Digital technology has changed the image of medicine, just as it has touched and transformed nearly every other aspect of our lives. From the mundane tasks of billing and recordkeeping to the weightier duties of diagnosis and prognosis, computers have revolutionized all aspects of medical care. Nowhere is this “digital revolution” more visible than in the radiologist’s laboratory. Imaging technologies such as computed tomography (CT), magnetic resonance imaging (MRI), and positron emission tomography (PET) have captured the imagination of doctors, patients, and the media, while fundamentally changing the way analog technologies, such as X rays, are used. Yet for all the novelty of these ways of seeing, they are, in many respects, not new at all; in a way, digital technology has revolutionized nothing in medical research and diagnosis. The rapid dissemination of these techniques and the voracious appetite for new processes and technologies (recalling the fervor for X rays at the turn of the century) indicate, in fact, the extent to which these imaging methods are part of a well-established tradition in medicine. This tradition certainly includes Western medicine’s long-standing dependence on technology, but more important, it includes the ways in which these technologies are created and used in daily medical routine. In other words, the digital revolu-

Scott Curtis

STILL/MOVING

Digital Imaging and Medical Hermeneutics

ution in medical imaging, like all revolutions, did not completely overthrow what preceded it; indeed, this particular revolution owes much to the analog approaches that came before.

There are any number of points of entry for a comparative history of analog and digital medical imaging. One could focus on the history of the technology by examining the similarities and differences in “hardware” and “software” design. We could emphasize the history of production by comparing the adjustments to the apparatus (as well as those required of the patient and the doctor) necessary to create a “legible” image. Or we could stress a history of reception by concentrating on the function of analog and digital images in day-to-day operations. I am interested in a specific problem within this last approach: how physicians “read” medical images—specifically, moving medical images—and how their interpretative procedures have changed with the advent of digital technologies. I will argue that, in fact, not much has changed. Physicians use digital images in much the same way that they have used analog images. This is, in itself, perhaps not surprising. After all, how else would we expect doctors to use them? I do not want to discount the novelty of these digital imaging technologies, but the use of images has implications for their production. If digital images are used just as analog images were employed, then it also follows that the very design of these “new” technologies has appropriated “old” procedures and practices. Once appropriated, these established protocols risk being subsumed into the category of “the new”—their history forgotten—and the “revolution” becomes complete. In the name of historical accuracy, if nothing else, it is important to demonstrate just how much these new technologies owe to their historical antecedents.

On a grander note, I also believe there is an essential continuity between the way physicians understand analog and digital medical images, which points to hermeneutic dilemmas at the basis of modern medicine. Grander still, a study of medical hermeneutics reveals the deeper connection between medicine and the humanities. Not only do they share a common object—our mortality or finitude—they share an interpretive approach. If medicine concerns itself with the confrontation between life and death, and if the humanities similarly focus on the human condition, ultimately both attempt to understand their objects (the human body, cultural texts) in the same way. That is, both approach their objects with a common hermeneutic strategy. This strategy, as we shall see, involves
conceptual movements between part and whole, depth and surface, past and present, and stillness and movement.

I believe that medicine and film studies have an especially strong connection in this regard; a shared interpretive approach that is evoked by moving medical images, which challenge physicians with the same problems of understanding as the living human body. Moving medical images recapitulate especially clearly some of the fundamental, confounding issues of medical representation, such as the creation and interpretation of “legible” images. How does one create an image of the human body that captures only the pertinent details but still can be understood by one’s audience? This is also an issue in film studies, where histories of production are tempered by histories of reception due to the constant negotiation between filmmaking and moviegoing, and where the interpretation of moving images must take into account issues of textuality and temporality. “Legibility,” therefore, is one of the most important issues shared by medicine and film studies.

“Legibility” is not a given in medical imaging. Since the sixteenth century, at least, medical illustrators have had to contend with the overwhelming, often mysterious detail of the human body. Given the pedagogical function of medical illustration, the doctor and/or illustrator found it necessary to “interpret” the detail and to manage it by means of visual emphasis or omission. That is, illustrators could not conceivably replicate every detail of the section of the body under scrutiny—they had to make choices about what to emphasize and what to omit in the illustration. With the emergence of photography in the nineteenth century, this problem of managing detail became even more acute, because it seemed that the camera recorded without emphasis, or at least that this new medium required different methods of “visual pointing.” With both medical illustration and photography, physicians tried to strike a balance between construction and recording, between subjectivity and objectivity. The same is true for digital technologies; the magnetic resonance imager generates an overwhelming amount of information in an acceptably “objective” way, but that information must be modulated, selected, and processed by the radiologist and his or her staff in order to create a legible—that is, readable, interpretable, productive—image.

The techniques for managing detail in medical imaging have a history of their own. In 1543, for example, Andreas Vesalius pro-

vided a familiar, hence immediately legible, context for his anatomical illustrations by giving the bodies shapes that recalled classical sculpture. Nineteenth-century medical photography organized its images using conventions borrowed from studio portraiture, demonstrating that, despite claims to total objectivity, aesthetic standards have always played a significant role in medical illustration. With the introduction of moving images to medical research and diagnosis, the question of detail was complicated by an additional factor—time—which required another set of “management techniques.” These techniques balance the aesthetic and scientific, the subjective and the objective. Digital medical imaging—although dominated by the still image—incorporates management techniques learned from the moving medical image.

In this essay, then, I try to accomplish two things. First, in an effort to historicize digital imaging technologies and their use, I briefly survey the history of three techniques for managing and interpreting the moving medical image: the spot film, the looped film strip, and the act of tracing images from motion pictures onto paper. Each of these techniques finds its echo in digital medical imaging, such as the captured “screen shot” from an echocardiogram, the repeated cycle in a cine-MR image of the human heart, or the edge-enhancement techniques common to most image-processing software. I argue that the function and even the design of digital medical imaging technologies incorporate methods of analysis common to analog medical images.

Second, and perhaps more important, in an effort to draw connections between medicine and film studies—and to understand the hermeneutics they share—I argue that even though medical imaging is overwhelmingly “still,” it cannot be understood apart from the “moving.” The dialectic of stillness and movement plays an important role in understanding the creation and interpretation of medical images in general. But in a broader sense, moving images in medical diagnosis and research enact important dilemmas of representation and interpretation at the very heart of medicine. Just as medicine must contend with an ephemeral, moving, vital object—the human body—so must physicians who integrate moving images in their research (for precisely its ersatz vitality) come to grips with an elusive, temporal object. The human body is oppugnantly alive, frustratingly resistant to contemplation, study, and interpretation; the history of medicine could be written as a history of attempts
to tame—to hold still—the unruly body through such techniques as autopsy and illustration. In this sense, medicine’s foundational hermeneutic dilemma rests on a dialectic of movement and stillness that is mimicked by the use of motion pictures in medicine and is reenacted in digital medical imaging techniques.

This dialectic is significant for its close relation to the line between life and death, which I explore throughout this paper. The essay is divided into six sections. I begin with a discussion of hermeneutics and its relation to the human body and its representations, before arguing for the privileged status in medicine of moving images of the human body. Foucault’s *Birth of the Clinic* will offer an opportunity to discuss the relation between life and death, while a discussion of film and photographic theory will connect that relation to stillness and movement. Finally, I present a survey of a variety of management techniques in digital medical imaging and end with their implications for changing conceptions of life and death.

Medical Hermeneutics

The pillars of Nature’s temple are alive and sometimes yield perplexing messages.—BAUDELAIRE, *Les Fleurs du Mal*

Before we can discuss the relation between movement and stillness in medicine—and in the use of moving images in medicine—we need to clarify the concept of “medical hermeneutics.” First, what is hermeneutics? Hermeneutics has been defined traditionally as the theory and method of interpretation, especially of the Bible. If, theoretically speaking, the presence of the speaker behind his or her spoken word ensures clarity and comprehension, the absence of the author of a written text generates a gap in understanding that must be bridged by interpretation. Difficult passages of the Bible required some interpretation in order to square them with other passages, as well as with the goals and standards of the community. In the early nineteenth century, Friedrich Schleiermacher extended hermeneutics to include all texts, not just the Bible, and theorized the method by which we interpret them. According to Schleiermacher, this method, the means to bridge the gap between the text and understanding, entailed a conceptual movement between the text and its parts. “Complete knowledge always involves an apparent circle,” Schleiermacher says, “that each part can be understood only out of the whole to which it belongs, and vice versa. All knowledge which is scientific must be constructed in this way.” This is known as the “hermeneutic circle”: understanding’s incessant movement between levels of the text.

Other theorists expanded the notion of hermeneutics to include other types of “texts,” each type requiring a different kind or number of “hermeneutic circles.” Johann Gustav Droysen applied hermeneutics to history and argued that historians circle between past and present. Sigmund Freud, as Paul Ricoeur argues, saw the human mind as a text and based his hermeneutic method on a surface/depth model. With these models and with hermeneutics in general, there are (at least) two types of circularity. There is a movement between levels of the object (part/whole, past/present, conscious/unconscious), and there is a circularity in the process itself: the object of study is tailored by the interpretation, which simultaneously calls for a retooling of the mechanics of interpretation brought to bear on the object. In other words, the gap between text and understanding is bridged by the circle, but it leaves neither untouched. There is always a mutual dependence and intermingling between “text” and “reader.” Hermeneutics implies, then, a “dialectic” that—for the purposes of this essay—connotes analysis, transformation, and recursion (repeated action).

So what is the role of “reading” and “interpretation” in medicine? What is unique about medical hermeneutics? And, perhaps more fundamentally, what, exactly, does the medical profession “read”? Is there a text in this examination room? In one sense, modern medicine has always tried to make the body legible: if Biblical hermeneutics recalls the incarnation of God’s word in text, or the Word made flesh, then medical hermeneutics reverses this equation to give us the flesh made word. Yet even the body itself is not the sole “text” of the clinical encounter. Beyond the physical examination of the patient, there is the patient’s medical “history” and the images, charts, and graphs from the laboratory, not to mention the patient’s own experience of the illness that prompted the call to the doctor. But it is not as if these are static texts just waiting to be explicated. Like the historian, the physician must actively bring these texts into being before/while bringing to bear the interpretative procedures. In any case, the text of medicine is constantly shifting and multiple. This is even more true if the ostensible object of study in medi-
cine is not the body but disease and death. The healthy human body is important as a model or ideal of normalcy, but even that is defined against and dependent on a conception of pathology.\textsuperscript{15} Judging from healthcare’s current focus, disease seems to be the real object of medicine; the human body is only its localization, its visualization. The body makes disease manifest, but disease itself is imperceptible; is cancer the collection of cancerous cells, the process that created the cancerous cells, or a category that encompasses all the symptoms brought on by the cancerous cells? These questions are disputed even today. Medicine, therefore, attempts to describe and diagnose things that it cannot see, imperceptible processes or inaccessible entities. The relatively modern attempts to visualize lesions requires an apparatus—both technological and interpretive—that signals a fundamental blindness in the medical gaze.

It is not that physicians are groping in the dark, but they deal with inherently ephemeral, transient, and imperceptible phenomena: fleeting fevers, real and phantom pain, invisible internal functions. Doctors read signs and symptoms as clues to processes that are inaccessible to direct observation, making medical hermeneutics a semiotic enterprise. Interpretation in medicine means reading signs (which are usually illegible to the lay public) against a larger context in order to arrive at a diagnosis or prognosis. (Of course, this larger context involves institutions and power relations, not only between doctor and patient, but between doctor and administrator, between doctor and staff, and between doctors.) Indeed, the hermeneutic circle in medicine encompasses not only part/whole, but also present/past (life/death), surface/depth, and—as we shall see—stillness/movement.

This hermeneutic activity is fundamentally speculative. Herein lies an interpretive model that, as Carlo Ginzburg notes, has informed the human sciences generally. Art history and history, literary criticism and psychoanalysis also see visible signs (e.g., brushstrokes, aphasia) as clues to deeper, imperceptible patterns (e.g., authorship, childhood trauma). For Ginzburg, the humanities owe their hermeneutics to an age-old semiosis at the core of medical practice. Furthermore, Ginzburg argues, both medicine and the human sciences are “highly qualitative disciplines, in which the object is the study of individual cases, situations, and documents, precisely because they are individual.”\textsuperscript{16} This focus on the individual case—even if it is meant to represent a larger group—limits the ability to quantify the data. In other words, because no two cases are exactly alike and no two manifestations of disease identical, medicine will remain an inexact science. Medicine can never attain the certainty of, say, classical physics because medical knowledge, like historical knowledge, is “indirect, presumptive, conjectural.”\textsuperscript{17} Each human body, like each historical event, is slightly different from the next, which makes it difficult to arrive at universal laws. The living human body and the past are both fundamentally resistant to quantification and direct perception.

What makes the body so imperceptible, so resistant to quantification? Not only are its internal functions hidden, but the body itself is dynamic. It moves. It is difficult to measure something when all the variables are constantly changing, or when the object itself won’t stand still. Indeed, it is hard to comprehend (from the Latin: to grasp or to seize) something that is alive. This conundrum recalls the troubled philosophical relationship between the real and the ideal: what is the relationship between the individual, disorderly, temporal object and the intemporal form it takes in our concept of that thing? How do we comprehend that which exists in time?\textsuperscript{18} Baudelaire’s lines above remind us of this cognitive dilemma as it relates to medicine: the body (“Nature’s temple”) is “alive” and, for that very reason, unreadable, or at least “perplexing.”

All this is not to say that doctors cannot make good (hence lifesaving) guesses. They do, and they work around these hermeneutic dilemmas quite well. Medical images and imaging techniques are an important part of the solution. Medical images (photographs, ct scans, etc.) make the imperceptible perceptible, hold the body still, and can provide the basis for quantification. An anatomical illustration, for example, reveals the hidden structures of the human body, allows the physician time to contemplate and to study these structures, and, if exact enough, can provide a sense of scale or even the grounds for measurement. Despite the fundamentally unquantifiable character of the human body and disease, modern medicine has gone to great lengths to ground its uncertainty in the certainty of science and its quantitative methods. These strides began in the late eighteenth century, accelerated in the late nineteenth century, and today have turned into a full gallop.\textsuperscript{19} Imaging techniques have been integral to this scientific, quantitative approach. Even more important, however, medical images have allowed physicians to comprehend, however briefly, the elusive human body.
graved sections to the Visible Human Project's digitized sections of human anatomy, representations of the human body have been medicine's conceptual prosthesis, its central, illuminating trope.

**Medicine and the Moving Image**

The fixation onto a corpse of a segment of immobile space may resolve the problems presented by the temporal developments of a disease. —Foucault, *The Birth of the Clinic*

Moving images of the body are a privileged example of medical imaging. Projected, these images come "alive" and mimic the detail and continuity of the living body. As such, they present physicians or researchers with the same hermeneutic problems as the living body: they are temporal and ephemeral, hard to read and difficult to grasp. But whether on celluloid, on videotape, or on digital media, moving images are also much more readily manipulated than the living body, much more malleable and controllable. In this regard, they are analogous to the cadaver—the domesticated and revealing, but also meager, version of the vibrant body. Foucault's comment above indicates that dissection and autopsy were at one time important solutions to the physician's hermeneutic dilemma. The temporal conundrums presented by disease and by the body were to some extent solved by medicine's ability to examine the intemporal cadaver. In other words, the corpse played a vital role in the formation of modern medicine. Both incarnations of the moving image (the projected image and the celluloid) compare more favorably to the living and the dead than medical drawings or photography, and this physical and functional analogy is the basis of a more profound and complicated relation between life, death, and moving medical images.

In other words, there is a deeply philosophical connection between film and modern medicine, a structural homology, affinity, and shared hermeneutic that commentators have neglected. Walter Benjamin's comparison between the surgeon and the cameraman comes the closest. In a discussion of the changing perception of art and reality in the age of their mechanical reproducibility, Benjamin explores the difference between painting and cinema by way of a medical analogy:

From this analogy, Benjamin finds two opposed ways of representing reality. On one hand, painting presents a view of "immediate reality" from a distance; there is a "natural" distance between the object viewed (such as a landscape) and the painter, a distance that is respected in the painter's appropriation of a scene. On the other hand, a movie set's view is so cluttered with technology that the "immediate reality" must be *extracted* by a special, almost "surgical" procedure involving correct camera placement and editing before it is presented on screen. Cinema's illusion of an immediate reality free of all artifice is possible only because of its highly mediated, technological nature. The difference between these two art forms, then, is the difference between the physical and psychic distance associated with painting's "aura" (comparable to the aura of the magician) and the physical and psychic penetration associated with motion pictures (and the surgeon).

Benjamin therefore theorizes the common connection between cinema and medicine to be one of technique, attitude, or approach. It tells us much about technological mediation and the relation between subjectivity and objectivity. The apparently "objective" (i.e., unmediated) medical image of the human body is also highly mediated by technology. The medical image, as a "pure aspect of reality," is extracted by a variety of techniques and technologies. Indeed, in the twentieth century, the very possibility of anything even approaching "objectivity" in science and medicine depends on technological mediation. The moving image is only one weapon in this arsenal. Benjamin's is an important point of comparison, but it does not touch on the connections between medicine's preoccupation with life and death and cinema's essential relation to this duality.
Likewise, the comparatively few book-length studies of medicine and cinema tend to focus on either questions of technique (how these films are made) or on the political and ethical implications of the close historical connection between medicine and moving images. For example, Anthony Michaelis’s valuable survey of scientific cinema, *Research Films in Biology, Anthropology, Psychology, and Medicine*, outlines in detail the technical issues involved in filming the human body and other natural phenomena. For Michaelis, however, film’s legitimacy as a scientific instrument is obvious and uncontested. Commenting on the astonishing variety of techniques employed in scientific cinema, he states, “In all of these we have discovered that only the quantitative use of cinematography, combined with frame-analysis, has produced the maximum amount of research data of which the motion picture film is inherently capable.” In scientific cinema, there is a double “extraction”: the camera penetrates and captures a reality otherwise invisible, and then, through quantitative analysis, useful, objective data is “extracted” from the image itself.

On the other hand, Lisa Cartwright’s important study, *Screening the Body*, is concerned primarily with the status of the human body under the medical gaze, and with cinema’s contribution to and complicity in this disciplinary surveillance. Cartwright argues that “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.”

While Michaelis is interested in what Benjamin might call the process of penetration and extraction, Cartwright is interested in the trials of the human body as a consequence of this process. Concepts such as “discipline” and “medical gaze” immediately signal Cartwright’s debt to Michel Foucault. But because of her interest in the political consequences of the relation between cinema and the body, her theoretical framework depends primarily on the investigation of power and the body in *Discipline and Punish*, rather than on Foucault’s earlier work on medicine proper, *The Birth of the Clinic*. There are, however, important insights in *Birth* that have been overshadowed by his later work. In the following section, I chart a course between Michaelis’s interest in the purely technical and Cartwright’s interest in the ethical, and explore, with the help of Foucault, the philosophical affinity between medicine and cinema.

--HEGEL, *Hegel’s Logic*

Foucault’s *The Birth of the Clinic* is an “archaeology of medical perception,” an account of the reconception of disease around the turn of the nineteenth century. During the seventeenth and eighteenth centuries, a “botanical” model of disease flourished, with accompanying ontological and taxonomic implications. Disease was conceived as a foreign essence; it had its own “life cycle” independent of its human host. Indeed, its connection to the human body was only coincidental. Like a plant, disease flourished in its “natural environment,” which was thought to be the home (as opposed to a hospital), and to diagnose the illness correctly it was necessary for the physician to let the disease develop and reveal its true essence. Once the disease displayed itself fully through its signs and symptoms, it could be placed in a classificatory scheme—that is, placed in relation to other diseases—and thereby accurately named and understood. Foucault calls this the “medicine of species”; disease existed conceptually, as an essence that was part of a larger taxonomy.

In the early nineteenth century, a new conception of disease grew out of and alongside changes in medical practice, especially the rise of case-oriented, hospital-based medicine and pathological anatomy. The existing knowledge of diseases and their symptoms was superimposed on the relatively new study of pathological tissues. Recordkeeping and autopsy, for example, changed the structure of medical knowledge, eventually localizing disease in the human body, specifically in lesions. Contrary to the medicine of species, this approach advocated intervention and eventually recognized the hospital as the “natural” environment for disease. New forms of
observation—what Foucault names “the medical gaze”—grew out of this intersection of hospitals, medical education, case histories, autopsies, and dissection. Foucault chooses to focus on the clinic (a hospital department or stand-alone institution devoted to a particular group of diseases) as an exemplary case study because its attention to individual case histories and its intense description of individual facts and their variations brought to light the temporal character of disease in a new way. As a result of these configurations, disease was no longer conceived as an ahistorical essence but, as Karl Figlio succinctly describes, as a “historical mode of life which the new pathological anatomy of tissues could visualize, from the moment of insertion until its death with that of the organism, as the rooting, growth, and spreading of lesions. The ‘space’ of the disease, including its essentially historical character, had become identical with that of the body,” a concept that we now find ridiculously obvious, but which Foucault uncovers as being historically constructed. 

The most profound effect of this change in the conception of disease is the concomitant reconsideration of the relation between life, disease, and death. Autopsies especially, relatively uncommon before the nineteenth century, became more routine, brought death under closer inspection, and played an important role in the transformation of ideas about life and death. Before the nineteenth century, the dichotomy was clear: life was considered an abundance, death an absence. Death was a boundary designating the absence of vitality, having no positive content of its own: a negativity, a purely quantitative subtraction. According to Foucault, “In eighteenth-century medical thought, death was the absolute fact.” but as pathological anatomists inspected corpses immediately after death, it became clear that death occurred in stages, “multiple and dispersed in time” (142). Death was recognized to be not an “absolute, privileged point at which time stops and moves back,” but like disease itself, death “has a teeming presence” (142). And this “teeming presence” spread back into life in the form of lesions, what Figlio aptly characterizes as “lesser and localized deaths.”

Autopsy, then, cast doubt on the clear dichotomy between life and death. Death was no longer an ultimate threshold but perhaps the very origin of disease, even an integral part of life itself. Life is not merely riddled with death; the two are absolutely correlative, mutually interdependent. And this reciprocity even implies that life is inherently pathological and degenerative. On one hand, death determines a priori the conditions of life, in that the forms of internal organization of the organism could be understood only as different ways of meeting the threat of death. On the other hand, under this scenario life becomes the principal source of its own destruction. When Claude Bernard, one of the most influential physiologists of the nineteenth century, said that “life is death,” he meant that “when a part functions, such as muscles, glands, nerves, brain, the substance of these organs is consumed; the organ destroys itself.”

Even before Bernard, physicians prominent in Foucault’s study had concluded that the normal functioning of the organism itself was intrinsically pathogenic, that the action of the organism gave rise to organic lesions; the parts of the body, by the very fact of their action, are pathologically altered (153).

In other words, nineteenth-century physicians conceived a dialectic between life and death. But this discovery was possible only because of death—that is, as a result of autopsy and dissection. At this point in the early 1800s, as Foucault notes, “life, disease, and death now form a technical and conceptual trinity…. It is from the height of death that one can see and analyse organic dependencies and pathological sequences…. The privilege of its intemporality, which is no doubt as old as the consciousness of its imminence, is turned for the first time into a technical instrument that provides a grasp on the truth of life and the nature of its illness” (144). Death not only becomes an object of study, in the form of pathological anatomy—it becomes the basis of study itself: “The analysis of the disease can be carried out only from the point of view of death” (144). It is therefore precisely because of death’s intemporality that medicine can obtain a measure of certainty: “Medicine discovered that uncertainty may be treated, analytically, as the sum of a certain number of isolatable degrees of certainty that were capable of rigorous calculation” (97). That is, physicians found the rigor required by professionalization (and compensated for medicine’s essentially speculative nature) not in “generality, but in the small number of endlessly repeated elements” (99) accumulated in the hospital and on the autopsy table. “Death,” says Foucault, “is the great analyst” (144).

This figurative relation between death and analysis points not only to a relation between stillness and hermeneutics but to the nature of scientific method. “Analysis” and its counterpart “synthesis” are fundamental concepts for scientific investigation. They
have been around at least since Plato, but they were most often considered separate procedures for investigating and demonstrating philosophical concepts, different ways to conduct one’s thoughts in an orderly fashion. But Sir Isaac Newton, in his *Opticks*, saw “analysis” and “synthesis” as two methods constituting a single procedure. The investigation of empirical phenomena (not concepts) required two mutually interdependent steps: “This Analysis consists in making Experiments and Observations, and in drawing Conclusions from them by Induction.” Synthesis, on the other hand, “consists in assuming the Causes discover’d, and establish’d as Principles, and by them explaining the Phaenomena proceeding from them, and proving the Explanations.” Analysis consists of breaking the empirical phenomena into manageable units (isolation by experiment), while synthesis means recombining these units into a larger picture. Synthesis is therefore a control mechanism, a method of verification absolutely vital to the entire procedure. In scientific method, then, analysis and synthesis are two sides of the same coin: decomposition and recomposition, breaking down and building back up.

Condillac, the patron philosopher in Foucault’s history, offers this similar definition of analysis (and also refers to the philosophical function of this procedure): “Be that as it may, to analyze, in my opinion, is nothing more than an operation arising from the concurrence of those operations which went before. It consists only in compounding and decompounding our ideas, in order to compare them differently, and to discover the relations among themselves, together with the new ideas which they are capable of producing. This analysis is the true secret of discoveries, because it makes us attend to the origin of things.” Foucault’s contribution to the history of medicine is his description of the way in which clinical practice, through “the medical gaze,” incorporated the correlated relation between analysis and synthesis. Even though it is called a “gaze,” Foucault stresses that “the medical gaze embraces more than said by the word ‘gaze’ alone” (164). Newton’s discussion of method in the context of a project on light and optics does not make an explicit connection between analysis and vision. But Foucault’s discussion of medical perception recognizes both that, while perhaps dominated by the visual register, the gaze encompasses other forms of observation and that analysis is necessarily bound up with the scientific employment of these tools. It is a “gaze that touches, hears, and, moreover, not by essence or necessity, sees” (164). Not just close observation, not just the trained touch of the physician, not just descriptive language, but all three and more, the gaze is “an act . . . that joins, in a single movement, the element and the connection of the elements among themselves” and is therefore “really no more than Condillac’s analysis put into practice in medical perception” (94). The gaze is not merely a way of seeing; it incorporates the scientific method by mapping the correlative relation between analysis and synthesis onto the mutual interdependency of death and life.

“This explains the enthusiasm that Bichat and his disciples immediately felt for the discovery of pathological anatomy,” writes Foucault, “they rediscovered analysis in the body itself; they revealed, in depth, the order of the surface of things; they defined for disease a system of *analytical classes* in which the element of pathological decomposition was the principle of generalization of morbid species” (131). In other words, these physicians were excited by the discovery of a homology between object and method on a variety of different levels: Condillac’s method of “compounding and decompounding” is discovered to be also a principle in how tissues function. The “isolatable degrees of certainty” found in “the small number of endlessly repeated elements”—that is, the trend toward isolation and quantification in method—finds its match in lesions, those “lesser and localized deaths.”

This last analogy between “death” and “certainty” is not flippant. It is no mere coincidence that pathological anatomy developed as a discipline during the same period that clinicians were defining their method, for this method depended on “the stable, visible, legible basis of death” (196). Nor is it simply that modern medicine is based on, as some have argued, an “epistemology of the corpse.” It signifies a breakthrough in medical hermeneutics, a work-around to the fundamental dilemma of medical diagnosis: the living body. Death offers the time to contemplate, to study; it holds still the body. At the same time, the knowledge that comes from the corpse is meaningful only in relation to the living body and the historical, temporal nature of disease. As one medical historian put it: “As soon as one used the ear or the finger to recognize on the living body what was revealed on the corpse by dissection, the description of diseases, and therefore therapeutics took quite a new direction.” The gaze and the language of description rests on the stability of the corpse, but moves as well, newly informed, to the living body. This back-and-
forth movement—between life and death, present and past, part and whole—exemplifies the medical task.

Still/Moving

Words move, music moves
Only in time; but that which is only living
Can only die. Words, after speech, reach
Into the silence. Only by the form, the pattern,
Can words or music reach
The stillness, as a Chinese jar still
Moves perpetually in its stillness.
—T. S. ELIOT, “Burnt Norton”

So what does Foucault’s archaeology of medical perception mean for the subject at hand? How does the relation between life and death concern the way physicians read the medical moving image? If, before the nineteenth century, “one knows death only by its opposition to life, in the same way that rest is manifested by its direct contrast with motion,” the history outlined by Foucault troubles this strict polarity on both levels: between life and death, and between stillness and movement. Certainly, the connection between the pairs is not coincidental: “still” connotes “inanimate” or even “dead”—as in “still life” (nature morte is the French equivalent)—as well as “timeless,” “motionless,” and “unchanging.” Yet its relation to movement should not be considered one of strict opposition, as Eliot’s lines above indicate. The complex relationship between stillness and movement, discontinuity and continuity, divisibility and indivisibility go back as far as Zeno of Elea’s paradoxes, which were intended to deny the reality of motion for the sake of a monistic philosophy, or a philosophy of “the one” (i.e., indivisible reality). Zeno did this by contradicting the commonsense belief in the existence of “the many” (i.e., distinguishable qualities and things capable of motion). For Zeno, therefore, movement and indivisibility are opposed; his paradoxes were designed to reduce to absurdity our assumptions about the divisibility of phenomena. Modern science, intent on this division, overcame Zeno’s paradoxes when it created logically consistent mathematical concepts of continuity and infinity that could promote quantitative approaches.

Henri Bergson returned to this issue in Creative Evolution, where he found, contra Zeno, that movement and indivisibility are not opposed but inextricably linked. Bergson maintains that the universe is in a perpetual state of flux; change and movement are the only constants, the only true reality. Our common perception cannot hope to grasp this flux, it can only extract determinate moments and hold them up as reality. Therefore, Bergson says, “our perception manages to solidify into discontinuous images the fluid continuity of the real.” Furthermore, he argues, the mechanism of cinema follows this pattern and reflects, therefore, our perceptual process, which science codifies into experimental method. In its insistence on finding the moments of “stillness” in the constantly moving flux, modern science is essentially “cinematographical.” Science, then, works like cinema in that the uncertainty of flux is traded for, or finds its basis in, lots of “little certainties” (which gives new meaning to Jean-Luc Godard’s dictum that “cinema is the truth 24 times a second”).

In modern science, we can find stillness in movement: the “determinate moments” of discontinuity extracted from our perceptual impression of constant movement. In modern art, by contrast, we find movement in stillness: Eliot’s Chinese jar; futurism’s “visible motion”; or cubism’s “vision in motion.” Photography seems to capture this tension best, especially since the development of instantaneous photography in the 1880s. As Tom Gunning notes, instantaneous photography cast the human body in a different light, or more precisely, in a different time: the time of the instant, caught in awkward and ungraceful (even “disgraceful”) poses. The snapshot ripped the instant out of its temporal flow. That flow is nevertheless deeply imbedded within it; its moments are “explosive,” just waiting (forever) to detonate. Surrealist André Breton described this dialectic of stillness and movement within the photograph as “convulsive beauty”: “There can be no beauty at all, as far as I am concerned—convulsive beauty—except at the cost of affirming the reciprocal relations linking the object seen in its motion and its repose. I regret not having been able to furnish, along with this text, the photograph of a speeding locomotive abandoned for years to the delirium of a virgin forest.” Breton’s imagined photograph captures several registers of time at once: the blinding speed of modern technology, the geological slowness of nature, and the stillness of repose.
Life and death are echoed in cinema and photography not merely through the representation of movement and stasis. The dialectic between life and death is also captured by the very nature and social functions of film and photography. As André Bazin argues, photography, like all the representational arts, has a “mummy complex” in its attempt at immortality: “By providing a defense against the passage of time,” the mummy “satisfied a basic psychological need in man, for death is but the victory of time. To preserve, artificially, his bodily appearance is to snatch it from the flow of time, to stow it neatly, so to speak, in the hold of life.” The paradox of photography (and the mummy) is that in this attempt to stow appearance in the hold of life, in this effort to hold life and time, the specter of stasis and death still reigns. Photography, like the mummy, is a double, an effort to preserve the past against what Bazin calls a “second spiritual death.” Freud’s formulation of the psychological function of the double—and its relation to death—recalls photography’s paradox:

For the “double” was originally an insurance against the destruction of the ego, an “energetic denial of the power of death,” as [Otto] Rank says; and probably the “immortal” soul was the first “double” of the body. The same desire led the Ancient Egyptians to develop the art of making images of the dead in lasting materials. Such ideas, however, have sprung from the soil of unbounded self-love, from the primary narcissism which dominates the mind of the child and of primitive man. But when this stage has been surmounted, the “double” reverses its aspect. From having been an assurance of immortality, it becomes the uncanny harbinger of death.

Furthermore, the photograph is like a mummy or a death mask in that there is an indexical relationship between the object and its representation, and this necessary relation distinguishes photography and film from the other arts. That is, like a fingerprint or a footprint, the photograph results from a physical connection between the object and the film as the result of a chemical process. Therefore, the object and the duration of the photograph is inscribed onto the film. Because it refers not only to the represented object, but also to the (already passed) time of its impression, the photograph is imbued with the tinge of death. For Roland Barthes, this connection to death is tied to photography’s immobility: ‘However “lifelike” we strive to make it (and this frenzy to be lifelike can only be our mythic denial of an apprehension of death), Photography is a kind of primitive theater, a kind of Tableau Vivant, a figuration of the motionless and made-up face beneath which we see the dead.”

Barthes finds death also in the photograph’s indexicality: “In Photography I can never deny that the thing has been there. There is a superimposition here: of reality and of the past. And since this constraint exists only for Photography, we must consider it, by reduction, as the very essence, the noeme of Photography. . . . The name of Photography’s noeme will therefore be: ‘That-has-been,’ or again: the Intractable” (76–77). And finally: “For Death must be somewhere in a society; if it is no longer (or less intensely) in religion, it must be elsewhere; perhaps in this image which produces Death while trying to preserve life. . . . Life/Death: the paradigm is reduced to a simple click” (92). Bazin argues that cinema “embalms time”; Barthes, on the other hand, defines photography in opposition to cinema. For Barthes, cinema’s temporal rush animates and thus obscures the subtle links to time and death delicately layered in the photograph. Garrett Stewart, however, argues against this strict dichotomy found in most theories of photography. If each frame of a motion picture were counted as a single photograph—a “lesser, localized death”—then cinema, as Bazin implies, is more like a walking mummy, the undead, or the reanimated corpse of Frankenstein’s monster. If the photograph implies, in Barthes’s terms, “that-has-been” and thus death, then cinema only gives the dead a semblance of life. Furthermore, if narrative fiction film must ignore this deadliness basis in order to keep going, as Stewart argues, then I would suggest that scientific film, in order to keep its project going, must revel in these fatal moments and ignore their narrative (dramatic) potential.

Barthes mimics the scientist when he admits “what Marey and Muybridge have done as operators I myself want to do as spectator: I decompose, I enlarge, and, so to speak, I retard, in order to have time to know at last” (99). And “I have the leisure to observe the photograph with intensity; but also, however long I continue this observation, it teaches me nothing. It is precisely in this arrest of interpretation that the Photograph’s certainty resides: I exhaust myself realizing that this-has-been” (107). The photograph teaches him nothing, refuses real understanding, because its certainty simply is
(or “has-been”). The immobility of the photograph allows us to examine it at leisure, to know, but its stasis is ultimately frustrating. I would argue, because stillness alone reveals nothing. Death, by itself, has no meaning. It is only as part of an interpretive dialectic between stillness and movement that the object of the photograph comes to light. The binarisms themselves are heuristic; it is the movement between them that brings them to life.

This movement is implied even in the opposite conceptions of death held by Foucault and Barthes. Foucault stresses the stasis of death, its function as stable ground, yet he recognizes its temporal dimension, not only in the unfolding of death in the living body but also in the necessary movement from dead to living in the process of analysis. On the other hand, Barthes’s emphasis on the “that-has-been” gives his conception of death a particularly poignant, temporal character, even while he focuses on the still photograph. For both theorists, the nature of death can be understood only through its opposite: if static, through temporality; if temporal, through stillness. The corpse or the photograph are comprehensible only through the movement of analysis or the passing of time, each of which, likewise, contain within them the tinge of stasis and death.

Medical film and photography have a relationship to the medical profession’s foundational dialectic between life and death that is not merely analogous or metaphorical but ontological as well. Medical films offer a convenient record of phenomena that meets the profession’s requirements for objectivity and transmissibility, but their function in medicine is not reducible to this criteria. They are not used simply because they are available; indeed, their function and use in medicine can reveal so much precisely because they are so overdetermined. Specifically, the dialectic of medical hermeneutics—the back-and-forth outlined above—is rehearsed in miniature in the design and interpretation of medical imaging techniques. With medical imaging, of course, the stakes (life and death) are not so high, but the rehearsal is nonetheless inevitably, ontologically tinged with real-life drama. Just as there is a movement from death to life in medicine, so there is a movement from still to moving in medical imaging. This dialectic is embedded in the techniques of reading and managing the detail of the image. In the next section, I focus on a variety of techniques in radiology to illustrate this point.

The individual is understood in the total, and the total from the individual... The process of understanding is as truly synthetic as analytic, as truly inductive as deductive.
—Droysen, Outline of the Principles of History

Probably the best example of the tension between movement and stillness in radiology is fluoroscopy’s “spot film” technique. Invented by Thomas Edison about a month after X rays were publicized in December 1895, the fluoroscope produces a simultaneous, real-time image of the patient on its translucent screen, which is coated with a material that fluoresces when exposed to X rays. The fluoroscope is still in use today; fluoroscopy now refers to the whole process of presenting a moving X-ray image on a television screen or on motion picture film. But its advantage (a moving image) is also its key disadvantage: for decades the image could not be controlled or captured with ease. Because it was not reproducible, the fluoroscopic image could not be displayed to a group, and therefore the information obtained by the technique remained “subjective”: the correlation of the images remained completely within the mind of the physician. On the other hand, the still image of the X-ray film (or even the moving image of X-ray cinematography) could be shared and thus was “objective.” Submitting a record to group scrutiny ratifies its objectivity; judgment is not limited to the single point of view of the physician, but is validated by the group. Objectivity resides in the exchange.

With the development of the “image intensifier” in the 1950s, the fluoroscope could participate in this exchange. The intensifier amplified the fluoroscope’s dim light (which before could only be viewed in a darkened room) many times, allowing physicians to view the image in daylight and record the image on motion picture film or, later, videotape. It also allowed the attachment of a still camera that could take “spot films” during the examination. As the examination takes place, the radiologist views the moving image on the monitor and punctuates the event by taking a still image of certain “determinate moments.” Not all moments need to be stilled; spot films are not, in other words, a Merey-like decomposition of the event. Instead, these still images function primarily as evidence of diagnostically significant phenomena, but they also help the radi-
ologist remember his or her "place" within the examination. That is, they function as "bookmarks," they remind the radiologist of the duration of the examination. Bookmarks in novels mark passages, not stoppages; when one returns to a bookmark, the flow of the narrative resumes. The marked point makes sense only in relation to the passage, to the larger contextual movement. In the same way, the spot film indicates a correlative relation between stillness and movement. The spot film makes some sense on its own, but its status as evidence is dependent on the duration of the examination. Likewise, the moving image is more legible when accompanied by the determinate moments marked by the spot films.

This explicit relation between movement and stillness recalls the first moving pictures themselves. As Tom Gunning notes, "the initial reception of motion pictures foregrounded their relation to—and transcendence of—the still image." Inventors and audiences alike associated motion picture cameras and projectors with developments in instantaneous photography. Gunning argues that the first projections by the Lumière brothers in 1895 emphasized this relation between photography and cinema by "starting each projection with the first image as a still, then cranking the machine into motion and endowing that image with life and movement." From the Lumière brothers' projection technique to Hollywood's fondness for Frankenstein's monster and his legacy, the back-and-forth between life and death, between stillness and reanimation, has been a favorite theme in cinema.

Today radiologists reenact that relation between stillness and "life and movement" with the pause button on a videocassette player and with digital screen shots of MPRs. Fetal sonograms, echocardiograms, X-ray angiograms, and others are routinely recorded on videocassette or digital media by the technician and reviewed by the physician, who stops and starts, cues and reviews back and forth. If early cinema audiences were "astonished" by the sudden animation of the lifeless image, and if this animation is the essence and pleasure of cinemática art, then the essence and function of the scientific moving image lies somehow in the opposite approach: the urge is not to start but to stop, not to animate but to suspend. Yet it is never quite so simple. Physicians analyze and synthesize simultaneously, even intuitively, after years of internalizing case studies and methods. Analysis and synthesis become part of the same operation. The relation is akin to that between anatomy and physiology in medicine. Anatomy as a discipline focuses on structure, stillness, the corpse, death; physiology on function, process, the living body, life. The historical relation between them has sometimes been competitive, but they are just as correlative as the other pairs examined here. Each contains part of the other. Analysis and synthesis, like anatomy and physiology, are never in strict opposition nor are they merely complementary, but in practice they are pressed so closely together that they form a single procedure.

The spot film is one way of managing the detail of the image, of controlling its temporal flow for analytical purposes, even if the exact timing of the spot film requires an intuitive relation to movement. Another technique for managing the moving image is the "cine loop." In digital medical imaging, this technique is fairly uncommon, although it is becoming more popular as computer memory and processor speed catch up with the information-intensive requirements of digital moving images. Basically, the term cine loop refers to any sequence of digitized movement that has been set to repeat; the technique is not technology-specific—it can be used in CT, MRI, PET, or even echocardiography. Rhythmic cycles, such as the movement of the lungs during breathing, the bending of joints, or the beating of the heart, are ideal subjects for this technique, but cine loops are used most often in cardiology, which prizes the ability to see the heart function in real time. (The paradox here is that a loop of a heartbeat cycle is not "real time," but only a "virtual" representation of the heart's own repeated, looplike action. In effect, the loop acts "real.") To create a digital cine loop, a CT or MRI scanner captures the information and creates still images. Selected sequential images (for example, at five-degree intervals) are then stored in computer memory and strung together to form a loop. This loop is recorded on videocassette or as an MPR, where it can be examined at leisure and compared to the original sequence of isolated images. The advantages of the loop are obvious: it allows physicians to examine the movement at their leisure while also providing, because of its correlation of space and time, a means of quantification.

Again, this technique recalls forms of early cinema. Precinematic devices such as the zoetrope and the zoopraxinoscope are basically repeating loops. The work of Muybridge and Marey—which focused on finite, rhythmic events, such as a woman descending stairs or a pole vaulter's attempt—also implies repetition. Edison's Kinetoscope contained a looped filmed sequence that would repeat
with every new nickel. The content of the scenes filmed for these machines matched the form: a group of blacksmiths hammering rhythmically, a somersaulting dog, circular dances, etc. Even after celluloid was freed from the confines of the peepshow, early cinema continued to feature “latent loops,” so to speak: 360-degree panoramas, parades of passing policemen, chases that merely show the same thing over and again.60

But the cine loop also has a long history in medicine. As early as 1912, doctors were recording physical conditions and projecting them in loop form.61 Rudolf Janker, one of the leading radiologists in pre- and post–World War II Germany, developed techniques for representing complete heartbeats on film with looped strips.62 Ever since, the loop has been a common method of viewing rhythmic action in radiology.63 Medicine’s loop has much in common with both Marey’s experiments and Edison’s. Marey was less interested in movement for its own sake than as a check against his analytical methods. Marta Braun elaborates: “Marey had cut apart the pictures that made up these earliest film bands and recomposed their movements in slow motion in an electric zoetrope to confirm his analysis in real time. . . . He was working on a projector whose sole function would be to mechanically synthesize the results of his analyzer, slowing down some movements and speeding up others. He was not after a machine that would replicate the continuity of perceived movement: such an apparatus would have been no use to him in his work.”64

Marey, as one would expect, follows scientific methods scrupulously: movement exists only in relation to stillness, synthesis only in relation to analysis. The cine loop in medicine also embodies this tension between fluidity and fragmentation. However, movement is not merely an experimental control, it also demonstrates what cannot be otherwise seen. While movement in science is reduced and dependent on analysis, movement in medicine still has value unto itself, precisely to the extent that the body itself has value. More important, the repeated action of the loop allows analysis and synthesis to occur at the same time. That is, the loop moves, but its short length and recursion allows one to grasp the movement by holding it in one’s mind for a moment. Like a treadmill, on which we move while remaining in the same place, the loop clearly “moves” but is conceptually “still.”

Finally, if the loop is in many ways the very basis of cinema, it is also, according to Lev Manovich, the basis of the digital: “Programming involves altering the linear flow of data through control structures, such as ‘if/then’ and ‘repeat/while’; the loop is the most elementary of these control structures.”65 If these control structures allow the data to be modified as it passes from input to output and back again, we have the famous “feedback loop” so central to theories of cybernetics.66 From the repeated application of algorithms (known as “recursive functions”) in programming code to animated GIFs, the loop appears to be the most basic element of the digital world. In medical technology, the design of CT and MRI scanners also implies a loop. Computed tomography and magnetic resonance imaging differ from conventional X rays in that they are not fixed to a single point of view. The machines are shaped like a big doughnut: in CT, X rays are emitted from all around the inside of the ring, in the middle of which lies the patient. (In MRI, strong magnets align the molecules within the patient’s body, which then emits electrical energy that is captured by the doughnut.) These scanners therefore capture axial, or cross-sectional, views of the patient’s interior. The information is therefore based upon a 360-degree slice of multiple, shifting views that evokes a circle or loop in both design and content.67

When physicians today discuss “image analysis,” they are usually not referring to the decomposition of movement but to a panoply of digital techniques designed to create more legible images. “Image analysis” refers to the process by which digital information is manipulated to create an image and elements are added so that the image is easier to read. For example, a CT scan of the brain might undergo some colorization in order to illustrate circulation patterns. Or these CT or MRI “slices” may be submitted to “voxel processing” and rendered as a three-dimensional, animated image. In echocardiography, “color flow Doppler” technique generates color-coded images of blood flow velocity. Similarly, echocardiograms are usually processed by the accompanying ultrasound software to generate a cross-sectional view of the heart in order to measure chamber dimensions and wall thickness.68 Digital images are more manipulable than their analog counterparts; image analysis is a common technique that uses this advantage in order to manage detail digitally and thereby produce more legible images.

Yet even this technique is not new to the digital revolution. Edge-enhancement technology, while standard in the digital realm, is
also common in the history of medical cinematography. The filmic image also contained too much information: often researchers would stop the film, project it onto a desk or wall covered with white paper, and trace by hand the outlines of the image, thereby focusing on the significant elements of the frame. Tracing was a standard technique in scientific and medical cinema. R. F. James demonstrated in 1935 how to trace the outlines of organs recorded through X-ray cinematography, and tracing has been repeated often as an analytical procedure throughout the history of radiology. In the sciences, Hans Fortner projected his films of single-cell life-forms onto huge sheets of paper in order to trace cellular movement as a function of time, as did German biologist Willi Kuhl in the 1940s. Arnold Gesell, one of the preeminent experts on child development, made tracings a standard procedure for his work, arguing that "the cinema registers the behavior events in such coherent, authentic and measurable detail that for purposes of psychological study and clinical research the reaction patterns of infant and child become almost as tangible as tissue." And so on. Scientists investigating everything from the pecking speed of pigeons to the horse's gait have hoped to "hold" the cinematic image even closer by tracing it. Even today, some radiology texts recommend tracing an image by hand in order to obtain quantifiable information. Tracing the image onto paper is a way of "dissecting" the image: tearing away, finding the important detail, extracting, quantifying. Image analysis and tracing rehearse the dialectic between the mental and the manual also found in the dissection of cadavers. Each of these techniques for managing the detail of the filmic image—the spot film, the loop, and the traced image, common to both medicine and science—have been around for as long as there have been scientific and medical films. What is striking is not so much their longevity but the way in which they have been appropriated. That is, these techniques are now built into the apparatus itself, rather than being ad hoc reconfigurations or additions to the machine. If the spot film was possible only with the addition of a camera to the image intensifier, the pause button and image-capture software now function to "hold" the image still for a moment. If the looped film strip required some manipulation of the celluloid and a special device for projection, now it is built into the very structure of the digital image. If tracing required extra steps and patience, now image distillation and enhancement is an option for any physician with money and a mouse. Every version of these techniques, however, has embedded within it this "back-and-forth" between stillness and movement, and with it a shadow of the drama of life and death. So is there any difference at all between the analog techniques and their digital counterparts? Does digital imaging express this drama differently?

Death and Digitality

Is not the animal organism revealed uniquely as a machine—extremely complicated, undoubtedly, but all the same manageable and obedient as any other machine? —Pavlov, "Experimental Therapeutics as a New and Exceedingly Fruitful Method of Physiological Investigation"

In Western culture today, death is almost immoral. We treat death as something foreign, to be staved off at all costs, to be denied. Not that humanity hasn't always feared death, but since the late nineteenth century, our medical conception of the relation between life and death has changed. The relationship is no longer correlative; now death and life are once again opposed. Death is not the organically inevitable element it once was; we have come to believe that a cell could live forever if properly maintained. That the organism is incapable of maintaining that balance by itself does not mean that death is a part of life, only that we have failed to keep the organism alive, due to technological ignorance or accident. Death is no longer internal to the organism—now it is external, contingent, accidental. Think of how doctors phrase the bad news: "there was nothing more we could do," which signals, on one hand, a certain powerlessness in the face of inevitability but also implies, on the other hand, that the power over death is theoretically in their hands, if only all the elements (environment, technological know-how, etc.) were aligned just right. Preventative medicine, organ replacement, life support—all have made the criterion of death technological rather than biological, robbing death of its privilege and authority and giving it to those in control of the technology. Death still reigns, but modern medicine does not believe in it any more.

This modern opposition between life and death recalls the pre-clinic conception of death as an absolute boundary, the opposite of life. But there is an important difference between that opposi-
tion and today’s. Consider brain-death criteria: “A comatose patient today whose loss of spontaneous brain functions is irreversible by existing resuscitation techniques is ‘dead.’ Another comatose patient tomorrow, in exactly the same physiological state as the first one today, is ‘not dead’ if in the meantime a new resuscitation technique has been introduced that can be used to reverse the coma.”

So in the twentieth century, life is not the opposite of death in the same way that the active is the opposite of the inert, because the same level of organic activity or inactivity can count as life or death, depending on the level of technology of the time. The criterion for death lies with us, not with God or Nature.

It would be tempting to argue that digital imaging expresses that change, that if death backed the photograph’s indexical image, guaranteed the photograph’s authenticity by its peculiar absent presence, then the lack of an indexical image in digital media means that death is no longer the absolute, no longer the guarantor of certainty. But this would be to misunderstand the nature of the digital medical image. While it is true that the images created by the CT or MRI scanner are not “pictures” of the body in the same way that X-ray films are, this does not mean they are not indexical. Even though the information gathered by the machines travels to the computer in the form of binary oppositions, ones and zeros, that information is nonetheless “indexical” in the sense that there is a necessary physical connection—even if only at the molecular level—between the object and its representation. It must be so; otherwise, the images would have no informational value.

If the digital medical image expresses our modern idea of death at all, it is in the “practically infinite manipulability” that the digital image promises. The ability to cut, paste, and replace at will; to be able to generate copy after copy without any “degeneration”; to be able to make changes with greater and greater rapidity—these are the hopes of modern Western medicine as well. Organ transplants, gene therapy, cloning: what are these except “energetic denials of the power of death,” attempts to extend the ultimate deadline? Of course, that deadline prevails, despite the digital. So what does the digital revolution really offer, especially if the techniques outlined in the previous section are merely newer versions of older practices? Convenience, or more bluntly, time. Time is the real currency of the digital realm, both in terms of time extended and time saved.

And this is, perhaps, the reason for their rapid infiltration of modern medicine. In the end—at the end—however, the fact that these technologies are “digital” means less than that they are “medical”: all these imaging technologies carry within them the drama of life and death.

Cinema, too. Like the human body, motion pictures are pathogenic. That is, films die just a little bit whenever they are projected; their very functioning brings about their own deterioration. After months of lifelike activity, a print must be “retired” because it has become worn and frail. Even when a new print has been struck from the original negative, that negative gives up part of its usable life to create that print. And so the cycle continues, until one day, through use or neglect, the line eventually dies out.

Many people hope that digital media will stall this pathetic cycle. Film archives experiment with digital techniques to “clean up” worn prints, while archivists debate the viability of DVD technology as a storage medium. We hope that the digital will extend the deadline, but film preservation, like medicine, eventually comes to the point where “nothing more can be done.” Again, the extent to which digital technologies owe their content, form, and function to older, analog models makes their digitality almost irrelevant. Instead, faced with that inevitability, in the struggle to hold on to a vanishing past or life, we try to find ways to understand and appreciate. Hence, the importance of hermeneutics.

Historicizing digital medical imaging technologies allows us to pause, replay the past, and cue forward to the present. In doing so, we not only find striking similarities but we mimic the hermeneutic strategy so important to medical understanding, and thereby partake of the appreciation of the human condition that medicine first provoked. Thinking about medical films brings out the relation of this condition to the dialectic of stillness and movement. Whether digital or analog, medical imaging techniques present doctors with the possibility of stopping time, of holding on to the unruly body and thereby—just maybe—holding disease and death at bay. Yet in the rush to seize, to hold, to read, and to analyze, physicians must still come back to movement and synthesis. In this hermeneutic movement, this back-and-forth, doctors productively, if perhaps unconscious, remind themselves of the line they cross every day between life and death.
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2 For a technological history of medical imaging, see Bettaynn Kevles, Naked to the Bone: Medical Imaging in the Twentieth Century (New Brunswick: Rutgers University Press, 1997), and Tibor Doby and G. Alker, Origins and Development of Medical Imaging (Carbondale: Southern Illinois University Press, 1997).
8 Martin Heidegger went one step further, arguing that even what we conceive to be simple perception is an act of interpretation. All understanding implies a “fore-conception” of “something as something,” even before we begin to interpret it thematically. For Heidegger, then, the “hermeneutic circle” refers to the fact that “interpretation always already has to operate within what is understood and nuture itself from this” (Heidegger, Being and Time: A Translation of Sein und Zeit, trans. Joan Stambaugh [Albany: State University of New York, 1996], 143).
17 Ibid.
22 Ibid.
28 Foucault, Birth of the Clinic. Subsequent citations appear as parenthetical page references in the text.
32 Hence, degeneration—the idea that all systems degrade into entropy—became the guiding principle in biology as well as thermodynamics. So see the essays collected in Degeneration: The Dark Side of Progress, ed. J. Edward Chamberlin and Sander Gilman (New York: Columbia University Press, 1985).
34 Sir Isaac Newton, Opticks (1730; New York: Dover, 1952), 404-5.
36 To drive this point home: "le regard médicale" deliberately evokes Sartre’s "le regard," which is primarily but certainly not exclusively visual. Jean-Paul Sartre, Being and Nothingness: An Essay on Phenomenological Ontology, trans. Hazel E. Barnes (New York: Philosophical Library, 1956); see especially "The Look," 252-302.
41 See, for example, Adolf Grünbaum, Modern Science and Zeno’s Paradoxes (Middletown, Conn.: Wesleyan University Press, 1967).
44 Dynamism in art is not exclusive to the modern period, of course; Laocoön, the Hellenistic sculpture now in the Vatican Museum, prompted Lessing to think about precisely this issue. See Gotthold Ephraim Lessing, Laocoön: An Essay upon the Limits of Painting and Poetry, trans. Ellen Frothingham (1766; New York: Noonday Press, 1957).
48 Ibid., 10.
Garrett Stewart, From Film to Screen: Modernism’s Photo Synthesis (Chicago: University of Chicago Press, 1999), especially chapter 1.
Ibid.
My discussion of spot film technique is indebted to an interview with Dr. Joel Leland, Attending Radiologist at Michael Reese Hospital, Chicago, and Assistant Professor of Radiology at the University of Illinois at Chicago, 17 November 2000.
See the essays collected in Physiology in the American Context, 1850–1940, ed. Gerald L. Geison (Bethesda, Md.: American Physiological Society, 1987).
A. E. Stein, “Ueber medizinisch-photographische und –kinemato-
graphische Aufnahmen,” Deutsche medizinische Wochenschrift (Berlin) 38 (1912): 1184.
For a discussion of the implications of this technology for vision and point of view, see Lisa Cartwright and Brian Goldfarb, “Radiography, Cinematography, and the Decline of the Lens,” in Incor-
My discussion of echocardiography is indebted to an interview with Dr. Catherine L. Webb, associate professor at Northwestern University Medical School, 5 November 2001. See also A. Rebecca Snider, Gerald A. Serwer, and Samuel B. Ritter, Echocardiography in Pediatric Heart Disease, 2nd ed. (St. Louis: Mosby, 1997).
Hans Fortner, “Die Punktweg-Methode: Ein Verfahren zur quanti-
Otto Koehler, O. Müller, and R. Wachholdt, “Kann die Taube An-
zahlen erfassen?” Verhandlungen der Deutschen Zoologischen Gesell-
See Snider, Serwer, and Ritter, Echocardiography in Pediatric Heart Disease, 134, and N. B. Schiller et al., “Recommendations for Quan-
titation of the Left Ventricle by Two-Dimensional Echocardiogra-
Wax or plaster models of organs (such as the heart or eye) also evoke this dialectic between the mental and manual. These life-size models help the student and physician correlate two-dimensional information to three dimensions. For more on the relation between


Ibid.

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