

Substrate, Platform, Interface, Format

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ABSTRACT

The rise of digital technologies in the 1980s led to the development of new formalist frameworks, as scholars tried to identify what distinguished so-called “new media” from all that came before it. Tracing this history across textual and media studies, I show how this formalism catalyzed the desire for more comparative histories of media even as it increased misunderstandings across fields. I then introduce and define four words that cut across textual and media studies: substrate, platform, interface, and format. Together, these terms offer a shared, cross-disciplinary schema for describing the media technologies that store, transmit, and process human culture.

THIS ESSAY ATTEMPTS TO DEVELOP A SHARED, FORMALIST FRAMEWORK FOR describing the material structure of all technologies that mediate human culture. At its most ambitious, the system that I develop here aims to encompass every physical object that humans have devised for storing, transmitting, and processing knowledge about themselves and their worlds, from first-century Roman scrolls and Nepalese palm-leaf manuscripts to a vinyl LP pressed in Detroit; from an Incan quipu to a broadside printed in Dublin in 1783 or an IBM tape deck. More realistically, the outcome may be a robust assessment of the relationship between book history, bibliography, and media studies at a moment when these fields are borrowing terms and concepts from each other, sometimes without deep knowledge of their origins.

This framework grows out of, and beyond, two concurrent strands of media formalism: textual studies after the sociology of texts and digital studies after hypertext theory. I begin by sketching the rise of these fields over the last three decades, attending specifically to how individual thinkers have schematized materiality. I then introduce and define four terms that reconstruct a bridge between them: *substrate*, *platform*, *interface*, and *format*. *Substrate* and *interface* refer to material structures; *platform*

and *format* refer to the materially-determined relationships that enable these structures to operate. On its own, each term illuminates the various functional components that make up any media technology. Together, they comprise a set that is, or by design should be, capable of describing how these components assemble into a functioning system. Both the individual terms and the framework as a whole provide a metric for comparison across time and discipline and thus contribute to collective efforts to research transdisciplinary histories of media and mediation. When combined with field-specific theories of reception, circulation, and experience, which these terms do not specifically address — like Robert Darnton's communications circuit or Stuart Hall's reception theory — this schema provides a more stable ground on which to analyze the material conditions of human worldmaking.

This formalist framework aspires to capture something common to the structure of media technologies, by which I mean, again, the material objects that mediate human knowledge. However, it is important to emphasize that I make no metaphysical claims about technology's fundamental nature. I take Alex Galloway's point that technological formalism has overemphasized media at the expense of understanding mediation — or as he puts it, has focused on “artifacts for storage, transmission, or processing” over “their supposed predicates: storing, transmitting, and processing” (2012, 18). Accordingly, I have designed this schema with a sense for media objects as both material things that their users perceive and experience as discrete objects *and* as a set of processes with variable boundaries not always accessible to human perception. Both things and processes might also be nested within each other. For instance, in my daily interactions with my laptop, I recognize and treat it as a discrete, individual thing that processes my direct inputs as well as its own communications with other devices, like my home wireless router. It also contains and activates, through these interactions, many other interconnected things and processes with their own protocols, each of which, ideally, might be described using the schema outlined in this essay. But none of the terms that I use to identify these components point to something that is in an ontological sense real. Rather, these words have their own entangled histories, to which I attend below. By drawing them together into a coherent framework, my primary goal is to reveal shared questions across multiple fields, as they are presently configured, and make possible new ways of answering them.

Thirty Years of Formalism

As computing technologies and access to the internet spread in the 1980s and 1990s, their materiality, functioning, and capacity seemed utterly unlike that of print- and paper-based media. This perceived novelty spurred scholars of literature, film, and media to articulate precisely which features distinguished “new” from “old” media, digital from so-called analogue technologies; and so new descriptive vocabularies flourished.

In textual scholarship, this line of thinking began when, sweeping aside earlier book-based conceptions of bibliography as “too limited”, D. F. McKenzie expanded the field’s definition of a “text” to incorporate all “recorded forms” (12). This included “verbal, visual, oral, and numeric data, in the form of maps, prints, and music, of archives of recorded sound, of films, videos, and any computer-stored information, everything in fact from epigraphy to the latest forms of discography” (13). Working within this wider purview, the task of the textual scholar is not merely to edit texts *in light of* their various material instantiations, McKenzie argued, but to “show that forms effect meaning”: that is, that the material stuff that helps convey any expression inevitably shapes, even determines, how and under what conditions it will be received and thus what it means (13). Here, bibliography broadens to become “the study of the sociology of texts”, which includes the systematic analysis of their transmission, circulation, and reception (13). McKenzie’s work has been highly influential in textual scholarship, to the extent that anyone working with what are often called “material texts” today can trace their own methods back to his arguments. Most recently, Matthew Kirschenbaum has applied McKenzie’s insights to digital texts, specifically how word processing software mediates the writing process through electronic inscriptions (2017, 2021). The success of Kirschenbaum’s approach has underscored the capaciousness of McKenzie’s original formulation.

Around the same time that McKenzie was showing how forms effect meaning, digital technologies like HyperCard and the Text Encoding Initiative’s technical standard were beginning to impact editorial methods and practices. As Joris van Zundert has argued, this “trading zone” between textual scholarship and computer science has created a “methodological pidgin” within digital humanities, a reduced (and sometimes reductive) shared vocabulary that influences how digital tools, editions, and interfaces have developed (87, 88). The origins of this pidgin might be traced back to early theorists who experimented with digital technologies. For instance, drawing on the language of cybernetics, communication theory,

programming, and biology, Jerome McGann in 1991 described the “textual condition” as “an interactive locus of complex feedback operations” and the text itself as “a laced network of linguistic and bibliographical codes”, where the “noise” of material form contributes critically to an expression’s “message” (12–14). Elena Pierazzo, too, has applied communication theory to editorial practice while emphasizing “modeling” — an idea adapted from statistics and quantitative methods — as “the key methodological structure of digital editing” (5). And Peter Shillingsburg has extensively and precisely conceptualized the materiality of texts through what he calls, following speech act theory, “script act theory”, a toolkit for unpacking the space of possibility for a text’s reception from its physical mediation, regardless of the underlying technology (1997, 2016). Thus bibliographers — working in the wake of McKenzie’s widened definition of the field, and in collaboration with actual technologies — have analyzed at length the relationship between texts and their manifold physical forms, from print to digital.

More recently, the idea of the sociology of texts has been given new currency in Elaine Treharne and Claude Willan’s taxonomy of “TEXT technologies”, a “capacious analytical and interpretive framework” for teaching and studying transmedia histories of the textual condition (1). Like McKenzie, they define a TEXT (which they write in small caps to distinguish it from the ordinary usage of “text”) broadly as any “voluntarily and intentionally human-created phenomenon that contains and imparts an interpretable and meaningful message, accessible to a community of receivers” (2). It might be a medieval manuscript, or a chair. From there, they develop a “core triad of concepts that might be thought of as the structure of all text technologies”: intentionality, materiality, and functionality (4). A “secondary triad” of production, transmission, and consumption helps “teas[e] apart the different stages through which a text moves” (22). Treharne and Willan’s schema shares many goals with my own, most especially that of developing a transdisciplinary vocabulary for discussing any object that stores and transmits human knowledge. However, whereas they treat materiality as one component within their larger framework, the present system focuses only on physical structure and so aims to offer a fuller, more detailed picture of the *objectness* of media technologies. For instance, they describe materiality as the adaptive pairing of a “substrate” and a tool used “to inscribe, stamp, manipulate, stimulate, modify, or otherwise interact with the substrate” (11); I augment this dyad to include the ways that substrates become platforms through the protocols of formatting and the physical joining of interfaces. I also prefer the term “media” to “TEXT”, which tends to perpetuate a limiting textual bias, even if only superficially.

Running concurrent with these developments in bibliography and textual scholarship were three overlapping waves of digital formalism in media, film, and literary studies. The first turned to the material structure of media objects as a means of understanding the seemingly novel structure of hypertext and other interactive interfaces, much as those textual scholars working in the wake of McKenzie had analyzed digital texts in general, and in fact some scholars like McGann and Kirschenbaum were working across both fields (McGANN 2001; KIRSCHENBAUM 2002). For instance, George Landow, a scholar of Victorian literature, showed how hypertexts make material the interventions of poststructuralist literary theory and in doing so catalyzed interest in electronic literature (1992). Perhaps the most influential theory of the 1990s was Espen Aarseth's "typology of cybertexts", a vocabulary for identifying the unique features of what he dubbed "ergodic literature", in which "nontrivial effort is required to allow the reader to traverse the text" (1). Ergodic literature need not be electronic; as Johanna Drucker (2008), N. Katherine Hayles (2020), Jessica Pressman (2021), Amaranth Borsuk (2012), and Élika Ortega (forthcoming) have shown, many artists' books and experimental novels exhibit "ergodic" traits. However, it was the structural novelty of hypertext literature and computer games, where the reader-player's agency assumes greater importance, that inspired Aarseth's intervention.

Meanwhile, in film and media studies, Lev Manovich was developing his own language of new media. According to Manovich, this set of five principles name "the emergent conventions, recurrent design patterns, and key forms" of digital technologies: they use *numerical representation*, are *modular*, allow for the *automation* of operations, exhibit *variability*, and enable cultural *transcoding* (12). As in Aarseth's typology, these principles emerge in Manovich's work through comparative shifts between earlier technologies (in his case, film) and close readings of digital interfaces. So important was comparison to these early taxonomies that Jay David Bolter and Richard Grusin gave the transfer between existing and emerging media a name: *remediation* (1999). As Bolter emphasizes, the term *remediation* was an attempt to dissolve the "tension between formal and cultural theories" of media by explaining the exchange of characteristics between older and newer media forms, especially the ways in which the former appropriate the cultural cachet of the latter (2002, 77).

As scholars debated these new terms, metaphors of surface and depth entered the discussion, returning focus to the material architecture of digital technologies. "Print is flat, code is deep", Hayles declared in the title of her widely-circulated 2004 essay introducing "media-specific

analysis”: a method of reading that “attends to both the specificity of the form” of literature “and to citations and imitations of one medium in another”, in the vein of remediation (69). Honing this formula, Kirschenbaum distinguished between the “formal materiality” of interfaces and the “forensic materiality” of their underlying storage devices. While Kirschenbaum’s overall project intended to “move beyond the formalism and poststructuralism that has characterized much of the writing about electronic texts”, his distinction in fact had the effect of enabling a more nuanced formalism than the first wave’s blunt taxonomies, and it has been widely taken up in the literature (2008, 17). For instance, Dennis Tenen has recently built on both Hayles’ and Kirschenbaum’s surface/depth imagery to describe digital media as containing *textual laminates* of formal and forensic materialities; analyzing these forms thus “involves the delamination of media composites” into their constituent layers (115). In perhaps the most extreme application of such metaphors, Benjamin Bratton has described the planet’s networked “megastructure” as “the stack”. Encompassing not just a single digital object but the entire technological apparatus, from smart grids to cloud storage, Bratton’s “stack” is, he argues, transforming politics, the social order, and governance across six interlocking registers: *Earth, Cloud, City, Address, Interface, and User*.

Bratton’s hybrid approach signals, and to some extent participates in, a third wave of digital formalism: a recent return to earlier efforts to taxonomize digital media, newly understood — in the wake of the material turn — as “objects” in themselves. In their widely-cited paper, “A Theory of Digital Objects”, Jannis Kallinikos and a team of information scientists from the London School of Economics argue that overemphasizing social influences has led the field to neglect the novel and conditioning materiality of digital forms and formats. To counterbalance this trend, they, like Manovich, assign digital media “a limited set of qualities that places them apart from other non-digital devices and systems (paper-based) for managing information”: they are *editable, interactive, open* (or *reprogrammable*), and *distributed* (2010, online). Such formal distinctions, they argue, are necessary “to account for the making of the interconnected information environment in which we live” and to appreciate the “new problems and risks” associated with the shift toward digital circulation and archiving (2010 online; see also LEONARDI et al. 2013). Because digital objects are capable of changing due to the intervention of human coders, other algorithms, or new data, philosopher Yuk Hui goes so far as to argue

that no philosophy of substance can adequately describe their materiality.¹ As he writes:

One can rewrite the whole code of a digital object, change its identity, and delete it in a second: what, then, is the substance of a digital object when its nature and identity are totally changed from point A to point B? One has to go down to the level of signals and voltages, but as we saw in the previous paragraphs, at that level objects become inconceivable. The question of substance proves bankrupt here.

(2012, 394)

Even as the materiality of digital media seems to recede into evanescent signals and voltages in this body of work, previously intangible relations come into being physically through the exchange of data, code, and information across dispersed digital infrastructures. Thus Hui argues for a shift away from a theory of technical objects grounded in questions of substance and toward a theory of relations, where objects are not isolated from but are constituted in their connectivity to all others.

As even this brief survey makes clear, media formalism across multiple disciplines has helped clarify the unique characteristics of digital artifacts. In the process, it has boosted a range of necessary new methods and practices, from hypertext literature and electronic editing to critical close readings of code. However, focusing on computational media's *differences* has also exaggerated the perceived split between old ("analogue") and "new" (digital) technologies and thus obscured connections across time, material form, and disciplinary approaches. Mutual misreadings pervade this breach. For instance, in their drive to justify the presumed novelty of digital technologies, some media scholars have flattened the complex materialities of print, paper, and all that is dubbed non- or, more confusingly, "pre-"digital. Tenen's recent study of formats shows these tendencies when he compares "more diffuse" electronic books to presumably "stable" printed books, a claim that runs directly counter to insights of the sociology of texts (2017, 111–14). At the same time, book

1. I am boiling down a dense philosophical argument for the sake of clarity. Hui writes: "A theory of digital objects demands a synthesis between Simondonian individualization and the Heideggerian interpretation of ready-to-handness (Heidegger would reject the idea that Simondon's thesis regarding technical objects poses any ontological questions, while Simondon would very much like to separate the technical from the social)" (2012, 393).

historians are increasingly adopting digital terms to describe premodern periods without acknowledging their origins. The *Broadview Introduction to Book History* (2017), edited by Michelle Levy and Tom Mole, incorporates chapters on “Intermediality” and “Remediating” but never cites Bolter and Grusin on “remediation” — a term they originally devised to *distinguish* “new media” like hypertext from the printed materials covered in Levy and Mole’s *Introduction*. Similarly, Garrett Stewart’s *Book, Text, Medium* (2020) frequently adopts the term “platform” as an imprecise substitute for “codex” and even includes a chapter on “Platformatics” without citing relevant literature from platform studies, internet studies, or technology studies more broadly.

Cross-fertilization and frictive comparisons between fields can be generative, shaking up assumptions and bringing outmoded concepts into focus, and work by McGann, Kirschenbaum, and Hayles are exemplary in this respect. However, borrowing terms devised to address field-specific questions without engaging the relevant literature can also prevent potentially more fruitful connections from taking root. Thus both digital textual scholarship and digital formalism within media studies have failed to lay the foundations for deeper histories of making and mediation across multiple forms and formats — despite the clear desire for more comparative and historicist work across all fields. The time is ripe, then, to step back and reconsider a shared schema for analyzing media objects. For the remainder of this essay, I develop such a framework from the basis of four components: *substrate*, *platform*, *interface*, and *format*. In what follows, I define each term in turn, setting it within its historical, semantic, and field-specific contexts, while keeping an eye toward connections between them.

Substrate

sub [beneath] + *sternere* [to stretch out, spread, scatter], Latin

With microscopes and spades, the new scientists of the eighteenth and nineteenth centuries were discovering wondrous worlds just beneath apparent reality: colorful layers of sediment stacked below the landscape; the grammatical groundwork of a language; the manifold surfaces upon which a seed might take root. It is in these fertile soils of inquiry that the English word *substrate* germinates. Meaning, in its contemporary definitions, both a foundation and an underlying layer, a substrate serves as

a material bedrock, the primary *stuff* from which other things — chemical reactions, meaning, plants — spring.

In Western philosophy, the word “substrate” taps deeply into the concept of *substances*, a term of art with a long, complex history. For Aristotle in one still-influential strand of his thought, a substance contains a *substratum* which marries *sensible form* and the *matter from which that form is made*. A substance is not, then, simply the smallest constituent units of matter, but matter at the point where it meets its intended function. Thus the substance of one printed version of this essay is not its chemical properties expressed in a formula, nor is it simply “paper”, undefined by its particular qualities. Rather, we might name its substance as cold-paste ink sitting on top of an acid-free (i.e., archivable) rag stock paper that is smooth enough to hold it (i.e., printable). In a different material form, its substance changes. For instance, as a digital PDF open on my MacBook’s Preview software, this essay’s substance would be, in part, electric charges stored at a set of addresses in my laptop’s random-access memory chip, not just the matter from which that chip is made. Because these charges refresh every 64 milliseconds, the digital version’s materiality is, as Hui has pointed out, dynamic and *in motion*, even as its Aristotelian substance remains roughly the same. Since the PDF is open on my screen, its substance might also include the changing pattern of liquid crystals that make it legible to me.

Merging some sense of this Aristotelian definition with the eighteenth-century origins of our modern word *substrate*, I define a substrate as *the nonsymbolic, asemic matter that enable a media technology to store, record, and playback cultural memory, defined in relation to its function within the broader system*. It is the most basic, bedrock unit(s) of materiality needed to describe and understand a device’s operation. This definition differs slightly from Treharne and Willan’s notion of a substrate as simply “the matter or surface or support on which the text is created”; but by folding in function, I take their broader point that any technology’s materiality brings together matter with some tool of inscription that enables that matter to mediate an intentional expression.

This definition of the word *substrate* brings clarity to the concept of materiality in two related but disparate threads of media scholarship. The first is digital materialism, or more specifically what Kirschenbaum, as mentioned above, has influentially described as a computer’s “forensic materiality”: “the amazing variety of surfaces, substrates, sealants, and other matériel that have been used over the years as computational storage media”, as well as a broader array of “engineering, ergonomic, and labor practices that attend computation — everything from labeling a diskette

[. . .] to the contours of the keyboard and mouse” and “the growing crisis of e-waste” (2008, 10–11). Correcting the screen-centrism of much digital literary studies, the notion of forensic materiality has brought to the fore the fundamentally physical nature of all digital inscription, even when it requires special imaging to see. The second is what Nicole Starosielski has dubbed “elemental analysis”, a concurrent turn at the intersection of ecocriticism, environmental humanities, and digital studies. Elemental analysis takes seriously “media’s material and conditioning substrates” and especially their connection to the earth, from the precious minerals mined to power iPhones and the server farms that make up “the cloud” to the undersea internet cables and environmental devastation wrought by heaps of e-waste in India (2019, online; MATTERN 2017; PARIKKA 2015; GABRYS 2011; PETERS 2015; COHEN and DRUCKERT 2015). While the wide range of thinkers working on both digital materialism and elemental analysis have sporadically dropped the word “substrate” into their work, drawing it out explicitly as a term of art, as defined above, hones the focus: it is not just any layer of stuff but *matter whose qualities enable a form to function*.

Because “substrate” is not a digital-specific term, it also connects these contemporary movements in and around media studies to similar turns in bibliography and book history. The origins of handmade paper in flaxseed, the wood of book boards, the leather of bindings and cords: all have been taken up recently as subjects for serious study, as book historians drill down from the layout of a page, its typography, or a book’s paratexts to the deeper networks of matter undergirding text technologies (SENCYNE 2020; CALHOUN 2020; DA ROLD 2020). This new interest in “scrutinizing surfaces”, as one special issue puts it, has highlighted how the formal qualities of certain materials have constrained or enabled various genres or modes of writing (OAKLEY-BROWN and KILLEEN 2017). To take just one example, Ann Blair, Roger Chartier, Peter Stallybrass, Don Skemer, and Ted Stanley have shown how erasable tablets made of paper coated with gelatin, amber varnish, or gesso supported the notetaking habits of Renaissance humanism and helped paper meet the rising bureaucratic demand of global mercantilism during the sixteenth and seventeenth centuries (SKEMER and STANLEY 2015; STALLYBRASS et al. 2004; STALLYBRASS 2006; CHARTIER 2007). In the near future, biocodicology may shift attention toward the genetic and chemical makeup of a book’s substrates, enabling teams of bibliographers, scientists, and conservators to tell — in collaboration with digital media scholars working in elemental analysis — much longer histories of the environment, global supply chains, and their entanglement over time (STINSON 2009; FIDDYMENT et al. 2019; HEDGES 2013).

Platform

platte [flat] + *forme* [form, shape, figure], French

If the Latin root of “substrate” refers to layers of matter stacked beneath a surface, “platform” is, in its French origins, the surface itself, the flat (*plate*) shape (*forme*) upon which objects are arranged. Literally, it is any lifted, level area, like the open terrace at the top of a building or boat; the walkway beside a train; a stage; or a plateau. Figuratively, this raised structure becomes a metonym for what it supports. Thus the platform of a church is the set of principles it promises to uphold; of a movement, a plan of action; of a political party, the positions advocated by those speaking from the top. Because a platform is a surface or exterior — contra other architectural metonyms like “foundation” or “bedrock”, both buried at a building’s base — its metaphorical use does not point down to a thing’s origins but looks outward toward a speculative future. That is, it is not the world one *has* built, but a model, pattern, or design for a world *desired*.

In the middle of the twentieth century, inertial platforms — devices that help stabilize a moving surface in relation to another point — were combined with computers in aeronautic and ballistic systems, giving rise to the use of the term within the technical literature. Later, as personal computing developed, the word “platform” transferred to the architectural hardware on which an operating system or applications might be built and run. In a 2007 blog post that has proved influential, Marc Andreessen defines this computational sense of platform as “a system that can be programmed and therefore customized by outside developers — users — and in that way, adapted to countless needs and niches that the platform’s original developers could not have possibly contemplated, much less had time to accommodate” (online https://pmarchive.com/three_kinds_of_platforms_you_meet_on_the_internet.html). The explosion of digital platforms and applications since then has expanded and diluted his definition, as companies like YouTube now strategically drift between literal, figurative, and computational uses of the word, as Tarleton Gillespie has shown. Thus digital and social media “platforms” are simultaneously a stage for promoting oneself, a set of libertarian principles, and an actual computer program that runs applications. They also move through a life cycle and can die, as underlying technologies become obsolete or users move on to other systems (LINGEL and McCAMMON 2022).

Around 2009, Nick Montfort and Ian Bogost offered “platform studies” as a field that might “connec[t] the fundamentals of digital media work

to the cultures in which that work was done and in which coding, forms, interfaces, and eventual use are layered upon them” (147). In justifying their approach, Montfort and Bogost emphasize that studying platforms forces media scholars to reckon with hardware and therefore has the potential to redress the screen-centrism of media studies. Thus while many scholars have attended to media at the level of *reception/operation*, including reader-response theories and media effects; their *interfaces*, through HCI, literary criticism, and the concept of remediation; their *form/function*, with the development of cybertext studies and ludology; and their *code*, through software studies and aesthetics, platform studies asks scholars to dig into “the abstraction level beneath code”, including “computing systems and computer architecture”, which “has not yet been systematically studied” (147). As the surface/depth metaphors in their analysis suggest, platform studies might be seen as participating in the second wave of media formalism; and like the other formalist approaches outlined above, it deals only with *digital* technologies, delineating what is new, electronic, or computational from all other media. In fact, Bogost and Montfort explicitly adopt Andressen’s definition of a platform as a system that can be programmed, and the series they edit tends to conceive of it even more narrowly as gaming consoles, with six of the eleven volumes published thus far covering them (CUSTODIO 2020; THERRIEN 2019; ARSENAULT 2017; ALTICE 2015; JONES and THIRUVATHUKAL 2012; MONTFORT and BOGOST 2009).

While in principle, then, platform studies has the potential to galvanize more materialist methods, in practice, it has tended to serve as, in Dale Leorke’s critique, a specific “brand” of scholarship focused narrowly on digital gaming and creative computing. By emphasizing consoles, this “brand” has, as Jussi Parikka and Thomas Apperly point out, conceptualized platforms as stable, consistent physical objects — “the” Atari, “the” Game Boy — when in fact they function more a set of techniques that only come into being as a uniform artifact “in the process of ‘doing’ platform studies” (353). Galloway’s intervention, mentioned above, is relevant here: as he stresses, computational technologies are not discrete objects, as the word “platform” would have us believe, but permeable bundles of processes and effects. Thus the rise of relational thinking in philosophy and media studies, evident in the third wave of formalism, presented challenges to platform studies from the moment it was proposed as a field of study.

Widening the gambit of the technologies being analyzed and expanding the field’s historiography to encompass the insights of media archaeology, textual scholarship, and bibliography would result in a different approach

to the platform: one that does not define it as a discrete, programmable package, but which activates all senses of this semantically rich word. Media objects are stages for content — think, for instance, about the way the codex as a designed system provides the dynamic surfaces upon which texts are arranged — and in the process become metonyms for what they support (“book” refers to the structure of the codex, its content, and the principles culturally signified by “bookishness”). They are also blueprints for future use, with intended function often following physical form. And even non-computational platforms are “programmable”, if programming means not just digital coding but setting the parameters of operation. For instance, a platform like the codex becomes programmable through McGann’s “bibliographical codes”, the protocols by which it functions to convey meaning. Michelle Warren brings these concepts together in her recent work tracking the long life of a single medieval manuscript from its making in twelfth-century England, to its re-packaging for nineteenth-century readers, to its various instantiations online today as JPGs and OCR-derived text. Attending meticulously to the ways that these different material forms shape the text’s reception and meaning, she argues that

The platform concept casts all book forms as ways of knowing rather than ways of being: from different vantage points, a book is a platform, a product of other platforms, and a component of still other platforms. Platforms gather points of history and then scatter, flatten, and fuse them.

(29–30)²

Thus while platform studies has helped illuminate the need to study technological systems, and to do so within their material and cultural contexts, this approach would gain more power from being in discussion with other, more historically-savvy fields.

Reconsidering the role of this word in the study of material technologies, then, we might revise and historically broaden platform studies’ definition

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2. Warren makes a further distinction between platform philology, or “practices of textual production that obscure the individuals who bring texts out of manuscripts and into wider circulation”, and platform codicology, “practices in publishing that influence how edited texts circulate as part of larger collections” (194). For others who have noticed the connection between platform studies and the material text approach to book history see LIU 2018, 100; JONES and THIRUVATHUKAL 2012, 159; KIRSCHENBAUM and WERNER 2014, 433ff; and ROWBERRY 2017.

to assert that a platform is *the conceptual wireframe that mediates between a set of physical substrates and their arrangement as an operable material structure*. If a substrate is matter defined according to, and at the level of, function, then platforms are the systems — both literal and figurative — that hold these substrates together into a functioning form. It is true, as much work in platform studies implies, that we as users tend to discern platforms as discreet, uniform, and at least reliable (if not wholly stable) objects: this is *my copy* of the journal, this is a *distinct website* with a unique URL. However, the perceived objectness of platforms does not obviate a formalist approach that excavates the discursive networks, including the cultural techniques, that intangibly shape that perception. Such a method might, through a comparative analysis of definitions, feel for the ways the edges between platforms form and shift over time.

Interface

inter [between] + *face* [surface], Latin

For the first century of its use, from roughly the mid-nineteenth through the mid-twentieth century, the word “interface” was a term of art in the physical sciences, specifically fluid mechanics. It was coined by engineer James Thomson to refer to the boundary where two different substances meet, mingle, or separate, as when the surface of water touches the surface of oil.³ By giving a name to this liminal zone, scientists brought it into being as a tangible plane of interaction, a space with its own material qualities and effects worthy of study.

Through transference, the scientific term came to mean, by the 1960s, any point of connection between two parties or systems. Carl Therrien defines it similarly today as “the point and/or modalities of communication between two systems” (2014, 305). This contact might be abstract, suggesting something more like “liaison”, as when two individuals in an organization each serve as the “interface” between their respective departments. Or it can be more concrete, as in the many actual devices developed to connect machines to each other, to a grid, or to humans. For instance, the physical interface between human users and personal computers is mediated by a range of peripheral hardware, including the keyboards, trackpads, cameras,

3. For a fuller history of the term’s development and use in Thomson’s work, see HOOKWAY 2014, 59ff.

touchscreens, and mice through which users give input, as well as the monitors, printers, and speakers that return output. Between human input and machine output is the Graphical User Interface (GUI), that array of manipulable digital icons that populate our screens, translating haptic motion, speech, and text into programmed instructions for software. And systems communicate with other systems through physical interfaces and their accompanying protocols, like the metal prongs that plug a computer into the electrical grid and the box transformer that converts this power to a lower voltage for the machine. Whether referring to human-computer interaction or other thresholds between surfaces (“inter” + “face”), an interface is, as Branden Hookway emphasizes, not a form so much as a *form of relation*. As he writes: “what is most essential to a description of the interface lies not in the qualities of an entity or in lineages of devices or technologies, but rather in the qualities of relation between entities” (4; see also DRUCKER 2020).

Because so much of daily life is now channeled through, and regulated by, an interface, it has been subject to much interpretation and critique. On the one hand are literary and visual theorists who have worked to situate digital interfaces within a long history of book-based design. For instance, by analyzing the design of medieval manuscripts, early printed materials, and artists’ books, Drucker attempts to “denaturalize the increasingly familiar interface that has become so habitual in daily use”, and does so with the aim of fostering a more humanistic approach to visualizing information, one focused on conveying knowledge to human subjects, rather than machinic “users” (2014, 9). Book artist Borsuk (2018) and information scientist Bonnie Mak have joined her in this interdisciplinary project. Lori Emerson, too, examines hypermediate design — from glitch art and digital literature to Emily Dickinson’s self-bound fascicles of poetry — in order to historicize and challenge the commercial tech industry’s rhetoric. As she argues, although companies like Apple pitch their products’ interfaces as smooth, transparent portals, “the dream in which the boundary between human and information is eradicated is just that — a dream the computing industry rides on as it attempts to convince us that the dream is now reality through sophisticated sleights of hand that take place at the level of interface” (x–xi). On the other hand are a cohort of theorists, like Galloway, who read digital interfaces as a form of neoliberal control. Wendy Chun states the case directly: “interfaces have become functional analogs to ideology and its critique — from ideology as false consciousness to ideology as fetishistic logic, interfaces seem to concretize our relation to invisible (or barely visible) ‘sources’ and substructures” (2011, 59). Shared

across these various archival, historicist, and theoretical approaches is a sense that the ubiquity of interfaces today urges a renewed attention to their history and power, and with it transmedia questions about design, control, freedom, and form.

As the above shows, the links between media and textual studies are, when it comes to this term, already quite strong. However, by concentrating on a book's surfaces — by seeing page layout and design, for instance, as the primary interface between readers and content — much of this work has inadvertently retrofitted the screen essentialism of some varieties of media studies to the codex and thus obscured the deeper connections between a digital platform's many interfaces and the structural mechanics of earlier technologies. Returning to Hookway's definition of an interface as a *form of relation*, we can see more clearly the book's myriad interfaces, the spaces *between* its surfaces. Gutters, folds, and cuts are all crucial links between paper and platform, just as the notches along the edge of a stack of quires serve as the threshold between binding thread and the structure of the book. Such liminal zones are akin to the USB port linking a machine to a memory drive in that they are governed by both material forms and protocols that enable, or disable, the technology's functioning: paper must be cut and folded properly, binding holes must be sized and spaced just so, thread must be well waxed and the quires not too tightly bound, or the book will not open, its gutters will not signify, its contents will glitch in their transmission. Similar interfaces might be identified in any non-codex platform, from the spaces between bamboo slats in a *jiance*, an early Chinese book form, to the back of the wet clay tablets used to label baskets of goods in early Mesopotamia, and which still bear the impressions of wicker. Though written in response to digital technologies, Hookway's own work creates space for this more capacious, transmedia reading when he asserts that "the interface is defined in its coupling of the processes of holding apart and drawing together, of confining and opening up, of disciplining and enabling, of excluding and including" (4) — a sentence that echoes Jacques Derrida's broad definition of a book as that which gathers together what is constantly being dispersed.

Thus interfaces are not just display technologies — though they may display content, too — but are more specifically *the joints between physical components within a machine, as well as its human subjects and the broader network of objects, protocols, and processes through which it moves*. Within the speculative architecture of media technologies that I am outlining here, the concept of "interface" sits between substrates and platforms. Specifically, interfaces mediate *materially* between the

bits of functional matter that comprise a technology (substrates) and the structure holding them together in a coherent, functioning unit (platforms). They are the physical seams stitching a patchwork of materials into a working machine, the nodes of connection that allow users to operate it, and the literal thresholds where the logic of one component is translated into the language of another.

Format

French *format*, perhaps from Latin (*liber*) *formātus*, (a book) formed in such or such a way

“Format” is one of the most important concepts in the history of technology, and a comprehensive history of its usage would be illuminating. Until that work is done, a sketchier account of how it gets taken up in English and applied to various media technologies must suffice.

For perhaps as long as the codex has existed, specific terms have been in use to refer to the way that a piece of parchment or a sheet of paper is folded to produce a book’s basic components: bifolia of two joined leaves nested into gatherings that are stacked and bound together. For instance, a book printed in *folio* during the hand-press period is composed of sheets of paper printed with two pages per side and folded once widthwise to form one bifolium of two leaves or four pages. In a *quarto*, the sheet is folded twice to form four leaves or eight pages, with four pages of type imposed on each side of the sheet; in *octavo*, it is folded three times to form eight leaves. If English-speaking printers in the handpress period wanted to refer to the size and shape of a book, they would simply include a sheet’s dimensions alongside these folding terms. Thus a “Crown folio” is a book made of Crown-size sheets folded once. To a working printer in a seventeenth century, no other word was needed: simply knowing the size of a sheet, how many folds, how many sheets in a gathering, and orientation would have been enough for her to know a book’s length and width, its shape, how it was imposed on the press bed, and how it was bound.

As Paul Needham has shown, the Latin term “forma” and French “format”, meaning shape or form, have been in use since at least the fifteenth century in Europe to help describe these various ways of laying out a text and binding a book. The term “forme” is also crucial to bibliography, since it refers to the imposed type and thus the model of a book to be printed. However, in English, the word “format” does not appear until

the nineteenth century; and when it does, it does not refer specifically to these printing and binding patterns but instead to a book's size or shape *in general*. Thus a book "in folio format" was simply a large book, and by implication an important or serious tome, whether or not it was composed of sheets folded once widthwise. (A book folded in quarto might actually be quite large, and thus described as a folio, if its sheets are big enough.) Outside the field of bibliography, readers still treat a book's format in this way. For instance, to say that a book is "in paperback format" imparts more information than merely that it has been bound in paper; the phrase carries with it connotations about the book's portability, content, genre, how easy or difficult it will be to read, where it might be sold, and so on. In other words, in common usage, a book's format names its cultural or social position in relation to its physical appearance. Gérard Genette roughly uses "format" in this way in *Paratexts* (1997, 17ff).

And so we come to the mystery: how did this *general word* for the size and shape of a finished book become a *term of art* in bibliography and later for media technologies more generally? As G. Thomas Tanselle points out in a magisterial essay on the word's usage, the exact point of transfer is unclear. The best we might do is adduce a few conditions under which the science of bibliography, and thus the scholarly usage of "format", developed in the second half of the nineteenth century. First, the introduction of steam presses and wove paper (new media), produced on a continuous roll rather than in individual sheets, fundamentally changed how books were imposed and folded. Thus what had seemed to early modern printers to be just "printing" became *hand-press* printing (old media), with its own distinct technical processes. When giving a name to these processes, nineteenth-century bibliographers, second, already had to-hand a new English word, "format", and third, could point to a long continental tradition of using the Latin "forma" and French "format" to refer to how the sheets of a codex had been folded. And so, in a linguistic twist, bibliographers seem to have adapted the general English word for a completed book's size or shape to the *concept* of how a block of text was imposed, folded, and formed into a codex, especially in the hand-press period. More precise labels like folio, or Crown folio, were then subsumed under this new umbrella term, "format".

Today, the format of books is the cornerstone of analytical and descriptive bibliography and thus critical to textual scholarship. Yet, as the word's history suggests, this understanding is in some sense anachronistic, and its exact meaning remains murky. For clarity's sake, I follow the definition that Tanselle ultimately crafts, wherein bibliographic format is

a designation of the number of page-units (whether of printing surface, handwritten text, or blank space) that the producers of a printed or manuscript item decided upon to fill each side of a sheet of paper or vellum of the selected size(s); if paper came to a printing press in rolls rather than sheets, format can only refer to the number of page-units placed on the press at one time for the purpose of printing one side of the paper.

(112–13)

In other words, format mediates between the size of a raw sheet of paper, before folding and inscribing, and how many pages of content are squeezed onto that sheet of paper to make a book. Or, to adopt the vocabulary I have been developing here, it names how a book's substrates (paper, parchment) hang together to form — shape, construct, fabricate, compose — a platform (the codex). Thus neither the size of the book nor the process by which it is made alone make its format; rather, it emerges in the relation between the two, between materiality and its making.

Not long after bibliographers began developing the concept of format to describe hand-press period printing, the same word was picked up and applied to emerging audiovisual media like photography, film, phonography, and, later, radio and television. As before, it is not clear precisely how the transfer occurred, but intuitively it makes sense. Even more than books, new media technologies need a term to name the size and shape of a particular object in relation to some recognized standard, because — unlike books — audiovisual media are designed in such a way that there is an inevitable distinction between the particular *thing* that is inscribed with data and the *thing* that records or plays that data back. Format provides the concept that mediates between these two objects. Thus the format of a film — the width, length, and orientation of its stills; its negative pulldown (how many perforations line each still, affecting aspect and orientation); the film gate (the size of the camera's opening); and so on — tells its viewer something about both the technologies on which the film was made and the technologies on which it should be watched. Likewise, a wax cylinder for a phonograph will not play on a turntable, even though it uses the same inscription technique as a vinyl record; format identifies substrate and determines platform. Without format, every audiovisual recording would be an idiosyncratic translation of sound and image into matter without any way of hearing or viewing the thing recorded again.

After transferring to bibliography and then audiovisual media, the word “format” expanded in meaning to include a sense for *how things are arranged*,

or a *mode of procedure*. Earlier usages had already paved the way for this new definition. For instance, as mentioned above, to say that a book is in paperback format implies more than binding style; the reader can expect that it will present its content and operate in a certain way. Similarly, in television, the notion of format means not only the screen but the style or genre of show, like a miniseries, carrying its own expectations for length and mode of presentation. This expanded definition relates “format” to the word “program”. From the Ancient Greek and then Latin *programma*, meaning a law or edict that has been publicly broadcast, “program” has been in use in English since the seventeenth century to mean something like a published notice. In the eighteenth and then nineteenth centuries, it began to take on the additional meaning of a plan or order for a set of proceedings, as in the “program” of a concert: the order in which a set of songs will be played, as announced on a handbill or board. The word naturally spread to early radio and television broadcasts, called “programs”, and from there to early computing, where it was used to name a sequence of operations to be performed by a machine. It is a small journey from “program” as a plan or order for proceeding to “format” as a mode of procedures, and by the middle of the twentieth century, both words were being taken up in the rapidly developing field of digital computing. The invention of the stored-program computer — a machine that can store and fetch data from memory — facilitated this uptake.

Finally, there comes digital “format”, most commonly understood today as *file* format. As a concept, digital format absorbs the various shades of meaning cast by the word’s other definitions. As in bibliographic usage, it mediates between the material substrates of computer memory, where data is inscribed or stored, and the platform that manages and processes that data, and it does so through the development of standards that regulate these channels of communication. Thus just as the folio format identifies how text has been imposed and sheets folded to create a codex, in some very fundamental way, digital format names how binarily encoded data has been “imposed” on a machine’s memory and “folded” together to form the content one sees on the screen. It is a materially- and protocologically-determined arrangement of data, and the procedures by which a computer program or software manipulates them. As I take it, this is what Tenen means when he writes that formats “translate between disparate systems of ordering and signification” and “mediate between data structures, transforming one into the other according to predefined rules” (96–7). And, just as format became a physical standard with audiovisual media, describing the shape and composition of an actual *thing* like a film or a record, the digital concept of a format bundles data and its attendant protocols into

the discrete, transferable chunks we call “files”, a metaphor drawn from paper media. It is hard to imagine the digital file existing as it does today had these earlier bibliographical applications of the word “format” not carved out the conceptual space in which it sits.

In his work on the history of the MP3, Jonathan Sterne has championed what he names *format theory*: a call for media historians to “focus on the stuff beneath, beyond, and behind the boxes our media come in”, highlighting “smaller registers like software, operating standards, and codes, as well as larger registers like infrastructures, international corporate consortia, and whole technical systems” (11). Within book history, Meredith McGill has taken up Sterne’s call in a series of published articles and chapters that consider the relationship between bibliographical format and format theory. Specifically, she points out how Sterne’s work can help book historians “zer[o] in on the aspect of culture that has proved most difficult for [them] to conceptualize: circulation”, or the gap between *production* (descriptive bibliography, codicology) and *reception* (reader-response criticism, studies of marginalia, histories of reading) (2018, 672). McGill demonstrates this in her own work on the nineteenth-century American ballad, in which she challenges typical genre-based interpretations by pointing to the wide range of printed forms in which these popular songs appeared. As McGill shows, attending to bibliographical formats — broadened to include Sterne’s capacious definition of file formats — puts pressure on the old taxonomies used to construct literary history.

McGill’s knitting together of media and book history lays the foundation for the robustly transmedia definition that I wish to propose here, namely: the format of a media object is the *protocological relationship between substrates that enables them to function jointly as a platform*. In other words, if interfaces are the material zones of contact between substrates, subjects, and systems, then formats are the standards that make possible an exchange of information across these thresholds. From another angle: if a platform is a structural wireframe that arranges material substrates, format is the set of rules, standards, and practices that allows the interfaces within this architecture to move expressions through the system. Substrates and interfaces are material; platforms and formats are the literal and conceptual models that turn this physical stuff into working technologies.

A media technology may be governed by multiple formats, each indirectly affecting the others. For instance, the specific layout of my laptop’s keyboard — how it encodes Roman characters and symbols — is one very visible format that gives shape, literally, to the human-computer interface. Similarly, the history of Chinese character keyboards, used by typists across

East Asia and the Asian diaspora throughout the twentieth century, tells the story of a format emerging in relation to a platform (MULLANEY 2017; TSU 2022). Another format, less visible to me, is the arrangement of glass, electrodes, and liquid crystals that comprise my LCD screen. Without the standards that regulate the size of the pixels, their grid, the location of the color filters, and the reactivity of the crystals — without a *format* — my screen would be an inert set of physical relationships (interfaces) between these layers (substrates). We might imagine each component as one sheet printed with a different imposition — some folio, some quarto, and so on. When these sheets are jumbled together in a pile, one might be able to see, in theory, how they form a text, but in practice they cannot *operate* as such — they cannot be read — unless the imposition is regularized. Only then can the sheets be folded and bound into a functioning platform, the codex.

Today, format has returned to its bibliographical roots in its verb form. As format, the noun, came to refer to digital file standards in the mid-twentieth century, the action of encoding a file came to be known as “formatting” it. The verbal definition also applies to digital storage: to format a drive is to set up a file system for storing data. Around the same time, the introduction of automated typesetting meant that computer programs were increasingly responsible for laying out the pages of a book according to the size of the sheet of paper on which it would be printed or, in other words, for *formatting* it, much as one would any other digital file. Technical manuals of the time show how the language of file formatting was absorbed into digital typesetting. For instance, a *Glossary of Automated Typesetting and Related Computer Terms* published in the 1960s by Composition Information Services, a company responsible for tracking electronic developments in the printing and publishing industries, includes a definition for “formatting, book: in computer-controlled book composition, after the print-out of corrected ‘galleys’ has been obtained, it is necessary to prepare a program tape or book format tape based on such considerations as a chapter sink, leading, lines per page, allowance for illustrations, position of the foils and running heads, etc.” (34). This sense of formatting as programming the text’s appearance is now widely used by word processing software and in the publishing industry, as authors are given “formatting” options and instructions that specify layout, design, and accidentals. Book historians may even casually refer to the “formatting” of older books, not digitally typeset, even though — and this is perhaps significant to the present history — no manuals on bibliography use “format” as a verb.

The history of how humans have devised material means of mediating their worlds is long and global — even, increasingly, astronomical; it brims with neglected material *stuff* now scattered across institutions and libraries, buried in the earth and the oceans, flung far into space, each evidence of a form of life. My definitions of the terms *substrate*, *platform*, *interface*, and *format* are not rigid truths but openings that invite these technologies, all technologies, into relation with those machines and modes of being that are already familiar to us. That is, the point of this exercise has been to redraw the disciplinary boundaries that circumscribe different media histories, to redefine the vocabularies that hold such perimeters in place, and in doing so to generate freshly transhistorical, transmedia scholarship.

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