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Ex Utero: Live Human Fetal Research and the Films of Davenport Hooker

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SUMMARY: Between 1932 and 1963 University of Pittsburgh anatomist Davenport Hooker, Ph.D., performed and filmed noninvasive studies of reflexive movement on more than 150 surgically aborted human fetuses. The resulting imagery and information would contribute substantially to new visual and biomedical conceptions of fetuses as baby-like, autonomous human entities that emerged in the 1960s and 1970s. Hooker's methods, though broadly conforming to contemporary research practices and views of fetuses, would not have been feasible later. But while Hooker and the 1930s medical and general public viewed live fetuses as acceptable materials for nontherapeutic research, they also shared a regard for fetuses as developing humans with some degree of social value. Hooker's research and the various reactions to his work demonstrate the varied and changing perspectives on fetuses and fetal experimentation, and the influence those views can have on biomedical research.

KEYWORDS: fetal research, biomedical ethics, medical film, history of embryology, therapeutic abortion, fetal imagery

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On December 6, 2010, an online science publication blog presented a recently discovered book by Davenport Hooker, Ph.D., *A Preliminary Atlas of Early Human Fetal Activity*.¹ The blogger immediately denounced its content as disgusting and unethical, declining to include the fetal images because he found them to be “obscene, pornographic.” When the story was picked up that same day by an online magazine with greater readership, the subsequent sixty-comment thread generally agreed with the blogger’s judgment.² The topic swiftly moved into an elective abortion debate, despite the author’s inclusion of Hooker’s statement that the fetuses were derived from clinically advised operations. The blogger and commentators were quick to assume that the women from whom the fetuses came were exploited African Americans, believed that Hooker’s work caused pain to the fetuses, and mistook the soft hairs—used in the films to elicit responses—for needles.

In 1932 Hooker had expanded on his comparative studies of fetal activity in common laboratory animals, producing the first filmed observations of a live human fetus.³ The physical development of the brain and spinal cord, as determined from studies of sectioned embryonic and fetal tissues, had been well documented in humans and animal models. Hooker intended to provide a complete atlas of the development, sequence, and appearance of living human fetal activity, providing a functional corollary to the anatomical form visible under the microscope. Immediately following a surgical abortion by hysterotomy, performed on an unnamed woman at a nearby lying-in hospital, Hooker took the seven-week-old fetus to an observation room. He touched and stroked the face, body, arms, and legs as a motion picture camera recorded the fetus’s corresponding movements and reflexes. Over the next thirty-one years, Hooker would

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observe more than 150 fetuses and prematurely born infants in this manner. The project resulted in over forty articles and one nine-minute medical film and contributed information and photographic stills to numerous scientific and popular publications.

This same research, though reflexively repulsive to a 2010 web audience, had been comfortably reported in *Time* magazine in 1938. Without subsequent rebuke, *Time* explicitly and uncritically described Hooker's acquisition, study, and photography of a twenty-five-week-old aborted fetus as it grasped a glass rod in its fist seconds before dying. Though the above-noted blog and *Time* article were presented in a different manner, today's reactions of condemnation, mistrust, and association with elective abortion stand in contrast to the understated coverage during Hooker's research.

Hooker, his colleagues, and the public did not view fetuses as the contentious, autonomous, and baby-like entities we perceive today. That shift arose from the interconnected and highly publicized emergences of biomedical ethics, the abortion controversy, and new fetal imagery in the 1960s and 1970s. But, as evidenced by certain of Hooker's actions and his audience's responses, Hooker and his colleagues did attribute social significance to fetuses in the 1930s, when he began his fetal activity studies. Hooker's own films would later contribute in no small part to the increased public visibility and personification of fetuses, which would in turn have a hand in creating public condemnation for the very methods that had produced those images. Demonstrating the impact of public opinion on biomedical research, methods of fetal research that resemble Hooker's experiments could, suppositionally, be legally and ethically

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acceptable today. But no such nontherapeutic research on live human fetuses has been reported in the literature in the United States since the 1960s.

This article builds on the already expansive work in fetal imagery (e.g., Petchesky, Duden), ethics of fetal research (e.g., Ramsey, Dubow), the abortion controversy (e.g., Solinger), the production of fetal subjectivity (e.g., Addelson, Casper), and particularly on Lynn M. Morgan's 2009 account of Hooker's research in relation to visual depictions of life through the display of dead embryos in the twentieth century.⁴ Though Morgan characterizes Hooker and his team as having "never humanized fetuses to begin with," Hooker's methods and the various reactions to his work instead demonstrate the complex, context-dependent, and individually variable perspectives concerning fetuses during and after the fetal activity project.⁵ In order to examine the situational constructions ascribed to these fetuses across time, individuals, and social locations by Hooker, his team, and, indirectly, popular audiences, I frame Hooker's fetal research project within the history and methods of fetal activity research, its contemporary and subsequent popular portrayal, the changing visual imagery of pregnancy, formal standards of biomedical ethics, and the documented language and conduct of Hooker and his team toward these fetuses.⁶

Fetal Activity Research

Hooker's research followed nearly a century of comparative and human precedents, which he explicitly acknowledged. The first systematic studies of fetal movement were conducted by University of Jena psychophysicologist William Preyer on animals, including frogs and birds, for

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an 1885 text on the physiology of the embryo.⁷ From 1898 through 1941 at the University of Kansas and later at the Wistar Institute, anatomist George Ellett Coghill formed the first comprehensive study of fetal activity, mainly in salamanders, including complementary research on the anatomical development of the nervous system.⁸ Coghill's findings inspired and shaped numerous similar projects in addition to Hooker's, including those of A. W. Angulo y Gonzalez at the Wistar Institute on rats, William F. Windle at Northwestern University on cats, and Leonard Carmichael at Brown University on guinea pigs.⁹ Comparative studies such as these resolved the fundamental principles of the development of vertebrate movement and established suitable research methods.

The earliest reported studies on human fetal movements appeared in the mid-nineteenth century. These were single cases, the results of chance availability of premature deliveries and opportunistic observation. The first of these studies was presented in 1837 by a physician at the Obstetric Clinical Institute of Berlin, who described the movements of a six-inch fetus that survived for thirty minutes of observation.¹⁰ More formal studies began in the 1920s, which included a larger number of fetuses. Italian researchers Bolaffio and Artom performed physical and electrical stimulation studies on twenty-eight human fetuses.¹¹ The first controlled scientific studies in humans, however, began with those of Swiss psychiatrist and neurologist Mieczysław Minkowski in the 1920s. Minkowski placed fetuses in a saline bath immediately following delivery and lightly touched them with a hair while dictating notes to an assistant. He observed a total of approximately seventy-five fetuses in this manner from 1920 through 1946.¹²

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The earliest films of human activity development came out of child psychology. Developmental psychologists increasingly used film as a technological supplement to traditional observations as a means of legitimating the field within the sciences.¹³ In 1919 John B. Watson, a behaviorist at Johns Hopkins, filmed human infant reflexes and responses to visual stimuli.¹⁴ Beginning in 1924, psychologist Arnold Gesell, at the Yale Clinic of Child Development, filmed infants in order to document and define a standard pattern of normal behavioral development.¹⁵ In the early 1930s, Hooker would combine methodological elements of these animal fetal studies, human fetal studies, and human infant studies in his filmed research on human fetal activity development.

Many physiologists in the early twentieth century turned to easily accessible domesticated animals or to institutional animal colonies to serve as proxies for human research materials.¹⁶ With colonies, researchers could acquire an abundant supply of fetuses at known ages, all obtained specifically for study. While a young student at Yale, where he received his bachelor's, master's, and Ph.D., Hooker had studied the muscular and nervous development of frogs.¹⁷ Later, Hooker and two colleagues at the University of Pittsburgh, John Spangler Nicholas and John C. Donaldson, undertook fetal activity observations using a rat colony the three had established.¹⁸ Under conditions identical to those he later used with human fetuses in Pittsburgh, rats demonstrated a predictable pattern of activity. Hooker posited, correctly, that humans would exhibit a different sequence than rats and all other animal models. He further proposed the possibility of primate studies to better approximate the human condition, but never attempted such studies before his work on humans.¹⁹ Primates as research materials were, prior

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to the widespread establishment of primate colonies in the late 1930s, in even shorter supply than human materials, and primates do not necessarily resemble any one particular aspect of human physiology more accurately than do other mammals.²⁰ Animal models had been necessary to lay the foundations of the field. The next step of understanding how human fetuses behaved, as was Hooker's objective, would require systematic study of a large array of human fetuses.

To obtain a larger number of human fetuses for study, the few researchers with these requirements in earlier projects (e.g., Minkowski; Bolaffio and Artom) had looked to hospital surgeries, especially therapeutic hysterotomies, as sources of fetuses. Hysterotomy is an invasive abdominal surgery, performed on a woman in a manner similar to a Caesarean section, which does not cause damage to the live fetus. The procedure is distinct from hysterectomy, a more radical surgery in which the uterus is removed. The term "therapeutic" denotes that the abortion is performed in consultation with a physician for the health benefit of the pregnant woman.

Human fetal material for biomedical study is, in contrast to common comparative material like fetal mice, extremely scarce. Live human fetuses outside the uterus are scarcer yet. Even when successfully obtained, their exact ages are often unknown, they are often dying due to prematurity, and they may be under the effects of anesthetics. As Hooker described the circumstances, "Early human material is a by-product of an operation to ameliorate disease" in women.²¹ An operating physician's main concern was for the health of the pregnant woman, not the retrieval of high-quality research materials.

Privileged access to human tissues for experimental research was often achieved through the establishment of professional networks.²² Such efforts in pursuit of embryos were carried out

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by the Carnegie Institution of Washington's Department of Embryology at Johns Hopkins University from 1914 to 1971 and by Arthur Hertig and John Rock's "egg hunt" at the Boston Free Hospital for Women from 1938 to 1953.²³ Carnegie researchers put out calls for embryos to physicians across the country, receiving the majority of specimens indirectly from miscarriages and gynecological surgeries. Hertig and Rock collaborated with surgeons to obtain very young embryo specimens from scheduled hysterectomies. When live embryos were infrequently needed for specific types of medical preparations, such as injection of dyes through the blood vessels, the embryo's arousal level was not a concern. Unlike the projects at Carnegie and in Boston, Hooker's work required large numbers of a peculiar research material: live, physically active human fetuses outside the womb. To obtain these, Hooker drew upon professional relationships with local gynecologists, as was the practice elsewhere. He in turn made fetal materials available to others, both for live electrical stimulation studies and in the form of preserved tissue.²⁴

No formal guidelines existed at the time to regulate research on human subjects of any age. Ethical experimentation depended entirely on the professionalism and reputation of researchers, as monitored by colleagues. As a colleague noted, "That a man without an M.D. degree had the needed trust and confidence of the obstetricians, the hospital superintendant and the other clinical staff members of the large obstetrical hospital that cooperated indicates their high level of respect for Dr. Hooker's judgment and discretion."²⁵ Hooker's professional relationships and reputation, as chair of the Anatomy Department and as managing editor of the *Journal of Comparative Neurology* for seventeen years beginning in 1933, were enough to

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legitimate his research and keep him essentially above reproach. His professional integrity allowed him to continue this type and scale of work for more than thirty years.

Hooker acquired fetuses directly from clinical surgeons “that became available, some spontaneously delivered premature, some derived from operations,” “in the interest of the health, sanity, or life of the mother.”²⁶ Though he never disclosed the hospital’s name in publications, the fetuses in Hooker’s study came from the Elizabeth Steel Magee Hospital, now the Magee-Womens Hospital of the University of Pittsburgh Medical Center. Magee Hospital was at the time a women’s lying-in hospital, serving as a maternity ward and center for gynecological surgery that averaged around twenty-four hundred births per year.²⁷ Reasons for therapeutic terminations, as detailed by Hooker, involved the risk of pregnancy to a woman’s physical health, including tuberculosis, hypertension, nephritis, epilepsy, and syphilis.²⁸ Mental health causes, as were variously and vaguely defined, included a small number of patients with diagnoses such as feeble-mindedness and nymphomania.²⁹ Significantly, decisions to terminate a pregnancy were made without any consultation with Hooker or his team.³⁰ Contrary to the assertion of the blogger in 2010, the vast majority of these particular abortions were performed on white women. Unfortunately, Hooker did not record additional details about the women undergoing these abortions beyond basic biological (e.g., age, racial categorization, sex) and clinical information (e.g., anesthetics administered, cause of abortion). But the wide popularity of lying-in hospitals at the time, combined with Magee’s history as a teaching hospital for both private and charity patients, suggests a likely range of socioeconomic backgrounds.³¹ Aborted or prematurely delivered fetuses at Magee Hospital were ordinarily provided to resident

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pathologists for routine analysis and then, presumably, were cremated.³² Fetuses used in Hooker's study went in front of a camera.

Hooker's Methods

Working, as Hooker was, with the cooperation of the University of Pittsburgh Department of Obstetrics and Gynecology, but without dedicated funding beyond his salary, the human fetal activity project had a modest beginning. Hooker bought a World War I surplus motion picture camera and rigged it with a foot pedal. This freed his hands to carry on the stimulations while allowing him to simultaneously operate the camera.³³ Hooker immediately pursued external funding to cover, among other necessities, a photographic assistant's salary. In 1936 he received the first external grant for \$500 from the American Philosophical Society in Philadelphia. In subsequent years he would benefit from the donation of the new George T. Ladd Laboratory of Anatomy specifically dedicated to the project at the University of Pittsburgh, a large grant from the National Institutes of Health, National Institute on Neurological Diseases and Blindness, and a number of smaller awards.³⁴

Hooker's first observations of human fetuses began in 1932 at Magee Hospital. For fetuses that showed any capacity for respiration (those of at least 23.5 weeks), Hooker performed observations over a warmed premature bed in the nursery, after clinical resuscitation when necessary. He noted that the youngest viable fetuses—those capable of survival after birth—during his studies were 27 menstrual weeks old (25 weeks after fertilization).³⁵ Untreatably nonviable fetuses—those under 23.5 weeks and the majority of these fetuses—were transferred

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promptly to the observation room. Hooker would separate nonviable fetuses from their placentas and other tissues, placing each in a separate shallow basin filled with a saline solution.

Observations began when Hooker placed the basin containing a fetus under the camera.³⁶ The main tools for his experiments were soft hairs mounted with paraffin wax into glass tubes, and bead-tipped glass rods (see Figure 1).³⁷ His intent was only to study movement, not to specifically cause or study pain. As the film rolled, Hooker touched and stroked the hair against a series of features, such as the mouth, palms, and back, to elicit reflex responses. Hooker's dictated notes include descriptions of the location of hair stimulation, observations of physical responses to that stimulation and spontaneous fetal movements that were not solicited by the hair, and notes on the other activities of the fetus such as breathing attempts and results of common newborn tests. For documentation purposes, each fetus was assigned a successive number following the human generic name, the first being "Homo #1."

FIGURE 1.

Throughout this experimental procedure, time was critical, as nearly all of the fetuses in Hooker's studies were in the process of dying.³⁸ Removed or delivered prematurely, they gradually asphyxiated without either a supply of oxygen through the placenta or lungs mature enough to be capable of respiration. Younger fetuses were responsive for approximately eight to twelve minutes, older fetuses for around twenty minutes.³⁹ Under these circumstances, the Pittsburgh team needed to begin experiments as close to the surgery as possible and mitigate predictable losses in time. Prior to the hysterotomy, the clinician performing the surgery would give Hooker an estimate, though often an inaccurate one, of the stage of the pregnancy. To stage

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the camera and spotlights in advance, Hooker would select one of a set of small plastic baby dolls that approximated the expected size of the fetus (see Figure 2). Once in the room, one to two and a half minutes was the average time between the separation of the fetus from its placenta and the first filmed stimulation.⁴⁰ In very few early instances, Hooker's team would attempt to keep a nonviable fetus alive by providing the attached placenta with oxygen, but this did not discernibly extend the duration of the experiment, and the practice was soon discontinued.⁴¹ Motion picture itself allowed for greater speed during the experiment and better opportunity for detailed observations: the Pittsburgh team could make frame-by-frame notes of movements that were otherwise indiscernible. Each case could be reviewed and transcribed repeatedly, by different observers, at different times.

FIGURE 2.

Hooker identified the patterned, mechanical sequence of human fetal responses that arises throughout fetal development. Activity gradually progresses from generalized movements to specific reflexes. "The behavior of an embryo or fetus is constantly changing as new neural connections . . . attain a functional state."⁴² From 6 to 7 weeks old fetuses showed no response. From 7.5 to 8 weeks old, when stroked on the mouth, nose, or eyelids, fetuses responded with a generalized movement of the head and upper trunk away from the stimulus. At 8.5 to 9.5 weeks the upper limbs and lower body became involved in these responses. Each fetus's movement was "within relatively minute biological variations, identical with every other" fetus of a similar age, therefore "the responses are also stereotyped."⁴³ At 10.5 weeks fetuses responded to palm strokes with slight finger flexure. When the lips were stroked around 13.5 to 14 weeks, fetuses pressed

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their lips together without moving the entire head. By 27 weeks fetuses had the ability to grasp and hold a glass rod.

Hooker had observed the development of sensory functions, but needed traditional histological studies to correlate these functional findings with anatomical development. After completion of observations and filming of nonviable fetuses, the bodies were prepared for postmortem anatomical analysis. From 1938 through 1971 Hooker's colleague and at that time assistant professor of neuroanatomy at the University of Pittsburgh, Tryphena Humphrey, M.D., Ph.D., used the preserved, sectioned fetal tissue mounted on glass slides to investigate the pattern of structural development of the human fetal nervous system.⁴⁴ Comparing the sequence of appearance in nervous system structures to the filmed responses elicited by Hooker in the very same fetuses, Humphrey was able to elucidate the relationship between morphological and functional development in human fetuses. She determined that each new progression in anatomical development precedes and enables each new physiological response. Humphrey had been regularly present during filming as well, and would later continue the considerable task of reanalyzing existing films following Hooker's death.⁴⁵ Despite their mutually referenced collaboration, obvious overlaps in content, and more than forty papers on the topic between them, Hooker and Humphrey generally published their coordinated results separately; the two are coauthors on only a handful of articles.

Over thirty-one years, Hooker and the Pittsburgh team observed the reflexive movements of more than 150 fetuses, attempting to achieve a complete series of fetal ages, from an estimated six weeks after last menstrual period to an infant born five weeks postmature.⁴⁶ Hooker's main

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contributions culminated in his 1939 publication of *A Preliminary Atlas of Human Fetal Activity* and the 1952 silent film *Early Human Fetal Activity*.⁴⁷ The images were so unique in the fields of psychology, psychiatry, experimental biology, neuroanatomy, obstetrics, and pediatrics that they have been relatively heavily cited and pictured in professional and popular publications alike.⁴⁸ While the study has not been repeated, the findings have provided enduring data.

Public Portrayal and Perception

Public portrayal of Hooker's fetal research was somewhat more candid during the 1930s and 1940s than it would be by the 1960s. In 1937 both *Science* magazine and the *New York Times* announced the first grant awarded for Hooker's fetal research.⁴⁹ In May 1938 a *Time* magazine article unapologetically described Hooker's research and a portion of his methods: "He has an understanding with a Pittsburgh hospital, which notifies him whenever it has on hand a living abortus so that Dr. Hooker can rush to the scene with his photographer, make pictures and experiments before the fetus expires."⁵⁰ In 1945 another *Time* article outlined the week-by-week reflex development of fetuses in Hooker's studies and described the fetuses as being "surgically removed from the womb in emergency operations."⁵¹ The explicit descriptions of the fetuses and their dying states indicate that the portion of Hooker's research that was presented was publicly accepted on its face and, evidently, with positive interest in the 1930s and 1940s.

Barbara Duden provides a conceptual history of fetuses prior to and formative of modern imagery.⁵² The pervasive popular view of fetuses in Western cultures up until the mid-twentieth century in had been that of pregnancy: the living, generally unseen form, sensed mainly only

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from movement (“quickenings”) and other signs of pregnancy in the mother. Even early imagery, such as the sixteenth-century sketches by Leonardo da Vinci, had idealized fetuses as recognizable plump newborns or small versions of older children, but in utero. Younger embryos, appearing much less child-like and often dead, were not commonly recognized as developing humans. The concept of a fetus, as distinguished from either precarious products of conception, children, or generalized pregnancy, arose only with its medical discovery, as described by Kathryn Addelson, at the turn of the nineteenth century.⁵³ The first of these medical depictions to chronicle early embryo and fetal development, as opposed to documenting more generally the pregnant uterus, appeared in 1799 with Samuel Thomas Soemmerring’s atlas. The work featured a series of illustrations of dead embryo specimens, often removed from maternal tissues, each representative of a progressive age. As Nick Hopwood details, this portrayal of the developing fetus, isolated from the pregnant body and represented by a succession of multiple dead specimens, continued through the embryo staging tables and basic reproductive research of the late nineteenth and early twentieth centuries, notably including the 1940s “Developmental Horizons” of George L. Streeter at the Carnegie Institution of Washington.⁵⁴ Such images appeared mainly in medical journals and textbooks, but sometimes in much more widely accessible venues as well, such as hygiene exhibits and educational pamphlets for children.⁵⁵

With increasing visibility of fetuses in the 1960s, medical narratives and images of dead embryos representing development would come to permeate popular culture, but were understood as representing live embryo development. In 1962 Geraldine Lux Flanagan published the widely popular *The First Nine Months of Life*, including images and information from

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Hooker's work.⁵⁶ That same year, *Look* magazine, in association with Flanagan's book, featured numerous black-and-white photographic stills from Hooker's films in an article titled "Dramatic Photographs of Babies before Birth."⁵⁷ Both were published in consultation with and with the support of Hooker. The photographs reflected the manner in which Hooker had studied the fetuses: in an artificially isolated context (a fact future fetal activity researchers would need to address).⁵⁸

Unlike the earlier *Time* articles, the book and *Look* spread were not explicit about the sources or dying nature of the fetuses. Only one circumventive caption suggests this state, identifying a "premature two-month-old embryo" (see Figure 3).⁵⁹ In reference to a series of stills from Hooker's study, *Look* magazine states that "in the tenth week . . . the baby can extend his body and legs."⁶⁰ An ex utero six-month-old fetus "turns somersaults in the womb."⁶¹ In a manner similar to those thoroughly documented in other contexts by Rosalind Petchesky and Catherine Cole, these photographs of isolated fetuses were presented as an age-progressive series, labeled in all but one instance as "babies," and organized as if representing one living fetus throughout its normal development up to birth.⁶²

FIGURE 3.

The 1962 *Look* and other visual media depictions in the early 1960s, including most notably the 1965 *Life* magazine photo spread and illustrated book by Lennart Nilsson, presented the first widely available photographs of fetuses.⁶³ Similar to the staging illustrations of earlier embryologists, Hooker's film stills and Nilsson's photographs were mostly of dying or dead fetuses wholly separated from their mother's bodies, but often described as growing and healthy

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despite the disembodiment. Displayed sequentially, these “fetus-as-spaceman” montages propagated a popular fantasy of autonomous life for fetuses that had not *publicly* existed when Hooker began his fetal research.⁶⁴ Hooker’s own films contributed to the artificial representation of independent fetal life to a wider American audience through the display of ex utero dead and dying specimens simulating imaginary fetal life. Whereas embryologists had once created these illustrations of fetal specimens for a particular style of scientific study, popular publications presented them as objective photographs of healthy, developing babies in utero.

Monica Casper and Sarah Franklin describe how this growing distinction between mother and fetus also exhibited itself in medical care during pregnancy starting in the 1960s, expanding from a focus on maternal to include fetal patients.⁶⁵ As one medical textbook put it, “The practice of perinatal medicine started when obstetricians, having resolved most of the problems of the mother, turned their attention to the fetus.”⁶⁶ A fetus was no longer an invisible, passive participant in a woman’s pregnancy, but a patient in its own right living in a “maternal environment.”⁶⁷ In the early 1960s, medical interventions arose to treat the in utero fetus affected by Rh disease (an immune response of the mother’s antibodies toward the fetus) with blood transfusions.⁶⁸ This and other heroic rescue measures demonstrated a newfound acceptability for a fetus to receive maternally invasive medical care for a problem exclusive to the fetus. Similarly, the few experiments performed on fetuses prior to the 1960s were generally restricted to anatomical observations and study, and not done for therapeutic purposes on live fetuses.⁶⁹ But with the “artificial placenta” life-support studies that piqued public attention in the late 1960s, a fetus prematurely outside the womb was not necessarily associated with death.⁷⁰ No

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longer a period of ambiguity that may or may not result in the birth of a child, pregnancy was increasingly viewed as a certain and controllable process. The promise of lower ages of fetal viability and the ability to treat morbidity in fetal patients would have effects on popular perception of fetal personhood and abortion as well.

Prior to the Supreme Court's 1973 *Roe v. Wade* decision, antiabortion laws had often been in place more for the protection of women's health than to preserve fetal life, and generally allowed for therapeutic abortions as decided by a physician.⁷¹ In the 1940s, therapeutic abortions were performed on an as-needed basis at the discretion of obstetricians and gynecologists and without a clear definition of which medical causes necessitated the procedure.⁷² Rickie Solinger chronicles the legal, political, and medical factors affecting access to abortions in the mid-twentieth century.⁷³ Though once perceived as burdensome or dangerous physiological processes sometimes justifiably treated by abortion, by the 1950s complications of pregnancy were increasingly perceived as conditions mitigable by other interventions of modern medicine, and therefore less often necessitating abortion. Fewer and fewer conditions were medically recognized as contraindications of pregnancy.⁷⁴ At the same time, laws persisted in requiring that a woman's life be threatened by pregnancy in order for a legal abortion to be performed. To promote a sense of unified conformity and to protect individual physicians from legal action, in the mid-1950s hospitals created abortion boards to review cases, effecting a radical decline in therapeutic abortions through the early 1960s.⁷⁵ Despite these boards, medical opinion of what conditions legitimated the procedure continued to vary widely.⁷⁶

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Although a Supreme Court brief in support of the antiabortion defense in *Roe v. Wade* cited, among other embryological evidence, Hooker's findings on fetal development, the court's decision did not directly address the legal status of a fetus.⁷⁷ The case instead upheld a woman's constitutional right to privacy in deciding with her doctor to perform an abortion.⁷⁸ The issue of abortion became conflated with issues of fetal personhood in the 1960s and 1970s as a pregnant woman and her fetus were increasingly perceived visually, medically, and legally as separate entities, sometimes with conflicting interests. This growing distinction between mother and fetus and indistinction between fetal life and death would have ramifications for medical research on aborted fetuses.

Subsequent Biomedical Ethics

With the 1973 federal decision on *Roe v. Wade* decriminalizing elective abortion, embryonic and fetal research became ideologically linked with the new abortion debate. Months after the decision, a series of articles in the *Washington Post* reported National Institutes of Health–funded research taking place in other countries on aborted human fetuses kept alive specifically for the purposes of experimentation.⁷⁹ Fears of aborted fetuses becoming an abundant specimen supply for biomedical researchers led to explicit regulation of fetal experimentation, anatomical donation, and disposal.⁸⁰ While fetuses were not new medical research materials, they were new to the medical ethics debate about research on humans and presented a unique set of concerns. As ethicist Paul Ramsey described the fetus, “So here we have an entity too alive to be dead, not mature enough to be a viable baby, yet human enough to be specially protectable.”⁸¹

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In the years immediately following the court's *Roe* decision, two notable federal regulatory reactions occurred. The Department of Health, Education, and Welfare (DHEW, now the Department of Health and Human Services) and the U.S. Congress put temporary moratoriums on live fetal research. The DHEW moratorium continued until a national commission tasked with providing ethical guidelines for fetal research could conclude its recommendations. In 1975 DHEW organized the National Commission for Protection of Human Subjects of Biomedical and Behavioral Research. This commission and its earlier iterations, along with the establishments of Institutional Review Boards in the 1970s, replaced the former reliance on individual investigator integrity in biomedical research ethics that had allowed such ethical transgressions as the well-known Tuskegee syphilis study.⁸²

The 1975 commission's report on ethical principles of research on human subjects included a separate section devoted specifically to fetal research. Subsequent reports have dealt more specifically with stem cell, fetal tissue transplantation, and very early embryo research, but none have superseded these 1975 findings. For this report, the commission reviewed the existing biomedical literature involving human fetuses, focusing on the previous decade. Research mostly involved live fetuses in utero, prenatal diagnosis of fetal disease, and dead fetal tissue. Though the commission identified more than three thousand total publications concerning research on human fetuses, fewer than twenty involved research on nonviable fetuses ex utero. All of these studies on live fetuses ex utero consisted of therapeutic research intended to extend lives, such as work to develop "artificial placentas."⁸³ None of the more than three thousand publications surveyed focused on nontherapeutic research on live, nonviable fetuses as Hooker's research had

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done. While fetal tissue and in utero therapeutic studies continue today, live fetal research without resuscitative purposes had disappeared from the medical literature in the United States by 1965.

The commission recommended broad standards for ethically acceptable acquisition of and biomedical research on fetuses with, disproportionately, the largest number of stipulations directed toward nontherapeutic research on live, nonviable fetuses ex utero. The commission had found that these studies in particular “disturbed the moral sensitivity of many persons” and required more specific attention.⁸⁴ The stipulations included, among other details, that the researcher must obtain informed consent from a representative of the fetus, show no social or economic biases in selection, have no effect on the decision, timing, or method of abortion, not artificially prolong the life of the dying fetus for purposes of experimentation, and not artificially hasten the death of the fetus in the course of experimentation; the scientific field must have previously completed adequate corresponding studies on animal models; and the information must be unobtainable by any other means. These standards are the same for fetuses intended to be aborted as for fetuses that had been expected to reach term. The commission’s findings demonstrate that, despite the potential for valuable and ethically acceptable experimentation on live, nonviable fetuses when the above regulations are followed, the U.S. biomedical community seemed to have already placed a self-imposed, unofficial moratorium on live human fetal research for at least the previous ten years. Research on fetuses could be legally and ethically acceptable, but existing social views of fetuses and growing public suspicion of medical research created prohibitive conditions for such experiments even prior to the 1974 DHEW moratorium.

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Hooker's research in Pittsburgh, begun decades before, can be compared to the ethical criteria outlined by the commission for work on nonviable fetuses ex utero. Hooker himself had completed pilot studies on rat fetuses and had reviewed a century of existing literature from animal models. His experimental methods did not decrease the life span of the human fetuses, but he had made a small number of unsuccessful attempts early in the project to extend their lives in order to lengthen the observation time. Hooker chose fetuses only by opportunity, without a discernible racial, social, or economic bias. Bias on the part of the Magee Hospital regarding terminations was, however, possible due to its high proportion of charitable services. Hooker never mentions whether the hospital obtained maternal consent, informed or not, to carry out medical research. Hooker himself played no role in decisions of whether to perform therapeutic abortions.⁸⁵ But he did not indicate whether or not hysterotomy, a procedure that carries considerable risk to a woman, was chosen for the experimental benefit of producing a living aborted fetus as opposed to other, much less maternally invasive abortion methods that usually damage the fetus in utero (e.g., D&C—dilation and curettage). While both methods were widely used in the United States at the time, D&C was a more common method of abortion in the first trimester and hysterotomy was more common in the second and third trimesters.⁸⁶ Therefore, hysterotomy may have been prescribed in many or all of these particular cases, regardless of intended research. Notable here, during the years he was acquiring fetuses, Hooker also held a senior staff position at Magee Hospital.⁸⁷ Though Hooker's work did not fall entirely within the realm of ethical acceptability as defined in 1975, it did approximate the spirit of the commission's standards before any such standards existed. But while very few had undertaken

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live fetal research prior to Hooker's project, none have published similar research (i.e., nontherapeutic study of living fetuses ex utero) in the United States since at least 1965.

A small number of other medical professionals in the early twentieth century had also followed this informal, contemporary ethical approach while procuring live human developmental research materials through hospital surgeries. Respected embryologists at institutions such as the Carnegie Institution of Washington's Department of Embryology, the University of Michigan Medical School, and the University of Rochester School of Medicine would inject preservatives or colored plastics into the umbilical vein while the heart was still beating in order to better preserve specimens or view venous structures.⁸⁸ Another research team seeking live or freshly dead human embryos in the 1930s and 1940s—the “egg hunt” of Arthur Hertig and John Rock—enlisted the cooperation of women scheduled for medically necessary hysterectomies.⁸⁹ The two asked married women with proven fertility to track their menstrual cycles and intercourse dates prior to surgery in order to recover very early human embryos. These women were aware of the ultimate intention to study their embryos, if any were found. Hertig, Rock, or a colleague explained the studies to the participating women in terms of aiding in the understanding of conception; the women described their contributions to the project as helping their “sisters’ who were infertile.”⁹⁰ The lack of documented contention from the 210 participants demonstrates that early products of conception were viewed as acceptable research materials not only by embryologists, but by the donors who (re)produced the embryos as well.

Outside of his lamentation on the limitations of using women's recall of last menstrual period as an aging technique for fetuses, Hooker does not mention the women from whom the

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fetuses in his study came. Discussion of the difficulty in obtaining human fetuses for study centered on professional cooperation of hospitals and physicians, not difficulties stemming from the reluctance of pregnant women or the acquisition of maternal consent. Visual imagery of the more recognizably human appearance of a ten-week fetus (as opposed to a fertilized egg) was, as noted earlier, rarely available to the public in the 1930s. But unlike the Boston “egg hunt,” whether or to what degree the women in Hooker’s project were informed of the use of their fetuses is unknown.

Contemporary Ethics of Fetal Research

Given the changed views of fetuses as autonomous, personified entities by the 1970s, how might we understand how Hooker and his contemporaries pursued research on dying human fetuses in the 1930s and 1940s? In her discussion of Hooker’s work and its popular presentations, Lynn M. Morgan interpreted the capacity they had to do perform these studies: “It is not that Hooker, his colleagues, or his audience de-humanized fetuses . . . they had never humanized fetuses to begin with.”⁹¹ Hooker was never met with insurmountable obstacles from the medical profession, the public, funding sources, or his own conscience. But certain of Hooker’s choices and the reception of his work indicate that live fetal research in the 1930s was not uncomplicated or impersonal.

Hooker never explicitly addresses his own philosophical or ethical thoughts on his fetal studies, and it is impossible to infer from this silence his viewpoints on the status of fetuses or his treatment of fetuses and pregnant women. We do, however, have access to reflections from

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his colleague, Tryphena Humphrey. In her memorial biography of Hooker, Humphrey related that, despite the few popular articles, publicity on the Pittsburgh project and methods was generally avoided. She stated that the public would have considered “even the tactile stimulation and observation of reflex movements of non-viable human fetuses” to be “‘experimenting’ on human beings.”⁹² Humphrey viewed the project as observation, not experimentation, and thought that public concern, misinterpretation, and suspicion were already possible in the 1930s. Even during a time when Hooker’s methods could be so openly relayed to a popular magazine audience, fetal research was thought by some to be a subject with potential for controversy. Hooker continued to regularly present his findings at prestigious invited lectureships, to medical students, and in other scholarly circles. Humphrey noted that “the primary reason was to make the work known in the scientific community and so an old story if unfavorable newspaper publicity should inadvertently occur.”⁹³ Thus Humphrey, if not Hooker as well, viewed his commitment to the dissemination of results partially as preemptive damage control.

While Hooker’s reputation allowed him to perform the research unimpeded, it did not guarantee him financial support. Adele Clarke has shown that the 1920s and 1930s saw the emergence of new sponsors and an increase in available funding for studies of embryology, reproduction, and development.⁹⁴ But Hooker’s success at obtaining sponsorship was not immediate. One colleague who had previously worked with Hooker on fetal studies using their rat colony noted that “financial support came slowly” for the human project.⁹⁵ From 1932 to 1935, while chair of the Anatomy Department at the University of Pittsburgh, Hooker had applied for grants ranging from \$750 to \$1,000 from the National Research Council, the Macy

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Foundation, and the Rockefeller Foundation.⁹⁶ All three proposals were rejected. In 1936 Hooker delivered a Harry Burr Ferris Lecture at Yale University, a series named for his father-in-law and a former mentor at Yale. That same year Hooker applied for and received a \$500 grant from the American Philosophical Society in Philadelphia, securing just half the sum he had originally requested. Tryphena Humphrey mentioned, without specifying names, that others who attempted similar studies were unable to obtain the necessary professional cooperation and financial support.⁹⁷ Hooker's discretion, along with his credentials and the significance of his work, would eventually garner large-scale funding, despite the use of live, aborted human fetuses as research materials.

Hooker, like his contemporaries, carefully noted that he and his colleagues were not performing or supporting elective abortions. Arthur Hertig, of the Boston "egg hunt," repeatedly expressed that "in all cases, the patient had not missed a menstrual period. We were not doing abortions, but we hoped we would find an ovum."⁹⁸ Hooker refers to the source of the human fetuses in his studies as "hysterotomies" in published works, completely avoiding the use of the word "abortion" in relation to his project. Despite its narrower popular and legal meanings, "abortion" was and is the common and neutral medical term for any event that terminates a pregnancy, regardless of the contributing circumstances.⁹⁹ The definition includes spontaneous abortions (i.e., miscarriage) and induced abortions, both therapeutic and elective. Hooker does use the recognized term "spontaneously aborted" in one publication, but only in reference to human fetuses in a colleague's studies.¹⁰⁰ Hooker's avoidance of the word "abortion" in

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describing his research materials indicates an intentional and diplomatic dissociation from the limited colloquial meaning.

Hooker saw the fetuses as the “by-product[s] of an operation to ameliorate disease,” as beings for whom death was imminent and unavoidable. They were the results of therapeutic abortions that occurred for the life or health of the mother, as professionally judged at the time. Hooker viewed the alternative to using these fetuses as the loss of a rare and invaluable research opportunity, because the fetuses would otherwise be treated as medical waste and disposed of accordingly.¹⁰¹ Without human studies, knowledge of prenatal activity would have remained dependent on unreliably analogous animal studies. Like many other embryological researchers of his day, Hooker considered it his duty to make use of the only available and appropriate research material toward a legitimate and worthwhile medical purpose.¹⁰² By ascribing the fetuses with experimental utility, Hooker and his team transformed these aborted human fetuses into laboratory research specimens within this social context, in a manner similar to that described by Michael Lynch using animals in the neurosciences.¹⁰³ Hooker and his team performed these laboratory procedures while viewing the fetuses in a different sense than they might have in other situations. But Hooker and his colleagues need not have maintained this one perspective to the exclusion of others, inside the lab or out.¹⁰⁴

Hooker regarded the reflex studies as “observations” causing no detriment to the fetus, similar in nature to the filmed “observations” carried out on healthy infants by respected psychologist Arnold Gesell at Yale. From 1924 to 1948 Gesell sought to compile data on normal human behavioral development. Like Hooker, Gesell was inspired by the work of embryologist

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George Ellett Coghill on salamanders, which correlated physical development with behavioral development.¹⁰⁵ And when Gesell sought to extend his research to earlier human development, he used Hooker's complementary fetal films as the main source of data for his 1945 book, *The Embryology of Behavior*.¹⁰⁶ That same year *Time* magazine reported on Gesell's research alongside references to Hooker's fetal studies.¹⁰⁷ Rather than an unconscionable research method performed by people who didn't value human fetuses, as portrayed in the 2010 blog, Hooker's work was interpreted as being comparable to uncontroversial work undertaken on infants and young children by developmental psychologists. Any distinction came more from their dying nature than from their fetal ages.

This underlying parallel to treatment of human infants is also demonstrated in a surprising inclusion of the detailed notes accompanying Hooker's fetal research. Hooker recorded the baptisms of a number, but not all, of the fetuses, as young as 8.5 menstrual weeks old, performed just before or during an intentional pause in the filmed observations.¹⁰⁸ Baptisms in cases of therapeutic abortion also occurred at other institutions, administered by hospital personnel, before, during, and after Hooker's three decades of fetal studies.¹⁰⁹ The Catechism of the Catholic Church describes the necessity of baptism as being so fundamental that, in an emergency, anyone with the right intentions can baptize.¹¹⁰ Several of the assistants in the room for Hooker's observations, who were not members of the clergy or individuals brought in solely for this purpose, performed these baptisms at Magee Hospital. No details were available regarding the circumstances under which the fetuses were baptized (e.g., fetal age, request of the mother, etc.), and no single discernible characteristic of the fetus, as recorded by Hooker, was

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consistently correlated with baptism (e.g., fetal age, cause of abortion, etc.). Without further details, it remains uncertain who requested the baptisms or under what conditions they were carried out. Regardless, the reflex study was an extremely time-sensitive process, and it is interesting that Hooker paused the research for the performance of a religious rite meant to incorporate a person into the Christian church. The baptisms indicate that at least some of those involved in the research, whether Hooker, an assistant, or a pregnant woman, viewed the fetuses not only as individual human beings, but as human beings in urgent need of religious salvation.

As evidenced by the comparison to Gesell's infant behavior project, performance of baptisms, and use of baby dolls in staging the camera, Hooker and his colleagues maintained an association of these fetuses with human infants. But Hooker did not go so far as to define them as such, instead finding unique terminology to represent their liminal, ambiguous status, situated somewhere between fetus and infant, but closer to the former. Hooker referred to them as "delivered fetuses" and to his studies as being on "prenatal" development. In all cases they are alive and ex utero, but in most instances they were never really "born" in a traditional sense. Their appearance outside the uterus is aberrant and without standardized terminology, and Hooker opted in favor of fetal rather than infant terminology. His careful language stands in stark contrast to popular descriptions in Flanagan's *The First Nine Months of Life* and the *Look* article, which generally refer to even young fetuses as "babies born very early."¹¹¹ More recent scientific references to Hooker's work even further distance their language from birth, abortion, or any common terminology, calling them "exteriorized fetuses."¹¹²

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Conclusions

Davenport Hooker's human fetal activity research exemplifies how views of fetuses are grounded in shifting social, medical, and historical contexts. Hooker's films, produced from 1932 to 1963, contributed substantially to newfound visual and biomedical conceptions of fetuses in the 1960s and 1970s as baby-like, autonomous human entities. But when viewed through the lens of this new fetal ideology by a 2010 web audience, that same filmed research violates acceptable or even tolerable treatment of fetuses. His methods, if modified in key respects formally established in the mid-1970s, could be legally and ethically acceptable, but are now incompatible with social perceptions of fetuses as young babies and of medical research as an essentially exploitive practice.

Hooker and his colleagues did not, however, operate under an uncomplicated and unhumanized concept of fetuses. Hooker considered fetuses to be necessary live research materials and, at the same time, did not object to the performance of a religious rite normally reserved only for people. The 1930s public also held a nuanced view of fetuses, both as generally acceptable materials for nontherapeutic research and as developing humans with social value. Hooker recognized that discretion and respect toward fetuses were essential to continuing his studies, and that his methods, if presented less cautiously, could be objectionable to a broader American audience. Hooker's project and the differing reactions to his work, both during and after the decades he conducted this research, demonstrate the changing, seemingly contradictory, context-dependent, and individually variable perspectives that have been held by scientists and

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the public toward fetuses and fetal experimentation, and the practical influence those views have had on biomedical research.

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2. Mark Frauenfelder, "Horrific Medical Booklet from 1939: Living Human Fetal Experimentation," Boing Boing blog, December 6, 2010, <http://boingboing.net/2010/12/06/horrific-medical-boo.html>.

3. Though Hooker does not make the distinction, those from conception through eight weeks are more accurately referred to as "embryos" and those from nine weeks until birth as "fetuses." Two conventions exist for prenatal ages: fertilization age, which is calculated from the date of conception; and menstrual age, which is calculated from last menstrual period and is normally two weeks greater than fertilization age. This article follows Hooker's inclusive sense of the term "fetus" and his use of menstrual instead of fertilization ages.

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5. Morgan, *Icons of Life* (n. 4), 201.

6. In experimental studies, the term “subject” is often applied to live human and nonhuman research materials alike. In order to avoid confusion with concepts such as subjectivity or with attributions of consciousness, sentience, or agency, I generally refer to the human fetuses in Hooker’s study instead as “materials,” as “specimens,” or simply as “fetuses.”

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11. M. Bolaffio and G. Artom, “Ricerca sulla Fisiologia del Sistema del Feto Umano,” *Archivio di Scienze Biologiche* 5 (1924): 457–87.

12. Mieczysław Minkowski, “Neurobiologische Studien am Menschlichen Foetus,” *Abderhalden’s Handbuch der Biologischen Arbeitsmethoden* 253 (1928): 511–618.

13. Scott Curtis, “‘Tangible as Tissue’: Arnold Gesell, Infant Behavior, and Film Analysis,” *Sci. Context* 24, no. 3 (2011): 417–42, 420–22. Medical cinematography became a substantial method of data collection, documentation, and dissemination across biological disciplines in the early twentieth century. See also Hannah Landecker, “Microcinematography and the History of Science on Film,” *Isis* 97 (2006): 121–32.

14. John B. Watson, *Studies upon the Behavior of the Human Infant: Experimental Investigation of Babies* (Chicago: C. H. Stoelting, 1919), film.

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17. Davenport Hooker, “Amoeboid Movement in the Corial Melanophores of *Rana*,” *Am. J. Anat.* 16, no. 2 (1914): 237–50. Hooker was the first Ph.D. graduate under biologist Ross G. Harrison at Yale University. Despite close familial and professional ties at (and job offers from) Yale, Hooker remained at the University of Pittsburgh from 1919 until the end of his teaching career in 1956, at which point he returned to Yale. See Tryphena Humphrey, “Davenport Hooker: 1887–1965,” *J. Comp. Neurol.* 126 (1966): 1–14, 3.
18. Jane M. Oppenheimer, “John Spangler Nicholas, 1865–1963,” *Biographical Memoirs, Nat. Acad. of Sci.* 40 (1969): 239–89, 248, 262–63.
19. Davenport Hooker, “Early Fetal Activity in Mammals: The Third Harry Burr Ferris Lecture,” *Yale J. Biol. Med.* 8, no. 6 (1936): 579–602, 602.
20. Robert Yerkes, *Almost Human* (New York: Century, 1925), 269; Gary D. Hodgen, “Primate Models for Pregnancy Hormone Secretion in Man: Fetal, Maternal, and Placental Factors,” in *Animal Models for Research on Contraception and Fertility*, ed. Nancy J. Alexander (Chicago: Northwestern University, 1978), 431.
21. Hooker, “Early Fetal Activity in Mammals” (n. 19), 590.

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23. Adrienne Noe, “The Human Embryo Collection,” in *Centennial History of the Carnegie Institution of Washington, vol. 5: The Department of Embryology*, ed. Jane Maienschein, Marie Glitz, and Garland E. Allan (Cambridge: Cambridge University Press, 2004), 21–61; Arthur T. Hertig, John Rock, and Eleanor C. Adams, “A Description of 34 Human Ova within the First 17 Days of Development,” *Am. J. Anat.* 98, no. 3 (1956): 435–94; Margaret Marsh and Wanda Ronner, *The Fertility Doctor: John Rock and the Fertility Revolution* (Baltimore: Johns Hopkins University Press, 2008).

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26. Davenport Hooker, *Evidence of Prenatal Function of the Central Nervous System in Man* (New York: American Museum of Natural History, 1958), 16; Davenport Hooker, *A Preliminary Atlas of Early Human Fetal Activity* (Pittsburgh: Author, 1939), 7.

27. Heard, Burkley, and Schaefer, “Electrocardiograms” (n. 24).

28. Davenport Hooker, Fetal Activity Protocols, Hooker-Humphrey Collection, National Museum of Health and Medicine, Silver Spring, Md.

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30. Davenport Hooker, "Fetal Reflexes and Instinctual Processes," *Psychosom. Med.* 4 (1942): 199–205, 200. Little exists in the Hooker-Humphrey Collection to further elucidate how or by whom decisions were made on whether to abort or which technique would be used (see the "Subsequent Biomedical Ethics" section). I found only one recorded instance of a coincident sterilization with abortion surgery, which did not clarify who requested the procedure or if maternal consent was obtained. Tryphena Humphrey, Fetal Activity Protocols, Hooker-Humphrey Collection, box HHR 11.

31. By the early twentieth century, hospital births and physician interventions were common not just for poor women, but also for middle- and upper-class women. For an explanation of this historical shift in childbirth practices, see Richard W. Wertz and Dorothy C. Wertz, *Lying-In: A History of Childbirth in America* (New Haven, Conn.: Yale University Press, 1989), 132–35. Carolyn Leonard Carson's account of maternity care in the early twentieth century, and specifically at Magee, provides a very general background on the women and relatively high quality of medical treatment at the hospital during this period; see "Maternity Care in the Progressive Era: The Elizabeth Steel Magee Hospital, Parts I and II," *Western Pennsylvania Hist.* 77, no. 3 (1994): 117–79.

32. Hooker, "Early Fetal Activity in Mammals" (n. 19), 593.

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33. Tryphena Humphrey, "Human Prenatal Activity Sequences in the Facial Region and their Relationship to Postnatal Development," *Proc. Amer. Speech Hearing Assoc. Conference* 6 (1971): 19–126, 19.

34. Davenport Hooker, "Notes from Physiological and Morphological Studies of Human Prenatal Development," Hooker-Humphrey Collection, box HHR 04.

35. Davenport Hooker, *The Prenatal Origin of Behavior* (Lawrence: University of Kansas Press, 1952), 76–77.

36. A small portion of these fetal activity films was digitally copied from originals at the National Museum of Health and Medicine and is currently viewable online. This digitization was done under the museum's collaboration with Louisiana State University, the Virtual Human Embryo Project. See http://virtualhumanembryo.lsuhsu.edu/videos/Fetal_activity_index.html.

37. Hooker used an esthiometer to test the strength of hairs used in the study, preferring "softer" hairs, sometimes tipped with a bead of rubber cement, because they would not puncture skin or directly stimulate muscles. See Hooker, "Early Fetal Activity in Mammals" (n. 19), 586–87.

38. Hooker filmed numerous surviving premature and full-term infants as well, but this is not the focus of the present discussion.

39. Humphrey, "Human Prenatal Activity Sequences" (n. 33), 19.

40. Hooker, "Fetal Reflexes and Instinctual Processes" (n. 30), 201.

41. Hooker, *Prenatal Origin of Behavior* (n. 35), 57.

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42. Davenport Hooker, "Development Reaction to Environment," *Yale J. Biol. Med.* 32 (1960): 431–40, quotation on 431.

43. Hooker, *Prenatal Origin of Behavior* (n. 35), 65.

44. This work was started at the University of Pittsburgh by a former colleague of George Ellett Coghill, Ira D. Hogg, Ph.D., in 1932, but continued by Humphrey until her death in 1971. Though her role in the overall project was unmistakably prodigious and deserves more attention than I provide, the focus here is specifically on Hooker's filming and films of live fetuses. The few details that do exist on Humphrey unfortunately appear only as side notes within biographies of her two main colleagues. Humphrey was a previous student of, and would later collaborate as regular coauthor with, her life partner, renowned neuroanatomist Elizabeth Crosby at the University of Michigan. A photograph of Humphrey in front of one of her amazingly detailed medical illustrations, drawn ambidextrously in colored chalk during classes, is shown in Jenelle Pifer, "The Great Equalizer," *PITMED* 14, no. 2 (2012): 27–31, on page 29. See also Whitley Hill, "Quiet Pioneer: Part II," *Med. Michigan* 10, no. 2 (2008): 14-15.<<Au: please provide the pagination.>>

45. Humphrey, "Human Prenatal Activity Sequences" (n. 33), 19.

46. Hooker, "Development Reaction to Environment" (n. 42), 434. See note 38.

47. Davenport Hooker, *Early Human Fetal Activity* (University of Pittsburgh, School of Medicine, 1952), film; Hooker, *Preliminary Atlas* (n. 26).

48. To name a few of the many, Arnold Gesell, "Human Infancy and the Ontogenesis of Behavior," *Amer. Scientist* 37, no. 4 (1949): 529–53; Viktor Hamburger, "Some Aspects of the

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Embryology of Behavior,” *Quart. Rev. Biol.* 38, no. 4 (1963): 342–65; Stephan Juan, *The Odd Body: Mysteries of Our Weird and Wonderful Bodies Explained* (Kansas City: Andrews McMeel, 2004); Alessandra Piontelli, *From Fetus to Child: An Observational and Psychoanalytic Study* (London: Psychology Press, 2012); and other works referenced in this article.

49. “Philosophical Group Gives \$19,200 Grants; 19 Research Awards Revealed in Advance of Society’s Meeting in Philadelphia,” *New York Times*, April 18, 1937, 12.

“Scientific Events,” *Science* 85, no. 2207 (1937): 378.

50. “Cinema: Embryonic Grasp,” *Time*, May 2, 1938.

51. “Science: Beginnings of the Mind,” *Time*, January 8, 1945.

52. Barbara Duden, “The Fetus on the ‘Farther Shore’: Toward a History of the Unborn,” in Morgan and Michaels, *Fetal Subjects, Feminist Positions* (n. 4), 13–25, 18–22.

53. See Addelson, “Emergence of the Fetus” (n. 4), 26–42, for an approach to the role of a fetus through its relationships to people and not as a person per se, analogous to inanimate objects as characters in a play.

54. See, for example, George L. Streeter, “Developmental Horizons in Human Embryos: Description of Age Group XI, 13 to 20 Somites, and Age Group XII, 21 to 29 Somites,” *Contrib. Embryol. (Carnegie Inst.)* 30 (1942): 211–35. Inconsistent age estimation had constituted a major complication in embryology since the early nineteenth century. For a detailed history of stage standardizations in embryology, see Nick Hopwood, “Visual Standards and Disciplinary Change: Normal Plates, Stages and Tables in Embryology,” *Hist. Sci.* 43, no. 3 (2006): 239–303.

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55. Nick Hopwood, "Producing Development: The Anatomy of Human Embryos and the Norms of Wilhelm His," *Bull. Hist. Med.* 74 (2000): 29–79, 78–79.

56. Geraldine Lux Flanagan, *The First Nine Months of Life* (New York: Simon & Schuster, 1962).

57. Geraldine Lux Flanagan, "Dramatic Photographs of Babies before Birth," *Look*, June 5, 1962, 19–23. Only pages 22 and 23 contain images from Hooker's study.

58. See, for example, Christa Einspieler and Heinz F. R. Prechtel, "Fetal Movements: Though They May Be Spontaneous, Yet There Is Method in Them," in *Fetal MRI*, ed. Daniela Prayer (New York: Springer, 2011), 177–90, 178.

59. Flanagan, "Dramatic Photographs (n. 57), 22.

60. *Ibid.*, 23.

61. *Ibid.*, 23.

62. Petchesky, "Fetal Images" (n. 4); Catherine Cole, "Sex and Death on Display: Women, Reproduction, and Fetuses at Chicago's Museum of Science and Industry," *Drama Rev.* 37, no. 1 (1993): 43–58.

63. Lennart Nilsson, "Drama of Life Before Birth," *Life* 58, no. 17 (1965): 54–71; Lennart Nilsson and Axel Ingelman-Sundberg, *A Child Is Born* (University of Michigan: Delacorte Press, 1967).

64. Petchesky, "Fetal Images" (n. 4), 269–70; Cole, "Sex and Death on Display" (n. 62); and as portrayed by the "Star Child" of the 1968 Stanley Kubrick film *2001: A Space Odyssey*.

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65. The topic of this article is not the fetus qua patient—the fetuses in this project were not the subjects of medical interventions performed on behalf of the fetus. The phenomenon is introduced here to provide the greater context in which Hooker’s fetal images were later displayed and interpreted. Casper, *Making of the Unborn Patient* (n. 4); Sarah Franklin, “Fetal Fascinations: New Dimensions to the Medical-Scientific Construction of Fetal Personhood,” in *Off-Centre: Feminism and Cultural Studies*, ed. Sarah Franklin, Celia Lury, and Jackie Stacey (London: HarperCollins, 1991), 190–205, 192.

66. Richard Beard and Peter W. Nathanielsz, *Fetal Physiology and Medicine: Basis of Perinatology* (New York: M. Dekker, 1984), v.

67. Meredith W. Michaels and Lynn M. Morgan, “Introduction: The Fetal Imperative,” in Morgan and Michaels, *Fetal Subjects, Feminist Positions* (n. 4), 1–9, 4.

68. Casper, *Making of the Unborn Patient* (n. 4), 31–34.

69. Monica J. Casper, “Operation to the Rescue: Feminist Encounters with Fetal Surgery,” in Morgan and Michaels, *Fetal Subjects, Feminist Positions* (n. 4), 101–12, 105.

70. For example, Robert C. Goodlin, “Cutaneous Respiration in a Fetal Incubator.” *Amer. J. Obstet. Gynecol.* 86 (1963): 571–79; Geoffrey Chamberlain, “An Artificial Placenta,” *Amer. J. Obstet. Gynecol.* 100 (1968): 624.

71. Eva R. Rubin, *The Abortion Controversy: A Documentary History* (Michigan: Greenwood, 1994), 14.

72. J. G. Moore and J. H. Randall, “Trends in Therapeutic Abortion: A Review of 137 Cases,” *Amer. J. Obstet. Gynecol.* 63, no. 1 (1952): 28–40.

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73. Solinger, *Abortion Wars* (n. 4), 15–32.

74. Edwin M. Gold, Carl L. Erdhardt, Harold Jacobziner, and Frieda G. Nelson, “Therapeutic Abortions in New York City: A 20-Year Review,” *Am J. Pub. Health* 55, no. 7 (1965): 964–71, 969.

75. Solinger, “A Complete Disaster” (n. 29), 248–49.

76. See Carole Joffe, *“Doctors of Conscience”: The Struggle to Provide Abortion Before and After Roe v. Wade* (Boston: Beacon, 1996), for a discussion of the complex politics within the medical field surrounding hospital abortion boards and the efforts of some reputable gynecologists to circumvent them in the interests of patients who had been denied therapeutic abortions.

77. “Roe v. Wade: Brief for Appellee” (U.S. Supreme Court, 1971), no. 70-18.

78. Nicholas P. Terry, “‘Alas! Poor Yorick,’ I Knew Him Ex Utero: The Regulation of Embryo and Fetal Experimentation and Disposal in England and the United States,” *Vanderbilt Law Rev.* 39, no. 3 (1986): 419–70, 422; Lori B. Andrews, “State Regulation of Embryo Research,” *Nat. Inst. Health, Papers Commissioned Hum. Embryo Res. Panel 2* (1994): 297–407, 299.

79. Victor Cohn, “Live-Fetus Research Debated,” *Washington Post*, April 10, 1973, A1, A9; Victor Cohn, “NIH Vows Not to Fund Fetus Work,” *Washington Post*, April 13, 1973, A1, A8; Victor Cohn, “Scientists and Fetal Research,” *Washington Post*, April 15, 1973, A1.

80. Terry, “‘Alas! Poor Yorick’” (n. 78), 422; see also Dubow, *Ourselves Unborn* (n. 4), 76–79, for a discussion of the growing distrust of and resistance to unregulated medical

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experimentation on humans, particularly the events occurring in reaction to *Roe v. Wade* that brought concerns over fetal research into the public domain.

81. Ramsey, *Ethics of Fetal Research* (n. 4), 62. Ramsey identifies analogous topics in medical ethics concerning research on humans that did already exist: research on the dying, the unconscious, and the condemned (28–29).

82. From 1932 to 1972 the Public Health Service had deliberately excluded around four hundred black men, without their consent, from syphilis treatment in order to study the disease. After this experiment was publicly exposed, an advisory panel recommended the establishment of a review board to regulate all federally funded research on humans. See Albert R. Jonsen, “The Ethics of Research with Human Subjects: A Short Story,” in *Sourcebook in Bioethics: A Documentary History*, ed. Albert R. Jonsen, Robert M. Veatch, and LeRoy Walters (Washington, D.C.: Georgetown University Press, 1998), 5–10, 8; and James H. Jones, *Bad Blood: The Tuskegee Syphilis Experiment* (New York: Free Press, 1993).

83. For example, Goodlin, “Cutaneous Respiration” (n. 70).

84. U.S. Department of Health, Education, and Welfare, *National Commission for Protection of Human Subjects of Biomedical and Behavioral Research, Report and Recommendations: Research on the Fetus* (Washington, D.C.: Government Printing Office, 1975), 69.

85. Hooker, “Fetal Reflexes and Instinctual Processes” (n. 30), 200.

86. Gold et al., “Therapeutic Abortions in New York City” (n. 74), 968; Moore and Randall, “Trends in Therapeutic Abortion” (n. 72), 36.

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87. Humphrey, “Davenport Hooker” (n. 17), 5.

88. George L. Streeter, “The Development of the Venous Sinuses of the Dura Mater in the Human Embryo,” *Am. J. Anat.* 18, no. 2 (1915): 145–78, 157; Bradley M. Patten, Human Acquisition Note Cards, Patten-Burdi Collection, National Museum of Health and Medicine, Silver Spring, Md., box PBN 9.1; Charles E. Tobin, “A Radiopaque-Plastic Injection Mass,” *Anat. Rec.* 98, no. 2 (1947): 137–45.

89. See Marsh and Ronner, *Fertility Doctor* (n. 23).

90. Arthur T. Hertig, “A Fifteen-Year Search for First-Stage Human Ova,” *JAMA* 261, no. 3 (1989): 434–35, quotation on 434.

91. Morgan, *Icons of Life* (n. 4), 201.

92. Humphrey, “Davenport Hooker” (n. 17), 7.

93. *Ibid.*, 9.

94. Adele E. Clarke, *Disciplining Reproduction: Modernity, American Life Sciences, and “The Problem of Sex”* (Berkeley: University of California Press, 1998).

95. John C. Donaldson, “Davenport Hooker, 1887–1965,” *Anat. Rec.* 155, no. 3 (1965): 408–10.

96. Davenport Hooker, “Notes from Physiological and Morphological Studies” (n. 34).

97. Humphrey, “Davenport Hooker” (n. 17), 7.

98. Hertig, “A Fifteen-Year Search” (n. 90), 435. These assertions were made in the 1980s—decades after the original research and within a much different social climate (see Marsh and Ronner, *Fertility Doctor* [n. 23], 104)—but in earlier papers Hertig and his colleagues

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similarly clarified fetal sources as “hysterectomy salpingectomy . . . for various therapeutic reasons” (Hertig, Rock, and Adams, “Description of 34 Human Ova” (n. 23), 435.

99. Annemarie Jutel, “What’s in a Name? Death before Birth,” *Perspect. Biol. Med.* 49, no. 3 (2006): 425–34, 429. All terminology surrounding fetal termination has its own complex assumptions, values, purposes, and conditions; I refer only to the established use of “abortion” within medical contexts. Correspondingly, “abortus” was previously a more common word for the products of abortion at any stage, though Hooker never applied the term himself (see its use in note 50).

100. Hooker, “Early Fetal Activity in Mammals” (n. 19), 601.

101. For an investigation of how medical research contributed to the classification of human fetuses as medical waste, see Lynn M. Morgan, “‘Properly Disposed Of’: A History of Embryo Disposal and the Changing Claims on Fetal Remains,” *Med. Anthropol.* 21 (2002): 247–74.

102. Hooker, “Early Fetal Activity in Mammals” (n. 19), 590. George W. Corner produced an engagingly informative account of his long career in embryology, exemplary of the thought processes and interpersonal relationships behind many experimental methods in the reproductive sciences in the twentieth century, in *Seven Ages of a Medical Scientist* (Philadelphia: University of Pennsylvania Press, 1981).

103. Michael E. Lynch describes the laboratory ritual that transforms an animal into a research object, commonly, but not exclusively, through “sacrifice,” and often in order to generate graphic data and demonstrations. See “Sacrifice and the Transformation of the Animal

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Body into a Scientific Object: Laboratory Culture and Ritual Practice in the Neurosciences,” *Soc. Stud. Sci.* 18 (1988): 265–89.

104. *Ibid.*, 282.

105. Curtis, ““Tangible as Tissue”” (n. 13), 429–30.

106. Arnold Gesell and Catherine Strunk Amatruda, *The Embryology of Behavior: The Beginnings of the Human Mind* (Oxford: Harper, 1945).

107. “Science: Beginnings of the Mind” (n. 51).

108. Davenport Hooker, Human Fetal Activity Protocols, Hooker-Humphrey Collection, boxes HHR 01 and HHR 07.

109. Joseph Bolivar de Lee, *Obstetrics for Nurses* (Philadelphia: W. B. Saunders, 1917), 220–21; Catholic Hospital Association of the United States and Canada, *Ethical and Religious Directives for Catholic Hospitals* (St. Louis: Catholic Hospital Association of the United States and Canada, 1949), 3; Stewart M. Brooks, *Review of Nursing: Essentials for State Boards* (Boston: Little, Brown, 1978), 109.

110. Catechism of the Catholic Church, 2nd ed. (1256).

111. Flanagan, *First Nine Months of Life* (n. 56), 75.

112. Holly M. Cintas, “Fetal Movements: An Overview,” *Phys. Occup. Ther. Pediatr.* 73, no. 3 (1987): 1–15, 4; Einspieler and Prechtel, “Fetal Movements” (n. 58), 178.

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Figure 1. Film frame of a five-month-old fetus, as pictured in *Look* magazine in 1962. Courtesy of the National Museum of Health and Medicine.

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Figure 2. Dolls used by Davenport Hooker in positioning the camera, now housed at the National Museum of Health and Medicine. ©2009 Arne Svenson. Courtesy of Blast Books and Arne Svenson.

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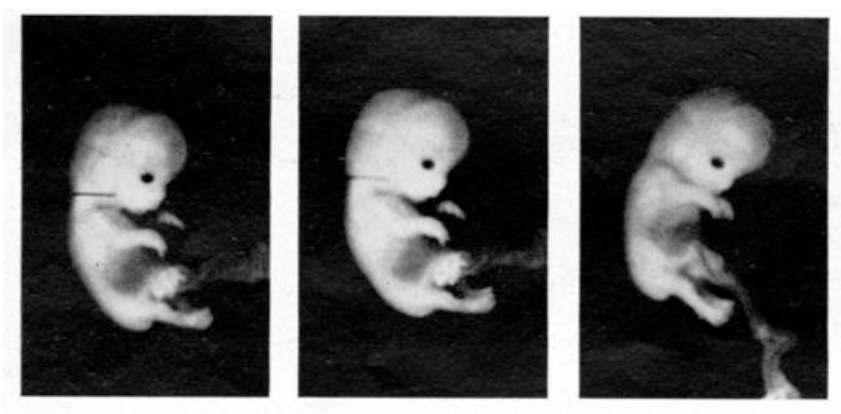


Figure 3. Three film frames from Early Human Fetal Activity of a two-month-old fetus, as pictured in *Look* magazine in 1962. Courtesy of the National Museum of Health and Medicine.