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Mediating Science: Draper's Tithonic Rays and Lunar Photography

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ABSTRACT

This article examines John William Draper's practice of lunar photography and his proposal of the so-called "tithonic rays" to argue that scientific phenomena emerge through the material and operational affordances of technical media rather than being merely recorded by them. The article offers a media-historical reinterpretation of Draper's experiments as a moment in which the daguerreotype itself co-produced new epistemic objects, challenging anthropocentric models of scientific discovery and emphasizing the active epistemic role of nonhuman agents.

The paper's central contribution is to show how Draper's daguerreotypes did not simply provide visual confirmation of existing theories but materially generated the very conditions for the emergence of new concepts of radiation and energy. By foregrounding the daguerreotype as a mediating actor in the formation of scientific theory, the article contributes to current debates in the history of science and media theory concerning the ways in which technologies participate in the production of knowledge.

Introduction: The Instrument as an Epistemic Agent

Scientific knowledge production practices are interwoven with a vast array of technical, graphical, and measuring instruments that produce, stabilize, and enable them. Technical devices, measuring apparatuses, graphic representations, and systems of inscription and registration do not merely accompany scientific work—they make it possible, shape its operational modalities, and substantially contribute to the very definition of what counts as "knowledge". The examples are manifold: from Horace-Bénédict de Saussure's cyanometer—a simple tool devised to measure the intensity of the blue sky and instrumental in systematizing atmospheric understanding—to Alexander von Humboldt's phytometer, which, by measuring soil humidity, enabled the observation of systemic relationships between climate, altitude, and vegetation. In each of these cases, the instrument is not a neutral support but an integral part of the very construction of the object of knowledge, playing a crucial role in the emergence and stabilization of a scientific discourse.

Despite this, instruments have not always occupied a central place in the history and philosophy of science. They have often receded from view and evaded theoretical

reflection, lingering in the background as if their role were merely executive and theoretically insignificant. Traditional accounts of science have tended to privilege human cognition, intentionality, and discourse, while treating nonhuman entities—such as instruments and artifacts—as passive tools in the service of knowledge production strategies (see Rheinberger 1997). The aim of this paper is to reclaim the technoscientific instrument from this servile status, where it is subordinated to predefined human goals. I challenge an instrumentalist vision that assumes technology neutrally and disembodiedly guarantees the achievement of objectives.

A growing body of literature, particularly following the rise of Science and Technology Studies (STS), has increasingly questioned this view, advocating instead for a more nuanced approach in which nonhumans are acknowledged as co-constructors of scientific meaning (Latour 1994; Rheinberger 1997; Verbeek 2005). Specifically, the idea that instruments are not merely passive vehicles but possess a certain agency expressed through operations, inscriptions, persuasions, and the activation of cognitive and operational processes has been gaining traction across the works of key authors straddling historical epistemology and STS. We can observe a gradual attribution of epistemic weight to the active role of technoscientific artifacts in knowledge production. Ian Hacking was among the first to explicitly theorize the contribution of instruments to theory construction, even while remaining concerned with the ontological status of the scientific entities thus observed. Hacking emphasizes that instruments of measurement modify the very activities of observation and research, as well as the conditions of existence of the scientific entities they manipulate—demonstrating that such instruments not only record reality but actively shape it (Hacking 1982).

Historian and philosopher of science Peter Galison engages in theoretical analyses that account for the complex "intercalation" (1997) of experimentation, instrumentation, and theory. Meanwhile, American philosopher Davis Baird articulates a notion of "thing knowledge" (2004), arising specifically from scientific instruments such as mechanical models of the solar system or the cyclotron—proposing a materialist culturology grounded in scientific artifacts. These three examples illustrate a growing attention to the epistemological role of instruments as material objects—marking a turn away from the conception of tools as merely functional or goal-oriented, even if they do not yet fully articulate a theory of their specific technological agency.

Bruno Latour is undoubtedly a central and connective figure within this theoretical landscape, particularly for his now-classic distinction between "intermediary" and "mediator"—first introduced in *We Have Never Been Modern* (Latour 1991), and later refined in *Reassembling the Social* (Latour 2005). This distinction effectively brings into focus the question of agency within the domain of technoscientific objects. An intermediary is defined as an entity that conveys information or action without altering

it, whereas a mediator always transforms what it transmits. In both cases, Latour refers to a kind of relational operator; however, while the former acts as a mere conduit between already-constituted entities, the latter initiates a generative process capable of reshaping and reconfiguring the elements it connects, giving rise to new entities. Within the framework of Actor-Network Theory (ANT), every technical object performs some form of mediation. The agency of a technoscientific instrument, therefore, resides in its capacity to intervene—often with a degree of autonomy and unpredictability—within the informational, cognitive, and operational flows in which it participates as a mediator. There exists a strong interrelation between scientific theories, measurement methods, and technical instruments—an entanglement through which theories and methodologies not only emerge but are actively co-produced.

To assert this is already to argue that the content of scientific knowledge cannot be separated from the technical devices that help shape and stabilize that knowledge through acts of mediation. The production of scientific knowledge always involves technical instruments that possess specific agencies—agencies that cannot be reduced to the intentions or anticipations of their designers, users, or constructors. Technical objects are capable of generating distinctive heuristic, experimental, and theoretical modes of engagement; they are capable of raising new questions and forging novel practices. As Jennifer Gabrys aptly notes, "instruments or tools are already mutually constituted with practices, so that new worlds concretize through engagement with instruments" (Gabrys 2019, 56). In this paper, I focus specifically on those "worlds" that are configured through the use of operations, techniques, and practices of scientific knowledge production.

Photography as a Scientific Medium: The Curious Case of Draper and Lunar Rays

Because of its close integration with scientific practice, the technical object acts as an active participant in the production of knowledge. In other words, scientific instruments define the very conditions under which knowledge can emerge and actively participate in the heuristic and experimental strategies of inquiry. Drawing on Latour's theorization of the mediator, we can consider scientific instruments more closely in their medial dimension. To explore this, I turn to a specific case study involving John William Draper—an English-born American chemist and a pioneer in daguerreotype photography.

Soon after the introduction of the daguerreotype in 1839—a groundbreaking photographic process developed by Louis-Jacques-Mandé Daguerre and Nicéphore Niépce—Draper was among the first to explore its potential, successfully capturing human faces within the same year. Shortly thereafter, Draper set up a photographic observatory on the roof of his home, where in 1842 he managed to produce a photographic

image of the solar spectrum (Hentshel 2002). A forerunner in both photography and radiation research, Draper employed the emerging technology of daguerreotypy to study the chemical effects of what he identified as “tithonic rays” (Draper 1844). What led Draper to propose this new type of radiation, to which he gave such a specific name?

When Draper began investigating the chemical action of light in the late 1830s, he was entering into a tradition already rich with studies on photosensitivity. His theory of tithonic rays emerged within the context of early photographic science and a growing fascination with so-called imponderables—such as heat, light, and chemical rays. Within this framework, Draper posited the independence of a new agent, distinct from both light and heat, that could produce chemical transformations without concurrent thermal effects (see Chang & Leonelli 2005). Draper was confident enough in the existence of these rays to declare “the agent involved in photographic results” a “clearly established and new imponderable substance, possessing striking analogies with light and heat, yet differing as much from them both as they do from each other” (Draper 1844, 159-160). While the tithonic ray never gained lasting acceptance—it was eventually reinterpreted in terms of the ultraviolet region of the spectrum—the theory marked a transitional moment in the understanding of radiation and chemical action. Draper's proposal reflected a broader nineteenth-century epistemic landscape in which the boundaries between light, heat, and chemical effects were still unsettled. The very concept of discrete “imponderable fluids” exemplified the pre-electromagnetic framework through which natural phenomena were understood. What is crucial to underline here is that the emergence of the tithonic ray cannot be dissociated from the daguerreotype plate itself, which functioned both as a material detector and as a heuristic indicator—shaping the very parameters of what could be observed, named, and understood. The daguerreotype’s silver iodide surface, with its limited sensitivity to infrared radiation but heightened responsiveness to shorter wavelengths, did not simply register phenomena passively: its specific chemistry actively filtered the world, amplifying certain effects while silencing others.

The strongest empirical support for Draper’s hypothesis came from his 1840 lunar photographs. Draper used the Moon primarily to distinguish between thermal rays and his tithonic rays: despite the absence of measurable heat, moonlight was able to blacken photographic plates (or tithonographic plates, as Draper preferred to call them) coated with silver halide. This clearly indicated that the Moon emitted some kind of radiation capable of producing a material effect on photographic media, yet not associated with detectable thermal energy. Draper’s argument for the distinct nature of chemical and thermal rays gained plausibility precisely because the instruments available at the time were unable to register any heat emitted or reflected by the lunar surface. Combined with other experimental data, Draper’s images of the Moon’s tithonic emissions gave him

enough confidence to propose a comprehensive pluralistic theory of radiation: "Light, heat, titonicity, phosphorogenic rays, and electricity formed the natural family of imponderable agents" (Chang & Leonelli 2005, 501).

It becomes evident that the boundaries of entities and phenomena as they are registered assume epistemic—if not ontological—frameworks shaped by the recording modalities made possible by the technical apparatus. The chemical reaction of the photographic plate provided the necessary articulation for the phenomenon of lunar tithonic rays to emerge as an object of human perception and scientific knowledge. Draper's photographic device did not passively capture natural events; rather, it revealed new entities whose very existence depended on the material constraints of the experimental setup. Had the daguerreotype been sufficiently sensitive to even minimal thermal emissions from the Moon's surface, would the concept of tithonic rays ever have been proposed? The Draper case thus illuminates more than a single misstep in the history of physics. It exemplifies a moment when the epistemic authority of the instrument—its capacity to generate visible traces—coincided with a nineteenth-century ideal of mechanical objectivity (Daston & Galison 2007). In this historical context, instruments and images were increasingly valued for their presumed impartiality; yet, Draper's experiment shows that such "objectivity" was itself materially co-produced by the affordances and limitations of the technical medium.

This case illustrates how experimental practice is far from being a mere act of detection. It is, rather, an operation upon reality, in which the existence of certain entities depends on the material possibility of producing and recording them. In this sense, the technical object is not merely a conduit but a co-author of the conditions under which scientific phenomena become visible and intelligible. It does not simply measure or represent the world; it actively contributes to shaping the epistemic contours of that world. The daguerreotype thus functions as a knowledge-producing apparatus with a clear medial value, in the Latourian sense outlined earlier—capable of generating transformations both in the material registration process (the blackening of the plate) and in discursive production (the conceptualization of a new type of radiation).

Phenomenotechniques: Human and More-than-Human Collaborations

According to the theoretical framework used to analyze Draper's case and his lunar photographs, instruments are to be understood as media because they enable scientists to access phenomena otherwise inaccessible to the embodied human perceptual system. More precisely, technoscientific instruments can be seen as mediators in a twofold sense. First, they "act as extension of our natural senses, rendering visible and tangible what

would otherwise escape the range of ordinary human perception" (Rheinberger 2016, 161-162). As perceptual prostheses, scientific instruments articulate the embodied sensorium by expanding its capacity to comprehend and make sense of reality. Second, instruments are able to extend the material effects of a phenomenon in such a way that it can "acquire contours" (Rheinberger 2016, 162). The daguerreotype makes visible the blackening effect caused by the chemical reaction of a particular kind of ray—imperceptible to the body—on the photographic plate. The mediating action of this device lies in its ability to produce occasions of materialization in which phenomenon and perceiver can come into contact. In this sense, technoscientific mediation plays an active role in the constitution of scientific objects: it does not merely transmit a preexisting phenomenon, but rather determines the coordinates under which such a phenomenon becomes phenomenologically constituted. The phenomenon itself is articulated through a technical inscription that enables it to be rendered present in a novel way.

To refine this understanding of mediators, I draw on a second, pivotal concept—namely, that of "phenomenotechnique". Originally proposed by Gaston Bachelard (1934; 1938), this notion functions as the conceptual linchpin of the French epistemologist's work and has since become widely influential across contemporary Science and Technology Studies (STS). Bachelard's concept accounts for the decentering of technology from its organic origins, and to illuminate its specific mode of operation: phenomenotechniques inscribe a phenomenon, offering a specific form of grasp that is independent from embodied perception. If mediation is always dual—drawing both the perceiver toward the phenomenon by extending perceptual capacities, and the phenomenon toward the perceiver by shaping the conditions of its material presence—Bachelard invites us to pay attention to the fact that there is a discontinuity between embodied modes of detection and those produced by technical instruments.[1]

Phenomenotechniques regulate the emergence of certain forces or natural phenomena in such a way that they become accessible to human sensibility—but only after having already acted upon the phenomenon through their material and functional logic. The daguerreotype offers a clear example: it is able to register the phenomenon of tithonic radiation through a technical process of inscription that is discontinuous with embodied perceptual mechanisms. The chemical sensor at the heart of the device does not operate like the human eye, for instance. While the daguerreotype ultimately translates something that can be assimilated into visual perception—a trace in the visible spectrum—the material conditions of its registration are fundamentally different. And it

[1] This specific key aspect of the notion of phenomenotechnique is later emphasized in Wolfgang Ernst's media archaeology. Specifically, Ernst seeks to liberate media from their cultural and historical oversaturation in order to foreground their operational and non-anthropocentric logic (see Ernst 2013).

is precisely from this difference that mediation becomes possible. Without what Bachelard calls an "epistemological rupture" (Bachelard 1938)—a break from the *a priori* conditions of embodied sensorium—there would be no opportunity to generate new knowledge beyond what is already inscribed within human perceptual capabilities.[2] If the daguerreotype can be seen as a medium capable of extending the human sensorium (allowing one to see more thanks to its functioning), this is only one side of its action. The other, equally crucial dimension lies in the distinct chemical principles that govern its technical operation—principles that are nonhuman and irreducible to organic perception.

In general, technoscientific mediators provide a unique and specific mode of access to reality and its phenomena. More than that, they crystallize and sediment the traces of their engagement with reality, and each time they are employed, they impose a significant part of the rules by which a phenomenon can be accessed and analyzed. In this sense, "the instrument represents the material existence of a body of knowledge" and becomes an agent capable of activating an "epistemic commitment" (Rheinberger 2006, 313).[3] Scientific inquiry always operates within technological constraints that shape its heuristic structures; epistemological grammar is invariably intertwined with phenomenotechnical operations. If it is true that phenomenon and technique co-constitute one another, it is because phenomenotechniques establish the conditions under which epistemologies and objects of knowledge can be articulated: the daguerreotype structures the experiential, operational, and theoretical field in relation to the phenomenon of radiation.

Emphasizing the technical dimension of experimental practices and scientific enterprise is not intended here as an argument for replacing human epistemic contribution with the internal logic of instruments. I do not view technological invention as a mere enhancement of human capabilities aimed at rendering them obsolete. Rather, the objective is to foreground a radical collaboration between human and nonhuman epistemic agents and to analyze in depth the logics underpinning that collaboration. It is only within this ongoing interplay—this mutual entanglement of human and technological elements, each with their distinct and indispensable contributions—that the dynamic nature of scientific practice can be adequately understood.

Recognizing the specific agency of technical instruments through the concept of phenomenotechnique therefore entails adopting a view of science as an intrinsically hybrid practice, wherein the human contribution is continually redefined through its dialogue with devices that not only amplify but also transform the very conditions under

2 Bachelard's notion of an "epistemological rupture" refers to a radical break with prior modes of thought or perception that is necessary for scientific progress. It marks a discontinuity between everyday experience and scientific reasoning, allowing new concepts and phenomena to emerge.

3 Translation from German into English by the author.

which knowledge can arise. Phenomenotechniques determine the very ways in which phenomena take shape, are stabilized, and rendered knowable.

Distributed Epistemologies

As Bachelard's notion of phenomenotechnique teaches us, the technoscientific instrument is not merely a prosthetic extension of human perception, but a condition of epistemic possibility. Instruments do not simply enhance human sensory capacities; they transform, displace, and decenter them, reshaping the sensible field and redefining what can be perceived, thought, and named. Knowledge production is deeply entangled with material "affordances" (Gibson 1979) and technical mediations that often precede, bypass, or simply do not pertain to human cognition and perception. As Hans-Jörg Rheinberger insightfully puts it:

> to serve as a scientific research instrument, the technology in question, in terms of its physical, chemical, or biological constitution, must be able to interact with the object under investigation in such a way that scientifically useful information can be extracted from the interaction. On the other hand, this also requires to shape the scientific object in such a way that it becomes commensurable with the technology in play. (Rheinberger 2016, 162)

If the technical object and embodied cognition are part of a co-constitutive process of epistemic conditioning, then scientific inquiry must be understood as a distributed practice (see Bleeker 2023), unfolding across heterogeneous agentive constellations in which human beings and technical apparatuses collaborate.

The case of Draper and the tithonic rays offers a privileged vantage point from which to interrogate the collaborative nature of scientific knowledge production. The daguerreotype does not simply record what human vision could never have seen on its own—it actively participates in the constitution of the very phenomenon under investigation, articulating the material and operational conditions necessary for the emergence of a new agent: the tithonic ray, previously undetectable and conceptually unthinkable. In this sense, the daguerreotype does not merely display; it mediates, and thus makes present the phenomenon, rendering it compatible with the human sensorium, while simultaneously rewriting it according to the specific logics of its photo-chemical operation.

The daguerreotype places "humans and their perceptions and experiences in a position of being implicated in larger apparatuses that to a considerable extent operate outside of their awareness" (Bleeker 2023, 265). However, this kind of decentering does not entail a loss of human agency. Rather, it marks a reconfiguration of agency within a broader system of co-implication and collaboration—one that has, until now, received limited attention, thereby risking the marginalization of its epistemic effects.

The fact that the concept of the tithonic ray was eventually abandoned in favor of a unified theory of radiation—one that no longer required a discretization between its seemingly distinct components (light, heat, chemical action) (see Chang & Leonelli 2005)—does not weaken the argument presented here. On the contrary, it reinforces the idea that no abstract theorization takes place solely in the minds of researchers; rather, every epistemic product is the result of a material entanglement with the available means of technical registration. Draper's theory of tithonic rays is inseparably linked to the agency of the photographic apparatus and to its persuasive capacity to demonstrate the existence of a "new imponderable" (Hentshel 2002). Draper's case exemplifies how instruments—far from being neutral extensions of human will—function as active mediators that shape scientific epistemology. His experimental work on lunar rays offers a compelling image of science as a practice in which humans and technical apparatuses collaborate, each contributing in heterogeneous and decisive ways. Emphasizing the collaborative dimension of this relationship helps avoid antagonistic frameworks in which the roles of subjects and devices are treated as mutually exclusive or hierarchically ordered.

Indeed, the embodied subject is not a stable, independent center of knowledge production, and the technical device is not a mere ancillary tool, passively executing or extending human goals and capabilities. Such a view rests on an anthropocentric assumption—that the human subject is the sole platform from which knowledge emerges, and that technology merely mimics, extends, or replaces it. By contrast, understanding the agentive co-constitution between human and nonhuman actors as a form of collaboration offers a more productive framework. It allows us to remain within a necessary polarity, where questions of agonism—who better detects, records, or describes—and antagonism—if I already do it, you no longer need to—are revealed as false problems. Neither pole originates from a position of epistemic primacy or independence, and thus neither is threatened by the presence of the other.

Conclusions

Drawing on insights from the philosophy of technology, historical epistemology, and media studies, this article has highlighted the role of instruments as epistemic agents. Specifically, it has examined the contribution of technical artifacts to scientific production through the case of Draper's experiments with daguerreotype photographic plates. Draper's work—his lunar photographs and the theorization of tithonic rays—serves as a paradigmatic example of how scientific knowledge emerges from a complex network of human and nonhuman actors, in which technical devices are not mere auxiliaries but co-authors of epistemological possibility.

Constructing a case study that assigns strong theoretical weight to a technical instrument has allowed a shift in epistemological focus—from the isolated human subject to the collaborative system of human and nonhuman actors that underpins all forms of knowledge. This also means accounting for what technology enables (or prevents) us from doing and thinking; attending to both the opportunities and the constraints that technical objects inherently carry. Draper's legacy is not simply an evocative episode in the history of scientific photography—it offers a broader methodological *exemplum*: in order to understand the genesis and validity of a scientific theory, one must go beyond its conceptual premises and reconstruct its material conditions of possibility, including its operational infrastructures, cultural practices, and technical devices.

Ultimately, Draper compels us to ask not what humans make instruments do, but what kinds of worlds and forms of knowledge become possible through their collaboration. From this perspective, science emerges as a materially grounded and distributed practice, nourished by the interplay of heterogeneous agents. To recognize the medial value of technoscientific instruments—and to understand them in terms of phenomenotechniques—is to affirm that all knowledge is always situated within a material and operational assemblage, where reality is not simply revealed but manipulated, negotiated, and made possible.

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