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On the Disappearance of the Animal Body: Animal Fat, Tallow, Candles, Soap, and Chemistry before 1830

ABSTRACT

This essay explores the uses of animal fat from domesticated livestock (cattle, swine, and sheep) in three separate, albeit closely related situations: as a substance harvestable from within the animal body, as a commodity reconfigured from its original form, and as a tool for scientific understanding in the late eighteenth and early nineteenth centuries. Using the concept of affordances, as initially described in the 1970s by James Jerome Gibson, and subsequentially amended by anthropologists, philosophers, and sociologists, as well as material culture or design historians, I trace animal fat across multiple stages of time and processing to show that while certain affordances remained constant throughout the period under consideration, material references to its origin within the animal body receded and ultimately disappeared. I explore the different forms of use and expectations that occurred in relation to animal fats within the cultural environments of the slaughterhouse, tallow chandlery, and soap-manufacturing facility. I conclude with the fundamental shift in ways of understanding animal fat that, beginning in the late eighteenth century, transformed a substance once highly specific and linked directly to a particular animal's body into something that was subject to chemical analysis and ultimately synthetization. This paper is part of a special issue entitled "Making Animal Materials in Time," edited by Laurence Douny and Lisa Onaga.

KEY WORDS: animal fat/s, animal chemistry, eighteenth-century industry, tallow, soap, candles, affordances, Michel-Eugène Chevreul

ANIMAL FAT WITHIN ANIMAL BODIES

Animal fat is a sticky, greasy-feeling, and smelly substance that forms within the body of mammals, birds, and fish. Within the body of its host, fat serves

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two purposes: it holds energy in reserve, and cushions or protects internal organs. Animal butchering practices adopted by Western societies through the centuries established differences among types of fat. Such properties as color, odor, taste, and tactile consistency were believed to depend on the source animal: cattle, swine, sheep, poultry, or fish. The location of the fat deposit within the body was significant. Fat that lines or surround organs such as the skin and the kidneys is sensually different from that embedded within muscle, marrow, or joints. Location also affected the quantity of animal fat available, and thus its collection and use by humans. Visceral or organ-cushioning fat could be isolated in sizeable pieces during the butchering process. Subcutaneous fat, fat adjacent to gristle or bone, or elsewhere within the body, might be scraped, boiled, or roasted out of those components.

The differences in quality, quantity, and collection method of animal fat affected the affordances of this material.[1] Early modern butchers, those who would conduct or oversee the slaughter and initial dismemberment of the body, often commanded blocks of visceral fat as part of their compensation.[2] Recovery of less-easily harvested fat was frequently a task for the purchaser of that animal component: the bone-seller, the apothecary, tanner, or leather-dresser. Within a household, control of collected fat ("kitchen-stuff") was a privilege of senior kitchen staff. As with the butcher's privilege, any payment for fat was pocketed by the person who isolated it. This system offered a way for workers to dole out favors, and also influenced the quality of the finished product, whether a smooth hide or a well-roasted joint of beef.

THE OPERATIONAL CONVERSION OF FAT INTO TALLOW

Fat removed from the animal body was rendered (purified) to increase its suitability for human gastronomic, medical, and mechanical purposes. Rendering is thus central to expanding affordances from those attributable to fat within the animal body (protection, energy, strength) to those which

1. I am grateful to Kjell Ericson and Sarah Teasley for their assistance and insight, especially as described in this special issue, into the range of animal materials facing this or similar issues, and the differing responses.

2. Roger Horowitz, Jeffrey M. Pilcher, and Sydney Watts, "Meat for the Multitudes: Market Culture in Paris, New York City, and Mexico City over the Long Nineteenth Century," *American Historical Review* 109, no. 4 (2004): 1055–83; John Houghton, "Butcher," *A Collection for the Improvement of Husbandry and Trade* [henceforth: *Collection*] 31 Aug 1694/5. On Houghton, see also note 5 below.

fat could provide once harvested. In early modern urban districts, rendering was a task of the tallow-chandler, an occupation that, as its name indicates, was closely tied to candle-making as well as fat-processing. The rendering process calls for slow heating to liquify the fat, followed by straining to remove undesirable particles. It reduced the odor, raised the melting point, and extended the life of what then might be called tallow or lard.[3] Rendering is an intentional process that removes components from the substance harvested from the animal. The elimination redirects the initial affordances of animal fat away from the animal body and creates additional affordances that connect to human uses.

Identifying and Characterizing the Multiple Affordances of Tallow

Tallow is both an affordance of harvested animal fat and a substance that facilitates other affordances for that material. The large proportion of fat in livestock animal bodies—about 10 percent of the weight of the animal—assured the availability of tallow in urban and non-urban districts alike.[4] In addition to its value as a foodstuff, tallow's affordances improved health and safety. At the turn of the eighteenth century, the apothecary and grocer John Houghton explained the medical affordances of tallow as an outcome of its sticky texture and soft-solid state.[5] It was a common ingredient in topical salves, used to protect or treat the skin of humans or domesticated animals.[6]

3. Tallow often refers to rendered beef fat but may be any semi-solid rendered animal fat. Lard is always the rendered fat of swine. Grease is a minimally rendered animal fat of unspecified origin.

4. Arthur Young, *Annals of Agriculture and Other Useful Arts*, vol. 10 (Bury St. Edmund, 1788), 328, http://archive.org/details/bub_gb_mkBNAAAAYAAJ; Houghton estimated London-based tallow production to be about 5,000,000 pounds of fat per year and noted this was not sufficient. John Houghton, "Farther Uses of Tallow, for Medicine, and Why," *Collection*, 8 Feb 1694/5; the current calculations are described in South Dakota State University Extension, "How Much Meat Can You Expect from a Fed Steer?," 6 Aug 2020. https://extension.sdstate.edu/how-much-meat-can-you-expect-fed-steer

5. John Houghton (1645–1705), F.R.S., was a London apothecary and dealer in luxury foodstuffs. At the turn of the eighteenth century, he capped his lifelong interest in "the improvement of my Country" through publication of a weekly *Collection for the Improvement of Husbandry and Trade* (1692–1704). Volume 6 (1694/5) includes detailed articles about tallow, tallow candles, and soap.

6. Richard Bradley, *The Gentleman and Farmer's Guide for the Increase and Improvement of Cattle* (London, 1732), esp. 243–45; Anthony Macmillan, *A Treatise on Pasturage* (Edinburgh, 1790), 188.

Tallow was also applied to wooden and metal objects, and to textiles, affording protection from water damage. It contributed to the affordance of softness or suppleness when turning animal hides into leather. Tallow afforded safer journeys when used in the shipyard and at sea, where it protected objects from the ravages of saltwater, and could waterproof or strengthen ropes, sails, and other fibrous accessories. Although historian John Muendel has identified the early and widespread use of olive oil as a lubricant for machinery, tallow and grease afforded the same decrease in friction, smooth operation, and decreased wear when applied to wood or metal parts of machinery that might rub against each other.[7] These same affordances would have been familiar within households, where tallow, a common, often locally produced, substance that could nourish, soothe, waterproof, and lubricate would be an important commodity.[8]

In the early modern period, however, the most common affordance of tallow was to illuminate. Less bright and more malodorous than wax candles, tallow-based lights were also less costly, and thus a material for the masses.[9] In his newsletter, Houghton estimated that "many thousands of [tallow] candles" were used in London every month.[10] Tallow afforded the extension of both work and leisure time within households and in public spaces such as inns and theaters. Like tallow preparation, candle production was an operational rather than a chemical process, and the affordance of illumination maintained a close connection to the initial form. To prepare candles, melted tallow was shaped around a wick and permitted to cool and harden. Other tallow-based illuminants included small pots of the material into which a wick was inserted. Rush lights, like candles, were made by shaping molten tallow around a material that would both consume the fat and maintain a flame.[11] The addition of tallow

7. John Muendel, "Friction and Lubrication in Medieval Europe: The Emergence of Olive Oil as a Superior Agent," *Isis* 86, no. 3 (1995): 373–93.

8. Hannah Glasse, *The Servant's Directory, or House-Keeper's Companion* (London, 1760); see the subsection "First, for Going to Market, to Chuse Flesh," in Eliza Fowler Heywood, *A Present for a Servant-Maid* (Dublin: George Faulkner, 1743), 51–53.

9. John Houghton, "Tallow Chiefly Used for Candles," *Collection* 1 Feb 1694/5. For insight into the value of tallow candles, see "Reading by Tallow Candles and Rushlight," YouTube video, 01:55, posted by Charles Dickens Museum, 27 Mar 2020. www.youtube.com/watch?v=c2YTsUjguts

10. Houghton, "Tallow" (n.4).

11. Joppe van Driel, "Ashes to Ashes: The Stewardship of Waste and Oeconomic Cycles of Agricultural and Industrial Improvement, 1750–1800," *History & Technology* 30, no. 3 (2014): 177–206, https://doi.org/10.1080/07341512.2014.988426; James Davis, Catherine Casson, and John Lee, "Recycling and Upcycling Waste in the Late Medieval Urban Economy," On History,

could afford a lowered cost to other illumination products such as those made from whale oil and spermaceti—industrialized rather than domestic animal fats—when it was added to those substances.[12] And, much as tallow was afforded by and contributed to the affordances of animal fat, tallow afforded and contributed to the affordances of soap.

SOAP

The value and affordances of animal fat and tallow were maintained and further extended through its conversion into soap. Just as rendering animal fat into tallow stabilized it and so increased its affordances, the soap-making process stabilized tallow, and thus expanded its uses. And, as with tallow rendering, soap production further distanced the animal material from the animal that was its underlying source. Cleanliness was an additional affordance of animal fat and tallow achieved through their transformation into soap. This was an important use but, in the early modern world, not always the principal one.[13]

Soap is the outcome of a chemical interaction between a fatty (and acidic) material and an alkaline (or basic) substance called a lye. Acid-base reactions were described by early modern physicians and chymists,[14] but the soap-making process was even then identified separately, as saponification.[15] To make soap, the components are stirred together, often over heat, until the mixture thickens. It is shaped, and then permitted to cool and harden.

3 Feb, 2021. https://blog.history.ac.uk/2021/02/recycling-and-upcycling-waste-in-the-late-medieval-urban-economy

12. It is worthwhile to note that the valuable products of Western whaling—bone, fat, and oil—are those considered by-products for land animals. See Nancy Shoemaker, "Oil, Spermaceti, Ambergris, and Teeth: Products of the Nineteenth-Century Pacific Sperm-Whaling Industry," *RCC Perspectives*, no. 5 (2019): 17–22. https://doi.org/10.5282/rcc/8958.

13. Georges Vigarello, *Concepts of Cleanliness: Changing Attitudes in France since the Middle Ages*, trans. Jean Birrell (Cambridge: Cambridge University Press; Maison des Sciences de l'Homme, 1988); Gustav Schäfer, "Historical Facts Concerning the Production and Use of Soap," *CIBA Review* 56 (1947): 2014–23; as well as Schäfer, "Development of Soap Boiling," 2025–37, and "Soap Trade and Production in the 19th Century," 2047, in the same volume.

14. "Chymistry" is the term certain historians of chemistry use to differentiate the studies and focus of a discipline that was no longer alchemy from that of later chemistry. See William R. Newman and Lawrence M. Principe, "Alchemy vs. Chemistry: The Etymological Origins of a Historiographic Mistake," *Early Science and Medicine* 3, no. 1 (1998): 32–65.

15. Otto Tachenius, *Otto Tachenius His Hippocrates Chymicu*, trans. J. W. (London, 1677), 13–14.

Saponification transforms the fat-plus-lye combination into a material with notably different characteristics from the original components. Soap is neutral or only slightly alkaline rather than dangerously caustic, as lye can be. It dissolves in water rather than floating on top as fats and oils do. Soap is not flammable, as fat and especially tallow are. It can become fully solid. And it facilitates removal of unwanted matter, including the fats and oils that comprise it.

Early modern descriptions of soap engage the senses with characteristics that reflected the use planned for the product. Soap might be black, white, yellow-green, blue, or marbled. It might smell of fat and lye, or of an herb, spice, or medicament incorporated into it. Soap might taste sharp or smooth; it might be soft or hard. Such details were managed by the soap-maker, through the choice of materials and production techniques. Certain types of soaps—often identified by place, name, or color—were considered a regional specialty.

Soap and soap-making (or soap-boiling), like tallow and tallow rendering, were well-established products and processes in towns and cities throughout England and Europe by the Middle Ages. Tracing the presence of animal materials in soaps and soap-making of the early modern West is, however, troubled by divergent contemporary statements and their underlying assumptions. Production systems in urban districts often relied on seed oils for soap-making; olive and rape-seed oils were traded north (from Spain, Italy, and France) and south (from the Netherlands), respectively. In the late eighteenth century, French chemist Jean Darcet (1725–1801) remarked that countries such as England and Germany used tallow or lard for soap-making. This practice, he claimed, was unusual in France, owing to the availability of olive oil.[16] In addition, English soap-makers' companies (guilds) prohibited the use of any "grece licour or fatnes" (tallow), in their products.[17] Both statements only refer to soap, but each may mean cosmetic soaps produced in urban areas. Other evidence suggests that tallow-based soaps were familiar, even common, in

16. Jean Darcet [Jean d'Arcet], Claude-Hugues Lelievre, and Bertrand Pelletier, *Rapport sur la fabrication des savons* . . . . (Paris: Imprimé par ordre du Comité de Salut public, 1795); Louis, chevalier de Jaucourt, noted this in his article for the Encyclopédie. See "Savon [Chimie]," in *ARTFL Encyclopédie*, vol. 14 (ARTFL, 1751), 719–20. https://artflsrv04.uchicago.edu/philologic4.7/encyclopedie0922/navigate/14/3983

17. Harold Evan Matthews, ed., *Proceedings Minutes and Enrolments of the Company of Soapmakers 1562–1642*, vol. 10, Bristol Record Society's Publications (Bristol: Bristol Record Society, 1940). www.bristol.ac.uk/Depts/History/bristolrecordsociety/publications/brs10.pdf

eighteenth-century homes and manufacturing sites throughout Britain, France, and elsewhere in Europe.

Few eighteenth-century publications detail the use of animal fat in soap-making, which further supports its general (and often modern) reputation as a homely substance, with affordances of good husbandry or subsistence. In fact, this is not quite true. In England, kitchen-stuff, the fat sold on from individual households, was combined with tallow to create a kind of soft white soap used to clean laundry and other objects.[18] John Houghton, in his description of soap in the English economy, implied that London for-hire laundresses preferred tallow-based soap and, a decade later, soap-maker Thomas Leader suggested "six pound of [tallow] soap will wash and keep clean a family of twelve persons for a month."[19] Leader also noted that the cloth-making industry consumed between one and three pounds of such soap for each length of cloth produced, and described a "second soap," made from "English ashes with rape oil, hempseed oil, tallow, kitchin-stuff and oil from Greenland" that is, scrap or waste materials."[20] Other eighteenth-century mentions indicate that the presence of tallow maintained an affordance in soap-making that was also present in candle-making: it could extend the other fatty materials used, such as the more expensive oils.[21] Consideration of contemporary sources make clear that soap, as an affordance of domestic animal fat, was widely familiar throughout the early modern West. It was unlikely to be traded afar, however, and was more typically used for industrial pursuits that demanded large quantities of soap.

Affordances of Soap from Animal Fat

The affordances of soap from animal fat mirror those of tallow, as those of tallow mirror the affordances of unrefined fat or grease. Variations within this stable pattern were contingent on location of production (town or country), producer (domestic or entrepreneurial), or the expected employment of any

18. *The Case of the Soap-Makers Making Green Soap* (London: s.n., 1711).

19. John Houghton, "Soap," *Collection* 15 Feb 1694/5; Thomas Leader and Anonymous, *Proposals Humbly Offered . . . for Raising above One Hundred Thousand Pounds per Annum, by Laying a Small Duty upon Soap* (London, 1707).

20. Leader and Anonymous, *Proposals* (n.19). "English ashes" were used to make lye. "Oil from Greenland" was whale oil.

21. Darcet, Lelievre, and Pelletier, *Rapport* (n.16); Henri-Louis Duhamel du Monceau, *L'art du savonnier* (Paris, 1774), https://gallica.bnf.fr/ark:/12148/bpt6k10676604q; Houghton, "Soap" (n.19); Schäfer, "Historical Facts," "Development of Soap Boiling," and "Soap Trade" (n.13).

product (the human body, the animal body, medical, industrial). Again, soap afforded protection, including from manifestations of ill health in the animal or human body, removing dirt and unpleasant odors that are its indicators. A soft soap made from animal fat and lye can afford, or assist in creating, a well-prepared leather hide, both protecting and lubricating (while also cleaning) the skin. Soap affords greater safety and longevity when chosen over tallow or fat as a lubricant, or mixed with it, owing to simplified removal and decreased flammability.[22] These capabilities exist whether the soap is applied to wood, metal, or fiber.

Authors of popular histories about soap or soap-making often mention that Pliny the Elder (23–79 CE) noted the practice of men in Gaul to color their hair red with a pomade made from fat and ashes.[23] As this combination creates a soap, Pliny's description seems to confirm the use of soap as a medium of application, capable of carrying more than medication to the body. It also points to an additional affordance, at least in northern Europe. The solid nature of soap, its easy accommodation of colorants and perfumes, and its relatively rapid drying time compared to oils and tallow would afford body decoration from this group of animal-fat based substances. The simple removal of soap with water was a further advantage of this use.[24]

Soap was also ingested—taken into a human or animal body—in situations that were both like and unlike this affordance of tallow or fat. Edibility as an affordance of the latter two substances was linked to nutrition, a value not assigned to soap. According to early modern understanding of acids and bases, however, the combination of fat and lye that comprised soap could be eaten to relieve such conditions as "the stone," excess stomach acids, jaundice, and gout.[25] Recommendations are unclear about the mechanism of effective relief:

22. William Falconer, *An Universal Dictionary of the Marine* (London, 1769); John Hardingham, *The Accomplish'd Ship-Wright and Mariner* (London, 1706).

23. Pliny, *Natural History, Volume VIII: Book 28*, trans. D. E. Eichholz, Loeb Classical Library 418 (Cambridge, MA: Harvard University Press, 1962), 128–31; Johann Beckmann, *A History of Inventions and Discoveries*, trans. William Johnston, vol. 3 (London, 1797), 239; Schäfer, "Historical Facts," "Development of Soap Boiling," and "Soap Trade" (n.13). There is no indication of the source for the red color Pliny mentions.

24. Isabella Cortese, *I secreti de la signora Isabella Cortese* (Venetia, 1561); Moyse Charas, *Pharmacopée royale galénique et chymyque* (Paris, 1676); Henri-Louis Duhamel du Monceau, *L'art du savonnier* (Paris, 1774); Darcet, Lelievre, and Pelletier, *Rapport* (n.16); Michel Eugène Chevreul, *Recherches chimiques sur les corps gras d'origine animale* (Paris: F. G. Levrault, 1823).

25. *Medical Commentaries*, vol. 8 (London, 1794), 68, 122; Adam Drummond, "An Account of the Virtues of Soap in Dissolving the Stone," *Philosophical Transactions of the Royal Society of*

it may be that its advocates believed that soap delivered both the soothing tallow and the corrective lye into the stomach more safely than would drinking a sufficiently alkaline liquid.[26]

An additional affordance for soap, separate from those attributable to its properties as a cleaning and lubrication agent, was as a chemical object, affording study of the combination and composition of its elemental nature, and contributing to the understanding of the materials they afford.

ANIMAL FAT IN CHEMICAL AND BIOLOGICAL SCIENCES

Animal fat and tallow, as materials linked with but physically separable from meat, hide, organs, and other components of the animal body, were subjected to extended analysis between the 1750s and 1830s.[27] Such efforts fell under the aegis of projects that explored the elemental nature and composition of animal bodies, and linked those studies and their findings with existing craft traditions.[28] These technoscientific explorations were both chymical—performed in the temporal and intellectual space that existed between alchemy and chemistry—and chemical, as that discipline was practiced in the later eighteenth and early nineteenth century. Investigators who examined animals or animal

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London 28 (1757): 221–27; James Jurin, *An Account of the Effects of Soap-Lye Taken Internally, for the Stone* (London: R. Manby and H. S. Cox, 1745); R. Lucas, *A Letter from Mr. Rob. Lucas, Concerning the Relief He Found in the Stone* (London: Royal Society of London, 1753).

26. Drummond, "Virtues of Soap" (n.25), 225–26.

27. Among those who investigated animal fats were Marcello Malphigi (1628–1694), Nehemiah Grew (1641–1712), and Wilhelm Homberg (1652–1715); Hermann Boerhaave (1668–1738), Stephen Hales (1677–1761), Pierre-Joseph Macquer (1718–1784), Antoine-Laurent Lavoisier (1743–1794), Claude-Louis Berthollet (1748–1822), Jöns Jacob Berzelius (1749–1848), Antoine-François de Fourcroy (1755–1809), Jean-Antoine Chaptal (1756–1832), Louis-Nicolas Vauquelin (1763–1829), Humphry Davy (1778–1829), Henri Braconnot (1780–1855), as well as Michel-Eugène Chevreul, discussed here.

28. In thinking about the idea of technoscience, and the goals of a group of people important to this study, I am indebted to work written or edited by Ursula Klein, including "Technoscientific Productivity," ed. Ursula Klein, special issue, *Perspectives on Science* 13, nos. 1–2 (2005); Ursula Klein and Emma Spary, eds., *Material and Expertise in Early Modern Europe: Between Market and Laboratory* (Chicago: University of Chicago Press, 2004); Ursula Klein, "Apothecary-Chemists in Eighteenth-Century Germany," in *New Narratives in Eighteenth-Century Chemistry*, ed. Lawrence M. Principe (Dordrecht: Springer, 2007), 97–137, http://dx.doi.org/10.1007/978-1-4020-6278-0_6; Ursula Klein, "Chemical Expertise: Chemistry in the Royal Prussian Porcelain Manufactory," *Osiris* 29, no. 1 (2014): 262–82. https://doi.org/10.1086/678107

materials in this epoch frequently aligned their research and approaches with the growing body of work on physiology.[29] Animal fats, often as tallow rendered from both domestic and wild bodies, became objects of study to support or refute commonplaces about the substance of nature from within the laboratory. Soap, and soap-making, became a means to test combination and composition. These chymical and chemical investigations, and the resulting changes to understanding of the material nature of animal fats, expanded and repositioned the affordances of both animal fats and the substances derived from them.[30]

One important aspect of this technoscientific endeavor was its role in the continued movement of animal fat away from the animal body, and of animal materialities away from animal fat. Where once affordances were connected to the source details of a specific kind of fat or tallow, laboratory investigations favored identification methods based in the combinations of carbon, hydrogen, and oxygen. The shift from the qualitative to the elemental assessment afforded laboratory replication of the essence of animal fat. The resulting synthetic substances maintained the affordances of animal fat, but the contribution from the animal once linked to it was no longer required.

Technoscientific explorations of animal fat as a chemical substance drew on classification efforts in natural history and also addressed the ongoing search for improved husbandry. In the latter part of the eighteenth century, French academician-chemists such as Antoine Fourcroy (1755–1809), Claude Berthollet, and Antoine Lavoisier explored the separation and analysis of fat as a chemical and physical material in a general way.[31] Their studies analyzed animal fats to determine their elemental composition and investigated the ways

29. Noel G. Coley, "Studies in the History of Animal Chemistry and Its Relation to Physiology," *Ambix* 43, no. 3 (1996): 164–87, https://doi.org/10.1179/amb.1996.43.3.164; Noel G. Coley, *Animal Chemistry from Lavoisier to Liebig* (Leicester: University of Leicester, 1969); D. C. Goodman, "The Application of Chemical Criteria to Biological Classification in the Eighteenth Century," *Medical History* 15, no. 1 (1971): 23–44; Frederic L. Holmes, *Claude Bernard and Animal Chemistry* (Cambridge, MA: Harvard University Press, 1974).

30. A similar set of investigations that took place slightly later is described by Podgorny and Garcia in this special issue.

31. Antoine-François de Fourcroy, *Philosophie chimique, ou Vérités fondamentales de la chimie moderne* (Paris, 1792), http://gallica.bnf.fr/ark:/12148/bpt6k15100791; Claude Louis Berthollet, "Précis d'observations sur l'analyse animale comparée à l'analyse végétale," in *Observations et mémoires sur la physique, sur l'histoire naturelle et sur les arts et métiers, etc.*, vol. 28 (Paris, 1786), 272–75, www.biodiversitylibrary.org/item/29338; see also Coley, *Animal Chemistry* (n.29).

fats from different animal sources combined. They and other specialists—often working under the aegis of a scientific society, a school of medicine or botanical garden—created new descriptions for the chemical properties of natural substances. A broad goal of such investigations was to further the understanding of chemical combination. New concepts replaced the iatrochemical theories based on sulfur, salt and mercury. The later explanations, such as those proposed by Étienne François Geoffroy (1672–1731), William Cullen (1710–1790), and Torbern Bergman (1735–84), were based on affinity.[32] In France, the Conseil de Commerce, with its system of national and regional inspectors, looked to recent studies as they monitored the condition and deployment of animal parts, including animal fats. Jean Darcet's 1795 report on soap, mentioned earlier, was thus one of several systematic investigations that contributed to expanded or new affordances for that material and the substances that comprised it.

Irina Podgorny and Susana V. Garcia, in this special issue, remark on the wide diffusion of chemistry throughout the study of nature in the 1840s. The nineteenth-century work of Henri Braconnot (1780–1855), Jean-Antoine Chaptal (1756–1832), Michel-Eugène Chevreul (1786–1889), Humphrey Davy (1778–1829), and Justus von Liebig (1803–1873) also connect examinations of animal materials with the establishment of organic chemistry as an independent field from its inorganic counterpart. The expected outcomes for their research maintained the technoscience orientation: to increase knowledge, and to develop production, especially in rapidly industrializing crafts, including textiles and shipbuilding. Again, when research programs engaged with animal fats, certain common affordances remained stable as the specifics changed. Among those who explored animal fats, the work of Chevreul, begun about 1812 and published as *Researches chimiques sur les corps gras* in 1823, was especially significant. It differs from earlier practical studies of animal fat, tallow, and soap-making in that its goal was to use both destructive analysis of fats and the soap-making process to understand differences in the composition and mechanisms of all animal fats. Chevreul's work completed the separation of traditional assumptions about an animal's fat as specific to that animal from expectations for the craft processes that manipulated it. While his explorations acknowledged the affordances of animal fats and tallows, an outcome of Chevreul's research was the transformation of fats-from-animals into fats-similar-to-those-found-in-animals.

32. See note 29.

The elements hydrogen, nitrogen, oxygen, and carbon were already established as the principal elemental components of all animals.[33] Chevreul's broad research goal was to determine the differences in animal fats via chemical analysis. This information would afford a new classification system, as he would determine appropriate quantities of fatty materials to use for industrial compositions—including soaps and illuminants.[34] The studies Chevreul presented in Book 5 of *Recherches chimiques sur les corps gras* consider the saponification of different animal fats, emphasizing first the animal fats in the composition and then the alkaline or basic substances critical to this reaction.[35] Chevreul included in his studies fats derived from the dolphin or porpoise, the jaguar, and the sperm whale—in addition to fats from geese, swine, cattle, sheep, and humans—among his samples.

In his studies, Chevreul broke from the traditional system of addressing an animal's fat, its tallow, and the soap derived from it. Instead of using animal sources and location within the animal body to reference quality or expectations of quantity (and so reflect affordances), Chevreul showed that breaking apart animal fats could afford new compositions, and he identified and named the fat components stearin and olein, palmitic acid, and cholesterol. This foundational work in organic chemistry and the chemistry of fatty substances further supported Chevreul's opinion about classifications of substances.[36] Natural history-based classification and affinity systems understood fats as animal-dependent species within genera that are a part of the classification family called lipids. Chevreul, in contrast, differentiated fats as acidic and non-acidic, and found both types in varying proportions within animal bodies. The materiality of the animal substances he used might be incorporated into the name of the acid (e.g., stearic acid refers to the Greek

33. Frederic L. Holmes, "Elementary Analysis and the Origins of Physiological Chemistry," *Isis* 54, no. 1 (March 1963): 50–81; Coley, "History of Animal Chemistry" (n.29); Goodman, "Application of Chemical Criteria" (n.29).

34. Chevreul, *Recherches chimiques* (n.24), 390. https://gallica.bnf.fr/ark:/12148/bpt6k1510005q

35. Ibid., 230. See also Book 3.

36. Jaime Wisniak, "Biography of M. E. Chevreul," in *Chemical Study of Oils and Fats of Animal Origin* (Philadelphia: Sarl Dijkstra-Tucker, 2009), xxiii–xxvii; Godefroy Malloizel, *Oeuvres scientifiques de Michel-Eugène Chevreul: doyen des étudiants de France 1806–1886* (Rouen: Impr. J. Lecerf, 1886); Georges Bouchard, "Les recherches sur les corps gras," in *Chevreul* (Paris: Éditions de la Madeleine, 1932), 101–10, https://gallica.bnf.fr/ark:/12148/bpt6k9760555v; see also Chevreul, *Recherches chimiques* (n.24); Michel-Eugène Chevreul, "Lettre de M. Chevreul à MM. les rédacteurs des Annales de chimie, sur le Mémoire de M. Braconnot, relatif aux graisses et à la saponification," *Annales de chimie* 94, no. 1 (1815): 73–79.

term for tallow, and caproic acid has a goat-like odor), but it is no longer an animal material in origin or in use. This system of elemental separation and subsequent identification and classification of all animal fats meant that these substances could transcend their source.[37] This in turn created new understandings and new affordances for fatty substances and for soap—new uses as well as new knowledge.

CONCLUSION

Animal fat, tallow, candles, and soap, as Justus von Liebig noted, share a principal characteristic of disappearing materiality—each substance maintaining value to humans because it is literally consumed.[38] Allied to this affordance of ephemerality is that of animal well-being and comfort. Affordances of good health and productivity are constants too, whether speaking of the animal pre-slaughter or the result of human manipulations. The trajectory that moves animal fat away from the animal body exerts an effect on the quality of the products it becomes, as processing affords increased longevity. Von Liebig also noted that an animal substance, once harvested, might turn rancid or grow moldy before its deployment assured its disappearance. Rendering animal fat into tallow or lard would slow but not stop that decay, and through that, extend the affordances of fat. Soap, the material of this animal-focused trajectory furthest from its animal origins, contributed new affordances, including better preservation of refined animal fat. All of these substances underwent reassessment in the late eighteenth century, when changes in chemical practices and understanding meant new affordances derived from their chemical analysis. The additional value affected not only the understanding of animal fat as a component of soap and an ingredient in soap-making but also the understanding of other organic materials. Soap, and the soap-making process, afforded opportunities to compare the nature and characteristics of different animal fats. The analyses conducted by Chevreul called on chemists' recognition of the affordances of specific animal bodies in ways seldom articulated in earlier decades. The similarities and differences he found among animal fats led to new combinations of the

37. Chevreul, *Recherches chimiques* (n.24); see especially the introduction and Book 2.

38. Justus von Liebig, "Letter XI," in *Familiar Letters on Chemistry*, ed. John Blythe, 4th ed. (London: Walton and Maberly, 1859), 142. http://archive.org/details/familiarlettersoooliebrich

components of fat for industrial purposes. An outcome of the subsequent laboratory synthesis was the creation of animal fat without the animal, with the same affordances, as well as new ones generated by these facsimiles. The effect on chemistry and chemical industries became conspicuous as the body of the animal disappeared.