MEDIA TECHNOLOGY AND SOCIETY

A HISTORY: FROM THE TELEGRAPH TO THE INTERNET

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Investigations into the nature of light constitute a venerable tradition. By the eighteenth century, various explanations, none broadly agreed, had existed to explain the phenomenon. (This was, in Kuhnian terms, a preparadigm phase.) Newton’s theory that light came in discrete bits, corpuscles, was pitted against the contradictory idea of Huygens that it was continuous. Dr Thomas Young, the father of physioptics, whom we have already met in connection with acoustic machines and as an influence on Faraday, here made his most fertile contribution to the scientific competencies underpinning modern communications systems by proving Huygens right. The proof was to stand for the next 104 years.

In 1801, Young was studying the patterns thrown on a screen when light from a monochromatic source, sodium, passed through a narrow slit. Areas lit through one slit darkened when a second slit, illuminated by the same sodium light source, opened. This phenomenon—interference—Young explained by assuming that light consists of continuous waves and suggesting that interference was caused when the crests of the waves from one slit were cancelled by the troughs emanating from the second. He was able to measure the wavelengths of different coloured lights, getting close to modern results. The importance of the concept of interference cannot be overstated since it is still current and lies at the heart of holography; but for television Young’s experiment was suggestive because, eventually, it allowed researchers to think of systems which treated light waves as telephony treated sound waves.

Television depends in essence on the photovoltaic (or photoemissive) effect, that is the characteristic possessed by some substances of releasing electrons when struck by light. The observation of this phenomenon is credited to a 19-year-old, Edmond Bequerel, in 1839, but it seems that his father, the savant Antoine Cesar, may have helped him to prepare his account for L’Academie des Sciences. Their
experiment demonstrated that a current passes between the two electrodes of a voltaic cell when a beam of light falls on the apparatus.

A Swedish chemist, Baron Berzelius, had isolated selenium, a non-metallic element of the sulphur group, in 1818, without noticing (in advance of Bequerel) that it was photoemissive. Selenium was initially of practical interest because it had a very high resistance to electricity. Willoughby Smith, a supervisory telegraph engineer involved in the laying of the first successful transatlantic cable, was directed to it because of this property.

While in charge of the electrical department of the laying of the cable from Valentia to Heart’s Content in 1866 I introduced a new system by which ship and shore could communicate freely with each other without interfering with the necessary electrical tests. To work this system it was necessary that a resistance of about one hundred megohms should be attached to the shore end of the cable…. While searching for a suitable material the high resistance of selenium was brought to my notice but at the same time I was informed that it was doubtful whether it would answer my purpose as it was not constant in its resistance.

(Garratt and Mumford 1952:26)

May, an operator of Willoughby Smith’s, noticed the correlation between the erratic behaviour of the selenium resistor and sunlight. Willoughby Smith investigated and made his results known in 1873.

When the bars were fixed in a box with a sliding cover, so as to exclude all light, their resistance was at its highest, and remained very constant…but immediately the cover of the box was removed, the conductivity increased from 15 to 100 per cent, according to the intensity of the light falling on the bar…. To ensure that temperature was in no way affecting the experiments, one of the bars was placed in a trough of water so that there was about an inch of water for the light to pass through, but the results were the same; and when a narrow band of magnesium was held about nine inches above the water the resistance immediately fell more than two thirds, returning to its normal condition immediately the light was extinguished.

I am sorry that I shall not be able to attend the meeting of the Society of Telegraph Engineers to-morrow evening. If, however, you think this communication of sufficient interest, perhaps you will bring it before the meeting.

(ibid.: 25)
It was deemed of ‘sufficient interest’ and a long process of investigation began.

Some of these enquiries led to devices, using first sodium and then potassium which proved to be more sensitive than selenium, specifically designed to produce photoelectricity. The contrivances never left the lab since, for theoretical physics, photoelectricity became a central area of investigation. Only the light meter (in fact, a practical and sensitive photocell) emerged, reaching the point of commercial production by 1913.

J.J. Thomson’s demonstration in 1897 that such photoelectric phenomena depended upon particles and not on waves was the first indication of the existence of sub-atomic particles. He called them, using a term suggested by Johnston Stoney, ‘electrons’ and suggested that what was happening in photoelectric emission was the liberation of electrons from the atoms of the substance through the action of the light. Thus was the belief in the indivisibility of atoms shattered and the dedicated, and fateful, investigation of the sub-atomic world begun. Crucial to this work was the electron beam tube or, as it came to be commonly called, cathode ray tube (CRT). Cathode rays had been described by Sir William Crookes in 1878 and the tube, which made the streams of electrons visible to the eye, was introduced in 1897, the year of the electron. The CRT, like all these devices except the light meter, remained within the lab, a tool of advanced physics and nothing more.

Eight years later Einstein explained the mathematisation of photoelectric emission (photoemissive) phenomena, in effect using it as a proof and extension of Max Planck’s quantum hypothesis of 1900 that ‘radiant heat…must be defined as a discontinuous mass made up of units (quanta) all of which are similar to each other’ (Handel 1967:39). Maxwell’s wave paradigm began to follow Franklin’s one-fluid theory into history since the experimental proof of Einstein’s ‘photons’ demonstrated that the higher the frequency of the light the greater the speed of the emitted electrons—which would not be the case if light were continuous. Newton was right after all, but so was Huygens; our current picture of light is a paradoxical synthesis of both descriptions.

The ground of scientific competence for television also contains other elements. In 1602 a Bolognese cobbler and part-time alchemist, Cascariolo, found a mineral—a sulphide of barium known as ‘Bologna Stone’—which would glow brightly after being exposed to light. This phosphor was of excellent value for the performance of tricks but it was so rare that a search was initiated for an alternative, that is for a stable phosphor which could be manufactured. In 1886 this was achieved. Fluorescence was a similar phenomenon whose investigation is of equal duration. That certain substances will emit luminous coloured light was noticed in antiquity and much described in the eighteenth century. Sir George Stokes, however, was the first to offer, in 1852, a reasonable explanation of the effect and to name it (after the mineral fluorspar).
MECHANICALLY SCANNED TELEVISION

All these strands together constitute the ground of scientific competence in relation to which the technological development of television takes place. Phosphors were understood. Fluorescent paint was being manufactured. The long-distance electrical transmission of images by means of the facsimile telegraph had been a reality since the middle of the nineteenth century. The cathode ray tube existed. Research into electro-optical effects led, by 1905, to the direct modulation of an electric arc through the action of a light beam and in 1907 the emission of light from a crystal rectifier had been reported (Phillips 1980:207). Knowledge of thermionic amplification had produced, by 1907, the practical basis for radio and radio-telephony systems. Photoelectric effects had been utilised in the production of light-sensitive cells by 1913. By the First World War, the dream of television was over thirty years old.

IDEATION: FAXES AND ‘FUGITIVE PICTURES’

Following the announcement of the peculiar properties of selenium and the excitement generated by the introduction of the telephone, numerous notions for ‘telescopy’ were put forward. The television receiver was first imagined by a Punch cartoonist as a two-way interactive device whereby those at home could talk to those on the screen by telephone. The telephonoscope’s screen stretched the entire width of the mantelpiece. It is unlikely that the artist, in 1879, would have had much grasp of how such a device might work. Yet the basic principles which were to lead to television were already understood by the scientific community.

Senlecq, a French lawyer, was the first to suggest how selenium might be used in a scanning system. He was, like most of these early thinkers, primarily concerned with a reprographic apparatus that would work telegraphically—telephotography or facsimile telegraphy, in effect. Senlecq envisaged television, as did most of his peers, not as the instantaneous transmission of images on to a screen but rather as the transfer of a single image, perhaps a series of images, on to paper. He published a brief account of a telectroscope in An English Mechanic of 1878. The device would reproduce at a distance the images obtained in the camera obscura. The scanning notion was expressed as follows:

An ordinary camera obscura containing at the focus an unpolished glass (screen) and any system of automatic telegraphic transmission; the tracing point of the transmitter intended to traverse the surface of the unpolished glass will be formed of a small piece of selenium held by two springs acting as pincers, insulated and connected, one with a pile and the other with the line.

(Garratt and Mumford 1952:26)
Senlecq’s receiver was simply a pencil operating on the same principle as the vibrating diaphragm in a telephone receiver, tracing its responses to the irregularity in the current (generated by the light hitting the selenium) on to paper. Senlecq refined the transmitter in a proposal two years later. Instead of a single moving block of selenium traversing the screen of the camera obscura he now suggested a mosaic of selenium cells, each to transmit by separate wires to a similar mosaic in the receiver.

Senlecq reported: ‘The picture is, therefore, reproduced almost instantaneously;…we can obtain a picture, of a fugitive nature, it is true, but yet so vivid that the impression on the retina does not fade’ (ibid.: 26). It is unlikely that Senlecq’s electrically driven pencil would have created the half-tones necessary to duplicate a photographic effect; nor was he concerned with movement as he was simply refining the telegraphic facsimile. He had, however, suggested a scanning system, involving moving the selenium across the ground-glass screen of a camera obscura.

His talk of ‘fugitive pictures’ stirred the imagination of others on both sides of the Atlantic. Suggestions along these lines involved increasingly complex mosaics of selenium and spinning mirrors. Some were even built. For example, in 1881, Bidwell demonstrated a contrivance where, for the first time, transmitter and receiver were synchronised. A single selenium cell was mounted in a box with a pin-hole aperture which was arranged within a frame so it could be cranked to rise and fall relative to a screen upon which the image to be transmitted was projected. At the receiving end a drum was rotated to match this motion and created a negative image on paper soaked in potassium iodide. The image was built up of a series of closely spaced brown lines. He showed the system to a number of learned societies (ibid.: 27–8).

The Bidwell machine can be classified in two ways. As a type of facsimile telegraph, it was redundant because these had existed for more than thirty years already (p. 28). In television terms, though, it can be considered as the most partial of prototypes because, although it successfully used photoemission as a means of creating an image, as a transmitter of single images, only in the crudest sense can it be considered as television at all. Bidwell deposited the apparatus in the Science Museum in London and did nothing further for a quarter of a century.

In January 1884, Paul Nipkow, a Berlin science student, filed patents for an ‘electric telescope’. He had, over that previous Christmas, placed a small disk perforated with a spiral of holes between a lens and an element of selenium which was inserted into an electrical circuit. He knew that selenium, when exposed to light, would vary any electrical current passed through it in response to the intensity of the light. When the disk spun the image was scanned, breaking it down into a series of varying light impulses. These, as they hit the selenium plate, created variable resistance in the circuit. At the other end of the circuit, the
process could be reversed. The electric current could be reconstituted into a series of light waves which, when passed through an exactly synchronous spinning disk, would reconstruct the picture. This could then be viewed through an eyepiece. After another year’s work Nipkow filed a master patent for television. Although he had established a viable system of ‘scanning’ with the disk, he then, like Bidwell, did nothing more. Bidwell was ‘inventing’ the fax which was already in existence and Nipkow was ‘inventing’ an ‘Elektrisches Teleskop’ which again, as the name he gave it reveals, was a substitute for a device which had existed for centuries.

Although the fantasy, albeit grounded in the principles of telephony, of seeing distant moving pictures with sound was in the air, nevertheless a confusion seems to have existed in the minds of many of these early television thinkers. They dreamed of the reproduction of movement, dreamed of it in advance of the cinema; but they addressed themselves to the transmission of stills, a species of almost redundant effort since (as we have seen) other systems already existed for such purposes. The advent of moving pictures did nothing to increase the need they were addressing with these experiments. This general blindness, though, certainly did not afflict one senior British ‘electrician’, Campbell Swinton, the man who had introduced Marconi to the Post Office.

In a letter published in *Nature*, on 16 June 1908, he outlined the most significant of all the early schemes for television. This description of a totally electronic system appears to have been prompted by a public promise made by M. Armenguard, the president of the French Society of Aerial Navigation, that ‘within a year, as a consequence of the advance already made by his apparatus, we shall be watching one another across distances hundreds of miles apart’. Shelford Bidwell, one of the few to have actually built a selenium device, knew the limitations as well as anybody. Not conceiving of any alternative to mechanical scanning, he was prompted by the Armenguard announcement to remind the world in print of his forgotten demonstrations which had taken place over a quarter of a century earlier. Then, in part in support of Bidwell, Campbell Swinton was moved to lay down the basic principles of modern television. He was dismissive of all mechanical scanning and multiple wire systems and suggested instead that the problem could:

> probably be solved by the employment of two beams of kathode [sic] rays (one at the transmitting and one at the receiving station) synchronously deflected by the varying fields of two electromagnets...indeed so far as the receiving apparatus is concerned the moving kathode beam has only to be arranged to impinge on a sufficiently sensitive fluorescent screen, and given suitable variations in its intensity, to obtain the desired result.

(ibid.: 31)
Three years later in his presidential address to the Rontgen Society he elaborated his ideas on the receiver by suggesting a special cathode ray tube which would have, at its front, a mosaic screen of photoelectrical dots but added, ‘it is an idea only and the apparatus has never been constructed’. In moving the vote of thanks Silvanus Thompson described the idea as ‘a most interesting, beautiful and ingenious speculation’ (Thompson 1912:15). In a way that can perhaps be categorised as rather typically British, Campbell Swinton carefully assessed the difficulties of an all-electric television system and determined it was not worth trying to build because of what he claimed would be the vast expense involved.

Before it became known as television, it was called telephotography, telescopy or teleautography. As late as 1911, a British patent official opened a new file on the matter as a branch of facsimile telegraphy, even though he called it television, a term first coined independently by Persky in 1900. By far the most interesting depositions in the new file were British Patents Nos 27570/07 and 5486/11 outlining ‘A Method of Transmitting Images Over A Distance’ using a velocity modulation cathode ray receiver awarded to Boris Rozing.

**PROTOTYPES: MECHANICAL SCANNING**

Paul Nipkow, who died in Berlin in 1940, worked all his life for a railway signal manufacturing company. In his seventies, in 1934, he assumed the presidency of the German Television Society. For the fifty years between the patent and the presidency he did nothing with television; nevertheless, his patent was a potent stimulus to a large number of others worldwide (Hubbell 1942:65). In fact, his ideas were much more stimulating, if only because they were apparently more practical than were Campbell Swinton’s and Rozing’s. The first decades of the twentieth century were the golden age of the Nipkow disk and its variants.

Mechanical scanning systems were now being built and selenium lag was no longer the major problem. More responsive substances had been isolated and various sophisticated arrangements of spinning mirrors and the like had increased the sensitivity of the photoelectrical elements yet further. Although the number of scanned lines generated remained few, the essential problem was perceived to lie more in the difficulties of maintaining exact synchronicity between the disks at either end of the system rather than with definition. From Hungary to the United States, where C.F. Jenkins, who had contributed significantly to the development of the movie projector, demonstrated an elegant apparatus, many ‘inventors’ were busily spinning disks. From 1923 Herbert Ives and others at Bell Labs were conducting television experiments. In 1927 they demonstrated, over 250 miles by wire and 22 miles by radio, a system identical in principle to these others. Two forms of apparatus were used, one giving a picture 2×2½ inches and the other 2
×2½ feet, a multi-element water-cooled neon lamp as the screen (Fagen 1975:790; Ives 1927:551). They also used the apparatus to scan film taken either at the transmitter or receiver end, so that a better illuminated picture could be achieved. Over the next few years Ives and his fellow workers increased the lines to seventy-two and introduced colour. By the early 1930s they had a two-way interactive system working in Manhattan. The videophone (that most beloved of all Information Revolution hardware) is thus decades old (Ives et al. 1930: passim). Its ‘inventor’, this same Dr Ives, told a British visitor:

frankly he has not the remotest idea whether the public want to see the fellow at the other end of the telephone line badly enough to pay a high price for the privilege. But when the AT&T started to develop the transatlantic telephone years ago, they did not know whether sufficient people would pay the necessarily high price to make a service profitable. But the transatlantic telephone does pay.

(Dinsdale 1932:139)

More seriously, the facsimile implications of these developments remained important, hence at least one strand of the telephone company’s interest in the matter. AT&T could, though, at the time of these experiments, do far better with existing equipment than with television. It was using a fax standard well beyond the capacity of any mechanical scanning system—a 5×7-inch image divided into 350,000 elements taking 7 minutes to transmit. Ives calculated that a television band to achieve similar detail would require the then rather unimaginable bandwidth of 3 million cycles per second, 7000 times the one being used.

By 1928, General Electric’s E.F.W. Alexanderson had gone so far with the disks that fairly regular experimental transmissions from the GE radio station in Schenectady could begin. GE also mounted a demonstration using a screen 7 feet square, erected in a local theatre (Biting 1965:1017). By 1929, the FRC had licensed twenty-two radio stations to transmit pictures. The game with WIXAV, Boston, was for a group of MIT students to go to the station while another group, in the college, gathered round the scanning-disk receiver and tried to guess which of their friends in the studio they were looking at (Fink 1945:146). But in general, despite the proliferation of different firms and mechanical systems, the American public was uninvolved in these experiments.

Among the many on the other side of the Atlantic who toyed with such devices was the Scottish entrepreneur, John Logie Baird, who spent the decade after 1925 devising increasingly complex scanning systems. By 1928 his Baird Television Development Company (BTDC), working on a thirty-line picture scanning at 12½ frames a second, was nevertheless building televisors (or receivers) for public domestic sale. However, nobody in either BTDC or the
Post Office was under any illusion as to the BBC’s interest in these developments. Baird, who had been at technical college with BBC Director-General John Reith, founded his Television Company the year before the Corporation received its charter, but the BBC treated Baird’s enterprise as that of an unwarranted upstart. Reith’s chief engineer, Peter Eckersley, was scathing about it:

The advisers of the Baird Television Company believe that this apparatus is sufficiently well developed to have a public service value. They contend that the attitude of the BBC is obstructive and irrational. The advisers of the BBC believe on the other hand that the Baird apparatus not only does not deserve a public trial, but also has reached the limit of its development owing to the basic technical limitations of the method employed.

(Briggs 1961:530 n.3)

The BBC has never found it difficult to adopt such a tone (at least prior to the organisational upheavals of the late 1980s and 1990s). In this instance it was fully justified. The fact remained that Baird’s was a partial prototype and it represented the end of the line, just as the BBC claimed.

Nevertheless, through a shotgun marriage once again arranged by the Post Office, the BBC did begin experimenting with television and evolved a working relationship with BTDC which was at times positively cordial. By 1930, ‘televisors’ were being sold at 25 guineas the set, and in April sound joined pictures in the transmissions. The system still produced an oblong picture of only thirty lines definition, although it had by now improved sufficiently for actual programming to be undertaken. The BBC began serious exploration of the new medium, transmitting, in July of that year, the world’s first ‘upscale’ television play, Pirandello’s The Man with the Flower in His Mouth in co-operation with Baird (Norman 1984:61). General Electric had broadcast the somewhat less esoteric melodrama The Queen’s Messenger from its Schenectady station two years before. The difference in style and ambition that characterised British public service and American commercial television culture can therefore be said to antedate the introduction of the all-electric system.

Whatever the excessive claims of the British press at the time, and the curious persistence of Baird’s reputation in British consciousness up to the present, the most extensive application of the Nipkow patent took place, unsurprisingly, in Germany. From 1902, when Otto von Bronk patented the Bidwell principle that the picture should be constructed out of a series of lines, through the demonstration of that technique by Ernst Ruhmer in 1909, the Germans recovered the insightful edge that Nipkow had given them and then abandoned (Hempel 1990:124). But progress was
stifled because the German authorities could see no supervening necessity for the technology. The same imperial arms race, which necessitated the development of the marine wireless, suppressed work on television because no military application could be envisaged. It was not until 1926 that any serious experimentation recommenced. In 1927 an instruction manual for ‘building a picture receiver’ was published and television demonstrations were the hit of the Berlin Broadcasting Exhibitions of 1928 and 1929 (Elsner et al. 1990:196). By this time the military were at last (and somewhat erroneously) thinking television might be of some use to aeronautics as well. On the other hand, some visionaries on the left were calling for the ‘Volksfernseher’, or ‘People’s Television Set’ (Hempel 1990:128).

Goebbels had expressed an interest in radio technology, including television, even before he became Nazi propaganda director whereupon experiments were spurred ahead by what Bill Uricchio has called ‘utopian visions and national security interests’ (1990:115). After the Nazis were elected in 1933, television at last became an important item on the Reich’s research agenda. Regular transmissions started in Berlin in 1935 using apparatus built by Fernseh A-G, a subsidiary of Zeiss Ikon and Bosch formed to exploit Baird’s patents, which achieved, for film transmission, 180 lines and twenty-five frames per second. ‘The success of this machine’, a colleague of Baird’s wrote in the 1950s, ‘was to no little measure due to the micrometer precision engineering tools which the Germans had available for disk construction’ (Percy 1952:14). This precision was taken a step further in that the disk was placed in a vacuum to reduce both interference and drive-power. Subsequently the Germans managed a mechanically created variation on interlaced scanning, thus achieving stability very close to the all-electrical (electronic) systems (Gibas 1936:741). This machine represents the mechanical scanning partial prototype in its final form.

Since this system, like Jenkins’, worked best when dealing with film rather than in the studio, Fernseh constructed a film camera with an attached developing tank, building on the proposal made by Ives in 1927. It produced a photographic image in under a minute which was then mechanically scanned—the Intermediate Film (IF) system. The Germans also used an electronic system based on the patents of the American Philo Farnsworth, for which they had signed an agreement in 1935. Farnsworth had produced an alternative electric tube (more on this below) that also worked best when transmitting film; so the IF system was ideally suited for this configuration as well. The Germans began an experiment to test this system against an electronic one based on patents held by RCA’s German allies, Telefunken. Because the results were accessible to the public, this was however declared an actual ‘service’, the world’s first. It was used to cover the Berlin Olympics in the summer of 1936. The network embraced five German cities and the service was not halted by the start of war. Moreover, in 1938 the Germans built a videophone link between Berlin and Nuremberg using an outdated mechanical solution to produce a 180-line standard.
Baird’s engineers, like their German opposite numbers, were also locked in battle with an all-electrical system (essentially the same as Telefunken’s and RCA’s) developed by Marconi’s and EMI in concert. In 1934, the Postmaster General appointed a committee under the chairmanship of Lord Selsdon to consider the development of television and to ‘advise on the general merits of the several systems’ then available (Garratt and Mumford 1952:38). The BBC was entrusted with the experiment. Baird’s company had by now refined mechanical scanning to give 240 lines and, to consolidate its strengths, it too adopted the German IF system which was available to it because of its patent alliances. BTDC now duplicated the earlier German mechanical feat and, in 1936, achieved their ultimate in mechanical scanning, 240 lines at one-twenty-fifth of a second. But it was a dead end. Despite Baird’s dictum of 1931 that ‘There is no hope for television by means of cathode ray tubes’, the receivers for these ‘high definition’ mechanical systems, both in Germany and the UK, were by now all-electric tubes with no trace of spinning disks (Briggs 1961:553). It was only a question of time before the disks disappeared from the transmission end of the system, too.

Baird withdrew entirely from the activities of the company that bore his name and spent the next three years experimenting with a large-screen, mechanically scanned (at 6000 rpm) colour television system with stereophonic sound! By then, Baird’s colleagues were using a mechanical scanner with IF for studio work and a purely BTDC film scanning (telecine) device, which observers felt was better than anything EMI had, for transmitting film. As in Germany, at the government’s behest, a final judgement was to be made between electrical and mechanical. The BBC organised BTDC and EMI for this test—a sort of experimental run-off, as Asa Briggs points out, like nothing so much as a nineteenth-century competition between rival steam locomotives (Briggs 1961:583). Sir Archibald Gill, a member of the 1934 committee, recalled that the case was not quite open-and-shut. The Baird system did indeed, even with the line and frame disadvantage, produce a slightly better picture than the EMI system when transmitting film (Garratt and Mumford 1952:28). As film transmission was held by all experts in every country to be vital as a major source of television images, this was no small advantage.

In the name of crude firstism, the British somewhat perversely have always dated the start of television ‘service’ from this clearly experimental exercise inaugurated in studios at Alexandra Palace, London on 2 November 1936 using both systems. It was, anyway, second to the equally unstandardised German ‘service’. The game between BTDC/Fernseh and EMI/Telefunken had been fixed by physics as Peter Eckersley had somewhat brutally indicated nine years before. Each mechanical element had given way to an electronic equivalent. Electrical scanners inexorably drew away in terms of performance, ease of operation,
reliability and general ‘elegance’. Only when transmitting film was there any question of competition and even then the electronic potential was clear. In the words of one of the BBC pioneers required to produce programs, turn-and-turn-about, using both systems: ‘Working in the Baird Studio was a bit like using Morse Code when you knew that next door [in the EMI studio] you could telephone’ (Norman 1984:129). By 1936 the question was not ‘mechanical vs. electronic?’ but rather ‘which electronic?’
A full year before Campbell Swinton’s 1908 letter to Nature, a Russian, Boris L’vovitch Rozing, had patented, in London as well as in Berlin and St Petersburg, an all-electric television cathode ray tube receiver. In the year of Campbell Swinton’s presidential address, this same Russian actually transmitted a signal to his receiver.

The cold war casts a curious shadow across the history of television. The earliest published accounts of its technological emergence were written from the mid-1930s to the mid-1950s during which decades the accident of Rozing’s birthplace had assumed a significance it otherwise would not have had. British writers in the 1930s claimed that Campbell Swinton’s analysis of the basic problem was, despite the fact that he did not work on his proposed solution, superior to Rozing’s more pragmatic approach. An American account dating from the 1950s described Campbell Swinton’s 1911 proposal as ‘a still more startling invention’ than Rozing’s work (Jensen 1954:175; emphasis added).

The Soviet treatment of technological history was the butt of much Western humour, although Russian ‘firstism’ about aeronautics was substantially boosted by Sputnik (Winston 1993:193). Everything from spiral mechanical scanning to a sequential colour system was supposedly patented in Russia before 1900. Nevertheless, such Stalinist claims that Russians had invented both radio (Popov) and television (Rozing) are no less—and no more—substantial and, at least as far as television is concerned, compared well with British pretensions in these matters. Certainly Rozing’s experiment is of a quite different magnitude from Campbell Swinton’s musings, for all that the latter envisaged the more completely modern scheme that was to prevail three decades later. But Rozing’s is an achievement that neither the chauvinism of others nor the rodomontade of official Soviet accounts should be allowed to taint although, since his contributions all predate the revolution, the rhetoric of the latter was faintly comic.
Boris Rozing was born in St Petersburg in 1867, took his degrees at its University and taught, from 1893, at its Technical Institute. He was interested in the electric telescope (as he was still calling it in the 1920s) and, noticing that the electron beam in the common cathode ray laboratory oscilloscope left complex luminescent patterns on the front of the tube, decided that this was his ‘ideal mechanism’ (Gorokhov 1961:75). In 1907 he patented such a circuit using electron beam deflection to modulate the intensity of the beam, by altering its velocity, in the receiver. Rozing’s idea, innovative and important though it was, had its precedents. His transmitter was built along the lines that were being commonly suggested before the turn of the century, that is, an electro-mechanical system using a mirrored drum of a known design. His more revolutionary receiver had been anticipated, too. A German patent of 1906 had already suggested the use of a cathode tube specifically for ‘the transmission of written material and line drawings’. This apparatus was designed and built by Dieckmann, and, like Bidwell’s, it survives. It used a standard Nipkow disk transmitter but here for the first time the image scanned was received on a cathode ray tube. Paradoxically, this breakthrough was counterproductive, for Dieckmann’s intended purpose was facsimile transmission and the lack of a hard copy was seen as a major disadvantage—just as some thought the radio telephone’s lack of privacy was a real drawback (Jensen 1954:174). In both cases the drawback turned out to be the *raison d’être* of the technologies.

Given the general state of tube technology in this period, Rozing’s proposed solution was at the very cutting edge of what was possible. What also distinguishes him is that he did not give up at the patent stage but actually built a series of partial prototypes and on 9 May 1911 he transmitted by wireless over a distance ‘a distinct image…consisting of four luminous bands’; but the rudimentary state of the cathode ray tube and electronic amplification meant that the line of development was not taken up by others. Even in Russia it seemed as if the problem would be better solved by mechanical scanning using substances of greater sensitivity than selenium, so Campbell Swinton’s suggestion and Rozing’s experiments were not pursued during and immediately after the First World War. The truth, which Rozing and Campbell Swinton saw but which most researchers ignored, was that while mechanical scanning and cathode ray devices were partial prototypes both working poorly at this point (and the tube was worse than the disk), the all-electrical system had the far greater potential.

Vladimir Zworykin emigrated to the United States twice after the Russian Revolution, the first time failing to find work. On the second occasion in 1920 he managed to secure a research post with Westinghouse (Waldrop and Borkin 1938:213). He had studied with Rozing at the Institute in St Petersburg and in 1912 he had gone to the College de France to do graduate research in theoretical physics and X-rays. During the First World War in Russia he built tubes and
aviation devices for the Signal Corps. In 1923 Zworykin patented a complete electrical television system including a pick-up tube, that is to say an electronic camera, along the lines suggested by Campbell Swinton. The camera was, as was Rozing’s receiver, adapted from the standard cathode ray tube but of a very different design. The electrons were now directed at an internal screen or signal plate which they were forced, by magnets mounted outside the tube, to scan in a zigzag pattern. The scanning system produced by the zigzagging dot was one which created the image sequentially, line by line, just as Nipkow’s spinning disk had done. At the home end the process was reversed. The internal signal plate of the camera became the phosphor-treated front end of the tube, the screen. The electron beam, again generated by a cathode and controlled by electromagnets, was modulated by the incoming wave. These variations were translated by the scanning electron dot into variations in intensity which became, through the phosphors, perceptible to the human eye.

Rozing had suggested that the speed of the stream of electrons could be varied in accordance with the intensity of the light, but Zworykin followed Campbell Swinton in varying the intensity of the beam itself to reconstitute the lights and darks of the scene before the lens. He also followed a Swedish researcher Ekstrom, who, in a patent of 1910, suggested that scanning could be achieved with a light spot. Zworykin’s camera tube, the iconoscope, used a sensitive plate of mica coated with caesium. It proved to be more photoemissive than potassium and certainly much more so than selenium. In the tube which Zworykin built, the photoelectrons are emitted the entire time the screen is illuminated by the spot but the charge is stored until the spot returns to build up the next frame. Then the electrons are discharged. In all the competing systems, whether mechanical or electrical, the stream of electrons was created by a fragment of light striking the cell and being discharged immediately. The iconoscope’s ‘charge storage’ system created an enormous increase in sensitivity.

Zworykin, writing in 1929 after his move to RCA, acknowledged other workers, French and Japanese, who had been following Rozing’s use of the cathode ray tube (Zworykin 1929:38). In Germany that same year, Baron Manfred von Ardenne had demonstrated an all-electrical system with sixty-line definition. He was the first to perfect the flying spot technique for scanning film and slides electronically and a CRT receiver for the home—the Volksfernseher. This was demonstrated at the Berlin Radio Exposition of 1931 and widely publicised abroad (Hempel 1990:129–31).

By 1932, Zworykin had a camera that worked more effectively, at least using reflected light in a studio, than any other available. It produced 240 lines, matching the most advanced mechanical systems, and it was demonstrated by a wireless transmission from New York to the RCA laboratory in Camden 80 miles away. This was still not quite an all-electric system since the synchronising pulses to stabilise
the image were provided not by circuitry but by a spinning disk. Over the next two years electronically generated synch pulses were added. At the same time Zworykin designed the interlaced raster which scanned every other line in any one frame so that the frame time was halved to one-sixtieth and picture stability further improved. This was because a sufficiently fast rate of change (sixty a second in effect) was created from frame to frame for the physiological requirements of critical fusion frequency (CFF), the point at which the eye ceases to see discrete pictures, to operate. Achieving this sort of speed was necessary because a single scan in one-thirtieth of a second gave a flickering impression.

Early in 1934 Zworykin wrote:

The present sensitivity of the iconoscope is approximately equal to that of a photographic film operating at the speed of a motion picture camera, with the same optical system…. Some of the actually constructed tubes are good up to 500 lines with a good margin for future improvement.

(Zworykin 1934:19–20)

Zworykin was fudging a little by not specifying a 16mm motion picture camera; for the ambition of all the television pioneers, mechanical and electrical was to match the quality of the contemporary amateur, i.e. 16mm, picture. For some, Jenkins for example, the home delivery of movies was the prime television research objective. The film industry defines film stocks in terms of lines per millimetre of film surface. The limiting resolutions of emulsions can be determined when the emulsion is used to photograph a chart upon which standardised blocks or lines of black have been printed. The film industry’s norm was a 35mm film which could photograph between thirty to forty of these lines per millimetre. To achieve the same density of visual information electronically, something like 1,200 lines on a cathode ray tube would be needed. This same normal film stock formatted for 16mm would, of course, also photograph the same number of lines per millimetre but to far cruder effect, since each line occupies more of the frame area. To match the resolving capacity of the 35mm norm a 16mm stock would need to photograph around twice as many lines (i.e. ninety per millimetre). Conversely, the normal 16mm standard of thirty to forty lines per millimetre can be matched on 35mm by twelve lines. It was at that standard that the television researchers aimed since its electronic equivalent required only around 400 to 480 lines.

In short, by the early 1930s, the whole thrust of the research was directed towards creating a 400-line picture, the equivalent of the contemporary 16mm film image (Schlafly 1951:50). This became ‘high definition’ television, the standard eventually adopted, in its 525/625-line guise, by most of the world. (As we shall see, sixty years later ‘high definition’ was redefined, as the world’s television
engineering community considered a 1200-line HDTV system (p. 140). Such a new standard simply matches the resolving characteristics of 35mm film.)

The British contribution to the search for an electronic equivalent of 16mm film was much facilitated by corporate musical chairs in the late 1920s. RCA took over Victor Phonograph Inc which in turn owned the British Gramophone Company. Thus RCA, born out of the ashes of British interests in the American radio market, came to own a slice of the British record industry. In 1931, the Gramophone Company was an element in the founding of EMI. In this way RCA now had a share of an English research laboratory. Moreover, the director of research there was Isadore Schoenburg who, like Zworykin, was another of Rozing’s ex-students.

Schoenburg, in 1934, decided that his research agenda should be for a 405-line electronic standard:

> It was the most dramatic moment in the whole of television development. He (Schoenburg) said, ‘What we are going to do, in this competition, we’re going to offer 405 lines, twin interlace. And we’re going for Emitron. We’re going to give up mirror drum scanning, we’re going along the lines of the electronic camera.’

(Norman 1984:107)

Sir Frank McGee, perhaps the most distinguished of the team, calls this ‘the most courageous decision in the whole of his (Schoenburg’s) career’, which it might well be; but these British pioneers also insist that they were working independently of their sister lab at RCA which is more difficult to credit. It is hard to believe that Schoenburg decided for the electronic solution without cognisance of what Zworykin had publicly announced, in January 1934, to be possible, never mind what private communication might have passed between the two labs. Zworykin, for example, recalled that two of Schoenburg’s engineers visited his lab late in the winter of 1933/4 for three months before the 405-line decision was made (ibid.: 105). Yet despite all this, one of these very engineers was claiming, in 1984, that ‘McGee and EMI owe nothing to RCA and only in 1936 did the two companies sign an agreement for a complete exchange of patents and information’ (ibid.: 49). Nothing?

The record clearly suggests that the essence of both cameras’ design was laid down in a patent of Zworykin’s dated 1923. Zworykin worked for RCA. RCA owned a slice of EMI. EMI’s research director shared a teacher in Russia with Zworykin. The teacher was a television pioneer. EMI engineers did visit RCA. The Emitron looked, not like Zworykin’s patent of 1923, but like his development of that patent, the iconoscope of the early 1930s. It was, in McGee’s own words, ‘fundamentally the same as the iconoscope’ (McGee 1950:598) except that, because
of British electrical supply characteristics, the pattern or raster scanned the picture lines every twenty-fifth of a second. By 1934, 343 lines had been demonstrated on the RCA iconoscope, not quite sufficient to match the definition of 16mm amateur movies. Zworykin, as his January 1934 paper reveals, was confident that this could be achieved. Further, the majority opinion in the US was that 441 lines was the maximum that could be accommodated in the six megacycle channels the FCC had mandated for experiments. All this was the context for British 405-line decision. Yet it would be wrong to suggest that the British therefore made no significant contribution to the development of the RCA system.

The American iconoscope, in the early 1930s, was barely usable, being very noisy; that is, it had too high a ratio of interference to signal. Indeed, the tube produced more noise than picture and was a lot less impressive than the high definition mechanical scanning systems then coming on line, which is why Schoenburg was being ‘courageous’ when he opted for it. The reasons for this poor performance were properly analysed and ultimately corrected first at EMI. In 1933, a member of the EMI team perfected a technique to stabilise the DC component of the signal, thereby solving a clearly understood problem. More significantly, the then mysterious process whereby the electronic signal was derived from the tube was elucidated by McGee. Secondary emission of electrons, within the tube, were found to be crucial (McGee 1950:599–600).

Indeed secondary emission was a third way, in addition to photo and thermionic emission, to obtain, within a component, free electrons. As a consequence of this understanding, the team of Blumlein, Browne and White (the first two of whom were to die testing experimental radar equipment in flight in 1942) set about suppressing the unwanted signals (Preston 1953:119). The patented circuits which did this were passed back to Zworykin and incorporated into the RCA camera and became the basis for the 1936 RCA/EMI agreement. McGee and Blumlein, in the emitron, made the iconoscope fully practical; but the emitron was, all protests aside, nevertheless essentially a variant of the iconoscope. RCA, it may be noted, never signed patent agreements, always buying what it needed outright. The EMI deal was one of only two occasions in the 1930s when this company policy was violated, obviously because of the closeness of the two organisations.

In Germany, RCA’s correspondent was Telefunken. Its engineers had abandoned mechanical scanning at exactly the same time as Schoenburg took his ‘dramatic’ decision to do the same thing and for much the same reason. Like EMI, Telefunken was working, with RCA agreement, on a design derived from Zworykin. It yielded the Ikonoskop-kamera. As in Britain, electronics (essentially the RCA interest represented by Telefunken) was pitted against mechanical scanning (essentially Baird represented by Fernseh). There a similar, if considerably more protracted run-off had begun during the Olympic Games. In the years that followed, the systems were allowed to coexist. In 1938, Fernseh covered the Nazi Parteitag
rally in Nuremberg. In 1939, Telefunken introduced its super-ikonoskop which produced 441 lines and worked well in the most adverse lighting conditions. By the outbreak of the War Telefunken had Fernseh on the ropes. Like BTDC, the latter had only television with which to support itself. Telefunken, like EMI, was a major electronics firm, with or without television. Telefunken slowly demonstrated the superiority of its system and with the Nazis’ decision to use the super-ikonoskop for coverage of the 1940 Winter Games, Fernseh finally lost out. The Germans had taken more than five years to reach the conclusion the British had come to in four months (Udelson 1982:110).

The greatest claim to the invention of television is undoubtedly Zworykin’s, and it was in all essentials first built under the aegis of four large electrical manufacturers, for every basic aspect of modern television systems conforms to Zworykin’s original patent description of 1923 and the devices he built to refine and develop those ideas in the 1930s. However, in another crucial sense, the invention was still in doubt at the end of that decade because the device was not widely diffused (Figure 11).
INVENTION II: ALTERNATIVE ELECTRONIC SCANNING

What hindsight reveals is that by 1936 the mechanical scanning systems were reaching their limits while the electronics systems were still at the outset of development. It is, though, tempting to ignore this and take a more contemporary view. At the time, the failure of mechanical scanning was seen as a rather good example of how in the twentieth century the lonely inventor (e.g. Baird) with his simple solutions (e.g. spinning disks) stood no chance against the great corporation’s team of researchers with their cutting edge technology (e.g. EMI and the CRT).

This rhetoric was implicitly deployed by Campbell Swinton in a lecture before the Radio Society of Great Britain in 1924:

> If we could only get one of the big research laboratories, like that of the G.E.C. or of the Western Electric Company—one of those people who have large skilled staffs and any amount of money to engage on the business—I believe they would solve a thing like this in six months and make a reasonable job of it.

(Jensen 1954:176)

In the event, with something less than the whole-hearted backing Campbell Swinton envisaged, it took the industrial researchers longer than six months to ‘invent’ television. The idea, though, that they generally worked in a way different from the old-style individual innovator nevertheless obtains an important boost in the received history. The technical development of television becomes a prime example of the industrialisation of innovation which is generally deemed to be such a prominent feature of modern life.

The position Baird occupies is crucial, for nothing is as powerful as the notion that he, an old-style private inventor, was limited to mechanical systems because he was unable to compete with the industrial lab in the more sophisticated area of the cathode ray tubes. In fact, Baird seems to have just had a thing about tubes and an obsession that his first thought was the best. Vic Mills, his earliest collaborator, alerted Baird to CRTs in 1924:

> I said you can’t play about with those spinning discs and think you’re going to get television. I told him to go ahead with cathode-ray tubes. I’d read about it in a book printed in 1919 and it made me want to take the long jump and avoid all this mechanical business. But if I knew only a little about the cathode-ray tubes, Baird, apparently, knew nothing. He was simply not interested. He could comprehend the mechanical
system but the idea of doing it all electronically appeared to be out of the question.

(Norman 1984:30)

These traits could just as well have manifested themselves under the aegis of a great corporation; and conversely, a lone inventor could have seized on the potential of the electronic system.

This last contention is proved by the career of Philo T. Farnsworth, the boy-wonder electrical genius who occupies Baird’s place in the popular American understanding of television history. Farnsworth, every bit as much an outsider as Baird was, nevertheless produced a serious, sophisticated electronic system to rival the dominant RCA/EMI/Telefunken one. His contribution was equal in sophistication to those made by McGee and the other workers in the great laboratories. Baird failed not because he was alone, but rather because he was simply wrong and the history of television is not as ready a prop for the industrialisation of innovation thesis as is commonly supposed.

Philo Farnsworth was a rural mid-Westerner who came from a Mormon home which acquired electricity only when he was 14. He learned his science from popular magazines and read up on mechanical television. At age 15 he confounded his chemistry teacher at high school by describing, on the blackboard, an all-electric device which he thought might work better. He left school and had no further formal education (Waldrop and Borkin 1938:211; Everson 1949:15–16). In 1927, aged 19, he patented an electrical pick-up tube (the heart of a camera) which operated on significantly different principles from Zworykin’s. Called an image dissector, it had the advantages of offering a more stable picture than the iconoscope. It used neither a scanning spot nor the storage principle but worked by translating the image into a pattern of electrons which were then passed across an aperture.

Something of a stand-off developed. The pictures produced by the dissector tube were of better definition and sharper contrast than those produced by the iconoscope. The Zworykin camera was a superior instrument for use in studios and outdoor pickup where lighting was a problem but in the late 1920s and early 1930s it did not work so well that it was self-evidently the clear winner. With the intense direct illumination found in a telecine device, the comparative (but rather theoretical) disadvantage of the dissector was wiped out. Apart from the fact that film transmission had been central to the research agenda from the beginning, this was why Farnsworth made a partner of Fernseh with its IF (instant film) system.

Farnsworth’s achievement was that, by one means or another, his was the more effective electronic camera in the earliest developmental phase. He was on to the secondary emission at the same time as EMI and indeed in 1937, made, what was to be his greatest contribution to electronics in general by designing an electron
photomultiplier specifically to exploit it. The multiplier allowed the weak electron output of the dissector tube’s aperture to be exponentially increased. It enabled Farnsworth to do this without using the charge storage principle patented to RCA. He was close enough, in fact, to worry RCA considerably. Both Sarnoff and Zworykin visited his laboratory and their professions of uninterest in his advances were not backed by their corporate moves against him. RCA mounted an interference action which Farnsworth successfully defended (with the help of his chemistry teacher and at a cost of $30,000).

By then Farnsworth was no longer a man alone. Unlike many individual engineers, he conducted himself as well in the boardroom as he did in his laboratory. He had joined the Philadelphia Battery Company. Philco, now a major rival of RCA, had begun by selling large domestic batteries to houses not on the electricity grid. As electrification killed this business, the company moved to radio manufacturing, first establishing itself by specialising, from 1927, in car radios. When Farnsworth joined, it was outselling RCA at nearly three-to-one and had over one-third of the market. Rivalry between the two firms climaxed, with Philco bringing an action against RCA for industrial spying, specifically charging that RCA operatives took some of Philco’s female employees to Philadelphia where (in the words of the affidavit) they ‘did provide them with intoxicating liquors, did seek to involve them in compromising situations, and thereupon and thereby did endeavour to entice, to bribe and induce said employees to furnish them…confidential information and confidential designs’ (W aldrop and Borkin 1938:219).

Protected by Philco’s broad back, Farnsworth was now able successfully to resist all RCA attempts to dislodge his 1927 patents. The dissector was sufficiently different from the iconoscope for him to maintain his rights, but his receiver was close enough for him to pick up Zworykin’s pictures on his apparatus. In 1935, after a three-year proceeding, Farnsworth successfully won his own interference action against Zworykin and RCA. Farnsworth’s device scanned an electronic image—in the words of his 1927 patent application, he had designed ‘an apparatus for television which comprises means for forming an electrical image’ (Udelson 1982:105). Zworykin, in his 1923 patent, the patent official held, had suggested scanning an optical image—a significant difference (ibid.: 112). Farnsworth left Philco (amicably) and in the early 1930s forged his international links, assigning his patents to Baird in the UK and Fernseh in Germany. In 1937, upon the introduction of the photomultiplier, he reached cross-patenting agreements with both AT&T and CBS, two more of RCA’s great rivals (ibid.: 107).

Farnsworth was too good a scientist not to realise that Zworykin’s charge storage principle, despite the photomultiplier, was superior—was indeed television, while his concept had produced, by however small a margin, a more partial prototype; but he was also too shrewd a businessman not to fully exploit the very real contributions he had made. He and his partners poached RCA’s
head of licensing to be the president of the Farnsworth manufacturing company which he created in 1939. The iconoscope was by now superior to the dissector even in telecines but the improvements that had allowed the iconoscope to overtake the Farnsworth camera had been purchased by incorporating Farnsworth’s concepts (as well as EMI’s). Indeed Zworykin acknowledged this by now designating his machine the ‘image-iconoscope’ exactly because it scanned an electronic analogue of the image, clearly infringing Farnsworth’s 1927 dissector patent. After five months of negotiations RCA was forced into a licensing agreement with him—an event whose only precedent was the EMI secondary emission deal. In September a general agreement was reached with Farnsworth and Zworykin published the details of his latest camera (Iams et al. 1939:541). Farnsworth’s biographer claims that the RCA vice-president who signed the contract wept (Everson 1949:246).

Both Zworykin and Farnsworth had opted for modulating their signals by strength—intensity—as the underlying principle of their television systems, although they dealt with the electron stream very differently. But at the outset Rozing had proposed, albeit very vaguely, a sort of frequency modulation system, whereby the greater the light the faster the stream of electrons. Frequency modulation of the audio signal had been perfected by Edwin Armstrong, another extremely sophisticated lone investigator. During this period Armstrong turned his attention to modulating the video signal in this way and his interest and presence further muddied the corporate and patent waters.

This phase of technological performance—‘invention’—can take place either synchronously with or subsequent to the crucial supervening necessity which ensures diffusion. In the case of television, the invention phase is synchronous with some underlying supervening necessities. These would include the general drives conditioning the development of popular entertainment which underpinned the development of cinema and radio—the addiction to realism in the culture, the supremacy of the nuclear family and its home, the industrialisation of the entertainment business. But there are other specific elements in the supervening necessity underpinning television which had not yet manifested themselves—spare industrial capacity at the end of the Second World War, for example, and the push to consumerism. Thus this invention phase is responsive to only some of the underlying social necessities sustaining the development and the eventual diffusion of television.

This partial operation of the full range of social necessities also accounts for the fact that ‘invention’ in this case proceeds synchronously with the second phase of prototype performance, allowing the British and Germans to hold run-offs between a partial mechanical prototype and the invention proper. But more than this, the lack of a clear supervening social necessity delays the diffusion of television and
becomes meshed with certain elements of suppression which also begin to emerge as television becomes ever more practical. Let us deal with the accelerators first.

NECESSITY AND SUPPRESSION: ENTERTAINMENT

Television, electronically scanned television, was a partially demonstrated but soundly grounded theoretical option by 1911. It was a mass medium by the mid-1950s. These forty-plus years yield one catalytic external supervening necessity, which is of greater moment than any single technological advance in the same period. It occurred after the conclusion of the Second World War.

The crucial enabling factor which transformed television from toy to mass medium was the spare capacity of the electronics industry in 1945/6. In the two years from April 1942 (according to the premier issue of *Television* magazine), defence spending had expanded the radio industry of America by between 1200 and 1500 per cent. More than 300,000 workers were involved. As the magazine put it: ‘The question now arises what to do with these facilities after the War, for the demands of aural radio alone will not be sufficient to keep many of them going. Only television offers the promise of sufficient business’ (Boddy 1990:45; emphasis in the original). James Fly, then chair of the FCC, wrote: ‘I think it quite likely that during the post-war period television will be one of the first industries arising to serve as a cushion against unemployment and depression’ (Hubbell 1942:xi).

As with radio in 1918, so with television in 1945. In America it was still ‘experimental’. RCA had built a plant for the Navy at Lancaster, Pennsylvania, which had mass-produced cathode ray tubes. Immediately after the war RCA bought the plant back and within a year was manufacturing a 10-inch table-top television, the ‘630 TS’. It sold for $385, which compares well with Sarnoff’s proposed 1916 price of $75 for a radio.

Even beyond the not inconsiderable commercial consequences of marketing the sets, RCA and others were strenuously arguing that the post-war economy needed enhanced levels of consumer demand in general which could be fuelled only by an effective new advertising medium. These considerations were finally to break the deadlock in the development of American television. As we shall shortly see, the social brake—suppression—was already being applied by various interests since at least the start of German and British public services (using, to all intents and purposes, RCA systems) in 1936. In the intervening decade the United States had been at war for only three years. The war cannot be claimed as the delaying factor in all the years of peace up to 1939 (or 1942). On the contrary, it was this war which provided, by creating a vast electronics industry, the final supervening necessity for television.
This necessity, though, would have been insufficient of itself had it not been for the other long-standing drives at work in the society, drives which created and sustained the research interest in television. As in Tolstoy’s tale of the giant turnip, the efforts of the mouse are required at the end of the farmer’s line of stronger helpers to get the monstrous vegetable out of the ground and into the house. The slowing cathode ray tube assembly lines are the mouse. The farmer, his wife and all the others are to be found, as it were, in those tendencies within society, previously discussed, that create entertainment and information forms for the urban masses. Television then follows the path beaten by radio to the home. It also trades, as does cinema, on those deep social addictions to realistic modes of production and narrative. All the background supervening necessities—addictions to realism and narrative—reinforced these industrial and economic perceptions of need (Winston 1996:22–6).

This then can help explain the stalls and delays to be seen in the history of television’s development. These general cultural traits constitute powerful underlying supervening necessities for television, but they are not of themselves strong enough in the period from 1936 (at the latest) to get a television system widely introduced to the public, either in the US, where such a possibility is denied by the government, or in the UK and Germany where, as I have explained above, it is encouraged. They sustained the R&D but they could not overcome the forces working to protect the status quo against the disruptive effects of the new technology.

This uneasy balance suffuses both the German and British experience of television in these years. Despite the clear articulated propaganda policy of the regime, the Germans never had more than between 200 and 1000 sets in the entire country, although admittedly almost all were sited in halls seating between forty and 400 (Uricchio 1990:115). The technical developments outlined above and the boost given by the coverage of the Berlin Olympics in 1936 ‘faild to meet public expectation’. By the time the Nazis decided to allow the Volkfernsehen (and risk people being rude about the regime in the privacy of their own homes) it was 1939 and the war intervened.

The technology was no more popular in the UK. The British, ignoring the supposed beneficence of the marketplace, inaugurated by government fiat a fullscale public experimental service in November 1936 using the two systems. In February 1937 the London Television Standard of 405 lines at 1/25th of a second, interlaced, was adopted and Marconi/EMI was allowed to broadcast alone. It was thus no longer ‘experimental’ but the public take-up of the service proves that it was nevertheless premature. Barely 2000 sets were sold in the initial year of operation, and this despite a reduction of about 30 per cent in their cost and the wonders of the first televised coronation. By the outbreak of war only about 20,000 sets had been sold.
There were a number of problems. Although viewers’ responses, audience research and the press were all largely favourable, the level of repeats drew criticism (Norman 1984:210–11). More serious public concerns among non-adopters of the new medium included the limited hours, worries about obsolescence because of the conflicting systems and an unawareness that the highly publicised low definition Baird picture was a thing of the past (Briggs 1961:611–12). These problems would have vanished if the market had been talked up, if the demand had been there; but the demand was not being stimulated as it was to be in the 1950s. Without the new ‘high definition’ electronic system being given the same level of public exposure Baird had generated for his almost unwatchable low definition experiments, television was by the outbreak of war in 1939 an over-hyped technology—in fact the first we have encountered. It will not be the last.

The making of extravagant claims ungrounded in performance realities is a new factor in the operation of the ‘law’ of suppression. Disappointed early adopters and media reporting of that disappointment become a deterrent. In the case of television, this allowed the BBC in the late 1930s to avoid having to make the sorts of decisions confronting it in the late 1940s, i.e. how to begin diverting resources to the new medium from the old, radio. And this draws attention to another obvious reason for the slightly lukewarm approach to television from the BBC in the late 1930s; radio was not then an old medium.

Giving established players in one technology the task of exploiting a new cognate, and therefore threatening technology is a not unusual way of ensuring that the ‘law’ of the suppression of radical potential will operate. Radio (and with it, the BBC) had barely come of age; and talking pictures were even younger than that. Both were prospering despite the Depression. Public attention, and with it the public’s purse, were therefore elsewhere. Whereas the public might tell researchers it wanted television, the entertainment industry stood ready to ignore the demand. In the US, the FCC saw its regulatory role in terms of ensuring corporate stability. That was the public interest it was defending. It took no notice of any evidence of public demand such as a 1939 poll which estimated that four million Americans were eager to purchase television sets (Udelson 1982:96). Instead, the commission still insisted on ‘experimentation’. Via its good offices, the radio and movie industries, because of the investments they had entailed, constrained television development.

The British experience shows that American hesitancies were probably justified because public demand, whatever people told the pollsters, was not really there. Asking people if they would like more entertainment and would pay for it is different from actually offering it to them and demanding money; but this is exactly what the BBC, having been forced into television, was doing in the years before the Second World War. However, no mass audience was created so no manufacturing
base emerged and, as we have seen, by 1939 there were almost no television sets in
British homes.

Television was invented in the straits between the Scylla of established industry
and the Charybdis of innovation; between the brake of established markets and the
need to create, through innovation, new markets. The broad social supervening
necessities, requiring highly iconic home-delivered entertainment systems,
sustained technological performance so that research on the device continued
through all this, but slowly. It would take the particular necessity of maintaining
wartime levels of electronic manufacture to make the television receiver—in
Britain and the US, as well as in the rest of the world—‘the shining centre of every
home’. Without that final push, the brakes were more powerful than the accelerator.

SUPPRESSING TELEVISION: 1935–48

The received explanation of what happened, in America, after television had been
‘invented’ is as follows:

The Radio Manufacturers Association (RMA), a trade group dominated by, but
not wholly a creature of, RCA, had set up a television committee which, by 1935,
was ready to set about establishing appropriate standards. RCA by this year had
reached 343 lines in an interlaced raster scanning at one-thirtieth of a second,
although Zworykin had made some tubes that could produce more than 400 lines.

In the following year, the FCC began the difficult business of making frequency
allocations for television in what was then still called the ‘ether spectrum’. The
RMA attempted to expand this agenda by offering ideas on standards as well. It
suggested that the FCC should establish, within the spectrum allocated, that all
‘experiments’ use a 441-line picture on a band six megacycles wide (the lines being
thought the maximum accommodatable in that bandwidth). Other matters,—the
polarity of the signal, the aspect ratio of the picture, the synchronisation standard—
were agreed within the RMA and also presented to the FCC. No mechanical
scanning systems were envisaged.

The FCC more or less accepted the bandwidth proposal as outlined by the
manufacturers but otherwise did not respond. The commission felt that further
‘experimentation’ was in order not to test mechanical against electrical scanning, as
was the case in Europe, but essentially because it was unable to arbitrate effectively
between RCA and its rivals, Zenith, Philco and Dumont. RCA’s increasingly
commanding patent position created fears of monopoly, especially since the
company’s style was to seek technological exclusivity. In 1930 the direct pressure of
consent decrees had pushed General Electric and Westinghouse out of RCA. (AT&T
had presciently given up its interests four years earlier.) The Justice Department had
found it increasingly uncomfortable to have the other companies, at the
manufacturing level, in supposed competition with themselves. RCA was no longer a creature of the industry but was now a corporation like any other. It did not dominate radio manufacture nor did it dominate programming, but none of its rivals in either of these spheres could match its total range of operation. Its corporate culture was a consequence of this. It owned a telegraph company and in 1937 was seen to be trying to extend its business in this area by buying up Western Union. It was a strapping and overweening bully-boy when it came to television. There Sarnoff was even prepared to take on the phone company by harking back to the earliest phase of the television research agenda: ‘The ideal way of sending messages (he said) is to hold up a printed sheet that will be immediately reproduced at the other end; facsimile transmission and television are about ready [for that]’ (Waldrop and Borkin 1938:127–8). Such behaviour provoked the thought in some minds that the Justice Department might have been deliberately encouraging the creation of a giant capable of taking on AT&T.

AT&T, with its history of constant conflict with the US government, tended to conduct itself with more restraint. It was far more amenable to cross-licensing agreements and the like, seeing the patent system as providing less complete protection than bargaining positions. Unlike RCA, AT&T’s corporate culture, formed in the Vail era, dictated controlled technological exploitation, careful market positioning and diplomatic engagement with the American regulatory regime. Since the threat was always against its telephone monopoly, it was prepared to share everything else to protect that core enterprise; that is to say, it always wanted a patent position in areas cognate to telephony. A good example of this can be seen in the way it chose to handle film sound. It did not directly take over Hollywood which its command of that technology would have easily allowed but which would have been anathema to the Justice Department. Instead, it made sound as widely available as possible.

It also sought to maintain a position with television. For example, when signing up every major film studio to its Westrex sound system, bar RKO which was owned by RCA, it insisted from the outset in 1927—well before any seriously viable all-electrical television system was in the offing—that all sound films shot using its equipment (the majority) were not licensed ‘for any uses in or in connection with a telephone, telegraph or radio system or in connection with any apparatus operating by radio frequency or carrier currents’ (Waldrop and Borkin 1938:128)—that is, television. In its usual farsighted way it was seeking a position in a developing technology which might metamorphose into a threat to one of its established businesses, i.e. the ERPE film sound company which marketed Westrex. Using ploys like this, AT&T hedged its bets. In the next decade, it maintained its interest in the videophone and concluded a deal for the Farnsworth patents which in turn gave it a lever over RCA. It was then forced to play the Westrex card by dropping all restrictions and limitations in the contracts and
royalty agreements for sound film as soon as RCA brought a legal threat to bear. But this concession allowed AT&T to force RCA into a general cross-patenting agreement (Greenwald 1952:185). At the end of the day, AT&T only had one real interest in this matter. It was determined to position itself in television as it had done in radio by building the network (p. 262).

Unfortunately, from the FCC’s point of view the other television players were less well placed and the commission could see them being swamped by RCA. The ostensible technical agenda of the American debate between 1936 and 1941 was comparatively meaningless. The hidden agenda was to hold down RCA by refusing to agree standards and permit a full-scale public service. The irony is that within weeks of this negative decision of the FCC in 1936, the Germans began broadcasting their version of the RCA system and within months the British variant was established as the London Television Standard. Defining the term ‘experiment’ as opposed to ‘service’ was becoming more a matter of policy than an assessment of the efficacy of the systems involved.

Thus RCA’s 1939 demonstration at the World’s Fair was designated as a ‘television service’, but by the company not by the commission. The RMA resubmitted barely altered suggestions for the standard but to no effect. A year later the FCC was still insisting that:

no attempt be made by the industry or its members to issue standards in this field for the time being. In view of the possibilities for research, the objectives to be obtained, and the dangers involved, it is the judgement of the commission that the effects of such an industry agreement should be scrupulously avoided for the time being. Agreement upon the standards is presently less important than the scientific development of the highest standards within reach of the industry’s experts.

(Fink 1943:11)

Had the war in Europe not suspended transmissions, the British would have been preparing to celebrate a fifth birthday at the time of this decision. The London Television Standard, with only 405 lines, worked well enough for there to be more complaints about repeats than about technical quality. The German broadcasts were not halted by war and their service continued. In America, the pattern established in 1927 to issue only experimental licences continued with anything between twenty and forty licensees being active, but without a standardised service. The FCC continued to insist that ‘As soon as engineering opinion of the industry is prepared to approve any one of the competing systems of broadcasting as the standard system, the commission will consider the authorisation of full commercialisation’ (Fink 1943:12).
In this stand-off situation within the industry and between the industry and the commission, the FCC and the RMA finally agreed to the formation of a National Television System Committee, which would include all qualified engineering opinions whether within the RMA or not. In short order, at least by comparison with the previous pace of events, 168 people produced 600,000 words in minutes and reports, met for 4000 man-hours and spent a further 4000 hours gathering on-site evidence and watching twenty-five demonstrations. All this was done within six months. From the time of the initial agreement to proceed in this way to the acceptance, by the FCC, of the final report of the NTSC a mere fourteen months had elapsed.

This was a rather less startling display of efficiency than appears at first glance. After all, virtually everything of substance had already been previously decided. The lines were increased to 525 because it was now known that this rather than 441 was nearer the effective maximum for the six megacycle band. FM audio was chosen. The VHF spectrum was secured. But for the rest the NTSC endorsed the RMA proposed standards of 1939 which were a rerun of the 1936 suggestions. On 27 January 1941, the chairperson of the FCC, James Fly, said: ‘This is another example of the best that is in our democratic system, with the best in the industry turning to a long and difficult job in an effort to help the government bodies in the discharge of their function so that a result may be achieved for the common good of all’ (Fink 1943:3).

What had been gained technically in television during the period of the 1936–41 delay was marginal: 525 lines were better than 441 lines but both were in the same range, the quality of the 16mm home movie image. At 525 lines that was still all that was achieved. As for the imposition of FM sound, it can be argued that the VHF band, being less subject to the sort of interference FM was designed to combat, did not require it—certainly, it required it less than did radio where the imperative was created by the poor quality of the AM bands. More than all this, at the end of the day in 1941, the two major technical options which really did need serious consideration were ignored. The possibility of moving to the UHF band, which the FCC had begun to license for experiment in 1937, was left hanging over the future of television and FM radio (which would have occupied the vacated VHF TV channels). And, prior to the NTSC agreement, CBS had demonstrated a viable colour system which was also ignored. Indeed the uncertainties of the art in 1941, when the bullet was bitten, were if anything greater than in 1936.

The introduction of a television service in the United States was delayed because the ‘law’ of the suppression of radical potential was at work. The disruptions feared were many. Television had to be made to fit into a media system already accommodating live events of all kinds, print, films and radio. And the diversity of manufacturing and programming interests had to be continued so that
the balances achieved across the entire mass communication industry would not be upset. Central to this were concerns over RCA’s approach. The British, grappling with the same problems, were quite specific as to what had to be guarded against. As the Selsdon Report which mandated the 1936 race between the television systems put it—‘any monopolistic control of the manufacturing of receiving sets’. The report goes on:

The ideal solution, if it were feasible, would be that as a preliminary to the establishment of a public service, a Patent Pool should be formed. We have seriously considered whether we should advise you [The Postmaster General] to refuse to authorise the establishment of a public service of high definition Television until a comprehensive Patent Pool has been formed.

(Selsdon 1935:16)

Although it had happened with radio, Lord Selsdon and his committee decided this was impracticable this time, perhaps because of the widespread range of techniques being suggested for television, and so gave the nod to the service anyway. In America the commission remained fearful of an RCA monopoly. However, the delaying tactic worked. RCA was contained. When television finally happened after the war, the firm was not alone. There were rival networks, many manufacturers, diverse programme suppliers. Its containment does not imply that it did not profit mightily from its television investment; as William Boddy says: ‘RCA…won the war’ (Boddy 1990:34). Nevertheless, it did not profit as mightily as AT&T had done from the telephone—that is, with a virtual monopoly.

The marketplace itself was not enough to ensure that result. On the contrary, since no ‘inventor’ came up with a system as viable as that of RCA’s ‘inventors’, the unfettered company would have cleaned up; or, as with early American telephony, chaos would have ensued with many minor competing systems needing to be absorbed. Hence the interventionist role of the FCC, unconcerned about the public but working most effectively to keep the industry stable through a period of threatened upheavals. The ‘law’ of the suppression of radical potential ensured that all the major radio industry players and AT&T should remain in the new game, and they did.

In this the commission was further aided by the war. The FCC had authorised the commercial (as opposed to the experimental) operation of television stations in accordance with the twenty-two NTSC standards on 1 July 1941. On 7 December the United States entered the war. The war prevented the creation of the mass medium of television but it also allowed the manufacturers to regroup for the new product with a minimum of disturbance. They ceased making domestic radios, more or less, and worked on material for the armed forces. When that stopped, they were
ready to take up television. Indeed, their need to make television receivers was the final supervening necessity.

However, if the end of the war found AT&T and the radio industry agreed about television, AT&T’s movie clients on the West Coast were not yet accommodated into the emerging order.

Received opinion has been that the film industry was caught napping by television and the Hollywood studio system was destroyed, but it is now generally agreed that the consent decree of 1948 forcing the studios to divest themselves of their cinema chains is of far greater moment than the arrival of American television’s first big year. At best, television was a third blow to Hollywood, which was not only suffering under this enforced reorganisation but also enduring the beginnings of McCarthyism.

The movie moguls knew all about television. After all the very first public television demonstration in America, by Jenkins, was specifically designed for the home delivery of movies. By the late 1920s AT&T was contractually limiting the studios by forbidding them the right to sell sound films which used its Westrex system to television even before the technology was in the marketplace. H.E. Alexanderson had used film for early GE television demonstrations in 1927 (Hilmes 1990:118). The Academy of Motion Picture Arts and Sciences in its report on television, in 1936, stated: ‘there appears to be no danger that television will burst upon an unprepared motion picture industry’ (Waldrop and Borkin 1938:126). By then radio shows, either with stars or edited soundtracks or both, had been produced in Hollywood for years and the movie community’s understanding of that world influenced its basic attitude to television. It was neither ignorant nor disdainful but rather imperialist. The moguls tried to usurp electronic distribution of video signals. They failed, but for all that their forces were distracted during a crucial period of television’s development, the ‘law’ of the suppression of radical potential saved them anyway.

Television became the dominant medium and it was owned by the radio interests yet, despite that, Hollywood (albeit changed and regrouped) nevertheless became its major production centre. Exactly how that was achieved constitutes the last phase of the operation of the ‘law’ of the suppression of radical potential in television history—from the end of the war to the mid-1950s. The maintenance of stability among the radio production interests during this same period is another element.

SUPPRESSING TELEVISION: 1948 TO THE MID-1950s

By 1948 television was finally poised to cover the nation. It had not been making much money but there were four networks, fifty-two stations and nearly a million sets in twenty-nine cities. In those communities, at least according to
popular press reports, all other entertainments were suffering. Then, in September, the FCC ceased to process licences. The official account justifies this action because stations, at 150 miles minimum distance, were found to be interfering with each other.

Originally, in 1945, the commission had determined that stations using the same channel should be 200 miles apart. This meant that whereas Chicago was assigned five channels, New York got only four and Washington and Philadelphia three each. The industry protested and the FCC dropped the distance to 150 miles against the advice of the engineers. The engineers were right. The confusion that followed caused a four-year freeze on new stations. A further 400 applications were simply held up.

Since it is clear that a competent radio engineer with a good contour map could have solved this problem in something less than the forty-three months it took the FCC, interference is scarcely a convincing explanation for the length of the delay. Adding the Korean War (which halted nothing else in America but which is cited as contributing) hardly helps to explain the length of ‘the freeze’.

The period between 1948 and 1952 saw the refinement of the de facto deal made in 1941 within the radio industry. The main threat to the stabilised diffusion period, which the 1941 agreement on standards had made possible, was caused by colour. By 1949, RCA engineers had produced what Sarnoff had demanded of them in 1946, a colour system compatible with the NTSC 1941 standards; that is to say, the colour signal would appear in black-and-white on a precolour monochrome receiver. Abandoning a semi-mechanical system, the RCA Laboratory concentrated on a method which used green, blue and red filters to sensitise three separate pick-up tubes within the camera. When the three resultant signals were superimposed on each other, via a system of mirrors, a full colour signal was created.

To receive it, RCA followed up on a concept of a German engineer, W. Flechsig, who had thought of a colour cathode ray tube in 1938, in which triads of colour phosphor dots, red, green and blue, were to be activated by a mesh of fine wires. Flechsig’s concept was simply an electronic version of the Lumières’ autochrome colour photography system of 1907 which also used this Pointillist sort of approach. Keeping the triads of phosphor dots, RCA engineers had modified Flechsig’s otherwise difficult, if not impossible, proposal by suggesting that instead of wires, electron beams could be used passing through a mask drilled with holes—hence ‘shadow mask tube’. When Sarnoff demanded a compatible colour system, this was the prototype to which H.B.Law of the Lab turned.

CBS had a rival system. It had been experimentally broadcasting in colour, under the direction of Peter Goldmark, since 1940, transmitting 343 lines. The CBS machine appears to be the very last in the line that starts with Nipkow in 1884, for Goldmark used a spinning disk, both in transmission and at the home end; but, as
the disk was used to create colour rather than for scanning, it really owed more to the earliest colour film projectors with their spinning trichromatic filters (Anon 1940:32–3). Goldmark was in a considerable tradition, even leaving the pre-twentieth-century Russian proposals aside. Baird, using trichromatic filters in a disk, had transmitted a colour picture in July of 1928 (Norman 1984:50). After his retirement from the race of 1936 he went back to this work. Also, in 1929, Dr Ives, of the Bell Labs’ videophone, although presumably no more certain as to the utility of the device than he had been two years earlier, nevertheless revealed a colour version (Ives 1929). It used sodium photo-emissive cells that were sensitive to the full range of visible colours.

In 1941, the NTSC had ignored both this tradition and the CBS experiments when making its recommendations; but, as it did not believe colour developments would necessarily result in compatibility with the monochrome standards it was establishing, this was logical. In a questionnaire issued at that time, the NTSC advisory panels concerned with this matter voted twenty-eight to seven against a compatibility requirement (Fink 1943:41). Anyway, contrary to the received history, by the late 1940s the CBS system was compatible with RCA monochrome receivers, if they had tubes smaller than 12 1/2 inches and a simple tuning bracket had been added to the set. In the light of this the FCC, determined to thwart any further extension of RCA’s dominance of television technology, adopted the CBS system in the middle of the freeze, in September 1950. The ploy did not work and the system was never introduced to the public. The manufacturers, tied to RCA for their black-and-white business, refused to accommodate the CBS bracket or make spinning disk receivers. A lawyer, involved in a congressional investigation of the FCC’s apparent failure to implement its stated anti-monopolistic policies, wrote: ‘We do not know whether any pressure was brought on them [the manufacturers] by their licenser [RCA]; but we do know that their refusals effectively ‘killed’ the CBS colour system which the FCC had adopted’ (Schwartz 1959:789).

A Senate report of 1950 evaluated the CBS/RCA systems (and a third system in a yet more experimental state) finding, across some eighteen measures of utility, efficiency and effectiveness, that the RCA system had eight better performance characteristics than CBS, four as good and six worse. In all, CBS’s colour fidelity was deemed to be better, but its sets could not, because of the spinning disk, produce pictures bigger than about 1 foot across (Senate 1950).

It might perhaps be thought that this hidden battle about colour, rather than the public débâcle over station distances, was the reason for the freeze. In one sense this is true, since the colour issue was part of the whole question of the continuing stability of the radio industry during the period of television’s initial diffusion. But colour in a more direct sense cannot be the reason. It came to the fore after the freeze had begun and was resolved, in favour of RCA, after it was over—at the end
of 1953. Anyway, rather like the British introduction of monochrome service in 1937, colour was premature. Americans no more rushed to buy colour sets than had the British to buy black-and-white televisions in the late 1930s. Sales did not really take off until the early 1970s and the result of American pioneering in the early 1950s was the adoption of an RCA system markedly inferior in quality to the systems developed slightly later for European broadcasters.4

The Commission, in opting for RCA colour in 1953, abandoned the rhetoric it had used to constrain television in the late 1930s and early 1940s; that is, an argument that delay was necessary because technical improvements could be expected. Further, the RCA decision was made despite the policy of resisting monopoly in all aspects and at all levels of American broadcasting. FCC lawyers warned of the serious consequences of proceeding with the RCA system without considering the patent situation. However, the commission had seen that the dangers of RCA’s monopoly were less disruptive to the industry than an insistence on the CBS system for the ideological sake of diversity (Schwartz 1959:788). Some went so far as to suggest that the colour inquiry was reopened, after the wavelength assignments had been cleared up, specifically to consolidate further the protection the major players had already received (Boddy 1990:51).

Beyond the fracas about colour and signal interference, the truth about the freeze was that the industry was not ‘frozen’ by it at all. In 1946 there were 5000 sets. By 1950 there were just under ten million. Two years later, the number of sets had increased to fifteen million and more than one-third of the population had them. Television was bringing in 70 per cent of broadcasting advertising revenues by 1952. The ‘freeze’ worked to suppress television as an area of exploitation for new interests. NBC, after all, had been encouraging its affiliates to obtain television licences for years. It and its main rival, CBS, transferred their hegemony to television. The owners of the first 108 stations, in effect the radio industry, were able to bed down and sew up the new structure as an echo of the old (Boddy 1990:50). The shape of American television behind this protective wall was established with the minimum of disturbance, despite the internecine disputes. Advertising revenues, programs and personnel were transferred from radio to television with comparative ease.

The freeze concluded with the issue of the FCC’s Sixth Report and Order which institutionalised these results. By 1952, in utter obedience to the ‘law’ of the suppression of radical potential, the broadcasting industry had metamorphosed from radio to television and nearly every audio-caterpillar had successfully become a video-butterfly.

Something else, less remarked upon, also happened during the ‘freeze’. In 1948 the top programme in the television schedule was Milton Berle’s The Texaco Star Theater on NBC, a variety show. It was soon joined by Ed Sullivan’s Toast of the Town on CBS. Both of these were live productions from New York. In 1952 the top show
was filmed in Hollywood, *I Love Lucy*. This is not to say that in these four years production moved from the East to the West Coast. It is simply to point out that the television industry’s structure, which looked at the outset of this period to be essentially live and in New York, looked at the end of it also to have a place for film and Hollywood. The implications of this move would take most of the 1950s to work out, but by the end of the decade, the era of the live New York productions in the prime-time schedule was largely past and people were already referring to it as ‘the Golden Age of American television’.

Hollywood’s first idea about television was to incorporate it. All the early pioneers had shown large screen as well as small formats and the possibilities of theatre television looked as real as domestic options. At the Swiss Federal Institute of Technology Professor Fischer shared Hollywood’s general view of television’s potential as a theatrical entertainment form and, in 1939, he developed the Eidophor which was to become the standard device for large screen television projection (Dummer 1983:119). In 1941 RCA demonstrated a $15 \times 20$ -foot screen which was installed in a few theatres (Hilmes 1990:121–2). By 1948, Paramount’s own system was installed in their Times Square showcase and the heavyweight boxing bout was established as a staple of the distribution system. By 1952 a network of more than a hundred cinemas was equipped with electronic systems yet within a year, theatrical television’s promise had been blunted (ibid.: 123). AT&T used the coaxial rate card to price the movie interests out of the market while the FCC denied them the right to use parts of the UHF spectrum instead. This block occurred exactly at the moment the freeze ended and the boom in domestic television finally took off. Even as this market opened out for its product, the film industry also decided to roll out a number of technological responses, as alternatives, as it were, to the Eidophor—Cinemascope, 3-D and other spectacles (ibid.: 123–4). Theatrical television, except as an occasional technique for big boxing matches, was totally suppressed. The large screen equipment, especially the Eidophors, survived as back projection devices only inside television studios until colour allowed for electronic image matting—Colour Separation Overlay (CSO)—instead.

A further option was explored during the ‘freeze’ and took a longer time to die, if indeed it is dead yet. Subscription television, for which (by the late 1940s) there was an ample range of hardware, began in Chicago on a trial basis in 1949 (Hilmes 1990:126). In 1953, Paramount’s test in Palm Springs was closed in response to a threatened legal action. The charge was that as the producer of the films it was showing on its system, it was once more, and illegally, engaged in exhibition. In 1953 it bought itself into ABC and became a major part of the raucous campaign against pay television which, for a time at least, united the cinema owners and the broadcasters. The FCC regulated these tests, but made it clear that it thought its duties lay in protecting the existing system from unexpected competition. Pay TV,
where individual programs rather than whole channels or services are bought, also languished.

Hollywood’s way forward into the television age did not lie with alternative television distribution systems but with the radio broadcasters. The freeze had shown two things: first, that short-form Hollywood series could be as popular as anything produced elsewhere, and, second, that old movies had appeal. The studios were quicker to respond to the former possibility. They had difficulty in establishing telefilm operations because to do so would have upset their theatrical clients—just as, in the 1980s, the American networks could not offer popular programme services to the cable industry without upsetting their broadcasting affiliates. But despite this, RKO did set up a subsidiary for telefilms as early as 1944. Slowly the deals were done; ABC with Hal Roach Jr; the first Disney special; Warner Brothers Presents.

After the freeze the trickle of Hollywood prime-time product became a flood. By 1955, telefilm raw stock consumption was ten times greater than that of the feature side of the industry. Of course, there were many new production entities involved in this but, despite the rise of some smaller entrepreneurs, it was essentially old Hollywood. A few of the players had regrouped under new banners but most were still manning the same stores.

After the freeze, with this beachhead in the schedules firmly held, beginning with RKO in 1956, the majors sold their libraries. By that time, New York had come to call, with both CBS and NBC building major production facilities in Hollywood, consolidating the tradition begun with radio. New York was left with news, sport, documentaries, variety and the daytime soaps, and Hollywood got the dramatic staple of the schedule. In 1949 none of this was clear. By 1952, the mould of American broadcast television was setting fast. After the freeze, the number of stations jumped to 573 broadcasting to nearly thirty-three million receivers. Between 1955 and 1960 another eighty stations and 36.5 million sets finally made America into the earth’s first televisual nation (Owen 1962:820).

The ‘law’ of the suppression of radical potential worked against the supervening necessities to hold television in limbo just outside widespread diffusion throughout the 1930s and 1940s. After the supervening necessity of spare electronic industry capacity made its introduction inevitable, the ‘law’ worked to contain its disruptive forces. This is true not just of the United States where the regulatory process existed in such an uneasy harness with the potential excesses of the free market—in the sense that, without the FCC, America could well have had more than one system on more than one standard, as had been the case with telephony in the years between the lapse of the Bell master patent and the imposition of order by the US government. In the UK, where government fiat had encouraged the premature television service, post-war progress matched that of the United States, although it was conducted somewhat more rationally. Here, and throughout most of the rest of
the world, the ‘law’ of the suppression of radical potential worked straightforwardly through austerity.

By the end of 1952 there were still less than three million receivers in the UK. When, by 1952 (the year when America finally got the go-ahead for national television), the BBC completed its network of major transmitters to reach 78 per cent of the population, it had less to do with the shakedown of warring elements within the industry than with basic economics. Yet there were such elements, and, as had been the case with radio, the BBC was allowed to develop a new technology without competition from commercial broadcasters. Only when the system was established and the BBC had successfully transformed itself from a radio into a bi-media entity did the advertising lobby in Britain finally get in on the act, winning, in 1954, the right to broadcast commercials and also, necessarily, the programs to put round them.

Elsewhere, with improving economic conditions, 1952/3 marks the true start of television diffusion. Italy began a five-year plan to cover the nation. North Germany’s network was completed. The French added Lille to Paris and started work on three other transmitters. In Canada, CBC began programming. By the early 1950s, and only then, could it be said that television had finally arrived. Further, in every nation, the arrival did not displace whatever interested parties pre-existed the ‘invention’. Everywhere, radio manufacturers and producing entities switched to television. There were no casualties. There were few new faces.