Only a heartbeat away ...

The cultural dialectics of cardiographics[1]

Irene Cieraad

Sedert de jaren zestig is het monitorbeeld van een afvlakkend elektrocardiogram gevolgd door een alarmerende signaal een vertrouwde manier geworden waarop in films de dood wordt gevisualiseerd. Geïntrigeerd door dit opkomst van dit nieuwe culturele icoon, probeert de auteur de popularisering van de elektrocardiografie te traceren. Het elektrocardiogram bleek al bij de uitvinding in 1906 een visualiseringstechniek met grote voorspellende waarde, die een ommekeer in de medische praktijk betekende. Afgebeeld als een onregelmatige zigzaglijn geschreven van links naar rechts paste het elektrocardiogram binnen een nieuwe grafische standaard waarin opeenvolgende bewegingen in de tijd als zigzaglijnen worden afgebeeld. Hoe deze grafische standaard zich heeft ontwikkeld tot een cultureel bepaalde manier om allerlei bewegingen door de tijd heen te beschrijven, waaronder de levensloop, is het onderwerp van dit artikel. Het filmbeeld van het afvlakkende elektrocardiogram op een monitor blijkt het resultaat van de wisselwerking tussen populair-medische opvattingen en de cardiologie als een van de zichtbaarste vormen van medische technologie in de twintigste eeuw.

[electrocardiogram, populaire beelden van de dood, cinema, medische technologie]

The front of a greeting card reads, '*JUST A LINE* to let you know I'm *ALIVE and WELL*.' On the inside an image of a regular and healthy cardiogram is represented to confirm the reader of the correctness of the message (Jaffe 1999: 125). It came as a shock to me to realize that a graphic representation produced by a sophisticated medical technology has been transformed – in such a short period – into a popular icon. For example, since the sixties we have been accustomed to the screen image of a flattening cardiogram on a monitor followed by an alarming beep to signal death and dying. Like a still of a flattening cardiogram is now a self-evident tv-icon accompanying news-items on matters of life and death, especially those concerning euthanasia. An image and sound that are quite different from the traditional stage act of expiring in which an actor struggles in drawing himself up while exclaiming his last words underlined by grotesque gestures.[2]

However, the screen image of a flattening cardiogram does not correspond anymore to the indication of death in the medical profession. By modern medical standards

the loss of brain functions, the so-called brainstem death, signaled by the flattening lines of an encephalogram, defines the professional notion of death (Van Till-d'Aulnis de Bourouill 1984). In the stage of brainstem death the heart still may function, due to artificial resuscitation. From a medical perspective, however, diagnosed brainstem death offers the perfect condition for the retaining of organs of the deceased for donation. So, although the flattening cardiogram is generally interpreted to be the medical definition of death, it is not.[3]

The history of the medical science testifies to shifts in the vital organs linked with the essence of life. Since antiquity air or blood was considered the life bearing force. It was only in the beginning of the seventeenth century that the medical focus shifted to the functioning of the heart. More than two centuries later – to be precise in the fifties of this century – the heart was overruled by the functioning of the brain. However, the popular usage of the screen image of the cardiogram only started in the sixties. Over the centuries popular opinion on vital parts lagged behind the medical opinion, as I will illustrate.

Also, the electro cardiograph invented at the beginning of this century by the Dutch physician Willem Einthoven was not introduced as a modern death-knell. From the very start the cardiograph was designed to make the pulses of the heart visible by graphics. The inventor's attention was concentrated on deviations of the normal pattern. These deviations were quickly interpreted as indications of heart diseases and failures. As a result, cardiology became more or less the art and science of reading and interpreting the graphology of the failing heart (Mannebach 1988; Snellen 1984). Within decades the electrocardiogram evolved from a solely diagnostic technology into a monitoring technology: permanent control of the heart in the intensive care. A development induced by the expanding screen and monitor technology of the fifties. In other words, the icon of the cardiogram is a popular interpretation of the more recent cardio-monitoring technology.

The following is an analysis of the cultural dialectics in the technological development and iconological representation of cardiographics. First, the medical history on vital parts will be described in relation to its concomitant technologies of perception. It will focus on the cultural environment of the sixties in which the monitor-image of the cardiogram was popularized. Secondly, the similarity of images produced by successive medical technologies of perception will be related to a cultural tradition in which not only the contractions of the cardiac muscle but all kinds of motions and even an individual's life course, are written and interpreted from left to right. Therefore cardiographics and writing do have more in common than the greeting card alluded to. Considering the lack of supporting evidence and theory, I do acknowledge that the latter connection is best to be termed speculative. Lastly, I will contemplate on the time-lag in popular and medical opinions not only on vital parts, but also on definitions of life's end and life's beginning.

Life-breath, heartbeat and brain-waves

The word life-breath refers to the ancient tradition of perceiving air to be the carrier of spirits, of *pneuma*. Transported through the veins to the heart, the air was channeled into the *aorta*, a term referring to Hippocrates' conception of the aorta to be a container of air. In conjunction with the heart the spiritus vitalis, the vital spirits, would emerge (Haneveld 1993: 28). The lungs, however, were perceived to cool the heart. This is not so strange a thought, considering the acceleration of respiration in heat or fever. Plato was the first to consider blood to be vital. The blood moved in a high and low tide to and from the heart. However, counting the pulses seemed a frivolous pastime. It was only in the seventeenth century with the publication of the famous treatise on the functioning of the heart *De motu cordis* (1628) written by the English physician William Harvey, when the heart was first described as a pump (Talbott 1970: 92-4). This historic background may explain why in the English language the verb pump refers not only to the sound of the heartbeat,[4] but also to breathing.

By mid seventeenth century the beating of the heart, the pulse, was also registered in musical writing (Haneveld 1991: 247). A visual pattern of peaks of notes that resembles the modern image of an electrocardiogram (plate 1). Although the academic records of cardiology do not refer to musical writing, it seems a very likely source of inspiration, considering the fact that the destined inventor[5] of the electrocardiogram – the Dutch physician Willem Einthoven – experimented at the turn of this century with the so-called phono cardiography (Einthoven et al. 1906). This is a graphical registering of the sound waves of the heartbeat recorded by a microphone (see plate 2). This type of graphical registering became a paradigm in the development of technologies of perception, especially in the field of medicine but not exclusively.

Einthoven's professional fascination for optics and the magical power of electricity culminated in the perfecting of a known electric device – the galvanometer – into a delicate research instrument, which he named the string galvanometer (Snellen 1995: 31-46). The vibrations of the string[6] in an electromagnetic field mirrored the variations of electromagnetic currents produced by the sound waves of the heartbeat. In 1906 he proudly announced that he had been able to produce the first tele-cardiogram by transmitting the cardiac tones of a patient in Leyden hospital by the then recently installed telephone cable to his laboratory at a mile's distance from the hospital (Verslagen 1906: 48-50).

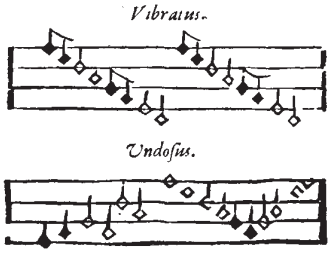

Plate 1

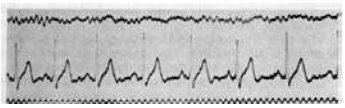

Plate 2

His professional enthusiasm, however, did not concern the graphical representation of cardiac tones as such, but the perfect transmission by telephone cables. In fact, the tele-cardiogram was a technical solution to a practical dilemma. With its total weight of 270 kilograms the string galvanometer and its additional electrical aggregates were not easily transportable to the hospital. Besides, the machinery tended by five operators, requested mechanical stability that was guaranteed in a separate annex built to Einthoven's laboratory. Likewise, the hospital staff's concern for the patients' well-being prevented transport of patients to Einthoven's laboratory.

By conquering these practical obstacles the tele-cardiogram reversed the traditional medical setting of nearness of patient to doctor into a revolutionary distance. Seated in his laboratory Einthoven was even able to predict the occurrence of cardiac disturbances of the hospital patient when reading preluding graphical aberrations. His clinical counterparts closely observing the patient whose cardiac tones were registered, were first baffled and later annoyed when Einthoven was able to inform them – also by telephone – of cardiac disturbances they were going to notice a few minutes later (Snellen 1984: 117). They experienced Einthoven's long-distance, but far more accurate diagnosis as a threat to their hands-on professional judgement. Their animosity not only prevented the installation of the electrical machinery on the hospital's premises, but also resulted in a cutoff of the telephone line connecting the hospital to the laboratory (Einthoven 1906; Mannebach 1988: 4-7; Snellen 1984: 116-7; Snellen 1995: 20-35).

Most of the international professional attention, however, was directed at the phono cardiogram's transmission over a mile's distance and the possibilities of the string galvanometer, that seemed very promising indeed.[7] The instrument's sensitivity in detecting minimal electrical activity inspired Einthoven to design the precursor of the modern electrocardiogram, which visualized the electrical currents generated by the successive contractions of the cardiac muscle. As the electric currents proved to spread evenly through the body's tissue, Einthoven gauged these minimal electric activities on the skin of the body's extremities. To assure an optimal receipt of the currents both arms or legs had to rest in extremely salty water, being the best conductor of electric activity. A photograph of a hospital patient with both arms in large bottles of salty water showed to the professional public in 1906 how the electrical currents were transmitted by wires to the string galvanometer in Einthoven's laboratory (plate 3).

Although the resulting graphical pattern of the cardiac muscle differed from the phonocardiogram, it was produced by the same instrument. The minimal vibrations of the vertical string in the galvanometer were first enlarged by microscopes and subsequently projected on photosensitive paper in a horizontal movement from the left to the right. This canted projection was Einthoven's willful translation of the string's vibrations into an imitation of a writing movement.

Einthoven excelled in the diagnostic interpretation of the two types of heart writing produced by the phonocardiogram and the electrocardiogram. He also immediately grasped the possibilities of the electrocardiograph in monitoring patients under surgery, but he was realistic when noting, 'in the future when the string galvanometer will be more common'(Mannebach 1988: 7). It was only in 1924 that his massive contribution to medicine was acknowledged and awarded the Nobel Prize.

Plate 3

In a speech in 1906 Einthoven referred to the significance of the new field of electro physiology to medicine, of which electrocardiography was just one promising possibility (Snellen 1995: 45). The registration of the brains' electric activity, however, awaited a better way of conducting the electric currents. In 1926 the German physician Hans Berger made the first human electroencephalogram by inserting needle-electrodes in the skin of the patient's skull (Gloor 1969: 7, 59). Its recording principle was based on the same string galvanometer, now writing brain-waves. However, the first attempts showed only one brain-wave in combination with a cardiogram and a zigzag line indicating the time in tenths of seconds. The development – in the fifties – of electrodes glued to the skin of the skull by salty jelly meant a virtual breakthrough, especially for the painless registering of the multiple graphics of an electroencephalogram.

From the very beginning of electrocardiography there have been numerous attempts in sizing the machinery down to manageable proportions (Mannebach 1988: 49). First the large bottles of salty water were replaced by electrodes glued to the chest. Only in the sixties the portable monitor writing the cardiogram on a screen came into medical practice.[8] The screen image of the cardiogram was soon to be popularized by tv-recordings of the electrocardiograms of American astronauts. Like the professional

amazement with the first telecardiogram at the beginning of the century the popular amazement with the tv-recordings had more to do with the distance (Mannebach 1988: 60-1). The sixties were crucial years regarding cardiology. The announcement in 1967 of the first heart transplant by the South-African surgeon Christian Barnard shocked the world (Mannebach 1988: 127-37). Tv-images of a patient surrounded by monitoring devices, were broadcasted all over the world. It initiated a worldwide media competition among heart surgeons. Being the popular heroes of the times, heart surgeons outdid each other in accomplishments.

Strange as it may be, but since then we have grown accustomed to a clinical situation in which a monitor registering the cardiogram is directly positioned at the patient's bedside. A situation resembling the most traditional medical setting of nearness, although the monitoring doctor is replaced by a monitoring technology within reach. Nowadays only patients with rare genetic cardiac defects are equipped with portable devices transmitting their cardiograms to the hospital for computer surveillance. In diagnosing ability the computer has outstripped the cardiologist. Although the diagnostic prospects of the electrocardiography are superb and its application much cheaper in combination with computer analysis, it is more and more abandoned. According to Weller who reviewed Einthoven's accomplishments in the field of cardiology, today's cardiologists prefer not only more advanced, but also more expensive and unfortunately more painful, intra vascular technologies (Mannebach 1988: 48).

Graphology: handwriting, heart writing and the ups and downs of life

When concentrating on the images these successive medical technologies of perceptions have produced, there are remarkable similarities to account for. For instance the image produced by the phono cardiogram and the seventeenth-century musical writing of the heartbeat have more in common than their peaks. It was not only the conversion of sound, the heartbeat, into an image, but also of sound into writing and reading. Like musical writing, the first electrically transmitted phono cardiogram was codified according to the writing of lines, written from left to right. Again a translation of sound, i.e. the human heartbeat, into musical writing was done before, but it also set a graphic standard for subsequent translations of movements, i.e. the successive contractions of the cardiac muscle, into the same type of writing.

In a correspondence with Samojloff, a Russian colleague of Einthoven, both proved to be very much aware of the writing parallel. When Samojloff congratulated Einthoven on his achievements in perfecting the string galvanometer he asked to read his congratulations aloud to his miraculous writing instrument, 'since it can write, but can't read'. Einthoven responded, 'I have carried out ... your request and read to the galvanometer your letter.' Apparently he listened and took in with pleasure and joy, 'all that you wrote ... but ... were you said that he does not know how to read' .... he cried: 'What, I can't read? It is a terrible lie. Do I not read all the secrets of the heart? I calmed him and advised him ... to work and toil as much as he could for the benefit of humanity and not to think of gratitude' (Snellen 1995: 102).

Since Einthoven's electrocardiogram we have grown accustomed to a translation of all kinds of movements and activities into writing, like economic movements into graphics, earth movements into seismograms, and cerebral activity into encephalograms. However, it is important to realize that neither the earth nor the heart, neither the economy nor the brain moves horizontally, from left to right in an up-and-down movement, but that it has become a culturally ingrained way of perceiving successive motions through time. Like a separate, zigzag time-line writing the seconds was Berger's way to stress the relation of the brains' activities to clock time. All these different types of graphics have been appraised not only for their combination of synchronic and diachronic reading, but also and more so for their predictive merits. Like Einthoven predicted a coming heart failure from reading a patient's electrocardiogram, neurologists predicted coming epileptic attacks by reading encephalograms, in the same way as seismologists were able to announce earth quakes by reading seismo- grams and economists tried to predict short or long-term crises from reading their graphics.

At the turn of the century when Einthoven developed his writing galvanometer graphology was a settling psychological discipline. In graphology handwritings are analysed for its personality characteristics. Handwriting being the result of the writing movement itself, became interpreted as a mediation of movements of a personality or soul, expressing a person's motives in life.[9] Till the sixties graphologic research has been a powerful instrument in psychological tests and especially in judging applicants' ability for a job by interpreting their handwritten letters of application. Apart from its tradition in company psychology, graphology was also practised as a diagnostic instrument in medicine. Sudden deteriorations of handwriting, especially of children, were interpreted as announcements of physical or mental illness soon to be revealed (Van Neer 1968: 288-90).

Interpreting handwriting to be the movement of the soul, is similar to reading the heart writing of an electrocardiogram to be the movements of the heart.[10] To speculate whether Einthoven got the inspiration for his writing galvanometer from musical writing, or from graphology, is irrelevant. Einthoven's technical inspiration was part of a cultural and intellectual tendency in which all kinds of movements – be it the cardiac muscle, the brains' activities, the tremors of the earth or the economy's well-being – came to be transposed in types of writings: up and down, from the left to the right. However, Einthoven certainly deserves the credits of being a forerunner.

The movement of life itself, its course written from the left to the right – from birth to death – was already a popular cultural image in seventeenth-century Holland.[11] These prints were called 'Steps of Age: Man's Rise and Decline – Sweet for One, Frightening for the Other' (Spruit 1986: 6). One reached the top of the steps at the age of fifty. After decline one found death at the age of one hundred. In view of seventeenth-century life-expectancies reaching an old age of a hundred years seems far too optimistic. The steps' constructed and most unrealistic symmetry is puzzling. Still, an important cultural image of life's course was created: a fresh start at the left, reaching only one peak in life at fifty and a drooping end of life at the very right.

Modern biographies, on the contrary, being descriptions of an individual's course of life, are often constructed according to the graphological tradition of the turn of the

century: the prediction of coming disturbances from reading early signs. Like an imbalanced youth in hindsight always seems to predict and explain peculiarities and failed marriages in later life. However, to refer to life's vicissitudes as its ups and downs seem to be a modern platitude mirroring the writings of a cardiogram.

Splitted images: life-breath and heartbeat

Although medical science since the late seventeenth-century recognized the pumping heart to be vital, popular opinion sticked to the classical life-breath and the more controllable function of breathing. For example, holding a mirror or a feather in front of the deceased's mouth was a common method to determine death. According to popular notions, even a weak breath would dim the mirror's glass or move the feather. Notorious failures of these methods in the cholera-epidemics of the nineteenth century caused a mass hysteria: the fear to be buried alive (Van den Bent 1983; Van der Berg 1965: 142-64; Spruit 1986: 100-5).

Precautions were taken, like the creation of special waiting rooms on graveyards where open coffins with the apparently dead could be watched for signs of revival or indeed decay. Since then, not only medical discussion, but also popular confusion on the instant of death mounted. As a result the public was more lenient to professional judgment. At the end of the nineteenth-century doctor's stethoscope became an accepted method for final control of cardiac arrest, being the new definition of death.

Life-breath, not withstanding the changing popular views on the vital parts since the nineteenth century, still dominates the act of expiring on stage. We are used to the act of someone struggling for breath to get his or her last message delivered to the world. Not only on stage but also in the traditional western movie it is still a familiar, yet grotesque portrayal of dying. Today, our uneasy feelings in viewing these expiring acts illustrate Ariès' categorization of our modern attitude to death, which he called the forbidden death (1976). The screen-image of a flattening cardiogram followed by an alarming beep is indeed a more instrumental and detached portrayal of dying.

In accordance with the traditional stress on life-breath, also the deceased's last words have long been treasured as important messages for the living. For example, in my history class of the sixties we had to learn famous last words by heart. According to our history book the patriotic Dutch prince of Orange groaned " Ayez pitié de moi, et de mon pauvre peuple" when he was shot by a sniper on the stairs of his Delft residence in 1584.[12] Nearly four hundred years later we had to memorize these words as an important message, illustrating the prince's compassion with the sufferings of the Dutch people under Spanish rule. Last words and patriotism proved to be fatal allies in Dutch national history, like the case of the nineteenth-century Dutch naval commander Van Speyk who refused to surrender to the Belgians, and chose to die in the explosion of his ship. His patriotic last words "I rather vanish into air," have been ridiculed since the sixties.[13]

However, in contrast to the traditional stress on life-breath in history schoolbooks, some science-fiction films of the late fifties juggled with advanced medical technologies and the latest medical definition of death. A movie like *The brain that wouldn't die*

(1959) hinted at the ultimate consequences of the medical definition of brain death by keeping a severed head alive.[14] In the sixties, according to film experts, the hospital became a favourite setting for film and tv-series, in which doctors figured as heroes in white armour on the battlefields of death and disease (Armstrong & Armstrong 1990: 174-5). A period, however, that parallels not only the triumphs of cardiac surgery and spectacular heart transplants, but also the popularization of monitor electrocardiography.

Topic and title of a more recent science-fiction movie *Flatliners* (1990) even presupposes some public acquaintance of cardiographics and its medical purposes. For a flatliner refers to the flattening line of an electrocardiogram and signals cardiac arrest. Without immediate reanimation the patient will surely die. The film is about five medical students who are intrigued by near-death experiences. By experimenting on themselves these students enforce on each other a temporary cardiac arrest. The enforced pause in their heart writings seems to be a metaphor for enforced reflection on their life histories and goals in life (De Vos 1990).

There is not only a time-lag in the public's acceptance of medical definitions of the vital part, but – as a consequence – also in the acceptance of the medical definition of life's end and life's beginning. When the cinematographic link between life's end and a monitor image of a flatliner in combination with an alarming beep was established, it gradually turned into an accepted icon of death and dying. Although the flatliner does not reflect the latest medical determination of life's end, it is more updated than the cinematographic portrayal of life's beginning. The sound of the first life-breath – the screaming of the new-born – still announces birth on stage and screen alike. Even though in real life the first moving contact between parents and their unborn child has been – since decades – the amplified sound of the heartbeat by a doctor's stethoscope, there is no counter image created of a cardiogram taking off.

Another medical technology of perception, ultrasound, is a more likely candidate to produce the popular icon of life's beginning. A birth announcement card received a few years ago reads, 'All of a sudden you were there. We were thrilled when hearing the boom-mity-boom of your little heart and seeing you wave "Here I am" on the sonagram.'[15] Since more than a decade the use of the medical technology of ultrasound for imaging the unborn in early pregnancy has become very popular with parents to be. No baby album seems to be complete without a sonagram photo (Petchesky 1987: 66). Therefore the most likely popular icon to represent the start of a new life will be a sonagram photo of the unborn. However, neither the unborn's sonagram, nor the monitor image of the unborn's cardiogram represents the latest medical definition of life: fully developed brains.

When relating the successive medical opinions on vital parts and its concurrent technologies of perception to the popular imagery, the time-lag is obvious. Today only the expiring acts in classical plays or in traditional western movies remind us of the ancient notion of vital spirits in its stress on life-breath and last words. It lasted more than three centuries before the heart and its pulses became more generally viewed to be the vital pump. Not surprisingly this century witnesses an ever increasing popular attention to the heart and its beat, mirrored not only in the icon of the cardiogram, but also and more so in the lyrics of pop songs. In the mean time medical definition has shifted

to the functioning of the brains. Perhaps – in due course – the image of a multi-lined encephalogram will replace the one-lined icon of a cardiogram. A multi-lined encephalogram might even reflect more adequately our post-modern idea of man's multiple identities.

Conclusion

In an analysis of the cultural dialectics between the medical and the popular domain the focus has been on the popularisation of the cardiogram. Born from an intriguing mix of popular medical images and advanced technological developments the cardiogram revolutionized not only the portrayal of death and dying on screen, but also our perception of life's course. Medical practice in its turn was greatly influenced by the media attention on heart transplants culminating in a rat-race amongst cardiac surgeons. Their media competition established not only the predominance of the heart in popular perception, but – as a consequence – also its medical image: the cardiogram.

By that time the encephalogram, the graphics of cerebral activities, had overruled the cardiogram in the medical determination of life and death. Not the heart, but the brains became the new medical standard of the vital part. This century the primordial time-lag between popular acceptance of the latest medical definition of the vital parts undoubtedly has shrunken. The acceleration of cultural dialectics is due not only to the enhanced communication in the electronic media, but also to the phantasmal speculations in science fiction movies on the consequences of the latest medical definition of life and death.

Notes

Irene Cieraad (1952), email: i.cieraad@chello.nl, is a cultural anthropologist and author of *De elitaire verbeelding van volk en massa. Een studie over cultuur* (1988, 1997 second edition) on the concept of popular culture in the history of cultural theory and modern western thought. More recently she developed a keen interest in material culture studies and technology studies. Syracuse University Press, New York, published her volume *At Home: An Anthropology of Domestic Space* (1999). Currently she is engaged in a NWO-research project on twentieth-century technological developments in the Netherlands. She also has a teaching post at the faculty of Architecture of Delft University on the topic of urban and domestic cultures in transformation.

1 This article is a revised version of a paper presented in the seminar on 'Technologies of perception' of the ASCA-conference 'Come to Your Senses' (Amsterdam, May 1998).

2 A protocol that reminds of the medieval *ars moriendi*, the so-called craft of dying in which the dying beseeched his place in heaven by exclaiming a fixed sequence of prayers and formulas (Beaty 1970).

3 In Ariès' (1976) categorization the medical refracturing of death and the process of dying are typical of the forbidden death.

4 Van der Berg (1965: 32-33) refers to the disbelief of Harvey's contemporary, the Italian scholar Parisano who insisted that 'nobody in Venice ever heard a heart pump'. Soley the sound of the heartbeat, however, initiated Harvey's visualization of the heart as a pumping organ, for the living body was not to be surgically opened yet.

5 There is always some irony in the title 'destined inventor' for there were several earlier attempts by others, like for instance the English physician August Waller who registered electrocardiograms of animals (see also Snellen 1984: 53-74).

6 The string was ingeniously made of a very thin filament of quartz, a sort of glass fiber, coated with silver.

7 In co-operation with his son, a technical engineer, Einthoven ventured on using the string galvanometer in direct radio transmission to the Dutch colonies in the East Indies. A likely profitable undertaking during the first World War when the Netherlands remained neutral and radio contact with the East Indies was established by amplifiers across the world. However, Marconi won the race in establishing direct, long-distance radio contact (See Snellen 1995: 49-51; 73-5).

8 Already in 1937 Wilson experimented with the cathode-ray oscilloscope, the precursor of the monitor (Burgh, 1961).

9 The German philosopher Ludwig Klages (1872-1956) developed the philosophy of graphology and its relation to personality (Elseviers 1960: 91-2, 127).

10 The German Mannebach (1988) also speaks of *Herzschrift*, literally meaning 'heart writing'.

11 See for example the engraving by C.J. Visscher (1586-1652).

12 Translation: 'God do have mercy on me and my poor people'.

13 In Dutch: 'Dan liever de lucht in'.

14 Also in an earlier movie *Donovan's brain* (1953) there is reference to the related topic of keeping just the vital brains alive for scientific research (Hardy 1995: 137-8, 187).

15 Birth announcement of Lucas Sven Berendsen, born 27th of February 1999.

References

Ariès, Philippe
1976 *Western attitudes toward death: From the Middle Ages to the present.* London: Marion Boyars.

Armstrong, Richard B. & Mary Willems Armstrong
1990 *The movie list book: A reference guide to film themes, settings and series.* London: McFarlane.

Beaty, Nancy Lee
1970 *The craft of dying: A study in the literary tradition of the ars moriendi in England.* New Haven: Yale University Press.

Burgh, G.E.
1961 Development in clinical Electrocardiography since Einthoven. *Nederlands Tijdschrift voor Geneeskunde* 105, II (32): 1594-1610.

De Vos, Eric E.
1990 Over de streep. *Skoop*, Special Issue *Flatliners*, pp. 1-10.

Einthoven, W., A. Flohil & P.J.T.A. Battaerd
1906 Het registreeren van menschelijke hartstonen met den snaargalvanometer, *Nederlandsch Tijdschrift voor Geneeskunde* 1906, part II (12): 818-26.
Elseviers
1960 *Elseviers kleine filosofische en psychologische encyclopedie*. Amsterdam: Elsevier.
Gloor, Pierre (ed.)
1969 *Hans Berger on the Electroencephalogram of man: The fourteen original reports on the Human Electroencephalogram.* Amsterdam: Elsevier.
Haneveld, G.T.
1991 *Het mirakel van het hart.* Baarn: Ambo.
1993 *Uit het hart gegrepen: Verhalen, gezegdes en gebruiken rond het hart.* Utrecht: Kosmos-Z&K Uitgevers.
Hardy, Phil (ed.)
1995 *Science fiction: The Aurum film encyclopedia.* London: Aurum Press.
Jaffe, Alexandra
1999 Packaged sentiments: The social meanings of greeting cards. *Journal of Material Culture* 4 (2): 115-41.
Mannebach, Hermann
1988 *Hundert Jahre Herzgeschichte: Entwicklung der Kardiologie 1887-1987.* Berlin: Springer Verlag.
Petchesky, Rosalind Pollack
1987 Foetal images: The power of visual culture in the politics of reproduction. In: M. Stanworth (ed.), *Reproductive technologies: Gender, motherhood and medicine.* London: Polity Press, pp. 57-80.
Snellen, H.A.
1984 *History of cardiology: A brief outline of the 350 years' prelude to an explosive growth.* Rotterdam: Donker Academic Publications.
1995 *Willem Einthoven (1860-1927): Father of electrocardiography. Life and work, ancestors and contemporaries.* Dordrecht: Kluwer Academic Publishers.
Spruit, Ruud
1986 *De dood onder ogen. Een cultuurgeschiedenis van sterven, begraven, cremeren en rouw.* Houten: De Haan.
Talbott, John H.
1970 *A biograpical history of medicine: Excerpts and essays on the men and their work.* New York: Grune & Stratton.
Van den Bent, M.J.
1983 Schijndood: een curiositeit? *Nederlands Tijdschrift voor Geneeskunde* 127 (50): 2301-04.
Van den Berg, J.H.
1965 *Het menselijk lichaam: Een metabletisch onderzoek.* Nijkerk: Uitgeverij G.F. Callenbach.
Van Neer, R.
1968 *Inleiding tot de psychologie.* 's Hertogenbosch: L.C.G. Malmberg.
Van Till-d'Aulnis de Bourouill, H.A.H.
1984 *Doodgaan, wat is dat? Hartdood, klinisch dood, schijndood, hersendood.* Utrecht: Bohn, Scheltema & Holkema.