l'officio del trinciante*, Vincenzo Cervio included a very interesting description of how both "barbers" and "butchers" illegitimately served as "professional food cutters" and "anatomized" the meat at the tables of gentlemen. Cervio argued that barbers were unable to cut the meat in a "polite" manner. Here emerges a significant overlap in the technical spheres of experts of cutting: butchers, barbers, cooks, and professional food-cutters.[21] Indeed, Cervio's *trinciante* had to possess significant expertise in dealing with the surfaces of cooked animals, vegetables, and fruits. For example, cutting off the peel of an apple was the subject of a very complex technical description: the peel itself had to be unbroken, but needed to remain whole to perform specific decorative functions on the plate.[22] The art of peeling the "skin" of fruits was treated by a number of European books on cookery and gardening throughout the early modern period. For example, Nicolas de Bonnefons' *Iardinier françois* (1651)—one of the most important cookery books of the 17th century—emphasized the pleasures of touching and manipulating the fruits: "some have the skin … so delicate that it needs a subtle and light hand to remove it with more decency."[23]

The compiler of the most comprehensive encyclopedia of the trades and sciences of the 16th century, Tommaso Garzoni (1549–1589), argued that cooks—among whom he included *trincianti*—combined different skills: they were "managers" because they knew how to organize a banquet; they were "poets" because they were able to rhetorically describe their dishes; "mathematicians" because they could count all the foodstuffs; "geometricians" in that "they measure the quarters of the veils, deers, and roes they prepare for dinner"; "musicians" because they played and sang when full of food and wine; "logicians" because they argued with each other; "philosophers" because "they tell what is the nature of the foodstuffs: sweet, bland, sour, spicy,

19 Scacchi (1609, index). On learned surgery, see Savoia (2019).

20 Long (2015, pp. 840–847).

21 Cervio (1581, pp. 104–105). Sandra Cavallo (2007) has described social, economic, and kinship strategies linking together surgeons, barbers, and what she called "artisans of the body" (upholsterers, furriers, wig-makers) forming knowledge communities based not only on practical knowledge, but also on gender identities and a sort of class awareness.

22 Cervio (1581, pp. 128–129). On cooking techniques, illustration, and knowledge in Renaissance Italy, see Krohn (2015, pp. 113–162).

23 Quoted in Von Hoffmann (2016, pp. 13–38).

sharp, and flavory"; and "physicians" in that "they treat a unruly appetite with the attractiveness of the dishes they are able to prepare."[24] Cooks, butchers, food-cutters, and surgeons all shared cognitive models involving an intellectual approach that accorded specific relevance to the surface of the body, and a practical attitude to manipulating the different layers of the bodies they were repairing, dismembering, or composing as edible matter.

Dissecting Citrus

Citrus was among the most coveted types of early modern fruits. Between the late 16th century and the first half of the 17th, visual and written descriptions of citrus fruits—along with a widespread desire for them—reached a peak in early modern Europe. Paintings (especially Dutch), natural history treatises, botanical repertoires, farming and gardening manuals, and so forth, all praised the virtues and appearances of citrus fruits from a variety of points of view.[25] Citrus fruits (essentially oranges, lemons, and citrons), imported into Europe from the eighth century following commercial and cultural exchanges with Arabic agronomists, were part of the tradition of medieval dietetics—that branch of medicine classifying vegetal and animal products according to their humoral complexions—and by 1660, literate gardener Agostino Mandirola (d. 1661) had classified no less than 80 varieties of citrus fruits.[26] Moreover, authors meticulously described their surfaces, often employing the same Latin term used for "skin": *cutis*.[27]

The first monographic work, although a very short one, on citrus fruits that broke with the tradition of medical dietetics was written by Nicolas Monardes (1493–1588), a physician from Seville who published a famous account of the flora and fauna of the New World.[28] His booklet on citrus was not illustrated, but it emphasized the artificial origins of the varieties of citruses cultivated by humans through experiments with grafting. Pietro Andrea Mattioli's (1501–1578) multiple editions of the famous commentary to the Greek botanist Dioscorides (ca. 40–90) contained detailed illustrations of the citruses and showed a good deal of attention to their surfaces. On the so-called "Adam's apples" (*pomi d'Adamo*), Mattioli wrote [**Figure 1**]:

> Their peel [*scorza*] is wrinkled, irregular, and has certain small fissures, as it if had bitten by the teeth; and that is where they got their name from, because the people believe that these were the fruits Adam bit in the garden of Eden. But those are all fables.[29]

24 Garzoni (1996, Vol. 2, p. 1097).
25 Westermann (2007).
26 Mandirola (1660, p. 487).
27 Sereni (2018, pp. 100–102); Baldini (2008).
28 Fernández González & Ramón-Laca Menéndez de Luarca (2002, pp. 149–164).
29 Mattioli (1568, p. 270).

Figure 1. Adam's apples. From *I discorsi di Pietro Andrea Mattioli* (p. 270), by P. A. Mattioli, 1568, Venice, Italy: Vincenzo Valgrisi.

Yet more detailed images appeared in a 1586 German edition of Mattioli's *De plantis* edited by natural historian and physician Joachim Camerarius (1534–1598), in which citrus fruits were represented in a new visual dissection or anatomical style, where the surface was placed along with sections of the interior, thus connecting the inner and the outer bodies of the fruits [**Figure 2**].[30]

The famous northern Italian agronomist Agostino Gallo (1499–1570) devoted an entire section of his late 16th-century treatise on farming to citrus gardens, praising their commercial value. From his description, it also clearly emerges that citrus fruits were shown off on a host's table for their aesthetic qualities:

> Gardeners make money out of the mature fruits, both the small ones and the beautiful ones. With the fruits which are not ripe one can make delicate candies, and crowns with small oranges which are pleasant to the eye and to the nose. And everybody knows how the ripe and beautiful citruses are in demand for banquets, for candying, and as food for the sick, for the preparation of medicaments, as all the experienced apothecaries know. From the peel [*scorza*] of the oranges one can make money, as they are used to make mustard and spiced bread, and citruses are sold to make citrus *confetti*. Gardeners can even make money from the rotten

30 Mattioli & Camerarius (1586, p. 149).

Figure 2. Anatomy-style sections of dissected fruits. From *De plantis Epitome utilissima* (p. 149), by P. A. Mattioli & J. Camerarius, 1586, Frankfurt, Germany: n.p.

> fruits, as they can be used to squeeze the juice or to take out the seeds …. If the cost is constant, so is the income.[31]

Gallo had introduced the section on citrus by praising the ingenuity of grafting techniques applied to citrus fruits, always devoting a special attention to the appearance and manipulation of their surface.

> I praise the practice of grafting a better citrus onto another tree of the same kind; because some of them are more beautiful in their peel, and bigger, longer, and more delicate in their perfume and taste. Some gardeners use to graft citruses onto lemon trees, because they believe the fruits will grow bigger, with a thicker skin [*scorza*], and more pulp; however, the most excellent gardeners rather graft lemon onto citruses, because the fruits grow much more beautiful, as the citrus tree has more humor than the lemon tree.[32]

The most lavishly illustrated treatise on citrus fruits in early modern Europe was written by the Jesuit Giovanni Battista Ferrari (ca. 1584–1655): *Hesperides sive de malorum Aureorum cultura et usu*, published in Rome in 1646. Ferrari was a professor of Hebrew at the Roman College, and after the election of Pope Urban VIII (1623–1644) in 1623 he became the gardener ("horticultural adviser") of the Barberini family. He took full advantage of the documents gathered by Cassiano dal Pozzo (1588–1657), an eclectic collector and natural historian and member of the Academy of the Linceans, who had collected information on citrus trees and fruits from gardeners working all over Europe (but especially from the Italian regions of Campania and Liguria). Cassiano gave his documents to Ferrari for the preparation of his treatise.[33] Playing with the traditional trope of the garden as a place of spiritual

31 Gallo (1572, pp. 150–151).
32 Gallo (1572, pp. 144–145).
33 Freedberg & Baldini (1997); Beniamino (2017).

Figures 3–4. Lemon containing another lemon; rugged peel of the "striated lemon from Amalfi." From *Hesperides* (pp. 269, 249), by G. B. Ferrari, 1646, Rome, Italy: Sumptibus Hermanni Scheus.

peace and delight, the book combined naturalistic descriptions, gardening techniques, and mythological accounts of the origins of citruses, and was illustrated by the likes of Domenichino (1581–1641), Guido Reni (1575–1642), Nicolas Poussin (1594–1665), Giovanni Francesco Romanelli (1610–1662), and Pietro da Cortona (1597–1669). The 80 illustrations, including those showing hybrids and teratological transformations, were mostly by the Dutch engraver Cornelis Bloemaert (ca. 1603–1692), and some of them were made with the aid of a microscope. As David Freedberg noted, "never had the surfaces of their [citrus fruits] peel been shown with such obsessive attention to every kind of texture, rugosity, lump, and protuberance."[34] However, as we have seen, Ferrari was part of a wider culture of citrus appreciation [**Figures 3–4**].

Here is an example of one of the many varieties of lemons described by Ferrari:

> The Etruscan land of Pietrasanta, close to Liguria, generates with the name of citron-lemon [*Limon citratus*] the most pleasant and sweet of the lemons, born out of grafting a citrus, which is called citron-lemon because of its color and perfume. In Florence, mother of all lemons, grows the best quality of them, with a double name. The first kind is called smooth, because it is less rough; the other kind

34 Freedberg (1996, pp. 41–54, quotation on p. 43).

> is called rough, because of its prominent lumps, or *broncone*, because it is rough as the trunk of a tree …. Often it takes a oblong and somehow swelling shape, then it gets thinner and pointed in the upper part …. The skin [*cutis*] is golden when the fruit is ripe, soft and light, full of cavities [*verruculis*] on the upper end, mostly hispid, wrinkled [*rugis caperata*], and sweet around the perfumed upper end, therefore it is good to eat. The pulp [*carnosa pars*] is almost two fingers deep, and very soft and sweet to the palate: the part covered with 10 to 12 membranes is juicy and a little acidulous. It contains around 20 seeds.[35]

It reads like he was describing human skin.

Besides the countless representations of citrus fruits in paintings, and the interest on the part of agronomists and natural historians, the rage about citrus is evident from the account of the German architect and traveler Joseph Furttenbach (1591–1667) from the city of San Remo (in present-day Liguria) in the early 17th century:

> We were conducted every day in the noble gardens of fruit trees that are comparable to entire woods, and that are full of oranges, citrus (and among citrus some of them were the size of a human head; someone showed me one which was 14 *libbre*, which I have sent, well-packaged, to Germany, and I marveled at how a thin branch could sustain such a citrus), and lemons, so many that the branches broke under the weight of such an abundance of fruits. … On the ground are a great number of oranges and lemons which rot there since people avoid those fruits that fell on the ground. But in part they are picked up by the poor, who squeeze their juice and sell it to the dyers in Genoa, who use them to color the silk *incarnatino*, or the color of flesh. They also distill the water of citrus flowers for the ladies who put it on their faces thanks to the sweet perfume of that distillation, and they sell it in the whole Italian peninsula.[36]

Citrus fruits were used and described for commercial, aesthetic, medical, naturalistic, and technical (the juice was used in the processes of chemical tincture) reasons. As shown by Piero Camporesi, such "rustic experiences" and "peasant knowledge" were acknowledged and exploited in the 17th century by eminent botanists and natural philosophers such as Paolo Boccone (1633–1704) and Lorenzo Magalotti (1637–1712) at the Medici court in Florence.[37] Natural philosophers were actively looking at what artisans were doing, and trying to replicate their "experiences." For example, in the Accademia del Cimento's collectively authored *Saggi di naturali esperienze* (1667), the authors mentioned experiments using lemon juice as an ingredient in exploring chemical reactions for making tinctures and colors.[38]

The emphasis on the peel, skin, and surface of fruits was linked to the contemporary emphasis of genres such as *historiae*, *observationes*, and *descriptiones* in the natural

35 Ferrari (1646, p. 236), translated by Freedberg (1996, p. 53).
36 Furttenbach (1627, p. 48).
37 Camporesi (1990, pp. 139–140).
38 *Saggi di naturali esperienze* (1667, p. 239). For citrus fruits in Cartesian mechanisms, see Baldassarri (2019, pp. 41–63).

sciences, which emphasized the external appearance of the natural objects, and in turn were influenced by commercial and technical descriptions of the integrity and peculiarities of such surfaces.[39] The surface of fruits was an object that could be perceived in multiple ways: as one layer of nature, as a commodity, as a decorative element, as the fruit of complex grafting techniques, as the ingredient for tinctures, and as the subject of a work of art. In this case, similar cognitive models centered on the surface straddled the boundaries between natural history, agronomy, and commerce.

Superficial Bodies

To give an idea about the breadth of the relevance of surfaces as tools for knowing nature, one could also think about other cognitive models connecting different bodies in the name of surface, such as those found in the earth sciences. The Western agronomic tradition from Columella (ca. 4–70 CE) through Pier de' Crescenzi (ca. 1233–1320) to Olivier de Serres (1539–1619) had already classified the surface of the earth, or the soil, according to its growing potential, through a specific observational language—it could be "fat, thin, strong, humid, dry, sandy, loose, etc."[40] Comparisons between the surface of the earth and the surface of the body were common in the 16th and 17th centuries, just as those connecting the human skin to the peel of fruits or the bark of trees. As shown by Maria Conforti, comparisons to the skin were made by physicians studying the particular volcanic landscape of Naples: one of them, Alsario della Croce (b. 1576), dubbed the volcano Vesuvius "an aposteme of the earth."[41]

Early modern geological knowledge, from 16th-century Italy to 17th-century Britain, and through to the 18th century, was all about the ways in which humans and the environment interacted with the surface of the earth. The Latin term *strata*, in the sense of layers made of chronologically accumulating sediments, was used for the first time with reference to rock layers by Niels Stensen (1638–1686) in the 17th century, and "involved a conceptual revolution."[42] Stensen gave new form to ideas circulating since the beginning of the 16th century—most prominently in the writings of Leonardo da Vinci (1452–1512) and Bernard de Palissy (1510–1589)—about the surface of the earth as a "deposit" of successive layers or "sediments" (a word employed in 17th-century chemistry), and therefore revealing the features of the earth in itself, and not as sign of something else.[43]

Meteorology was the science of the surface of the earth in the Renaissance, dealing with earthquakes, floods, and so forth, as well as with the "belly of the earth," and was thus an essential conceptual point of reference for ways of conceptualizing nature

39 Pomata & Siraisi (2005, pp. 1–38); Pomata (2010, pp. 193–236); Carroll Simon (2018, pp. 1–3).
40 Saltini (1979, p. 151).
41 Conforti (2017, pp. 135–157).
42 Ellenberger (1988, Vol. 1, p. 237); Bek-Thomsen (2013, pp. 289–305).
43 Ellenberger (1988, Vol. 1, pp. 237–238, 116–148).

based on the opposition between surface and depth.[44] The analogy between human skin and earth surfaces goes back to at least the 15th century. For example, a passage by Renaissance architect and engineer Leon Battista Alberti (1404–1472) stated that "the whole crust of the earth, and mountains in particular, consists of page-like skins, some denser, some more rarefied, some thicker, some thinner."[45] In his 1560s and 1570s courses on practical medicine in Padua, Girolamo Mercuriale defined skin as composed of two layers—*cutis*, close to the muscles and flesh and seat of nervous terminations, and *cuticula*, the most external one—which together have the function of protecting the body, of allowing the passage of vapors and superfluous substances through the pores, and of securing integrity and beauty to the human figure.[46] In the same period, experts on mining and metalwork, such as the famous Saxon humanist Gregorius Agricola (1494–1555), often created analogies between phenomena of erosion and sedimentation happening both on the surface of the earth and within its interior.[47]

About 30 years earlier than Mercuriale's description of human skin, Vannoccio Biringuccio (1480–1539) began his book on metallurgy and the arts of fire by drawing analogies built on reports by people who walked the hills and the mountains looking for ore by inspecting the surface of the earth: "They [the ores] show themselves almost like the veins of blood in the bodies of animals, or the branches of trees spread out in different directions."[48] Manuals for barber-surgeons written by members of the guilds in Italy between 1584 and 1669 painted a picture of the human body that was strikingly different both from that of Galenic-style internal physicians—a body crossed by humors—and from that of the new Renaissance anatomists, which was made of solid organs but conceived in terms of an architectural structure going deeper and deeper, from the skin to the muscles to the bones, from the veins and arteries to the nerves.[49] The body of the barber-surgeons was marked by its superficial characteristics: the network of veins to be opened for bloodletting, the softness of the skin to be cauterized, the parts of the surface on which cupping glasses could be applied, the parts to be anointed with special unguents, and the skin to open to extract bullets as well as bladder stones—an entirely superficial topography of the body.

Thinking according to a similar cognitive model, even the most canonical authors of the scientific revolution employed ways of reasoning about nature that valued surfaces. Here is a passage from the Galileian natural philosopher Evangelista Torricelli (1608–1647):

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44 Barnett (2019, p. 24).
45 Dal Prete (2018, pp. 415–441).
46 Mercuriale (1601).
47 Agricola (1912, pp. 25–42).
48 Biringuccio (1943, p. 13). For an overview of the historiography of mining and an approach to working out nature through mining, see Asmussen & Long (2020, pp. 8–30). For overviews of the history of mining, see Morello (1981, pp. 1–84); Ellenberger (1988, Vol. 1, pp. 195–211). On Biringuccio, see Bernardoni (2011).
49 On barber-surgeons in early modern Italy, see Cavallo (2007); Pomata (1981, pp. 161–183); Pitré (1992, pp. 134–144).

All flowers blooming on the grass, all plants greening in the woods are like mouths and tongues through which matter shows its internal inclinations. These inclinations are, as one can clearly see, based not on going deep towards the center of the earth, but rather to move away from it .... What a shameful desire would be if earthly things would wish to bury themselves into the deepest and narrowest parts of the earth? Either they could never get there, or, even if they got there, they would stay there, buried alive, away from vegetative nature [*natura vegetante*], in the cold of a perpetual death, in the idleness of an eternal sterility.[50]

This is a typical anti-Aristotelian passage; it is a critique of the doctrine of natural places according to which the four elements of air, water, fire, and earth all have a fixed place within a closed universe. Moreover, Torricelli established a textual relationship between the interior and the exterior, with the surface as a text indicating some meaning located in the depth. But it is worth noting that he also described observational and natural movements that ran parallel to each other, and went not from the outer layer towards the center, but rather from the inside towards the outside—namely the surface—where nature could be fully contemplated.

A cognitive model organized around a stratigraphic and layered conception of natural bodies, allowed by the ontological and epistemological autonomy accorded to their surface, also emerged from collections of medical consultations. Such collections were mostly composed of letters exchanged between physicians concerning more or less difficult cases that affected their patients. Often written at a distance, having received only a verbal description of the symptoms, these collections were mostly traditionally Galenic: they included a description of the symptoms, a diagnosis involving humoral imbalances, and indications of pharmacological and dietetic (or much less frequently surgical) therapies. Collections of consultations included a number of skin diseases, or, more precisely, skin problems, whose symptoms demanded a tremendous amount of attention from the observing physician. New observations that did not necessarily fit the orthodoxy of humoral theory frequently crept in, leaving room for often-unacknowledged innovation. Let us take a closer look at one eloquent example from the collection of cases put together by the German physician Joseph Lautenbach, who had studied in Padua and Bologna, in 1605. In the case that follows, while the etiology remains strictly Galenic—revolving around bad humors and a badly tempered liver—the longer descriptive parts concern the symptoms on the surface of the body.[51]

The consultation was for Bernardo Interiano, a philosopher and theologian, who "leads an absolutely moral life." The entry is organized as follows: natural temperament of the patient, description of the symptoms, past treatment, and finally needed treatment.[52] Interiano was an erudite, 37-year-old monk, of a hot and dry temperament. Regarding the complexion of the brain, the doctor reported that excrements

50 Torricelli (1823, pp. 137, 140).

51 Siraisi (2007); Nutton (2019, pp. 472–486). On the emerging autonomy of the human skin in early modern medicine, see Gadebusch-Bondio (2005); Murphy (2020). On the medical and surgical evaluation of superficial signs, see De Renzi (2007); Maclean (2000). On consultations, see Agrimi & Crisciani (1996, pp. 1–31).

52 Lautenbach (1605, p. 9).

flowed scarcely and with difficulty: from this he inferred a state of heat and dryness. In particular, the patient's liver was hot and dry, as demonstrated by the large veins, full of blood, and from the fact that during summertime "little crusts" (*crustulis*) would sometimes appear on his hands. From the heat of the most important parts of his body, one could see several excrementitious vapors rising, which were converted into many hairs of a reddish color, and a hirsute appearance of the body. Moreover, the color of the skin was "yellowish," a clear sign of bilious humors.[53]

The body of the monk was slender, and he was rather weak. For many years he used to debate on the most arduous matters of theology and philosophy, both in private and in public, and was therefore used to contemplating abstract ideas. The monk was completely immersed in "difficult speculations and holy mysteries." He was very moderate and sober in matters of food and drink, and "completely chaste."[54]

The physician then discusses his patient's "preternatural affection." For 8 years he suffered—in the winter but much more so in the summer, when he was usually busy—from the most intense pruritus on his back (from the neck to the buttocks), and also on his chest, belly, and arms from the elbow up to the shoulders. The patient felt the need to ease it with violent frictions of his clothes or by scratching the skin with his nails, which brought about "little scales" (*squammulae*) very similar to "*furfura*," above which there remained "traces that have the color of iron rust" (*vestigia ferruginea*). This disease could be called "pruritus," since—fulfilling the Galenic definition of disease—it affected at least one bodily function. In fact, if pruritus, the iron-rust-colored spots on the skin, and the skin disease called *furfura* were considered together—concluded the physician—it could be that this disease was that which prior authorities called *Alabras nigra*, *Morphea*, *Leuce*, or *Vitiligo*.[55]

According to Galen—the physician went on—the cause of this illness is a wrong assimilation of food. The internal, but antecedent, causes are the excessively burnt and melancholic humors, proceeding from the heated liver, which the natural heat cannot convert into proper nourishment. The proximate external cause is either the poor diet typical of the monks, or the habit of excessively exercising the mind.[56]

Regarding therapy—the doctor stated—the patient has washed himself four times with the thermal waters of Lucca, twice with the waters of Genoa, twice with those of Ferrara, and always after purgation (that is, after inducing vomiting). Since the disease broke through, the patient underwent regular sessions of phlebotomy. Advised by a *consilium* from "the most excellent college of medicine of Bologna," the doctor reported that he had tried all possible treatments, including medicaments; baths; anointing the affected parts of the body with oil of tartar, oil of viper, powders with vinegar, sulphur, egg yolk, and other unguents; and cupping glasses.[57]

Once all the possible internal causes of the disease had been suppressed, the *furfura* nonetheless remained on his skin. The doctor concluded that "it is clear that

53 Lautenbach (1605, p. 10).
54 Lautenbach (1605, p. 10).
55 Lautenbach (1605, p. 10).
56 Lautenbach (1605, p. 11).
57 Lautenbach (1605, p. 11).

the true causes of the illness were not touched."[58] This case shows a short-circuit between the treatment, the symptoms, and the supposed causes. After all, the Galenic tradition was not always a useful tool when faced with complex surfaces. Despite all efforts, superficial diseases could not be catalogued within the pigeonholes of traditional theoretical, university-taught medicine. The irregular, broken, at times incomprehensible surface of the body took on a life of its own in the physicians' observations.

Conclusion: "You Can't Have Wood Without Bark"

The nature of the circulation of surface knowledge among different historical actors of different genders and social classes, and with access to different intellectual tools, is one of the most important issues raised by studies of early modern vernacular science and artisanal knowledge. These relationships are largely a matter of appropriation, as natural philosophers and natural historians often took advantage, consciously or not, of the habits of observation and ways of producing knowledge of subaltern groups, natives in the colonies, illiterate women, artisans, gardeners, butchers, cooks, barbers, and so forth. Paraphrasing Carlo Ginzburg's suggestion on how to work with Inquisition records, historians of early modern science can treat natural philosophers as "informants" in order to grasp part of the complex oral and bodily knowledge of nature.[59] This methodological suggestion is relevant in the case of the history of surface knowledge, allowing us to expand the framework of "appropriation" and to look for circular and reciprocal influences between learned and "popular" cultures.

The surface of natural things invited observation, manipulation, measurement, and re-configuration, and promised to unveil the knowledge of depths. Focusing on surfaces means to cut across the anachronistic separation between humans, animals, and the vegetal world, which were largely thought of as a continuum in both pre-modern intellectual traditions (including alchemy and natural philosophy) and in the artisans' practical worldview. It would certainly be an oversimplification and an exaggeration to argue that one overarching cognitive model based on surface knowledge guided the practical and theoretical developments of early modern science. However, this article has shown that cognitive models, as ways of manipulating and thinking about surfaces that cut across "disciplines" and trades, can show connections and similarities between them. Natural historians exploring citruses could employ the same visual style as the anatomists when emphasizing the layered constitution of nature; butchers, professional meat- and fruit-cutters, and surgeons could reason and cut according to similar cognitive approaches despite their different practical and professional goals; physicians could give the surface of the body a new centrality in describing the their patients' symptoms.

58 Lautenbach (1605, p. 11).
59 Ginzburg (1989, pp. 156–164).

Moreover, while cultural and technical connections between artisans and scientists have been much investigated, it would be advisable to contextualize these narratives within wider social and economic historical perspectives, as Edgar Zilsel originally did in 1942.[60] Recent literature on the history of artisanal knowledge has downplayed the economic context of such an explosion of techniques and its relevance for early modern science, as the phase, broadly speaking, of the passage from manufacturing to industrial capitalism. However, artisanal epistemologies were not formulated, tacitly or not, in a void, and early modern artisans did not live and work only within the narrow borders of their cities; on the contrary, their crafts were increasingly placed in the context of global economic systems and proto-industrial labor organizations, moving from a regime in which artisans could choose the methods and timing of their work to one in which these were decided by a central organization external to artisanal work. In other words, surface-centered cognitive models were shared and exchanged within the socio-economic context of early modern Europe, when artisanal practices and the new sciences became part of a large-scale redefinition of economic exchanges and ways of producing goods.[61]

Bachelard's stigmatization of the myth of "depth" as one of the epistemological obstacles to the development of contemporary science must be put into perspective. Surfaces as models producing knowledge occupied the mind and the hands of the early moderns well before the late 18th century. Within a context of increasing proto-industrial manufacturing, global commerce, new mechanics of social distinction, and new ways of exploiting the natural "resources" through agriculture, gardening, and mining—and just as anatomists paid more and more attention to human skin when dissecting—surgeons, natural historians, butchers, gardeners, physicians, and merchants alike found their way into natural matter via observation, manipulation, and assessment of its superficial strata. For many early moderns bodily engaged with nature, surfaces were not just texts to be read for signs of deep inner truths (although they were also that) and then thrown away, but material objects to be studied and worked out as part of nature, or as one layer of nature. Surfaces acquired greater or lesser degrees of autonomy in early modern knowledge, and experts on them paved the way for the hunt for the secrets of nature. As a result of shared cognitive models rooted in the economic and social life of early modern Italy—and Europe at large—the nature of these artisans and scholars was a layered nature, made of solid bodies, where all layers could reveal some truth, some secret, some technique: surface and depth came to be perceived as part of the same nature, with the same ontological dignity.

Thinking about these practical and intellectual phenomena in terms of cognitive models can lead to exploring new questions regarding the shared language used by different actors. Moreover, at the same time when Galileo Galilei (1564–1642) and the other main characters of early modern physics expelled qualities from the realm of

60 Zilsel (2003, pp. 7–21).

61 Wallerstein (2004); Cook (2008); Poni (2009); Ambrosoli (1997); Thompson (1967, pp. 56–97); Curry & Secord (2018, pp. 535–544).

science ("secondary qualities" such as color, heat, sound, and so forth did not matter for understanding the mathematically written book of nature, which contained only quantitative substance and movement), experts on natural bodies of different kinds manipulated matter and analyzed it in terms of the qualities of its surface.[62]

As a 16th-century Italian proverb ran: "you can't have wood without bark" (*non hai legno, senza scorza*).[63]

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62 Galilei (1623, pp. 196–201).
63 Florio (1591, p. 157).

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