

*Title:* Diverse Shapes: Used Goods as Material Resources in Early Modern Sciences

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## **Diverse Shapes: Used Goods as Material Resources in Early Modern Sciences**

*Abstract:* Narratives of supply chains and raw materials ill-fit early modern Europeans' "thrifty" habit of reusing and reworking goods into new forms. This article stresses the importance of such habits for early modern work using the example of paper, as a medium, instrument, and epistemic resource in various domestic and scientific spheres. Thrifty perspectives challenge not only linear supply narratives but also enduring accounts of the identities of materials themselves.

➤ Figure 1 here (figure 1 A and B should be side by side)

Figure 1. "Secondary use" playing card used as part of a card catalogue. Author's collection and photograph.

Current discussions of supply chains often begin with "raw materials," extracted from the Earth then transported to be manufactured into goods then distributed for sale to consumers. Early moderns participated in, and pioneered, extractive industries. But they also made much use of existing goods to create new ones. A playing card, made of layers of paper pasted together, carries the inscription on one side "Petites lettres sur de grands philosophes 1757" (fig. 1). The other side is the ten of diamonds. The card has been used to catalogue a book in someone's collection, in this case by French playwright and disciple of Voltaire Charles Palissot de Montenoy. It was common in the seventeenth and eighteenth centuries to give playing cards, printed on one side only, what is now called by collectors a "secondary use."

Scholars designed alchemical equipment on playing cards, used them to announce lectures, and catalogued libraries with them. Paper carried epistemic weight, as a medium, an instrument, and as a means to organize knowledge.<sup>1</sup> The vocabulary of “consumers,” “producers,” “raw materials,” and extractive industry ill-fits this economy of what I have called “thrifty science.”

Historians have demonstrated how the fetishization of raw materials hides the social and environmental costs of extractive industries. Many early modern scientific, industrial, engineering, and agricultural projects had catastrophic consequences leading to deforestation, pollution, and climate change.<sup>2</sup> In this era of climate catastrophe an appreciation of these processes is essential. The identities of materials themselves, however, warrant further scrutiny. Extractive narratives may presuppose the existence of material kinds awaiting extraction, when it is the process of extraction itself that demarcates the identity of the materials.<sup>3</sup> Lissa Roberts and Joppe van Driel have shown how, before the nineteenth century, a great many varieties of coal were thought to exist, as many as there were locations to find them, with definitions of coal being diverse and variable. However, when coal became a valuable fuel and commodity, prompting increased mining and production, legal battles, often involving scientific expert witnesses, led to much stricter definitions of coal and a stricter specification of its chemistry. José Ramon Bertomeu Sánchez has similarly shown how arsenic took on a particular legal and chemical identity as law courts, police, journalists, and men of science sought to determine its use in murderous poisonings in nineteenth-century

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<sup>1</sup> See also the essay on “paper knowledge” in this Focus section, and Carla Bittel, Elaine Leong, and Christine van Oertzen, eds., *Working with Paper: Gendered Practices in the History of Knowledge* (Pittsburgh: University of Pittsburgh Press, 2019), 46–59.

<sup>2</sup> See, e.g., Carolyn Merchant, *The Death of Nature: Women, Ecology and the Scientific Revolution* (San Francisco: Harper Collins, 1980); Eric H. Ash, *The Draining of the Fens: Projectors, Popular Politics, and State Building in Early Modern England* (Baltimore: Johns Hopkins University Press, 2017); Londa Schibeinger, *Plants and Empire: Colonial Bioprospecting in the Atlantic World* (Cambridge, MA: Harvard University Press, 2004); Rachel Koroloff, “Juniper: From Medicine to Poison and Back Again in 17th-Century Muscovy,” *Kritika* 19 (2018): 697–716.

<sup>3</sup> Lissa L. Roberts and Joppe van Driel, “The Case of Coal,” in *Compound Histories: Materials, Governance, and Production, 1760–1840*, ed. Lissa L. Roberts and Simon Werrett (Leiden: Brill, 2017), 57–84.

France.<sup>4</sup> Expanding this perspective, it is tempting to argue that, in fact, the whole periodic table was less a discovery of elements than the construction of a stable series of entities whose manipulation and employment could bring profits and uses in the nineteenth century, primarily to those who controlled such definitions.<sup>5</sup> Just as biologists in this period reified the diversity of humankind into supposedly distinct races, so chemists turned what had been a varied and amorphous body of material kinds into a strictly defined set of elements. Definitions erased identities that were at once spiritual, emotional, and ritualistic in favor of measurable or quantifiable properties amenable to analysis by men of science. Processes of extraction and exploitation developed in tandem with this scientific reification, so that knowledge, capital, and power were thoroughly intertwined. Narratives of extraction, processing, and supply then correlated with and reinforced this reification of chemical and commodity identities, reshaping the moral economy of materials and distorting both the variability of material identities and diverse economies of use that did not rely on freshly supplied materials for productive endeavors.<sup>6</sup>

The historical task, then, is to recapture alternative social, moral, and material economies and identities which these nineteenth-century processes obscured from view. A convenient shorthand for this endeavor is the study of “oeconomy,” an early modern term which, as Margaret Schabas, Van Driel, and Roberts have shown, incorporated multiple dimensions of comprehension.<sup>7</sup> “Oeconomy” meant something like “management” or

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<sup>4</sup> José Ramón Bertomeu Sánchez, “Arsenic in France: The Cultures of Poison during the First Half of the Nineteenth Century,” in Roberts and Werrett, *Compound Histories*, 131–160.

<sup>5</sup> It has been suggested that Mendeleev used playing cards to draft the periodic table, but see Michael Gordin, *A Well-Ordered Thing: Dmitrii Mendeleev and the Shadow of the Periodic Table*, revised edition (Princeton: Princeton University Press, 2019), 255n46.

<sup>6</sup> For an overview, see Bruce Robbins, “Commodity Histories,” *PMLA* 120 (2005): 454–463.

<sup>7</sup> Joppe van Driel, “The Filthy and the Fat: Oeconomy, Chemistry and Resource Management in the Age of Revolutions” (PhD thesis, University of Twente, 2016); Margaret Schabas, *The Natural Origins of Economics* (Chicago: University of Chicago Press, 2005); Margaret Schabas and Neil De Marchi, “Introduction,” *History of Political Economy* 35. Special issue: *Oeconomies in the Age of Newton*, ed. Margaret Schabas and Neil De Marchi (2003): 1–13; Lissa Roberts, “Practicing Oeconomy during the Second Half of the Long Eighteenth Century: An Introduction,” *History and Technology* 30 (2014): 133–148.

“order,” but in describing the “Oeconomy of Nature” rather than the natural “environment,” commentators viewed “Nature” as at once material, moral, religious, economic, political, and social. Hence oeconomy was not simply about the extraction and exploitation of materials for profit, but the prudent use of materials as a means to avoid having to extract more in the first place. As one German dictionary put it, oeconomy entailed “how to acquire possessions, how to prudently make use of what has been acquired, storing it with practical thrift and increasing it, which is even a greater art than that of acquisition itself.” Jean-Jacques Rousseau defined oeconomy as “the prudent management of what one has, instead of the means of acquiring what one has not.”<sup>8</sup> Achieving this had diverse emotional, moral, and spiritual meanings, since the material world was ultimately a gift from God that humans needed to steward wisely.

These definitions take us towards an early modern “oeconomy” quite distinct from the extractive “economy” of the modern era. This may be further elaborated through a focus on the home. The history of domestic experimentation has been opened up in recent years following interest in artisanry and science and in female knowledge-making enterprises.<sup>9</sup> While households purchased raw materials and goods from across the globe in the early modern period, linking them to violent global networks of extraction and distribution, they also produced much themselves, warranting attention alongside more familiar sites of material extraction such as mines, forests, or the oceans. Besides cultivating plants and livestock in gardens and small farms, householders also worked to “prudently make use of what has been acquired,” so that reuse and recycling of existing goods was common. As I have argued in the English case, godly householders were encouraged to be *thrift*y, seeking to

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<sup>8</sup> Quotations from Van Driel, “The Filthy and the Fat,” 86–87.

<sup>9</sup> For an overview, see Donald L. Opitz, “Domesticity and the Sciences,” *Histories* 2 (2022): 259–269, <https://doi.org/10.3390/histories2030020>; Sandra Cavallo, “The Domestic Culture of Health,” in *The Routledge History of the Domestic Sphere in Europe 16<sup>th</sup> to 19<sup>th</sup> Century*, ed. Joachim Eibach and Margareth Lanzinger (London: Routledge, 2020), 455–474.

balance the acquisition of new goods with the best use of those already owned.<sup>10</sup> Used goods were thus often the “raw materials” out of which new goods were made.

The oeconomy of paper provides a useful example, since paper was made use of for diverse material and epistemic ends.<sup>11</sup> Early moderns treated paper rather like plastic, as a flexible material serving multiple functions that could be reworked into different forms over time. Paper was itself a recycled commodity made from linen rags. In London, rag merchants gathered old clothes to provide the industry with materials which were mashed into a pulp then spread into thin sheets and dried. The city’s collectors, often Jewish, walked a regular route crying “old clo,” exchanging “flowers, trinkets, crockery, and jewelry” for linen before assembling at the Rag Fair on Rosemary Lane by the Thames to trade their goods.<sup>12</sup> Papermakers bought the rags to transform into paper in their workshops. As Heidi Craig has shown, London’s citizens were conscious of these cycles, which carried rich emotional and spiritual resonances.<sup>13</sup> In 1655 the poet Henry Vaughan described the career of flax plants used to make linen employed to make paper for printing a Bible:

Thou knew’st this papyr, when it was  
Meer seed, and after that but grass;  
Before ‘twas drest or spun, and when  
Made linen, who did wear it then,  
What were their lives, their thoughts & deeds

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<sup>10</sup> Simon Werrett, *Thrifty Science: Making the Most of Materials in the History of Experiment* (Chicago: University of Chicago Press, 2019).

<sup>11</sup> Here I draw on Simon Werrett, “The Sociomateriality of Waste and Scrap Paper in Eighteenth-Century England,” in Bittel, Leong, and von Oertzen, *Working with Paper*, 46–59.

<sup>12</sup> Adam Mendelsohn, Daniel K. Richter, Kathleen M. Brown, Max Cavitch, and David Waldstreicher, “The Rag Race: Jewish Secondhand Clothing Dealers in England and America,” In *Capitalism by Gaslight: Illuminating the Economy of Nineteenth-Century America*, ed. Brian P. Luskey and Wendy A. Woloson (University of Pennsylvania Press, 2015), 76–92, on 78.

<sup>13</sup> Heidi Craig, “Rags, ragpickers, and early modern papermaking,” *Literature Compass* 16 (2019), <https://doi.org/10.1111/lic3.12523>.

Whether good corn, or fruitless weeds.<sup>14</sup>

Used paper was itself recycled routinely, as in the case of playing cards. Letters and envelopes served to wrap food or were used as baking paper in ovens. The pages of old books served as toilet paper, to cover windows in poorer households, or to powder wigs and curl hair.<sup>15</sup> Scholars used paper to make instruments and employed scraps and waste paper for note-taking and classificatory endeavors.<sup>16</sup> Experimenters recorded recipes by writing vertically over paper already containing horizontal text.<sup>17</sup> Paper's reuse entailed material, emotional, financial, and religious considerations and involved diverse controversies and debates in the seventeenth and eighteenth centuries. Choices of how to reuse paper were classed and gendered. Scholars sought to turn scholarly papers into archives and lambasted cooks and housewives who would make use of them to line pies. Male scholars supposed women failed to read books, only using them to curl their hair. This oeconomy of paper reuse was nicely captured in Thomas Johnson's edition of John Gerard's herbal of 1633, perhaps one source for Vaughan's reflections:

God of his infinit goodnesse and bountie hath by the medium of Plants, bestowed almost all food, clothing, and medicine vpon man. And to this off-spring we also owe (for the most part) our houses, shipping, and infinite other things, though some of them Proteus like haue run through diuers shapes, as this paper wereon I write, that first from seed became Flax; then after much vexation thred, then cloath, where it was cut and mangled to serue the Fashions of the time: but afterwards rejected and cast

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<sup>14</sup> Henry Vaughan, "The Book" from his *Silex Scintillans: Sacred Poems and Private Ejaculations* (London, 1655), quoted in Craig, n.p.

<sup>15</sup> Werrett, "The Sociomateriality of Waste and Scrap Paper."

<sup>16</sup> Boris Jardine, "Collections and Projections: Henry Sutton's Paper Instruments," *Journal of the History of Collections* 17 (2005): 1–13; Boris Jardine, "State of the Field: Paper Tools," *Studies in History and Philosophy of Science Part A* 64 (2017): 53–63; Staffan Mueller-Wille, Isabelle Charmantier, "Carl Linnaeus's Botanical Paper Slips (1767–1773)," *Intellectual History Review* 24 (2014): 215–238.

<sup>17</sup> See, e.g., the Massingberd family recipe book discussed in Katherine J. Allen, "Manuscript Recipe Collections and Elite Domestic Medicine in Eighteenth-Century England" (PhD diss., Wolfson College, University of Oxford, 2015), 58.

aside, yet vnwilling so to forsake the seruice of man for which God had created it,  
agaïne it comes (as I may terme it) to the Hammer, from whence it takes a more noble  
forme and aptitude to be imployed to Sacred, Ciuill, Forreine and Domesticke vses.<sup>18</sup>

Like Vaughan's poem this is an exemplary oeconomic description of paper that reveals the distinct features of early modern thinking about materials. Paper exists in a cycle or circular oeconomy of divine creation. Word and Works are combined, since the existence of raw materials is simultaneously a divine message (accounts of paper's cycles thus often appeared in reference to the making of Bibles). Rather than fetishize materials by making their histories invisible, those histories, rooted in divine benevolence, are highlighted. Plants and other raw materials are then a *medium*, a means through which God communicates to "Man" His benevolence by creating things for Man's "service." Early moderns frequently spoke of service, rather than utility, and rather than say "reuse" or "recycling" they spoke of putting things into service. Service was a term applying equally to humans and nonhumans, all of which could do "service" to others. Hence the social and material were to be understood as a continuum. This is further reflected in the idea that materials exist for human ends, but there is little sense here that they have strictly defined identities, since they are subject to "run through diuers shapes" in a constant process of circulation between different physical forms and types of service. For both Vaughan and Johnson, flax becomes cloth which becomes paper. It is this ambiguous and open-ended identity which nineteenth-century legal battles, regulation, and chemical science attempted to pin down. But for early moderns, material things were "incomplete," having definite and serviceable properties, but not being identified by a single use since that use was subject to change in the future.

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<sup>18</sup> John Gerard, *The herball or Generall historie of plantes. Gathered by Iohn Gerarde of London Master in Chirurgerie very much enlarged and amended by Thomas Iohnson citizen and apothecarye of London* (London, 1633), "To the Reader."



Within this circulation and flux, diversity of service was to be celebrated. Rather than see value, as later industrial culture did, in continuous specialization and division of labor, there was rather value in the “polychrest” nature of materials, the capacity of things to serve many uses.<sup>19</sup> In contrast to the highly defined elements of the periodic table or the legally constituted chemistry of coal, early modern paper had a “noble forme” precisely because of its emotive and practical variability, its “aptitude to be impolyed to Sacred, Ciuill, Forreine and Domesticke vses.” As the German dictionary put it, there was more art in working out new uses for existing things than in producing new things in the first place.

### *Conclusion*

Such was the constellation of values and meanings one might have brought to a simple playing card in the early modern period. This essay has argued that while histories of raw material extraction and supply are essential to appreciate significant networks of capital, knowledge, and violence in the early modern period, there is also value in exploring the reuse of existing materials at this time. Against scientifically defined material identities formulated in an industrial context largely in the nineteenth century, “oeconomy” was presented as an alternative interpretational framework for materials within which the material, moral, social, emotional, and spiritual were integrated and engaged. In the age of oeconomy, the identities of materials were more fluid and flexible, because it was an everyday goal to make the most of things, changing forms and functions when it suited. Paper, the “plastic” of the early modern period, was valued for its polychrest uses and capacity to be reworked and reused for various domestic, experimental, and epistemic ends. Hence while the early modern period undoubtedly gave rise to an exploitative industry of extracting and processing raw materials

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<sup>19</sup> Werrett, *Thrifty Science*, 32–33.

from the environment, many early moderns still did their best to “make use” of what they already had.

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