Lisa Cartwright, *Screening the Body: Tracing Medicine's Visual Culture*, Minneapolis and London: University of Minnesota Press, 1995

xi The cinema as an institution and an apparatus for monitoring, regulating, and ultimately building "life" in the modernist culture of Western medical science.

The assertion that the motion picture, in conjunction with more familiar nineteenth-century medical recording and viewing instruments and techniques, such as the kymograph, the microscope, and the X-ray apparatus, was a crucial instrument in the emergence of a distinctly modernist mode of representation in Western scientific and public culture—a mode geared to the temporal and spatial decomposition and reconfiguration of bodies as dynamic fields of action in need of regulation and control.

xiii At the turn of the century, the motion picture apparatus was crucial in the emergence of a new set of optical techniques for social regulation.

Xiv The bodies [neurological films] depict resist the meanings imposed upon them by medicine.

Xvii The purpose of this study, then, is not only to fill in gaps in the canons of film studies and the social studies of science, but also to demonstrate how the cinema, an instrument of popular entertainment, functioned as a part of a social apparatus through which the cultures of Western science and medicine shaped and built the life they studied, and how individual subjects and cultures aided, confounded, or resisted Western medical science's normative life-building projects in the first half of this century.

2 I suggest that the scientific analyses of living bodies conducted in laboratories of medicine and science were in fact based in a tradition that broke with the photographic and theatrical conventions that would [3] inform both the documentary and the narrative cinema—a tradition that is linked to laboratory instruments of graphic inscription and measurement such as the myograph, the kymograph, and the electrocardiograph.

3 The cinematic apparatus can be considered as a cultural technology for the discipline and management of the human body, and that the long history of bodily analysis and surveillance in medicine and science is critically tied to the history of the development of the cinema as a popular cultural institution and a technological apparatus.

4 I argue throughout this book that the importance of the film motion study is primarily neither its contribution to a singular dominant industry or optical paradigm nor its contribution to medical knowledge. Its greatest importance is its function as an intertext between popular and professional representations of the body as the site of human life and subjectivity.

[The] compulsion to reveal the interior technologies of the living body on motion-picture film involved a break with older conventions of photography and, perhaps para-[5]doxically, instituted a crisis in scientific observation generally.

5 The pleasures of "distances" analytic viewing, I argue, are not peculiar to the genre of the motion study but have pervaded the popular cinema and other institutions. Surveillant looking and physiological analysis, then, are not just techniques of science. They are broadly practiced techniques of everyday public culture.

7 Many of these machines, the numerous cameras, projectors, and compound instruments that emerged over the course of the nineteenth century, in fact were no mere little machines, the silly contraptions of amateur inventors; they were fairly sophisticated instruments used in laboratories of

physics, chemistry, and physiology. […] The cinema's emergence cannot be properly conceived without acknowledging the fascination with visibility that marked the preceding decades of nineteenth-century Western science.

8 Medical and scientific film motion studies provide evidence of a mode of cinematic representation and spectatorship that is grounded in a Western scientific tradition of surveil-[9]lance [surveillance], measurement, and physical transformation through observation and analysis.

10 With the emergence of biological modes of representation, we find a historical break between observation (or image) and object of knowledge—a break in which the visualization of "life" becomes all the more seductive to the scientific eye even as the limitations of representation are made plain.

11 Paradoxically, as imaging becomes a more central means of diagnosis and study throughout the nineteenth century, sensory perception (including sight) is progressively destabilized as a source of anatomical knowledge.

12 [John Tagg, *The Burden of Representation: Essays on Photographies and Histories*, Minneapolis: University of Minnesota Press, 1993, 11:] We are dealing with the instrumental deployment of photography in privileged administrative practices and the professionalised discourses of the new social sciences—anthropology, criminology, medical anatomy, psychiatry, public health, urban planning, sanitation, and so on, all of them domains of expertise in which arguments and evidence were addressed to qualified peers and circulated only in certain limited institutional discourses. […] In terms of such discourses, the working classes, colonized peoples, the criminal, poor, ill-housed, sick or insane were constituted as the passive—or, in this structure, "feminised"—objects of knowledge. Subjected to a scrutinizing gaze, forced to emit signs, yet cut off from command of meaning, such groups were represented as, and wishfully rendered, incapable of speaking, acting, or organizing for themselves. The rhetoric of photographic documentation at this period […] is therefore one of precision, measurement, calculation, and proof.

13 The fascination with physiological and technological spectacles of "life" was a transversal phenomenon, cutting across popular, public, and professional visual cultures.

17 A popular attraction at Coney Island's Luna Part was Topsy, a four-ton elephant captured in Africa and brought to the United States, where she lived in captivity for twenty-eight years. Topsy's popularity increased dramatically when she killed three men, to the horror and amazement of Luna Park spectators. An uncontrollable, man-killing beast was a much more exciting attraction than a docile animal. The Luna Park authorities decided, however, that Topsy posed too much of a risk alive. The execution that they plotted proved to be an attraction almost more popular, and undoubtedly more dramatic, than the display of the living animal had been. Luna Park officials commissioned the Edison Manufacturing Company to build an apparatus for the electrocution of the elephant. […] [18] The Edison Manufacturing Company must have banked on the fact that in 1903 audiences would have paid not only to observe an intervention in the "regulated activity" of the "living being" but to study this intervention again and again on film, just as the laboratory scientist might want to watch just such a film over and over to analyze the execution of "life." The one-minute *Electrocuting an Elephant* documents the moment of the elephant's death. But, more importantly, it also documents public fascination with scientific technology and its capacity to determine the course of life and death in living beings, even those as physically and symbolically powerful as the elephant.

20 Cinematography was quickly incorporated into laboratory practice as an experimental technique, to be used alongside a range of techniques of inscription and visualization (including kymography, microscopy and photography).

23 [John McIntyre's X-ray film of a frog's leg in motion, and Ludwig Braun's cinematography of a dog's beating heart] suggest that the physiological cinema is marked by a drive not only to segment, to measure and to quantify movement, but also to render visible parts of the living body that were previously considered to be too interiorized, too minute, or too private to be seen by the researcher's unaided eye. The imaging of the body's interior space in medicine and science has suggestes to some scholars a narrative of Western advancement characterized by technology's prosthetic augmentation of the sensory powers already built in, as it were, to the scientific observer's body. This argument suggests that devices designed to visualize physiological processes in effect enhanced researchers' perceptual powers, extending the observer's epistemological domain into previously uncharted territories—an Enlightenment project that continues in today's medical imaging technologies.

Here, Braun's use of cinema film—a kind of use typical of physiological cinema at the turn of the century and after—suggests that the augmentation of sight, and imaging as such, may not have been the central agendas in modernist science's optical invasion of the body's interior space. Rather than simply augmenting the senses of the scientific observer, cinematography supplemented or replaced sensory perception. The inscriptions of data produced through techniques like kymography or cinematography in the physiological laboratory replaced the sensory observations of the physician or technician as a privileged source of scientific knowledge. Jonathan Crary argues this case with regard to physiological optics in the early decades of the nineteenth century. He states of contemporary visual practices:

Most of the historically important functions of the human eye are being supplanted by practices in which visual images no longer have any reference to an observer in a "real," optically perceived world. If these images an be said to refer to anything, it is to millions of bits of electronic mathematical data. Increasingly, visuality will be situated on a cybernetic and electromagnetic terrain where abstract visual and linguistic elements coincide and are consumed, circulated and exchanged globally. [Jonathan Crary, *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century*, Cambridge: MIT Press, 1990, 2]

24 This "antivisual" and graphic tendency in medical imaging that can be traced from Macintyre and Braun to the present.

[…] Shift toward graphic inscription as a means of recording interior processes.

27 What is "observed" is not the phenomenon but an encoded inscription of an activity functioning beyond sensory thresholds, or an activity whose life can be measured only against its physiological condition of death. Far from prosthetically enhancing the senses, the kymograph and its linear, digitally encoded image fils the vacuum in signification produced by the failure of sensory observation.

30 In [Arago's] account, the light record is presented as a graphic and digital index, an image that forgoes the conventions of perspective built into the photographic lens. Prefiguring the temporal unit of the cinema frame, the light-intensity indices function together as a quantitative register of temporal difference much like a series of film frames. [Serial, proto-chrono photography].

33 F. A. Talbot, author of an early history of the cinema, points out that what appeared to be a flat wall was in fact a deep cavity (not unlike Edison's Black Maria). "The cavity may be likened to a shed," Talbot explains, "the front wall of which is removed and the whole interior blackened" with velvet, pitch, and a flat black paint [note: F. A. Talbot, *Moving Pictures: How They Are Made and Worked* [London, 1912], New York: Arno Press, 1970, 20]. Paradoxically, this deep space was essential to the rendering of an apparently flat backdrop, eliminating the light reflection that an actual flat surface would produce.

In one study of human locomotion done at this site, Marey clothed a human body in black

from head to foot. This costume was marked with graphic white lines and points, creating a kind of skeletal framework on the exterior of the subject's body. Filmed walking against the backdrop of the dark shed, the black-clothed body in effect disappeared from the image field—that is, except for the schematic skeletal lines that marked its limbs and torso. The fixed-plate sequence produced in the study of the man in black appears as an abstract series of linear registers—a skeletal image that functions, in much the same way as does the kymographic line of Macintyre's radiographic film of a frog's joint, as a graphic map of relational points across a virtually two-dimensional space […]. Further demonstrating the penchant for flatness that is so evident in this series is the fact that Marey further compensated for the "problem" of computing dimensional lenticular space by devising mathematical equations to "correct" spatial irregularities in the image due to the curvature of the lens and resultant variations in lens-to-object distance across the image field.

35 One might note that many of the statit photographic studies of criminals were used to construct a cultural typology of bodily form and appearance, whereas Marey appears to have used photography to drain cultural content fro the body surface, and from its static image.

36 A crucial difference between these static photographic techniques and Marey's is of course the fact that the former were produced with the idea of charting deviance, whereas Marey was interested in establishing a record of a norm.

[…] Tracing and disciplining the moving body was of course not unique to Marey and the nineteenth century. In *Discipline and Punish*, Foucault describes the Prussian regulations of 1743 that specified the economy of movement to be enacted by the soldier in order to use his time most efficiently: six stages to bring one's weapon to one's foot, four to extend it, thirteen to raise it to the shoulder, and so on. Marey's studies, though conducted more than a century later, were also conducted in large part to gain knowledge about the function of the human body in the military and in sport; to find ways to streamline and capitalize on the energy exerted by the human body in motion; and to make the body conform to physiological standards.

39 The dependency on technology, and the dispersal of embodied sight, triggered in science some often peculiar attempts to maintain authority over subjects by maintaining authority over the optical field. But I also argue that these attempts at centralized corporeal control by technical managers (doctors, technicians, scientists, radiologists) are complicated by the body under study. The living body, as object of technical knowledge, often functioned as a dynamic force within the experimental apparatus, a force that eluded and reflexively disciplined the gaze of the technical observer.

47 Videotelemetry, a technique currently used experimentally in neurology to monitor epileptics. The patient lying in bed is hooked up to an electroencephalograph machine and placed before a video camera. The camera is left on around the clock, its continuous image available at any time for comparison with the simultaneously generated electroencephalogram. Clearly, surveillance of the body continues to be an important technique in medical practice.

80 If at the turn of the century the neurologist was unable to render the body docile and compliant, by midcentury the neurologists is unable to make his own body perform its duties within the apparatus of the scientific gaze. The self-enucleated woman mirrors the state of the postwar neurologist. He is himself a figure stripped of his ability to control and direct the operations of the disciplinary gaze. By midcentury, the cinema camera, with its singular viewpoint and its supervisory camera operator behind the lens, is no longer an adequate instrument for the task of managing organic illness.

82 Sight must become more like the blood: fluid, pervasive, and unfixed from a locale. The researcher's sense of sight is thus subjected to all manner of technological augmentation, displacement, and verification; its authority is dispersed across instruments like the kymograph, the

cinematograph, and the microscope. Perception becomes unhinged from the sensory body and is enacted across an increasingly complex battery of institutional techniques and instruments.

83 Placing a specimen on the instrument's stage and closing one eye to peer through the viewfinder, the microscropist sees the body in a manner that effectively distances the observer from the subjective experience of the body imaged. Excised from the body, stained, blown up, resolved, pierced by a penetrating light, and perceived by a single squinting eye, the microscopic specimen is apparently stripped of its corporeality, its function, and its history even as it serves as a final proof of health, pathology, or sexuality of the subject whose body it represents.

84 Technical literature on microscopy is quick to point out that it was the ability to resolve the magnified image, and not the sight of invisible entities in itself, that truly excited scientists. […] The representational microscopic image differs from the representational painting or photograph in that its accuracy cannot be confirmed against the human eye's view of its object. […] The thrill of the spectacle of life was replaced by the intellectual stimulation of close inspection. Magnifying lens and observer's eye both became part of a new compound apparatus. But if the single lens of the simple microscope prosthetically augmented the eye of the observer by extending its range of vision, it also made it impossible to ignore the observer's [85] dependency on technology. The compound lens system took this subjection of the observer's eye a step further, calibrating and correcting its subjective perception.

86 The idea that lens and light both have agency and can be marshaled to render the object is crucual to the modern culture of microscopy. Long before techniques such as remote sensing or video surveillance were introduced in Wester warfare and industry, compound microscopy effectively embodied the optical paradigms that would come to be associated with these late-twentieth-century techniques of discipline and domination. Like these later techniques, microscopy incorporated the individual observer in a decentralized and self-correcting virtual sensory apparatus —an apparatus capable of facilitating inspection of visually inaccessible territory with optical precision and detail. But as with these later techniques, a point of instability was always the lack of a reassuring view by eye of the territory charted. In the absence of a conventionally perceptible field, microscopists were burdened with the knowledge that what they saw through the viewfinder might still be a distortion—or, worse yet, an image artifact (a scratch in the surface of the lens or a stray fleck of dust).

In the absence of a conventional view, nineteenth-century microscope makers established optical standards to test the accuracy of their instruments. Interestingly, the standard against which they compared their views was not an object per se but a representation: a print rendered from the image viewed through the microscopic lens.

90 [grille de vision] Resolution standards such as the mechanically ruled plates made by Nobert were introduced essential to measure distances across the image field. With a good microscope, one could easily compute the space between each ruled line on Nobert's test plate. But Novert did not provide a means for measuring the depth of the grooves his machine carves. The microscopic view, like the photographic image, is essentially flat. However, unlike most photographs, the microscopic image does not represent potentially vast three-dimensional space on a flat field, but rather renders an already relatively shallow space. […]

In the nineteenth century, Marey strategically reduced the human body he studies to a series of lines and points, erasing those aspects of human physiology that interfered in the production of a graphic map of bodily movement.

105 The history of the subject that is truly rendered invidible in this microscopic world is finally not a history of the seeing subject, but a history of the social subject whose body is diced, sliced, replaced by user-friendly animal and machine surrogates, or interspersed with technological

mechanisms, only to be magnified and re-[106]solve beyond any hope of recognition or restitution. But should we lament the loss of this organic body?

107 [On] the historical convergence of the cinema and radiography.

[…] X-ray images functioned, and continue to function, as icons, fetishes, and artifacts of health, life, sexuality, and, most significantly, death. […] As an aesthetic and a set of conventions, the X-ray is both gothic and modernist; as a medical tool, it has been regarded as a technique for both destroying and saving lives; and as a mode of scientific knowledge, it has revealed more about the modern body than any other imaging modality, drawing on both centuries-old iconography and modern visual paradigms to generate new configurations of the body.

108 The X-ray body […] is treated with the popular 1950s technique of 3-D associated with science fiction film (and its image of outer space), rendering the body's inner space a place of futuristic fantasies.

110 The X ray was more often represented during [its early days] as a wild, unknown natural force that had to be harnessed and managed in order to be put to good use. Thus the early history of X-ray imaging is not only about the management and control of bodies through imaging; it is also about the management and domestication of a potentially dangerous force of nature in medical culture. [→ "Taming of the ray"]

125 "Martyrs of the ray": Impossibility of identifying the technician, scientist, or physician as the seat of authority in techniques of medical power. Rather, the technician of the gaze occupies an unstable position that at times merges with that of patient and object.

127 In a chapter devoted to "the effects of the X-rays on the author's body," [physician, radiologist, and industrialist Emil] Grubb coolly outlines in detail the gradual deterioration of his flesh as he subjected his body to X-ray testing. […] [128] Grubbé's example is an extreme example of the submission of the technician and his "natural" body to the "death ray" and its powerful technological apparatus. His story is instrctive, though, because it makes clear a problem in theorizing agency: it becomes difficult to analyze the distinction among subjects, objects, and agency in the cultural apparatus of radiography. Radiographic knowledge (information about dosage, image interpretation and use, and so on) **is acquired only at the expense of test bodies**. Because of his proximity to the instrument, the radiographer was often the person whose body was given up to the process, willingly or not.

131 The X-ray photograph was received by its viewers as a static and bloodless image evoking death, whereas the moving X ray suggested the potential to breath life into that image, animating it and investing it with newly configured surfaces and fluids, symbolic flesh and blood.

137 The animation of the death image also included techniques that ultimately cast the X-ray image squarely in the realm of popular culture. Whereas Macintyre's 1897 X-ray film functioned ambiguously as popular novely and motion study research text, the moving X rays of the 1930s, 1940s, and 1950s were often quite unambiguously encoded as spectacle even in the scientific context.

146 Although the new medical imaging technologies are without question being used as a form of surveillance and control of bodies and communities, it would be a mistake to represent these technologies as simply tools of social domination. Without question, knowledge and authority are exerted through the surveillant techniques of disease management; however, certain bodies are systematically excluded from this gaze. One's identity is defined, in part, in terms of one's position within or on the margins of a social body composed through a visual apparatus that operates in

terms of both what it will not image and what it will. Though medicine may control the bodies and communities it images, it also offers imaging as a class and cultural privilege.

147 The X ray, penetrating the opaque surface of the body to display previously imperceptible evidence of disease, is critically implicated in inscribing the private interior of the body within a surveillant gaze that makes disease both visible and public.

153 The X ray, a register of the passage of activated electrons through the field of the body, provides something quite different from the light imprint of the body surface. Far from a photograph of the body's interior appearance (the skeleton, the organs), the X ray is a record of variations in density throughout different regions of the body—a graphic image void of the familiar signifiers of difference attached to the surface appearance of the body encoded in the photograph.

162 It is by now commonly held that medica lultrasound had its origins in military systems used in World War II to locate submarines and other objects hidden below the surface of the ocean. As Rosalind Petchasky has noted in her important study of ultrasound on ibstetrics, “most technologies in a militarized society either begin or end in the military,” and ultrasound is no ex-[163]ception. [Rosalind Pollack Petchesky, “Foetal Images: The Power of Visual Culture in the Politics of Reproduction,” in *Reproductive Technologies: Gender, Motherhood, and Medicine*, ed. Michell Stanworth, Minneapolis: University of Minnesota Press, 1987, 69. […] Carol Stabile, “Shooting the Mother: Fetal Photography and the Photography of Disappearance,” *Camera Obscura* 28, 1992, 179-205]

170 Communities are thus defined, in part, in terms of their relative positions within or on the margins of a social body composed through **a surveillant apparatus that operates as much through what it refuses to image as through what it fixes clearly in its sight**. The point, then, is not that images constitute privileged medical knowledge and power over those imaged and therefore women should resist being imaged; rather, women lust actively reconfigure technologies of representation—precisely because these technologies have been invested with the power to transform the body physically. Although medical imaging technologies may not be a cure, they are a critical—and heavily funded—area of visual culture. Thus this field is in need of active feminist technological refunctioning and countersurveillance.