Arts & Crafts (and iPads): Digital Craft and Political Economy

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In discussions of craft since the digital revolution in architecture of the past twenty years it is common for an author to situate their position relative to the Arts and Crafts movement of the late 19th and early 20th centuries. Scholars have repeatedly and rightly noticed striking parallels between reactions in design thinking to the industrial revolution and reactions to the digital revolution in architecture. Proponents of various digital schools invoke the likes of William Morris and John Ruskin as historical theoretical foils to visions of craft in the digital age. There is, however, a tendency to overlook or dismiss as naïve the socio-political ambitions that underwrite the better-known aesthetic styles of various craft movements. Revisiting the political economy of movements like the Arts and Crafts and its allies prompts questions about various contemporary formulations of digital craft. Reinterpreting, for example, Ruskin's prescient critiques of the technological revolution of his time still suggest social, political, and economic implications for handicraft in our own digital age. To define these questions and potentials, this paper will review the historical moral imperative of craft; survey representative attitudes towards craft in several prominent digital schools of thought; and suggest alternative ways of engaging the socio-political possibilities of digital handicraft through architectural drawing with digital tablet computers, such as the iPad.

THE MEANING OF CRAFT

In his recent critique of capitalism historian Eugene McCarraher turns not to Marx but to various 19th Century Romantic movements for models of a more life-affirming – "enchanting" or "sacramental," in his words – economy of production.[1] In one example McCarraher focuses on the American Arts and Crafts movement's three-fold aim to "…promote the revival of handicraft, restore an ethos of craft that extolled joy in work and producers' control of technology, and […] reconcile the regeneration of artisanal culture with the advantages of mechanization and mass production."[2] Here, interestingly, the presence of the maker's hand on the object was seen as a radical challenge to the alienating effects of industrial capitalism. In addition to well-known craft proponents William Morris and John Ruskin, contemporary thinkers as different as Lewis Mumford and revivalist Ralph Adams Cram were concerned with the so-called alienation of workers from their work.[3] This alienation can be summarized as a disconnection between the activities that constitute the working life of a maker on one hand and the thing made as an objective manifestation of that life in the world on the other. [4,5] To better understand the potential for this kind of socio-political meaning in a digital version of craft, we will first examine how traditional craft movements appear in current thinking about digital architecture. Analysis will focus on three characterizations of craft in two current schools of thought: The Digital Discrete and two versions of Post-Digital architecture.

CURRENT VIEWS ON DIGITAL CRAFT

"DIGITAL DISCRETE"

As with any diverse movement, the exact definition of the Digital Discrete is difficult to pin down.[6] Nonetheless, surveying a recent special issue of *Architectural Design* dedicated to the movement, a common tendency is apparent: embracing a post-human design ethos both in how designs are conceived and how they are constructed.[7] In the act of design, the Digital Discrete consciously eschews any method that attempts to domesticate or humanize sheer computational force. The notational mathematics of calculus, for example, that symbolically describes relationships between potentially infinite sets are out, while literal near-infinite lists of discrete data points with which only a modern computer could grapple are in.[8] On the side of fabrication, a common thread is the enthusiasm for computer-controlled or even robotic fabrication and assembly of architecture. In fact, the post-human impulse underlying these two trends is made explicit. For example, the introduction to architect Phillippe Morel's contribution to the issue distinguishes the Discrete from other movements precisely by its "break away from anthropomorphism" and "[freedom] from human-imposed parameters."[9] Essentially, Digital Discrete advocates for as complete an embrace of the digital in architecture as (post-) humanly possible.

So, what of craft in this post-human Digital Discrete? Guest-editor, Gilles Retsin, laments William Morris and John Ruskin's supposed focus on ornament and failure "to understand the ability of industrial mass-production and standardization to bring quality housing and radical new architecture to the masses.".[10] Digital craft is identified with work from the first generation of digital architects that explored curvilinear forms, variation and

non-standard seriality afforded by parametric geometry. These early digital adopters' focus on "beautiful and unique things," is dismissed by Retsin on the same grounds as the 19th Century Arts and Crafts – because small craft-practices (whether analog or digital) cannot achieve the scales of production necessary to create full-size buildings much less effect societal change.[11]

It is the Discrete's insistence on the social ambitions of its project and its critique of craft on the grounds of social inefficacy that is difficult to reconcile with the movement's post-human technological vision. Movements such as the Arts and Crafts were driven, explicitly, by a socio-political reaction to industrialized capitalism's alienating effect on the worker and not on a romantic nostalgia for certain forms and motifs. John Ruskin, unfavorably contrasting modern cities with those, such as Pisa, from which historical Italian craftsmen were able to draw inspiration for their work makes this clear: "I repeat, that I do not ask you nor wish you to build a new Pisa for them. We don't want either the life or the decorations of the thirteenth century back again; and the circumstances with which you must surround your workmen are those simply of happy modern English life, because the designs you have now to ask for from your workmen are such as will make modern English life beautiful."[12] Traditional craft movements were born from a concern for the same "social implications" that Retsin claims for the Digital Discrete. Concerns, he says, that make the Discrete "crucial in terms of a production chain and its social implications" as a "post-capitalist technology that has the fundamental ability to democratize and decentralize production."[13] To what end, though? Traditional craft movements envisioned individuals doing work that would bear the mark of their fulfilled, unalienated, undivided labor - but these are dismissed as socially ineffective. The Discrete, on the other hand, imagines post-human designs constructed by artificially intelligent robots. The systems are decentralized, in some sense, but the solution to the socio-political problem of the worker seems to be to remove them altogether.

Again, Ruskin is called to mind, this time in his critique of political economy, *Unto This Last*. In one episode Ruskin questions the economic establishment through the work of economist John Stuart Mill. Mill, Ruskin recounts, applauds the decision of a hardware manufacturer to stop purchasing silver plate and jewels to thereby hire additional workers to produce simple flatware. Ruskin wryly responds, "had I written this paragraph it would surely have been asked of me, What is to become of the silversmiths? […] I very seriously inquire why ironware is produce, and silverware is not?"[14] Similarly, what is to become of trades and craftspeople in the production systems and society envisioned by the Digital Discrete? Instead of constructing buildings, do these former tradespeople now assemble the machines that build buildings for them? The industrial division of labor alienated workers from their work. The near constant mediation of digital tools, I argue, only increases the estrangement between designer, fabricator, object and user. Is further concentrating the means of architectural production, both for design and construction, into the hands of a few software and now robot manufacturers obviously preferable to the craft vision of independent and properly valued tradespeople?

"POST-DIGITAL"

If one could be persuaded of a resonant and relevant social project embedded in craft, perhaps it will still be objected that its anachronistic opposition to technology makes it obsolete today? Such is the objection of architect and theorist Michael Young in his 2013 essay "Natural is Not In It" that accompanies a Yale School of Architecture design-build seminar publication.[15] Young, like many digital theorists, positions his interpretation against an image of traditional craft, saying, "Craft always hints toward a manual tradition, passed between masters and apprentices through a guild like training. It suggests a mundane connection between material and the hand. Craft resists the abstractions which drive the use of mathematics and geometry; it resists the theorization of philosophical discourse."[16]

The allegation of mundane resistance to math and geometry suggests a general opposition to technology. Again, one finds challenges to this characterization of the craft project if one knows to which theorizers of philosophical discourse to look. For example, rather than a blanket prohibition on technology, prominent social philosopher Lewis Mumford saw in some of the oldest craft traditions a model for how technology could be applied in order to maximize its benefits and avoid the social problems discussed above.[17] This "American Ruskin" and "Romantic critic of capitalism," maintained a sympathy and appreciation for technology while still opposing the machinations of modern industrial production.[18] It is ironic that the outdated guild system mentioned by Young is also referenced by Mario Carpo in the same publication in sardonically hellish terms, complete with "blood, sweat and tears and much gnashing of teeth."[19] In fact, Mumford finds an unexpected model for the rightly ordered embrace of technology in the guilds of the 14th to 17th centuries – exactly because they are continuations of a model invented and perfected earlier in Benedictine monasteries: "What the monastery began, the medieval guilds carried through; for they not merely laid down a fresh basis for association in craft and trade, but they restored to work the esthetic and moral values, conditioned by religion, that governed the rest of their life."[20,21] It is worth quoting Mumford's summary of the Benedictine innovation at length, as it seems just as relevant today as it was then:

> "[The Benedictine monks] readily turned over to machinery those operations that could be performed without benefit of mind. Rewarding work they kept for themselves: manuscript copying, illumination, carving. Unrewarding work they turned over to the machine: grinding, pounding, sawing. In that original discrimination they showed their intellectual superiority to many of our own contemporaries, who seek to transfer both forms of work to the

> machine, even if the resultant life proves to be mindless and meaningless."[22]
>
> —Lewis Mumford, *Technics and Human Development*

Revising the common image of craft with an eye towards its socio-political subtext and nuanced appreciation of technology, I ask: what insight does *this* broader understanding of traditional craft have to offer digital architecture today? To answer, I will turn to one alternative narrative of digital handicraft focusing on the architect's relationship to fabrication and drawing.

POST-DIGITAL DRAWING

Michael Young continues in the essay discussed above, to argue that the emerging specialization of measured architectural drawing in the renaissance was the successor to the earlier guild-based craft traditions.[23] Young attempts to sublimate the notion of craft as a relationship between material and a worker's hand into the architect's new 'craft' of mediating various disciplines through measured drawing. The claims of this interpretation are two-fold: first, drawing and handicraft were always species of the same more abstract notion of technological mediation; and second, digital craft emerges as higher levels of "detail, precision and commitment" in architects' digital drawings and models are required when they are directly responsible for fabrication.[24]

An alternative reading of the assembly of architecture by architects might see it as something of a pyrrhic victory: First, craftsman are removed from collaborating on a building to assembling it as unskilled labor or producing components in a factory, only for architects to replace workers on the assembly line. This would seem cynical, if the logical conclusion of this process weren't established to be autonomous robots fabricating and assembling everything as we saw in the slightly more recent Discrete movement discussed above. This eventuality somewhat complicates suggested parallels between medieval craft traditions and digital design-build.[25]

A corollary to both of these digital projects is a radical optimism in concentrating the required means of production in increasingly fewer and more complex companies that provide software and computer-controlled machines. One episode in Young's argument is emblematic of the difference between traditional craft and recent digital readings of it. Young argues that the fears of Morris and Ruskin were saved by pictorial representations of ornament in publications like those of Owen Jones and not by a return to craft traditions. "These images acted as training both for the sensibility of the designer and the sensibilities of the burgeoning consumer public entering the market for industrially produced goods."[26] One must completely omit the socio-political thesis of most craft movements to see this training as an answer to Ruskin and Morris. The ability of consumer culture to devour design movements and destroy underlying causes while spitting out visually similar copies is perhaps the defining lament of arts and crafts' failure. Eugene McCarraher traces consumerism's power to coopt "potentially revolutionary desire into mass-marketed joie de vivre" through movements as diverse as anarchism and bohemianism in addition to the Arts and Crafts.[27] The lament of this failing bridges stylistic and political divisions. For example, in 1914, prominent (and idiosyncratic) Gothic Revivalist, Ralph Adams Cram, pointed to the "so-called 'arts and crafts societies'" acquiescing to division of labor as the source of his loss of faith in their potential.[28,29] Popularizing the style for mass consumption is exactly, from the point of view of craft, what doomed its socio-political mission. It is in response to this pattern of cooptation that Cram insists the architect "should be a kind of universal solvent, by means of which architectural designers, workmen, artificers, craftsmen, and artists should come together, and, while preserving their own personality, merge their identity in a great artistic whole."[30] Note that Cram was speaking in what he claimed was a scarcity of skilled craftsmen a hundred years ago. His response, though, even as a heroic architect type, was not to take over fabrication but to insist it is "the manifest duty of the architect to search out these individual craftsmen and to bring them into alliance with himself."[31] Many current digital movements, by contrast, want to double-down on trying to implement socially-conscious digital projects deep within a much more evolved post-industrial consumer culture-coopting machine.

As for identifying craft with precision? From Cram, "It is better to accept work that is in a measure defective, if it is so created, than a more perfect and plausible product that involves division of labour."[32] Or Ruskin, "so long as men work as men, putting their heart into what they do, and doing their best, it matters not how bad workmen they may be, there will be that in the handling which is above all price."[33]

Again, many still-relevant concerns emerge from the traditional craft movements when one gets beyond the familiar image of them as so many aesthetic styles or retrograde nostalgias. Contrary to this image we have seen: the priority of handicraft has always been to serve as an indicator of social-political health of the worker; craft traditions can and have engaged technology and modern culture; and precision and technical virtuosity are not equivalent to craft. Most fundamentally, the division of labor from the objects that manifest it in the world was the subtext of craft then and still looms as a serious question for many of today's visions of digital architecture.

IPADS AND ARCHITECTURAL DRAWING

I propose an alternative story of digital craft that embraces the traditional idea that the point of all craft is to testify to the presence of rightly ordered individual human expression through labor on the crafted object.[34] The key, I argue, is simply the *legible* presence of *individual* human labor on an object, regardless of its technological circumstances. This litmus test for digital craft satisfies the socio-political ambitions common to all traditional craft while preserving stylistic and technical freedom to explore within it. It does, admittedly, create challenges for

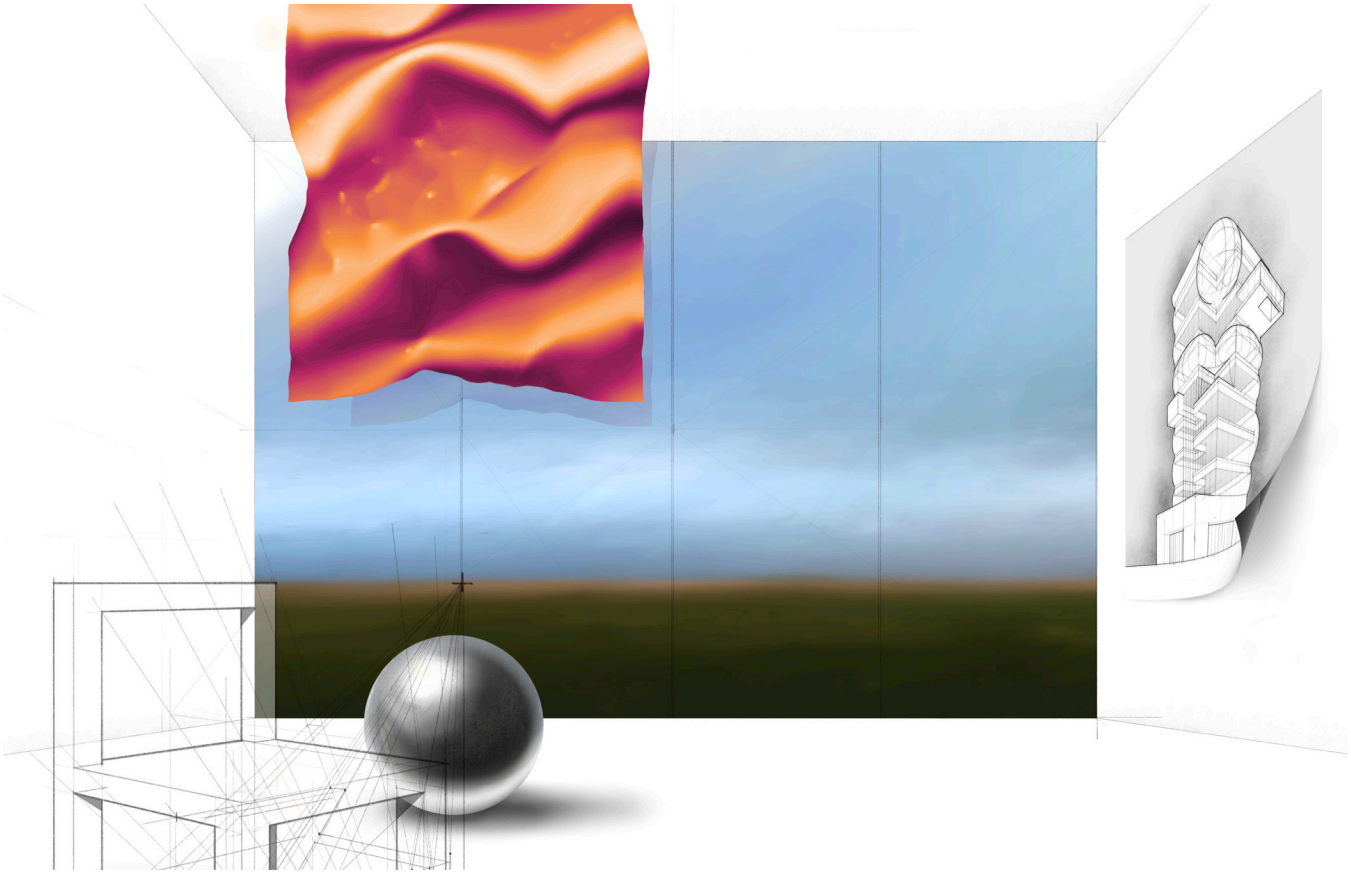

Figure 1. Scenographic digital collage of digitally hand-drawn and painted elements. iPad and Procreate. By the author.

various digital projects – but only so far as they claim to inherit craft or dismiss its without addressing its actual concerns. If the difference between digital handicraft and alienating digital labor is the empathic trace of a human hand, how does one reconcile that "According to Michael Young, unhandedness is a stylistic feature of today's digital avant-garde: the overwhelming richness of digitally created detail induces feelings of discomfort, or estrangement."?[35]

The remainder of the paper will discuss one area ripe with potential for digital craft, architectural drawing, on the following observation: If digital craft is simply a problem of legibly encoding individual, embodied human action upon artifacts of digital production, then it seems significant that various kinds of digital tablets allow for the direct input of human hand movement into digital drawing environments. Further, they are utterly common, financially obtainable, and completely portable today. From the point of view of craft, iPads seem like a revelation, so why the relatively little attention afforded them in architecture?

Perhaps part of the answer is that discussions of hand drawing are conspicuously few among the digital avant-garde. In this discourse, as we have seen above, the focus is too often on how the role of the drawing has evolved relative to digital fabrication and less on drawing as an act in itself. The question of drawing as mediator between design and fabrication is certainly relevant. Nonetheless, the most obvious theoretical intersection between craft, digital technology and architectural drawing would still seem to be the idea of architects as craftsmen of digital drawings. So, what of the labor of crafting drawings in the digital age? Have architects become alienated from *our* work of drawing buildings?

In fact, there is evidence from within the contemporary digital avant-garde itself that the answer is yes. This alienation results less from a division of labor, though, than from the increasingly narrow range of drawing tools we use and homogeneity of the types of drawings we make with them. A recent series of op-eds in two prominent design magazines encapsulate the issue. In a March 2017 editorial in *Metropolis* magazine, architect Sam Jacob describes the project of post-digital drawing, for which he is known. For him, the "super-collage possibilities" of image-making in Photoshop and Illustrator are a reaction to the impoverished state of precision- and fabrication-obsessed architectural drawing in the current digital status quo.[36] One year later, Mario Carpo sounded the alarm on just this brand of the Post-digital. In his op-ed, "Post-digital Quitters: Why the Shift Toward Collage is Worrying," Carpo warns, "In my experience, when architects start talking about sfumato, collage, or watercolors, it's time to start worrying. Architects cannot do without

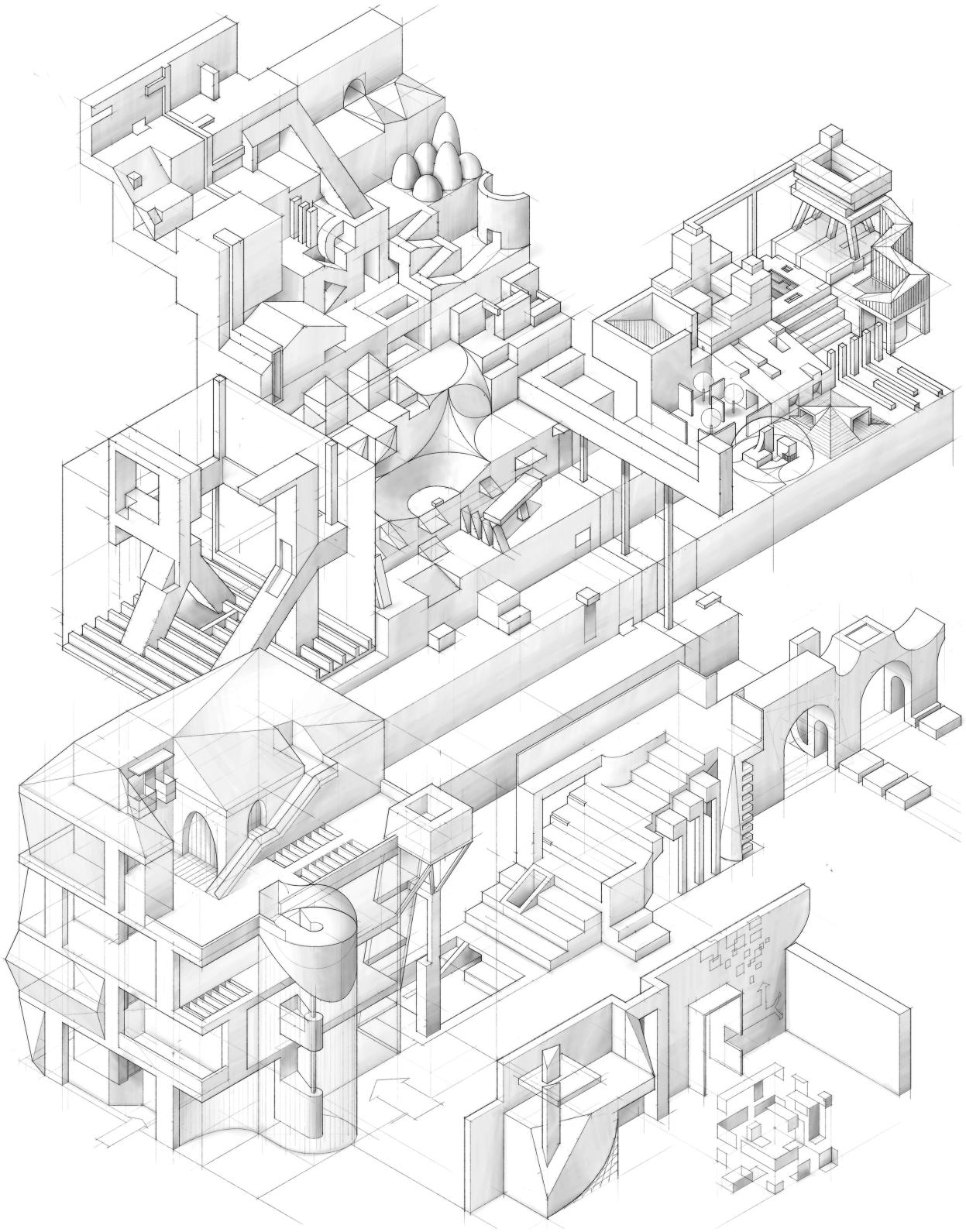

Figure 2. Assemblage and synthesis of various digitally hand-drawn isometric studies. iPad and Procreate. By the author.

technology, but technology can do without them."[37] Only two months later, architect and self-identified Post-digitalist, Adam Fure, offered some clarifications to the definition of Post-digital to which Carpo was responding. The digital avant-garde championed by Carpo, Fure says, tends to focus too narrowly on the novel and exotic cutting edge of digital tools. Post-digital, he says, "calls for a critical examination of the tools and technologies we take for granted."[38] He continues, "the mundane activities of daily digital life are arguably as important as the most technically sophisticated work with machines [...] as they affect more people."[39]

With this exchange, the potential for tablet-based digital drawings to provide new avenues of exploration for digital craft in architecture is made clear. The ubiquitous iPad represents exactly the kind of powerful but prosaic digital tool overlooked by the digital avant-garde. Further, the potential for alienation in architecture from no longer crafting images directly, evidenced by the emergence of Post-digital collage, is resolved by the simple fact that iPads trace the movement of your hand instead of the selection of points. Because a stroke on an iPad captures at least gesture and pressure, the empathic marks of the work attests to the individual behind the drawing, despite it being a digital drawing. Further, the priority of the hand is balanced with sophisticated graphics computation to provide graphic tools for an unmatched range of visual style (not to mention digital fundamentals like 'undo' and layers).

I will conclude by listing several of the most exciting potentials for tablet-based drawing and digital craft. These observations derive from approximately two years of the author's own case-study of crafting various kinds of drawings using and iPad Pro and Apple Pencil 2. These topics represent genuine moments of revelation that occurred while this digital native (and former tablet-skeptic) explored the tool.

First, the most jarring potential is the ability to make realistic, complex, and organic material textures by directly drawing or painting them. This is particularly interesting in relation to the collage school of Post-digital representation. The 'found' aspect of collage is, of course, meaningful in its own way. That said, the ability to create custom textures of marble, wood, or plaster, complete with the inconsistencies and willful figuration that defies algorithmic definition is a new level of authorship for architectural image-making. Further, one can create a catalog of elements that can be collaged into a new drawing, all of which was directly delineated by the architect, as shown in Figure 1.

Second, is the familiarity with form and geometry that is required to manually construct projections. Although certainly slower than digital modeling and raytraced rendering, manually constructing forms, shadows, reflections, and materiality provokes a level of intimacy with visual qualities that is meaningful. I would argue that the surreptitious training in geometry required of any manual construction reveals properties that can be functionally useful in design. Similarly, the geometric lessons gained while hand drawing provide a firmer basis for defining parametric operations when you do need to work faster and with more complexity. The same is true with material effects – one considers the play of light and subtle distinctions in color and reflectivity, for example, when one draws them instead of selecting them.

A cousin to the limited speed of hand-constructing drawings is the embrace of limited resolution in raster-based drawings. The net result is a freer exploration the image because one must only resolve two dimensions instead of three and at a fluid level of precision governed only by the desired visual result. Infinitesimal floating-point precision can be deferred until it is needed to implement a defined visual goal.

Third, the range of graphic manipulation (which architects use daily in Photoshop and Illustrator) combined with the strokes of almost limitless brushes (which architects far more seldom use) provide a functionally limitless range of visual style. This visual range seems, to the present author, to translate into a range of architectural styles explored within the drawing, too. The drawing examples included here attest to that fact as affinities can be seen even to the diverse styles discussed above: piecewise discrete aggregations (Fig. 2), scenographic collaged vignettes (Fig. 1), object-scale material studies (Fig. 3), curvaceous blobs (Fig. 4) and old school constructions (Fig. 5).

Fourth, the pandemic has created an unprecedented challenge of working with design students remotely. All at once, the ability to pick up a pencil or marker was largely replaced with crude markups through web-meeting platform annotation tools. In-person distancing has stifled the ability to huddle together and work out designs through drawing. The ability to transmit a crafted drawing instead of just a markup has perhaps never been more important – not only for design but for drawings that carry something human into the isolation of remote learning. Certain drawing-intensive critique scenarios, like working through schematic plan layouts in second-year design, have proved the necessity for rich hand-drawing in remote teaching.

Finally, work currently underway in my own graduate level seminar is exploring "New Media and Two-dimensional Architectural Drawing." Students are combining tablet drawings with the two-dimensional game engine, Construct 3, to explore new ways of *interacting* with natively two-dimensional architectural drawings. Two observations fuel the work. First, three-dimensional modeling and visualization have advanced so quickly that two-dimensional drawings are seen as a static glimpses of more-meaningful three-dimensional models. Second, billions of people around the world interact with sophisticated two-dimensional graphics through mobile digital games and apps every day. Architectural drawing may find new audiences by prioritizing two-dimensional drawing in this space.

Figure 3. Object-scale material study with digitally hand-drawn textures. iPad and Procreate. By the author.

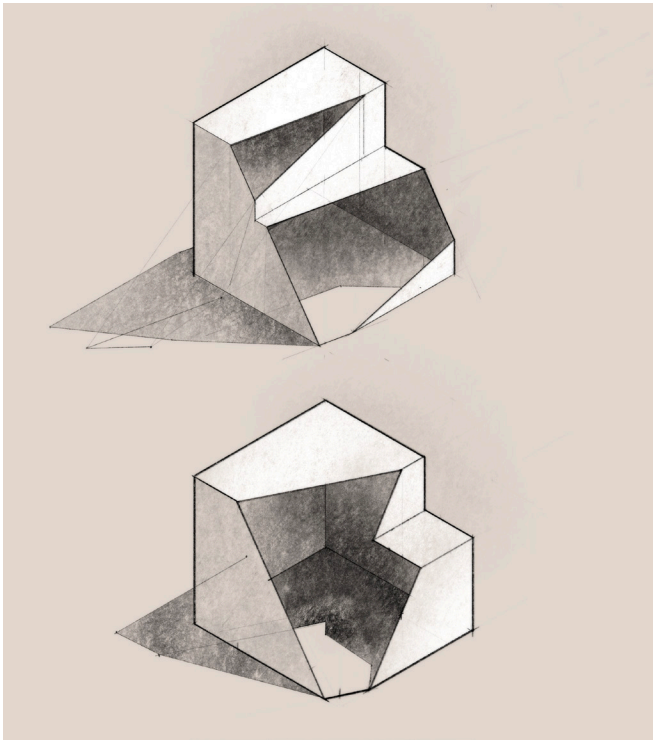

Figure 5. Digitally hand-constructed and shaded geometry studies. iPad and Procreate. By the author.

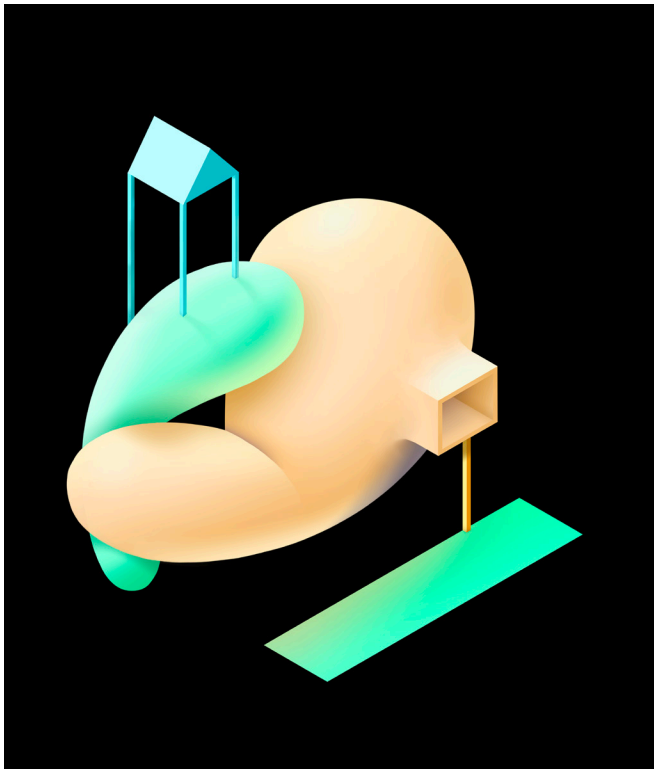

Figure 4. Digitally hand-drawn and shaded study of curvilinear forms. iPad and Procreate. By the author.

ENDNOTES

1. Eugene McCarraher, *The Enchantments of Mammon: how capitalism became the religion of modernity*, (Cambridge, MA: The Belknap Press of Harvard University Press, 2019), 11
2. McCarraher, *Enchantments*, 310.
3. Even the early Bauhaus extolled handicraft, masters, apprentices, and a guild "without class distinctions" see Gropius, Walter. "Program of the Staatliches Bauhaus in Weimar," in Ulrich Conrads edited *Programs and Manifestoes of 20th-century Architecture* (Cambridge: MIT Press, 1975), 49
4. This is, no doubt, a personal synthesis of a far-ranging and surprisingly bi-partisan idea. Karl Marx is most associated with it, but one can find more than one papal encyclical dedicated to the "condition of the worker," for example. See St. John Paul II. *Centesimus Annus*. Vatican website. Mat 1, 1991. http://www.vatican.va/content/john-paul-ii/en/encyclicals/documents/hf_jp-ii_enc_01051991_centesimus-annus.html and Leo XII. *Rerum Novarum*, Vatican website, May 15, 1891, http://www.vatican.va/content/leo-xiii/en/encyclicals/documents/hf_l-xiii_enc_15051891_rerum-novarum.html.
5. This complex idea has appeared in various permutations since its popularization in the 19th Century, but it commonly illustrates the transition from relatively independent worker craftsman of the premodern era to the division of labor typical of corporate industrial manufacturing. The definition of the paper draws from a useful description of its origin in Hegel and adoption by Marx in Frederick Copleston, *History of Philosophy* (New Jersey: Paulist Press, 1963), vol.7: 204, 329.
6. "One person's discrete brick, so the saying goes, is another person's component in a continuous wall," Neil Leach points out in his "counterpoint" essay concluding the 2019 special edition of *Architectural Design, Digital Discrete: Reappraising the Digital in Architecture*. Neil Leach, "There is No Such Thing as a Digital Building: A Critique of the Discrete," in *Discrete. Reappraising the digital in architecture*. Special issue of *Architectural Design*, no. 2 vol. 89 (March/April 2019): 137.
7. Gilles Retsin, et al, *Discrete. Reappraising the digital in architecture.* Special issue of *Architectural Design*, no. 2 vol. 89 (March/April 2019)
8. Mario Carpo discusses this idea at length in Mario Carpo, *The Second Digital Turn: Design Beyond Intelligence* (Cambridge: MIT, 2017)Bottom of Form, 65-79.
9. Phillipe Morel, "The Origins of Discretism, Thinking Unthinkable Architecture," in *Discrete. Reappraising the digital in architecture*, Special issue of *Architectural Design*, no. 2 vol. 89 (March/April 2019), 15. For an example of robotic construction, see Mollie Claypool, "Our Automatd Future: A Discrete

Framework for the Production of Housing," in*hitectural Design*, no. 2 vol. 89 (March/April 2019), 50

10. Gilles Retsin, "Introduction: Discrete Architecture in the Age of Automation," in *Discrete. Reappraising the digital in architecture*, Special issue of Architectural Design, no. 2 vol. 89 (March/April 2019), 10
11. Ibid
12. John Ruskin, "Modern Manufacture and Design," in John Ruskin and John D. Rosenberg, *The Genius of John Ruskin: Selections From his Writings* (Charlottesville, VA: Univ. Press of Virginia, 2000), 227
13. Retsin, "Introduction," 8, 13
14. John Ruskin, "Unto This Last," in John Ruskin and John D. Rosenberg, The *Genius of John Ruskin: Selections From his Writings* (Charlottesville, VA: Univ. Press of Virginia, 2000), 255
15. Michael Young, "Natural is Not In It," in *Assembly: post digital craft : Yale School of Architecture*, Studio Book Series, ed. Buck, Brennan, David Bench, and Jacqueline Ho (New Haven, CT: Yale University School of Architecture, 2012)
16. Young, "Natural," 31.
17. See Lewis Mumford, "Pioneers of Mechanization," in *Technics and Human Development – The Myth of the Machine* (New York: HBJ, 1967), vol. 2: 263-294.
18. McCarraher, *Enchantments*, 479
19. Mario Carpo, "Digital Craftsmanship," in *Discrete. Reappraising the digital in architecture*, Special issue of Architectural Design, no. 2 vol. 89 (March/April 2019), 19
20. Mumford, "Pioneers," 272
21. Mumford is the first to note the peculiarities of Monasticism that enabled many of its successes. For Mumford, though, this does not detract from the magnitude of their innovation, which was to dignify labor, first; and then to embrace labor-saving machines such as the water and wind mills to avoid spiritually and intellectually numbing levels of physical fatigue.
22. Mumford, "Pioneers," 269
23. Young, "Natural," 31
24. Ibid, 38,34
25. See Mario Carpo, "Post-hype Digital Architecture," cited in Young, "Natural," 37.
26. Young, "Natural," 34
27. McCarraher, *Enchantments*, 308.
28. See Cameron MacDonell, *Ghost Storeys* (Montreal: McGill-Queens University Press, 2017), 24. "[Cram] was both a fierce optimist and a dire pessimist, a Romantic visionary and a blunt pragmatist, an advocate of democracy (after a fashion) and a conservator of monarchy, an overt racist and a sincerely inclusive collaborator."
29. Ralph Adams Cram, *The Ministry of Art* (New York: Houghton Mifflin, 1914), 160, https://archive.org/details/ministryofart00cramiala/page/n7/mode/2up
30. Cram, *Ministry*, 158
31. Ibid
32. Cram, *Ministry*, 161
33. John Ruskin, "The Seven Lamps of Architecture," in John Edward Tyas Cook and Alexander D. O. Wedderburn editors, *The Complete Works of John Ruskin, Library Edition* vol. 8, 214, https://www.lancaster.ac.uk/media/lancaster-university/content-assets/documents/ruskin/8SevenLampsofArchitecture.pdf
34. Note this is a different claim than deducing a human must have been involved with the production of an object by virtue of its existence and calling however many technicians might have been involved craftsmen. In any case, the clarity of this kind of deduction is fading in the age of artificial intelligence which by definition aims to come as close as possible to computer-autonomous authorship in a range of disciplines.
35. Carpo, *Second Digital Turn*, 80.
36. Sam Jacobs, "Architecture Enters the Age of Post-Digital Drawing," *Metropolis*, March 2017, https://www.metropolismag.com/architecture/architecture-enters-age-post-digital-drawing/
37. Mario Carpo, "Post-Digital 'Quitters': Why the Shift Toward Collage is Worrying," *Metropolis*, March 2018, https://www.metropolismag.com/architecture/post-digital-collage/
38. Adam Fure, "What does it really mean to be 'post-digital' in architecture and beyond?" *The Architect's Newspaper*, May 2018, https://www.archpaper.com/2018/05/postdigital-for-the-record/
39. Ibid