3. Roman Concrete

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Archaeology writes human history based on material traces.[1] Yet it has been surprisingly reluctant to write truly *material* histories. Instead, form has featured as the signifier of historical change: changing mentalities are read from new tableware shapes; altered political relations from novel building types; shifts in socio-economic cycles from new styles of packaging. Material changes, instead, are relegated to the timespace of geological epochs, as in the debate surrounding the Anthropocene and the role of plastic as one of its guiding fossils in geological stratigraphies (Harris; Waters et al.). Within the more fine-grained timespace of human history, materials similarly feature as delimiting broad eras, a legacy that can be traced back to Thomsen's Three-Age system separating the (Eurocentric) human past into Stone, Bronze, and Iron Ages. According to such models, once discovered or invented, materials are simply part of the stock of human resources, passively waiting to be formed, shaped, modeled, and thus given a historical role.

The consequences of placing materials outside of history have been dire. This epistemological move has fostered a denial of coevalness (Fabian): if stone tools are of a different epoch altogether, then so are their users. It has also been complicit in colonial resource-grabbing: severing mute matter from its historical entanglements paves the way for capitalist alienability (Irvine). Finally—and this is the issue tackled in this chapter—it skews the human histories we write, slanting them in favor of the drama of human agency.

Concrete offers a productive case study to destabilize the role of matter in history-writing. Concrete as a structural component rather than a surface or a bonding agent first appeared in Late Republican Italy, probably around the second half of the second century BC (Coarelli; Mogetta). It is thus one of the rare pre-industrial examples of a material whose invention is historically anchored. Yet invention narratives are at danger of activating the distinct moment of invention and development, only to have the rest of a material's history slide back into a mass of mute matter at the whim of human instrumentalism (e.g., Blake and Van Deman 327; Jackson

1 This chapter revisits and deepens parts of an argument made earlier in Van Oyen, *Finding the Material*.

and Kosso 283; Quenemoen 65). This chapter explores two alternative material histories: one following Tim Ingold's organicism and "generative fluxes" (12); the other inspired by Karen Barad's notion of performativity and "material-discursive phenomena."

Matter is in constant flux. The multivalent rhythm of its pulse blurs the analytical distinctions between geological and historical timespaces. Roman concrete is a composite material consisting of a core of rubble bonded with mortar, often contained by a facing of stone or brick. The material histories of these components stretch far back in time: the fine aggregate used for the mortar in Roman Italy, for instance, consisted of volcanic ashes or so-called "pozzolana" from various formations along Tyrrhenian Central Italy (Lancaster, "Concrete Vaulted Construction" chapter 2). Volcanic ash reacted with lime to create an exceptionally strong and durable conglomerate; yet this chemical reaction needed water and was therefore not possible when hot temperatures caused rapid evaporation (Lechtman and Hobbs 99; Lancaster, "Concrete Vaulted Construction" 52). The mortar's longevity that resulted in the preservation of such things as Roman harbor infrastructure up to today was thus the product of a highly specific and fickle confluence of "currents of the lifeworld" (Ingold 12): millennia-old geological processes responded to contingent conditions of temperature and humidity at the time of construction.

Mixed in with the mortar were *caementa*, heterogeneous fragments of stone or tile that formed the core of concrete walls (Lancaster, "Innovative Vaulting" 19). The ability to reuse the rubble from previous buildings without having to carve each individual piece was a boon amidst a bustling building industry in Late Republican Rome. In what was effectively a form of recycling (Duckworth et al.), each fragment carried with it its own history and the concrete wall, vault, or building that resulted became a temporary halting point of meshworks knotting together different buildings, projects, and fabrics. In contrast to its modern counterpart, Roman concrete was not poured but layered: the facing of walls arose in tandem with layers of mortar in which the *caementa* were placed (Blake 160; Lechtman and Hobbs 102). From the perspective of crafting, this technique did not require a radical break with previous modes of stone-built construction. Vaults and domes, instead, necessitated that form was conceived before matter. Indeed, their negative space would be modeled in wooden formwork, resulting in close collaboration between architects, carpenters, and construction workers (Lancaster, "Concrete Vaulted Construction" 22–50).

This shift from matter growing to form being modeled through matter identifies an important lacuna in the material history of concrete sketched so far. Absent from an Ingoldian narrative of growth, flux, and flow are politics, economics, and inequalities. These only enter when we acknowledge the ruptures within the flow, the stopping points, the fractures, and the boundaries—an epistemic move guided by Barad's question of how concrete "comes to matter."

"Roman concrete" was not an undifferentiated category. *Caementa*, for instance, became gradually more standardized. Concrete buildings of the second century BC employ coarse *caementa*, often forty centimeters in size or larger, and randomly laid (Blake 160; Jackson and Kosso 280). From the Augustan period onwards, the size of individual components decreased to about ten to thirty centimeters, now regularly ordered in layers. In addition, from imperial times onwards, the properties of *caementa* became increasingly adjusted to their position and role in the building. Heavier components were placed at the base of vaults and domes, while lightweight materials occupied positions higher up.[2] As a result, higher-end construction projects would import specially sourced stones to serve as *caementa*. Whereas *caementa* had been a key component in fostering the Ingoldian flow of recycling in the initial phases of concrete construction, they now actively halted, interrupted, and redirected those flows, creating additional costs and demands.

The volcanic ash that formed the fine aggregate of the mortar-mix was also subject to an increasing process of differentiation and categorization. The greyish ash from the Bay of Naples, *pulvis puteolanus*, was preferentially selected for underwater construction and exported across the Mediterranean for use in harbor facilities (Jackson and Kosso 273; Jackson).[3] Trajanic monuments on land in the city of Rome, instead, favored the reddish ash (*pozzolane rosse*) over the black variants from distinct geological horizons around the city (Bianchi et al. 77).

The process of sorting and categorization erected new boundaries between materials and between their users. The widened palette of choice generated distinctions as one choice excluded the other, and choices became ranked (Bourdieu). Not importing special lightweight pumice for use in high vaults, for instance, would place building, builders, and commissioners in an inferior position to those able to do so. Not everyone's concrete was the same, and concrete became one more differentiator in a Roman game of inequality and consumption.

The semantics of concrete extended beyond the city of Rome. For instance, at the small rural site of Podere Marzuolo, Tuscany, an early first-century AD builder chose to break with the local building tradition of employing earthen walls on low, stone socles. Instead, they designed a large-scale building with concrete walls, one-meter-deep foundations, and a facing of diamond-shaped stones, so-called *opus reticulatum* (Van Oyen, *Innovation and Investment*). A longstanding argument reads these diamond-shaped stones as a narrative of efficiency: by front-loading the labor of cutting, the carved blocks could easily be assembled by an unskilled labor force that flooded the city of Rome as a result of war and urban pull (Coarelli 18; Torelli 155;

2 See Lechtman and Hobbs 102; Lancaster, "Concrete Vaulted Construction" 59–62 for examples of this strategy as applied in individual buildings; Lancaster et al.; Quenemoen 65; Wilson Jones 187, for the second-century AD Pantheon.

3 On export, see Hohlfelder and Oleson 224–25; Oleson et al. 206.

Mogetta). In Rome and environs, such *opus reticulatum* stones were carved from relatively soft tufa stone. In the stone-poor region of Marzuolo, instead, rounded, hard calcareous river stones were used, making carving rather more difficult and creating imperfectly fitting stones. The result was a huge investment of labor both at the carving and the assembling stages. Instead of an instrument of expediency, building in concrete at Marzuolo was a spectacle and a statement that paraded form *despite* matter: its aim was to stake a claim of differentiation and power.

If it seems like we have now returned to a model of passive matter waiting to be formed in the pursuit of human drama, we should quickly re-center concrete's own material logics. Early concrete buildings mimic the forms of preceding stone architecture or "trabeated" architecture, with its posts, lintels, plinths, and sharp angles (Wilson Jones). It took several centuries of experimentation and confidence-building for builders to release concrete's structural and spatial affordances. In particular, the lateral thrust of concrete structures made the traditional load-bearing walls, piers, and columns redundant. Stronger still, it was structurally impossible to create flat ceilings in concrete; the material demanded to be curved. As a result, spaces became newly opened up, with sequences of vaults creating uninterrupted vistas and axiality and with domes aspiring to a new sense of centrality and verticality. Buildings increased in scale (Quenemoen 68–9) and focused on interaction inside of their impressively shaped volumes rather than on integration in a broader landscape (MacDonald 31–41; Ball). Concrete thus generated a wholly novel architectural language, facilitating large gatherings of people yet severing their connection with any outside world. This language translated into—and reinforced—the new social and political concerns of the Roman imperial order, an order in which citizens barely partook in politics, and in which even the elites had limited maneuver space in the face of an all-powerful emperor and imperial court. As anything but passive matter, concrete, then, actively dazzled, muting an increasingly muzzled body (im)politic.

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