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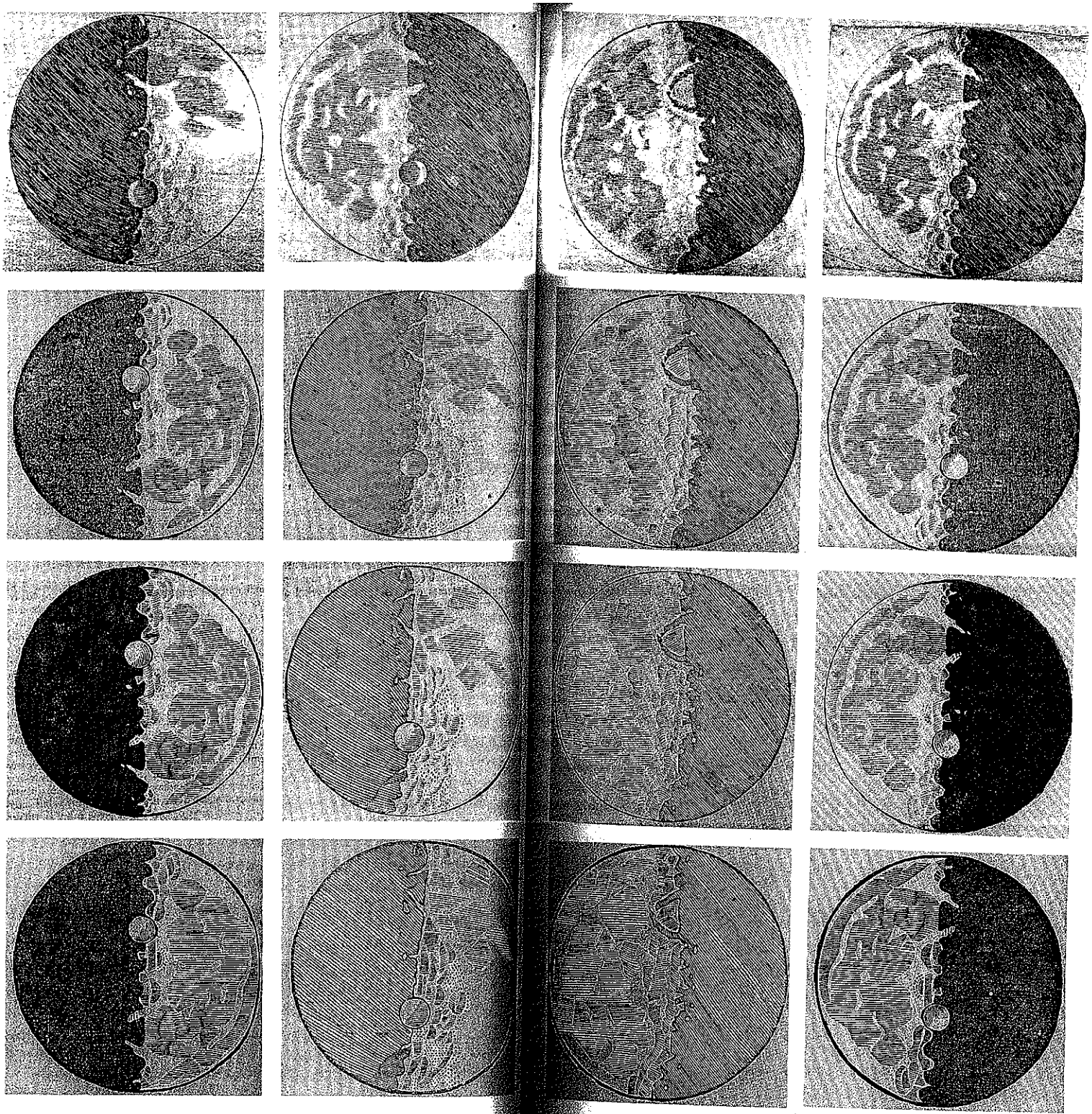

FIG. 1.9. Illustrations of the lunar surface, from the first and three subsequent editions of Galileo Galilei's *Sidereus Nuncius*.

These are perhaps the most famous of all early modern scientific illustrations. They were the first images to show the lunar surface, revealing it to be rough and cratered, and constituted an important element in the campaign to establish the imperfection of this heavenly body. It is especially striking, then, to note the transformations wrought on Galileo's images through their reproduction. Here, the first row (*across*) of pictures is Galileo's own, printed in his Venice edition of the *Sidereus Nuncius* (1610). The second comes from an unauthorized impression issued almost immediately in Frankfurt. Note that the sequence of the first two pictures has been reversed. Moreover, the exigencies of such unauthorized printing dictated speed and economy, and as a result changed the images themselves. As well as showing degradation in each picture, the first and fourth images of this impression were in fact printed from the same woodcut, rotated through 180°. The third version reproduced here was issued in London in 1653. It reused the same blocks as the Frankfurt edition, again duplicating the first and fourth images. It also reiterated the sequence of the unauthorized version. So did the fourth version, printed in 1683. By this time the painstakingly crafted verisimilitude of Galileo's original drawings had been significantly eroded—a degradation in which the practices of piratical reproduction had played a large part.

(*top row*) Galileo Galilei, *Sidereus Nuncius* (Venice, 1610). (*second row*) Galileo Galilei, *Sidereus, Nuncius* [*sic*] (Frankfurt, 1610). (*third row*) Galileo Galilei, *Sidereus Nuncius* (London, 2d ed., 1653). (*bottom row*) Galileo Galilei, *Sidereus Nuncius* (London, 3d ed., 1683). (By permission of the Archives, California Institute of Technology.)

was not just for the intrinsic value of these observations that the *Sidereus Nuncius* had such an impact. In fact, Galileo and his allies deployed the book brilliantly to make its success.[35] He was angling to enter the court of an absolute prince, Cosimo II de' Medici, whose family had long been linked iconographically to Jupiter. Paying for the printing himself, Galileo named his new Jovian satellites accordingly. As the "Medicean stars" they formed the centerpiece of the book he now presented to the grand duke. It was not easy. Galileo actually had to change the name in mid-printing, after Medici officials told him that his original choice of "Cosmian" would not meet with approval; the new name was glued over the old on the pages already printed. He then went in person to make the presentation, ensuring that Cosimo would successfully see the new phenomena through his telescope. When Galileo distributed additional copies to princes and cardinals across Europe, along with spyglasses to support his claims, he did so under the carapace of Cosimo himself via the Medici diplomatic service. In promulgating the announcement, Galileo had presented Cosimo with heroic and noble homage, for which the conventions of patronage suggested an appropriate response. When that response came, Galileo declared that his whole "being" had been transformed. Perhaps for the first time, a mathematical practitioner underwent the transfiguration into court philosopher.[36]

Galileo was trying to create a new kind of authority on, and for, natural knowledge. The construction of this persona and the elaboration of his work in cosmology and mechanics thus took place together, and both rested on the skillful exploitation of patronage dynamics at an absolutist court. The point is a rather subtle one. Patronage was not simply something that could be used as a tool to achieve aims defined by other, perhaps scientific, criteria. It helped constitute at once what were reasonable aims to adopt, what were good claims to make in pursuit of those aims, how they could best be made, and to which audiences. Evidence came into being and was accredited by means of the civil culture of the court. There was no "Galileo, scientist" standing outside this cultural realm and manipulating its mechanisms in order to achieve objective ends. It is important to appreciate this, since at each crucial moment of transition—from Venetian patronage to Florentine, and thence to papal—books were central to Galileo's advance. From the *Sidereus Nuncius,* so effective in raising him to Cosimo's court, to the

35. Galilei, *Sidereus Nuncius* (1989), 1–24, 87–113; Biagioli, "Galileo's System of Patronage"; Westfall, "Science and Patronage."

36. Galilei, *Sidereus Nuncius,* 19, 90–1; Galilei, *Opere,* X, 353; Biagioli, *Galileo, Courtier,* chap. 2. John Dee did request the title of Philosopher and Mathematician to Emperor Rudolf II before Galileo achieved his own elevation in Florence, but without success: Clulee, *John Dee's Natural Philosophy,* 224. Westman, "Astronomer's Role," is essential for understanding the significance of this transfiguration.

Dialogo, which triggered his downfall at the hands of Pope Urban VIII's Inquisition, books were key elements in any strategy to take advantage of patronage opportunities.[37]

At court, what appear to modern eyes to be scientific disputes were seen by participant and spectator alike in these different terms. They would be triggered and structured by Galileo's patron for purposes of diversion and the expression of status. He was expected to produce entertaining and involving debates, and to challenge other court philosophers of sufficient rank.[38] While it was important not to lose such a dispute, it was also important to conduct it properly; and, as Tycho Brahe had known, regular challenges by qualified individuals were imperative to show that one's status was being recognized. So, for example, when the Medici ambassador presented a copy of the *Sidereus Nuncius* to imperial mathematician Johannes Kepler, he responded correctly with a printed reply dedicated not to Galileo, but to the ambassador. In a sense, Galileo was engaging with Kepler; but Cosimo was also communicating with the Holy Roman Emperor.[39] Unlike Tycho, however, Galileo had no private press. His book fell immediately into the hands of commercial printers. By late 1610 an unauthorized impression had appeared in Frankfurt, his fine illustrations marred by hasty reproduction. For the rest of the century these adulterated images would be reproduced repeatedly. Countless readers saw them—far more, in all likelihood, than ever came upon the authorized originals of what are probably the most momentous astronomical images of their era.[40]

Even exempting such piratical enterprises, the social dynamics of challenges were modified by the unavoidable involvement of new personnel and places. The case of Galileo's 1623 work, *Il Saggiatore,* is instructive in this respect. It was printed in April and May in a few hundred copies. In October the work was ritually presented to the pope and important cardinals. This was the courtly aspect of its production. But Galileo's allies also used the

37. For this portrayal I am indebted to Biagioli, *Galileo, Courtier,* esp. chaps. 1, 2, 6. See also Eamon, "Court, Academy and Printing House"; Biagioli, "Galileo's System of Patronage." Some aspects of Biagioli's work—particularly his claim regarding the association between Cosimo and Jupiter—have been strenuously challenged by Shank, with results that remain inconclusive at the time of writing. The particular thrust of Shank's attack means that it does not directly impinge on my own argument. See especially Biagioli, "Playing with the Evidence," and Shank, "How Shall We Practice History?"

38. Biagioli, *Galileo, Courtier,* 163; Biagioli, "Galileo's System of Patronage," 30; Castiglione, *Book of the Courtier,* esp. 68 ff.

39. Drake, *Galileo Studies,* 131–8.

40. Galilei, *Sidereus Nuncius* (Venice, 1610); Galilei, *Sidereus, Nuncius* [*sic*] (Frankfurt, 1610). It is perhaps worth adding the rider that the latter edition was unauthorized as far as anyone then or now has known; Galileo (like Isaac Newton later in the century) was quite capable of perpetrating his own "unauthorized" publications. The point remains that he was unable to oversee the production of the work, and in particular that of its illustrations.

book in what looks much more like a process of publication. They did so in order to expose the tactics of a Jesuit antagonist lurking behind the pseudonym of "Lotario Sarsi." They ensured that one of the licenser's copies was delivered early to the Sun bookshop. This was a well-known center for libertine literature, which the Jesuit would surely be monitoring for such works. Its proprietor had agreed to cooperate in the plan. Sure enough, "Sarsi" arrived and seized upon that very copy. He "changed color" on the spot, attacked the bookseller himself as personally responsible for the text, and left declaring loudly that he would take up the challenge and produce a rebuttal within three months. In so doing, he revealed himself as Orazio Grassi, lecturer in mathematics at the Collegio Romano and the Jesuits' most prestigious architect. The bookseller immediately told Galileo's allies of his outburst. Two of them wrote excitedly to their friend to tell him the news, whereupon Galileo came to Rome and successfully preempted Grassi's rebuttal.[41] Access to the bookshop, and the character of both the premises and its proprietor, had transformed the dispute.

Here was something quite alien to Tycho's Uraniborg. For Galileo too, however, despite this success it was ultimately to prove an inauspicious development. In the events of his notorious fall not only the printers and booksellers, but the entire licensing and publication mechanism, would be implicated. The *Saggiatore* incident led directly to this far more significant affair. It began in 1623 with the election of Galileo's ally, Maffeo Barberini, as Pope Urban VIII. This was the spur for Galileo, becalmed in Florence, to seek a position of favor in Rome itself. He did so by using two tools: *Il Saggiatore* itself, which he redirected at the last moment and presented to Urban, and his long-projected Copernican work on the tides. The first of these was a great success. After the incident at the Sun bookshop, Urban had it read to him at table, and seems to have relished its wit and rhetorical dexterity. He began to accord Galileo audiences, in which his favor seemed clear. So clear, in fact, that Galileo probably understood himself released from a private instruction issued some years earlier not to engage in public support for Copernicanism. He returned to Florence and began writing his greater work, which became the momentous *Dialogo . . . sopra i due Massimi Sistemi del Mondo.*

The *Dialogo* was not immediately or obviously scandalous. In fact, it successfully underwent an extensive licensing procedure, such that the

41. Galilei, *Opere*, XIII, 145–8; Galilei, *Sidereus Nuncius*, 94, 102; Redondi, *Galileo: Heretic*, 28–67, 179–83; Drake, *Galileo at Work*, 268–77, 279, 284–5, 287–8. It is perhaps worth stressing that those involved in this plan probably knew "Sarsi's" actual identity throughout; the objective was to get an open declaration from Grassi of the fact, and of his future intentions.

printed edition could boast as many as five imprimaturs.[42] Initially planned to appear in Rome in 1630, it was finally published only in 1632 in Florence. The book was in the event duly licensed in both cities, but nonetheless it caused a stir. Another of Galileo's Jesuit opponents, Christoph Scheiner, immediately repeated Grassi's error by revealing his outrage in front of the bookseller, who dutifully reported it back to his friends.[43] Murmurs soon spread that Galileo had violated Bellarmine's confidential instruction, which was rumored to ban him from even discussing the issue of Copernicanism, let alone supporting it. Events then moved very quickly. In April, Galileo's ally and patronage broker in Rome, Ciampoli, fell from grace, just as Urban came under stringent attack from Spanish interests for insufficient zeal in pursuing the Thirty Years' War and the struggle against heresy. This was a crucial development. Ciampoli was just the kind of intermediary needed by such a book to smooth its progress in courtly circles; he it was who had read *Il Saggiatore* to Urban at table. Without such mediation the *Dialogo* would soon prove vulnerable, especially as the pope now associated its publication with Ciampoli's newly established impropriety. In these circumstances, what might otherwise have been appreciated as witty dialogic sallies came to be read very differently. Papal sensibilities took its barbs as personal affronts. That summer Urban called in the book, appointing a commission to investigate the circumstances of its appearance. In the autumn he transferred the case to the Inquisition. In February Galileo was summoned to Rome. From April until June negotiations continued in secret. The pope urged the Inquisition on, however, and Galileo was finally resolved to be "vehemently suspected of heresy"—one of the most serious offenses in the Inquisition's ambit. He was forced to abjure, and sentenced to permanent house arrest.[44]

Sudden and irrevocable, Galileo's fall has remained one of the most resonant incidents in history, let alone in the history of science. Here, as throughout Galileo's life, the uses of a book had proved crucial to the transformation. This was no Tychonic success story. It would be difficult to identify fixity or immutability as important to the role of the *Dialogo* at any stage of its story. Galileo's fate was decided by different criteria. His fortunes, and in Mario Biagioli's terms perhaps even his identity, rested on the way in which his book would be read. As scholars working in the last two decades

42. Its five licenses are reproduced in Galilei, *Dialogue*, [2]. For problems over printing and licensing, see Drake, *Galileo at Work*, 311–14, 319–20, 332–44, and Westfall, "Patronage and the Publication of Galileo's *Dialogue*," esp. 386–7, 393.

43. Galilei, *Opere*, XIV, 359–60.

44. Finocchiaro, *Galileo Affair*, 32–9; Drake, *Galileo at Work*, 344–52. After this chapter was written, Paula Findlen and Tara Nummedal kindly showed me their "Scientific Books in the Seventeenth Century," which includes an excellent discussion of Tycho, Galileo, and Kepler.

have revealed, Galileo was a fine mathematician, a profound philosopher, a superb rhetorician, a devious antagonist, and an agile courtier; but even he could not control such readers.[45]

FROM FIXITY TO CREDIT

A new historical understanding of print is needed. What will it look like? One immediately evident feature will be its regard for the labors of those actually involved in printing, publishing, and reading. Another will be its respect for their own representations of printing, embracing both its prospects and its dangers. The dangers in particular will loom larger and more substantial than they have hitherto. Historians tend to disregard such perils as accidental; early modern readers and writers knew otherwise. They had good cause to fear that in the realm of print seemingly in prospect, authorial control over such efforts as Galileo's would be undermined. More than that, some of them thought that it was *already* undermined. Increasingly they articulated responses by which the culture of the learned gentleman could be saved from this "mechanick art." Perhaps we should remind ourselves of the extent to which those responses appeared to fail—of the extent to which the print culture of the eighteenth century could be perceived by contemporaries, not as a realization of the rationalizing effects now so often ascribed to the press, but as destabilizing and threatening to civility. Such a stance, artificial though it would be, might help us to distance ourselves from the apparent stability of our own print culture, with its uniform editions, mass reproduction, and typographical fixity. Early modern fears would then begin to appear not as incidental lapses, defined a priori as marginal, but as credible statements of experience. They would finally be recognized as no less substantial than the phenomenon of fixity itself.

The Nature of the Book tries to treat all sides of the world of print with equal historiographical respect. In so doing, it inherits and attempts to develop initiatives central to the current state of cultural history. In particular, it reflects the important French field of *histoire du livre.* This field, at first associated with the *Annales* movement, has since the 1950s developed into an academic industry in its own right.[46] At the same time, its approaches

45. Biagioli, *Galileo, Courtier,* 2–3, 87. For the different aspects of Galileo cited here, see also Drake, *Galileo at Work*; Feyerabend, *Against Method*; Moss, *Novelties in the Heavens*; Wallace, *Galileo's Logic of Discovery and Proof.*

46. Its origin is conventionally dated to the appearance in 1958 of Febvre and Martin's *L'Apparition du Livre* (which has appeared in English translation as *The Coming of the Book*). Perhaps its most ambitious recent product has been Martin, *History and Power of Writing.* I have surveyed the field and its implications at greater length in Johns, "Science and the Book."

have changed substantially. Its original practitioners dedicated themselves to accounting for the effects of printing in terms of quantitative measures of manufacture and distribution. They divided up the realm of print by subject matter and by the social character of purchasers, hoping to arrive at objective indices of cultural change. In fact, fewer useful figures emerged than had been hoped for. But the approach, so representative of *Annales* historiography, nonetheless had—and still has—substantial advantages. Above all, it suited commonsense perceptions of what it is that most properly characterizes print: the large-scale reproduction and distribution of precisely the same objects. Eisenstein's representation of print culture effectively embodies those same perceptions, albeit without the quantification. However, as illustrated by the examples of Galileo and Tycho, there were also costs to such a strategy. One was that it was effectively "indifferent to the objects themselves." It assumed that successive editions of a work were essentially the same, whatever their variations in text, format, or appearance. It would have accounted the Venice edition of Galileo's *Sidereus Nuncius* the same as the unauthorized Frankfurt impression.[47] Another, equally serious, disadvantage was that it remained silent about how the objects being counted were employed by readers such that they could have divergent cultural consequences. It could not have explained the different receptions accorded Galileo's *Dialogo,* because it ignored what Roger Chartier calls the "intellectual 'labor'" required to put a book or paper to use.[48]

Chartier himself has been central to efforts to address these costs. He has worked to recover the different modes of labor surrounding printed materials, revealing how readers in local settings could "appropriate" in different ways the books they read. From this perspective, ways of reading are recognized as "social and cultural practices." Like other such practices, they have a history, and one that can be reconstructed. The practical implications prove substantial. Sensitivity to the historical character of these practices often shows that an apparently authoritative text, however "fixed," could not compel uniformity in the cultures of its reception. In practice, rather the reverse seems to have happened. Local cultures created their own meanings with and for such objects. For example, during the Counter-Reformation, printed images issued in large numbers in an attempt to standardize religious practice instead frequently served as vehicles for continued differentiation. The elements of a printed book—its format, layout, and typography—acted as no more than elements in an instrument, the book itself, that was useful for constructing knowledge. They were the tools, among others, with

47. Chartier, "Postface," 624–5. Contrast Eisenstein, *Printing Revolution,* 21–2; Eisenstein, *Printing Press,* 80–90, 103–4.

48. Chartier, *Cultural History,* 33–4.

which users forged readings. In general, we may conclude that print entailed not one but many cultures, and that these cultures of the book were themselves local in character.[49]

As the opening pages of this chapter implied, there was one concern in particular that possessed early modern readers, and that may be used as a key to the rest. Could a printed book be trusted to be what it claimed? Perhaps a reader would be prudent to reserve judgment. On the most obvious level, whether a *Sidereus Nuncius* printed in Frankfurt was really Galileo's text, or an *Astronomiae Instauratae Mechanica* produced in Nuremburg was really Tycho's, could justifiably be doubted. More broadly, the very apprehension that printed books might not be self-evidently creditable was enough to rule out any possibility of their bearing the power attributed to them by most modern historians. And that apprehension was widespread. Piracy and plagiarism occupied readers' minds just as prominently as fixity and enlightenment. Unauthorized translations, epitomes, imitations, and other varieties of "impropriety" were, they believed, routine hazards. Very few noteworthy publications seemed to escape altogether from such practices, and none at all could safely be regarded as immune a priori. It was regarded as extremely unusual for a book professing knowledge—from lowly almanacs to costly folios—to be published in the relatively unproblematic manner we now assume. Contemporaries had good reason to be wary. Their editions of Shakespeare, Donne, and Sir Thomas Browne were liable to be dubious. So were those of Robert Boyle, not to mention the first "scientific" journal, the *Philosophical Transactions*. Even Isaac Newton's *Principia* suffered from unauthorized reprinting. From Galileo and Tycho to Newton and John Flamsteed, no significant learned author seemed to escape the kinds of practices soon colloquially subsumed under the label of piracy. This meant that even when a book was not so treated, the possibility that it might be still permeated the negotiations, practices, and conventions by which it was made, distributed, exchanged, and used. If piracy was as widespread as commonly feared, then trusting any printed report without knowledge of those processes could be rash. Profound problems of credit thus attended printed materials of all kinds. Without solutions there could be few meaningful uses for books—and perhaps no durable reasoning from them.

49. These and similar points have been made in many contexts: Chartier, *Order of Books*, 16–17; Chartier, "Culture as Appropriation"; Chartier, "Publishing Strategies," 155–60; Chartier, "Practical Impact of Writing," 122–6; Chartier, *Culture of Print*, 1–5; Chartier, "Du Livre au Lire"; Chartier, *Cultural Uses of Print*, 3–12, 70; Chartier, *Lectures et Lecteurs*; Chartier, "Texts, Printings, Readings"; Chartier, *Passions of the Renaissance*, 1–11, 110–59, 326–61, 362–95; Bourdieu and Chartier, "La Lecture"; Martin, "Pour une Histoire de la Lecture"; de Certeau, "Reading as Poaching"; Darnton, "History of Reading"; McKenzie, "Typography and Meaning"; McKenzie, *Bibliography and the Sociology of Texts*; Martin and Vezin, *Mise en Page*. On the specific theme of *mise en page* see also Laufer, "L'Espace Visuel du Livre Ancien"; Laufer, "Espaces du Livre"; Pastoureau, "L'Illustration du Livre." Compare also the fascinating discussion of "kitsch" in Clark, "Scientific Revolution in the German Nations," 97–8.

It should not be surprising, then, that contemporaries did not always identify fixity as a central characteristic of print. Surveying the books available to aid ocean navigators, Edmond Halley, for one, noted that "the first Editions have generally been the best; frequent Copying most commonly vitiating the Originals."[50] Even when people did refer to enhanced reliability, it was often in the face of direct evidence to the contrary. Textual corruption of even such closely monitored texts as the Bible actually increased with the advent of print, due to various combinations of piracy and careless printing.[51] The first book reputed to have been printed without any errors appeared only in 1760. Before then, variety was the rule, even within single editions. Martin Luther's German translation of Scripture was actually beaten into print by its first piracy, and in succeeding years the proportion of unauthorized to authorized texts was roughly ninety to one; these included Luther's own translation, newly ascribed to others (including Catholics), and others' work reattributed to him. A century later, the first folio of Shakespeare boasted some six hundred different typefaces, along with nonuniform spelling and punctuation, erratic divisions and arrangement, mispaging, and irregular proofing. No two copies were identical. It is impossible to decide even that any one is "typical."[52] In such a world, questions of credit took the place of assumptions of fixity.

In attending to this issue, *The Nature of the Book* builds on Steven Shapin's identification of trust as a key element in the making of knowledge.[53] Where Shapin concentrates particularly on intersubjective trust, asking fundamental questions about *whom* one should believe, why, and in what circumstances, *The Nature of the Book* identifies a similar issue in the trust accorded to printed materials. It asks how readers decided *what* to believe. A central element in the reading of a printed work was likely to be a critical appraisal of its identity and its credit. Readers were not without resources for such an assessment. When they approached a given book, with them came knowledge about the purposes, status, and reliability of printed materials in general—knowledge they used to determine the appropriate kind and degree of faith to vest in this unfamiliar object. Yet here too they also brought to bear knowledge about kinds of people. Their worries about

50. *Atlas Maritimus & Commercialis*, i–iii.

51. Black, "Printed Bible." Eisenstein dismisses Black's argument out of hand: *Printing Press*, 80.

52. Newman, "Word Made Print," 106–7 and passim; de Grazia, *Shakespeare Verbatim*, 15–19, 42; Kernan, *Printing Technology*, 48.

53. Shapin, *Social History of Truth*; Schaffer, "Social History of Plausibility," 129.

literary credit were often resolved, as a matter of everyday practice, into assessments of the people involved in the making, distribution, and reception of books. Readers worried about who decided what got into print, and about who controlled it once it was there. The twin problems of whom and what to credit were in practice often combined into one.

When early modern readers determined a book not to be worthy of credit, they could do so on a number of grounds. It was in the attribution of "piracy," however, that the issues of credibility and print particularly converged. The term seems to have been coined by John Fell, bishop of Oxford, to describe the rapacious practices of London printers and booksellers. It had a technical meaning: a pirate was someone who indulged in the unauthorized reprinting of a title recognized to belong to someone else by the formal conventions of the printing and bookselling community. But it soon came to stand for a wide range of perceived transgressions of civility emanating from print's practitioners. As such, almost any book could, in principle, find itself accounted a piracy, whatever its actual circumstances of production and distribution. Historians of printing have therefore misconstrued instances of alleged piracy in at least two senses. First, they have seen piracy, like fixity, as inherent in the object, and not as a contestable attribution. Second, furthermore, they have assumed cases of piracy to be exceptions, accidental (in the philosophical sense of the word) to the essentially stabilizing character of print. Contemporaries were not so sure of this. Incidents that have been retrospectively dismissed as isolated and exceptional often seemed to them commonplace and representative. They might even be seen as attempts to undermine, and thereby to reform, the whole structure of the book trade. Even when conducted in more humdrum circumstances, moreover, and with less ambitious ends in sight, piracy still had powerful implications. Its apparent prevalence affected the economic and cultural conditions of all printed and written communication. It conditioned the accreditation of printed materials of all sorts, from the humblest ABC to the most elaborate encyclopedia.[54]

54. An inspiration for this treatment, as for other aspects of this book, has come from medieval history. Medievalists have devoted much attention to activities of "forgery" and "plagiarism." They have constructed a sophisticated historiography addressing the diversity of acts since subsumed under such labels, immersing the subject in a detailed and authoritative treatment of the cultural uses of writing and reading in general. Medieval "forgery" is appropriately seen as a form of truth-creation, justified (and perhaps even determined) by contemporary ideas about the nature and purposes of writing. It was also extraordinarily common. Perhaps half the documents known from Merovingian times are by our lights fake, and two-thirds of the documents known to have been issued to ecclesiastics before 1100 would now be reckoned forgeries. See Grafton, *Forgers and Critics*, 24–5, 30–32; Clanchy, *From Memory to Written Record*, 118–20, 231–57; Stock, *Implications of Literacy*, 59–87; Constable, "Forgery and Plagiarism." For a robust contrasting view, see Brown, "*Falsitas pia sive Repre-*

For the learned, and for natural philosophers in particular, this had peculiarly important consequences. In the agonistic field of early modern natural knowledge, allegations of piracy readily shaded into charges of plagiarism. Such allegations therefore extended to the reputation of authors. That is, unauthorized printing threatened to "unauthorize" authors themselves. Even more important, it threatened the credibility to be attributed to their ideas. Like print itself, piracy therefore had *epistemic* as well as *economic* implications: it affected the structure and content of knowledge. For an enterprise like experimental philosophy, in particular, which depended implicitly on the trust accorded to the printed reports issued by its protagonists, the consequences threatened to be nothing short of devastating.

The Nature of the Book provides the first extensive taxonomy of practices labeled piratical—from piracy itself, through abridgment, epitomizing, and translation, to plagiarism and libel. It not only traces the people, places, and practices through which books came into existence and were circulated. It also shows how allegations of impropriety in general, and of piracy in particular, emerged from the practices of the printing house and bookshop. It thus explains how and why such allegations gained their apparent ubiquity. Moreover, it then proceeds to ask how these changes could possibly be comprehended in terms of the polite civility supposed to guide intellectual conduct, and how claims that such practices had been pursued affected the reception of the works concerned. In short, it addresses precisely the epistemic significance of piracy.

Printers and booksellers were manufacturers of credit. They had to be. The skills of those producing and trading in books, and the perceptions of those using them in learned work, might not intersect harmoniously. Whether or not they did at the moment of publication, moreover, accounts of printers' and booksellers' actions might still be drawn upon later by critics and rivals to challenge the value of any particular book, for example by alleging piracy. When they did succeed in remaining in the background—a rarer achievement than we might suppose—it was likely to be the result of hard and continuing work carried out "behind the scenes." A principal aim of *The Nature of the Book* is to recover this work and display its importance. While it mentions many instances in which publishing enterprises failed to proceed smoothly, then, its intent is not just to attest to the frequency of such failure. It instead substantiates Marc Bloch's dictum that "a good cataclysm suits our business." The historian, Bloch pointed out, often depends on "calamities" for the preservation and revelation of information, and this

hensibilis." For these medievalists' perspectives on print—which deserve more attention than they have received—see Clanchy, "Looking Back," and Rouse and Rouse, *Authentic Witnesses*, 449–66.

is no exception.[55] Problems and disputes were often the occasion for the creation of records documenting practices that remained unrecorded in cases of more successful publication. This volume is accordingly concerned to use such testimony to display the commonplace and unremarkable quite as much as the disastrous and spectacular; and especially to use the latter to reveal the former. The indispensable agency of printers and booksellers might remain unnoticed, for example, since the credit of their products depended on its being so. They themselves developed sophisticated ways of ensuring that they stayed just sufficiently in the background to avoid suspicion of either subterfuge or authorship. But in disputes the character of a bookseller or printer mattered. For readers attuned to its significance, anonymity itself might then become a source of suspicion.[56] Historians can put the resulting allegations to use as evidence. They need no longer be complicit in the cabal by their own silence.

The ways in which such agents thought of and represented themselves were therefore of central importance to the received credit of printed knowledge. The point is not a simple one. What it was for a printer or bookseller to act "properly" could be determined in any number of ways. The principles of such propriety were consequently liable to vary. Yet it is impossible to understand impropriety without at the same time comprehending these, the conventions of propriety that were allegedly being violated. The two came into being in tandem. Chapter 3 thus addresses the ways in which printers and booksellers themselves fought to create a trustworthy realm of printed knowledge by articulating such conventions. The civility they adopted was complex, but it was also highly consequential. On its central concept of "propriety" rested the authorship of every writer who aspired to profess knowledge in print. Its maxims, reconstructed below, were important not just because of their use in resolving individual cases of piracy or unlicensed printing, but because they became central to the trade's representation of itself as a respectable craft. How printing should properly be practiced, in what ways it should properly be regulated—in effect, what printing itself *was*—would all be defined by reference to them. The epistemic significance of piracy therefore extended, reflexively, to printing itself: the very nature of print remained unresolved throughout the early modern period, and piracy was central to its resolution. From the practical régime described in chapter 3 emerged print culture itself.

Chapters 4 and 5 trace how this happened. Chapter 4 tells the story of John Streater, a printer with a remarkably sophisticated republican philosophy. Streater's actions threatened to transform the nature of print and society simultaneously. His activities and interests ranged widely, from soldiering and arms dealing to natural magic and law reform. In particular, though, Streater tried to redefine the grounds of proper action for printers and booksellers by doing *historical* work of an extraordinarily ambitious sort. He rewrote the history of printing in an attempt to reconfigure its governing political culture and thereby redefine its current and future identity. The initiative was then inherited from Streater himself by others who pursued cognate goals through the eighteenth century. Chapter 5 examines their rivalries. It explains the new historical identities they forged for both print and its propriety.

55. Bloch, *Historian's Craft*, 74–5.

56. For example, in his attacks on Ursus, Tycho Brahe was given to remarking upon his antagonist's book's having been published without a printer's name, as was customary for "notorious libels": Jardine, *Birth of History and Philosophy of Science*, 16.

In fact, the use of historiographical work to create new identities and proprieties is an idée fixe of this book. It has become well known that scholarly figures attempted this kind of enterprise fairly frequently. So, however, did craftsmen and hacks. Joseph Moxon placed the press and the printer in a tradition of the mathematical sciences going back, through Tycho Brahe, to Vitruvius; chapter 2 describes his work. Streater and his ally, the embittered ex-Cavalier Richard Atkyns, told the history of printing as one of proto–industrial espionage. Sir Thomas Browne constructed a history of plagiarism, and Joseph Glanvill articulated a double-usurpation theory of ancient philosophy in order to criticize Aristotle and make room for the experimentalists of the Royal Society. These characters appear in chapter 7. Astronomer Royal John Flamsteed, the subject of chapter 8, went further still, and constructed three parallel histories: that of his own feud with Newton; that of Tycho's with Ursus (of which he thought the former was a recapitulation); and a full history of astronomy from biblical times to the present, designed to culminate in its own appearance at the head of Flamsteed's great *Historia Cœlestis Britannica*. Through these he tried to guide posterity to an understanding of his own proper identity. Each of these historiographical projects plays its part in the narrative that follows. I take such historical self-representation to be of central importance in constituting the identities agents felt themselves to possess, and hence in influencing their notions of proper action for their contemporaries too. The historiographical efforts recounted in chapter 5, in particular, led directly to the assumptions of reliability and credibility from which the print culture of the modern age arose. And the present work is of course no exception to this rule. The transformed history presented in *The Nature of the Book* is intended to encourage new thinking about the character of print in our own age.

The sources of print culture are therefore to be sought in civility as much as in technology, and in historical labors as much as in immediate cause and effect. The "printing revolution," if there was one, consisted of changes in the conventions of handling and investing credit in textual materials, as

much as in transformations in their manufacture. The point deserves to be stressed explicitly. I do not question that print enabled the stabilization of texts, to some extent; although fixity was far rarer and harder to discern in early modern Europe than most modern historians assume. I do, however, question the character of the link between the two. Printed texts were not intrinsically trustworthy. When they were in fact trusted, it was only as a result of hard work. Fixity was in the eye of the beholder, and its recognition could not be maintained without continuing effort. At no point could it be counted on to reside irremissibly in the object itself, and it was always liable to contradiction. Those faced with using the press to create and sustain knowledge thus found themselves confronting a culture characterized by nothing so much as indeterminacy. If printing held no necessary bond to truth, neither did it show a necessary bond to falsity or corruption. Each link remained vulnerable to dispute. It is this epistemic indeterminacy that lends the history of the book its powerful impact on cultural history. Understanding how it could be overcome to make knowledge and hence cultural change is what the history of the book is for.

There did exist strategies that could be adopted in order to secure as much credibility for printed objects as readers needed. Chapters 6 and 7 describe such strategies, as pursued by gentlemen and philosophers in a number of different settings. They argue that their pursuit was vital for the establishment of both new philosophies of nature and new practices of knowledge-making. A central tactic in most cases was that of attributing trust to a book on the basis of an evaluation of a person. Look closely at attributions of credit to printed materials, and, as already noted, there will generally be an attribution of credit to an individual involved. "It must be only by the Marks and Properties of an *Imposture,* that we can know an *Imposture* from that which is a real Truth, when attested unto us," counseled Humphrey Prideaux in a much-read analysis of the credibility of alleged scriptural writings. But in identifying such "marks" of imposture, attention should center on consideration of its maker and his conduct. If the producer seemed a wicked man, using "craft" and "fraud" to propagate a claim for his own interest, then that claim could justifiably be accounted a falsehood.[57] Prideaux's recommendation was conventional enough. Similar exhortations appeared in many works of his era. In action, these skills were therefore intriguingly recursive. Readers assigned credit to printed materials

57. Prideaux, *True Nature of Imposture,* "A Discourse for the Vindicating of Christianity from the Charge of Imposture," 6–8. For a fascinating and extremely suggestive treatment of early strategies of credit adopted in an effort to circumvent piracy, see Newman, "Word Made Print." For bible printing and reading see also Cole, "Dynamics of Printing," and Tribble, *Margins and Marginality,* 11–56.

on the grounds of knowledge about their makers, which was in turn assessed partly in terms of printed sources already accredited. In such ways might knowledge become more secure.

But this was only one of many possible strategies. From the printing house and bookshop, through the craft center of Stationers' Hall, to the learned sites of the Royal Society of London and the Royal Observatory at Greenwich, *The Nature of the Book* identifies the techniques developed in each location by which books could be appraised and accredited. The use of print for making knowledge depended on these local practices of printing, exchange, and reading. The bookshop and printing house were regularly identified as places of promise and achievement. But they were also centers of conflict, plotting, and betrayal, where the proprietor could exhibit a notable fluidity of social identity. In anachronistic terms, he or she—the book trades were remarkable for the participation of both men and women—merged the roles of socialite, friend, ally, entrepreneur, and even spy. His or her responsibility for the contents of a book seemed almost infinitely negotiable: however tactically unwise, outbursts such as those by Grassi and Scheiner against the bookseller were not intrinsically unreasonable. Hence the merging of trust in people with trust in things. Concerns over the effect of printing were readily expressed in terms of such practitioners. Bookshops represented points of attraction for potential Brunos and Patrizis, it was said, in part because those who ran them were so inclined. They were also frighteningly good at their work. To flirt with anachronism once more, besides being manufacturers of credit, seventeenth-century booksellers were the best sociologists of literature of their day.

The autonomy and creativity of Continental scholar-printers in these respects are well known. Eisenstein conjured an image of what she called "print-shops" as "'polyglot' households"—nodal points for the transfer of people, writings, and knowledge. The European "print-shop," she suggested, was where the "scholar" and the "craftsman" really met.[58] In some respects, and under certain circumstances, the smaller printing house or bookshop of London, Paris, or Rome could become a similar social site. Indeed, the household unit typically found here was perhaps rather more appropriate for such sociability than the relatively large operation of an Elzevir or a Plantin. But it also had to operate under more evident regulatory constraints. Eisenstein's view was that printers and booksellers were "natural" enemies to outside regulation of any kind. In fact, this was far from the case. In cities like London and Paris, the vast majority supported licensing

58. Eisenstein, *Printing Press,* 139, 399–400, 443–7, 520–2, 581–603, 653–4. Compare Zilsel, "Genesis of the Concept of Scientific Progress."

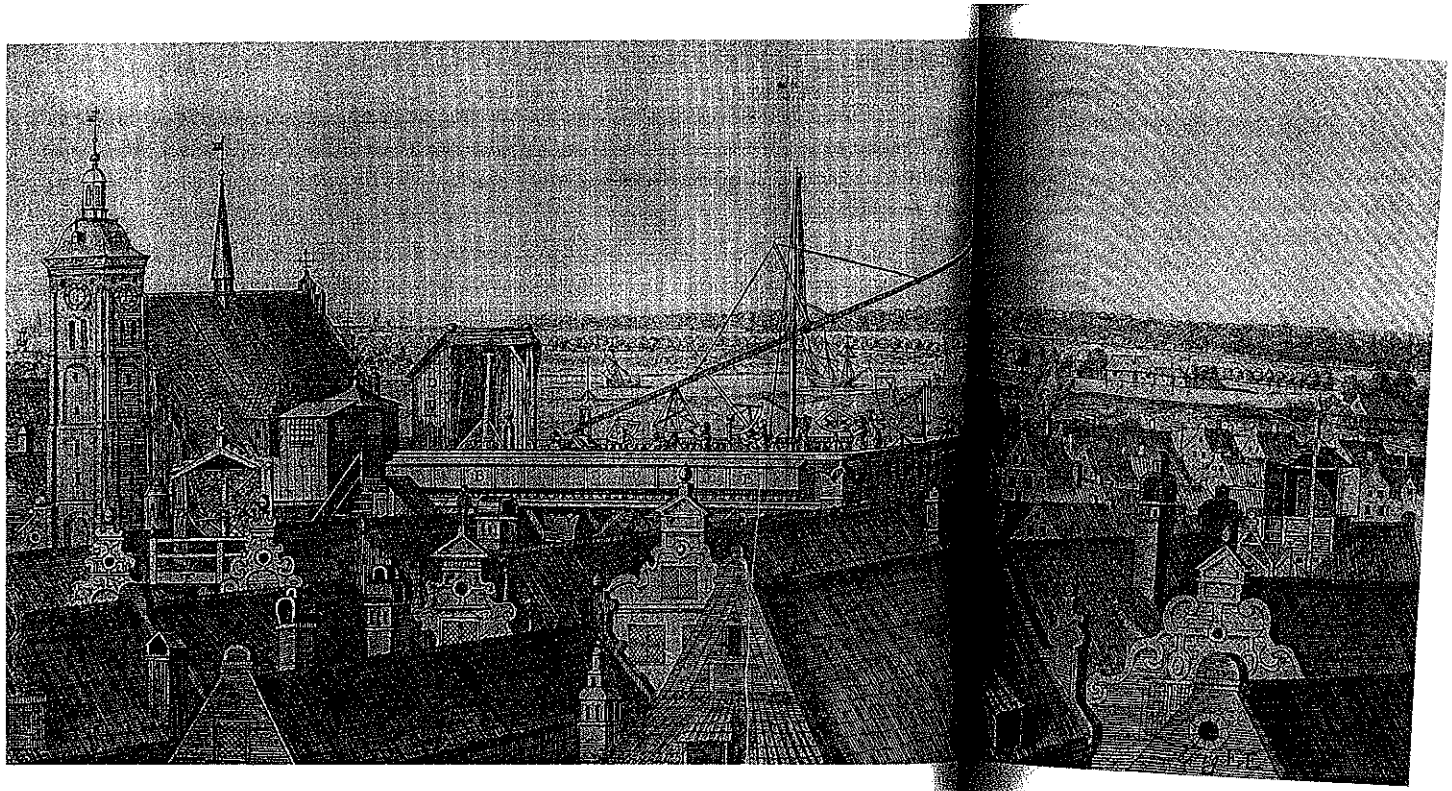

FIG. 1.10. Hevelius's "Civic Stellaeburg" in Danzig (now Gdansk). Hevelius's city building housed every device needed for an astronomer, from telescopes and lens-making equipment to a printing house. He sought to guarantee the credibility of his printed representations by doing all the corresponding activities, from observing to engraving, himself. His success was mixed. Still he needed imperial privileges to forbid other printers' "frauds"; and astronomers like John Flamsteed felt able to cast doubt on his accounts of these processes. Hevelius, *Machina Cœlestis*. (By permission of the Syndics of Cambridge University Library.)

and similar régimes. They had good reason to do so. Those systems were deemed necessary to guarantee trust, order, and propriety in their craft.[59] Livelihoods therefore depended on them. A new understanding of these measures is needed. It must acknowledge their use to suppress texts of which the state disapproved—a use that was certainly real, but that included publications discreditable for reasons of piracy as well as of sedition or obscenity. But it must also appreciate the obverse of this function: the central role contemporaries ascribed to such systems in the maintenance of any trust at all in the realm of print. Printers were "mechanicks," as much in need of "licensing" as preachers (especially "mechanick" preachers) and medical practitioners (the analogue here being "empiricks"). For similar reasons, the book trades themselves participated in their own regulation.

Some went further still. They proposed ways to change the very nature of the printing enterprise and to transform the character of its practitioners. There were ambitious attempts to establish a non-"mechanical" printing house for learned work, for example. In England the most notable such effort was Archbishop William Laud's at Oxford. Inherited by John Fell at the Restoration, Laud's initiative was eventually secured as Oxford University Press.[60] The appointment of quasi-genteel "patentees" was, as chapters 3 and 4 show, an even more ambitious strategy to change the very nature of printing so as to eliminate problems of discredit. Patentees were wealthy printers or booksellers—or even gentlemen from outside the trade altogether—to whom the crown granted exclusive rights to key titles, or indeed to whole classes of publication. One patentee held the right to all law books, for example; another held that to all bibles. It was reckoned that they and their books would be securely trustworthy by virtue of their gentility and their dependence on royal favor. In the eyes of some, they could become a model for a future realm of print guaranteed by a decreed civility. Perhaps an urban equivalent to Tycho's civil press—or at least, to Hevelius's at Stellaeburg—could be constructed (fig. 1.10).

59. Eisenstein, *Printing Press*, 442. It is also significant that early modern images of the press showed a greater diversity than recognized by Eisenstein. Eisenstein shows only the complimentary iconography of Prosper Marchand ("The press descending from the heavens"); we need also to remember the devils chasing each other through the printing house portrayed in Huss's *La Grante Danse Macabre*, and broadsheets mocking those who believed anything produced by the press. Something of this iconographic range is reproduced in chapter 5 below. For an example of the importance of Catholic censorship in astronomy, see Gingerich, "Censorship of Copernicus."

60. Ward, *Oxford University Statutes*, I, 205–6, declaring that an *architypographus* must be appointed so that "sordid and vulgar artizans may not pervert the indulgence of that most clement prince [Charles I] to their own private lucre . . . experience has shown [that] these mechanical artizans . . . pay the least possible attention to calligraphy, or the beauty or elegance of the work, but thrust into publication any works, however rude and incorrect."

To the early modern world, then, the character of the printing house and the civil order in which printed books could be accorded trust were interdependent. Bookshops too were places encouraging novel interactions, as indeed were institutions such as the Royal Society. Throughout this book close attention is therefore accorded to the details of such locations. Readers will be led down the darkest alleys of London, and guided through homes and workplaces to reveal their characters with an intimacy few early modern gentlemen can have shared. But here, it may be thought, crouches a paradox. Does the importance of print not lie precisely in its ability to transcend such local contexts and enable communication across wide distances? Surely such a close focus on individual locations risks obscuring this, the most consequential issue of all. It is a real question, with implications beyond the understanding of print alone. The next section addresses this apparent paradox, and from a correspondingly broad perspective. For a central theme of *The Nature of the Book* is to see this power to transcend place as something itself in need of explanation.

PLACE, PRACTICE, AND KNOWLEDGE

> Books are a load of crap.
> PHILIP LARKIN, "A Study of Reading Habits," *Collected Poems*, 131

The Nature of the Book concentrates for the most part on one country, England, and in particular on its capital city, London.[61] The focus is by no means exclusive, and in fact discussion does extend across Europe as appropriate. Nevertheless, the question must arise: why? The choice may appear arbitrary. More to the point, it may seem perverse to address questions of the identity and consequences of print by examining *any* one location, when the very essence of print, supposedly, is that it enables human beings to transcend their immediate circumstances and communicate reliably with others in different times and places. These are important questions. One plausible answer to the first derives from the extensive attention that historians have directed at the emergence of polite commerce in Augustan England.[62] As part of this, England became one of the earliest nations to develop a sophisticated commercial culture of printing and publishing, and its concepts of authorship, liberty of the press, and intellectual property have been of influence across the world. It warrants attention for that reason alone. But a further justification may also be advanced—one that addresses the more fundamental question of why it is appropriate to focus on any one location at all.

61. Strictly speaking, from the early eighteenth century Britain succeeded England as the political entity in question. Since my discussion covers a long period before union, and in any case concentrates on the region around London, I have generally referred to England here. The issue of national identity was a charged one, however, as has been brought to the fore in such recent studies as Colley, *Britons*; Russell, *Fall of the British Monarchies*; and Morrill, *Nature of the English Revolution*, 91–117.

62. The most recent and comprehensive survey is the massive three-volume series formed by Brewer and Porter, *Consumption and the World of Goods*; Bermingham and Brewer, *Consumption of Culture*; and Brewer and Staves, *Early Modern Conceptions of Property*.

This book concentrates on the implications of printing for knowledge, and for knowledge of nature in particular, for reasons already outlined. It does so at what was undeniably a time of extraordinary creativity in the history of science. Early modern England witnessed not only the invention of experimental philosophy and the advent of the Royal Society, but the achievements of such figures as Francis Bacon, William Harvey, Robert Boyle, and Isaac Newton. *The Nature of the Book* aspires to address some of our founding assumptions about how such successes were attained. To do so, it concurs with much current work in the history of science in relating knowledge to its particular social and cultural settings. The universality of science, such work suggests, is an achievement realized only through much hard work. That work is necessarily specific to its particular sites, be they medieval universities, Renaissance courts, or Victorian laboratories.[63] Such are the places that have harbored the kind of skilled practices through which knowledge has been created and sustained. From this perspective, museums, laboratories, and royal palaces are seen as not just architectural structures, but distinct social spaces generating different practices fertile of new knowledge.[64] The knowledge fashioned in such places answers the needs of the moment, addresses the questions of the time, and satisfies the standards of the local culture.

For the historian, print and science share a rather intimidating characteristic. Both appear to transcend place. Scientific knowledge, it has been asserted, is by its very nature true wherever one may find oneself. That is what constitutes its claim to objectivity.[65] Print seems blessed by a similar

63. See especially: Shapin, "House of Experiment"; Biagioli, *Galileo, Courtier*; Hannaway, "Laboratory Design"; Westman, "Astronomer's Role"; Ophir, Shapin, and Schaffer, *Place of Knowledge*; Outram, "New Spaces in Natural History"; Moran, *Alchemical World of the German Court*; Smith and Agar, *Making Space for Science*. For the importance of localization in the history of the "scientific revolution," see also Porter and Teich, *Scientific Revolution in National Context*, and Schuster, "Scientific Revolution," 223–4. Jardine's *Scenes of Inquiry* lucidly explains the philosophical issues at stake.

64. De Certeau, *Practice of Everyday Life*, 117. Elias's treatment of the royal court, for instance, illustrates how it merged family and government in a coherent figuration: Elias, *Court Society*, 1, 41–65; Foucault, "Space, Knowledge, and Power."

65. Ophir and Shapin, "Place of Knowledge," 3–4; Porter, *Trust in Numbers*, 217–9 (which notes the widely cited certificate of science's universality, that "the same textbooks can be used all over the world"); Johns, "Ideal of Scientific Collaboration."

transcendence: in many historians' hands, it appears to hint at something floating apart from specific, compromised, adulterated actuality. Just as appreciations of science have too often eschewed attention to the detailed intricacy of knowledge in the making, so cultural historians' appreciation of print has too frequently stopped short at the doors of the printing house.[66] But if the universal character of science can be appraised as an achievement, warranted and maintained by situated labors, may the same not be true of print? The suggestion is at the core of this book's approach. Searching for print culture in the making, we actually zero in not just on London, but on particular streets, buildings, floors, and rooms. We shall try to recover the identities, representations, and practices of the people who lived and worked in those rooms. And we shall see how hard they worked to create the realm of print, in a complex and unforgiving web of such domains. The close attention paid by *The Nature of the Book* to the intricate details of individuals' practices, characters, and motivations, far from being peripheral, is thus essential. Such a focus must be adopted in order to show how print, like scientific truth, attains the level of universality—by the hard, continuous work of real people in real places.

This makes the conjunction of the history of print with that of science especially intriguing. The juxtaposition becomes only more curious when one recalls the enormous—perhaps even defining—role that historians have almost unconsciously ascribed to print in the history of science. That history is routinely represented in terms of a chronological skeleton, the joints of which are dates such as 1543, 1632, 1687, 1789, 1859, and 1905.[67] These years are etched in the memory of every historian of science with a permanence no others can match. They seem ineluctable. Novel historiographical approaches leave them unscathed. And all, of course, are publication dates, ranging from Copernicus's *De Revolutionibus* (and Vesalius's *De Humani Corporis Fabrica*) to Einstein's revolutionary paper introducing special relativity. To that extent, the history of print and that of science are tacitly acknowledged to coincide. Yet, strangely, recent historiography has implicitly directed attention away from the conjunction. The reason for this apparent paradox is subtle, and even rather profound.

There is a sense in which the history of early modern science no longer exists. Historians now employ all the resources of cultural and social historiography in an attempt to explain why people made certain claims in certain circumstances, and why they were or were not believed; whether or not such claims are, to modern eyes, "scientific" has ceased to seem so important. Indeed, although the early modern world recognized something it called "science" (or, more likely, the Latin *scientia*)—namely, the kind of demonstrative knowledge produced by geometers or infallible logicians—it did not acknowledge anything like the modern enterprise. And it certainly did not harbor any scient*ists*.[68] The consequences of accepting this prove substantial. The extent of acceptable topics has widened enormously. Movements previously assumed peripheral—Jesuit philosophy, for example, or, perhaps most spectacularly, hermeticism—have been reassessed as powerful and authoritative in their particular settings. More canonical subjects have also been transformed. Experimental philosophy and Newtonianism, in particular, are no longer seen as gaining straightforward victories over self-evidently inferior opposition. On the contrary, they are seen as struggling for credibility in a cultural bazaar filled with more different candidates for natural knowledge than had ever existed before, offering greater potential rewards. Their proponents' strategies must accordingly be understood as developing in response to these formidable and effective opponents. As they did so, they themselves diverged; it is difficult now to identify any one thing to call "Newtonianism." An appreciation of the viability of alternatives has thus had enriching implications for our understanding of the canonical successes of the "scientific revolution" too.[69]

But this appreciation of a far wider range of places and practices has also had its costs. If natural knowledge was such a localized thing, then the processes by which it came to be transferred from place to place become rather mysterious. Talk of diffusion or dissemination will not now pass muster. The evocation of an all-powerful central source from which influence spreads across an inert terrain is no longer tenable, because sites of reception previously supposed passive are now recognized to have been vital, dynamic, and appropriative. Notions of "popularization" become equally problematic, since they too generally posit audiences as passive receptacles of influence rather than positive agents of appropriation.[70] With respect to

66. This could not be said of bibliographers, but then these have often been too modest in their historiographical objectives. Historians of the book such as Henri-Jean Martin are a more consequential exception, for which see above, pp. 28–30.

67. The dates of Copernicus's *De Revolutionibus*, Galileo's *Dialogo*, Newton's *Principia*, Lavoisier's *Traité Élémentaire de Chimie*, Darwin's *Origin of Species*, and Einstein's "Zur Elektrodynamik bewegter Körper" respectively.

68. For the origins of the latter term see [Whewell], review of Sommerville's *On the Connexion of the Physical Sciences*, 58–60, and Ross, "*Scientist*," 71–5.

69. Dear, "Jesuit Mathematical Science"; Henry and Hutton, *New Perspectives*; Hannaway, *Chemists and the Word*; Webster, *From Paracelsus to Newton*; Schaffer, "Newtonianism." For other rehabilitations see Feingold, *Mathematician's Apprenticeship*; Gascoigne, "Universities and the Scientific Revolution"; Gascoigne, "Reappraisal of the Role of the Universities"; Feldhay, "Knowledge and Salvation"; Feldhay and Elkana, *After Merton*.

70. An excellent alternative is presented by Secord, "Science in the Pub." See also Latour, *Science in Action*, 132–44.

knowledge based in experiments the problem is especially evident. The transfer of this particular species of practical, performative knowledge to different sites could never be straightforward, if only because the replication of the localized skills in which such knowledge was based proved riddled with difficulties. Early modern experimentalists knew this all too well; it has only recently been rediscovered by historians. But what was most flagrantly true for experimental knowledge was also true, if less obviously, for other claims to epistemic authority.

Here lies another reason to focus on England. In London, the Royal Society (chartered in 1662) pioneered solutions to these intractable problems. In part it did so by aggressive intervention in the realm of print. A long-term consequence was a transformation in both print and natural knowledge. Indeed, one of the most interesting and unusual aspects of Restoration experimental philosophy was that it explicitly confronted this situation. Robert Boyle and his colleagues at the Society recognized it remarkably early, and advanced notably cogent solutions. One aspect of their responses is well known, and has been extensively analyzed of late. For all its difficulty of achievement, experimental philosophers appealed to replicability as testament to the truth of the knowledge they professed. In one sense, that very difficulty was an asset: it helped make successful repetition in different cultural settings a robust criterion of truth. The result was a claim about replication that has become central to the authority of modern science. But the character of the obstacle to replication also deserves note. As has become well known, successful repetition of an experiment elsewhere often required the transfer of more than just written or printed materials alone. Extensive social contact between practitioners was needed in order to reproduce cultural skills and settings in a new site. A skilled practitioner might even have to travel in person between the two locations in order for the attempted replication to succeed—or, for that matter, for it definitively to fail. It thus seems that nobody in 1660s Europe built an air-pump successfully by relying solely on Boyle's textual description of the engine. Some, we know, tried; all, we think, failed.[71]

A key assertion of the sociology of knowledge has been that this is true not just in practice, but in something approaching principle. Experimental knowledge of the kind sought by Restoration natural philosophers must necessarily be founded in skills, the character and application of which can never be stipulated exhaustively by written rules. Replication requires the recreation of a performative and interpretative culture in which candidate attempts can be conducted. Building new air-pumps could indeed be done

71. Shapin and Schaffer, *Leviathan and the Air-Pump*, 229–30, 235.

from recipe-like textual instructions, but only if interpreted in a shared recipe-reading culture. That is one reason why such knowledge seems to be inescapably social: it depends on the face-to-face interactions that help constitute such a culture.[72] It is also why some historians of science have directed their attention away from what they think of as "texts." These are not, they suppose, the prime building blocks of either society or knowledge.

Yet there must be more to say about the importance for the construction of natural knowledge of the construction of print. Early modern natural philosophers did make and use a variety of written, printed, and engraved objects. They labored over books, periodicals, letters, "schemes," and any number of similar textual and pictorial materials. They expended very large amounts of time and money doing so—larger, as chapter 7 will show, even than those expended on experimental instruments like the air-pump. Even the most basic historicist sensibility is likely to rebel at the thought that all this activity was intrinsically futile. In fact, it is possible to argue that it was central to enterprises dedicated to making knowledge—even experimental ones.

Several historians have already noted that experiments often did not, in fact, need to be replicated at all. Rhetoric helped.[73] Boyle and his interlocutors developed sophisticated and prolix ways of writing reports of their experimental trials. By stating explicitly every circumstance of the experimental scene, a report sufficiently crammed with detail could aspire to persuade distant readers that they had as good as been there themselves. In that event, they effectively became "virtual witnesses" to the experiment itself. Such virtual witnessing could thereby render the actual practice of replication largely otiose. The skills of an experimenter may indeed have demanded complex cultural modes of transfer and appropriation, then, in which texts were not omnipotent (fig. 1.11). But if "texts" were ineffective for transmitting manual skills, more tangible objects could be put to use to mediate the creation of consensus by means of recruiting readers. Books, periodicals, papers, letters, maps, graphs, and diagrams did move back and forth between sites, proving extremely useful tools for the making and maintenance of knowledge. Rhetoric, however persuasive, came into being and achieved its effects only when incarnated in such objects. Historians of science need

72. Collins, *Changing Order*, 55–7, 70–73, 77; Gooding, Pinch, and Schaffer, *Uses of Experiment*, 10–13; Lynch, *Scientific Practice and Ordinary Action*, 211–4. Compare Lawrence, "Incommunicable Knowledge," for tacit knowledge in the history of medicine. Eamon, *Science and the Secrets of Nature*, is the most recent work to concentrate on recipe-like texts: see esp. 130–33.

73. Dear, "*Totius in Verba*"; Dear, *Literary Structure*; Gross, "Rhetorical Invention"; Bazerman, *Shaping Written Knowledge*; Moss, *Novelties*. For "virtual witnessing," see Shapin, "Pump and Circumstance," and Shapin and Schaffer, *Leviathan and the Air-Pump*, 22–79.

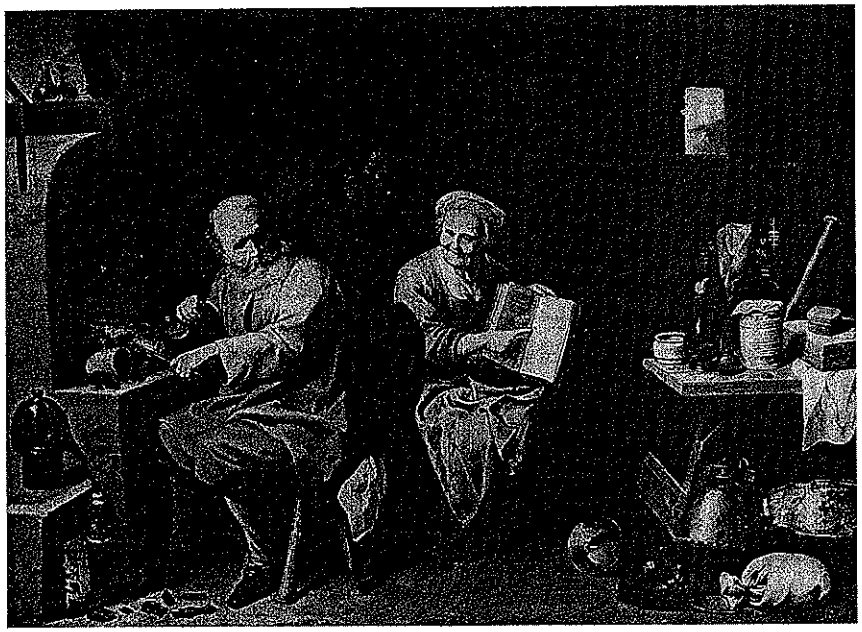

FIG. 1.11. Reading skills juxtaposed with experimental dexterity. David Ryckaert III, *The Alchemist* (1648). (By permission of the Syndics of Cambridge University Library.)

to begin considering in detail their processes of manufacture, distribution, and use.[74]

Use in particular is important here. It raises rather a subtle issue, hinted at in general above but now requiring explicit attention. Almost all historians put themselves in the place of early modern readers and assume that their own act of reading replicates that of their historical counterparts. But this substitution may not be entirely innocuous.[75] A rather different approach is suggested if one identifies reading itself as a skill, just as historically specific as the more obvious dexterity involved in experimentation. If reading has a history, then assuming that modern readers' responses to a printed page accurately reproduce those of seventeenth-century men and women becomes problematic. Attendance to the conventions constraining the appropriation of printed objects in particular historical settings seems much more pertinent. Agreement across cultural spaces arose out of the exercise of such reading skills. Rhetoric, however expert, depended on them. The questions addressed in *The Nature of the Book* are of a correspondingly specific order: of how an experimental paper was actually composed by *this* writer, made by *these* workmen, distributed by *these* merchants and diplomats, and discussed in *these* ways, by *these* people, *here,* in *these* circumstances, with *these* results. This very minuteness of focus enables it to trace a grand process: the elaboration of a print culture and a culture of natural knowledge in tandem.[76]

74. There are exceptions. Golinski, *Science as Public Culture*, and Stewart, *Rise of Public Science*, largely escape this charge by paying close attention to contexts of use.

75. Chartier, *Pratiques de la Lecture*, 7; Chartier, *Cultural History*, 40.

Chapter 6 pursues this specificity to its most intimate level. It examines how early modern people represented reading itself, in terms of their very minds and bodies.[77] Directing attention to the human frame, it asks how readers sought to understand their experiences in terms of its "passions." The implications of their quest extended very widely indeed: from the fortunes of Protestantism to the transmutation of metals, and from the education of gentlemen to the development of women's authorship. It also impinged directly upon their responses to Creation. Investigating the "book of nature" was thus a profoundly reflexive process: early modern people arrived at natural knowledge through reading, a skill that they in turn understood in terms of the natural knowledge so gained.[78]

Recognition of the ineffable character of skill thus need not imply that print is a peripheral subject for the historian of science. On the contrary, in the future we shall need to marry the two. The history of reading suggests one way to do so. The salience of printed books and papers cannot now simply be exorcised by alleging the inability of texts to determine their readers' conclusions; that they were unable to force concurrence does not

76. Gingerich and Westman are among the few historians of Renaissance science to have consistently attended to the entire history of books, from writing to reading: e.g., Gingerich, "Copernicus's *De Revolutionibus*"; Gingerich, "Censorship of Copernicus"; Westman, "Proof, Poetics, and Patronage"; Westman, "Reception of Galileo's *Dialogue*"; Gingerich and Westman, *Wittich Connection*. William Eamon, although his work centers on books, does not generally venture into such details: see especially his *Science and the Secrets of Nature*, and also his "Books of Secrets"; "Arcana Disclosed"; "From the Secrets of Nature to Public Knowledge"; "Court, Academy and Printing House." Rostenberg's *Library of Robert Hooke* is another recent exception to the rule, but one riddled with errors.

77. See also Johns, "Physiology of Reading in Restoration England" and "Physiology of Reading and the Anatomy of Enthusiasm."

78. Shapin, *Social History of Truth*, xviii–xix. For the image of the Book of Nature, see Eisenstein, *Printing Revolution*, 455–6, 471–8; Brooke, *Science and Religion*, 75–81; Blumenberg, *Lesbarkeit der Welt*; Findlen, *Possessing Nature*, 55–63 (much the most interesting recent set of remarks on the subject in English); Dingley, *Vox Cœli*, sigs. [A5^r]–[A6^r]. For shifts in the modern significance of the metaphor, see also Traweek, *Beamtimes and Lifetimes*, 160–1. Nehemiah Grew referred to John Wilkins holding the Bible in one hand and Grew's own book—some pages from the book of nature—in the other, as a commentary on the first, "by which, in part God reads the World his own Definition, and their Duty to him": Grew, *Anatomy of Vegetables Begun*, sigs. A4^r–[A7^r].

mean that such objects were not interpreted at all. The reading of a book is no less skillful, and no less local, than the conducting of an experiment.[79] To understand the transformation of science into an apparently universal culture, then, we need to create a history of the reading practices surrounding scientific books as detailed and intricate as the appreciation we already have of the experimental practices surrounding scientific instruments. *The Nature of the Book* marks the beginning of that enterprise.

NATURAL KNOWLEDGE IN ENGLAND: WISDOM IN THE CONCOURSE

> Wisdom crieth without; she uttereth her voice in the streets: She crieth in the chief place of concourse, in the openings of the gates: in the city she uttereth her words, saying, How long, ye simple ones, will ye love simplicity? and the scorners delight in their scorning, and fools hate knowledge? Turn you at my reproof . . . But ye have set at nought all my counsel, and would none of my reproof: I also will laugh at your calamity . . . For the turning away of the simple shall slay them, and the prosperity of fools shall destroy them.
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> PROVERBS 1:20–32

Translating the experiences of Galileo and Tycho into the rather different situation of late Renaissance England is not a straightforward task. The courts of Elizabeth, James I, and Charles I never attained the culture of absolutism surrounding those of Rudolf or Cosimo—much though they may have tried—and there was no official court philosopher here.[80] Yet in some ways English natural philosophy disputes were modeled on such Continental forms. Books and manuscripts played just as central a role in English courtly life, and percipient historians have noted the extent to which those presented at court might be assumed to bear the patron's authorship.[81] Nor did this courtly role end with the Civil War. As we shall see in chapter 8, as late as 1712 not one of the four hundred copies printed of John Flamsteed's

79. See especially Chartier, "Culture as Appropriation"; Chartier, *Pratiques de la Lecture*; Chartier, *Lectures et Lecteurs*; Chartier, "Texts, Printings, Readings"; Chartier, *Passions of the Renaissance*, 1–11, 110–59, 326–61, 362–95; Martin, "Pour une Histoire de la Lecture"; de Certeau, *Practice of Everyday Life*, 165–76; Cressy, *Literacy and the Social Order*, 1–18; Darnton, "History of Reading."

80. The nearest equivalent was John Dee, as attested in the possibly sarcastic remarks of real courtiers: Sherman, *John Dee*, 7–8; Roberts and Watson, *John Dee's Library Catalogue*. See also above, note 36. Compare Harriot, who made similar observations to Galileo's but was unable to make them count: Jacquot, "Thomas Harriot's Reputation"; Henry, "Thomas Harriot and Atomism"; Cormack, "Twisting the Lion's Tail."

81. Goldberg, *James I and the Politics of Literature*, e.g., 1–9. James I had visited Uraniborg itself: Thoren, *Lord of Uraniborg*, 334–5; Brahe, *Opera*, II, 11–12.

Historia Cœlestis—the greatest work of observational astronomy then in existence—seems actually to have been sold, but volumes were distributed through diplomatic channels across Europe and as far as Muscovy. Flamsteed, like Tycho in Prague, held the title of royal astronomer, and chapter 8 will show the extent to which he modeled every aspect of his conduct on Tycho's. But the difference between English and imperial natural knowledge may be measured by his failure. Although his observatory on Greenwich Hill more than matched his predecessor's Uraniborg for the accuracy of its instruments, Flamsteed had no private printing house. For him, the consequences were to prove calamitous.

In England, there was no noble Tycho Brahe able to boast his own autonomous printing operation. There was no way in which the production of learned books could be taken out of commercial hands. Philosophers could not hope to emulate Tycho's success—partial and compromised though even that success was—because they had to live and work in an environment of city and court in juxtaposition. They had to reconcile civility with commerce. They had to utter their wisdom in the streets of London, where its reception would be far from secure. The first thing to appreciate about the articulation and reception of natural knowledge in early modern England is its insecurity. The achievements of the Royal Society were consequently but one element in a continuing history of attempts to discipline print and render it a sound platform for building a godly nation. That history included the development of vital and lasting new concepts of authorship, publication, and reading.

A series of proposals for the reform of knowledge and its circulation grappled with this situation. Most influential were the ambitious schemes put forward by James I's lord chancellor, Sir Francis Bacon. Bacon's identification of a trinity of transforming inventions—compass, gunpowder, and press—is, of course, famous. It is often assumed from this proclamation that Bacon recommended the open printing and publication of knowledge to aid in its advancement. Yet this is a misapprehension. Bacon in fact represented the printing press as a prime example of how inventions should *not* be sought. He believed that there was "nothing in the art of printing which is not plain and obvious." Speaking to Queen Elizabeth through the personified figure of Natural Philosophy, he called the press "a gross invention," which had been not so much invented as "stumbled upon and lighted on by chaunce."[82] And he certainly did not recommend unrestricted publication of knowledge, urging rather its retention within a tiny community of

82. Martin, "'Knowledge Is Power,'" 97–103; Martin, *Francis Bacon*, 64–8; Bacon, *Works*, IV, 100, 113–5. However, in the *New Atlantis* the (anonymous) inventor of printing did merit a statue in the gallery of inventors: ibid., III, 165–6.

royal licentiates. Both opinions derived from his view of the purpose and organization of knowledge. Bacon aimed to make natural philosophy a sector of the state. Regarding himself primarily as a statesman and royal counselor, he wished to establish an administrative mechanism for generating natural knowledge that would best serve the advancement of the crown. The best natural philosopher, in this vision, would be the best state official. His greatest targets in proposing this scheme were thus what he called "voluntaries": individuals who claimed a right to profess knowledge independent of the state's bureaucracy.[83] In order to eradicate such dangerous knowledge-peddlers, it would be necessary to "purge the floors of men's understandings," and to replace their independent notions with rigid, unified rules of operation. "The business," he decreed, "must be done as if by machinery." The press was the exception that proved this rather daunting rule. It was a device discovered by chance, and by disorganized artisans. Yet it had prospered, and the commonwealth had profited by its success.

Or had it? True, there were many new books to be read; but this did not mean that they conveyed any more genuine knowledge. Bacon urged that his bureaucracy create new editions of classic authors, "with more correct impressions, more faithful translations, more profitable glosses, more diligent annotations," the implication being that the creations of the press were at present profoundly *un*satisfactory. Besides, open printing encouraged dangerous ambitions. Bacon therefore insisted that his own proposals be known only to "some fit and selected minds," and that the knowledge produced by his state machinery be similarly guarded. In the *New Atlantis,* his grand vision of a political state founded on natural knowledge, the personnel of Solomon's House were required to take an oath of secrecy. Only three selected individuals were allowed to be "Interpreters of Nature." The governors would authorize only approved conclusions to be made public on their periodic "circuits." And the deep knowledge on which their useful promulgations were based would never be revealed at all.[84]

A problem of authorship thus coincided with that of knowledge. In Bacon's era, ambitious treatises of natural knowledge were being written by an unprecedented multiplicity of writers: not only royal counselors, but lawyers (like Bacon himself, and later Sir Matthew Hale), mathematical practitioners (like Robert Recorde, Sir Henry Billingsley, Robert Norman, and Thomas Digges), university scholars (like Nathaniel Carpenter and John Wallis), churchmen (like John Wilkins and Seth Ward), and physicians (like William Harvey, William Gilbert, and Robert Fludd). Soon women like Margaret Cavendish would be added to their number. What was their claim

83. Martin, *Francis Bacon*, 56–63, 121–6, 150, 163, 173.

84. Bacon, *Works*, III, 165–6, 323–5; Martin, *Francis Bacon*, 149–51, 163–4. Contrast the portrayal in Elsky, *Authorizing Words*, 200–4.

to legitimacy in so acting? How were their arguments properly to be resolved? Ironically, all claimed to offer unity and an end to the discord inspired by the very proliferation of voluntaries in which they themselves participated. Even natural magicians, conventionally identified as the worst of voluntaries, tried to establish their credentials as bringers of order by waxing indignant at the "cavilling, brabling" and seditious scholastics.[85] Whether expressed as ridicule or hostility, opposition to illegitimate authorship became a pervasive feature of English writing on the natural world.

Bacon's was a forthright statement of one ideal for the determination of disputes in natural knowledge. It effectively envisaged an English social equivalent of Uraniborg. All practitioners must be licensed by court officers, resolution of arguments must be centralized and decisive, word of the debates must be restricted to the central legislators, and there must be no publication to the populace without central approval. Printing, dispersal, and reading of books were to be monitored by a privileged élite according to its civil conventions. For a Jacobean counselor it was a tempting prospect. And it would be repeated in various forms by successive systematizers later in the century. Gabriel Plattes's proposed state "Laboratory," for example, would admit only someone prepared to stay inside "till he be brought forth to go to the Church to be buried." Even this seemed mild compared to Macaria, where anyone dispersing unlicensed opinion would, quite simply, be executed.[86]

But although Tychonic isolation was tempting, it was not achievable. Courtly aspirations notwithstanding, in England there would always be other printers, booksellers, writers, and readers at work. The fact was that book dispersal did not operate entirely through diplomatic and courtly channels. There was a national and international book trade, and before long even books directed at restricted audiences—including, as already observed, both Tycho's and Galileo's—participated in it. Courts were continuously being reminded of the unpredictability (and worse) that could result, and again England's was no exception. If the propriety of disputes was that of the court—or, for that matter, the university—then the very involvement of the book trade introduced an important new element. It was not necessarily disastrous; Galileo, after all, embraced this realm for a while with

85. For a particularly insistent example see Fludd, *Mosaicall Philosophy*. Fludd raised the denial of controversy into an ontological principle, insisting that all apparent contrariety in the natural world must be referred to the undivided action of God; the quarrels of scholastics, he thought, corresponded to their idolatrous respect for natural oppositions such as antipathies.

86. Plattes, "Caveat for Alchymists," 87; [Plattes], *Description of the famous Kingdome of Macaria*, sig. B2^r (contrast the misleading impression given in Eisenstein, *Printing Press*, 305, which is often repeated by historians). Winstanley made preaching for hire one of the few capital offenses in an ideal society: Hill, *Turbulent, Seditious and Factious People*, 338.