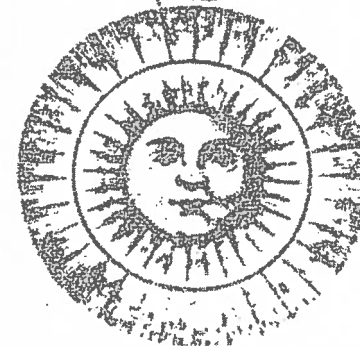


Men, Women, and the Birthing of
Modern Science

Edited by Judith P. Zinsser



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Women and Science in the Sixteenth and Seventeenth Centuries

*Different Social Practices, Different Textualities,
and Different Kinds of Science*

The impetus for this essay came from recognizing that men and women practised science in the same places and with roughly the same equipment up until the middle of the seventeenth century. However, they practised science for different reasons, leading them to communicate in different ways, and these different rhetorics have had a long-term impact on access to scientific power and to the legitimation of particular methodologies and of various kinds of scientific knowledge. The focus of this essay is on the modes of communication used by women for sharing and preserving knowledge, and the impact that these modes had on the kind of knowing and the kind of science in which they engaged. Their practices ran parallel to those of modern science and suggest ways of engaging with the natural world that were not recognised by the scientific community at the time, and which we still have difficulty valuing.

One significant, but taken for granted, aspect is that women were not, with rare exceptions, involved in generating "natural philosophy" in the eras before the fifteenth century. Natural philosophy was primarily communicated through oral disputation with formal rhetorical rules, accompanied by some manuscript circulation and commentary. The rhetoric of women's communication about interaction with the physical world, which pertained directly to their responsibilities for domestic medicine and household technology, may have been oral, but there is no record of formal disputation or their education in it. When men of the seventeenth century brought together scientific debate

with practical experiment, it is arguable that natural philosophy gave way to science and philosophy as distinct areas of knowledge. At this time, the growing number of educated women could have introduced a written rhetoric more appropriate to their own practice. However, they did not, and the trajectory of this essay attempts to understand why.

One primary question is: why with so many women having a considerable reputation for the practice of experiment, and with so many of them closely associated with the men who formed the Royal Society, were they then excluded from meetings and communications? The simple fact is that, for example, one of its predecessors, the Hartlib circle,¹ included many women who corresponded with others, both men and women, about medical remedies, agriculture, botany, chemistry, and pharmacy. It was undoubtedly the case that some women were accorded more respect than others. In the early years of the circle, Joan Barrington predominated, in the 1640s it was Dorothy Moore, and in the 1650s it was Katherine Boyle.² Their participation was marked by manuscript culture, and the cessation of Hartlib's copyhouse in 1660 may distort the actual events. Nevertheless, that so many men of the circle and their close associates went on into the Royal Society, which excluded these women, must have changed the way in which women in general were perceived and in which they perceived their own contributions.

From my own close research activities alone³ we find that Katherine Boyle (married name Katherine Jones, Lady Ranelagh) probably knew most of the membership but was particularly close to her brother Robert Boyle, to Richard Jones, to John Beale, and to Thomas Willis. She and her brother lived in the same house in London in their latter years, a house which held his laboratory.⁴ Her associate and friend Dorothy Moore (born Dorothy King, later to become Dorothy Dury)⁵ corresponded with William Petty, John Pell, Henry Oldenburg, and John Clotworthy. Alethea Talbot (who later became the Countess of Arundell and Surrey) had worked with many, including Elias Ashmole, and was the mother of Henry Howard. Her sisters Mary and Elizabeth, with their friend Anne Clifford, had had close connections with Gilbert Talbot, John Aubrey, and William Cavendish. And of course there are many more connections,⁶ including the mother/son link between Joan and Thomas Barrington⁷ and the husband/wife relationship of Mary and John Evelyn.⁸ Many of these women were not only in the Hartlib circle⁹ but were also associated with the group at Wadham College, Oxford,¹⁰ and peripherally, through Kenelm Digby, with Gresham College.¹¹

The women who were being praised for their scientific judgement until the end of the 1650s by the very men who established the Society may have been excluded because of a need to define gender characteristics in a different way. After all, the seventeenth century in England saw the construction of the domestic housewife, that radically new imagined entity, the unpaid shadow necessary to a middle-class way of life. It would have

been difficult to differentiate between the abilities of women and men on theological grounds, and in most cases the aristocratic titles of these women would have made it impossible on the grounds of status. I would like to suggest that the reason women were excluded from the Royal Society was largely because of their social practice of science, which was tied to a local community.

While most of the evidence for the argument that follows is drawn from the written and manuscript material left by gentlewomen and noblewomen, I would argue that their common basis in communal activity provides grounds for a reasonable hypothesis that other women in the community were practising science in the same way. Curiously, it may also be the case that the need to redefine gender derived from an urge to democratise. Because the new practices and the rhetoric used by men of the Royal Society legitimated their social practice as part of the new proto-liberal social contract, the product of the Civil War and the events surrounding the coronation of William and Mary in 1688, the social practice of science by women was placed outside England's new definition of the democratic citizen and the practices associated with it.

Rhetorical Elements in the Practice of Science for the Men of the Royal Society

The practice of science for men in the Royal Society came to be defined by two primary rhetorical elements that distinguished it from the practice of science by men preceding the Royal Society. First, in the Society itself and in its published *Transactions*, scientific practice consisted of a public display of intervention into nature, by way of visual demonstration and written representation of that intervention or experiment, so that it could be repeated.¹² In this, Royal Society practice appears at first sight not much different from the social practice of scholastic and early Humanist *scientia naturae*, which worked from supposition, through demonstration, in the oral rhetoric of disputation. Yet despite the similarities supposition is not analogous to hypothesis. Neither is the Aristotelian demonstration derived from the *Posterior Analytics* analogous to visual demonstration.¹³ Nor is the oral rhetoric of disputation analogous to written representation. However, the fundamental difference is that for a medieval world, interventions into nature were correspondent rather than actual. The medieval scientist was interpreting God's structure, which was unfathomable. Even Aquinas never went beyond the doctrine of suppositional necessity and probability. In contrast, the Royal Society scientists were dealing with the possibility of actual intervention, from which ultimately would be derived the certainty and universalism of modern science.¹⁴ Where the two kinds of scientific practice were similar is in their social structure, especially in terms of the self-contained, end-directed rhetoric of club culture fostered by each.¹⁵

The second element defining the rhetoric of Royal Society practice came from that specific intervention in the actual. This was carried out initially in laboratories, but more often at home in kitchens and stillrooms—places quite private compared to the end result of public demonstration. In this, Royal Society practice was again similar to the earlier practices of artisans and tradespeople working on “secrets,” which were also intensely private even if always without public demonstration, to avoid intellectual theft.¹⁶ But the fundamental difference between the practice of these earlier experimenters and that of the early modern scientist, was the need to link private experiment with public discussion: to link the intervention in the actual with public display of that intervention in visual demonstration and written representation.

Why was there this importance to link the private practice of intervention with public display and discussion? Largely, I suggest, because the men involved saw a need, theological, political, and ethical, for greater access to the “secrets” of nature. But as this paper will go on to explore, women practising science had already developed a procedure for exchanging information about scientific knowledge, so why did the men not follow their specific mode of communication? Part of the answer is that men in the Royal Society were differently organised than women and needed different rhetorical structures for communication. There were more of them who perceived themselves to be part of a community, and that community was not local, but regional, national, and international. Also, the men often wished to exchange information across larger geographical space; hence, they needed to write rather than develop knowledge by speaking to each other or by tacit observation. They perceived themselves, consciously or not, as class and gender unified, part of a much larger movement toward the unification of a particular class and a specific gender that was becoming represented in politics. The structure of communication in their modern science displayed the structure of the universal man/private citizen dichotomy made necessary by the evolving liberal social contract: representation had to be stable and repeatable to make the representative democracy of post-Hobbesian politics work,¹⁷ just as it has to be stable and repeatable to make the experiment replicable. In other words greater access to the secrets of nature, for the men of the Royal Society, was a democratic necessity. Early modern science responded to this growing need for access, to a larger public, and to making knowledge public. And it answered that necessity by developing strategies that became simultaneously appropriate to political representation in the proto-liberal social contract.¹⁸

The Social Practice of Science by Women

So in what sense was the social practice of science different for women? To understand some of this detail I need to look back into the sixteenth century, over 150 years marked out by the dates 1534, 1617, and 1649. Un-

til the early sixteenth century women had been involved in the commercial practice and use of science, although this became increasingly difficult with the controls levied by guilds over trade¹⁹ and by the Church over medicine in the late fifteenth century.²⁰ One large body of practice was in nunneries, which frequently had to engage in a self-sufficient scientific technology. Nuns, along with many women, practised medicine on Biblical authority, working in hospitals and almshouses with the signal role of touching the bodies of their patients, because physicians did not. Even women of the gentry and nobility were associated with hospitals, although more usually as patrons.²¹ But also, all women had to practise some form of science daily, from the preservation of food to the production of cleaning agents and the maintenance of healthcare for people and animals, and there were many other practices which would now be called chemical technology. Women of the gentry and nobility had to oversee these practices if not perform them themselves:²² we find this attested to in account books²³ but also implied by the architectural arrangement of the late-medieval house in which mistresses, masters, and their household members lived closely alongside each other, around the great hall.²⁴ Most of this practice was habitual technical performance, but from manuscripts we learn that several women at least engaged with and responded to changes in the environment, for example, learning how to deal with smallpox coming into England in the late fifteenth century. Although women did work with the commercial secrets of the artisan world, they had a much larger commitment to communal information—this kind of science being one of the primary modes for women to participate in “service” or public action in society.

The year 1534 marked the beginning of the dissolution of the Roman Catholic Church in England. A number of historians have linked the growing power of the Royal College of Physicians (incorporated in 1518) and the attendant difficulties for the poor to receive or obtain medical attention to the rescinding of the Quacks Charter in 1542–44. At the same time there was a sharp increase in the number of vernacular books on medicine addressed to yeomen and to the gentry from the 1530s onward—many of these with phrases such as “for the common good” or with references to the “commonweal(th)” embedded in the titles or addresses to the reader.²⁵ As important, if not more so, was the effect of the dissolution on the hospitals and almshouses run by the Church all over England, which had been particularly key to rural areas.²⁶ From the little research there is in the field come examples such as St. Leonard’s in York, a huge hospital which was simply closed; St. Giles’ in Beverley, to which the Earl of Rutland acquired patronage before abolishing;²⁷ and St. John’s in Exeter, which was given in 1540 to Thomas Carew, who promptly turned it into a private dwelling.²⁸ Presumably because most of the evidence was burned when substantial buildings like Fountains Abbey were gutted, there is little paper evidence of the role of the monasteries and nunneries in interaction with local communities. However, I would hypothesise partly from the extensive trade that

we know went on between the religious and lay communities, and partly from the tensions that resulted from the dissolution, that the religious houses had a substantial social role in their region, which probably included medical care and the provision of items of chemical technology either in practice or through patronage.

The dissolution also meant the redistribution of grounds and buildings into the hands of the new gentry and the new nobility: this in itself being one of the reasons for the plethora of books which acted as guides to behaviour when one became responsible to, or for, a community of people dependent on the lands. The main result of redistribution was the formation of the English country house phenomenon: the gentry and nobility decamped to the country house from the London court at various times during the year. The English country house operated a green, self-sufficient economy, often directly maintaining over one hundred to three hundred people and indirectly many more. They were large-scale businesses for the period. I would again hypothesise that some of these estates may have replaced the functions of the monasteries and nunneries in terms of health-care and the provision of other household and agricultural products. While that is an hypothesis, we do know that from 1530 to 1580-90 a generation of gentlewomen and noblewomen became increasingly recognised for their skill in preparation of many household and medicinal chemicals and pharmaceuticals: Honor Lady Lisle;²⁹ the Cooke sisters, daughters of the tutor to Edward VI and Elizabeth, one of whom, Mildred, married Thomas Cecil, becoming the Countess of Essex, whose household was described as a "domestic university";³⁰ and Ann Dacre, the wife of Thomas Howard, Duke of Norfolk and Surrey, whose son Thomas married Alethea Talbot and whose grandson Henry became a member of the Royal Society.³¹

The work of these women is relatively well known; what I would like to stress here is the communal element of their work, the way they integrate it into service for their household and local area. And there is evidence of a class continuum of this kind of science practice, including not only the nobility but also the gentry and the emerging middle-class housewife. Thomas Tusser's *100 Pointes of Good Huswifery* (1557), dedicated to Lady Elizabeth Paget, stresses the need for any housewife to know how to carry out basic preparations, especially of herbs,³² and to do surgery.³³

By the end of the sixteenth century, there were many women practising science and medicine, but the practice had diversified. No longer was it only from necessity or from service, but it had developed into a leisure activity. The women of the gentry and aristocracy practising between 1590 and 1649 include the relatively well-researched Ann Clifford, Margaret Hoby, Grace Mildmay, Alethea Howard and Elizabeth Grey (the Talbot sisters, whose third sister, Mary, was married to William Cavendish), Margaret Duchess of Cumberland, Joan Barrington, Brilliana Harley, and Queen Henrietta Maria, as well as many others.³⁴ Some practised only for

what was needed for their families; others like Grace Mildmay produced on a commercial scale. They may have practised, as Hoby and possibly Mildmay and Barrington did, not only as a leisure activity but as religious and communal service.

Or they may have taken up practising as one of the indications of the status of noblewoman, as the distinctly short-lived nobility of the Talbot sisters' family may have decreed. Science, medicine, and chemical technology, including the use of new foodstuffs such as sugar—a notoriously difficult substance with which to experiment—seem to have become by the end of the sixteenth century markers of status. John Partridge's *The Widdowes Treasure* (1585) addresses the reader, saying that this kind of information is necessary to a particular kind of woman. They need to know how to perform these tasks in order to behave appropriately. In other words, the practices are a signal of conduct. There is evidence for a number of related books in the period having been written by women but midwived by men,³⁵ and books in these fields are clearly one of the most important genres for printing and publishing directed at women readers.

Increasingly, the idea of service as a responsibility of the aristocratic lady became redundant as the nobility crystallised in the reign of James I. Aristocratic households began to design and live in buildings that separated them physically from their retainers, who became "servants" rather than household members. Science began to be practised not only in the kitchen but also in the laboratory. For example, Mary Sidney (Mary Herbert) had her own laboratory, which was used by her brother Phillip and by William Cavendish, but there is little evidence that she was tending to a larger community. The development may partly be due to a shift to an urban environment in which these women did not have a distinct community.³⁶ It also may be partly a response by an increasingly leisured class to the question of what to do with their time. There may be an analogy between the circles of reading that developed among privileged women³⁷ and the groups of women experimenting (whose works are attested to by the attributions of recipes in manuscript writings).³⁸

It is also quite possible that the practice of science was a permissible mode of intellectual interaction and of interaction with men since nearly all these women worked with men. Ann Dacre and Mrs. Dyce worked with Dr. Martin of Kornbeck (doctor to Henry VIII); Mary Sidney with her apothecary, Adrian Gilbert, and with Thomas Mouffet;³⁹ Elizabeth Grey with several people (according to Aubrey); Alethea Howard with individuals both at home and abroad as she found people with similar interests; Mildmay with her local doctor and apothecary; Barrington with Hartlib; and Henrietta Maria with Kenelm Digby and Thomas Mayerne. If one looks at Gerard's *Herball* or at any number of extant manuscripts, men and women working together seems to have been common practice among the gentry and yeomanry as well.⁴⁰ But the signal characteristic of these partnerships is the relative lack of aristocratic men.⁴¹

In 1617 a significant event took place. The Royal College of Physicians gained control of the *Pharmacopoeia Londoniensis*, the publication of the recipes used by the newly incorporated Society of Apothecaries. The control of the Apothecaries by the Physicians had begun in a slightly earlier period,⁴² but 1616–17 was the first time that one finds warnings to women not to overstep their mark in books related to these areas,⁴³ and from 1617 to 1653 only one new book for women was published that was concerned with household science.⁴⁴ Furthermore, whereas in the earlier period we can often plot an interest in science from parent, especially mother, to daughter, we do not hear about the practice of the daughters of any of these women. It is probably significant that the women closest to the future members of the Royal Society in the 1640s and 1650s, Katherine Boyle and Dorothy Moore, were both from Ireland. Another hypothesis I would offer is that women in Ireland continued to be educated as their mothers had been a generation earlier, even though the fashion may have died out in England. Not only Katherine but also her sisters Mary and Lettice wrote and practised in the various areas of science, medicine, and household technology.⁴⁵ Dorothy Moore's sister Margaret Lowther was considered immensely learned, and her correspondents Margaret Clotworthy, Elizabeth Carey, and Ann Stanhope seemed to have had similar intellectual interests.

Not until after 1649 does this unofficial but effective prohibition on books for and/or by women cease, and I would suggest that the significant event was Nicholas Culpeper's English translation of the *Pharmacopoeia*. As the historian Jonathan Sanderson has demonstrated, Culpeper's translation broke the monopoly of the Royal College of Physicians and put herbal and medicinal knowledge back out into the public for the "common good" and for commercial profit.⁴⁶ Swiftly following its publication, a torrent of related books were published, including Alethea Howard's *Natura Exenterata* (1655), Elizabeth Grey's *A Choice Manual* (1653), and "Henrietta Maria's" *Queen's Closet Opened* (1655), the latter two going on to become best sellers. Among the first English-language books interested in science, technology, and medicine published under women's names in England, these aristocratic titles opened a door, and many more women of the gentry and the emerging middle class such as Hannah Wolley soon entered the space—and not only women but also men of the middle class. Again, men of the aristocracy were significantly absent until the publication of the *Transactions of the Royal Society*. The close control of the Royal College of Physicians over women's access to knowledge may be one of the factors involved in the exclusion of women from the Royal Society, since 60 percent of the College was elected to the Society between 1663 and 1670.⁴⁷

How did these women from the sixteenth and seventeenth centuries practise science? Like men, they practised in kitchens, stillrooms, and very occasionally laboratories. But unlike men, they worked directly with and

for people in their households and local communities. It is a pointed comment that Alethea Howard's book is subtitled *Nature embowelled/ By the most/ Exquisite Anatomisers of Her*, an explicit reference to surgery and the use of one's hands. Andrew Boorde notes in his *Breviary* (1547) that physicians needed astronomy, geometry, and logic for their distinctly hands-off analysis and diagnosis and were expected to talk to their patients but not to touch them. In contrast, a surgeon "need[s] to know the complexion of his patient, and to consider the age, the weakness, and strength, and diligently to consider if the sickness, sore or impedymment, be perticular by himselfe: or els that it have any other infyrmyte concurrent with it."⁴⁸ A surgeon therefore cannot treat that person in the abstract and has to get his hands dirty. Just so, women were expected to practise surgery and therefore to work with their hands and not their eyes alone.⁴⁹ But more important, a surgeon needed to know something about the context of the patient; he, as many of the women discussed above, dealt with the community and the environment out of which an individual came. This was and is a more complex, indeterminate, and rather messy business than that of the distant physician.

In contrast to the men of the Royal Society, the women also worked in specific communal locations: either their family environment, their community, within the confines of the English country house, or among groups of practitioners. They communicated possibly by way of circles of friends, and probably by way of visitors and visits they themselves made. The types of rhetoric appropriate to circles of friends, visitors, extended families, and larger communities generated the communication of and access to a free flow of knowledge documented by the attributions in the many surviving manuscripts, and in some of the printed publications. Communication was also necessary for the testing of suppositions and hypotheses.

The manuscripts of women from the 1530s to 1660 are marked by an increasing awareness of Paracelsian science, with its attendant focus on hypothesis and experiment—Mary Sidney's patronage of the Paracelsian Thomas Mouffet at a time when Paracelsian experiment was not yet widely accepted is interesting to note. But women's manuscripts also consistently combine this awareness of more experimental and hypothetical approaches with a continuance of Galenic attention to the human body as a holistic system and a concentration on the humours theory that preceded physiology. The signal difference between the two methodologies in terms of medicine is that the Galenic assumed that any one patient will need a specific and different treatment from another, while the Paracelsian assumed that one disease will have a remedy common to all people. Women's manuscripts contain evidence of both approaches.

Partridge's *The Widdowes Treasure* lists the remedy "To cause one to pisse" as "approved" and "A precious ointment" is "probatum est"; and many recipes are followed by "It is approved."⁵⁰ This Paracelsian testing of general remedies within a book that offered the Galenic strategy of many

individual remedies for one illness so that different contexts could be covered was typical. The historian Linda Pollock notes that Mildmay's listing of different cures by context—old, women, young, wounded, etc.—is an explicit attempt at Paracelsian analysis.⁵¹ Howard's *Natura Exenterata* is even more obvious. It offered different cures for a range of ailments, and a whole section of the book was devoted specifically to Paracelsian experiments. The "Address to the Reader" commented that "Method, tis true, may rectifie and informe the reasonable faculty in man, yet be of very little assistance in accidents, whose uncouth causes are not lyable to Rule. . . . They who *do* (though emperically) are to be preferred before those who dispute and talk."⁵² In the accounts of remedies, one finds clear notes joining context-specific remark with acknowledgement of "proof": "a Fistula, Canker, or other old soar, which healed the old festered fistula in the brest of Mr Tho. Wood curate of Newington in his dayes. Probatum est," or "Approved . . . by the Lady Capel. 1646," or "proved by her that distilleth the sweets waters at Hampton Court," the last example being doubly important for its implication that women were employed to carry out chemical technology.⁵³ The Galenic approach to the whole body still anchored the growing Paracelsian experimental understanding of these manuscripts and books in the community. It is interesting that just as the earlier vernacular books explicitly aimed to help the commonweal(th), men writing in this way in the seventeenth century often intended their work also for the common good.⁵⁴

Because these women worked in communal locations, the notion of testing favoured by modern scientists as replicable visual display was not relevant. And because their communication was primarily either oral or tacit, and by informal apprenticeship and observation, there was little need for the formal rhetorical strategies of written proof. The early practice of women differed from that of artisans also working with tacit knowledge and the oral because of its communal location and its noncommercial application. But there were changes as well. By the middle of the seventeenth century, women of the gentry and aristocracy increasingly brought an educated perspective that included astronomy, geometry, and logic to their practice, often learned from the men with whom they worked. Dorothy Moore distinguished, in her short tract on the education of girls, between fantastic secrets like conjuring or manipulation, and real scientific experiment, with the implication that you need testable and replicable knowledge as well as technical skill within your communal setting. The women were bringing together the eye and the hand, linking the two in a social practice that was not class unified, nor gender unified, and which was located in small communities. The democratic access they built used a rhetoric of tacit knowledge and the oral, as well as manuscript, and therefore had a need for contingency, responsiveness, and repetition with variation; they imagined their interventions into nature as requiring a knowledge and practice slow to change.

Experiment and Representation

The men who were to form the Royal Society were also bringing together disputation and practice, but for different reasons. In itself the incorporation of experiment into abstract disputation would yield little. What was needed was a different understanding of the textuality necessary to the new science. Much earlier than the Royal Society, others interested in opening up the democratic structures of modern science, such as Copernicus, Bacon, and Galileo, recognised a new rhetoric for scientific writing.⁵⁵ In late sixteenth-century England, the work of Hugh Platt is possibly the best example of someone attempting to bring the practical experiment of the artisan's commercial secrets into the public domain. Many of his books were balancing acts between protected guild knowledge and new inventions that he wanted to draw to the notice of a wide readership. What Platt lacked was a theory that argued that this knowledge could not be individually owned because it resulted from God's work: it was universal. It took Bacon to hammer out an initial rhetorical strategy. He attempted to recast the topical and situated logic of dialectic and rhetoric of the old disputation as illustrative and expressive of scientific procedure and observation. He recognised the orderly quality of the topics, yet also the way they insist on contingency, repetition with variation, and context. Kenelm Digby also recognised this "order within context" in his comments on translating the popular *Secrets* of Albertus Magnus.⁵⁶ Robert Boyle affirmed it throughout his writing.⁵⁷

But there are cognitive problems for the "topics" of classical rhetoric in writing and in print that do not have the same impact on mathematical, syllogistic, or rational logics. The variability and contingency of the topics, such as "quantity" or "degree," bear in a different way on repetition in the oral than in print. In print the relative stability and uniformity of representation does not encourage one to repeat common grounds, or to foreground argumentative premises for different situations. Instead, if you return back over your writing, you do so to check for proofs of earlier premises; so repetition needs to be precise and exactly replicable. To counter this issue in writing as it moves into the duplicating technology of print, a number of results occurred: moving into print culture, one lost the direct relationship between orator and audience. In the written, the reader's immediate response is not to the "character" of the speaker but to the "genre" of the writing, and there was an intense diversification of genre in the sixteenth century. When printed, the marginalian commentary of the manuscript moved partly into the structure of indices and tables of content as well as into the margins of books. Furthermore, the use of manuscript commonplace books, in which writers would collect sayings, examples, and illustrations, and which were often an end in themselves, became instead a highly significant precursor to printed writing.⁵⁸

The topics themselves were gradually delegitimated because they were not reliable enough for maintaining the stable representations ultimately

required by modern science. The classical topics suffered by comparison with the non-contextual, non-social logic of mathematics. They were gradually downgraded by a new education system interested in method but not in social context, because that system was socially enclosed and privileged. At the same time the classical topics were co-opted: the categorical topoi of essence, quantity, quality, time, state, relation, place, and active/passive became internalised as phenomena in the new science. They moved from being contingent to becoming *status causae*, or necessary grounds, and were on their way to becoming essentials. By the middle of the seventeenth century, rhetorical inventions, the loci for argument, became the "laws" of science. For example, Boyle's Law—if the temperature is constant, the pressure of a gas is inversely proportional to the volume—is an invention, a proffered probability, but was turned into a universal and became a second-order textuality of modern science.

The Textuality of Social Practice⁵⁹

The rhetoric found in manuscripts written by women or inscribed for them, such as letters, household recipes, and medical notes, uses the topics as a central device, connecting observation from tacit knowledge with the oral and with the written strategies of the anecdotal and autobiographical, and representing experiment often in diary form: in other words, repeated but contextualised differently by day-to-day change. In addition, most of these manuscripts are collections of recipes from several people. There is no single authorial point of view, but more the kind of editorial voice one might find in a magazine.⁶⁰ Because there was no recognised wider public for women's writing until the 1650s, this writing itself usually perceived no need for print, no need for public replicable visual display, and no need for a change in rhetoric or textuality because of a different medium. It may be significant that the published writings implicitly by women prior to the 1650s were midwived by men, and that the first three books ostensibly written by women in the 1650s were published after their deaths and by men. The women themselves may have written manuscripts, but they saw little need for print. After all, those contributing to the Hartlib circle experienced extraordinarily wide circulation of their ideas just by writing letters, or through people writing letters about their practices. But when the topics were delegitimated as reasonable argument by the new rhetoric of early modern science, so also was the rhetoric of the social practice of science by women in local and situated communities.

If the issue for the evolution of modern science in the Royal Society of the seventeenth century was partly one of adapting written and visual rhetoric into a stable technique suitable for representation, the issue for women practising science was quite different. The social practice of science by English women until the end of the nineteenth century, and indeed up until the domestic technology revolution of the mid-twentieth century,

was delineated by a range of factors: an ongoing tradition of apprenticeship, communal practice, oral communication, and manuscript record, along with exclusion from a wide public; the denial of access to a more expansive intellectual collaboration; their discouragement from education; and the singular fact that they were not considered citizens even in the world preceding the seventeenth-century social contract and therefore were not included in the new political structure and had no rights to "universal" knowledge. The attempt to reenter formal scientific practice in the nineteenth century was marked in England by a not surprising recasting of household work as "domestic science," but became a dismal failure in its effort to use the encoding textuality of modern science to represent the remnants of communal practice.

Perhaps we should argue that the textuality used by women for their social practice of science was entirely appropriate; we just need to understand what it implied. When Alethea Talbot's *Natura Exenterata* (1655) says that it will offer the "Recreation of Employment" rather than the "Representation of Experiment," we need to learn how to read the structure of the book to appreciate the subtle differences between "re-creation" and "re-presentation"—one of which is that nothing is re-created in the same way, while the purpose of re-presentation is to allow for exact replication of the experiment. Another difference is that re-creation combines the idea of doing with the action of the words, while re-presentation is always an acknowledgeably inadequate mode of expressing the experiment's interaction with the natural world. But another way of looking at this is to argue that women missed their chance, or were deprived of its opportunity, to produce a textuality more appropriate to the social practice of science in a modern world in which social relations were significantly different from those in the late medieval and early modern periods.

Most twenty-first-century scientists recognise that the textuality they work with is inadequate. It is taken as given that words cannot exactly convey the intervention into nature; they can only describe the experiment so that it is replicable, allowing the people repeating to experience the same intervention when they do the experiment. In comparison, communication of technological procedure and information is not attended by these doubts; representation is a necessary matter of accuracy and replicability rather than any attempt to provide the "reality" of nature which science attempts to offer. One of the reasons why writers such as Mary Sidney or Margaret Cavendish, who were not considered "proper scientists," are profoundly interesting to the history of science is because they understood that the textuality of modern science as it evolved is inappropriate to what it is really doing, which is engaging with the physical world rather than representing the experiment. One can argue that each of these women tried to find a more appropriate "re-creational" form for modern science's engagement with nature, but neither attempted to write in a generic form appropriate to the social practice of science. Cavendish was openly aware of

the issue, saying, "The truth is, I have somewhat Err'd from good Huswifry, to write Nature's Philosophy, where, had I been prudent, I should have Translated Natural Philosophy into good Huswifry."⁶¹

Were the social scientific practice of women to be described, far more would be needed to convey the contingencies and variability dependent on social context. And the end would not be replication but varied repetition in a social context. The process would also take more time than the schedules of modern science allow. We still do not have a textuality appropriate to this communication, a textuality that recognises and communicates situated knowledge in science, that is inclusive of a wider public, and that is democratic. This is, of course, the fundamental basis of the feminist critique of the social practice of science and has been ongoing since the seventeenth century.

Footnote: Another Hypothesis

It seems to me significant that in the throws of the revolution of domestic technology in mid-twentieth-century Britain there was a radical textual shift in writing about one of the areas of women's work in the home: food and cookery. Although there had been earlier examples, works by writers such as Elizabeth David, Jane Grigson, and Alan Davidson introduced the postwar British public at the least to a whole new way of thinking about food and nutrition. They did so not by simply informing people of new products or offering different recipes but by constructing innumerable contexts of possibility for individual readers. Davidson's trilogy of books on fish⁶² combines anatomical classification with detailed line drawings and commentary on habitat, all appropriate to a "scientific" book on biology or physiology. At the same time it also contextualises the writer's life and the procedures of his writing and offers a variety of recipes directly connected to the commentary on habitat. Reading such writing is slow work; it asks for commitment. It does not promise replication of an eating experience, because one cannot replicate the habitat. Its knowledge is openly partial, is sensitive to the environment, and invites readers to engage on their own terms. Generically unique, the trilogy offers a far more daringly scientific work than quasi-novelistic accounts by scientists trying to provide context by way of fiction. The signal difference is that writers like Davidson, Grigson, and David, although they became household names, were taking on the writer's risk that honours textuality, knowing that the work may not find a readership, whereas scientists today cannot afford to take that risk and are bound by their contracts to a particular kind of representation that can only become more and more inadequate.⁶³

Notes

1. Samuel Hartlib began to invite correspondence from scholars, writers, philosophers, scientists, travellers, and others from the early 1630s to 1660. He established a scriptorium which copied letters from one individual out to many others and on receiving the replies also copied these back to interested readers. For more background on

the Hartlib papers, see Mark Greengrass, Michael Leslie, and Timothy Raylor, eds., *Samuel Hartlib and Universal Reformation: Studies in Intellectual Communication* (Cambridge: Cambridge University Press, 1994).

2. Boyle's manuscript book of recipes (British Library, Sloane, 1367) has attributions to Barrington, and Hartlib's "Ephemera" has numerous citations to recipes by Barrington, Moore (both as Moore and Dury), and Boyle (as Lady Ranelagh).

3. L. Hunter, "Sisters of the Royal Society: The Circle of Katherine Jones, Lady Ranelagh," in *Women, Science and Medicine, 1500–1700: Mothers and Sisters of the Royal Society*, ed. L. Hunter and S. Hutton (Stroud: Sutton, 1997), 178–97.

4. See R. Maddison, *The Life of the Honourable Robert Boyle* (London: Taylor and Francis, 1969), for a description of Katherine's household.

5. For more information on Dorothy Moore, see L. Hunter, ed., *The Letters of Dorothy Moore* (Aldershot, UK: Ashgate, 2004).

6. See for example, J. Loftis, ed., *The Memoirs of Anne, Lady Halkett and Ann, Lady Fanshawe* (Oxford: Clarendon Press, 1979), 109.

7. A. Searle, ed., *Barrington Family Letters 1628–1632* (London: Office of the Royal Historiographical Society, 1983); the MSS are in the Essex Record Office, D/DBa T40 1/2.

8. F. Harris, "Living in the Neighbourhood of Science: Mary Evelyn, Margaret Cavendish and the Greshamites," in Hunter and Hutton, *Women*, 198–217.

9. Samuel Hartlib, whose papers reside with Sheffield University, for his copying bureau included women's writing, particularly that of Dorothy Moore. These are cited frequently in Hartlib's own notes, his "Ephemera."

10. See Hunter, "Sisters of the Royal Society," 186.

11. The Gresham connection is important since many of the professors went on to become part of the Royal Society, but Gresham College insisted that its professors be single and male, only electing the first female professor in 1996.

12. S. Shapin argues that this occurred because of a need to witness and to consider knowledge claims "in a social setting." See "The House of Experiment in Seventeenth-Century England," *Isis* 79 (1988): 375. Yet despite the useful insight that many scientists first practised at home and then transferred their experiment to the Royal Society, Shapin makes no comment on the women involved nor on the different kinds of social setting that might condition the act of witnessing. See also L. Hunter, *Critiques of Knowing: Situated Textuality in Science, Computing and the Arts* (London: Routledge, 1999), and the discussion in chapter five of repetition as second order textuality.

13. For a useful discussion, see P. Dear, "Narratives, Anecdotes, and Experiments: Turning Experience into Science in the Seventeenth Century," in *The Literary Structure of Scientific Argument: Historical Studies*, ed. P. Dear (Philadelphia: University of Pennsylvania Press, 1991).

14. Of course this is a gradual process toward universals, and the earlier outlook is retained by members of the Royal Society for many years. B. Shapiro argues that Robert Boyle, for example, linked his theory of hypothesis to "man's inability to penetrate the essence of things." See her *Probability and Certainty in Seventeenth-Century England: A Study of the Relationships Between Natural Science, Religion, History, Law, and Literature* (Princeton, NJ: Princeton University Press, 1983), 53.

15. For a discussion of the way universals "implies a co-ordination of particular experiences," see the introduction to D. Gooding, T. Pinch, and S. Schaffer, eds., *The Uses of Experiment: Studies in the Natural Sciences* (Cambridge: Cambridge University Press, 1989), xiv.

16. For detail on books of secrets, see W. Eamon, *Science and the Secrets of Nature: Books of Secrets in Medieval and Early Modern Culture* (Princeton: Princeton University Press, 1994).

17. See Hunter, *Critiques of Knowing*, especially chapter four.

18. As above, see chapter five on the evolution of the liberal social contract. See

also the now classic Carole Pateman, *The Sexual Contract* (Stanford, CA: Stanford University Press, 1988).

19. R. Warnicke, *Women of the English Renaissance and Reformation* (Westport, CT: Greenwood Press, 1983), notes that women were increasingly excluded from guild work from 1450 onward.

20. C. Rawcliffe, *Medicine and Society in Later Medieval England* (Stroud: Sutton, 1995), 186.

21. For example, Lady Anne Butler, the patron of a leper house in Torrington; see N. Orme and M. Webster, *The English Hospital 1070–1570* (London: Yale University Press, 1995).

22. Rawcliffe notes the references to women giving better treatment at home than doctors, referring to the Paston Letters, vol. 1, 218, 291, 628.

23. N. Penny, ed., *Household Account Book of Sarah Fell of Swarthmoor Hall* (Cambridge: Cambridge University Press, 1920).

24. P. Brears and P. Sambrook, *The Country House Kitchen* (Stroud: Sutton, 1998), offers several articles discussing the history of the architecture; see especially the article by Peter Brears.

25. For example, Roger Bacon's book on *Best waters Artyfycialles . . . for the poore sycke* (1530?), the *Treasure of pore men* (1540), and *The glasse of helthe: A great treasure for poore men* (1540). H. Cook, *The Decline of the Old Medical Regime in Stuart London* (London: Cornell University Press, 1986), cites P. Slack's note that there were during this period roughly twenty people for each vernacular medical book in print.

26. Orme and Webster suggest that many hospitals were confused with religious houses and were closed or suppressed in the 1530–45 period; *The English Hospital*.

27. Orme and Webster, *The English Hospital*, 163.

28. See P. Russell, *A History of the Exeter Hospitals, 1170–1948* (Exeter, UK: James Townsend and Sons, 1976), 10.

29. See her treatment for the stone in M. S. Byrne, ed., *The Lisle Letters* (Chicago: University of Chicago Press, 1981), 2:399.

30. D. M. Meads, ed., *Diary of Lady Margaret Hoby, 1599–1605* (Boston: Houghton Mifflin, 1930), attributes this comment to Thomas Bright (255). The Cooke sisters are singled out, alongside royalty such as Elizabeth I and the Princess of Bohemia, as women of wisdom and learning, in Charles Gerbier, *Elogium Hereinum of the Praise of Worthy Women* (London, 1651).

31. L. Hunter, "Women and Domestic Medicine: Lady Experimenters 1570–1620," in Hunter and Hutton, *Women*, 89–107; see also Sister J. Hanlon, "These Be But Women," in *From the Renaissance to the Counter Reformation*, ed. C. H. Carter (New York: Random House, 1965).

32. See Cook, *The Decline of the Old Medical Regime in Stuart London*, who cites F. Poynter, "Patients and Their Ills in Vicary's Time," *Annals of the Royal College of Surgeons* 56 (1975): 142–43; and A. Clark, *The Working Life of Women in the Seventeenth Century* (1919; repr., London: Routledge, 1982), 254–59.

33. W. Harrison, quoted in "The Ladies of Elizabeth's Court," in *Early English Meals and Manners*, ed. F. J. Furnivall (Early English Text Society, OS32, 1868), xc.

34. D. J. H. Clifford, ed., *The Diaries of Lady Ann Clifford* (Stroud: Sutton, 1990); Meads, *Diary of Lady Margaret Hoby*; L. Pollock, *With Faith and Physic: The Life of a Tudor Gentlewoman, Lady Grace Mildmay, 1552–1620* (London: Collins and Brown, 1993). For a hint of Cumberland's activities, see her funeral sermon, British Library, Harl. 6177. See Searle, *Barrington Family Letters*, and the descriptions on 21, 36, 69, 191–92, 230, 232. See T. Taylor, ed., *Letters of the Lady Brilliana Harley* (London: Camden Society, 1853), and comments on 46–47, 53, 128.

35. L. Hunter, "Technical, Domestic and Rhetorical Books, 1557–1695," in *A History of the Book in Britain*, ed. D. F. Mackenzie and J. Barnard (New York: Cambridge University Press, 2003).

36. It was noted as early as John Mirfield's *Breviarium Bartholomei* (1407) that the poor could not depend on the regular life demanded by traditional Galenism that made sensitivity to daily continuity and change a helpful medical factor; F. M. Getz, ed., *Healing and Society in Medieval England* (Madison: University of Wisconsin Press, 1991), xxiii.

37. L. Schleiner, *Tudor and Stuart Women Writers* (Bloomington: Indiana University Press, 1994).

38. For example, see MS 3574 in the Worthing Museum, or the numerous MSS held in the Wellcome Library, such as No 213 Acc3988.

39. A. McLean, *Humanism and the Rise of Science in Tudor England* (London: Heinemann, 1972).

40. J. Gerard, *The Herball or Generall Historie of Plantes* (London, 1596).

41. For example, *Natura Exenterata* lists four noblemen, sixteen doctors, and twenty-nine gentlemen; Wellcome MS 1340 of the Boyle Family, partly in Katherine Boyle's hand, lists two doctors, two gentlemen, three gentlewomen, and seven ladies.

42. John Partridge's address to the reader in *The Treasure of Commodious Conceits* (1584) is dedicated to Richard Wistow, an assistant surgeon, with comments indicating that despite some recipes being "hidden secrets," presumably because of repression from the Physicians, he will reveal them here for the public good.

43. Hunter, "Technical, Domestic and Rhetorical Books."

44. This book is *The Ladies Cabinet Opened* (1639), ostensibly by Lord Ruthven, but possibly by his wife, a good friend of the Talbot sisters and Anne Clifford.

45. Hunter, "Sisters of the Royal Society," 182. See also T. Crofton Crocker, editor of the Earl of Warwick's *Autobiography* (London, 1848). Mary Boyle became Lady Warwick. Elizabeth Walker, the wife of Warwick's Chaplain, was said to be an outstanding female practitioner; D. E. Nagy, *Popular Medicine in Seventeenth-Century England* (Bowling Green, OH: Bowling Green State University Popular Press, 1988). On people using Mary Boyle's stillroom as their "shop for chirurgery and physic," see S. H. Mendelson, *The Mental World of Stuart Women: Three Studies* (Brighton: Harvester, 1987), 99.

46. J. Sanderson, "Nicholas Culpeper and the Book Trade" (PhD diss., University of Leeds, 1999).

47. K. T. Hoppen, *The Common Scientist in the Seventeenth Century: A Study of the Dublin Philosophical Society, 1683–1708* (London: Batsford, 1972).

48. A. Boorde, *The Breviary of Helthe* (1547).

49. A. L. Wyman, "The Surgeoness: The Female Practitioner of Surgery, 1400–1800," *Medical History* 28 (1984): 22–29.

50. John Partridge, *The Widdowes Treasure* (1585), E8; F5; e.g., G7.

51. Pollock also notes that John Hester's *A Joyfull Jewel* (London, 1579) was one of the earliest books to include Paracelsian recipes, and did so alongside remedies deriving from the humours.

52. The "Address to the Reader" is signed "Philiatros."

53. Alethea Talbot Howard, *Natura Exenterata* (1655), 280, 281, 58. Pollock refers us to Wellcome MSS 635, 160 (Ann Brunswick), 363 (Sarah Hughes), and 751 (Elizabeth Sleigh and Felicia Whitfield) for further examples of women integrating the new science with old practice.

54. One example would be John Hester's books, reprinted for many years, for which the 1633 edition of *The Secrets of Physick and Philosophy* (London) claimed to be a necessary contribution to society, without which we see "no comonwealth, no societie to continue long happy" (A5). Kenelm Digby's *Chymical Secrets* (London, 1682) noted that "Tis impious and unchristian to forbear the Publication of those things, which being rendered Publick, well effectually redound to the Advantage and Comfort of miserable Men" (A4), and Robert Boyle's *Medicinal Experiments* (London, 1692–94) provided recipes easily "made serviceable to poor Countrey People." Both these latter books were probably written much earlier in the century.

55. P. Dear argues in "Narratives, Anecdotes, and Experiments" that Boyle used a probabilistic rather than an axiomatic model.

56. K. Digby, *A Treatise of Adhering to God* (London, 1634), A4v; for further commentary, see Hunter, "Sisters of the Royal Society," 191.

57. This is, by the way, one of the reasons why Nicholas Culpeper was also an astrologer, a fact that people today find difficult to understand. Astrology offers a structure for understanding people within a detailed environmental context. Healthcare procedures today take into account when and where you were born, what your family history is, and to what environmental forces your body has been exposed in order to assess present or future risk. Astrology, which is as determinist as genetics (or not), provides an ordered method for presenting all this information. Significantly, Robert Boyle's writing is close to that of his sister, so close that one suspects that effectively they cowrote some texts. For example, the recipe for "Sore Eyes" in her MS Welcome 1340 (Boyle Family) is very similar to Boyle's in his *Medicinal Experiments*, vol. 2 (London, 1693).

58. See A. Blair, "Humanist Methods in Natural Philosophy: The Commonplace Book," *The Journal of the History of Ideas* 53 (1992): 541–51.

59. See Hunter, *Critiques of Knowing*, particularly chapters three, four, and five.

60. The "Address to the Reader" at the start of Alethea Talbot Howard, *Natura Exenterata*, apologises for the recipes being "out of order" because they were contributed by different people, but goes on to say that the publication needed to be hastened for "public good" and that the table at the back is so accurate that it is "as if" the contributions "had been placed in their order."

61. M. Newcastle, *Philosophical and Physical Opinions* (London, 1663), A2v.

62. A. Davidson, *Mediterranean Seafood* (Harmondsworth: Penguin, 1972); *Seafood of South-East Asia* (Singapore: Federal Publications, 1976); *North Atlantic Seafood* (London: Macmillan, 1979).

63. See Hunter, *Critiques of Knowing*, chapter five.

STEPHAN CLUCAS

Joanna Stephens's Medicine and the Experimental Philosophy

In the introduction to their groundbreaking collection of essays *Women, Science and Medicine, 1500–1700*, Lynette Hunter and Sarah Hutton have suggested two main reasons why women have been traditionally excluded from the history of early modern science and medicine. Firstly, they point to the fact that the contributions of women to knowledge in the period often took place in the context of what they call "oeconomics" (i.e., within the "primary economic unit of the family within the local community"), an area which has traditionally been overlooked by historians as a site of serious intellectual and technological endeavour. Despite the fact that the "technology with which they worked became a fundamental part of the emerging experimental methodology" of the natural philosophy of the period, women practising within their communities have been persistently ignored by standard histories of science and medicine.¹

The second reason (closely linked with the aforementioned failure to attend to the "oeconomic" realm) is that the historical narratives of traditional histories of science or medicine have—wittingly or unwittingly—excluded women, together with other marginalised social groups of the period (such as laboratory technicians) from their accounts. In the history of medicine, Hunter and Hutton note, "the learned practitioners and theorists receive notice, but the lowly healers and midwives, the mere 'mechanicks' of medicine are left out of the account."² This process, I will argue, begins long before the first histories of science and medicine, in the narratives of physicians and members of the Royal Society in the late seventeenth and early eighteenth century who, in the process of demarcating the institutional and professional boundaries of emergent experimental, medical, and scientific knowledge, constructed models of professional or expert knowledge which exclude women, along with