Mediaa kokemassa: koosteita ja ylityksiä

Experiencing the Media: Assemblages and Cross-overs

Toimittajat // Editors

Tanja Sihvonen & Pasi Väliaho

Mediatutkimus // Media Studies 2003

Erkki Huhtamo

Mr. Duchamp's Playtoy

or Reflections on Marcel Duchamp's Relationship to Optical Science[1]

> *Don't speak about it yet, although you may mention that I am doing a playtoy. I intend to put it on the market.*
> – Marcel Duchamp to Katherine Dreier, Spring 1935

Avantgarde artists of the 20th century often referred to devices known as "pre-cinematic" in their works.[2] Max Ernst recycled late 19th century printed images of the zoetrope or Étienne-Jules Marey's "Station physiologique" (claimed to be the world's first "film studio") in his dreamlike collages. Joseph Cornell created boxes of thaumatrope discs, characterizing them as "surrealist toys".[3] Frederick Kiesler applied the idea of the peepshow box both in his theatrical stage sets and in his exhibition designs.[4] Oscar Fischinger made abstract animations for the Mutoscope, a hand cranked peepshow viewer. Several artists (including Fischinger) created coloured light projections that derived from the magic lantern show, and particularly one of its highlights – the abstract moving chromatrope lantern slides, also known as "artificial fireworks".[5] The recurrence of such re-enactments is not a coincidence. It was part of the avantgarde's lively interest in obsolete artefacts and popular culture of the past. Although a break with the past has been considered an important element in the ideology of modernism, it was never as definite as was earlier believed. The main targets of the modernist reaction were the traditions and the aesthetic canon of Western academic art and its institutions. For movements like Dadaism and surrealism popular magazine illustrations, everyday objects and "low" culture were sources of inspiration that could be evoked in the fight against bourgeois eliticism and conservative taste. Kirk Varnedoe's and Adam Gopnik's *High and Low* gives us a detailed overview about the extent of this process.[6]

Certainly, the references to optical persistence of vision devices and other "philosophical toys" were often just occasional markers and playful reminiscences, one motive among many. They could, however, also lead to actual experimentation with visual technology, anticipating later forms of media cultural

production. In this respect no-one went further than Marcel Duchamp, whose reputation as one of the most influential artists of the 20th century has been constantly growing. Optical experimentation with the physiology of vision was an important ingredient of Duchamp's art-making process from his early paintings *Sad Young Man on a Train* (1911) and *Nude Descending a Staircase* (1912), all the way to his final chef d'oeuvre *Etant donnés* (1945–1966) and his last work, *The Anaglyphic Chimney* (1968), a hand-made stereoscopic slide to be viewed with 3-D glasses, created just one month before Duchamp's death.[7] During the intervening decades Duchamp created numerous works that explored issues now considered crucial to (audio)visual media culture. These include the nature of perception, optical illusions, interactivity and tactility, the relationship between the viewer and the viewed, the formation of the self, and the processes of immaterialisation and commodification of cultural production. Duchamp's involvement with optics provides a vantage point to observe the ways in which ideas about optical phenomena migrate from one context to another and are transformed and re-defined in the process. Although his highly idiosyncratic trajectory cannot be generalized, it may still give us clues about the internal logic of audiovisuality, including the relationship between "old" and "new" forms of moving images.

In this chapter I will provide a reading of Duchamp's involvement with moving image technology and optical science, relating it to the "real" field of the physiology of vision. I will first sketch the background of Duchamp's interest in optics. For the sake of brevity, I will pass the relationship between his early paintings like *Nude Descending a Staircase* and chronophotography, which is well known and adequately researched.[8] I will begin by dealing with *The Bicycle Wheel* (1913), Duchamp's first readymade, analyzing the optical issues it raises. The main section of the chapter consists of an analysis of the stages of Duchamp's Precision Optics "project", a series of optical experiments conducted during a period of seventeen years from 1918 to 1935. This "project" will be interpreted as an extended role-playing performance, with Duchamp enacting the role of an optical scientist, or (in his own words) a "precision oculist". This coincides with the activities of another of Duchamp's alter egos: Rrose Sélavy. I will review Duchamp's career as a precision oculist by relating it with that of a real-life optical scientist, the Belgian Joseph Plateau (1801–1883), the inventor of the Anorthoscope and the Phenakistiscope, among other things. This gives me an opportunity to compare Duchamp's involvement with optics with the experiments and discoveries that Plateau and fellow scientists made in issues like persistence of vision and stereoscopy. Although Plateau may not have been Duchamp's actual role model, he might well have been. After analysing the Precision Optics "project", I will situate Duchamp's experiments within the fabric of the 20th century (audio)visual culture.

From "Retinal Painting" to "Gray Matter"

Duchamp began his career as a painter. Why did he suddenly abandon painting already in the 1910s? According to the most common explanation, this happened as a reaction to the rejection of his painting *The Nude Descending a Staircase* (1912) by the hanging committee of the Salon des Indépendents exhibition in Paris. Obviously the objection towards the painting, influenced by cubism as well as the serial photographic experiments of the "chronophotographers", had to do with its strong evocation of movement, a feature that according to the cubist-oriented committee associated it too clearly with Italian Futurism.[9] Be it how it may, Duchamp soon became involved with selecting everyday objects and exhibiting them as "readymades". This, as well as his optical and pseudo-scientific "research", effectively served to distance him from the established art world and its values. As the elaborate schemes and diagrams for his early chef d'oeuvre *The Bride Stripped Bare by Her Bachelors, Even or The Large Glass* (1915–23) demonstrate, engineers and scientists, rather than artists, now provided Duchamp with role models. He began to emphasize issues like objectivity, order, detachment and indifference, opposed to the romantic notion of the intuitive and emotional artist. As Francis M. Naumann has observed, it is significant that Duchamp chose to concentrate on issues like perspective and optics – basic elements of visual art – without even meaning to apply them to painting. Duchamp launched a critique of "retinal painting", with impressionism as one of his main targets. As he explained, "[s]ince the advent of impressionism visual productions stop at the retina. Impressionism, fauvism, cubism, abstraction, it's always a matter of retinal painting. Their physical preoccupations: the reactions of colors, etc., put the reactions of the gray matter in the background."[10]

In his effort to bring the "gray matter" back to the center of creativity, Duchamp developed a position that was in harmony with the theories around the physiology of vision, formulated since the early 19th century. These theories, exhaustively analyzed by Jonathan Crary, emphasized the active role of the human body in the formation of the impression of external reality.[11] Our perceptual apparatus does not mirror reality truthfully; out of the visual impulses entering the retina (or even produced independently within the body) our central nervous system creates an image that is a dynamic melange of the external and the internal, stimuli and responses. In the 19th century this discrepancy was demonstrated by numerous optical instruments, bearing names such as the thaumatrope, the anorthoscope, the phenakistiscope and the stereoscope.[12] In their own ways all these instruments achieved a transformation of the "raw" visual data when observed in use. The thaumatrope, for example, was a simple cardboard disc with two cotton strings. When spun between fingers, the images drawn on both sides of the disc merged together.[13] The phenakistiscope was a disc with the stages of a motion sequence drawn along its perimeter. When held against a mirror and observed in rotation from the backside through slots cut along the edge of the disc, an animation loop was created. With the stereoscope two photographs shot from slightly different angles could be made to merge in the user's mind, producing an illusion of depth.

Against this background, there is some irony in Duchamp's choice of the concept "retinal painting". For Duchamp, arresting the visual impulse on the retina effectively denied the possibility of painting as a truly cerebral activity. Retinal paintings provided impressions and surface effects, instead of forcing the mind of the observer to interfere actively and penetrate beyond the apparent. In the 19th century physiological theory, on the other hand, the belief that the image of the outside world was momentarily arrested on the retina provided the basis for the model of active spectatorship. As has frequently been pointed out, theoretically the development of the moving image was based on this erroneous conception. Duchamp's insistence on the need to go beyond the retina reflects the correction of the theory of the persistence of vision by Max Wertheimer in 1912.[14] As Wertheimer pointed out in his explanation of the phi-phenomenon, nothing ever stops on the retina; everything depends on the receptive and interpretative faculty of the brain. It is the slowness of the human brain in analysing subsequent visual impulses that makes the illusion of the moving image possible. Against this background the concept "retinal painting" should be seen as a metaphor rather than as a physiological statement.

Duchamp's preoccupation with re-integrating the "gray matter" with the creation and perception of visual artefacts is a complex issue that cannot be exhaustively dealt with here. As Linda Dalrymple Henderson's massive study about Duchamp's scientific influences has shown, his ideas came from many directions, and were by no means limited to physiological theories.[15] Still, optical experiments provided Duchamp – perhaps his intensive involvement with chess notwithstanding – with his most long-term conceptual occupation. As has already been mentioned, chronophotography, in itself an offspring of physiological science, was a direct influence on paintings like *Sad Young Man on a Train* (1911) and *The Nude Descending a Staircase* (1912).[16] Technically chronophotography had been made possible by the invention of instantaneous photography in the 1870s. Either by series of synchronized cameras or by special multiple exposure cameras chronophotographers like Muybridge, Marey, Anschütz and Londe froze the motions of humans and animals (and sometimes even inanimate entities like balls) in series of successive (or superimposed) instantaneous shots. Craig Adcock has argued that the influence of the idea of the *instantané* (snap-shot) is not only limited to its impact on Duchamp's early paintings. It characterizes even his invention of the readymade around 1913.[17] Just like instantaneous photographs, the readymades can according to Adcock be treated as frozen "events", insulated from their original spatial-temporal continuums.

The Bicycle Wheel (1913) as an Optical "Instrument"

Among the early readymades (those made before the invention of the word "readymade", coined by Duchamp around 1916) there is one which merits particular attention: *The Bicycle Wheel* (1913). By attaching the front fork and the rim of a bicycle wheel upright on a wooden stool Duchamp came to realize an artefact that has attracted many interpretations, some of them associated with optics and kinetics. This is understandable, because in a way that differs from all the other readymades *The Bicycle Wheel* combined a static object (the stool) and an actual mobile element (the wheel). Some evidence suggests that Duchamp may not have had any intellectual second thoughts when assembling this object (his very first readymade), although he much later told an interviewer that it was a "gadget" he enjoyed watching in motion, "like a fire in the fireplace."[18] The fact that the wheel could be manually set in motion led Jack Burnham to identify The Bicycle Wheel in his classic *Beyond Modern Sculpture* (1968) as "the first use of a working mechanical principle" in an artwork. He saw this work as a predecessor to kinetic art because of the "virtual volume" created by the spokes of the wheel in motion.[19] Burnham also remarked that the work creates an ambiguous perceptual situation. The viewer simultaneously looks at and looks through, a situation Duchamp actually investigated in many later works, including *The Large Glass* (not mentioned by Burnham in this context) and his *Mile of String* design for the First Papers of Surrealism exhibition in 1942.[20]

Although Duchamp may not have considered *The Bicycle Wheel* primarily as an optical experiment, it is important to note that observing the spokes of wheels in motion had already been used by early 19th century optical scientists as an instance of the discrepancy between the outside events and "retinal activity". The example was already mentioned in Peter Mark Roget's seminal paper read at the Royal Society in London in 1824.[21] A few years later, Joseph Plateau evoked the same example in his Ph.D. dissertation when explaining the straightening of curved lines achieved by the Anorthoscope, a demonstration instrument he had designed.[22] Of course one has to ask how aware Duchamp could have been of these scientific theories at this early stage in his career. Naumann suggests that the absence of the tyre from the rim would have been meant to encourage the viewer to focus on the turning mechanism of the wheel displayed as if in an exhibition of the latest bicycle technology. Varnedoe and Gopnik have proposed bicycle store window displays and wheel jacks for repairing tyres as possible influences.[23] In any case the arrangement of the two everyday objects that make up the work effectively effaces their normal uses and functions. The position of the front fork makes it impossible to sit on the stool. Likewise, the placement of the bicycle wheel obliterates its practical function, transportation. Instead of serving linear movement from place to place along a street, its original "pure" cyclical rotation becomes the center of attention.

Although Duchamp may have initially used the principle of aesthetic indifference, as he often claimed, as the criterion for selecting the readymades, it is interesting to note that in 1921 he turned to the bicycle wheel again, using it this time as a support for optical experimentation. He attached hand-drawn

discs with abstract circles to a spinning bicycle wheel and filmed them with his own film camera.[24] By this time Duchamp was already deeply involved in optical research. In subsequent experiments he replaced the bicycle wheel as a support by the gramophone turntable or by custom made motorized plates. Thus the integration of *The Bicycle Wheel* to the Precision Optics "project" remained incidental. In retrospect, however, certain qualities of *The Bicycle Wheel* have gained in importance. Although it is not known whether Duchamp himself ever encouraged the audience to touch the wheel and rotate it, the layout of the work at least potentially invites one to do so.[25] The possibility of manually rotating the wheel and controlling its speed makes the work practically a prototype for tactile interfaces, hands-on displays and interactive media art. Interestingly, the same haptic possibilities had been offered by the hand-operated 19th century persistence of vision devices. Having barely been introduced in scientific circles, they were often rapidly put on the market by their inventors and publishers. Rotating a phenakistiscope disc attached to its handle was in principle a similar tactile experience than putting Duchamp's *Bicycle Wheel* in motion. The differences had to do with the context – a crucial issue in the case of the readymade – and with the fact that when playing with the phenakistiscope the optical illusion was without a question the central issue. In the case of *The Bicycle Wheel* it was not.

The First Explorations of the Precision Oculist

Duchamp created his first works that explicitly explored optics while staying in Buenos Aires in 1918–1919. The first one of these bore the enigmatic title *To Be Looked at (From the Other Side of the Glass) with One Eye, Close to, for Almost an Hour*. It was followed by a small "rectified readymade" titled *Handmade Stereopticon Slide* (1918–19). In a sense both of these works can be considered studies for Duchamp's main work-in-progress, *The Large Glass*, but they are also interesting in their own right. The former is a study for the detail of *The Large Glass* known as the "Oculist Witnesses" (témoins oculists). It is a glass pane with diagrammatically presented shapes (a pyramid, an obelisk, rays in the shape of a fan) and a magnifying lens (a kind of peephole) embedded in the glass surface. The "viewing instructions" of the title are inscribed on a beam that crosses the glass pane almost horizontally. The work can be seen as an exercise in seeing conceptually, evoking an optician's "eye chart" (in French: *témoin oculiste*).[26] This is emphasized also by the "prescriptive" title. Staring at the various shapes inscribed on the glass according to precise perspectival calculations, will purportedly transport the (patient) observer to a realm beyond pure retinal sensations.

The Handmade Stereopticon Slide explores related issues. Duchamp bought a stereoscopic card depicting an aesthetically unremarkable view of an open sea. On the pair of images, Duchamp drew in pencil a pair of geometrical rhomboid forms. When seen with a stereoscope the three-dimensional rhomboid seems to be floating in the air (without any clear depth cues the sea itself produces

a very poor 3-D effect, which must have amused Duchamp).[27] In both works Duchamp raised the issue of simultaneously looking at and looking through, creating three-dimensional shapes that seem virtual and immaterial.[28] The most basic difference was that *To Be Looked At* emphasizes monocular vision ("with One Eye"), while *The Handmade Stereopticon Slide* deals with stereoscopic vision. The tension between the perception of depth by one eye vs. by both eyes manifested itself frequently in the context of the later works within the Precision Optics "project". Interpreted in the light of Jonathan Crary's well known ideas about the shifts in the area of the visible in the 19th century, one might claim that Duchamp was engaged in a kind of border play at the gray zone between two different visual regimes. This play does not, however, seem to correspond with Crary's idea of the historical transition from the monocular camera obscura model to the binocular stereoscopic model. In both monocular and binocular forms Duchamp's explorations seem to be firmly anchored to the body as the ultimate observer and producer of the vision.

Although often considered ephemeral in Duchamp's production, *The Handmade Stereopticon Slide* is highly interesting when assessed in relation to the history of stereoscopy. With his work Duchamp in a sense reversed the historical trajectory of stereoscopy, returning to its scientific beginnings. During the 19th century, stereoscopy had undergone a change in its cultural and ontological status.[29] Its basic principle was first demonstrated in the 1830s by Charles Wheatstone. The stereoscope was meant as another "philosophical instrument" to demonstrate the active role of human perceptual apparatus in creating the picture of external reality. After it had been commercialized in the early 1850s, it soon became a very successful instrument for producing and maintaining optical illusions. By its supporters the stereoscope was often claimed to lead the viewer into a kind of out-of-body experience. Instead of anchoring the perception firmly in the human body, "the perceiving mind" was felt to leave the body. In Duchamp's rectified readymade the later illusionary stereoscopy (represented by the found stereocard) provides just a background for the reappearance of Wheatstone's rhomboidical ghost. One should not forget that Wheatstone originally demonstrated his invention with pairs of hand-drawn three-dimensional shapes and not with photography which was not yet available. If stereoscopy had (in a metaphorical sense) increasingly become a pleasure for the "retina", Duchamp's work brought it back to its cerebral origins.

Experiments with Rotating Discs

After returning from Latin America to New York in January 1920 Duchamp continued his optical experiments with his friend Man Ray. The result of the collaboration was the first of Duchamp's optical machines, Rotating Glass Plates (Precision Optics) (1920). Five planes of glass strips with curved stripes were attached one behind the other on an axis which could be rotated by a motor. When the spinning glass strips were observed from the front, an illusion of a round virtual still image was produced. Another effect was the disappearance of

depth. Accordingly, the observer would see the illusion of a static, two-dimensional flat disc with concentric circles. Some years later, this time in Paris, Duchamp managed to build another, more sophisticated optical machine known as Rotary Demisphere (Precision Optics) (1925). Some years earlier Duchamp had began to experiment with abstract animated hand-drawn discs with (de)concentric circles.[30] Rotary Demisphere was engineered and built from "bottom up", although using some pre-existing elements. Considering the effects it produced, this machine could be characterized as a "reverse engineered" version of its predecessor. Instead of a flat static plane, Rotary Demisphere created an illusion of a constantly moving and oscillating three-dimensional space. This was achieved by rotating a wooden cone, painted with eccentrically positioned concentric circles, by means of an electric motor. By applying cyclical, rotating motion, a principle that had already appeared with *The Bicycle Wheel*, Duchamp managed to create quite a convincing illusion of a three-dimensional "virtual volume". The difference of the effects could be compared to that between the thaumatrope and the phenakistiscope. However, the latter added another element, the effect of depth, explored earlier with the stereoscope.

With his spiral discs and the Rotary Demisphere (Precision Optics), Duchamp had managed to achieve a 3-D space without resorting to traditional stereoscopy.[31] With Man Ray, he even attempted to make a 3-D film about the Rotary Demisphere in motion (following up on Man Ray's stereo photographs of the Rotary Glass Plates), but the exposed film got destroyed during the primitive developing process. A little later he produced a normal (monoscopic) film, aided by Man Ray and the young filmmaker Marc Allégret. *Anémic Cinéma* (1925–26) features a series of ten abstract rotating discs that create pulsating spatial effects along the depth axis. Alternating with these discs Duchamp used nine rotating discs with puns written on them in the form of a spiral. The effect of these two types of discs is remarkably different: in contrast to the illusion of three-dimensionality created by the spiral discs, the pun discs remain flat and don't achieve any form of animation (except for the rotation of the disc itself). In a sense the model for this alternation can be found in the Rotary Demisphere (Precision Optics), which had a pun ("Rrose Sélavy et moi esquivons les ecchymoses des esquimaux aux mots exquis") inscribed on the outer edge of the copper ring surrounding the cone with the spirals. When in operation, this pun would rotate with the disc without causing any persistence of vision effect (nor being even visible). In *Anémic Cinéma* the spiral and the pun were separated on different discs.

Interestingly, a somewhat similar relationship between image and text can also be found from 19th century thaumatrope discs, which often contained a pun or a quiz in addition to the images.[32] Spinning the disc caused a persistence of vision effect, while the pun (often in the form of question and answer) had to be read simply by turning the immobile disc around in one's fingers. In motion the text would not have been visible. Although simultaneously present on the disc, the reception of the image and the text required different modes of perception. Although there is no direct reference to the Thaumatrope in Duchamp's writings or works, he must have known this well-known device, a

standard feature of textbooks on optics. Whether the alternation between the two types of discs in *Anémic Cinéma* served a specific purpose, or was merely necessitated by film's linearity as a medium is open to debate.[33] Clearly there is a discrepancy between the linear motion of film and the cyclical motion of the discs. It can hardly be claimed that Anémic Cinéma handles the discs in a particularly innovative manner, in a way that would add something to their "first principles". The film is close to a straightforward documentation of phenomena that hardly needed the filmic medium at all. Things might have been different in the case of the (failed) stereoscopic film, because in it the illusion of depth was in the center of Duchamp's interest.

While making *Anémic Cinéma*, the discs were placed on rotating gramophone turntables for shooting. A decade later Duchamp returned to this idea, using it to create something different: a saleable product that marked the logical ending of his Precision Optics "project". In the Spring 1935 Duchamp wrote to his American mentor, the collector Katherine Dreier: "I am going to make a playtoy with the discs and spirals I used for my film - The designs will be printed in heavy paper and collected in a round box! I hope to sell each box [for] 15 francs and many (Each disc is to be seen turning on a Victrola)."[34] Duchamp's idea was to produce a set of discs that could be animated by means of a normal gramophone. It seems he was serious in his intention to sell the Rotoreliefs (Disques Optiques) for the general public, and not just for the cultured art audience. Five hundred boxed sets were produced, and French trademark protection applied for. Duchamp himself introduced the product by renting a stand at the Concours Lépine inventors' fair in Paris in 1935. There was little commercial interest towards his invention and Duchamp soon dropped the idea of mass-marketing. The surviving sets – and subsequent limited art editions – became treasured art collectors' items.

Playing the Role of an Optical Scientist

As Rosalind E. Krauss has reminded, from the 1920s Duchamp's business card defined him as a "precision oculist".[35] Duchamp claimed to represent a field called "Precision Optics". Like the "Oculist Witnesses", this concept also had a basis in reality. As Linda Dalrymple Henderson has pointed out, "Precision Optics" was an industrial term that gained interest in America after the First World War. It was used by the "Optical Society of America" that tried to rival Germany's optical industry. Duchamp created his own idiosyncratic version of Precision Optics cultivating "dimension changing illusions, physiological effects and sexual associations."[36] After abandoning his career as a painter, Duchamp engaged himself in a game of redefining the relationship between the self and the surroundings by creating a new identity, or rather, identities. The most famous of them is no doubt Duchamp's female alter ego Rrose (originally: Rose) Sélavy that first appeared in the autumn of 1920 in a photo taken by Man Ray, soon after the building of Rotating Glass Plates (Precision Optics). For nearly twenty years Duchamp marked most of his works as Rrose Sélavy, including Rotary

Demisphere (Precision Optics) and *Anémic Cinéma*.[37]

I would like to suggest that the "precision oculist" provided Duchamp with another role model, whose activities began before Rrose Sélavy appeared and who led a parallel life with the female alter ego, at times merging with her. As a precision oculist Duchamp created a career that obliquely simulated that of a real life optical scientist. By having a closer look at his Precision Optics "project", we can even claim that with his self-made career he re-enacted much of the trajectory of the optical science of the past one hundred years, adding to it his own sense of role play and irony, and contributing even a few real discoveries. Duchamp not only built optical "demonstration instruments"; he also reflected on the uses of optical science in society. It would be possible to draw parallels between the lives of actual optical scientists and that of the "precision oculist". For the sake of brevity, I will limit myself to a short comparison with the career of the famous Belgian optical scientist Joseph Plateau (1801–1883), whose inventions bear similarities with those of the Precision Oculist. Incidentally, like Duchamp, Plateau had also received education as a painter, before abandoning it and turning into science. Throughout his long and distinguished academic career, the physiology of vision remained Plateau's main occupation. He was a supporter of the experimental method, creating numerous research and demonstration instruments. Of these particularly three, all based on rotating discs, are worth evoking in this context: the Anorthoscope (1829, marketed 1836), the Phenakistiscope (1833) and "Plateau's Spirals" (1849).

The Anorthoscope was, according to Plateau, "a completely new form of anamorphosis".[38] It was a complicated instrument, which made it possible to "straighten" an anamorphically distorted image printed on a disc. The disc had to be spun in the instrument at a certain speed, with a slotted shutter disc rotating in the opposite direction. This produced an illusion of a stationary image. In its principle of using motion to produce an illusionary still image, the Anorthoscope resembled the Thaumatrope, which was well known to Plateau. Instead of "rectifying" a distorted image, the Thaumatrope created a composite image out of fragments drawn on the different sides of the disc. Although they had a nature of their own, Duchamp's Rotating Glass Plates (Precision Optics) belong to this line of optical investigation. Duchamp's machine is a "persistence of vision" device. By means of continuous motion, it reconstructs a virtual composite image out of physical image fragments. The difference lies in the centrality of the depth/flatness issue and in the emphasis on abstraction (most Anorthoscope and Thaumatrope discs were representational).[39] In motion the image produced by the Rotating Glass Plates (Precision Optics) may have evoked the spinning propeller of an airplane, or devices like "Newton's disks" and "kaleidoscopic tops", used by scientists and teachers to demonstrate the mixing of colors and their mutual interaction.[40]

In a sense Plateau's most famous invention, the Phenakistiscope (1833), reversed the function of the Anorthoscope by creating an illusion of continuous cyclical motion.[41] The relationship between the Anorthoscope and the Phenakistiscope could be compared to that between Rotating Glass Plates (Precision Optics) and Rotary Demisphere (Precision Optics). Duchamp's

method in simulating depth could be explained as an effort to merge the qualities of the Phenakistiscope and the Stereoscope. Although Duchamp himself saw this as related to the exploration of the "fourth dimension" (as his notes from the 1910s demonstrate), the endeavour was not entirely new. Efforts to combine the qualities of the Phenakistiscope (motion) and the Stereoscope (depth) had been made already since the mid 19th century. The French scientific instrument maker Jules Duboscq patented in 1852 a Bioscope, the principle of which had been developed in collaboration by Charles Wheatstone and Joseph Plateau. By means of the Bioscope, a Phenakistiscope disc containing two rows of photographic images could be viewed simultaneously in motion and "in relief" (the images had to be viewed via adjustable mirrors).[42] Although the Bioscope never became a success (no example is known to have survived), as an apparatus it anticipated Duchamp's efforts.

With the Bioscope, the production of the illusion of depth was still connected with the binocular principle of the stereoscope. Yet although most of the phenakistiscope discs had been limited to depicting motion on a two-dimensional plane, some discs, including a few designed by Plateau himself or by his artist friend Jean Baptiste Madou, achieved a remarkable illusion of depth, with animated figures rushing continuously from the distance towards the spectator, like the ghosts in a Phantasmagoria show; by reversing the motion, the figures could be made to retreat.[43] In some later discs, known as "Plateau's Spirals" (1849), Plateau found an even more effective way of manipulating the illusion of depth. By staring intensively at a rotating disc with an image of a spiral and then moving one's gaze to another object, the object seemed either to protrude or to retreat depending on the spinning direction. Duchamp's rotating discs bear a certain similarity with Plateau's Spirals, at least when it comes to their function.[44] Yet they are by no means simple replicas of existing models.

Cultural Interpretation of the Rotoreliefs

The "final episode" of the Precision Optics "project", the production and marketing efforts of the Rotoreliefs (Disques Optiques), explained above, fits well to the cultural model set by Plateau and others. In the 19th century many of the optical demonstration instruments invented by scientists were soon put on the market as educational toys. A case in point, Plateau's Phenakistiscope appeared in toy stores and printers' shops already in 1833, just a few months after the principle had been introduced in scientific circles. Plateau even designed some enticing discs himself. A set of six discs was enclosed in an attractive box with instructions, a rotating handle and even a mirror with a table stand. Numerous sets soon appeared on the market in different countries. Although the Phenakistiscope seems to have been received as a fashionable novelty at first, it soon turned into a children's toy. Beside the Phenakistiscope, numerous other "philosophical toys" appeared on the market. Many of them have had a long lasting appeal. Modern versions of zoetropes, praxinoscopes, thaumatropes and phenakistiscopes are still sold at science museums and creative life stores.

The parallels between these educational toys and Duchamp's Rotoreliefs are obvious. Duchamp carefully prepared a set of six (the same number as in the Ackermann phenakistiscope sets!) discs, with a subject on both sides, enclosed in a round box. In perfect conformity with the tradition, Duchamp's box contained instructions and also a simple (monocular!) "viewer" that was meant to block out one eye to enhance the 3-D illusion. The discs were meant to be rotated on a normal gramophone, a method Duchamp had already used in his experiments. The idea of turning the gramophone into an optical machine was not absolutely original.[45] Although Duchamp may not have been aware of it, already in the 1920s several "persistence of vision" devices for the gramophone had been brought to the market, including a zoetrope (Witte's Moviescope) and a set of phenakistiscope discs (Gramophone Cinema or Kineophone).[46] A further parallel with established conventions is Duchamp's decision to include among his discs several stylized, but clearly representational subjects, including a lamp, a Japanese fish in a bowl, a hot air balloon. Even the abstract subjects were given descriptive titles (Snail, Cage, etc.).

Why did Duchamp decide to use these figurative subjects, after having abandoned painting so many years ago? Was it to enhance the toylike quality of the Rotoreliefs? Was it out of fear that a set of abstract discs would not be attractive enough to sell? Or was it a conscious or unconscious reference to the tradition of the philosophical toys, one that has so far gone unnoticed? The answer to all of these questions may be "yes", with reservations. Yet although it seems Duchamp was serious in his intention to create a product for general distribution, he did not do so at the cost of his artistic integrity. Creating mechanically reproduced, (potentially) mass distributable items was at the time of the Rotoreliefs becoming one of Duchamp's (or rather, Rrose Sélavy's) central occupations. *The Green Box* had been finished in 1934, and *The Box in a Valise*, a portable miniature museum purportedly covering Duchamp's career, would, after many years of preparation, be completed in 1941. Rotoreliefs fitted comfortably into this line of activity, although compared with *The Box in a Valise* their "retrospective" play with Duchamp's career was more indirect. Although based on earlier explorations, the box contained, after all, new designs. The customary puns had also been reduced to more laconic captions, although not without some surprises.

Conclusion

What was the basic "idea" of Duchamp's Precision Optics "project"? Linda Dalrymple Henderson has summed it up in a straightforwardly technical manner, stating: "In his Precision Optics [...] Duchamp's focus was the creation of virtual relief using motion as a dimension-creating entity and an alternative to the effects of the anaglyph or stereoscopic photograph that also interested him."[47] Duchamp himself spoke about the creation of the illusion of three-dimensionality "not with a complicated machine and a complex technology, but in the eyes of the spectator, by a psychophysiological process" as his achievement, re-affirming

thus the bond between his "project" and the physiology of vision.[48] Duchamp would often discourage interpretations that went further that this, stating once about Rotary Demisphere (Precision Optics): "I would also regret if anyone saw in this globe anything other than 'optics'."[49] Duchamp knew from his encounters with scientists that the discs he had designed did not simply replicate earlier achievements, but demonstrated previously undiscovered principles.[50] Thus they were a form of real research, not just meta-research. The comparisons between Plateau and Duchamp have not been meant to belittle the originality of Duchamp's contribution. Referring to Plateau has only provided a background sketch to help put Duchamp's role-play as a "precision oculist" in context.

Warnings about limiting the interpretation to pure 'optics' have not been effective. Thus for Rosalind Krauss, for example, Duchamp's optical works form a bridge between 19th century psychophysiological theory of vision and the 20th century psychoanalytic theory. She speaks about "the erotic theater of Duchamp's Precision Optics". For her Duchamp's discs are, "unlike Maxwell's turning disks [...] intent on addressing vision's relation to desire."[51] The mechanism of desire manifests itself in the endless pulsating movement of the rotating discs. These discs are without a practical, productive function. Located in the body, their endless rotation expresses insatiable desire.[52] The cyclic repetition of the movements denies satisfaction over and over again, turning Duchamp's optical machines into kind of erotic torturing machines, or "bachelor machines".[53] Such an interpretation could find support from the psychoanalytic readings of *The Large Glass*, the ultimate depiction of a bachelor machine in function. On the other hand, as Linda Dalrymple Henderson has reminded, Duchamp's experiments get further than the sexual play; they cannot be reduced merely to the play with libido.

Duçhamp's involvement with optics was, although important, just one aspect of his manifold career, and cannot be separated from his other concerns. Nevertheless, it anticipated activities that have since become more and more common on the field of media culture and media art. Although works like Rotating Glass Plates and Rotary Demisphere are still considered somewhat peripheral in Duchamp's oeuvre, their importance for the future forms of media art cannot be underestimated. They were among the earliest machines constructed by an artist for strictly non-utilitarian purposes. This gesture has had an enormous importance for the efforts to harness new technology to creative purposes. Likewise, Rotoreliefs pioneered the idea of the "artist's software", an artwork published as a large edition and meant to be consumed by means of hardware already at the buyer's disposal. As such it anticipated works released as video cassettes, CD-ROM's or DVD's. Perhaps the most important contribution, however, was Duchamp's extended role-play. By distancing himself from the traditional role of the artist and approaching those of a scientist and an engineer, Duchamp formulated a new kind of creative profile. The "precision oculist" may have used ingredients of the past for his experiments, but he was facing the future.

Notes

[1] This chapter is a considerably revised version of a paper read at the Excavating the Future conference, Goethe Institut, Prague, Dec. 3.–5. 2001.

[2] The concept "pre-cinematic" (or proto-cinematic) is used frequently to refer to the technologies that "anticipated" cinema. It is problematic, in that it presupposes a teleology pointing to cinema as a fulfillment of an earlier development.

[3] Two such early works, *Jouet Surréaliste* and *Le Voyageur dans les Glaces* (circa 1932), are pictured in Polly Koch (ed.), *Joseph Cornell/Marcel Duchamp...in resonance.* Ostfildern-Ruit: Cantz Verlag 1998, 162–163. The traditional thaumatropes were spun in the hands by means of two cords attached to the disc. Cornell uses a simple mechanical hand-held spinning device which was available for purchase. The idea of making the two sides of a disc merge by spinning it is the same. Cornell also used found stereoscopic photographs, cut into half, as the visual material for his "film script" *Monsieur Phot* (1933). See Koch (ed.), *Joseph Cornell/Marcel Duchamp*, 165.

[4] See Frederick Kiesler, *Artiste-architecte.* Ed. Chantal Béret. Paris: Éditions du Centre Georges Pompidou 1996.

[5] Chromatropes were mechanical magic lantern slides. Two coloured discs, inserted in a wooden frame, could be made to rotate in opposite direction. This created a constantly changing abstract "ornament".

[6] Kirk Varnedoe & Adam Gopnik, *High & Low. Modern Art, Popular Culture.* New York: The Museum of Modern Art (distr. Harry N. Abrams) 1990.

[7] See Arturo Schwartz, *The Complete Works of Marcel Duchamp. Revised and Expanded Paperback Edition.* New York: Delano Greenidge 2000, 53, 59. Although Duchamp himself mentioned the name of Marey as his influence in later interviews, Linda Dalrymple Henderson has recently tried to prove that the influence derived not so much from Étienne-Jules Marey, the most famous European protagonist of chronophotography, as from his former student Albert Londe, the chief photographer at the Salpêtrière hospital. Londe came into direct contact with Duchamp's brother Raymond Duchamp-Villon, who had served as a medical intern at Salpêtrière in the 1890s. Dalrymple Henderson has paid attention to the "squelettes schématiques" that Paul Richer, a professor of anatomy, published in his book *Physiologie artistique de l'homme en mouvement* (1895). They were schematic representations of Londe's chronophotographic series. Richer's version of Londe's chronophotographs seems the closest model to Duchamp's work. The Anaglyphic Chimney was inspired by the book Les anaglyphes geometriques by H. Vuibert. See Linda Dalrymple Henderson, *Duchamp in Context: Science and Technology in the* Large Glass *and Related Works*. Princeton, N.J.: Princeton University Press 1998.

[8] About the influence of chronophotography, and particularly the work of the French physiologist Etienne-Jules Marey on modern art and modernism, see chapter 7 in

Marta Braun, *Picturing Time: The Work of Etienne-Jules Marey (1830-1904)*. Chicago & London: The University of Chicago Press 1992, 264–318.

[9] See Francis M. Naumann, *Marcel Duchamp: The Art of making Art in the Age of Mechanical Reproduction*. Ghent & Amsterdam: Ludion Press 1999, 42. The painting was shown in New York's Armory Show in 1913, where it became a sensation; especially in the US, the work was forever associated with Duchamp's name.

[10] Cit. Rosaling Krauss, *The Optical Unconscious*. Cambridge, Mass.: The MIT Press, 123. For Duchamp, artists like Seurat and Mondrian, whose choices of form and color were dictated by more theoretical and intellectual concerns, were exceptions. Duchamp's concerns were shared by the Surrealists who also tried to get rid of retinal satisfaction, of the "arrest at the retina".

[11] Jonathan Crary, *Techniques of the Observer*. Cambridge, Mass.: The MIT Press 1989.

[12] For a general treatment, with many color illustrations, see David Robinson, "Masterpieces of Animation/Capolavori dell'Animazione 1833–1908". *Griffithiana* 43/1991.

[13] In his *The Language of New Media* Lev Manovich erroneously claims that the thaumatrope causes the effect of animation! See Lev Manovich, *The Language of New Media*. Cambridge, Mass.: The MIT Press 2000.

[14] See Joseph and Barbara Anderson, "Motion Perception in Motion Pictures". – Teresa de Lauretis & Stephen Heath (eds.), *The Cinematic Apparatus*. London & Basingstoke: Macmillan 1980, 81.

[15] Dalrymple Henderson, *Duchamp in Context*.

[16] The connection between Duchamp's painting *Nude descending a staircase* (1912) and chronophotography has been dealt with extensively, and there is no reason to deal with it in detail here. One model may have been provided by Marey's single plate chronophotographs, in which the successive stages of a motion sequence were captured "superimposed" on a single photographic plate. Indeed, it is probable that Duchamp was familiar with Marey's (and also Muybridge's) work at the time. It has also been suggested that Duchamp was directly influenced by Marey's former student Albert Londe (see note 7). Braun, *Picturing Time*.

[17] Craig Adcock, "Marcel Duchamp's 'instantanés': Photography and the Event Structure of the Ready-Mades". – Stephen C. Foster (ed.), *"Event" Arts & Art Events*. Ann Arbor, Michigan: UMI Research Press 1988, 239–266. Adcock also pays attention to the fact that Duchamp's Box of 1914, a collection of sixteen photographic prints of Duchamp's notes about *The Large Glass* (not yet begun) mounted on cardboard, was housed in a box originally used for photographic plates. Five copies were made, each in a box with different label. The original label for one of them has the words "Plaques extra rapides" (see figure 13.1., page 241). In a sense, the planning process for The Large Glass was captured in a

chronophotographic series. Francis M. Naumann knows no earlier example of a series of texts reproduced as photographic series and issued as a limited edition. See Naumann, *Marcel Duchamp*, 56.

[18] Jeanne Siegel, "Some Late Thoughts of Marcel Duchamp". *Arts Magazine* 42 (December 1968–January 1969), 21–22. It has also been suggested that the combination was based on a wordplay: roue + selle = Roussel . As known, Raymond Roussel had imagined absurd machines, often associated with linguistic puns, in his writings. Also Alfred Jarry had already used gyroscopic bicycle wheels as "time machines". All of these machines, including *The Bicycle Wheel*, can be classified as "bachelor machines". See Jean Clair & Harold Szeemann (eds.), *The Bachelor Machines*. New York: Rizzoli 1975.

[19] Jack Burnham, *Beyond Modern Sculpture*. New York: George Braziller 1968, 224, 227–228.

[20] See Lewis Kachur, *Displaying the Marvelous: Marcel Duchamp, Salvador Dali, and Surrealist Exhibition Installations*. Cambridge, Mass.: The MIT Press 2001, 182–194. The idea of looking at / looking through is also present in X-Ray photography, another novelty in the early 20th century that Duchamp was interested in, as Linda Dalrymple Henderson has shown. About the early uses of and discourses around X-Ray photography, see Lisa Cartwright, *Screening the Body: Tracing Medicine's Visual Culture*. Minneapolis and London: University of Minnesota Press 1995.

[21] Laurent Mannoni, Donata Pesenti Campagnoni & David Robinson, *Light and Movement. Incunabula of the Moving Image*. Pordenone: Le Giornate del Cinema Muto et al. 1995, 212.

[22] In his dissertation (1829) Plateau used for example the following examples from real life: in heavy rain we do not see drops but parallel streaks; of wheels turning we do not see the spokes but a blurred image; fireworks are seen as long trails, like meteorites. Maurice Dorikens, *Joseph Plateau 1801-1883. Leven tussen Kunst en Wetenschap/Vivre entre l'Art et la Science/Living between Art and Science*. Gent: Provincie Oost-Vlanderen 2001, 165.

[23] Varnedoe & Gopnik, *High & Low*, 275.

[24] See Naumann, *Marcel Duchamp*, 97. The discs of 1921 are the first ones Duchamp is known to have produced. In the 1960s, Stan Vanderbeek, perhaps as an homage to Duchamp, created a "Primitive Projection Wheel", a kind of zoetrope with the rim of the bicycle wheel as its bottom. See Stewart Kranz, *Science & Technology in The Arts. A tour through the realm of science+art*. New York: Van Nostrand Reinhold 1974, 240.

[25] In this sense *The Bicycle Wheel* differed from Duchamp's other readymades that rather created distance when shown in a gallery, ironically re-enacting the taboo of touching an art object. The idea of an artwork to be touched was evoked by others in Duchamp's circle, for example by Man Ray's *Objet à detruire*, a "prepared" metronome.

[26] Duchamp also bought actual optician's eye charts and sent one of them to his American mentor Walter Arensberg. It has been preserved in the Philadelphia Museum of Art (for illustration, see Naumann, *Marcel Duchamp*, 79).

[27] As a stereocard the original view is so poor that one begins to wonder whether Duchamp could have shot it himself for the purpose. At least it seems an amateur photograph, rather than a commercially made card. The commercial production in the early 20th century was massive and highly sophisticated.

[28] An obvious later reference point for *The Handmade Stereopticon Slide* are the "floating" geometrical 3-D shapes Ivan A. Sutherland used in the early demonstrations for his pioneering head-mounted display in the late 1960s. Sutherland HMD was a see-through helmet: the person wearing it saw the surroundings and the virtual objects superimposed on it. Similar ideas were later explored by media artist Jeffrey Shaw in several installations.

[29] See Laura Burd Schiavo, "From Phantom Image to Perfect Vision: Physiological Optics, Commercial Photography, and the Popularization of the Stereoscope". – Lisa Gitelman & Geoffrey B. Pingree (eds.), *New Media, 1740–1915*. Cambridge, Mass.: The MIT Press 2003, 113–137. It should be stated, however, that the optical scientists have continued to use the stereoscope as a research instrument, in spite of its commercialization.

[30] Also Duchamp's friend Francis Picabia used spirals and circles in a painting named *Optophone*. Duchamp writes about it in an auction catalogue (1926): "He searched for optical illusions with almost 'black and white' means: the spirals and circles which play on the retina. This amusing physics found its esthetic formula in his hands." Duchamp was either just polite or calculating: he had organized the auction at Droyot in Paris as a money-making venture.

[31] In 1920 Man Ray had taken a series of stereoscopic photographs of the Rotary Glass Plates, some of them in motion. This compensated interestingly for the flattening of space to the device achieved. See Schwartz, *The Complete Works of Marcel Duchamp*, 682–683; see also Dalrymple Henderson, *Duchamp in Context*, 312.

[32] An early introductory text (1826) about the Thaumatrope by John Ayrton Paris (its supposed inventor) is in itself full of puns: "It is well known that the Laputan philosopher invented a piece of machinery, by which works could be composed by a mechanical operation; and the Quarterly Review has asserted, that a certain English poem was fabricated in Paris, by the powers of a steam engine; but the author of the present invention claims for himself the exclusive merit of having first constructed a hand-mill, by which puns and epigrams may be turned with as much ease as tunes are played on a hand-organ, and old jokes so rounded and changed, as to assume all the airs of originality. The inventor confidently anticipates the favour and patronage of an enlightened and liberal public, on the well-grounded assurance, that 'one good turn deserves another;' and he trusts that his discovery may afford the happy means of giving activity to wit that has been long stationary; of revolutionising the present system of standing jokes, and of putting into rapid circulation the most approved

bon mots." (John Ayrton Paris, *Philosophy in Sport Made Science in Earnest.* London: Longman, Rees, Orme, Brown, and Green 1827, 10–11, cit. John Barnes, *Dr. Paris's Thaumatrope or Wonder-Turner*. London: The Projection Box 1995, 25–26).

[33] See Schwartz, *The Complete Works of Marcel Duchamp*, 710.

[34] Cit. Naumann, *Marcel Duchamp*, 124.

[35] Krauss, *The Optical Unconscious*, 96.

[36] Dalrymple Henderson, *Duchamp in Context*, 210. Even a quick web search with Google reveals the extent to which the concept is used today in company and product names, etc.

[37] The copper ring surrounding the painted cone of the Rotary Demisphere bore the text: "Rrose Sélavy et moi esquivons les ecchymoses des esquimaux aux mots exquis." According to the final credits of *Anémic Cinéma*, its copyright belonged to Rrose Sélavy.

[38] Cit. Dorikens, *Joseph Plateau 1801-1883*, 165.

[39] Another difference is that Duchamp chose to give his machines very prosaic, scientific sounding names, no doubt to further distance them from art. The names of the 19th century devices were often fantastic neologisms, certainly coined to help their commercial marketing. With Rotoreliefs, Duchamp submitted to this way of thinking.

[40] I have not been able to find out if the stripes on the glass blades of Rotary Glass Plates (Precision Optics) were coloured or monochrome.

[41] The same device was invented simultaneously by Simon Stampfer in Vienna. Stampfer named his device the Stroboscope.

[42] Laurent Mannoni, *Le grand art de la lumière et de l'ombre. Archeologie du cinéma*. Paris: Nathan 1994, 224–226; Dorikens, *Joseph Plateau 1801-1883*, 169–170. (Dorikens reproduces the only known Bioscope disc on page 74 and a reconstructed version of the Bioscope on page 76; no existing copy of the device has been found to date.)

[43] An alternative early name for the Phenakistiscope was the Fantascope (also used of the second edition of Plateau's set, published by Rudolph Ackermann in London, 1833). The same name was used about the special magic lantern used in the popular Phantasmagoria show. Its most well known "special effect" was the attack of a monster from the screen towards the audience. This was achieved with a mobile "fantascope" hidden behind the screen. Plateau's letter to Michael Faraday on 8 March 1833 connects the phenakistiscope with phantasmagoria: "Vos expériences sur les roues tournant devant une glace m'ont inspiré l'idée d'un nouveau genre d'illusion qui m'ont paru très-curieuses et qui, en modifiant la manière de les

produire, pourraient peut-être recevoir d'autres applications, par example dans la fantasmagorie" (cit. Dorikens, *Joseph Plateau 1801-1883*, 269).

[44] For examples, see Dorikens, *Joseph Plateau 1801-1883*, 98. Dalrymple Henderson has also noticed the connection between Plateau's spirals and Duchamp's rotating discs.

[45] The tradition of turning sound records into visual objects and using the record player as an optical machine was continued by many artists, as the exhibition catalogue Broken Music. Artists' Recordworks (Berlin: DAAD Galerie, 1989) amply demonstrates.

[46] Both came as sets in boxes. Examples can be found from the writer's collection. There were also devices like "phonograph dancers" etc., mechanical figures that began to move when placed on the rotating turntable.

[47] Dalrymple Henderson, *Duchamp in Context*, 212. In 1945 Gabrielle Buffet characterized Duchamp's project as "a successful unpublished optical experiment which falls within a mixed and complex scientific class at the borderline between psychology and physics." (cit. Dalrymple Henderson, *Duchamp in Context*, 211).

[48] cit. Krauss, *The Optical Unconscious*, 135.

[49] cit. Dalrymple Henderson, *Duchamp in Context*, 211.

[50] According to Dalrymple Henderson, Duchamp recognized the dimension-changing quality of his spirals, a central feature in the literature on the fourth dimension. Combining the spiral with eccentric circles was something new. In 1924 the Italian psychologist C.L. Musatti wrote about the "stereokinetic effect" in relation to rotating eccentric circles, but Duchamp had used it already earlier.

[51] Krauss, *The Optical Unconscious*, 135.

[52] There are rare erotic phenakistiscope discs from the late 19th century that could be related to this. I have seen a disc in which a hand masturbates the male sex organ, endlessly.

[53] See Clair & Szeemann (eds.), *The Bachelor Machines*.