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Invisible Culture
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The Naked Truth or the Shadow of Doubt?
X-Rays and the Problematic of Transparency

by Corey Keller

Late into the evening of 8 November 1895 Wilhelm Conrad Röntgen, a physics professor at the University of Würzburg, made a discovery that would revolutionize science almost overnight. While conducting experiments with cathode rays in his laboratory, he remarked a peculiar glow with highly unusual properties emanating from a nearby fluorescent screen, the source of which he could not identify. The rays were not refractable like visible light, nor could they be magnetically deflected as cathode rays could. Most remarkable, however, was their capacity to penetrate a variety of opaque substances: wood, paper, rubber, and most astonishingly, human flesh. The rays not only passed through these materials, but they made marks on photographic plates placed behind them, leaving a shadowy picture of the *interior* of the original object. Unable to pinpoint the rays' physical makeup, Röntgen called them X-rays.1 News of Röntgen's discovery spread quickly across Europe and the United States. The theme that resounded throughout these reports was the X-rays' capacity to make visible what was imperceptible to the naked eye. A 16 January 1896 headline in *The New York Times* was typical, claiming in bold type: "Hidden Solids Revealed!" The papers trumpeted the X-rays' ability to see through opaque objects of all kinds, and illustrated these reports with pictures demonstrating the X-rays' uncanny powers of revelation [Fig. 1, Fig. 2, & Fig. 3].

The proposed applications for this newly-enhanced vision were myriad and innovative, sometimes prescient and frequently ridiculous. The potential medical uses of the X-ray, for example, were seized upon immediately. For the first time in history doctors could visualize and document the interior anatomy of a *living* person and see structures previously visible only during surgery, or after death upon autopsy. Suddenly it was possible to see broken bones and to locate deeply-embedded foreign objects without transgressing the skin. X-rays were also rapidly marshaled into legal and forensic investigations, operating as both a tool of surveillance and documentary evidence. It was not long before the X-rays were used to examine unopened luggage for contraband and to distinguish between real and imitation gemstones.

The X-rays' ability to see through opaque substances also tapped into Victorian anxieties about privacy. Although the X-rays' value as a scientific tool was undisputed, the public recognized the threat of the new technology's less honorable applications in the private sphere. The flood of X-ray-inspired poetry, fiction, and caricature that immediately followed Röntgen's announcement speaks to the powerful hold the idea of X-ray vision exercised on the popular imagination, as does the spate of bizarre inventions designed to protect the unsuspecting citizen from the inquiring minds and prying eyes of X-ray equipped "peeping Toms" [Fig. 4].

What united the proposed applications for the new technology -- both the practical and the far-fetched -- was the force of the connection assumed between seeing and knowing. In each instance the assumption was that the extension of the range of vision the X-rays offered would necessarily result in an unprecedented expansion of the scope of human knowledge (though the information the X-ray might produce was greeted by different audiences with varying degrees of enthusiasm).2 The X-ray could function as a substitute for the human eye, only with greatly enhanced capabilities. At the same time the X-rays offered the possibility of seemingly infinite vision, they also raised powerful questions about the *limits* of the human sensory perception. Consequently, the model of vision suggested by the X-ray challenged long-held beliefs about how knowledge of the world was acquired and cast doubt on any philosophical understanding of the world as knowable through sensory observation.

The X-ray's status as an instrument of visual information was further complicated by its immediate association with photography. Advertisements for X-ray supplies promised to deliver "Photography of the Unseen" and "Photography of the Invisible" to scientists and amateurs alike [Fig. 5]. By the mid-nineteenth century, photography had already come to serve as a critical tool in a wide variety of scientific fields. The model of mechanized vision photography provided was deployed in support of a scientific method predicated on faith in an empirically-knowable and -- more importantly -- *visible* world. The X-rays' categorization as a form of photography was therefore problematic; X-rays drew on the medium's authority while simultaneously subverting the visual and epistemological model photography had come to represent.

The X-rays' classification as photographic, although not fundamentally accurate, was both immediate and uncontested. The headlines of *The New York Times* on 29 January 1896 corroborated this assumption. In an article disclosing the unfolding details of Röntgen's discovery, the newspaper promised evidence of "Invisible Objects Photographed." The following day the lead article described "A

Light in Dark Places: Roentgen's Photographs through Flesh and through Wood." This categorization of the X-rays as a photographic process was pervasive in the early reports: the leading European medical journal, *The Lancet*, indexed the myriad articles pertaining to Röntgen's discovery under the heading "New Photography" for the first three volumes of 1896. It was only mid-way through that year that the subject was organized under the more clinical-sounding heading of "Roentgen Rays."

This understanding of the X-ray as a form of photography was not merely a question of semantics. Professional photographers were among the earliest and most avid experimenters with X-ray imaging. Predicting that the popular fascination with the X-ray would parlay into a financial gold mine, many photographers converted their portrait studios into X-ray labs, not only supplying images to doctors for diagnostic purposes, but also offering X-ray "sittings" to the general public. Technically speaking, the X-ray apparatus operated quite differently from a camera: the rays were aimed at the object to be imaged, and those that passed *through* left a mark on the photographic plate placed behind it. Indeed, the pictures produced by X-rays are more closely related to the photograms of plants and lace made over a half century earlier by the photographic pioneer William Henry Fox Talbot than to the lens-derived images traditionally associated with the photographic process.3 Nonetheless, the X-ray's association with photography was tenacious, and had an enormous impact on the way the pictures were received and vested with cultural authority.

This popular conceptualization of the new technology in the familiar terms of photography is made clear in a cartoon published in a February 1896 issue of *Life* magazine [Fig. 6]. The photographer, standing beside his cloth-draped camera, holds up the lens cover and instructs the country farmer posing before his lens to "Look pleasant, please." Although the jovial expression on the subject's face seems to obviate the need for such instruction, the photographer, equipped with X-ray vision, is privy to what we cannot see. As the cabinet card photograph at the right side of the frame clearly reveals, beneath the farmer's overall-clad exterior lurks the grinning figure of the Grim Reaper, and the tool he grips in his hand is transformed from commonplace farm implement into the scythe of death. The cartoon alludes directly to the uncomfortable awareness of human mortality most viewers experienced upon seeing pictures of their own bones: even Mrs. Röntgen remarked of her husband's early X-ray pictures of her skeletal hand that she had seen the shadow of her own death. However, the X-ray portrait of the farmer not only reminds the viewer of the inevitability of death, more importantly, it insinuates that things are not always as they appear on the surface.

In his depiction of the X-ray picture as a traditional portrait, the cartoonist has

effected a double reversal: not only does the X-ray equipment operate like a conventional camera (which is to say backward), but the conventional reading of the photographic image is itself inverted. The photograph is here figured as an image that *reveals* unsuspected truths, rather than *documents* observable phenomena. The cartoon also upends conventions of portraiture (both painted and photographic), which had long held that the mark of a good portrait was its evocation of the sitter's mental and moral character in his outward appearance.[4] By discrediting any understanding of the visible world as inherently truthful, the X-ray portrait reveals the utter superficiality of such a truth-seeking enterprise.

The X-rays' refutation of the authenticity of external appearances stands in marked contrast to the way photography was employed in other arenas of nineteenth-century science. By the 1860s and 1870s, the photographic camera had emerged as a key tool of scientific positivism, standing in for the human observer to produce mechanical records of visible experience. The photographic image's apparent fidelity to reality, its ability, in Fox Talbot's words, to let nature "draw her own picture," resulted in a widespread equation of the medium with truthfulness.[5] The seeming verisimilitude of the photographic image also afforded it a unique epistemological status within a scientific practice that placed great stakes on the observation of the visible world. In nineteenth-century psychiatry, for example, the theory of physiognomy was enjoying a renewed popularity, and photographers like Hugh Diamond photographed the mentally ill in order to document the outward manifestations of interior psychic phenomena.[6] The photograph not only recorded facial features more accurately than could a hand-drawn illustration, but could also capture the fleeting expressions of emotion believed to be indicative of the patient's mental state. In these studies the picture serves as a transcriptive record and is understood to replicate what any attentive person on the scene could have observed with his or her own eyes. Moreover, the picture could stand in for the object of study itself, removing the need for direct observation of the patient. The photograph thus functions simultaneously as both document and specimen. This application of the camera betrays a faith not only in empirical observation of the visible world but also in the transparency of the photographic image.

The camera, as it figured in the work of Hugh Diamond (or any other number of mid-nineteenth century scientific practitioners) replaced the human observer; its "mechanical eye" a more perfect substitute for that of the human. Metaphors likening the photographic camera to the eye abounded in the scientific discourse of the day. Jules Janssen, the prominent astronomer, dubbed the apparatus the *vraie rétine du savant* (the true retina of the scientist). This configuration of camera-as-eye must be understood, however, in contradistinction to the new awareness of how the human eye *did* in fact function.

Nineteenth-century science was increasingly cognizant of the embeddedness of human vision in physiological function and, as a result, was aware of vision's contingency and subjectivity. As Jonathan Crary has argued in his *Techniques of the Observer*, these new discoveries led to a fundamental shift in the way vision, and its relationship to perception, was understood.7 He asserts that this new understanding of vision as subjective dethroned an older model which he terms "Cartesian" or "Classical." This Cartesian model, symbolized by the optical device of the camera obscura, rests on the possibility of an objective and rational observer and assumes that sight provides unmediated access to reality. Although photography figures little in Crary's narrative, the camera's status as an information-gathering tool must nonetheless be considered against the background of the shift that he describes. The photographic camera not only bore a structural resemblance to the camera obscura, but it also seemed to uphold its now-defunct visual and epistemological model. By the mid-nineteenth century, photography had become all but synonymous with a rational, objective, and stable model for both vision and the acquisition of knowledge about the world.

The X-ray – coupling as it did the mechanical objectivity of the camera-eye with a super-human range of perception – on one level seemed to ably serve the ideals of positivist science. But its status as document, at least at the outset, was not guaranteed. While the X-ray was understood to inherit the camera-model of vision, it produced an entirely different model of visuality, one that disavowed the photograph's inextricable association with visibility. Unlike photographs, which replicate visible experience, the X-rays produce a data set existing nowhere but in the photograph itself. Furthermore, the data the X-ray provides is virtually unverifiable. This paradox was brought into sharp focus by the 1896 medical malpractice suit filed by James Smith, the first American legal case that attempted to introduce X-rays as evidence.8

Smith had complained of leg pain resulting from a fall, but the doctor who examined him was unable to locate a fracture. Several months after the initial examination, Smith sued the doctor for negligence. At trial, Smith's lawyers showed X-ray pictures of Smith's leg that bore clear evidence of the femoral fracture the doctor had failed to identify. As the legal historian Tal Golan illustrates in his analysis of the case, despite their routine appearance as juridical evidence today, in 1896 the X-rays' admission was not assured. Even the evidentiary status of "conventional" photographs was hotly contested in legal circles for much of the nineteenth century. Photographs were not considered primary evidence, but rather were employed as supplemental evidence. In other words, an eye-witness to the scene was required to vouch for the photograph's veracity.9 The X-ray understood as a form of photographic image was therefore expected to meet this same standard. This was clearly not feasible, as it was impossible to produce a

corroborating witness. As a result, early judges who heard the case deemed the X-ray unfit for evidentiary purposes; as one judge stated: “there is no proof that such a thing is possible. It is like offering the photograph of a ghost, where there is no proof that there is any such thing as a ghost.”10 Eventually, and only after numerous demonstrations of the process, the ruling judge in Smith’s case admitted the pictures into evidence.

What Smith’s case makes clear is the X-ray’s peculiar condition as a representation, a representation independent of visual experience and subject to analysis on its own terms. The judge’s decision is also indicative of an important shift in the status of the photograph: once understood as a transcription of the visible world, the photograph is reconfigured as a translation of invisible data into visual form. Moreover, this translation must be understood as an abstraction, both in epistemological and pictorial terms. As Lorraine Daston and Peter Galison have pointed out, the X-ray, by collapsing the three-dimensional body into a two-dimensional image produced a picture that neither corresponded exactly to the material world nor provided entirely legible data.11 The flattened, collage-like pictures were so abstract that even doctors trained in human anatomy had difficulty deciphering them and had to rely upon the interpretations of expert technicians. If the mid-nineteenth century had understood the camera to operate like a mechanical stand-in for the human observer and the photograph to serve as a transparent record of the visual experience, the X-rays’ “photographic” representations of invisible phenomena raised serious questions about the adequacy of that older model.

The significant differences between “traditional” photography and the kind of pictures the X-rays produced were not lost on the nineteenth-century observers. As the writer A. A. Campbell Swinton observed in March 1896, the application of the word photography to the pictures made with the X-ray was, as he put it, “plainly a misnomer.”12 Swinton described the new process, elaborating on the aesthetic and ontological differences between X-ray images and traditional photographs:

> The resulting impressions are silhouettes or transparency-pictures; they originate from true shadows of the things portrayed, the structure of which is given in terms of the opacity to the X-rays of their various parts. And this opacity is of so abnormal a kind that the process brings about startling inversions of visibility, the commonly unseen being laid bare, while the encasing substances which alone show to the eye are rendered inconspicuous or evanescent. The familiar *surface*-photography has, in short, obtained as an ally a wonderful art of *organic* portraiture, already promoted and availed of with unexampled zeal, although it would have been pronounced six

> months ago, alike by the learned and the unlearned, a fantastic impossibility.[13]

Swinton's text outlines a set of critical dichotomies between the two processes: photography depicts an object's visible surface where X-rays probe its invisible depths; photography supports knowledge through observation where X-rays produce mediated knowing through representation. Swinton sees the X-rays' "new" photography as a complement to the "old" mode. To the photograph's truthful description of the visible, the X-ray adds a new level of "organic" knowledge. But in fact the X-ray did more than serve as an ally to "surface-photography": it also cast doubt on the very paradigm that underpinned that kind of empirical observation. The X-ray derived its authority from its perceived relationship to photography while simultaneously undermining the medium's own epistemological foundation, attenuating the once-unassailable connection between visibility and knowledge.

The X-rays were not the first instance of photographing what was invisible to the human eye. Astronomers, for example, used time-lapse photography to make pictures of stars too weak to be seen; over the course of several hours, the light emitted from the star accumulated sufficiently to register on the plate. The motion studies of Etienne-Jules Marey and Eadweard Muybridge, undertaken in the decade preceding Röntgen's discovery, also produced visual records of movements and phenomena too rapid to be perceived by human vision. But the X-rays' impact on the public imagination was unrivalled by any other photographic technology, and their revelations profoundly shook popular confidence in the human sensorium. In a 1903 essay entitled "The World Beyond Our Senses," Carl Snyder describes the growing appreciation of the sensory shortcomings of the human body: "Beyond all that the eye may see, that the ear may hear – outside of any native sense, – there lies an unseen, unheard, unfelt universe whose fringe we are just beginning to explore."[14] Snyder compares the X-rays' awakening of the public to this imperceptible world to what Helen Keller would feel upon regaining sight and hearing. Helen Keller—then the focus of public attention as the first deaf, dumb, and blind person to attend university, and on the verge of completing her degree at Radcliffe – serves as an evocative metaphor for the modern condition. "Slightly we realize," Snyder writes, "that in some sense we are all Helen Kellers, and that ours too is a Helen Keller world."[15]

The X-ray photographs provided data that was unverifiable by normal visual means and, in some cases, contradicted widely-accepted understandings of common phenomena. That these images nonetheless came to be accepted as accurate or objective documents points to an erosion in the nineteenth-century faith in human vision and the transference of that faith to the camera itself. By 1896, the connection between seeing and knowing was less certain, undermined in part by

the imaging technology that had once seemed to confirm it.16 If the camera had been envisioned as an antidote to the destabilization of modern vision and a rational and objective mode of observation, the discovery of the X-rays and the scientific and popular revolution they effected brought an end to this model's viability.

Photographic historians have tended to treat the photographic medium as all-of-a-piece, glossing over the subtle shifts and disjunctions that marked its evolution, manipulating its history to support a teleology that culminates in the "straight" photograph. The medium-specific terms of this modernist narrative continue to dominate discussion of lens-based imagery today. By considering what the X-rays meant to a contemporary audience, and the way they complicated the definitions of such terms as objectivity, truth, and document, we are able to consider a more specifically nineteenth-century understanding of the photographic medium.

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1. For a thorough overview of the discovery and history of the X-ray, see Bettyann Holzmann Kevles, *Naked to the Bone* (New Brunswick, N. J.: Rutgers University Press, 1997). See also Otto Glasser, *Wilhelm Conrad Röntgen and the Early History of the Röntgen Rays* (San Francisco: Norman Publishing, 1993).

2. For an excellent discussion of the nineteenth-century understanding of the connection between knowledge and vision, particularly in relationship to photographic visuality, see Douglas R. Nickel, "Photography and Invisibility," in *The Artist and the Camera: Degas to Picasso*, ed. Dorothy Kosinski (New Haven and London: Yale University Press, 1999), 35-40.

3. These photograms were made by placing an object directly on a sheet of sensitized paper and exposing it to light. The resulting image was literally a fixed shadow of the original object. One of the earliest names for the images made by X-rays on photographic plates was in fact *skiagraph*, derived from the Greek word for "shadow picture."

4. This assumption that a good portraitist would be able to convey the high character of his sitter was so profoundly ingrained that many portrait

photographers adopted traditional painterly conventions in order to enhance the daguerreotype's "expression of character." For a discussion of this phenomenon, see Alan Trachtenberg's essay "Illustrious Americans" in his *Reading American Photographs: Images as History, Mathew Brady to Walker Evans* (New York: Hill and Wang, 1989), 21-70.

5. William Henry Fox Talbot, *An Account of the Art of Photogenic Drawing: or, the process by which natural objects may be made to delineate themselves without the aid of the artist's pencil* (London: Royal Society, 1839), n.p. In their important essay, "The Image of Objectivity," Lorraine Daston and Peter Galison explore at length the use of mechanically-produced images in scientific illustration in relation to historically diverse definitions of objectivity. In particular, their inquiry is concerned with the nineteenth-century moral impetus to suppress subjectivity in science through the use of such mechanically-produced images as photographs. See Daston and Galison, "The Image of Objectivity," *Representations* 40 (Fall 1992): 81-128.

6. See Diamond's paper, "On the Application of Photography to the Physiognomic and Mental Phenomena of Insanity" (read before the Royal Society, London, May 22, 1856), reprinted in Sander L. Gilman, *The Face of Madness: Hugh W. Diamond and the Origin of Psychiatric Photography* (New York: Brunner/Mazel, 1976), 17-24. On the use of photography in nineteenth-century psychiatry, see also Martin Kemp, "'A Perfect and Faithful Record': Mind and Body in Medical Photography before 1900," in Ann Thomas, *Beauty of Another Order: Photography in Science* (New Haven and London: Yale University Press, 1997); and Sander Gilman's pioneering study, *Seeing the Insane* (Lincoln, Nebr.: University of Nebraska Press, 1996).

7. See Jonathan Crary, *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century* (Cambridge, Mass. and London: MIT Press, 1990).

8. For an excellent analysis of the legal implications of this case, see Tal Golan's essay "The Authority of Shadows: The Legal Embrace of the X-Ray," *Historical Reflections/Reflexions Historiques* 24 (Fall 1998): 437-458.

9. Ibid., 448.

10. Ibid., 450.

11. Daston and Galison, 106.

12. A. A. Campbell Swinton, “The Photography of the Invisible,” *The Quarterly Review* 183 (January and April 1896): 500.

13. Ibid.

14. Carl Snyder, “The World Beyond Our Senses,” *Harper’s Monthly Magazine* 152 (June 1903): 117.

15. Ibid. Ironically, the proof the X-rays provided of phenomena undetectable by the human sensorium was used to support other, less traditionally scientific, claims. If the judge in the James Smith case dismissed the X-ray’s validity as evidence because “[i]t is like offering the photograph of a ghost, where there is no proof that there is any such thing as a ghost,” many spiritualists argued the converse. To their minds the X-ray, by pointing out the limitations of human sense perception and by providing photographic proof of the invisible, left open the possibility of the existence of spirits and telepathy. Moreover, the X-rays also appeared to support the claims of spirit photographers. As James Coates writes in *Photographing the Invisible*: “To say that the invisible cannot be photographed, even on the material plane, would be to confess ignorance of facts which are commonplace – as, for instance, to mention the application of X-ray photography to the exploration of the muscles, of fractures of bone, and the internal organs. Astronomical photography affords innumerable illustrations of photographing the invisible. In the foregoing, and analogous cases, the photographing is that of material, though invisible, objects.” Coates, *Photographing the Invisible: Practical Studies in Spirit Photography, Spirit Portraiture, and other Rare but Allied Phenomena* (London: L. N. Fowler and Co. and Chicago: The Advanced Thought Publishing Co., 1911), 2.

16. The shift from a reliance on direct observation to mediated representation of data that is inaugurated in the nineteenth century by such technologies as the X-ray also has profound resonance in contemporary media culture. In today’s technological culture, where wars are waged by generals thousands of miles away from the battlefield and intelligence is gathered not by spies but by spy satellites orbiting the earth, this radical disconnect between seeing and knowing is almost entirely unacknowledged. The faith once placed in the human eye has been replaced by a near-total dependence on technologically-inflected vision. Our willingness to trust the visual data produced by such modern technologies as the PET scan, an instrument that images the thought processes and emotional

responses of the human brain, depends on a system of belief that has its roots in the discourses of nineteenth-century scientific photography.