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Samir Boumediene

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FIGURE 19.3 Studio of Agnolo Bronzino, *Eleonora di Toledo*, c.1562–1572. Oil on panel, 77.8 × 58.7 cm
WALLACE COLLECTION, LONDON. IMAGE: CC-BY-NC-ND 4.0

Samir Boumediene: Differences that Matter: Material Substitution, Value and Innovation

In these comments, I will consider material substitution from research I've been conducting on the history of drugs and on the use of *succedanea*. In this perspective, material substitution involves a major philosophical question: what is difference? If we follow the classical distinction between difference of nature and difference of degree, we could consider material substitution as an illustration of the second case: a *succedaneum* is almost the same thing as what it replaces, but with a small difference of degree. In practice, things are more complex. You can replace a material by another one that is *very similar*, but you can also replace it with a *completely different* one.

In the first case, the key question is to determine the differences that matter and the ones that don't. For instance, *Artemisia absinthium* and *Artemisia vulgaris* can be used indifferently in some situations, because there are enough similarities between them. Such an assumption raises several issues, however. Firstly, if you can ignore some differences, you can also hide them, and this is why, in practice, substitution can facilitate fraud. Secondly, the situations in which differences *don't* matter are not as stable as it might appear: Alain Touwaide (2012) has shown that Ancient practitioners needed to follow rules that defined the people, diseases and contexts in which small changes could be hazardous. But, thirdly, the fact that differences *do* matter also opens other possibilities: if a *succedaneum* can in some cases be less efficient than the original, in other cases it can be better. Substitution allows therapeutic modulation and innovation.

Let's consider, now, the second case: how can one material replace another that is completely different? Here, the key question is to determine the property (or the set of properties) shared by two things. For instance, the malleability or resistance of some plastics make them useful for replacing ceramic, wood or bone. In these cases, the artificial substitute is expressly designed around the property it imitates. Although diametrically opposed to the previous example, this one raises exactly the same issues: the substitute may lead to fraud, it may be either worse or better, and it may pave the way for innovation. A specific question is raised when a product has been designed to have just one property. It can be an advantage if the material it replaces has other properties considered to be dangerous, but it can be a problem if the power of the original material resides in the complexity of its structure that the substitute does not mimic. The core of the debate between synthetic pharmacology and phytotherapy lies here.

Hence, the issue of difference is linked to another issue: value. By positioning heterogeneous items on a unitary scale, value creates at once commensurability

of and hierarchical differentiation between them. Here I will limit my comments to mercantile value, where the unitary scale is expressed by prices, and where the production of a commodity is captured in two ways of behaving with it: using and selling. This struggle between 'use-value' and 'exchange-value' was at the core of a notional transformation occurring during the sixteenth century. Until that time, as I have argued with Valentina Pugliano, the notion of the *succedaneum* was neutral: it referred to any kind of substitutive remedy.¹⁵ With the development of the exotic drugs trade, a second, depreciative meaning began to appear: as with the German 'ersatz', *succedaneum* referred to a second-choice option. In the language of mercantile value, this was expressed as a lower price. Accordingly, the use of *succedanea* implied a calculation: for whom was low cost more important than better quality?

The depreciative connotation of *succedanea* has been reinforced by their link with fraud, which precisely consists of substituting a less valuable product for the original without declaring it. This has contributed to the neglect



FIGURE 19.4 A goa stone. Made in India from a paste of clay, crushed shell, amber, musk and resin, this object was a common early modern substitute for the stones found inside the stomachs of certain kinds of animal, known as bezoar stones, which served in medicine to treat numerous complaints and as an antidote to poisons. While contemporaries knew that artificial and natural bezoar stones differed in origin and composition, goa stones remained highly valuable commodities throughout the early modern period, and were stored in ornate containers, as shown here

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of substitution as a theme in the history of knowledge. Some seminal works, however, have shown how crucial reproducibility was in early modern science and technology: what processes could be imagined to certify that two things or two phenomena might be considered equivalent? In the secrecy of laboratories and apothecaries' shops, fraud occurred not only when practitioners wanted to decrease their costs, but also when they confronted shortages of an ingredient. At any rate, creating an equivalent product, whether at a lower price or not, was a constructive way to face constraints.

If mimesis can be considered as the production of the self, it also consists in understanding the difference between self and other. Adulterating a product requires knowledge of how to conceal differences – and consequently also of how to see them. In seventeenth-century Livorno, for instance, the apothecary Giacinto Cestoni was considered the best supplier of exotic plants: the papers he left show that he knew exactly how they were adulterated. Following the intuition of historians of art, we could say that the best expert is always the *faussaire* or forger.

Another way to understand the role of substitution in the history of knowledge is to focus not only on the substituted thing, but also on the substituting thing. For instance, if we wanted to replace sugar, all ersatz substances will be considered to be 'quasi-sugar' and substitution will be considered to be emptiness. But if we examine this story from the point of view of the substituting product (stevia, for instance), substitution will be an addition that leads in this case to a new use of the plant. Many of the remedies employed against particular diseases were originally used as substitutes for others (something today referred to as 'drug repositioning'). A large part of the history of medicaments is to some extent continuous with the history of *succedanea*. Accordingly, the value of products derives not only from their acknowledged properties, but also from their capacity to imitate others, or, contrariwise, from their non-substitutability. In other words, high value belongs either to the product that cannot be replaced (in the history of pharmacy, the specific, i.e., the only substance that is effective for treating a particular disease), or to the product that can replace all the others (the panacea).

In today's world, we find this intertwined history of innovation, science, commerce and technology in debates surrounding forms of renewable energy (is it possible to replace carbon?), but also in the production of soy, an almost universal substitute for meat, forage, plastic, etc.¹⁶ This leads me to a final remark. If the search for alternative solutions can be a motor for innovation, it can also make knowledge disappear. In a world where everything can be replaced by the kind of low-cost solutions William Morris criticised in his time,

many practices may be lost.¹⁷ When overused, material substitution tends to lead us to forget that differences matter.

◆ Benjamin Aldes Wurgaft *is a historian, writer, and ethnographer whose recent work concerns copying meat by growing it in laboratories. This seemingly most obvious and ethical of mimetic acts, however, is fraught with complexities deriving from meat's entanglement with consumers' aesthetic expectations and their corporeal self-knowledge:*

Ben Wurgaft: Mimicked Meat

There are many ways to mimic meat, defined for these purposes as animal muscle and fat consumed as food. You can fold sheets of bean curd to imitate duck, chicken, pork, or beef, a method traditionally used to provide vegetarian meat in China. You can turn pea proteins into a kind of slurry, along with other ingredients, and then extrude them at high pressure and temperature to create a “burger” with something approaching the texture and flavor of conventional hamburger. Such tactics try to approximate the sensory qualities of animal muscle and fat while using a very different, plant-based, substrate. But why not mimic meat using animal cells? From 2013 to 2019 I conducted ethnographic research with scientists, engineers, and entrepreneurs who hope to produce ‘cultured meat’, which begins with animal muscle stem cells carefully cultivated in bioreactors.¹⁸ At the time of writing, cultured meat is not yet a consumer product. Two motivations for creating cultured meat predominate. Many in the ‘cultured meat movement’ hope that they can replace much of conventional industrial agriculture with cultured meat, undercutting, first, the enormous cruelty to animals that industry entails, and second, the significant environmental footprint of that industry; by some accounts animal agriculture produces 14% of the world’s greenhouse gases *per annum*, and is very expensive in terms of land and water used. From the perspective of mimesis, though, cultured meat entails both technical challenges and a certain critical perplexity, the latter because it does something quite unusual: copying a naturally occurring form, animal flesh, not by using a different substrate, but by using the expected natural substrate, artificially grown. You could call cultured meat a ‘carnal skeuomorph’.¹⁹ Skeuomorphs (Greek for ‘container-shapes’) are objects defined by their shape, rather than by a necessary relationship between material and shape. Sometimes they develop because a group of designers and builders continue to produce the same form while working with new materials.

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Endnotes

- 1 Bijker 1995; Hughes 1985; Wurgaft 2019, 2020a; Miodownik 2014. 'Geckel' is the name of a biological adhesive that uses carbon nanotubes to mimic the structure of a gecko's feet (Autumn 2006).
- 2 Mueller 2021.
- 3 'Memorandum of conference. Subject: Aflatoxin (peanut mold toxicity)', 21 November 1962, Folder Aflatoxin Studies, 1962, 1963, vol 1; General Subject Files 1938–1974, 1963, 426.6 THRU 428.2.-.31, Box 3511; Records of the Food and Drug Administration, Record Group 88; National Archives at College Park, Md.
- 4 Asao *et al.* 1963.
- 5 Buechi *et al.* 1967.
- 6 Trost & Toste 2003.
- 7 Minar 1999.
- 8 Auerbach 1994.
- 9 Wunder 2019, 258.
- 10 See examples in Pitman 2016, 2019.
- 11 For more on this, see Pitman 2020a, 2020b.
- 12 Cortese 1584, 205.
- 13 Spilman & Herrick 1914, 94. Thanks to Michael Pearce for this reference.
- 14 This research is part of the Refashioning the Renaissance project that has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement number 726195).
- 15 Boumediene & Pugliano 2019.
- 16 Du Bois 2018.
- 17 Morris 1996.
- 18 See Wurgaft 2019.
- 19 See Wurgaft 2020b.