the doctor settles in a certain place. It is difficult for wandering spa doctors to build such a "lasting relationship" with their patients.

Sabine's plan to run the hospital goes awry because Gräsler sees her not as an emancipated woman, but as his possession [220]. However, she exerts a positive influence on him: after Gräsler meets Sabine, he works diligently: "Not only did he carefully follow the case histories of his patients, but he also endeavored to fill the gaps in his theoretical knowledge that gradually arose by studying medical works and magazines as much as possible" [219].

A significant change occurs in Gräsler when his mistress Katharina becomes severely ill with scarlet fever. Katharina asks if he could cure her illness. He replies, "Yes, I will, Katharina, I will" [219]. Because she was indirectly infected by a child Gräsler had treated, though he was cautious, he feels responsible for her illness: "Gräsler leaned over the patient, caressed her cheeks and hair, kissed her on the forehead, assured her that in a few days she would be well again and that she would then have to go back to him right away; that he would never leave her again and take her wherever his fate would lead him; that it had driven him back with all his might, and that she was his child and his beloved and his wife, and that he loved her dearly, as no creature has ever been loved" [219].

Gräsler watches over the sickly woman all night. He treats her out of a sense of both medical responsibility and love. Ultimately, his attempts are in vain and Katharina dies. After her death, Gräsler marries the widow Sommer and becomes the adoptive father of her daughter, who had indirectly infected Katharina with scarlet fever.

One can say that the novella *Doktor Gräsler, Badearzt* could be used as a textbook on patient care. By his narrative, the doctor-poet Arthur Schnitzler shows doctors that they should treat their patients humanely, as they would their family or loved ones.

Hearts and brains in motion: medical animated film as a popular and controversial medium for education and research

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Parts of this contribution are published elsewhere [221].

An unusual film finding was recently reported in the archives of the National Library of Medicine in Bethesda, Maryland, a result of the NLM's efforts during the past few years to systematically organize, account for, and make accessible their rich but unmanageably large medical film collection [222].

As described in his essay, Oliver Gaycken, the scientific-film historian and scholar [223], did some masterful sleuthing to trace the origins of a film produced in 1970 catalogued only as "Anatomical Animation by Frank Armitage" [224]. Delving further into this finding, Gaycken identified the film as indeed produced by the artist, Disney illustrator, and enthusiastic medical illustrator Frank Armitage (1924–2016). More than ten minutes long, the film depicts a kaleidoscopic multimedia voyage through human anatomy—replete with animated drawings, graphic illustrations, science fiction film clips, and historical art works. Armitage's voice-over explicitly emphasizes the artistic value and visual quality of these images, which go hand in hand with medical science to form a direct intercommunicative system intended to engage viewers such as artists, physicians, students, and other audiences.

Of Medical Humanities and Medical Film Archives

Until recently, such substandard archiving was a typical fate for many medical films of the past [225, 226]. After their usefulness diminished due to outdated medical research techniques and procedures, as well as to changing film formats, these films were often forgotten, disposed of, or stored away without proper archival care. Their separation from accompanying materials—such as doctor's guides, research notes, (film) production notes, information booklets, and patients' records—further hindered the evaluation and appreciation of how significant these collections are for medical education (as well as for empirical research in the field of contemporary film and medical history). The ultimate result was that the didactic, artistic, historical, and empirical value of these visual highly aestheticized communicative sources was frequently overlooked. Medical films, whether intended for higher clinical, educational, or more cultural public health instruction, are supposed to communicate in ways that are more accessible, entertaining, or artistic. Thus, these medical media can be categorized with other medical humanities, as they interface with artistic as well as scientific issues involving visual production, design, and communication of medical knowledge. By regarding medical films as both medical instruments and visual artistic forms of expression and communication, we can see medical films as an optimal—even prototypical—example for advancing the analysis of how the highly interdisciplinary medical humanities can be applied in different fields [227]. Different disciplines assign different values and definitions to what the medical humanities should be. Evolving forms of medical treatment, operation techniques, and technological, scientific, media, and social standards are not only documented on film but are also circulated and communicated via film, shaping the perceptions of medical education and research and popular conceptions about medical practice and knowledge [228]. Now, and in times past, harnessing the medical motion picture for the purposes of public health, public information, instruction, and pedagogical purposes has been accompanied by lively debates about the implications of image-based—rather than text-based—knowledge transfer. Attitudes vacillate between high hopes for the motion picture's educational capacity and dire warn-

ings about dissipation of knowledge and cultural decline. Debaters raise the question: What does it say about film art and about society if the latter relies, and appears, on film for the transfer of medical knowledge?

The introduction of film into medical research and education since the 1890s (and then again, nominally, after World War I) was based on a set of qualities deemed to make this medium highly efficient for teaching and learning: the purported objectivity and lifelike quality of the photographic moving image; film's potential to render visible phenomena that are not discernible by the naked eye; and film's easy dissemination via mechanical reproduction such as X-ray [229]. As the latter point suggests, appreciation of film as a potential medium for medical research and education was facilitated by the explosion of mass media following the 19th century, which fueled efforts toward a democratization of knowledge. Visual learning and communication as promulgated in the concept of the "object lesson" were key components in these initiatives. Building on this lineage, the commonplace use of film as a medium and art form, and cinema as a sphere of popular culture, have posed new challenges and modified the established conceptions, procedures, and standards of 20th-century medical education, communication, and visual organization of scientific knowledge.[33]

In late 19th-century Europe and the United States, the initial development of cinematography into a method usable in medical research lacked any consistent focus. However, after British photo technician Eadweard Muybridge (1830–1904) and French physiologist Étienne-Jules Marey (1830–1904) turned to "pre-cinematographic" serial photography to capture images of animal motion and other physiological processes such as the beating of the heart, and after the Lumière brothers toured with the newly introduced *Cinématographe* through the hotspot cities of Europe from 1895 on, the first interested scientists (above all, medical researchers and university lecturers) turned to cinematography as a promising diagnostic and research tool as well as a tool for teaching and communication [230–233]. This early "medical cinema of attraction" [234] followed common ways of proceeding within clinical research. These approaches supported the handling of different devices and mechanically produced image processes: making measurements and visualizing, demonstrating, and observing natural phenomena and physiological procedures with the help of microscopes, blood pressure monitors, X-ray apparatus, and scientific photography. Now, pathological and normal forms of movement could be made tangible and visually recordable via the cinematograph.

Fig. 26 Graphic animation of the heart in the film "Anatomical Animation by Frank Armitage (USA 1970)" [224] (U.S. National Library of Medicine, Online, ©Frank Armitage. Reprint by courtesy.)

[33] These questions are a crucial part of the ongoing FWF-funded (FWF Stand-Alone Project P 32343-G) research of the project team of which I am a part: Educational Film Practice in Austria https://tfm.univie.ac.at/en/forschung/drittmittelprojekte/laufende-drittmittelprojekte/educational-film-practice-in-austria/ (30 March 2020).

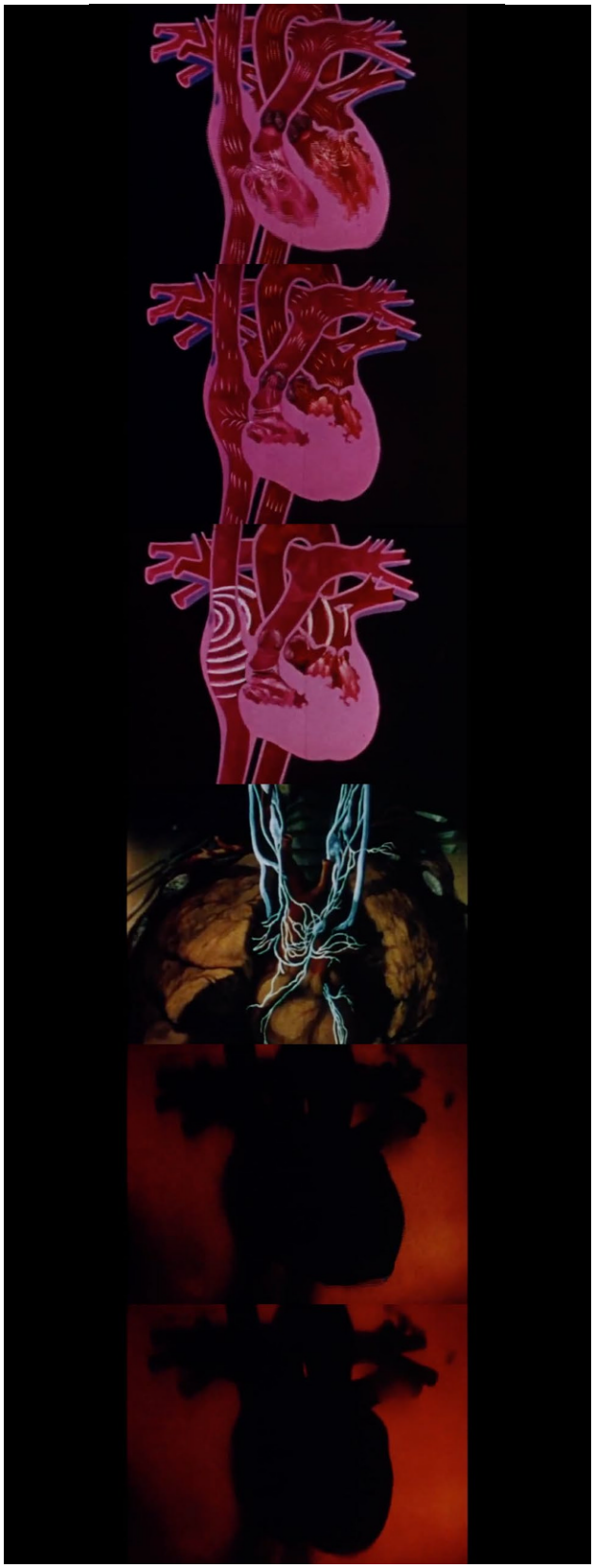

Fig. 27 Graphic animation of the brain in the film "Anatomical Animation by Frank Armitage (USA 1970)" [224] (U.S. National Library of Medicine, Online, ©Frank Armitage. Reprint by courtesy.)

As we will see in the following section, Frank Armitage's decision to devote his experimental anatomical illustration film nominally to the heart and brain structure followed a long-standing interest in visually encoding/decoding the essential organic motifs of living organisms by using "(...) the method of serial section motion pictures" to give "the impression of 'travelling' through the anatomical structures (...) for the easy visualization of difficult spatial relations."[34] In his film, Armitage pointed to "the chance to observe heart function in a large variety of ways" through the illustrated graphic human heart, vessels, and brain. He specifically considered "the value of animation as an art form" that enhanced this "controlled medium" and as an "organized graphic adventure" capable of graphically "slicing through the human brain" (Figs. 26 and 27). In this respect, the artist stressed further, "there's a great value and a lot of satisfaction—you being able to adjust a concept, frame by frame, as one would with brushstrokes on a painting." [35]

Of hearts and brains and the "The Physiological Film Theater"

At the university clinics of the General Hospital in Vienna, the experimental pathologists Salomon Stricker (1834–1898) and Ludwig Braun (1867–1936) focused their research on the rational use of clinical motion pictures and initially produced experimental neuroscientific serial photographs of human brain slices and of beating animal hearts (Fig. 28). Before the clinicians turned to filming experiments, these serial photographs were taken during vivisections on sedated animals and shown via specially developed projection devices, such as the episcope, in the clinical university amphitheater [235–237].

Stricker and Braun's first explicit filming of a test subject was the beating heart of a dog recorded in the operating room of their Viennese department in 1896 (Fig. 29). Braun considered the anatomical motion pictures to be generating objective quantitative single-image analyses which, according to Braun, were showing changes in form and shape as well as providing an unobstructed view of the motion of the beating heart [238–240].

In addition to increasing visual information, these imaging tests also encouraged further consideration of the potential of film in medical research and education. The already lively contemporary debate about animal experiments and how to proficiently limit them (as demanded by animal rights activists, for example) in the Vienna anatomical and pathological departments, also encouraged experimental physiologists to turn to film. Programmatically, the adoption of film offered a possible solution by which animal experiments, and especially vivisections,

[34] Unpublished manuscript: Nichtenhauser A. History of Motion Pictures in Medicine, ca. 1950 [1954]. In: Modern Manuscripts Collection. History of Medicine Division, National Library of Medicine. Bethesda, MD. MS C 380.

[35] Transcript of Armitage's voice-over: https://collections.nlm.nih.gov/transcript/nlm:nlmuid-8801174A-vid (30 March 2020).

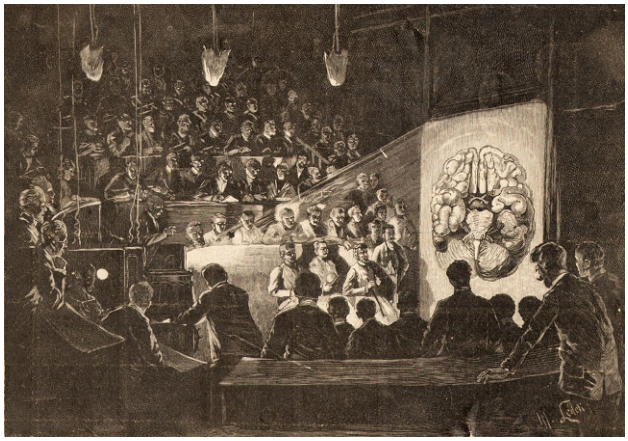

Fig. 28 Demonstrations with the electrical episcope in the lecture hall of Professor Dr. Stricker in Vienna. Original drawing by B. Ledeli. (© Josephinum. Ethics, Collections and History of Medicine, Medical University of Vienna. MUW-FO-IR-000230-0002, digital copy. Reprint by courtesy.)

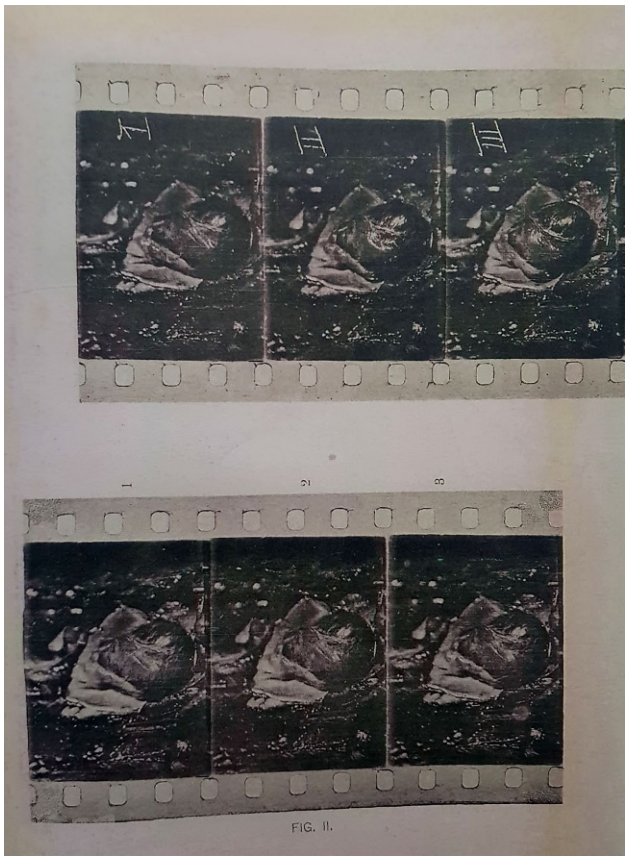

Fig. 29 The cinematographic method of the heart (of a dog) after Ludwig Braun (Ludwig Braun, Über Herzbewegung und Herzstoss. Jena: Gustav Fischer Verlag 1898, Tafel I Fig. II. [240], printout publication, private archive. Reprint by courtesy.)

could be rationalized. Scientific film enthusiasts argued that instead of requiring dozens of animals, only one animal's life would have to be sacrificed for medical training and experimental demonstrations. In addition, possible histological studies known to be difficult to access within an instructional timeframe could be projected independently of laboratory time and space; being visually reproducible on film, they could be shown to a larger number of students who would otherwise have had no opportunity to work on individual preparations [241]. The emerging cinematographic invasive view into the open body, which made the beating heart and neuro-histological images of brain pathology visible in an animated form, stimulated visualization strategies that allowed scientists to draw conclusions about the "properties and states of the body world" [242] in a time- and presentation-efficient manner. Thus, this novel cinematographic method, considered progressively objective, was argued to make procedures focused on the heart and the brain more accessible for comprehension and analysis [243].

Of animation as art technique and stylistic device

Whether on the blackboard of a medical lecture hall, or explaining complex organic processes or operation/treatment techniques to patients, medical professionals have commonly used drawing as an aid for transferring knowledge. Before the introduction of minimally invasive cameras during surgery and of computer-controlled technologies to discern objects invisible to the naked eye, innovations such as analogue hand-drawings, charts, diagrams, graphs and eventually photographs, and live action and animated films enriched medical and popular-scientific education [244]. However, compared to the evidentiary status accorded mechanically produced images, and to what media scholar Kirsten Ostherr calls "epistemologies of medical animation," these "animated sequences were often treated merely as enhancements of the film's technological and educational merits rather than having any scientific authenticity or adding purely scientific value" [245]. Schematic drawings of human anatomy were roughly drawn by a medical instructor in front of the camera, on blackboard or canvas, to highlight certain organic details; and medical drawings—including animated neuroscientific serial sections—were directly animated via film. But the applications of various new techniques for animated films, as seen in Armitage's and Braun's examples, not only came to be regarded as a convincingly fascinating and well-liked approach that gave the impression of "travelling" through the anatomical structures, but also helped put these artistic and research techniques on the map in the clinical and popular worlds—and beyond [246].

As we have seen in this early phase of experimental medical films, however, it quickly became apparent that the potential forms and areas of application, and their actual implementation, were far more difficult to realize than the first self-proclaimed medical film authors had anticipated [247, 248]. German physiologist and neurologist practicing at the Viennese Department at that time, Karl Reicher explicitly turned to neurological filmmaking in the early 20th century to make neuroscientific phenomena visible. As a contemporary of Stricker and Braun, he was very likely familiar with their early neurophysiological visual teaching methods and film demonstrations

and integrated them into his research using animated film. He was particularly interested in making visible the invisible by animating histological and neuro-anatomical serial pictures such as dissected brain slices [249]. While some physiological, surgical, and neuroscientific film enthusiasts, as well as journalists, reported profusely on the cinematographic journey through human anatomy, critics were quick to point out the limitations of this new form of visualization for clinical research. Among their targets were inadequate technical implementation such as missing slides or rigid specimens (not suitable for animation), poor lighting conditions and lack of color intensity, the sensitive equipment, and the high complexity of surgical techniques during filmed dissections and invasive procedures. Also, the less objective and more subjective forms of medical image creation, such as medical graphic illustrations and drawings, were criticized for not displaying the full potential of directly mechanically produced imaging, although they opened up visual medicine in many more ways, such as those shown in Armitage's *Anatomical Voyage*.

Conclusion

As shown above, the primary sources—documented media reports, specialist press articles, and scientific publications—about the historical use of medical (animation) film as a research and scientific communication tool in a sociohistorical context often promised more than was actually delivered by the diverse applications and potential opportunities that were implemented in medical research and teaching. The ongoing and periodically renegotiated improvements related to the production, distribution, and communication of research and instructional films did not produce a coherent success story. Instead, they created a specific novel way of producing, communicating, and circulating visual medical knowledge. Thus, medical cinematography ultimately shaped visual scientific practices that extended far beyond the boundaries of the scientific milieu, and influenced popular ideas about what clinical research and images of health and illness should look like. Controlled by surgeons, teachers, filmmakers, illustrators, national and private film producers, and, last but not least, manifested in the patient's body, a hybrid form of medical science-cinematographic iconographic images was generated by and with the help of cinematography. This "hybrid" has given shape to the ways we imagine and reflect on organic knowledge. Many of these "ways" were only realized in recent decades, with computer-controlled technologies such as MRI and CT. But we have shown above that many were long anticipated—some, more than a century ago—in the early considerations and tests of cinematographic techniques [250, 251].

Why literature in medicine?

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Introduction

Modern medicine is a scientific and highly technical field. At first glance, it seems to have little in common with artistic creation; yet the practice of medicine often involves a narrative element. To give one example, narratives play a central role in communications between patients and physicians. Proximity to people and confrontations with borderline questions of human existence are fundamental to both medicine and the arts. Because physicians professionally deal with people's everyday lives, they also need to confront existential questions themselves: What do I mean by a good life? What do I mean by a good death? And what do I think comes after death? Questions about how to live a good life or how to deal with suffering and pain are of as much interest to the medical art of healing as they are to the fine arts. Likewise, confrontation with the Great Unknown, with the process of dying, with death, and whatever comes afterwards, has always occupied both physicians and artists. Experiences such as birth, health, illness, pain, suffering, and death, which constitute the everyday life of a physician, are difficult to cope with for all those involved. These everyday experiences are reflected in art as well, especially in literature. Not only can encounters with representatives of the medical profession and medical institutions be elaborated in an artistic way [252], but also medicine itself is a cultural product that brings together creative and imaginative elements as well as specialized knowledge and skills.

On the way … medicine as a natural science

In Greek antiquity, the authors of the *Corpus Hippocraticum* no longer pursued concepts of health and disease based on divine intervention and religious assumptions, but searched for natural causes to explain the emergence of disease or the maintenance of health. Thus, a comprehensive understanding of health and disease based on dietetics and humoral pathology was established in premodern times. In this context, dietetics was to be regarded as *modus vivendi* (life style). Great importance was attached to the environment's impact on well-being, as is the case in the Hippocratic treatise "*De aëre, aquis, locis*" (On Air, Waters, and Places). The idea of including environmental factors in the understanding of health and disease has re-emerged in modern life sciences, especially in the concepts of epigenetics. According to this comprehensive understanding of health and disease, the best physician was simultaneously a man of science *and* a philosopher. The same idea is probably at work in the minds of those who, in our day, would like to reintroduce a preliminary course in philosophy (*Philosophicum*) into the medical curriculum [253]. During the 17th century,

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