

Will the 3D Revolution Happen? A Brief Perspective on the Long History of Stereoscopy (with special thanks to Eisenstein and Bazin)

Ian Christie

James Cameron's *AVATAR* inaugurated a new phase of commercial 3D cinema at the end of 2009 – and also precipitated the final stage in the full conversion of cinema to digital. Many cinema operators who had been skeptical or hostile to digital projection were persuaded that their outlay would at least be repaid by the attraction of digital 3D, however short-lived this fashion might prove, and so the tipping point was reached in digital conversion.¹ Yet *AVATAR* and its immediate successors were not only commercially successful on a scale that dwarfed all previous 3D releases, but also provoked an even greater hostility toward the format than its earlier manifestation had in 1952-1954. The canonical version of this is Roger Ebert's 2010 article entitled "Why I Hate 3-D (and You Should Too)," which was followed by many similar and equally extreme expressions of animosity.² Ebert's main assertion was that the process "adds nothing essential to the moviegoing experience." Among other reasons he gave for "hating" 3D were: "for some, it is an annoying distraction [...] for others, it creates nausea and headaches"; adding for good measure that "it is unsuitable for grown-up films of any seriousness" and "limits the freedom of directors to make films as they choose."³

Most of Ebert's assertions are obviously polemical or subjective. In addition to box-office results, there is in fact considerable evidence that many have found 3D does "add" to their moviegoing experience. A survey commissioned by the UK Film Council and British Film Institute in 2011 recorded *AVATAR* as the third most frequently cited film that "affected" a balanced sample of UK respondents, with many commenting on its spectacular visual effects and on how 3D intensified their emotional engagement.⁴ And empirical research comparing viewers' experience of the film seen in 2D and 3D found that the latter created great "presence" or immersion overall.⁵ Subsequently, two non-mainstream films, *CAVE OF FORGOTTEN DREAMS* (Werner Herzog, 2010) and *PINA* (Wim Wen-

ders, 2011) enjoyed wide success and acclaim in the art house sector which had hitherto been hostile to 3D. But such evidence seems unlikely to persuade those who have felt affronted or “conned” (according to Mark Kermode⁶) by 3D since its return in 2009, regarding it as, in Thomas Elsaesser’s colorful summary, “an aberration, a travesty, and an abomination.”⁷ What I wish to focus on here is the recurrent argument, already voiced in the 1940s, that 3D “adds nothing” to normal cinema experience; or that if it does “add something,” this is either gratuitous or distracting.

Cinema history, of course, records similar responses to earlier additions to cinema’s prevailing regime. The introduction of synchronized sound and of photographic color (as distinct from applied coloring) were resisted by many at the end of the 1920s, largely on the grounds that these intruded into a medium which was felt to be already mature. An editorial in the avant-garde journal *Close Up* in 1928 spoke of the “future of pure cinema” as “safe in Soviet filmmakers’ hands,” faced with the “excrement and reactionary strivings of talking and talking color films.”⁸

Even earlier, the very invention of moving pictures or “animated photography” had been deplored as “unnecessary.” An art critic writing in 1896 was clear that the Cinematograph had no artistic value, but might prosper “statistically,” by mechanically reproducing what was placed before it as “slabs of life.”⁹ However, there can be no doubt that during the 1930s, “an explicit and pure style of silent film” was felt by some to be under threat from synchronized sound, color and even stereoscopy, even though it is unclear how widely and coherently this view was held.¹⁰ What is less widely understood today, by cultural critics and within the industry, is that a similar sense of crisis reappeared at the end of the 1940s, after sound and color had been assimilated, and that the new threats to “film as art” were seen to be changing screen format and the first demonstrations of Polaroid 3D, as well as the looming challenge of television.

Many of the complaints against 3D that have surfaced since 2010 were first heard between 1946 and 1954, accompanied by denunciations of the widescreen format that became established with Cinemascope in 1953. But there were also trenchant arguments voiced in support of these new formats, which remain little known; and two of the most intriguing were by André Bazin and Sergei Eisenstein, neither of whom have traditionally been seen as engaged in the 3D debate.

Total Cinema

Several generations of film students are familiar with Bazin’s seminal text “The Myth of Total Cinema,” possibly one of the most widely quoted and anthologized of all writings about the origins of cinema. This was in fact a review of the first volume of Georges Sadoul’s history of cinema, *L’Invention du cinéma 1832-97*, which dealt more comprehensively than before with the pioneers of moving

images. From this, Bazin concluded that the 19th-century inventors saw “in their imaginations [...] the cinema as a total and complete representation of reality [...] the reconstruction of a perfect illusion of the exterior world in sound, color and relief.”¹¹ Probably few of the many who have read this have noticed the inclusion of “relief,” since Hugh Gray’s non-translation of “relief” does not immediately evoke stereoscopy in English.¹² However Bazin continues in the same vein, crediting a French historian P. Potoniée with the view “that it was not the discovery of photography but of stereoscopy, which came onto the market just slightly before the first attempts at animated photography in 1851, that opened the eyes of researchers.”¹³ And he adds, “there was not a single inventor who did not try to combine sound and stereoscopy [relief] with animation of the image.”¹⁴

Bazin would write two short articles about stereoscopy in the 1950s, immediately before and after the brief period when 3D films were being widely seen and discussed, as part of the industry’s response to what was perceived as the threat of television. The first, published in 1952, offered a brisk survey of stereoscopic theory and processes as a prelude to welcoming Norman McLaren’s animations in “artificial 3D,” which Bazin reported being “as difficult to describe to anyone who has not seen some of this prodigious film artisan’s ‘flat’ animations,” but best described as “abstract painting in motion and 3D.”¹⁵ For Bazin, 3D film may be “a trivial scientific curiosity,” but he predicted it would probably make “a leap as great as that from *L’ENTRÉE DU TRAIN* (Lumière, 1896) to the train engine sequence in *LA BÊTE HUMAINE* (Renoir, 1938).”¹⁶ Bazin insisted that the demonstrations at the Festival of Britain in London “already proved that 3D affords the same interpretations, with an operation as orchestrated and utterly artistic as ‘flat’ cinema,” and invited his readers to “quickly take this new and decisive step towards total cinema.”¹⁷ The echo of his review six years earlier is unmistakable: realizing projectable 3D marked an important step toward making that “myth” of the previous century’s obsessives and visionaries a reality.

Eisenstein and Stereo in Depth

Sometime in late 1947 or early 1948, Sergei Eisenstein wrote a long essay on “stereo-cinema,” which has been claimed as his last completed text.¹⁸ Having first appeared in English in 1949, this was included in the third collection of Eisenstein’s writings in English, *Notes of a Film Director*, in 1970.¹⁹ For unknown reasons, the essay exists in two versions, with the English version omitting a long central section of some 20 pages, presenting in effect the beginning and end of Eisenstein’s passionate advocacy of stereoscopy.

The most immediate reason for the essay was that the Soviet film industry had just produced its first stereo feature film, Aleksandr Andrievsky’s *ROBINSON CRUSOE* which was released in November 1947, with Crusoe played by Eisenstein’s former pupil, Pavel Kadochnikov (who had played Vladimir in *IVAN THE*

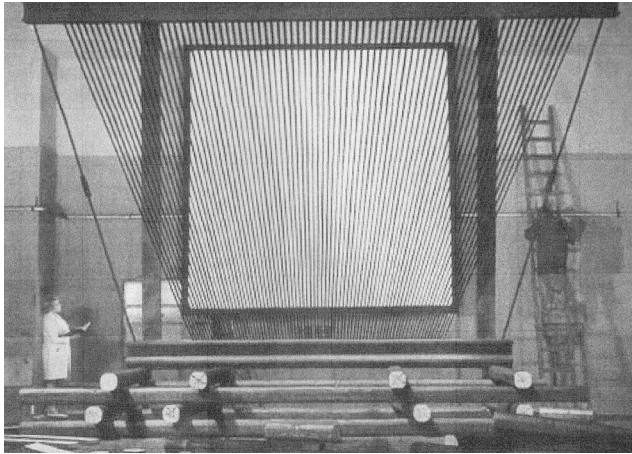


Fig. 1: The Ivanov autostereo system screen in Russia from 1941.

TERRIBLE PART 2 [1958], which, however, was then banned, and would not be seen until the late 1950s).²⁰ One phrase indicates that Eisenstein had seen ROBINSON CRUSOE: he talks about Robinson's raft trying to slip past the tangled lianas as "one of the best stereoscopic shots," before going on to use it as the basis of a rhetorical flourish: "the day is near when, instead of rafts, we shall see galleys, frigates, cruisers, battleships and dreadnoughts arriving in stereoscopic film ports."²¹ What Eisenstein does not mention is that the film was presented in a pioneering "autostereoscopic" format, using a specially constructed screen which did not require viewers to wear glasses.²²

Anticipating the optimism of Bazin, Eisenstein asserts that "it is as naïve to doubt that stereoscopic film is the tomorrow of the cinema, as it is to doubt that tomorrow will come."²³ Linked to this confident claim is a political argument: "the bourgeois West treats the problem of stereoscopy either with indifference or scorn, but the inventors and researchers in the Land of Soviets, its government and its leading officials, pay a great deal of attention to it."²⁴ Eisenstein takes as his target the French scriptwriter and sometime editor Louis Chavance, who had written skeptically about stereoscopy in July 1946.²⁵ The quotations Eisenstein cites amount to asking – as many have done once again – who needs it? What will it add to drama or comedy, even if it has some application to filming sculpture? Eisenstein brands Chavance "conservative" and "obscurantist," hence a typical proponent of Western ideology. We Soviets, he continues, are different; and the essay ends with a paean of praise for "the glorious and triumphant tomorrow [...] and those who have joined us in leading mankind towards a bright future!"²⁶

The tone of this polemic is similar to that of a number of articles written in 1947, including the notorious "Purveyors of Spiritual Poison," in which Eisenstein attacked a number of recent American films as examples of "the skill, in-

ventiveness and technical mastery of American cinema used in the service of darkness and oppression,” singling out Griffith’s *THE BIRTH OF A NATION* (1915) as an “ultra-reactionary” film that “celebrated the formation of the Ku Klux Klan, a fascist organization.”²⁷ There were many contextual reasons for this harshly critical stance. After the Central Committee’s banning of *IVAN PART 2*, Eisenstein had published a ritual self-criticism, but was still hoping to be allowed to “correct” the film. More generally, since 1946 Stalin and Zhdanov had emphasized the need to politicize all areas of life, with a special emphasis on ending cultural and scientific deference to the West.

But even if these factors influenced the framing of the essay, and its professed scorn for Western “backwardness,” the main aim of the full-length text is to outline an historical poetics of stereoscopy.²⁸ After his opening declaration on the “inevitability” of stereoscopic cinema, linked to the triumph of *ROBINSON CRUSOE*, Eisenstein proposes an argument not unlike that of his essay on Disney and animation, based on what would today be termed evolutionary biology.²⁹ Forms of art, he claims, stem from what is deepest in human nature, and their survival is governed by the same law of natural selection that prevail in other spheres of life. An example of non-survival that he offers – which reflects the prevailing hegemony of Socialist Realism at this time – is “so-called ‘pure’ abstract art,” “which could exist for a short period as a reflection of the doomed social class than engendered it.” Eisenstein’s counter-example is “a no less abstract form of art that has existed unchanged for centuries – the circus.” Circus, he claims, deals in “feats of dexterity, strength, self-possession, purposefulness – all in keeping with man’s inborn striving for the fullest development of these abilities.” Likewise sport “provides us with the most perfect forms of exercising our natural faculties, not only as spectators but as active participants.”³⁰

From this standpoint, the test for 3D being a valid art form with a future must be that “it answers some inner urge, some requirement of human nature,” and there should be a history of striving to satisfy this urge “through different stages of social development and artistic means.”³¹ But before exploring this history, Eisenstein offers a brief phenomenology of the stereo-cinema illusion, noting three main effects. First, there is representation which stays within the experience of conventional cinema, “like a flat high-relief suspended on the surface of the screen”; secondly, the representation “recedes deep into the screen, drawing the spectator into unknown depths”; and thirdly, the representation “‘falls’ out of the screen into the auditorium” – an effect which can be “overwhelming.”

Although these mark a new stage in creating and manipulating the illusion of volume for the spectator, Eisenstein argues that on close examination stereo-cinema is only developing tendencies which were already inherent in cinema at the time of its birth, bringing these to a more perfect expression. A similar realization followed the introduction of synchronized sound and color: these were improvements on what had been present but inhibited in silent and monochrome

cinema. So, stereo-cinema favors “foreground composition,” placing objects near the camera to accentuate depth – a style which Eisenstein traces back through his own films, from the famous image at the end of *IVAN PART 1* (1944), with the Tsar in close-up profile and a column of his subjects snaking away into the distance,³² through many compositions in the unrealized *QUE VIVA MEXICO!* (1932), including the Day of the Dead and a woman’s face in close-up along the diagonal of a pyramid, and further back in *OLD AND NEW* (1929) and even in *STRIKE* (1925). A similar tendency can be found in the Hollywood tradition that runs from Erich von Stroheim, through his former assistant William Wyler’s *JEZEBEL* (1938) and *THE LITTLE FOXES* (1941) – in which Eisenstein describes the use of the wide-angle 28mm lens as “almost abusive” – up to *CITIZEN KANE* (Welles, 1941), which takes this technique “to the level of trickery and the absurd.” Earlier, such compositions were also frequent in the work of Degas and Toulouse-Lautrec, Eisenstein observes, testifying to the influence of Japanese models on these artists, and feeding his own precocious attraction to this technique.

He admits that the most evocative examples of this tendency are still found in “flat cinema,” which is explained by the necessity of using the “least expressive” 50mm lens when shooting in stereo. But despite such current limitations,

it is stereo-cinema that gives us the real sensation of the two main spatial tendencies in contemporary cinema: that of “sucking” the spectator towards what was formerly the surface of the screen, and of “discharging” over him what hitherto remained flattened on the mirror of its surface.³³

Why should these new expressive possibilities of stereo-cinema exercise such a powerful appeal for the spectator? Eisenstein’s answer is that, if “ordinary” cinema is the offspring of Edison and Lumière, stereo-cinema is also the great-grandson of theater, of which it represents the latest and most socially developed form.

What follows (and was omitted entirely in the English versions) is a lengthy excursus on the history of theater, which Eisenstein divides into three main phases. In the first “primitive” stage, reaching back into prehistory but also surviving until recently in the collective rituals of Bali and Siam (Thailand), there is no distinction between performer and spectator: all participate.³⁴ The second phase in all its varied forms is characterized by an “organic union” between action and audience, where the performance seems to penetrate a mass of spectators. In such forms, he suggests, there is immediately a “nostalgia” to unite the dissociated roles of performer and audience, by seating arrangements which bring at least some audience members close to the performance area, or enable the performers to mingle with spectators. This nostalgia is not just a feature of the modern era, Eisenstein insists, but is present throughout the long history of



Fig. 2: Jacques Callot, engraving, *The Combat at the Barrier* (1627), recording an entertainment for the Duke of Lorraine in Nancy, with the audience surrounding the performance and participating in it.

theater as we know it. His examples range across the history of carnival, court masques and baroque theater (citing engravings by Baltazarini and Callot), the move to arena-style auditoria in the later 19th century (as in Wagner's Bayreuth Festspielhaus), the Japanese Kabuki theater, with its *hanamichi* runway linking stage and auditorium, up to performance in the round in the 20th century, and finally to the Russian and early Soviet avant-garde theater, from Eisenstein's former mentor Vsevolod Meyerhold, the great Symbolist producer turned Constructivist, to his own work at the Proletkult, with his 1921 productions of *The Mexican* and *Léna*, both seeking to engage the audience in avant-garde ways and challenge theatrical convention.

Even in conventional theater, Eisenstein finds revealing examples of this desire to create a connection, often by verbal means, as in long speeches clearly addressed to the audience rather than other characters, and he cites an anecdote from the Moscow Art Theatre – described as the last defender of the “fourth wall” – where the great actor Ivan Moskvina regularly played the governor in Gogol's *Dead Souls*, and once shouted at the audience: “What are you laughing at? It's yourselves.” In this same passage, he recalls a conversation with Pirandello in Berlin, when the playwright spoke of wanting to write a film script in which characters would argue with the projectionist – and this prompts a recollection of the anarchic comedy *HELLZAPOPPIN* (Potter, 1941) where this does indeed happen. But what cinema also offers – making it effectively the third phase in the history of theatrical representation – is the ability to “make illusion almost tangible,” through its use of elements of reality “transformed by the creative will of the artist.”³⁵

The “simple technique” of cinema has long been able, “by means of lens and microphone,” to make us “invisible observers of the most secret actions taking place within four walls.”³⁶ But, Eisenstein insists, “the cinema as art” wants to go further, beyond the interior monologue (which he had identified in the early 1930s as one of the major opportunities granted by sound), to “penetrate into the inner processes of thought and feeling.” In contrast to the preceding condensed history of theater, which drew on a lifetime of theatergoing and research, Eisenstein’s account of the growing tendency to “subjectivize” cinema was clearly influenced by his recent viewing and access to Western cinema literature.³⁷ In rapid succession, he cites the “I” of the narration in Hitchcock’s *REBECCA* (1940), the psychoanalytic basis of *SECRETS OF A SOUL* (Pabst, 1926), *SPELLBOUND* (Hitchcock, 1946) and *LADY IN THE DARK* (Leisen, 1943), the dream sequences of *The LOST WEEKEND* (Wilder, 1945) and *DREAM GIRL* (Leisen, 1945/48),³⁸ and the first-person camera in *DR. JEKYLL AND MR. HYDE* (Mamoulian, 1931), *LADY IN THE LAKE* (Montgomery, 1947) and *A MATTER OF LIFE AND DEATH* (Powell, Pressburger, 1946). All of these serve, in different ways, to align the viewer with the central character’s perception, and clearly fascinated Eisenstein, even if he feels obliged to denounce them as examples of a “pathological introspection towards which Western ‘creators’ have turned, breaking with the healthy realism that would not serve reaction.”³⁹ However, like the increasingly frequent breaches in theater’s “fourth wall,” they demonstrate an immersive ambition, reaching toward that “aspiration” which Eisenstein detected in earlier phases of culture.

For Eisenstein, Aldous Huxley’s satirical vision of the future in *Brave New World*, with movies replaced by “coloured and stereoscopic feelies,” offering a new level of erotic stimulation to their viewers, amounts to an ironic diagnosis of the fate of bourgeois culture, aided by its science.⁴⁰ His defense of stereo-cinema in Soviet hands insists that it is democratic, uniting performers and audience; and thus embodies “progress,” in socioeconomic as well as aesthetic terms, just as synchronized sound and color did, confirming cinema as the third phase of theater – recapturing that primordial unity of performer and audience. So those who attack it, like Chavance, can be dismissed as bourgeois defenders of an elite form of cinema and theater.

The confrontational rhetoric of the early Cold War may make Eisenstein’s advocacy of 3D seem naïve, or merely propagandist, but it also fits well with his major conviction that cinema constituted the latest phase of social ritual leading toward the “art-work of the future.” Just as the history of theater reveals a struggle to overcome the early schism between performers and audience, cinema initially entrenched this breach during its first half-century, but was now on the brink of solving the problem. To ask “what does stereo add” would be to miss the point, according to Eisenstein, since it obviously enhances the immersive realism of cinema-theater. In an extraordinary finale, the essay ends by listing recent

technological developments which have extended human capacities (infra-red glasses, radar, computers), arguing that these all require “absolutely new arts, unknown forms and dimensions, going beyond the palliatives that traditional theatre, culture and cinema are revealed to have been.”⁴¹ Hailing the advent of “a new dynamic stereoculture,” he insists that there is nothing to fear in the coming of this new era of art. Instead, echoing Wagner’s call for a new kind of artwork, we should,

prepare our consciousness for the coming of new themes which, multiplied by the potentialities of new techniques, will demand a new aesthetics for successfully realising these new themes in the novel, breath-taking works of the future.⁴²

Stereo Installations and the Battle of the Formats

Although it is the short-lived Hollywood 3D wave of 1952-1954 – which included *BWANA DEVIL* (Oboler, 1952), *IT CAME FROM OUTER SPACE* (Arnold, 1953), *HOUSE OF WAX* (De Toth, 1953), and *DIAL M FOR MURDER* (Hitchcock, 1954) – that has loomed large in accounts of the history of 3D, it was in fact stereoscopic installations as part of exhibitions or as stand-alone attractions that convinced many of its potential. The launch of *ROBINSON CRUSOE* had followed the earlier establishment of a permanent Stereokino in Moscow, which showed an 80-minute program of three films in Ivanov’s “autostereoscopic format.” After visiting this, Ivor Montagu, a producer, critic, co-founder of the Film Society in London and friend of Eisenstein, wrote:

When all film is stereoscopic and we have forgotten that we ever accepted the convention of the flat-image as real, it seems unlikely that we shall remark on the stereoscopic film’s appearance of reality, any more than we remark at present on the conventional flatness of the two-dimensional film.⁴³

Such installations were in vogue in the post-war world, and at the UK’s 1951 Festival of Britain, the Telecinema (the forerunner of the British Film Institute’s Southbank cinema complex) displayed two technological marvels, large-screen television and stereoscopic films, which the future theorist and filmmaker Peter Wollen recalled as a vivid childhood memory:

When I was thirteen years old, I went to the Festival of Britain, a kind of World’s Fair which was held in London to celebrate the Hundredth Anniversary of the Great Exhibition of Victorian times [...]. The Telekinema was the first theatre specially built to project television onto a large screen – as you sat waiting for the films to come, you watched the rest of the audience as they

were televised entering the theatre.⁴⁴[...] The main programme consisted of specially made films for which you had to put on polarizing glasses, with one lens red and the other green. There were two animation films in the programme, made by Norman McLaren, and a demonstration film of the London Zoo. For me, the great moment was when the giraffes stretched their necks out from the screen and high over the audience, as though you could stretch up and touch them.⁴⁵

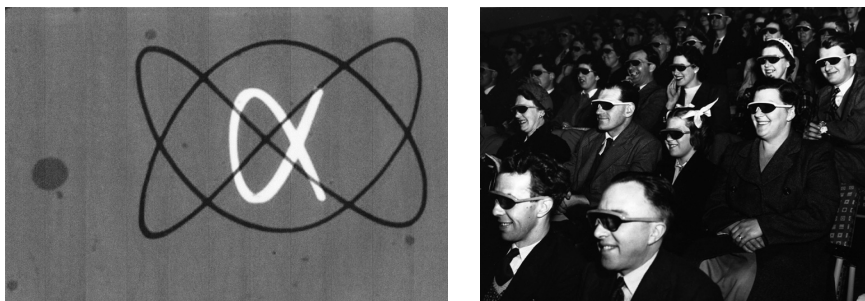


Fig. 3: Norman McLaren's "artificial" 3D film AROUND AND AROUND, using an oscilloscope image, was seen by large and enthusiastic audiences in London and Paris in 1951-52.

Bazin was similarly inspired when he wrote about 3D in 1952, after the 3D films from the festival of Paris were shown in Paris, and he refers to the theoretical work that lay behind this program by Raymond Spottiswoode.⁴⁶ Having analyzed the geometry of the stereoscopic illusion, involving the axis of convergence of the two camera lenses and the focal plane of the image, he announced that Spottiswoode had paved the way for variation in apparent depth, so that "the filmmaker now has as much creative control over the third dimension as his various lenses give him over framing and visual style."⁴⁷ For Bazin, this brought 3D into the same creative sphere as the deep focus staging he admired in Welles and Wyler, which depended on the use of the short focal-length lens (Bazin was already writing with enthusiasm about deep focus in Wyler and Welles at exactly the same time as Eisenstein, although his more familiar texts date from the 1950s; and he would not have known of the cameraman Gregg Toland's involvement with a pioneer 3D camera system in the 1930s).⁴⁸

However, what excited Bazin's admiration most was the "artificial 3D" created by McLaren "using only one standard camera and calculating the precise separation and axis of convergence for each part of the image."⁴⁹ Instead of the separated planes and dioramic effect of early 3D, Bazin found in McLaren's "poetic sensibility" evidence that modern 3D "lends itself to the same range of interpretation and concerted use for artistic purposes as 'flat' cinema." Evoking Fernand

Léger's transposition of his painting practice into black-and-white photography in *BALLET MÉCANIQUE* (1924), Bazin suggested that "today stereoscopy in color would give him a means that is purely painterly and unimaginable outside stereoscopic cinema [...] to create moving forms in space."⁵⁰

Bazin's initial argument in favor of 3D cinema is thus substantially different from Eisenstein's, which rested on the re-creation of a revitalized shared space between viewer and percept. Bazin is attracted by the potential, glimpsed in McLaren's *NOW IS THE TIME* (1951), for a fundamentally new plastic experience, unconnected with enhanced "realism." However, three years later, Bazin wrote again on the subject in the same journal, in an article entitled "The 3D Revolution Did Not Happen."⁵¹ New technical processes were launched under the banner of stereoscopy [relief], he writes, "and perhaps a true stereo cinema would have constituted a real revolution, comparable to that of sound." What happened instead, eclipsing the short-lived promotion of 3D, was the launch of Cinemascope in 1953, which prompted Bazin to observe that

no-one today, even if watching a film in cinemascope, imagines this is cinema in three dimensions. As for the only commercial process that truly offered the impression of depth, that based on anaglyphs and perfected with Polaroid glasses, its failure was so rapidly clear that the films made in this process were more often seen in flat versions.⁵²

1953 had marked the apogee of 3D's first commercial presentation, with the result that even films made in the format were largely seen "flat," like Hitchcock's *DIAL M FOR MURDER*. By 1956, 3D was already a distant memory, and one tainted by "failure." The Bazin who had foreseen great potential in McLaren's short films was now pragmatically weighing the commercial success of Cinemascope ("already installed in 32,000 cinemas") against its artistic significance. His conclusion was that all the new techniques – which included Cinerama and VistaVision, as well as Cinemascope – had some negative consequences for the quality of projected image, often blurred or cropped – but on balance could be considered "rather positive without being revolutionary." The most positive result was that

in place of the old screen with immutable proportions, [there are now] three or four different formats to break old habits and stimulate the formal imagination of filmmakers, leading them to re-think anew their *mise en scene* (cf *Lola Montes*). Equally, the attention aroused by all this commotion can only help to attract the curiosity of spectators.⁵³

Since Bazin is often miscast as an aesthetic conservative, it is refreshing to find him reporting from the midst of the "battle of formats" of the early 1950s in such

a pragmatic tone. A footnote to the 1956 article even suggests that “the famous, sacrosanct [principle of] framing may not be as important as is it considered to be by the aestheticians of cinema.”⁵⁴ Amid widely differing standards of presentation, with many cinemas poorly converted for widescreen formats, Bazin proposes the “practical conclusion that an informed and well-organized spectator must not only choose their films carefully but also the cinemas they patronize.”⁵⁵

Expanding the Screen

The “failure” of 3D in 1952-1954 continues to be cited as a reason why we should be suspicious of its return in digital form; and this failure is often assumed to be the result of audience rejection. However, as long ago as 1980, Peter Wollen concluded that “exhibitors [...] defeated 3D,” having “consistently resisted conversion costs.”⁵⁶ Cinemascope, he added, “was able to make headway because it involved minimal adaptation of the projector, under the economic pressure of competition from TV (and also to eliminate 3D).”⁵⁷ Looking back at the enthusiasm displayed by both Eisenstein and Bazin after their first encounter with 3D, it is striking that both invoke histories of anticipation – Bazin reaching back to the pre-cinema era of optical inventions, and Eisenstein to the long history of dramatic performance – to justify their sense that this would “complete” the cinematic illusion, together with stereophonic sound.⁵⁸ Neither assumed that it would merely “add something” to existing cinema, even if this represented its initial novelty value, but rather that it could usher in new possibilities, and potentially a new art form.

The two main progenitors of moving pictures, Thomas Edison and Louis Lumière, both believed that their inventions were incomplete without stereoscopy. According to the pioneer film historian Terry Ramsaye, Edison included “the stereoscopic picture idea” in what was described as “an obscure and abandoned patent application” from 1891, three years before the Kinetoscope made its public debut.⁵⁹ In practice, however, combining the phonograph with moving pictures fully occupied his attention. The Lumières registered a patent for an Octagonal Disk Stereo Device in 1900, at a time when many others also patented devices for stereo projection, but none apparently with any success. However Lumière persevered, and in 1936 published an article on “Stereoscopy on the Screen,” with a drawing of a projection system, followed by a patent for a special colored screen in 1938.⁶⁰ Yet the 3D films that Lumière had shot were not seen in 3D until 2010, when the installation of digital projection that AVATAR and its successors promoted made screenings possible.⁶¹

There are indeed parallel “long histories” involved, and as Bazin’s 1955 article makes clear, it would be misleading to focus on 3D in isolation, even during its brief 1950s heyday. We need to consider instead two broad issues, which have been intermittently intertwined, yet are distinct: the place of 3D in cinema and

the place of cinema in stereoscopic practice. Since the mid-1990s centenary celebrations, traditional “birth of cinema” narratives have increasingly been superseded by multi-dimensional histories of the technologies that coalesced to become “cinema” from around 1912 until the first decade of the 21st century. Despite recurrent efforts to isolate a particular phase of this history as cinema “proper,” and to defend it against vulgar “additions” (sound, color, 3D, variable screen-shape, video, digital imaging, live performance transmission), the social practice of cinema has vigorously modified and re-invented itself for over a century. Nearly twenty years before his stereo-cinema essay, Eisenstein had argued that cinema should forsake its slavish attachment to the horizontal rectangular screen, “based on deductions from traditions in the art forms of painting and stage practice,” and instead experiment with a variable “dynamic square.”⁶² The occasion was a debate then under way in Hollywood about the desirability of a widescreen format known as “grandeur film,” and Eisenstein’s arguments drew on a range of sources as eclectic as in his 1948 essay, including references to the physiology of perception, claiming that the human eye could accommodate vertical scanning as easily as horizontal, and to the impact of the still-new synchronized sound.⁶³ “Acoustics help optics!” proclaimed Eisenstein, on the threshold of the sound era, claiming that this offered a chance to rethink all the parameters of cinema, and anticipating the call for stereophonic sound he would also make in 1948.⁶⁴

Eisenstein may have been one of the most outspoken and theoretically minded of major directors, but there were others arguing for radical change in cinema’s presentational format. Michael Powell, for instance, shot *OH, ROSALINDA!!* in Cinemascope in 1955, although later lamenting the poor quality of lenses then available, and in the following year he would film *THE BATTLE OF THE RIVER PLATE* in VistaVision, relishing its greatly increased frame size and hence immersive potential.⁶⁵ Looking back at these experiences of “early adoption,” he referred to having “always been against projecting [the image] in the cinema with a black surround,” instead of having using photo-electric cells to create a “sympathetic surround for color films, so that the overall tone on the screen wouldn’t suffer.”⁶⁶

Besides questioning the dominance of standardized formats, it is equally important to remember that “film” – in the physical sense of a transparent image-strip of whatever gauge and composition – despite being long at the center of this ensemble, has never been confined to cinema(s), having also been part of domestic, “non-theatrical” practices. From the point of view of stereoscopy, film-strip technology was arguably the major obstacle to its widespread adoption, since it required either precise synchronization of two projectors, or a reduced size of side-by-side image on the same filmstrip. Digital projection has vastly simplified this process, making possible *AVATAR* and its successors.

The fact that almost all aspects of moving-image practice now use digital technology has not, however, eliminated use of the terms “film” and “cinema” (or their equivalents in other languages). Whether we will continue to call this “multiple and multiform” ensemble *cinema* is both a lexicological and an aesthetic or philosophical question.⁶⁷ But within it, 3D is perhaps best understood as something like a comet, returning at periodic intervals to light up the sky of cinema with a spectacular display, before retreating into darkness. The 1952-1953 perihelion has been vastly exceeded in magnitude by the post-2010 return of digital 3D, although this now seems to be waning, in both creative and commercial terms.

Two New Visual Cultures: Depth before Movement

A second issue, however, is that of “stereoscopic culture,” most of which lies outside cinema, and whose history is more continuous, and certainly much longer and fuller, than recent polemics would have it. The term dates from 1838 when Charles Wheatcroft gave a paper on binocular vision at the Royal Society, and demonstrated a mirror device that he called a stereoscope, “to indicate its property of representing solid figures.”⁶⁸ Wheatcroft used hand-drawn images, but after Daguerre’s and Fox Talbot’s demonstrations of fixing a photographic image in 1839-1840, photography offered an obvious way to produce matched images reliably; and in 1849 David Brewster constructed a lenticular, or lens-based, stereoscope, which was soon mass-produced by the French instrument maker Jules Duboscq.

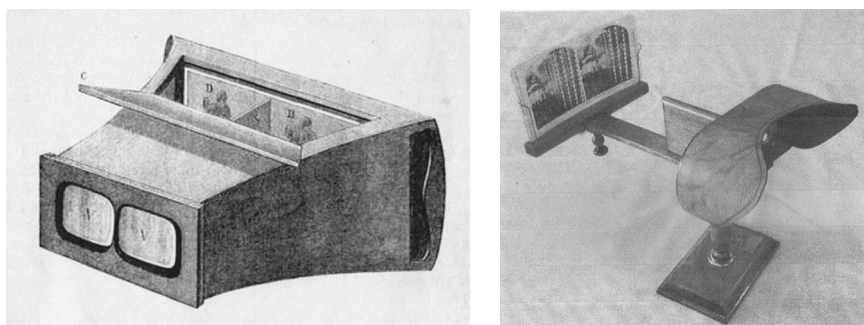


Fig. 4: Brewster’s lens-based stereoscope and the simplified Holmes version. Versions of these would dominate the home-3D market for the second half of the 19th century.

Between the 1850s and the early 20th century, the stereoscope became a ubiquitous domestic appliance, arguably the first modern communications device in a series that would eventually include the telephone, radio and television. The



Fig. 5: The Great London Exposition of 1862 received over six million visitors, and images from it published by the London Stereoscopic Company helped consolidate their early dominance of the stereo market.

London Stereoscopic Company, founded in 1854, aimed to have “a stereoscope in every home,” and after the American polymath Oliver Wendell Holmes, Sr., launched his elegantly simplified model in 1861, a variety of types proliferated.⁶⁹ In a famous article from 1859, Holmes envisioned the device’s development:

The consequence of this will soon be such an enormous collection of forms that they will have to be classified and arranged in vast libraries, as books are now. The time will come when a man who wishes to see any object, natural or artificial, will go to the Imperial, National, or City Stereographic Library and call for its skin or form, as he would for a book at any common library.⁷⁰

Holmes’s prediction was fulfilled to the extent that the London Stereoscopic Company’s catalogue offered 100,000 views by the early 1860s and Underwood and Underwood in New York were selling 10 million per year by 1900. The stereoscope rapidly became what we can recognize as a prototype for many subsequent media systems, such as picture postcards and cigarette cards, and more technological media, such as the magic lantern and the phonograph, in which a privately owned device gives access to a repertoire of pre-recorded items. Much that was later expected of film was indeed already anticipated in the industrialization of stereoscopy. And as Potonniée, Sadoul and others would suggest, the wide popularity of the stereoscope has as plausible a claim to having inspired the drive toward “animated photography” as any simple desire for moving pictures.

There was also a social or communal dimension of stereoscopy, often forgotten in Anglo-American accounts. Projecting stereo images by magic lantern proved difficult, despite many attempted solutions between the 1850s and 1890s,

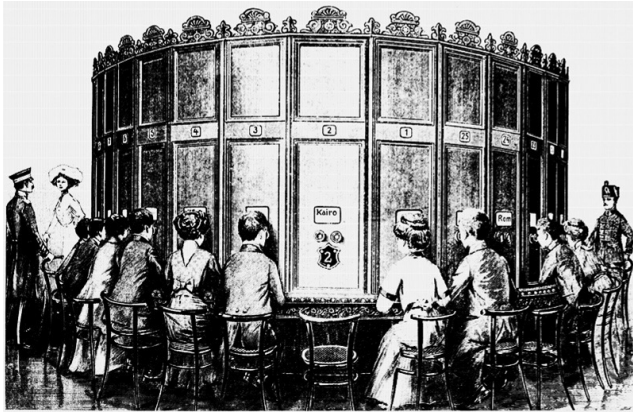


Fig. 6: August Fuhrmann's "Kaiserpanorama" allowed multiple spectators to view stereo images simultaneously, with the slides being changed automatically.

and the term "Stereopticon" commonly used for a twin-lens or biunial lantern in the United States has often been mistakenly thought to imply successful stereo projection.⁷¹ However, after a display at the 1855 Paris Exposition, stereoscopes began to be arranged in circular structures, so that a number of viewers could see a succession of views that were changed automatically.⁷² Having seen this display, Brewster envisaged "sixty views of Rome placed on the side of a revolving polygon with a stereoscope before each of its faces, [so that] a score of persons might [...] see more of Rome, and see it better, than if they had visited it in person."⁷³ This public deployment of stereoscopes was developed on a commercial scale by several entrepreneurs, one touring a cylindrical structure with a clockwork mechanism to advance fifty glass stereographs, and another creating a network of 250 permanent "Kaiser-Panorama" establishments, mainly in Germany and Central Europe, which offered a 30-minute travelogue to twenty-five patrons, backed up by an elaborate distribution system to refresh the program. The quality provided by these systems was considerably higher than that of printed stereocards viewed at home, and a number survived well into the 20th century – joined in the 1890s by Kinetoscope and later Mutoscope parlors in the first phase of moving image exhibition.⁷⁴

Looking back from our present vantage point, it is clear that the relative positions of cinema and stereoscopy changed during the early decades of the last century. While one emerged from music halls and fairgrounds to become a shared, predominantly social and commercially driven experience with seemingly universal appeal (although home cinema continued the traditions of 19th-century domestic entertainment), stereoscopic entertainment apparently lost ground and became "old fashioned." No doubt the popularity of Eastman's box cameras contributed to a shift in photography toward "personalization," rather than forms

requiring more complex procedures. Equally, the proliferation of cheap colored picture postcards may have eroded stereoscopy's former preeminence in topography and travel.

Entertainment and leisure applications may have led the way in stereoscopy during the 19th century, but with Röntgen's discovery of X-rays in 1895, new vistas in medical imaging appeared. A patent for making stereoscopic X-ray images was filed in the same year, and medical applications of stereoscopy have since proliferated.⁷⁵ The unprecedented scale of carnage in the First World War created an urgent need "to localize the projectiles inside a soldier's body," and this was initially achieved by means of tomography, or "slice radiography," "showing cross-sections through body parts at regular intervals," before computer-aided scanning (CAT), introduced in 1972, led to magnetic-resonance imaging (MRI), which today offers "two- or three-dimensional images of great quality."⁷⁶ Other medical applications of 3D include teaching, pre-surgical planning, and imaging for public engagement. The other main field which quickly adopted and developed stereoscopy was warfare, with gun-sighting an early application, followed by aerial reconnaissance, bomb and missile aiming, and today an expanding field of "military training, visualization and remote observation applications," according to the website of a major supplier of such systems.⁷⁷

One 3D innovator who benefitted from military interest in his work was the pioneer of polarization lenses, Edwin Land. Land contributed to a strong 3D presence at the 1939 New York World's Fair, where for "ten magic minutes" over one and a half million visitors saw a stop-motion animated film featuring the assembly of a Chrysler car, using Land's polarized filter system.⁷⁸ The 3D film proved so popular that another was made, in color, for the 1940 Fair; and as already noted, the Festival of Britain would provide a UK platform to demonstrate advances in 3D cinema at the Telekinema, where some half million spectators queued to fill every seat during the 22 weeks of the 3D programs.⁷⁹ More permanent 3D installations would become a feature of IMAX theaters, then mainly in museums, from 1985 onwards, and Disney entertainment parks, where a specially produced 3D science-fiction short, *CAPTAIN EO*, directed by Francis Coppola, made its debut in 1986.⁸⁰ The group viewing experience of projected 3D had become part of the revival of the fairground-com-expo begun by Disney in 1955, where it would exemplify the futuristic "Tomorrowland" theme that was an intrinsic part of Walt Disney's vision.

Meanwhile, the re-birth of "domestic" 3D also began at the 1939 World's Fair, where visitors could sample the earliest model of what would become the View-Master, a sleekly modern handheld 3D viewer that used Eastman's vivid new Kodachrome emulsion stock to present "reels" (actually discs) mainly of spectacular scenery. This phase of the modernization of 3D continued in 1947, when the Stereo-Realist Camera was launched for the US amateur market, using what would become the standard photographic format of 35mm reversal film, and

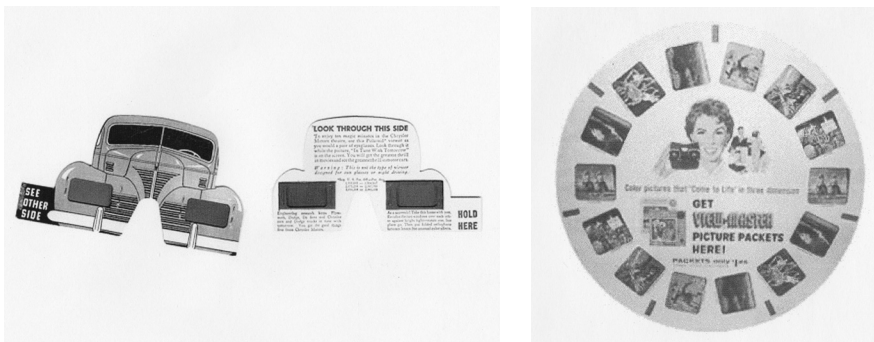


Fig. 7: 3D at the 1939 New York World's Fair, with a Chrysler advertising film shown in Polaroid 3D and the launch of the View-Master home viewer, re-kindling enthusiasm for "personal stereo."

attracting a new generation of amateur 3D enthusiasts who were soon served by a growing number of manufacturers.⁸¹ In 1952 Bolex introduced a 3D 16mm movie kit, also aimed at the amateur market and no doubt linked the rising tide of interest in commercial cinema at that time.⁸² Interest in 3D has persisted among amateur photography and film communities, and has continued into the digital era, with Pentax cameras offering a simple 3D system from 2002 and enthusiasts using two camcorders to create "DIY" 3D. A new digital 3D camera by Fuji, appropriately appeared in 2009, the year that ended with AVATAR – as if once again symbolizing the potential reunion of the domestic and the spectacular branches of stereoscopy. Meanwhile, many television receivers have been marketed as "3D ready," in anticipation of the growth of 3D television transmissions beyond the limited currently offer available.⁸³ And "live 3D," as seen at recent music festival performances, seems to be emerging as a new form.⁸⁴

The Revolution Postponed – or Defeated?

At the time of writing, it is received opinion that the "3D boom" in cinema which began in 2010 has waned;⁸⁵ and confident predictions by the major electronics companies, led by Sony, that 3D television and gaming consoles were about to conquer the domestic market have become noticeably muted. For skeptics and vocal opponents, this merely confirms its novelty status, and the hollowness of aesthetic claims. More dispassionate observers might argue that until "autostereo" systems are available, not requiring glasses, 3D will remain a minority choice within mainstream entertainment and communications. Nearly twenty years ago, Brian Winston's study *Technologies of Seeing*, which offered a theorization of technological change in visual media, concluded with a short chapter entitled "The Case of the Third Dimension."⁸⁶ The previous chapter had analyzed in detail how



Fig. 8: Special camera filming for Wim Wenders's dance film PINA (2010), the first major art-house success in 3D.

the promise of HDTV had been frustrated over many decades because there was insufficient incentive – and some entrenched disincentives – to carry through this long-awaited improvement on “normal” television. Winston’s explanatory model posits two forces at work in all major technological paradigm change: “super-vening social necessity” and its antithesis “the ‘law’ of suppression of radical potential.”⁸⁷ His survey shows that without pressure from the former, both technological problems and vested interests can and will frustrate what are clearly possible, and attractive, developments. “Given our fundamental addiction to realism,” he writes, echoing Bazin, “there is no underlying reason why a true three-dimensional motion picture system should not achieve a cultural fit and be dif-fused.”⁸⁸ He accepts that wearing glasses remains an obstacle, but notes that progress with holography, which seems to offer a solution to this, has been slow, lacking the incentive of any felt “social necessity.”

Given the fevered rate of contemporary technological research, driven by the immense profitability of systems that achieve wide diffusion, “autostereo” systems do indeed exist, both in niche markets and at the prototype stage for wider consumer use. There are also holographic systems for medical use, offering “natural 3D perception [for] multiple viewers.”⁸⁹ And Hewlett-Packard’s “diffractive optics” research promises 3D displays on mobile phone screens within the fore-

seeable future – on which a scientific commentator on this technology (who has worked on prototype laboratory autostereo), commented: “All that remains is the more nebulous question of whether human beings want or need 3D displays.”⁹⁰ More nebulous – or more fundamental than the technological solutions now becoming available, and the commercial judgment of those able to “suppress” (in Winston’s term) or accelerate them?

The only likely reason for wide acceptance of 3D entertainment, as distinct from such applied fields as medicine and military logistics, is aesthetic: that which pleases or satisfies our sensory judgment. Less than four years into the era of mass-market digital 3D cinema, the most positive aesthetic responses to the experience have probably come from audiences for *AVATAR*, *PINA*, *TOY STORY 3* (Unkrich, 2010) and *HUGO* (Scorsese, 2011) and a handful of smaller-scale successes, such as *STREETDANCE 3D* (Giwa, Pasquini, 2010). Despite the range of new technical-cum-aesthetic problems that now face filmmakers, it is the widely shared and distinct aesthetic appeal of these pioneering films that has built momentum, amid so many mediocre and crass 3D releases.⁹¹ The most obvious lesson from cinema history is that both recorded sound and color took years to be assimilated into the working practices of filmmakers around the world – the handful of canonic successes that are known today hardly represent what was typical in early sound and color production – so it is unreasonable to expect more than a minority of early 3D films to be aesthetically successful.

But there are perhaps other lessons, or at least hypotheses, from history. The hostility expressed by some of cinema’s taste-makers toward sound and color (cf. *Close Up*, cited earlier), and later widescreen, stemmed from a desire to defend what was seen as cinema’s hard-won status as “art”; to distance it from the taint of the fairground or amusement park, from novelty or “mere sensation.” Something similar is clearly apparent in the demand “what does it add?” or “who needs it?” And underlying this are deep-seated aesthetic positions, involving attitudes toward realism, novelty and “world-building.”⁹² The history of pictorial and plastic art offers many examples of long-standing prejudices against “colored” rather than monochrome media, most obviously in classical statuary, but also in photography; and against genres such as *bas relief* sculpture, blurring the distinction between three-dimensional sculpture and “flat” image-making, and more generally against such “deceptive” or illusionistic pictorial forms as *trompe l’oeil* mural and ceiling painting and panoramas, compared with framed pictures. 3D, at least in the early phase of its latest incarnation, challenges the aesthetics of distance and composure, insisting on engagement and potentially immersion. It reasserts the bodily kinesthetic dimension of the cinematic illusion, which film connoisseurship has largely suppressed. Already a sense of 3D’s lost history is becoming apparent, not only in the Lumière films from the 1930s, but in two archival discoveries from the 1950s now made viewable as never before on Blu-ray: the Cinerama feature *HOW THE WEST WAS WON*

(1952), which includes what has been described as John Ford's "masterpiece" *THE CIVIL WAR*,⁹³ and Laurence Olivier's VistaVision *RICHARD III* (1955).⁹⁴ These processes were rivals to two-strip 3D in their day, and their restoration allows us to experience something of their original immersive ambitions by means of a large screen and high definition. The return of Hitchcock's *DIAL M FOR MURDER*, now showable in digital 3D, also reveals this as the first masterpiece of stereoscopic "chamber cinema": controlled, astute and ironic in its play with the new dimensionality on offer.

Many of the recent arguments against 3D cinema – apart from legitimate accusations of studios and exhibitors profiteering, and the low ambition of many films rushed out in the format – seem flimsy, and easily challenged from one's own and others' experience. For those who emphatically do not share Eisenstein's sense of a vast new arena opening up, or of living through what the Polish filmmaker Jerzy Hoffman has called "the third revolution in cinema,"⁹⁵ this may be aesthetic preference, or prejudice masquerading as sturdy common sense. However, the future of stereoscopy, alongside other forms of enhanced audiovisual experience such as holography, Virtual Reality and High Dynamic Range imaging, will not be decided finally in the cinema, where only a fraction of total film viewings now take place.⁹⁶ We live irreversibly in a multi-platform world where, as Elsaesser has rightly observed, 3D "is changing our sense of temporal and spatial orientation and our embodied relation to data-rich simulated environments."⁹⁷ In this sense, its cinema career marks a highly visible "return of the stereoscopic repressed," while a range of other immersive and interactive devices carry us forward into a highly diversified new era of mediation.⁹⁸ But 3D digital cinema also offers us, even if only on rare occasions, a unique contemporary experience of the technological sublime.

I am grateful to Grant Weidenfeld for generously giving me access to his translations and to the Bazin Archive at Yale University for the Bazin texts discussed above (<http://bazin.commonsworld.org/index.php>). Thanks are also due to Margaux Guillemard and Ondrej Novak for timely help with references and documentation.

phical Transactions of the Royal Society of London, Part B 353, no. 1377 (1998): 1935-1942.

51. Sherry, "Media Effects Theory and the Nature/Nurture Debate," 92-93.

Will the 3D Revolution Happen? A Brief Perspective on the Long History of Stereoscopy (with special thanks to Eisenstein and Bazin)

1. In his lengthy and well-informed survey of the state of 3D cinema, Thomas Elsaesser records the view that 3D may have been little more than a ploy to finance wholesale digital conversion: Elsaesser, "The 'Return' of 3-D: On Some of the Logics and Genealogies of the Image in the Twenty-First Century," *Critical Inquiry* 39 (Winter 2013): 221-222.
2. Roger Ebert, "Why I Hate 3-D (and You Should Too)," *Newsweek*, May 20, 2010, available at <http://www.thedailybeast.com/newsweek/2010/04/30/why-i-hate-3-d-and-you-should-too.html>. See also Mark Kermode: "3D exists not to enhance the cinematic experience, but as a pitiful attempt to head off piracy and force audiences to watch films in overpriced, undermanned multiplexes," in "No, Your Eyes Aren't Deceiving You – 3D Really Is a Con," *The Observer*, April 11, 2010, available at <http://www.theguardian.com/commentisfree/2010/apr/11/3d-avatar-hollywood>.
3. Ebert, "Why I Hate 3-D..."
4. Northern Alliance and Ipsos MediaCT study *Opening Our Eyes: How Film Contributes to the Culture of the UK* (London: UK Film Council/British Film Institute, 2011), available at <http://www.bfi.org.uk/about-bfi/policy-strategy/opening-our-eyes-how-film-contributes-culture-uk>, 58-61.
5. See T. Troscianko, T.S. Meese, and S. Hinde, "Perception While Watching Movies: Effects of Physical Screen Size and Scene Type," *i-Perception* 3, no. 7 (2012): 414-425; also later unpublished work by Hinde comparing responses to AVATAR in 2D and 3D, which record greater feeling of "presence" with the latter. Kermode claims that "as anyone who has watched AVATAR in both 2D and 3D versions will know, the wow factor of this sci-fi *Smurfahontas* is more the result of adventurous digital landscaping than any forced stereoscopic illusion." *loc cit*.
6. Kermode, "No, Your Eyes Aren't Deceiving You."
7. Elsaesser, "The 'Return' of 3-D...", 318.
8. Editorial "As Is" by Kenneth Macpherson, in: *Close Up* 3, no. 3 (1928): 13.
9. O. Winter, "The Cinematograph," *New Review*, May 1896; reproduced in *Sight & Sound* (Fall 1982): 51-54.
10. See for instance, Rudolf Arnheim, *Film* [1933], partially reproduced in *Film as Art* (London: Faber, 1969), 129.
11. André Bazin, "The Myth of Total Cinema," in *What Is Cinema?* vol. 1, ed. Hugh Gray (Berkeley & Los Angeles: University of California Press, 1967), 20.
12. Relief can be translated as "depth," "relief" (as in raised), or referring to stereoscopy, which was clearly the sense intended by Bazin in this case.

13. Bazin, "The Myth of Total Cinema," 20. This seems to be a miscitation of Georges Potonniée, *Les origines du cinématographe* (Paris: Publications Photographique Paul Montel, 1928).
14. *Ibid.*
15. André Bazin, "Un nouveau stade du cinéma en relief: le relief en equations," *Radio, Cinéma, Télévision*, no. 131 (20 July 1952): 5. I was first alerted to this by Grant Weidenfeld's essay, "Bazin on the Margins of the Seventh Art," in *Opening Bazin: Postwar Film Theory and Its Afterlife*, ed. Dudley Andrew and Hervé Joubert-Laurencin (New York: Oxford University Press, 2011). Norman McLaren's films were *AROUND AND AROUND* and *NOW IS THE TIME TO PUT ON YOUR GLASSES* (both 1951, 10 mins), co-produced by the Canadian National Film Board and BFI Experimental Film Fund. For an account of the making of *AROUND AND AROUND*, see the catalogue, *Norman McLaren* (Edinburgh: Scottish Arts Council, 1977), 26. Also shown at the Festival was a documentary *A SOLID EXPLANATION*, featuring Raymond Spottiswoode, and filmed at London Zoo, which Peter Wollen recalled in his "An Alphabet of Cinema," in *Paris Hollywood: Writings on Cinema* (London: Verso, 2002), 17.
16. Bazin, "Un nouveau stade," 5. Bazin refers here to *L'ARRIVÉE D'UN TRAIN À LA CIOTAT*.
17. *Ibid.*
18. By its translator, Catherine de la Roche, "About Stereoscopic Cinema," *Penguin Film Review* 8 (1949): 5. Marie Seton dated this "long article on stereoscopic films" to the period around Eisenstein's 50th birthday on 23 January, *Sergei M. Eisenstein: A Biography* (New York: Grove Press, 1960), 474.
19. Sergei Eisenstein, *Notes of a Film Director* (New York: Dover Publications, 1970), 129-137. This collection is stated to be "a corrected republication of the English translation (by X. Danko) of *Zamyetski Kinoryezhissyyora* (compiled and edited by R. Yurenev, originally issued by the Foreign Languages Publishing House, Moscow, n.d. [after 1948]." Richard Griffiths wrote in his foreword that "Eisenstein himself published the present collection, to which its translator has subsequently added three articles written later." However, since Eisenstein died in February 1948, the exact date and provenance of the essay remain unclear.
20. According to some accounts, this film had been completed some years earlier, but its release was presumably delayed by the war.
21. Eisenstein, "Stereoscopic Films," 129.
22. Ivanov's system involved two interlocked 70mm prints projected onto a special beaded screen, whose pattern "is located at a certain distance from the reflecting surface; this permits the perception of two different images by the left and right eyes." *The Great Soviet Encyclopedia*, 3rd ed. (New York: Macmillan; London: Collier Macmillan, 1970-1979). The Ivanov system was demonstrated with short films, such as *CONCERT*, shown in a specially equipped Moscow cinema in 1941, followed by cinemas in other Soviet cities. See Mark Schubín, "3D: The Next Big Thing?" *The Schubíncafé*, December 31, 2011, available at <http://www.schubincafe.com/tag/stereo-kino/>.
23. Eisenstein, "Stereoscopic Films," 129.

24. *Ibid.*, 135.
25. Louis Chavance, "Au Temps du Centenaire," *Le Magasin du spectacle*, no. 2 (Paris: Robert Laffont, 1946).
26. Eisenstein, "Stereoscopic Films," 137.
27. Sergei Eisenstein, "Purveyors of Spiritual Poison," *Sight and Sound* 16, no. 63 (1947): 103.
28. I have used the French translation of the full text, "Du cinéma en relief," included in *Eisenstein: le mouvement de l'art*, eds. Naum Kleiman and François Albera (Paris: Editions du Cerf, 1986), 97-158. A new English translation by Sergey Levchin, has appeared in the Canadian journal *Public*, no. 47 (Spring 2013), which I was not able to consult before this publication went to press.
29. For an evolutionary biological approach to cinema, see Torben Grodal, *Embodied Vision: Evolution, Emotion, Culture and Film* (New York: Oxford University Press, 2009). Also Grodal, "Tapping into our Tribal Heritage: LORD OF THE RINGS and Brain Evolution," in *Audiences: Defining and Researching Screen Entertainment Reception*, ed. Ian Christie (Amsterdam: Amsterdam University Press, 2012), 128-142.
30. Bazin, "Du cinéma en relief," 98. Bertolt Brecht had earlier compared sport as a field where spectators are active and informed with the passive audiences for theater. See his essay "Emphasis on Sport" cited in John Willett, ed. and trans., *Brecht on Theatre: The Development of an Aesthetic* (New York: Hill and Wang, 1977), 6.
31. Bazin, "Du cinema en relief," 98.
32. According to Eisenstein, this image was based on Hiroshige's print of a landscape with a bird dominating the foreground, from the *Hundred Views of Edo* (1857).
33. Eisenstein, "Du cinema en relief," 108-109.
34. Eisenstein apparently drew his Siam reference from the experience of the governess Ann Leonowens (mistakenly described as American, although she was in fact Anglo-Indian) made famous by Margaret Landon's fictionalized account in *Anna and the King of Siam* (1944), the basis of the subsequent 1951 musical and later film.
35. Eisenstein, "Du cinema en relief," 147-148.
36. *Ibid.*, 148.
37. Contact with the West was severely reduced before and after World War Two, but the wartime alliance provided temporary access to many films and publications.
38. Eisenstein refers to Elmer Rice's 1945 play *Dream Girl*, which was not filmed until 1951 (by Mitchell Leisen).
39. Eisenstein, "Du cinema en relief," 152.
40. *Ibid.*, 153. Aldous Huxley's novel, *Brave New World*, was published in 1932.
41. *Ibid.*, 157.
42. Eisenstein, "Stereoscopic Films," 136.
43. Ivor Montagu, "The Third Dimension – Film of the Future," in *The Cinema*, ed. Roger Manvell (London: Pelican, 1950), 132-139.
44. This is in fact what today's evening audiences at the Cannes Film Festival experience in the Palais des Festivals.
45. Wollen, "An Alphabet of Cinema," 17.
46. Four films were shown in London: the fourth being *ROYAL RIVER*, a travelogue of the Thames, and the first 3-D travelogue ever to be shot in color. See Raymond

- Spottiswoode, "Progress in Three-Dimensional Films at the Festival of Britain," *Journal of the SMPTE* 52 (April 1952): 291-303, available at <http://www.archive.org/stream/journalofsociety58socirich#page/n299/mode/2up>. "As the Festival of Britain drew to a close, the four films continued to be shown in London together with newsreels. They were also distributed to other European capitals and to the United States. Given the unique requirements for stereoscopic projection, British advisors were dispatched abroad to provide guidance on running the projectors. Charles W. Smith was one such roving technician who went to Paris in 1952." Janet Leigh Foster, "A Three Dimensional Life: Charles W. Smith FBKS FRPS," *Journal of 3-D Imaging* 158 (October 2002). Available at <http://www.stereoscopy.com/3dlegends/charlessmith.html>. An additional short report in *Radio, Cinéma, Télévision* lists a fifth film shown in Paris, *THE BLACK SWAN*, a ballet film "which demonstrates the most effective possible use of depth of field at the service of narrative." André Bazin, *Radio, Cinéma, Télévision* no. 131 (20 July 1952): 5.
47. Bazin, "Un nouveau stade," 5.
 48. On Wyler in *La Revue du cinéma* nos. 10 and 11 (1948); and in *Cahiers du cinéma* no. 1 (1951). These are before the more familiar articles from 1950-1955, composited by Hugh Gray as "The Evolution of the Language of Cinema" in *What Is Cinema?* vol. 1, 23-40. What emerges from this chronological reading of texts from 1948-1952 is a ferment of excitement, in which exaggerated "depth" effects in 2D cinema are discovered, by separate commentators, to anticipate stereoscopic 3D experiments.
 49. Bazin, "Un nouveau stade," 5.
 50. *Ibid.*
 51. André Bazin, "La revolution par le relief n'a pas eu lieu," *Radio, Cinéma, Télévision* 324 (1 April 1956). The title alludes to Jean Giroudoux's 1935 play, *La guerre de Troie n'aura pas lieu* [The Trojan War Will Not Happen], 4.
 52. *Ibid.*, 5.
 53. *Ibid.*
 54. *Ibid.*
 55. *Ibid.*
 56. Peter Wollen, "Cinema and Technology: A Historical Overview," in *The Cinematic Apparatus*, ed. Teresa de Lauretis and Stephen Heath (London: Macmillan, 1978), 19.
 57. *Ibid.* [my italics].
 58. Eisenstein noted the importance of stereo sound to accompany stereo film in his 1947 essay, and recalled how he had wanted to add rear speakers at the Bolshoi Theatre for the Ride of the Valkyries in his 1938 production of *Die Walküre*.
 59. Terry Ramsaye's, *A Million and One Nights: A History of the Motion Picture through 1925* (New York: Simon & Schuster, 1926), 69. Ramsay's history was heavily influenced, and endorsed, by Edison, and includes many claims about the dating of his and Dickson's early moving picture work which have since been questioned.
 60. Louis Lumière, "Stereoscopy on the Screen," *Society for Motion Picture Engineers Journal* 27 (September 1936): 315; "Colored screen for stereoscopic projections," United States Patent 2136303, 1938.

61. Presentations of Lumière 3D films by Thierry Fremaux in Paris, at the Europa Cinema Conference in November 2010, and in Bologna, at Il Cinema Ritrovato in 2010.
62. In a speech to the Technical Branch of the Academy of Motion Picture Arts and Sciences in Los Angeles on September 17, 1930. This was subsequently printed as "The Dynamic Square" in *Close Up* in 1931, and appears in Jay Leyda, ed., *Film Essays and a Lecture* (London: Dobson, 1968); also in Richard Taylor, ed., *Eisenstein: Writings, 1922-1934* (London: British Film Institute, 1988).
63. Eisenstein, "The Dynamic Square," in Taylor, *Eisenstein: Writings*, 215.
64. *Ibid.*, 216.
65. See Richard Collins and Ian Christie, "Interview with Michael Powell," *Monogram* no. 3 (1972): 37.
66. *Ibid.*
67. See Philippe Dubois, "Présentation," in *Oui, c'est du cinema/Yes, It's Cinema* (Pavian di Prato: Campanotto Editore, 2009), 7.
68. Charles Wheatcroft, "Contributions to the Physiology of Vision – Part the First. On Some Remarkable, and Hitherto Unobserved, Phenomena of Binocular Vision," June 21, 1838, available at <http://www.stereoscopy.com/library/wheatstone-paper1838.html>. Stereo derives from the Greek word στερεός, meaning "solid."
69. A physician, poet and journalist, Holmes (1809-1894) did not patent his stereoscope, enabling many different producers to enter the market with viewers and sets of stereographic cards.
70. Oliver Wendell Holmes, "The Stereoscope and the Stereograph," *The Atlantic*, June 1959, available at <http://www.theatlantic.com/magazine/archive/1859/06/the-stereoscope-and-the-stereograph/303361/>.
71. Workable stereo projection solutions were proposed by Duboscq, D'Almeida and Pepper, but none was ever widely adopted. See "Stereoscopic Projection," in *Encyclopedia of the Magic Lantern* (Ripon, Yorkshire: Magic Lantern Society, 2001), 293-294.
72. Erkki Huhtamo, "Towards a History of Peep Practice," in *A Companion to Early Cinema*, ed. André Gaudreault et al. (Chichester: Wiley, 2012), 42.
73. David Brewster, *The Stereoscope: Its History, Theory and Construction* (London: John Murray, 1856), 163.
74. Earlier Phonograph parlors, together with automated peepshows such as Alois Polanecky's Glas-Stereogram-Salon and August Fuhrmann's Kaiser-Panorama, served as models for the exhibition of the earliest moving-pictures entertainment machines, Edison's Kinetoscope and the rival Mutoscope. See Huhtamo, "Towards a History of Peep Practice," 43-44.
75. See E. Thomson, "Stereoscopic Roentgen Pictures," *The Electrical Engineer*, March 1896, and many articles by this American X-ray pioneer. See also R. Van Tiggelen, "In Search for the Third Dimension: From Radiostereoscopy to Three-Dimensional imaging," *Belgian Journal of Radiology* 85 (2002): 266-270, available at http://www.radiology-museum.be/Pdf/article_0081.pdf.
76. Van Tiggelen, "In Search for the Third Dimension," 270. See also, Marco Agus et al., "Medical Visualization with New Generation Spatial 3D Displays," presented at the

- Eurographics Italian Chapter Conference (2007), accessed at http://www.researchgate.net/publication/221210439_Medical_Visualization_with_New_Generation_Spatial_3D_Displays; and Kyoung Won Nam, et al., "Application of Stereo-Imaging Technology to Medical Field," *Health Inform Res* 18, no. 3 (September 2012): 158–163, available at <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3483472/>.
77. Industrial Electronic Engineers Inc., available at <http://www.ieeinc.com/news/iee-develops-3d-display-handheld-military-applications>.
 78. Details of this, and its 1940 successor, made in Technicolor, *New Dimensions*, can be found at <http://www.rokemneedlearts.com/carsindepth/wordpressblog/?p=8345>. On the View-Master, see the Wikipedia entry and its sources, including an essay on the design appeal of the device by Jonathan Glancey, at <http://www.theguardian.com/artanddesign/2008/jul/31/viewmaster.design.classic>.
 79. This claim was made by the project's technical director, Raymond Spottiswoode. Spottiswoode, "Progress in Three-Dimensional Films at the Festival of Britain," 292, available at <http://archive.org/stream/journalofsociety58socirich#page/n301/mode/2up/search/spottiswoode>.
 80. This short film, produced by George Lucas and starring Michael Jackson (and edited by the noted 3D skeptic Walter Murch), offered many Disney parks customers their first encounter with projected 3D, until it was withdrawn due to scandals surrounding Jackson.
 81. See Ray Zone, *3D Revolution: The Story of Modern Stereoscopic Cinema* (Lexington: University Press of Kentucky, 2012), 160. According to Suzanne Lloyd Hayes, in addition to her grandfather, who took thousands of 3D slides, fellow-members of the Hollywood Stereoscopic Society in the 1940s included Dick Powell, Art Linklater and Ronald Colman (Lloyd Hayes, *3-D Hollywood: Photographs by Harold Lloyd* [New York: Simon & Schuster, 1992], 10).
 82. The artist Zoe Beloff has used the Bolex 16mm system for a series of films, including *SHADOW LAND* (2000), *CHARMING AUGUSTINE* (2005) and *THE SOMNAMBULISTS* (2008), influenced by "media archaeology." See a 2011 interview with her by Jussi Parikka: "With Each Project I Find Myself Reimagining What Cinema Might Be': An Interview with Zoe Beloff," *Electronic Book Review*, October 24, 2011, accessed at <http://www.electronicbookreview.com/thread/imagenarrative/numerous>.
 83. An announcement that the BBC was discontinuing the 3D service started in 2011 was made in July 2013, citing "disappointing" viewing figures. Iain Thomson, "BBC Abandons 3D TV, Cites 'Disappointing' Results," *The Register*, July 5, 2013, available at http://www.theregister.co.uk/2013/07/05/bbc-cuts_3d_tv_service/.
 84. On 20 July 2013, the pioneer German techno band Kraftwerk played at Latitude in Norfolk, accompanied by 3D visuals that required the audience to wear glasses. See "Latitude Festival 2013: Kraftwerk Intrigue with Imaginative 3D Set," *Metro*, July 21, 2013, available at <http://metro.co.uk/2013/07/21/latitude-festival-2013-kraftwerk-intrigue-with-imaginative-3d-set-3891558/>.
 85. Despite this widely voiced view, the box-office data for 3D releases, and the releases planned up to five years ahead, indicate that these are still extremely profitable. See the chart at IMDb's Box Office Mojo, available at <http://boxofficemojo.com/genres/chart/?view=main&id=3d.htm&p=.htm>.

86. Brian Winston, *Technologies of Seeing: Photography, Cinema and Television* (London: British Film Institute, 1996), 109-118.
87. *Ibid.*, 4-6, 117.
88. *Ibid.*, 109.
89. For instance, SETRED's "Clariti Display and Samurai-3D Medical Imaging Software enable[s] surgeons, radiologists and other medical professionals to view more patient image information at one time than ever before to potentially save time, reduce errors and improve certainty of surgical interventions" ("Clariti: Holographic 3D Visualisation Technology for Medical Applications," brochure, available at http://www.setred.com/setred_clariti.pdf).
90. On the Hewlett-Packard research, see: Damien Gayle, "Get Ready for the iPhone 3D: Radical New Smartphone Display Can Show Three Dimensional Images without Special Glasses," available at <http://www.dailymail.co.uk/sciencetech/article-2296463/Revolutionary-3D-display-unveiled-today-used-smartphones-years.html#ixzz2cJjBo7hc>. On Neil Dodgson's work at the Cambridge University Computing Laboratory on autostereoscopic displays, see <http://www.cl.cam.ac.uk/research/rainbow/research/autostereo.html>.
91. On the specific challenges of 3D aesthetics, see Barbara Flueckiger's illuminating article, "Aesthetics of Stereoscopic Cinema," *Projections* 6, no. 1 (Summer 2012).
92. On the concept of how films build "worlds" for spectators, see Dan Yacavone, "Toward a Theory of Film Worlds," *Film-Philosophy* 12, no. 2 (September 2008): 83-108.
93. See the review of *HOW THE WEST WAS WON* by Dave Kehr: "How the West Was Won," *New York Times*, September 8, 2008, available at <http://www.nytimes.com/2008/09/09/movies/homevideo/09dvds.html>.
94. *RICHARD III* has been restored with a 4k scan of original elements and published by Criterion.
95. Comments by Jerzy Hoffman on making his film *THE BATTLE OF WARSAW 1920* (2011) in 3D, in an interview with Konrad J. Zarębski: "Battle of Warsaw 1920: Interview with Director Jerzy Hoffman," *Culture.pl*, July 2011, available at http://www.culture.pl/web/english/resources-film-full-page/-/eo_event_asset_publisher/eAN5/content/battle-of-warsaw-1920-interview-with-director-jerzy-hoffman.
96. Some 6% of total film viewings in the UK took place in cinemas, according to research conducted by Ipsos-MORI for the Northern Alliance and Ipsos MediaCT study *Opening Our Eyes*.
97. Elsaesser, "The 'Return' of 3-D," 221.
98. See Leon Gurevitch's "research provocation," "Virtual Finally Reality? The Media Archaeologies of Immersive 3D and the Oculus Rift," *Stereoscopic Media*, August 19, 2013, accessed at <http://www.stereoscopicmedia.org/?p=395>.

Television's Many Technologies: Domesticity, Governmentality, Genealogy

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