University of Strathclyde

Department of Mechanical Engineering

An Early History of British Military Television with special reference to John Logie Baird

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Statement of Copyright

Acknowledgements

No path to a completed Doctoral thesis is ever easy and this one has required its own complement of struggle. I would therefore like to thank those that have assisted me in many ways to reach the conclusion of my work.

Firstly I would like to record appreciation for Doctor Peter Waddell who invited me to Scotland to commence research. Throughout, the irrepressible Dr Waddell has been a constant source of assistance and enthusiasm. There were many others whose assistance I appreciate. These are: Dr Jan Uhde, Bill Boehlen, Neil Rimington, Michael Bennet-Levy and Elsie Thomas. I would also like to thank for their assistance the staff of the Public Record Office and Christies; Mary Godwin of Cable and Wireless and Victoria Williams of Hastings Museum.

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Without the continuing support, in many ways, from Professor Malcolm Baird and his sister Diana Richardson this thesis may never have been completed, for which I am eternally grateful. The same can be said of Ray Herbert, whose guidance is manifest throughout this thesis.

There are many others who have assisted me during my researches and I thank from all for their help.

And to Lesley, who has been my partner throughout research for this thesis -
this chapter is at an end and the next is just beginning.

Contents

Abstract

Since the Publication in 1986 of *The Secret Life of John Logie Baird* by Tom McArthur and Dr. Peter Waddell the subject of J.L.Baird and his company's involvement with British military technologies has been brought to public attention. There has previously been no comprehensive academic assesment using primary sources of the suggestions offered in these books. Here is recorded British military television investigations from 1926 to 1946, with special reference to J.L.Baird, using previously ignored Public Record Office files and other sources.

The precise role of J.L.Baird in Baird Television Limited (BTL) after the mid-1930s is discussed but still remains a matter for debate. This situation is important to the understanding of who was responsible for the variety of military projects undertaken by the Baird organisation.

The technology of aerial reconnaissance using television had a strong influence on British military television investigations. Television for aerial reconnaissance was the first military application suggested for the technology and became practical after the fighting services contacted J.L.Baird in 1926. This investigation continued with BTL into the 1930s and later included Marconi-EMI. These activities have had little previous assessment and yet significantly influence British military television history.

During World War Two J.L.Baird personally investigated a facsimile system whilst being funded by Cable and Wireless. The technology used by J.L.Baird was based on a rapid processing camera for facsimile transmission. This technology had previously been investigated by his company in collaboration with the Air Ministry and Admiralty from 1937 to 1940 for Television aerial reconnaissance.

There can remain no doubt that militarily useful applications of television, particularly for aerial reconnaissance, were a significant part of the investigations of J.L.Baird and his companies

This thesis is dedicated to my father

Warren Gooding Hills

3.5.33 - 20.10.99

CINTEL

RANK CINTEL LIMITED
Worsley Bridge Road · Lower Sydenham · London · SE26
Telephone Hither Green 4600 · Telegrams Cintel London SE26

Our Ref. BLJM/EG.
Your Ref.

6th March 1962.

Mr. W.G. Hills,
64 Anerley Park,
ANERLEY. S.E.20.

Dear Sir,

We write to offer you employment with this Company as Development Engineer in our Television Department, at a salary of £1,050. per annum, payable monthly in arrear; notice is determined by one month from either side.

You would be granted one day per week for attendance at Technical College until the end of the session 1962/63.

The present hours are from 8.48 a.m. to 5.15 p.m. Monday to Thursday, and to 4.45 p.m. on Friday. There is a three-quarter hour mid-day lunch break, with Canteen facilities.

The Company operates a Pension Fund, and it is a condition of employment that all full-time employees join when they become eligible; a brief outline of the scheme is enclosed herewith.

We should be glad if you would complete and return the attached form to us, giving your acceptance to the terms of this engagement, and perhaps you would also let us know the earliest date you can commence your duties with us.

Yours faithfully,
RANK CINTEL LIMITED.

B L J Murphy

B.L.J. Murphy.
Personnel Manager.

Encl.

Directors: The Lord Rank, J.P. (Chairman) John Davis (Joint Deputy Chairman) G. Dernley-Smith, C.B.E. (Joint Deputy Chairman)
J. C. G. Bell (Managing Director) W. M. Codrington, C.M.G., M.C. C. C. Moore Dudley Seward, O.B.E. Kenneth Winckles, M.B.E.

Warren Hills worked for a couple of years at Rank-Cintel until March 1964 when the Worsley Bridge Road premises was closed. He was reluctant to move with the company because he had a second child due the following month. Whilst at the company he assisted in bringing the tele-cine apparatus out of the valve age and into the new era of transistorisation.

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1 Introduction

1.1 A very brief history of John Logie Baird

Since the Publication in 1986 of *The Secret Life of John Logie Baird* by Tom McArthur and Dr. Peter Waddell the subject of J.L.Baird and his company's involvement with British military technologies has been brought to public attention. Suggestions in this book differ from the conventional history of J.L.Baird as defined by the majority of all Baird historians. [i] It will be noted that unlike the suggestions initiated by McArthur and Waddell, little attention is given to military investigations or the divide between J.L.Baird and his company. The following is a brief synopsis of the conventional history of J.L.Baird.

John Logie Baird was born in Helensburgh on August the 13th 1888. As a schoolboy Baird showed an early interest in technology. He constructed a glider, a telephone exchange and provided his family home with electric lighting. During his early school days he met Jack Buchanan who became a life long friend and who co-financed J.L.Baird's last business venture in 1944. At the Glasgow and West of Scotland Technical College, now the University of Strathclyde, John was given technical training that was to serve him well during his television investigations. The outbreak of World War I deprived him of commuting his diploma to a degree at the University of Glasgow. He attempted to enlist for active duty but was rejected on grounds of ill health. Instead of fighting, he was employed by the Clyde Valley Power Company as a mains engineer. During this period he made various contacts which were to be useful in later life as well as developing an entrepreneurial spirit. Money gained from the successful sale of a special sock provided John with the ability to travel to Trinidad. This protracted trip was the first of a variety of journeys he made to foreign countries and began his life long interest in global rather than national, social rather than capitalist concerns.

On return to Britain the Scotsman moved south and undertook various business ventures in London. With failing health, a problem that recurred throughout his life, he travelled further south to Hastings. In 1923 John Baird resurrected his interest in television which he had first investigated as early as 1912 in Scotland. He then obtained his first television patent and subsequently formed a company, Television Limited. After gaining the first stages of success by transmitting simple monotone silhouettes, known as shadowgraphs, he then moved his concern to London. In his laboratory at 22 Frith Street, Soho, he achieved true television images in October 1925 and publicly demonstrated them on the 26th of January 1926.

This success gained the inventor great public interest and much needed finance. He developed and expanded his company whilst improving his television system. After moving to larger laboratories at 133 Long Acre in 1928 he demonstrated colour, stereo and trans-Atlantic television. There then followed a period of rapid expansion with the formation of various oversees subsidiaries, including Baird-Nathan in France and Fernseh A.G in Germany, under the umbrella of the Baird International Television company. After initial resistance from the Post Master General and the BBC, Television Ltd began experimental transmissions of 30-line television in Britain in 1929. These broadcasts were taken over by the BBC in 1932 and continued until 1935. The 30-line service gained much public interest for television and it was decided to establish a television service using a higher definition. In order to choose a system both Baird's company, now called Baird Television Limited (BTL), and Marconi-EMI (M-EMI) were entered into public broadcast trials in November 1936 at Alexandra Palace in north London. After the destruction of much of the BTL laboratories, equipment and records in the fire at Crystal Palace in south London, M-EMI were chosen as the company to continue public television.

BTL, which had been effectively owned by the cinema chain Gaumont British Picture Corporation (G-BPC) since 1932, then turned its attention to the development and production of large television screens for installation in cinemas. After five installations and orders for many more, this activity was halted by the outbreak of World War II in September 1939. Proceedings to place BTL into receivership were begun and much of the staff of the company dispersed into war related activities, particularly in the new technology of radar. In the late 1930s BTL had investigated television aerial reconnaissance for the French Government and produced equipment. This experimentation continued during the war but was curtailed by the fall of France.

John Logie Baird had drifted apart from his company when G-BPC assumed control and he continued research independently of the company. He had personally demonstrated television in cinemas during 1930 and 1932 and added colour to a cinema television screen in 1938. After the dissolution of BTL in 1939 he then concentrated on colour and stereoscopic television, which he researched and demonstrated at his home near to the remains of his company at Crystal Palace. Finance for these and facsimile experiments were generously provided by the Cable and Wireless company. In preparation for the post war period the pioneer of television formed John Logie Baird Ltd with his schoolboy friend Jack Buchanan. Unfortunately, ill health dealt him a fatal blow on the 14th of June 1946 and many of his dreams for post war television died with him.

....

And that is the general understanding of the history of the man and his companies. Most of the books reviewed for the above synopsis generally emphasise the activities of J.L.Baird personally. The books *John Logie Baird, television pioneer* by R.W.Burns, *Seeing by Wireless* by R.M. Herbert and the CD-ROM *Visions: The Life and Legacy of John Logie Baird* by A.R. Hills are an exception to this statement as they provide some information from the perspective of the Baird Company. This thesis assesses Military television technologies from both J.L.Baird's perspective and that of his company.

1.2. The first television experiments by J.L.Baird.

Fig. 1.1. *17 Coldingham Avenue, Yoker*
Source: R. Haas

The subject of John Logie Baird's first experimentation with television has been of interest to historians. Since this matter was first addressed in historic literature by Dr Peter Waddell in 1976, other information has become available. In his autobiography, J.L.Baird describes his experiments with selenium in his parents' kitchen in the first decade of the century. This chemical was capable of transducing light waves into an electric current and may have been investigated for potential use in television experiments. In 1976 Dr Peter Waddell suggested that Baird's first experimentation with television was at 17 Coldingham Avenue, Yoker between 1912 and 1915[ii], and R.W.

Burns reinforces this suggestion in his 1986 book *British Television: The Formative Years.* [iii] In 1996, Malcolm Baird stated that it is very possible that his father's first work on television was at Yoker.[iv] This subject was also discussed in the author's first thesis about J.L.Baird in 1996 called *Eye of the World: John Logie Baird and Television.*[v]

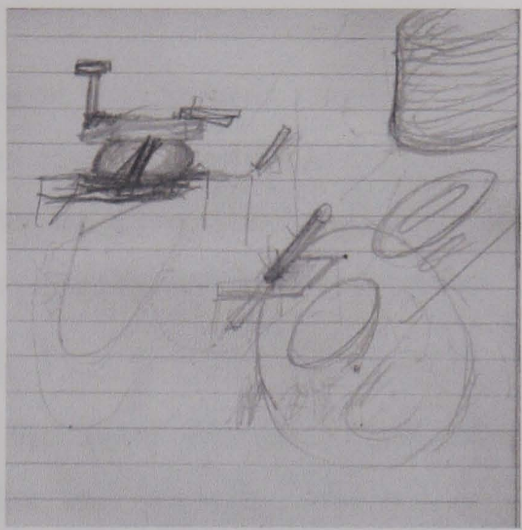

Fig. 1.2 *Images from J.L.Baird's College notebooks*

Source: University of Strathclyde

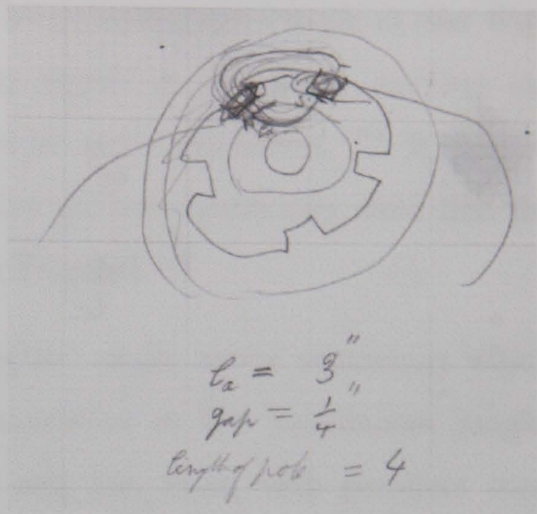

Fig. 1.3 *Image and text from J.L.Baird's College notebooks*

Source: University of Strathclyde

Whilst at the University of Strathclyde the author reviewed, in the archives, various notebooks which belonged to J.L.Baird. The University was originally the Glasgow and West of Scotland Technical College and it was there that J.L.Baird studied engineering for a Diploma. Dr Douglas Brown has suggested to the author that two images contained in these notebooks may refer to television like devices. Figure 1.1 could be interpreted as being a Nipkow scanning disc with spark emitter and Figure 1.2 could be a phonic wheel used for synchronising a television transmitter with a receiver. This similarity is also noted in the author's CD-ROM *Visions: The Life and Legacy of John Logie Baird.*[vi]

In *Vision Warrior* MacArthur and Waddell suggest that full-system television experiments were also conducted in Trinidad. The authors quote an article by J.L.Baird entitled "My Fight for a Dream", published in the *Sunday Chronicle*, 15 November, 1936: *"Then my health broke down and I decided to go to Trinidad. There I would not only recover my health, thus enabling me to carry on with television, I would also make some money, which I could spend on experiments".*[vii] Dr Waddell supplemented this information in an undated letter to Nicholas Moss. In this letter Waddell quotes the following week's edition of the *Sunday Chronicle* which recorded J.L.Baird in an item entitled "How Television was Born" as stating *"The only progress I made in that West Indian year was towards television. I spent my nights in the jungle working out problems, and on my return to England I was ready for new experiments."*[viii] It must be noted that the above statements made by J.L.Baird do not specifically state that the Scotsman actually undertook experiments whilst in Trinidad.

In *Vision Warrior* anecdotal evidence is added to the above statements which suggest that there was actual television experimentation in the Trinidadian jungle. MacArthur and Waddell quote a Mrs. Murrain and Mr. Bain, who recollect their conversations with a Mr. Aparico. Mr. Aparico was an assistant to Baird, and according to Mr. Bain, said, *"Cables were connected between the two houses so that pictures were visible. Apparently they were seen hazily, but one could recognise the faces that appeared..."*[ix]

The authors also quote a Mr. Philip Yearwood as stating, *"I was told that locals suspected* [Baird] *was practising obeah, or black magic, because of the strange flashing lights in the house at night".*[x] This author has questioned Mr. Yearwood on this subject and he stated that after McArthur and Waddell had contacted him, he asked the friend who had given him this initial information for more information. Mr. Yearwood said that his friend then denied all knowledge of this earlier statement[xi]. The aforementioned quotation of Mr. Bain regarding Mr. Aparico's statement which suggests recognisable faces were transmitted may not be correct. When J.L.Baird did his experiments in Hastings, two of his assistants, Victor Mills and Norman Loxdale, state that the inventor was *"...pleased when he finally saw a shadowgraph of Mills' fingers"*[xii]. The date associated with this picture is March 1923. A shadowgraph picture is only a basic black and white outline. In 1925, Baird himself wrote of his problems in getting beyond a shadowgraph picture,

> *The distinction between the transmission of shadowgraphs and that of actual objects* [such as a face] *is much greater than is first apparent. With shadowgraphs the light-sensitive cell is only called upon between total darkness on the one hand and the full power of the light source...*[xiii]

The attainment of light and shade detail rather than black and white outlines is the only way of showing a recognisable face. This is considered true television, which J.L.Baird was first to achieve on 2 October, 1925. It is therefore unlikely that J.L.Baird achieved true television in Trinidad in 1920, and then on return to Britain was unable to reach this important stage again for another five years. Malcolm Baird was questioned on his father's work in Trinidad. He stated that a further problem for his father at that place and time was the lack of a reliable electrical supply for such things as the photo-cells and electric motors[xiv]. Whether J.L.Baird actually worked on television in Trinidad has as yet to be fully substantiated.

1.3 The relationship of John Logie Baird to his companies

The interaction between British military organisations and John Logie Baird can be clearly established during the first investigations in the 1920s and early 30s. However, according to J.L.Baird's autobiography he took a less active role in his company when the Gaumont-British Picture Corporation assumed control in 1932. This separation of J.L.Baird from his company is key to the understanding of who was responsible for the military investigations. Below is testimony from past-Baird employees and J.L.Baird himself, which emphasises the split between the inventor and his company.

Ben Clapp, one of J.L.Baird's more important assistants has written,

As you may be aware Capt. A.G.D West (ex-Asst. Chief Engineers BBC) joined the Baird Company as Technical Director in late 1932. Almost from this time Baird had little to do with the Company's work but carried out experimental work at his home at Crescent Wood Road, Sydenham in a laboratory specially built for him by the company and on a grant of money from the company.[xv]

Another of Baird's assistants Bill 'Curly' Sayers has written,

Baird was greatly estranged from Baird Television, decisions were made by A.G.D.West (who later was killed in a climbing accident in Switzerland) and T.M.C. Lance. To the best of my knowledge Baird only visited the Crystal Palace laboratories once between Sept. 1935 and the day of the fire, he frequently spent time in his lab, on one of the floors of the South Tower where he had a transmitter, this was not affected by the fire. Captain West recently appointed as Technical Director of Baird Television on 13th July 1933 told [Noel] *Ashbridge of the BBC that Baird was "in the process of going out of the Company"*[xvi]

Paul Reveley, who worked for J.L.Baird from February 1932 to late 1938, has made similar observations,

Thereafter [1933], *concurrently with a major injection of new funds from the Gaumont British Film Corporation, Capt. A.G.D. West was recruited to oversee their* [BTL] *expenditure, and he became de facto Managing Director. J.L.Baird was pushed to one side of the main stream of his company's activities from this time forward... For reasons of continuity of outward publicity policy, this fundamental change of responsibility was never explicitly announced, and from* *outside J.L.Baird continued in public image to be the presiding genius for all the Baird Company's activities, regardless of whether they were in fact within his circumscribed area of decision or not.*[xvii]

The following note, written by J.L.Baird during a board meeting, noted as from 1938 but more probably from 1932, reinforces the above point.

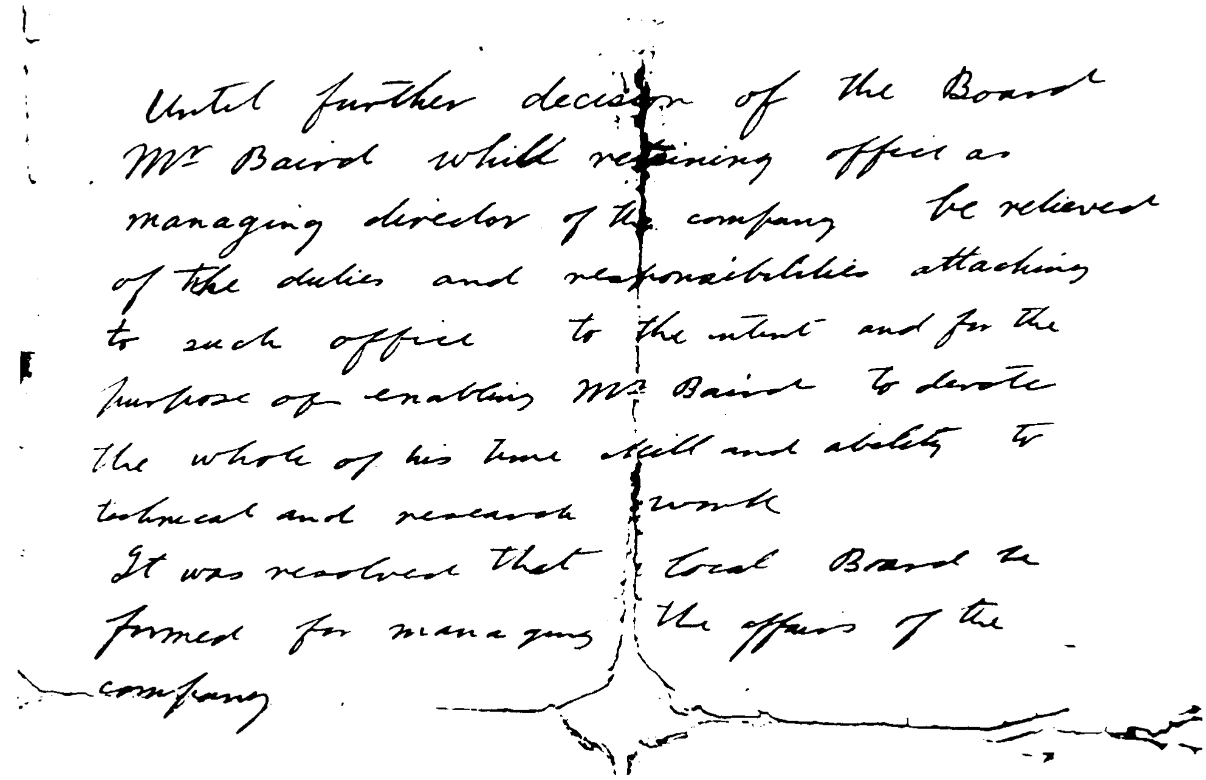
Until further decision of the Board
Mr Baird while retaining office as
managing director of the company be relieved
of the duties and responsibilities attaching
to such office to the intent and for the
purpose of enabling Mr Baird to devote
the whole of his time skill and ability to
technical and research work
It was resolved that local Board be
formed for managing the offices of the
company

Fig. 1.4 *A note written by J.L.Baird.*
Source: R.M. Herbert

Text of above note

Until further decision of the Board Mr Baird While retaining office as managing director of the company be relieved of the duties and responsibilities attaching to such office to the intent and for the purpose of enabling Mr Baird to devote the whole of his time [,] *skill and ability to technical research work*
It was resolved that local Branch be formed for managing the offices of the company

Later military communication with Baird Television Ltd from 1936 to 1940 usually directed its enquiries to Captain A.G.D. West. The Public Record Office (PRO) files from this period concerning television reconnaissance investigations and allied facsimile research make no direct reference to J.L.Baird personally. This situation is also shown in the PRO files concerning Cinema Television Limited during the war when it was manufacturing components for military purposes. The wartime diaries of J.L.Baird, generously supplied to this author by Professor Malcolm Baird as well as the notes of Dr Szegho, indicate that there was some interaction between J.L.Baird and Captain West, but provide no detailed information about the nature of interaction. For instance on January 11th 1940, J.L.Baird simply writes in his diary, "*Ring West.*"

1.4 Research Method

All historic investigation whether academic or otherwise is subject to the choice of sources selected for the investigation. Primary sources, those which have the least interpretation are considered the most valid. However, these sources, for instance Public Record Office files, are in themselves interpretations of events by those responsible for providing the initial recording, and this in turn is subject to the selection process of those who assembled the files.

Another important consideration is the dominant trends of historic investigation. The dominant trends of J.L.Baird investigators have provided a general consensus of information as illustrated above. The books of McArthur and Waddell have suggested an alternate interpretation and this in turn has created an alternate historic trend which has introduced a variety of new subjects for historic consideration. It will be demonstrated that not all of the suggestions by the Scottish authors can be validated by other sources. Some of the facts recorded by the these authors have indicated directions of investigation that reinforces a wider interpretation of the history of J.L.Baird. Further research has provided much information that supplements the suggestion that J.L.Baird and his companies were active in military technologies.

The investigative route from which a thesis such as this is derived is important in the understanding of the information recorded and the method used to obtain the information. Below is a brief synopsis of the history of the author's research into John Logie Baird.

The author's first investigation on J.L.Baird produced a short undergraduate paper for a course at the University of Waterloo, Canada in March 1995. To provide information for this paper a handful of sources were reviewed and augmented with an interview, which was recorded on video film, with Professor Malcolm Baird. Following this paper an undergraduate thesis based on a much wider body of information and personal interviews was researched. To this end, a trip to Britain for a month in 1995 was undertaken. In Britain many articles about J.L.Baird from the Science Museum Library and other sources were reviewed. Two trips to Scotland were arranged and interviews with Dr Peter Waddell, Douglas Brown and Diana Richardson, J.L.Baird's daughter were recorded on videotape. Video recorded interviews were also made with Baird historian Neil Rimington and past Baird employee Ray Herbert. Whilst writing the thesis at the university of Waterloo there was regular consultation with Professor Malcolm Baird and Dr Peter Waddell via e-mail. In April 1996 the author graduated with a BA (Hons) in Fine Arts with a specialisation in Film Studies, which was recorded on the Dean's Honours list. After reading the final text of the author's academic thesis Dr Waddell provided an invitation to Scotland to review his collected information on J.L.Baird and research for a Doctoral thesis.

In October 1997 the author entered the University of Strathclyde Department of Mechanical Engineering directly under Dr Waddell. The author was then provided direct access to the extensive files collected by Dr Waddell in his twenty years of research on the subject of J.L.Baird. The basic remit of research was to investigate further the various suggestions put forward by Dr Waddell and McArthur's books as well as to find new information concerning British Military television technology that related to J.L.Baird.

Douglas Brown was also researching J.L.Baird at the University of Strathclyde and produced a MPhil concerning the electronic investigations of Baird. It was decided that both Brown and the author would divide research on Baird so that he investigated the commercial public aspects whilst the author directly assessed military investigations. This division was in principal a good idea as it meant that as much research as possible could be undertaken and two complimentary theses be produced. The original idea was that information found would be shared and used by the relevant investigator. Since being awarded with his doctorate in November 2000, Doctor Brown has placed his thesis under a moratorium. Dr Brown has informed the author in an e-mail of the 8th of March 2001 *"I am afraid that my publisher indicated that a moratorium was necessary to avoid any unnecessary publishing of the material prior to them deciding on a release date for the book."* The publisher of Dr Brown's book will be Mr Gilbert Tomes.

There are also the diaries of Mr Gilbert Tomes, a scientist who worked for Cinema Television Ltd during WWII on technologies such as photo-cell production and cathode ray tube production. Mr Tomes has assembled some of his memoirs in a document entitled *Jumbo's Diaries*, and these include specific reference to his activities with the Baird organisation. Various Baird historians have copies of these diaries including Dr Brown, Anthony Kamm, Ray Herbert, Professor Burns and the author's supervisor Dr Waddell. Unfortunately, these diaries were not available for consultation by the author.

The inability of the author to review the PhD thesis of Dr Brown or the diaries of Mr Tomes obviously affects the information contained in this thesis.

Whilst researching full-time, the author produced a CD-ROM entitled *Visions: The Life and Legacy of John Logie Baird* for the Scottish Cultural Resources Access Network. The process of designing a hypertext-linked series of information emphasised to the author the value of a cross-referential structure for information, which in turn affected the design of delivery of information in this thesis. Much specific research was undertaken. The resultant CD-ROM was released at a University media event coinciding with the opening of the University of Strathclyde John Logie Baird Centre for Visions Technology. The CD-ROM has since received positive critical review in the television history journals *405-Alive* and *Newsletter of the Narrow Bandwidth Television Association.*

During a public lecture about J.L.Baird at the IEE in Savoy Hill in 1997 the author met Professor Russell Burns. Prof. Burns, at that time the only other person to have obtained a PhD on the subject of J.L.Baird, suggested that one of the fundamental problems facing Baird researchers was the lack of information about Baird found in the Public Record Office (PRO) in Kew. In *Vision Warrior*, Mc Arthur and Waddell express a similar opinion with reference to PRO file AIR 2/1775 and state on page 243, *"This filed information is particularly valuable, as no other indication has ever been located of the Baird Company's involvement in secret contracts for the British Government and other foreign powers".* The author then chose to investigate if this was the case. After many weeks researching at the PRO it was discovered that there were a considerable number of files concerning British military television research many of which include the Baird organisation, some of which record secret contracts placed with the company.

Dr Waddell and Professor Burns have focussed on two PRO files AIR 2/269 and AIR 2/1775. The former discusses the earliest military television investigation and refers directly to J.L.Baird personally. The latter records a British perspective of television aerial reconnaissance (TV/AC) as investigated by Baird Television Limited and Marconi-EMI. After further research at the PRO other important files were discovered, particularly AVIA 13/1263 and ADM 1/18581 which provide a considerable amount of information about TV/AC. Then the PRO upgraded its public search system to a computer database which greatly assisted the search process. The many files already discovered could then be supplemented by others found rapidly using this system.

The time available for research at the PRO has had a direct influence on the contents of this thesis. Dr Waddell and Professor Burns had to travel to London and stay in rented accommodation for research at the PRO. This situation obviously restricts the amount of time available for research. The author had considerably less restriction, being a native of London with parents still residing there. The author was therefore able to stay in comfortable surroundings for weeks at a time and research at leisure. This situation, combined with the variety of PRO files available that have not been previously reported, has produced a thesis focussed on this source.

The discovery of these PRO files has influenced the subjects discussed. Whereas, television aerial reconnaissance occupies small parts of McArthur and Waddell's books as well as Professor Burns' recent book, it is discussed here from a much wider perspective. Ray Herbert, who worked on part of the Baird TV/AC project, and who has published articles about this activity, was unaware of the extensive nature of these investigations. Gordon Craig developed the rapid processing technique for the Baird Intermediate Film system which was later investigated many times by the Admiralty, Air Ministry and Signals establishment for a facsimile version of TV/AC. Craig became Squadron Leader Craig and was awarded an OBE for his wartime activities with photographic reconnaissance. He was unaware that the technology developed by him was investigated for aerial reconnaissance. The wide variety of modern books published about WWII photographic reconnaissance make no mention that there was contemporary investigation using television.

The PRO files have provided an extensive variety of primary source information, which describe in detail the extent of military investigations by J.L.Baird and his companies.

From the beginning of research the author was made aware of the value of personal interviews with people directly concerned with the activities of the Baird organisation. By far the most useful informant has been Mr Ray Herbert who was not only personally involved but has also become a prolifically published historian on the subject. Herbert's close relationship with many past Baird employees still surviving has been a useful source of primary information. Mr Herbert has also supplied a wide variety of other information for inclusion in this thesis. Further perspectives have been added from personal interviews, for instance, with Elsie Thomas, who produced photo-cells and cathode ray tubes for the Baird organisation. The extensive collection of material from Dr Waddell's files have been most useful, particularly personal correspondence he had with a variety of people, some no longer alive. Contemporary journal articles have also been of much use in widening the scope of this thesis.

Whereas no research can claim to be exhaustive, this thesis provides a critical assessment, which supplements the knowledge available about J.L.Baird and his companies within the restrictions of reasonable length and depth dictated by the comprehensive nature of this particular subject.

1.5 References

[i] The principal books written about J.L.Baird are,

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Tiltman, R. (1933). *Baird of Television*. New York: Arno Press.

[ii] Dr Waddell, in his article "Seeing by Wireless" in *New Scientist*, 11 November 1976, cites two references:
The Motor News. (1926, June 26). pp 788.
Imrie, W. (1966). *Both Sides of the Burn; The Story of Yoker*. Bell, Aird and Coghill.

[iii] Burns, R.W. (1986). *British Television: The Formative Years*. London: Peter Peregrinus. pp. 9.

[iv] Baird, M.H.I. (1996, February 28). Interview with the author.

[v] Hills, A. R. (1996). *Eye of the World: John Logie Baird and Television*. BA(Hons.) Thesis, University of Waterloo. pp. 16-18

[vi] Hills, A. R. (1999) *Visions: The Life and Legacy of John Logie Baird*. CD-ROM. Glasgow: SCRAN.

[vii] My Fight for a Dream. (1936, November 15). *Sunday Chronicle*.

[viii] How Television was Born (1936, November 22). *Sunday Chronicle*.

[ix] Mc Arthur, T. and P. Waddell (1990). *Vision Warrior*. Orkney: Orkney Press. pp. 92.

[x] Ibid, pp. 90.

[xi] Yearwood, P. (1996, January 1). Interview with the author.

[xii] Bridgewater, T.H. (1981, April 8) Interview with Norman Loxdale and Victor Mills.

[xiii] Burns, R.W. (1986). *British Television: The Formative Years.* London: Peter Peregrinus. pp 34. Quotation from Wireless World and Radio Review, January 1925.

[xiv] Baird, M.H.I. (1995, February 23). interview.

[xv] Clapp, B. (1979, February 15). Letter to Dr. Peter Waddell.

[xvi] Sayers, W. (1987, November 16). Letter to Dr. Peter Waddell.

[xvii] Reveley, P. V. (1979, January 29) Letter to Dr Peter Waddell.

2 Literature Review

2.1 The Baird Historians

There are currently six historians actively researching J.L.Baird and it is from them that additions to this history are being produced. As history is subject to its writers, a brief introduction to the principal personalities currently researching J.L.Baird is provided here. In alphabetical order, they are;

2.1.1 Prof. Malcolm Baird

John Logie Baird's son Malcolm has produced a variety of articles on the work of his father. He is currently preparing a book with author Antony Kamm that will emphasise some of the personal aspects of his father's life.[i]

2.1.2 Dr. Douglas Brown

The University of Strathclyde already has the MPhil thesis written by Brown entitled, *The Contribution of John Logie Baird to Television and Related Technologies.* Brown has recently obtained his doctorate with a thesis on the commercial aspects of Baird's work, originally proposed to complement this author's thesis at the same university. Unfortunately, Brown's dissertation has been placed under the cloak of a moratorium and is not available for consultation by this author.

2.1.3 Prof. Russell Burns

This prolific author has published the most recent comprehensive book on J.L.Baird. This is his third book concerning television history and he has also published a variety of journal articles.[ii] The publications of Burns also include the history of electronics, and most notably with reference to this work, include the Fultograph facsimile machine and the photo electric shell detonators.

2.1.4 Ray Herbert

The first-hand knowledge of Herbert is particularly useful to modern research on Baird, particularly on the subject of his involvement with television aerial reconnaissance. Herbert has collected much information from a variety of past Baird employees. The results of his researches have been published in more than fifty articles as well as a book.[iii]

2.1.5 Don McLean

McLean has researched the technology of J.L.Baird's Phonovision, recording 30-line television onto gramophone discs, in detail. His research, which has been published in journals and a book[iv], is an example of a specialist approach to a distinct subject that will likely characterise the work of further Baird historians.

2.1.6 Dr. Peter Waddell

Since his first publication on J.L.Baird in 1976,[v] Dr Waddell has suggested that J.L.Baird and his companies were involved in various military activities including radar. He then co-authored *The Secret Life of John Logie Baird* and *Vision Warrior*, [vi] in which these suggestions were added to with further detail. The work and enthusiasm of this particular author initiated the production of this thesis.

2.2 The literature record with relation to chapters.

2.2.1 Chapter 3: The First Investigations by John Logie Baird and the British Government into Television as a Military Tool

This chapter encompasses the wide variety of military applications first suggested for television. Commentary based on the work of Devereux (1991)[vii] provides an early introduction to the history of military use of electricity. As television came within the realms of a practical possibility both the Admiralty and Air Ministry made investigations. Burns (2000), McArthur and Waddell (1990) as well as the CD-ROM (1999) from this author have recorded these early investigations[viii]. Burns has also contributed two papers on this subject[ix]. It is of note that much of the information about this early investigation is based on PRO file AIR 2/269, cited by both authors using the previous reference number AIR 2/S 24132. This file has been closely assessed by this author. With reference to this file, Patent GB 295210 issued to Television Ltd after a requirement suggested by the Air Ministry is discussed. The apparatus described in the patent was designed for signalling fall of shot from aircraft and 1919 PRO file AIR 2/116 was reviewed to asses methods used before television. Television research was subject to the Radio Research Board which was formed in 1920, informed by PRO file AVIA 8/14. Contemporary magazine articles, which initiated the Admiralty investigations, are also recorded.[x] There are other PRO files which provide a useful supplement to AIR 2/269, namely; PRO AIR 2/2743, *RESEARCH & DEVELOPMENT ESTABLISHMENTS (Code B, 65): No 10 Dept., RAE, Farnborough: addition of research duties, 1926-1928.* AVIA 23/553, *Area system: experiment to investigate the possibilities of the transmission and reception of written messages by some form of television, 1932 and* ADM 204/247. *Report on general considerations of television, 1925.*

Burns suggests that British military television research stopped in 1927, whereas AIR 2/2743 clearly shows it continued, although with a reduced priority. AVIA 23/553 states that the Signals Experimental Establishment produced successful equipment in 1930, which provided for a television based signalling system capable of encryption. It is noted that this system is similar to patent GB 324 029 issued to the Baird company in 1928 for a television text system.

There is a letter written to Helensburgh library in 1976 suggesting J.L.Baird was personally involved in military signalling experiments at Aldershot in 1928/29. Contemporary magazine reports make no mention of this activity. However, PRO files AVIA 23/476, *Superposition of telephony and teleprinter-telegraphy on earth-return lines at Aldershot, 1929* and DSIR 36/4408 *Facsimile research* suggest that similar experiments described in the letter were undertaken but there is no mention of J.L.Baird personally. McArthur and Waddell (1990) have also discussed this subject but without reference to the PRO files. A further PRO file reviewed was ADM 1/8740, *Reports on various forms of signalling including visual, 1930.*

The Fultograph facsimile system was used for signalling experiments by the British military, and information on the technology is included to provide a more complete understanding of the contemporary technology. Information about this technology is found in PRO AVIA 13/294 *Wireless transmission of still photographs, 1928-1935* and DSIR 36/4408 *Facsimile research*. In the former file, which refers to Fultograph testing with Airship R100 there is an anomalous reference to Baird television equipment. McArthur and Waddell (1990) suggest this fitting was known by journalist Joseph Bisset. Personal letters to Waddell by Bisset have been quoted in this thesis which provide further detail, but this remains the only testimony to suggest such an activity.

The concept of television for use to enhance human vision is introduced in this chapter. This was an application of television investigated by J.L.Baird in the same year that he first demonstrated television. This subject is discussed in detail in chapter two.

2.2.2 Chapter 4: Noctovision and the British Military investigation of Infra-Red Radiation

The background to the first military interest in Infra-red technology (IR) is provided by R.V.Jones and W.N. Arnquist.[xi] Jones, who refers to Arnquist, was personally responsible for some of the British military investigations into IR, providing his testimony particularly with an added dimension. J.L.Baird's autobiographical notes are used to introduce the subject of his own IR investigations and these are supplemented by an article by a contemporary observer.[xii] J.L.Baird gained much publicity for his invention and this generated various newspaper and magazine articles, which have been reviewed.[xiii] The alternate use of signalling using infra-red, referred to in the first chapter, is re-iterated with reference to patents GB 295 210 and US 1 781

799. PRO files also reviewed regarding this technology included; ADM 204/1439, *Use of EMI telescope for signalling on land.* ADM 204/1544, *Infra-red telescope for signalling morse,* AVIA 23/768, EMI *Infra-red telescope, 1941.*

Philip Hobson worked with J.L.Baird on Noctovision and has produced an article recording his experiences.[xiv] Burns (2000) and Mc Arthur and Waddell (1986) refer to this article as a primary source of information on J.L.Baird's Noctovision. Hobson has also placed his records of television investigation in the Glasgow University Library and these have been used to provide further assesment of the early investigations by J.L.Baird.

After the cessation of Admiralty interest in Noctovision in 1930, the British Government again became interested in IR technology from the Baird company. R.V.Jones made this suggestion in a letter[xv] to Dr Waddell and this is corroborated by PRO AIR 2/1775 *COMMUNICATIONS (Code B, 25): Baird television: investigation, 1936-1942.* Part of this interest included the Admiralty as stated in PRO ADM 1/18581 *ADMIRALTY (5): Naval application of high speed facsimile system and television: demonstrations, trials and Admiralty policy,* as well as other suggested applications, such as bomber guidance by IR, recorded in PRO AIR 9/32 *Wireless television and R.D.F., 1923-1937.* In the period covered by these files BTL were issued patent GB 441 235 for aircraft guidance assisted by IR technology. This patent is discussed in chapter four.

Later in 1940 the Admiralty visited BTL to discuss the production of an image intensifier system by the company. This information is recorded in ADM 204/1432 *Baird Television Ltd: image converters, 1940* and illustrates a process of co-operation between the company and the fighting service. According to Arnquist (1959) and Jones (1972), the development of IR technologies was overtaken by radar technologies and Jones personally offered suggestions of combining the two technologies. A modern manifestation of combination between IR and radar is mentioned.

The World War II operational use of IR technologies is discussed briefly. According to Pratt (1948) Infra-red image converter tubes were used during WWII by the British Military to assist vehicles driving at night and for reconnaissance craft to return to their ships.[xvi] Investigation of another proposal for IR use was conducted with reference to PRO ADM 1/26022, *Infra-red detection and telethermo destruction ray, 1940-45.* A brief description of some of the German uses of IR is provided using information from Pratt (1948) and from PRO AIR 14/850 *Countermeasures to enemy use of infra red: methods of detection, 1943 Nov.-1944 Jan.*

2.2.3 Chapter 5: John Logie Baird and Radar ?

The term Radar is used here to mean reflected radio wave technology, which supplants the British terms Radio Direction Finding and Radiolocation. This chapter is included to discuss the suggestions of Dr Waddell's first publication[xvii] on J.L.Baird as well as further information in the *Secret Life of John Logie Baird* (1986) and *Vision Warrior* (1990).

Two patents[xviii] for reflected radio wave television issued to J.L.Baird are mentioned in these books. Their viability as radar has been closely assessed and further commentary by R.W.Burns included. PRO files AVIA 12/137, *RDF early history* AVIA 10/348, *The history of radio and radar AVIA* 10/348, *The history of radio and radar* have also been consulted.

The transcript of an interview with an early assistant to J.L.Baird, Norman Loxdale, which was supplied by Neil Rimington has been consulted. This interview records that J.L.Baird undertook reflected radio wave experiments. McArthur and Waddell mention this activity and they make no direct reference to this transcript. Dr Waddell has stated recently that he was unaware of this particular transcript.

A comprehensive list of all references to radar in the wartime diaries of J.L.Baird, never before assembled, has been provided from a photocopy of the diaries supplied to this author by Professor Malcolm Baird. The diary suggestions, particularly mentioning that J.L.Baird was seeking work from amongst others, a General Whittaker who is stated as being in "*Supreme Charge of Radar* (sic) *Location*" is discussed. Research by this author, Professor Malcolm Baird, Dr Peter Waddell and Ray Herbert has not discovered the identity of General Whittaker.

Two patents issued to J.L.Baird that he referred to in his diary as concerning radar are also discussed. The suggestion proposed by Dr Waddell that these patents refer to anti-jamming of gun laying radar has been investigated. The following PRO files have been consulted: ADM 220/67, *The Substitution of Visual Sighting by Television Systems with Special reference to Gunnery Directors, 1949.* AIR 2/3023, *Radar and radio countermeasures - RDF and Air Ministry Stations*, AIR 2/5530, *Radar and radio countermeasures – installation of Aircraft Gun Laying in Aircraft,* AVIA 12/140, *RDF equipment for gun laying transmitters*, and AVIA 22/1383, *Development of automatic gun laying*, AIR 2/4509, *Radar and radio countermeasures – employment of civilians, 1940, AIR* 2/3378, *Gun laying equipment: Design papers, 1938-40,* AVIA 7/3335, *Gun laying set MK III, 1941-44* and AVIA 8/513, *Invention relating to colour and stereoscopic television, 1937.* None of the above files mention anything related to J.L.Baird.

The use of Metropolitan Demountable Tetrode transmitter valves by BTL which were also used for British Defence radar is discussed from information supplied by Ray Herbert. PRO files AVIA 2/1969, *RADAR AND RADIO COUNTERMEASURES (Code B, 61): R.D.F. stations, 1937-1940.* AVIA 10/47, *Development of RDF: papers by E J C Dixon SIR ROBERT WATSON-WATT, 1937,* AIR 2/2618, *Selection of firms and provision of finance for R.D.F.* ADM 178/143, *American interest in Metropolitan Vickers 1936-37*, BT 64/21 *Discussion on U.S. control of Metropolitan Vickers*, and

AVIA 12/139, *RDF equipment trials – General 1937-39*, have also been consulted for this section. Further information on this activity may be in the PhD thesis recently submitted to the University of Strathclyde by Douglas Brown, which is currently closed by moratorium.

PRO file AIR 2/2877, *PHOTOGRAPHY AND CINEMATOGRAPHY (Code B, 58): Baird Television Ltd. rapid processing camera projector, 1938-1939*, a previously unreported file, has been consulted which indicates that Baird Television Limited were consulted for supply of equipment which had top priority at the Telecommunications Research Establishment (TRE) at Bawdsey Manor. This file refers to the BTL IF system which was subject to ongoing research by the Admiralty and Air Ministry detailed in chapter four. Further files regarding this topic which were reviewed are; AIR 2/3110, *Radar and radio countermeasures – Bawdsey papers 1939*, AIR 2/2228 *Radar and radio countermeasures – Provision of aircraft*, and AIR 2/2593 *Radar and radio countermeasures – calibration of RDF equipment, employment of balloons, 1937-41.* The production of cathode ray tubes at Cinema Television Limited, listed in various PRO files, is referred to and detailed in chapter five.

The suggestion, particularly by newspaper journalists[xix], that J.L.Baird was personally involved with radar is discussed and compared to letters from Baird staff and respected radar engineers.

A small note was published by Mr Bob Miller in the *Sunday Post* on July 21st 1996, that suggested that J.L.Baird worked on radar at the TRE Worth Matravers. A letter was sent to Mr Miller and after a long period of time of no reply various telephone calls were made to the newspaper. No further information was provided by Mr Miller. Conservative MP Sir Michael Marshall had also made similar suggestions to Miller, so it was decided to personally visit Worth Matravers. It had been suggested that J.L.Baird was a well-known local personality and leaflets were distributed in the area to see if any residents remembered the inventor. Five replies[xx] were received from this distribution, all from people who were involved with the TRE. One respondent, Mr P. Lowrie stated that J.L.Baird worked with a Dr Faraday at Leeson House in Langton Matravers, near to Worth Matravers. Further research, in connection with Centre for the History of Defence Electronics (CHIDE) and review of J.L.Baird's wartime diaries, has provided no supplementary information.

2.2.4 Chapter 6: Television Aerial reconnaissance

Only one part of this subject, the supply of television equipment to the French Government, has ever been critically assessed. For this reason the subject of the early history of television aerial reconnaissance (TV/AC) is divided into sections to more adequately explain the technology and its development.

2.2.4.1 Section 6.2. Inception of television reconnaissance by aircraft

The initial stages of military interest in television which referred specifically to aerial reconnaissance is re-introduced, with reference to the first chapter. The role of the EMI company in sending facsimiles via military transport is included with reference to PRO file AVIA 13/294 *Wireless transmission of still photographs, 1928-1935.*

The importance of the BTL Intermediate film technique (IF) is emphasised with reference to an article on the subject by Ray Herbert.[xxi] Bruce Norman (1984) has suggested that the system was not useful, but this thesis suggests that this particular system was investigated repeatedly for military use. Gordon Craig OBE has recorded the BTL developments of the IF system in a file at the British Film Institute. This file has previously escaped attention by other Baird historians and as the technique is directly relevant to TV/AC it is reported in detail here.

The subject of BTL patent GB 441 235 for an infra-red guidance system using rapidly processed cine film is then introduced. Anatole Stoyanowsky, the co-patentee is discussed with reference to him in J.L.Baird's autobiography and PRO file J 13/16536 *Supreme Court of Judicature: High Court of Justice, Companies Court: Companies (Winding-up) Proceedings, Name of Company: Baird Television Ltd & Cinema Television Ltd, 1940.* The citation of this patent in *Vision Warrior* is discussed.

2.2.4.2 Section 6.3. International interest in television for use by reconnaissance aircraft

The concept of the general British attitude towards foreign TV/AC investigation is introduced with reference to previously unreported file PRO AIR 2/1733 *Air Ministry and Ministry of Defence: Registered Files.* This file provides information about British interaction with Russia and Czechoslovakia. The situation regarding Germany is discussed with reference to *Vision Warrior* as well as files regarding German military control of television. Another comprehensive PRO file AIR 2/1775 is used which has been previously referred to in part by McArthur and Waddell. This file provides information regarding the British attitude towards Japanese television developments. A report in *Electronics and Television and Short-Wave World* of October 1939, which suggests the Italians had operational TV/AC, is considered and discussed with reference to research by Ray Herbert.

The tender for supply of television equipment to Russia by BTL and M-EMI is synthesised from PRO files AIR 2/1775 and AIR 2/1733. The decision not to allow M-EMI to tender equipment for Russia is recorded from PRO CAB 104/102 *Air Defence Research Sub-Committee: use of television apparatus in aircraft, 1936-1939.* Although detailed tenders were supplied to Russia by BTL a commentator recorded in PRO AVIA 13/1263 *Television transmission from aircraft: various papers, 1936-43*, suggests the equipment was never built.

2.2.4.3 Section 6.4. Baird Television Ltd and French Television Aerial Reconnaissance

The supply of equipment by BTL to the French government is the only facet of the early history of the state of the technology after 1927 which has received detailed historic assesment.[xxii] The reason for this attention is that one of the modern Baird historians was personally responsible for designing and testing some of the equipment.

Again, information on this activity is derived from the comprehensive PRO files AIR 2/1775 and AIR 2/1733. The parallel project investigated by M-EMI is mentioned with reference to Herbert and comment by M-EMI engineer Dr E.L.C. White,[xxiii]and PRO file AIR 28/359, *Operational records book, Hendon.* A detailed assessment of the BTL project is provided with images supplied by Mr Herbert. The eventual fate of the aircraft and equipment is discussed with reference to a French Baird Employee[xxiv] as well as PRO file AVIA 13/1263. PRO file AVIA 13/285, *Wireless and photography in French aircraft* has also been consulted. Public interest in TV/AC at this time is discussed in sources found in *Motion Picture Daily, Popular Science Monthly* as well as in a previous assessment in CD-ROM *Visions: The Life and Legacy of John Logie Baird* (1999) by this author.

2.2.4.4 Section 6.5. The British Trials: Marconi-EMI or Baird Television, Facsimile or Television

The first public interest in high definition television in association with aircraft is reported from *Practical and Amateur Wireless.* The event recorded involves a KLM aircraft which was fitted with a television for reception of a broadcast. McArthur and Waddell have also commented on this event. Simon Vaughn, curator of the Alexandra Palace Television Society has provided this author with footage of the Gaumont British newsreel excerpt concerning this event. From the newsreel it has been possible to determine the type of aircraft used as well as the receiver type.

The KLM flight publicised BTL as they were about to commence the television trial at Alexandra Palace. The selection of M-EMI to supply equipment for broadcast television rather than BTL has created the legend that Baird Television Limited was a failure. One author particularly responsible for this attitude is Bruce Norman. From enclosures in PRO ADM 1/18581 and AIR 2/1775 it is demonstrated that both the Admiralty and Air Ministry required BTL equipment immediately after the Alexandra Palace trial for British military purposes. Earlier commentary of British interest in airborne television is recorded in PRO AIR 9/32, *Wireless television and R.D.F., 1923-1937.*

Trials with M-EMI equipment in a prototype Blackburn aircraft are discussed from AVIA 13/1263. A brief discussion of this unique aircraft, and associated pictures are provided from two books concerning Blackburn company aircraft.[xxv] Commentary on these trials by the Admiralty is found in ADM 1/18581, as is the parallel TV/AC investigation by this Ministry. Particular note is recorded of the differing rates of scanning for facsimile or television transmission.

Images of Baird facsimile systems from the files of Dr Douglas Brown are included. Unfortunately, Dr Brown has not supplied the supporting notes which may exist in the records of Baird scientist Dr Constantin Szegho in his possession. These images may also be included in Dr Browns PhD thesis which at the time is unavailable for consultation. There is some discussion of possible descriptions of equipment and the images are provided here for future reference when further information becomes available to historians.

The development and demonstration of BTL facsimile equipment is provided from PRO ADM 1/18581 with associated discussion. The British Government interest in further television trials is produced from PRO files AVIA 13/1263, AIR 2/1733, AIR 2/1775 and ADM 1/18581. These trials included the fitting of M-EMI equipment to an

Anson aircraft and are supplemented with information from PRO files AIR 2/3568, AIR 25/518, *NO. 22 (ARMY CO-OPERATION) GROUP, Operations Record Books, 1926 April-1940 December* and AIR 25/520, *NO. 22 (ARMY CO-OPERATION) GROUP, Appendices, 1939 Sept.-1940 December*. The whole being created from a synthesis of these seven PRO files and interviews with Ray Herbert.

2.2.4.5 Section 6.6. The Wellington Enigma

The only evidence that suggests equipment was fitted to a Wellington aircraft exists in PRO AVIA 13/1263. The fact that this information exists in a PRO file in more than an individual entry suggests that some form of activity, whether actual or for the purposes of mis-information, must have taken place. A discussion is provided from group and base records recorded in PRO files AIR 25/687, *NO. 70 (ARMY COOPERATION (TRAINING)) GROUP, Operations Record Books, 1940 December.-1945 July,* AIR 25/688, *NO. 70 (ARMY COOPERATION (TRAINING)) GROUP, Appendices, 1941 April.-1945 June,* AIR 25/689 *NO. 71 (ARMY COOPERATION) GROUP, Operations Record Books, 1940 Dec.-1941 August* and AIR 25/690, *NO. 71 (ARMY COOPERATION) GROUP, Appendices, 1940 November.-1941 August.* Interview with Ray Herbert, who has questioned personnel connected with the Anson trials, as well as publications concerning the squadrons based at Odiham, where the aircraft was delivered, and correspondence with Odiham, Farnborough and Hendon Air Museum offer no further information.[xxvi] Further information regarding this activity may still be found in the PRO but extensive searching by this author, with the assistance of PRO staff over a period of four years has provided nothing more at the time of writing.

2.2.4.6 Section 6.7. Revival of interest in Television Reconnaissance during the War

From the previous chapters it is noted that British research of television for use in aircraft was discontinued in 1940 and revived in 1943. BTL were required to supply details of TV/AC equipment to America for their research as noted in PRO AIR 2/1775. Information on American TV/AC investigation is derived from various publications by the RCA company.

PRO AVIA 13/1263 records the British 1943 revival and indicates that CTL, formerly BTL, had produced equipment for night photography as well as TV/AC equipment. Part of the discussion includes British assesment of American equipment as recorded in PRO AIR 2/3568, *AIRCRAFT: Equipment (Code B, 5 21): Aircraft television equipment: trials, 1939-1945.* File PRO AIR 65/100, *Cine Photography of low level attacks, 1944*, AVIA 6/16427, *History of photography from air at night, 1939-45*, AVIA 18/1826, *The evaluation of an aircraft closed circuit television channel in the role of a photographic reconnaissance sight, 1950* were also consulted.

Allied to TV/AC investigations was interest in the use of the technology for sending and displaying plots. For these experiments the Scophony Company were used and information on this project is derived from PRO ADM 1/13764 *Admiralty, and Ministry of Defence, Navy Department: Correspondence and Papers.* The investigations by EMI in consultation with E.G.Bowen of Bawdsey Manor TRE were also consulted from file PRO AVIA 7/26, *Positions of aircraft by the application of television techniques.* It is noted that Mc Arthur and Waddell (1990) refer to signalling activity by the Scophony company using the Skiatron dark trace cathode ray tube as described in this public file. After a certain amount of experimentation it was recorded by the Admiralty, in PRO ADM 1/18581, that TV/AC investigations were again postponed due to lack of interest by all three services.

As a post-script it is expressed that a modern TV/AC company used a system which had an historic basis with the Baird IF system. Information for this statement is taken from a recording of a lecture, attended by the author, given by Mr Uttley-Moore a director of the company. PRO file AVIA 6/15533 concerning a television aerial reconnaissance system for the TSR2 aircraft which involved work by CTL was also reviewed. This file concerns work undertaken in 1951 and therefore falls without the remit of this thesis.

2.2.5 Chapter 7: Cinema Television Ltd 1937-1946

A brief history of the early investigations into large screen television is provided from publications by Burns, Moseley and Wheen.[xxvii] Reference is also made to patent GB 222 604, the first issued to J.L.Baird for a television screen. Attendees to J.L.Baird's first large screen demonstration are provided from McArthur and Waddell (1990), and Herbert (1998).[xxviii] The demonstration of the Derby two years later in 1932 is informed from contemporary publications as well as J.L.Baird's autobiography.

Stimulated by this early interest in cinema television the Gaumont-British Picture Corporation (G-BPC) became involved in television companies, including BTL. This involvement is recorded in *The Story of Scophony* by Thomas Singleton as well as PRO BT 58/249, *INVESTIGATIONS INTO FIRM'S AFFAIRS (Code No.13): Companies Act, 1929. Sec. 135: Investigation into the affairs of Gaumont-British Picture Corporation Ltd. 1938-1939.* This file also provides information about the complex monetary manipulation of BTL by the G-BPC, a subject also discussed by Burns (2000).

According to Douglas Brown, there is no clear evidence of the precise date of the formation of Cinema Television Ltd. Company's House provided no further information after a personal enquiry. The trading name change to CTL from BTL is informed by various PRO files including ADM 204/1432, *Baird Television Ltd: image* *converters, 1940.* The demonstration of the Boon Danahar fight is recorded from various contemporary articles and from reminiscence by Ray Herbert.

The effective collapse of BTL, when it was placed into liquidation is noted by J.L.Baird and Ray Herbert in their diaries. The official receivership communications from 1940 to 1945 are found in PRO J 107/164 *Supreme Court of Judicature: High Court of Justice, Companies Court: Registrars' Notes, 1944.* The continuation of the division between J.L.Baird and his company is described with reference to Mr Herbert, the Scotsman's diary as well as a note written recorded in the introduction. Activity in the grounds of the Crystal Palace, where the Baird organisation (BO) was based, is included from information gathered from the Crystal Palace Foundation as well as the minutes of the Crystal Palace Trustees. The term Baird organisation is used to denote either John Logie Baird personally, Baird Television Ltd, Cinema Television Ltd or Cintel, when it is unclear from the sources precisely which organisation was responsible. Two publications provide information on a domestic fire detector, developed by the Baird organisation as a saleable product to provide much needed income for the company.[xxix]

The manipulation of the Baird organisation into a military production company is discussed with reference to enclosures from PRO AVIA 22/2719, *High-speed and pressure recording apparatus: design and production by Cinema-Television Ltd., London, Contracts: Policy, Conditions, Capital Assistance, 1940-1942.* CAB 104/102 and BT 58/249 *INVESTIGATIONS INTO FIRM'S AFFAIRS (Code No.13): Companies Act, 1929. Sec. 135: Investigation into the affairs of Gaumont-British Picture Corporation Ltd. 1938-1939.* A 1940 Admiralty development contract for image converter tubes is also referred to, from PRO ADM 204/1432 *Baird Television Ltd: image converters, 1940.* PRO file AVIA 13/384, *Philips image transformers*, which discusses an invention by a Dr Couteriers for viewing the ground from aircraft at night was also consulted. This subject has been previously unrecorded with reference to PRO files by other Baird historians. AVIA 22/2719, *High-speed and pressure recording* *apparatus: design and production by Cinema-Television Ltd., London, Contracts: Policy, Conditions, Capital Assistance, 1940-1942* also provides information for other wartime government military contracts issued to the Baird organisation.

The concept of the photo electric proximity fuse is introduced with reference to two papers written by R.W.Burns.[xxx] Three PRO files AVIA 15/49, *Ministry of Aircraft Production and predecessor and successors: Registered Files,* AVIA 13/874 *Bombs: detonation by photo-electric means, 1937-1939* and AVIA 13/891, *Photo-electric bomb: dropping tests, 1940-41* on this subject were reviewed as well as a book which mentions trials.[xxxi] PRO files AVIA 13/905, *Photo-electric bomb: proximity fuzes, 1940-42.* and AVIA 22/2752, *Development of P.E. cell. Cinema Television Ltd., London, Contracts: Policy, Conditions, Capital Assistance, 1940-1941* which discusses the Baird Organisation development of the PE Cells, not quoted by Burns in his papers on the subject, is then used to provide relevant information and is supplemented by commentary from R.V.Jones via Dr Waddell.[xxxii] Some details of BO photocell production are provided from the diary of Gilbert Tomes via Dr Douglas Brown. PRO AVIA 22/2752 also provides information on British internal security interest in BO employment of foreign nationals. Other details of CTL production of military equipment is derived from PRO AVIA 22/2719 as well as a personal interview with a woman employed for said production.[xxxiii]

The discussion of demolition of the two Crystal Palace towers is derived from PRO CAB 120/835, *Miscellaneous Crystal Palace Towers,* AIR 2/2877 *PHOTOGRAPHY AND CINEMATOGRAPHY (Code B, 58): Baird Television Ltd. rapid processing camera projector, 1938-1939*, AVIA 22/2719, the minutes of the Crystal Palace Trustees as well as a statement made in *New Scientist* in November 1976. This last *New Scientist* reference has been previously discussed by Mc Arthur and Waddell (1990). Some of the PRO files were previously assessed by this author in the CD-ROM *Visions...* (1999).

Production of cathode ray tubes by CTL is derived from the minutes of the Committee for the Co-ordination of Cathode Ray Tube Development contained in PRO files AVIA 7/1231, *Committee for the Co-ordination of Cathode Ray Tube Development: minutes and papers, 1943-44* and AVIA 7/1232, *Committee for the Co-ordination of Cathode Ray Tube Development: minutes and papers, 1943-44.* This information is supplemented by reference to PRO file AIR 2/1775, the diary of Gilbert Tomes and the testimonies of Elsie Thomas and Ben Clapp. PRO file AVIA 12/184, *Radio and radar production – War Histories* has also been consulted. Information about the production of ballistics metering equipment is derived from PRO files ADM 204/1432 and AVIA 22/2719.

Land mine locator production by CTL in their Worsley Bridge Road and Rink Cinema Factories is taken from PRO AVIA files 22/861, *Mine detectors: research and development, Director of Scientific Research, 1940-1943.* 22/862 *Mine detectors: research and development, Director of Scientific Research*, 1943-1946 and 74/15, *UHF mine detector for non-metallic mines, 1944-47.* The testimony of Ben Clapp, mentioned above is included as is that of Alan Carter also a CTL employee concerned with this project. An article written by S.S. West (Not A.G.D.West) cleared for publication as mentioned in AVIA 22/862 *Mine detectors: research and development, Director of Scientific Research, 1943-1946*, has also been given attention.[xxxiv] A spin-off of land mine locator investigation by CTL was the production of a metal locator for surgeons. This investigation is included from information in PRO AVIA 22/872 *Detector of metallic objects embedded in the body: unsuccessful development by Cinema-Television Ltd., Director of Scientific Research, 1944-1945.*

Shortly after the war in 1946 CTL staff assisted British Government interrogation of German television technologists. Whereas it is important to give reference to this activity it has not been provided in detail as this falls beyond the remit of this thesis. Future investigation will require close reference to PRO AVIA files 6/14398, *Examination of German cathode ray tubes,* 54/1490, *Television in Army* *equipment: use, 1945-1954.* 22/908, *Television equipment: development, Director of Scientific Research, 1945-1946.* 22/970, *Television equipment: development.* 39/70, *Television, DIGEST OF PRODUCTION INTELLIGENCE, 1945-1946.*and 39/14, *Television, CENTRAL RADIO BUREAU OF GERMAN ELECTRONIC INTELLIGENCE, 1945-1946.*

After the war CTL produced a series of displays of television in cinemas, a subject included in PRO files HO 45/24294 *ENTERTAINMENTS: Television equipment in cinemas: development and draft regulations, 1939-1950* and WORK 25/261 *Southbank Tele-Cinema, 1951.* Details of this activity are added from a letter written by A.G.D.West to Baird organisation technologist Constantin Szegho as well as from post war Rank Cintel employee Arthur Dungate.[xxxv]

J.L.Baird's personal display of the Victory Parade on large screens in cinemas, shortly before his death, has been previously discussed by other historians including Burns, Herbert and Waddell. Information about this activity can also be found in PRO HO 45/24294.

2.2.6 Chapter 8: John Logie Baird and Cable & Wireless

To provide a simple history of early British facsimile investigations, previous discussions are re-introduced such as the investigations included in PRO AIR 2/269, DSIR 36/2257 *Facsimile research, 1930-37,* DSIR 36/4408, *Facsimile research, 1930-37,* AVIA 13/294 *Wireless transmission of still photographs, 1928-1935,* AVIA 23/476 *Superposition of telephony and teleprinter-telegraphy on earth-return lines at Aldershot, 1929* and AVIA 23/553 *Area system: experiment to investigate the possibilities of the transmission and reception of written messages by some form of television, 1932.* File PRO AVIA 23/404, *Dummy tape perforator for secret telegraphy, 1928, AVIA* 23/386, *Secret telephony experiments, 1928* were also consulted. A variety of other sources are also referred to including IEE Proceedings and publications by Cable and Wireless.[xxxvi]

The employment of J.L.Baird as a consultant to Cable and Wireless is included in most histories of the inventor with varying degrees of detail. Important commentators include M.H.I. Baird, Burns, Herbert, Hills, Moseley and McArthur and Waddell. Details for this piece are supplemented by the personal diary of J.L.Baird and files directly from the Cable and Wireless archive. In his most recent book[xxxvii] about Baird Burns has made direct reference to the C&W archive. The author has spent three days in the C&W archive at Porthcurno with freedom to view all files, but has found no further reference to J.L.Baird which supplies any more detailed information.

An investigation of a voice synthesiser for transatlantic broadcast undertaken during WWII is included from information provided in an interview with Eric Turpin. The commercial versions of the machine are discussed, with supporting reference.[xxxviii]

During his consultancy with C&W, J.L.Baird attempted to gain further finance by starting a new company entitled the Baird Holding and Development Trust. An archive of letters relating to this activity was placed for sale at Christies auction house. This author has reviewed these letters, referred to parallel references in J.L.Baird's diary and published an article for 405-Alive, a television history journal. This totally original information is also included in this thesis. The inventor eventually formed an unrelated company called John Logie Baird Limited as mentioned by Herbert in *Seeing by Wireless.*

A discussion is then provided about the technology investigated by J.L.Baird for C&W. Journalist Leon Laden referred to a demonstration of this equipment in January 1945 and offers a rare example of a description.[xxxix] BTL equipment described in PRO ADM 1/13764, *Admiralty, and Ministry of Defence, Navy Department: Correspondence and Papers* and AVIA 13/1263, *Television transmission from aircraft: various papers, 1936-43* is referred to as a possible source of the technology used by the inventor. PRO AIR 10/ 4977, *Automatic high speed signalling apparatus*, was also reviewed. Both

Margaret Baird, the inventor's wife, and his close assistant E.G.O. Anderson have suggested the technology developed by J.L.Baird was used for the RCA system Ultrafax. Dr Waddell has suggested that J.L.Baird's system was identical to Ultrafax, a statement possibly motivated by a letter he received from E.G.O. Anderson in 1974.

There are in existence some sources of information to which this author has no access, that may more adequately describe details of J.L.Baird's system. These sources include: papers referring to Major Church, the diaries of Mr Gilbert Tomes, the notes of Dr Constantin Szegho held by Dr Douglas Brown and the PhD thesis submitted to this author's university library by Dr Brown, but which is under a moratorium until January 2003.

For future historians this author has included references in J.L.Baird's diary to his consultancy with Cable and Wireless and the Baird Holding and Development Trust.

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CHAPTER 3

The First Investigations by John Logie Baird and the British Government into Television as a Military Tool

Fig. 3.1 *An early artists impression of Television Reconnaissance*

Source: *The Experimenter*. November 1924.

3.1 Abstract

In the early 1920's John Logie Baird investigated television, finally producing the worlds first demonstration in January of 1926. Members of British military departments quickly visited Baird and modified their own television investigations accordingly. Initial Government military interest focussed on television for aerial reconnaissance. This interest later developed into signalling using television. J.L.Baird developed and offered to the military systems for both these applications. As a result of the disparate research by the Scottish inventor he also patented low light imaging systems as well as a system for producing an image using no light but radio waves. Both systems were subject to independent investigation by British Military organisations.

3.2 The Early use of Electricity as a Military tool

As soon as new technologies are created they are often investigated for military adaptation. If a new technology shows promise in its infancy, then its development may also be assisted or even accelerated for military purpose. This has been the case from the first chariots to the Internet.

As soon as basic electrical phenomena had been harnessed, it was pressed into military service. Tony Devereux in his book *Messenger Gods of Battle* offers an excellent description of the earliest days of electricity in military service. According to Devereux, the Russian Baron Schilling was the first person to use electricity for military purpose. In 1812 Schilling remotely detonated a mine using cables laid across the river Neva at St Petersburg.[i] This event was important for it illustrated the use of electricity for basic instantaneous communication. The first important military communication of a complex message occurred during the Crimean War in 1855. Military communication of written messages over hostile territory had not advanced from the ancient Greek chariot until this moment. During the Crimean war a submarine cable was laid across the Black Sea between Cape Kalagria and Varna. The cable, laid by the British and French forces, assisted communication with their headquarters. The messages were sent using an early form of code similar to Morse [ii].

Although, according to Devereux, the cable was not of crucial military importance, it was an effective use of the technology and would have been more significant if events during the war had taken a different course.

As developments in electrical technology advanced, the general question of sending images, particularly moving images, began to be addressed. Various scientists throughout the world advanced proposals and undertook experiments in order to achieve television. By the beginning of the twentieth century various image-scanning techniques had been devised and suitable photoelectric transducers proposed. However, the limiting factor for all these experimenters was amplification of the small electric currents issuing from the transducers. The availability of suitably powerful amplifiers in the early 1920s provided the final key component.

3.3 'Experiments in Connection with the Use of Television in Aircraft'; the first investigations

Just like television, much investigation into flight was undertaken in the 19^{th} century. Powered flight was achieved by the Wright Brothers on 17^{th} of December 1903 at Dayton, Ohio. Five years later the Wright brothers signed a contract with the United States army for investigation into aviation. Even before television had been demonstrated, serious propositions were made to combine both technologies for British military service.

C. Francis Jenkins in America and John Logie Baird in Britain both joined the race to produce television images using the new amplifiers in the early 1920s. Stimulated by the television experiments of C.F.Jenkins, *The Experimenter* magazine in America published an article in November 1924, suggesting that television could be used by the military for remote control and reconnaissance by aircraft. *The Daily Express*, no doubt aware of British television investigation by J. L. Baird, quoted the American article in their item entitled 'Aeroplane with Eyes'.[iii] This article reported the views of Dr W.H.Eccles, president of the Radio Society of Great Britain. It suggested that a pilot-less aircraft could be guided by television and also relay reconnaissance information back to a ground station. These suggestions stimulated British military interest in airborne application of television.

One week after the publication of the *Daily Express* article the Superintendent of the Royal Aircraft Establishment (RAE) wrote to the Secretary of the Air Ministry suggesting that television should be investigated and that the 'ultimate problem to be solved' was its use in combination with aircraft.[iv] Television investigation had already been part of the Air Ministry agenda but it seems that this communication accelerated the Ministry's interest.

On 26th of January 1926 John Logie Baird produced the world's first television demonstration in London. Shortly afterwards on the 10th of February the inventor was visited by Dr R.T. Beattie who had been practically investigating the problem of television at the Admiralty Research Laboratory since 1923.[v] The Admiralty's television research had been unsuccessful and they were keen to utilise the Scottish inventor's equipment. Beattie's report of J.L.Baird's television apparatus resulted in direct co-operation between the Admiralty and Air Ministry for investigation into television for aircraft.

To aid this ministry co-operation,[vi] Lt. Colonel H. P. Lefroy of the RAE visited Baird's company Television Ltd on 2nd of June 1926.[vii] The report produced by Lefroy shows a clear understanding of the limitations of television at that time and within those limitations the uses to which it could be placed. The main purpose of placing television in aircraft at this time was for spotting fall of shot, either from artillery or ship's guns. Television in its early form could not accurately reproduce a view of the ground as seen from an aircraft, but as Lefroy states; it could assist in reporting gunfire. This early understanding of the limitation of television for reconnaissance foreshadowed events for the next twenty years.

As a result of his visit to Baird, Lt. Col. Lefroy proposed a system in which an observer would place a pointer on a map or photograph. This indicator would then be received as a point of light by a remote plotter. The point of light would disappear as the observer's pointer was removed, but the plotter could record shell falls by marking his map.

John Logie Baird publicly declared his interest in aerial reconnaissance by television in the Falkirk Herald of 18th September 1926; he is quoted as saying

Television would have a pacific effect upon warring nations. It would show the hidden enemy. Aeroplanes would no longer wireless their scanty reports but the electric eye within them would reproduce unerringly the entire field of action and the very shell bursts.

John Logie Baird was a life long fan of the writings of H.G.Wells. Wells had written *War in the Air*, which was first published in *Pall Mall Magazine* in January 1908.[viii] This novel, inspired by the contemporary developments of aircraft, emphasised the importance of aircraft for future warfare. Ironically, the book even mentions a first historic flight of a heavier than air machine from Crystal Palace to Glasgow and back, two places which were to be associated with J.L.Baird. Inspiration for invention can come from many places and as a fan of Wells it is likely that J.L.Baird was aware of the portents suggested by this book.

A meeting was held at Television Ltd in London attended by Baird, Beattie, Lefroy and others in 1926. As a result of this October 6th meeting J.L Baird offered the RAE a demonstration of 'automatic spotting by radio transmission'.[ix] The offer included an aircraft friendly miniaturised version of the original apparatus, which in June had occupied 'a 10 foot cube' (3 metres). The dimensions could now be reduced to 12 X 12 X 6 inch (30 x 30 x 15 cm) and was hoped to weigh just 12 lbs (5.5 kg).[x] This system was to be used in the manner suggested by Lefroy. Television required a full grey scale along with movement. By removing these attributes, i.e. just having two-toned images without movement, the necessary miniaturisation may have been achieved

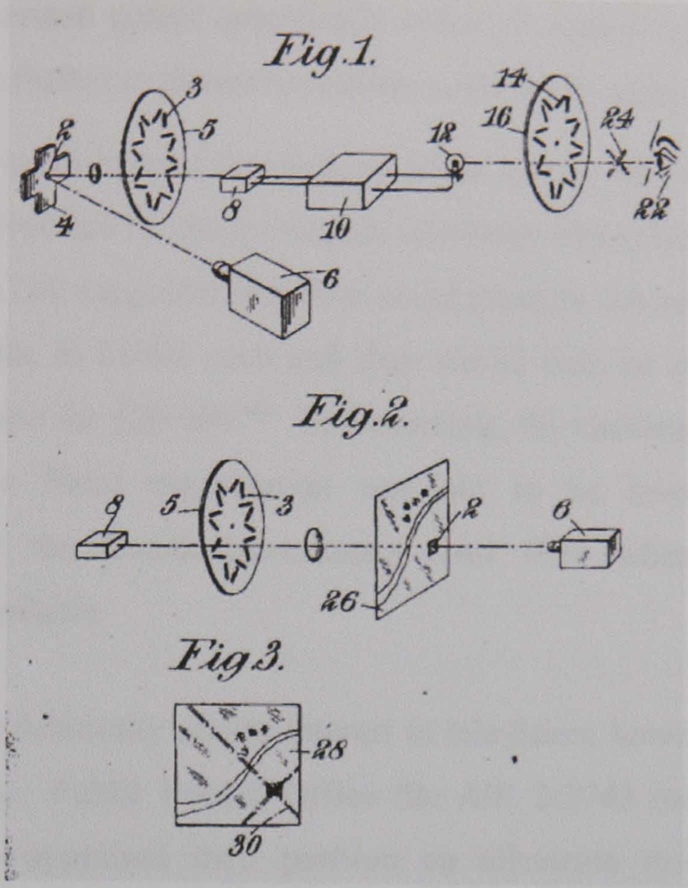


Fig. 3.2. *Remote spotting apparatus defined by J.L.Baird's patent GB 295 210*
Source: Patent GB 295 210

J.L.Baird's company Television Limited, submitted patent application GB 295 210, for this new invention on 9th of August the following year. The Baird system used specially slotted scanning discs, which interacted and could place crosses on maps or photographs. The patent notes its advancement over Lefroy's suggested system and notes "*... a cross can be more easily seen than can a mere luminous image of the light spot, or can indicate more clearly the position of the spot on the object or view.*"[xi] Added to this system was a means of observation using 'non-visible light' for darkness or reduced visibility. Another patent issued to Television Limited also included a specification for signalling using non-visible radiation. This American patent, US 1 781 799, had further attributes which stated that any desired device could be controlled using non-visible signals i.e. Infra red or ultra violet rays. McArthur and Waddell (1990) refer to a quote by Sir Ambrose Fleming that states J.L.Baird used infra-red radiation for secret signalling.[xii] It is possible that Fleming was referring to active development of the aforementioned patents as the American patent specifically refers to signalling. Research for this thesis has found no further evidence to confirm or deny this suggestion.

The ability to see beyond the capacity of the human eye was later an attribute often attached to proposals for more complex television like systems and is discussed below. Television Ltd suggested that they could produce ten sets of equipment for aerial reconnaissance at £2000 each and they would then be prepared to sell full rights of the invention for £20 000.[xiii] Unfortunately, the Government did not accept this offer and the Baird organisation was not to be involved in television reconnaissance for the British Government until 1936 when higher definition systems became available.

In 1927 the Admiralty ceased interest in television; however, this is not true of the Air Ministry. Public Record Office file AIR 2/2743 indicates that the Air Ministry simply re-appraised their position on television research. On 6th of December 1927 the Director of Scientific Research (DSR) for the Air Ministry, H.E.Wimperis suggested the continuation of television research, albeit with a reduced 'C' priority rating.

Mc Arthur and Waddell (1990) have provided their own assesment of file AIR 2/269 which relates to early television investigations by the military services and J.L.Baird. This assesment is included in a chapter entitled "The Mystery Ray", predominantly about radar, and provides the following statement,

> *It is difficult to avoid the conclusion that this* [PRO file AIR 2/269] *is a decoy production with a smattering of detail, meant to draw attention from the very important radio wave radars that were undoubtedly the subject of experiments in Britain at this time.*[xiv]

The aforementioned enclosure from AIR 2/2743 also notes "*The detection of aircraft by radio methods*" and assigns it the priority rating of 'B'. If there was such a strong active body of research on 'radar' technologies then it would probably have gained an 'A' priority rating in place of radio control of automatic pilot or suppression of erroneous radio wave emissions from electrical components. Mention of interest in reflected radio wave technology is included in PRO file AVIA 13/279 concerning Wireless/Telegraphy board investigation into general secret matters including patents. A reference is made to patent GB 643 328 for "Improvements in or relating to methods of determining positions, directions or distances of objects by wireless waves" issued on the 1st of March 1928. The patent was issued to Lt Leonard Alder of HM Signal School, Portsmouth and Captain James Salmond of the Royal Navy.

The Air Ministry DSR assigned television research to the recently formed Wireless/Telegraphy section of the Royal Aircraft Establishment (RAE). A letter written on the 16th of February 1928 by H.McAnally to the Secretary of the Treasury suggested that a principal scientific officer be taken from the Wireless and Photographic Department of the RAE and assigned specifically to tasks directly related to radio and aircraft. Subsequently RAE 10 Department was formed. Prior to creation of this department it had been suggested that research of this type be conducted by either a joint services establishment or by a private company. The Marconi Company was specifically named as a potential candidate for research tasks. However, it was noted that '*a firm like Marconi's however is so much internationalised as to call for caution in envisaging such an arrangement*'[xv]. These misgivings were either forgotten about or ignored when nine years later this company was asked to be a research unit for the Air Ministry when Television Reconnaissance again became a high priority.

In America in 1929 the *Detroit Free Press* reported that C.F Jenkins, an American television researcher, was about to place television equipment in an aircraft for reconnaissance.[xvi] It is unclear whether this experiment was ever undertaken. The American Government and the Radio Corporation of America did eventually undertake research on television for reconnaissance beginning in the late 1930s. This investigation is discussed further in chapter eight.

3.4 Signalling

The sending of visual images via electricity was investigated as soon as systems became available. An early example of such a transmission was sent on the 30th of November 1924. On this day a picture of the Prince of Wales was transmitted using wavelengths of between 10 and 20 kilometres from London to New York. The image was scanned using telegraph dots of varying frequency and length and was controlled by the output voltage from a photoelectric cell[xvii]. Due to lack of sensitivity of the available photoelectric cells a transparency of the Prince had light shone through it rather than reflected from an opaque picture. Similar methods were used in the earliest television experiments. The main restriction of this process was that it took between 30 and 40 minutes to send a normal 5 x 4 inch photograph.

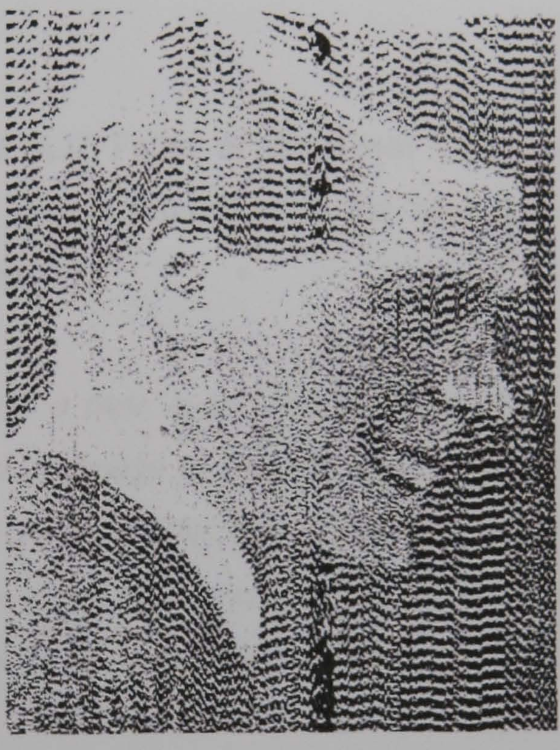


Fig. 3.3 *Image of the Prince of Wales received in New York, 30th November 1924*
Source: Cable & Wireless archives

The transmission of text messages did not require the subtle shades to render the contours of the human face and therefore could be sent using a more narrow bandwidth or faster than for television. Television systems, particularly in their primitive form with neither shade nor movement offered the required clarity of image and, more importantly, speed of transmission. For this reason television signalling was included in the earliest military investigations of television.

An example of such a television-based system is illustrated in British Patent 264,174 issued on the 9th of June 1926 to the German Company Telefunken Gesselschaft. Like the previously described telegraph system the German system shone a light through a transparent film. The Telefunken system used a mirror scanner to deflect the light and explore the film, which would be either continuously or intermittently moving. Hence this system was capable of sending text messages. The patent also mentions that the system could operate with infra-red light and be modified to afford some level of secrecy of transmission. These last elements would have been of particular interest to the British Military television investigators. Two years after the issue of this patent a similar system was investigated by British military organisations.

In 1929 Colonel A.C Fuller of the Royal Corps of Signals and a Royal Engineer investigated a system referred to as the 'area system of telegraphy'. The system was described thus:

A message written on a tape is passed slowly in front of an aperture at the transmitting end and an image of this message is seen passing slowly across a similar aperture at the receiving end. The message can be read out by an observer and written down by a second person. The system has advantages in that it will operate through considerable jamming and gives quite a large measure of secrecy.[xviii]

A letter to Helensburgh Library written in 1976 by a Mr James Heath, also reported by McArthur and Waddell (1990),[xix] suggests that John Logie Baird personally visited Aldershot Military Establishment in 1928 and 1929 for experiments with the 2nd Divisional Signals. Mr Heath writes, *Baird was conducting experiments in several types of Army Field Communications, and new systems. The main one at that time being his tryout in the back of a Morris six wheeled truck to transmit messages through army field cables using an old Oliver green typewriter and batteries.*

Mr Heath describes J.L.Baird's experiments, which were unsuccessful at that time, as involving the sending of "pictures through the atmosphere". Although Mr Heath suggests Baird wore the military uniform of a Lieutenant in the Supplementary Reserve of Officers, there is only circumstantial information linking Baird with a military uniform.[xx]

PRO files AVIA 23/476 *Superposition of telephony and teleprinter-telegraphy on earth-return lines at Aldershot, 1929* and DSIR 36/4408 *Facsimile research* state that experiments of a similar description were conducted at Aldershot at this time. However, there is no information to confirm J.L.Baird's presence at Aldershot in these files.

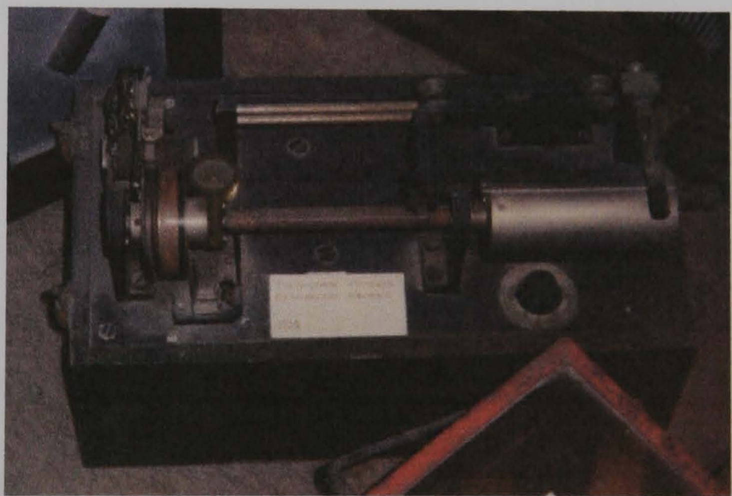
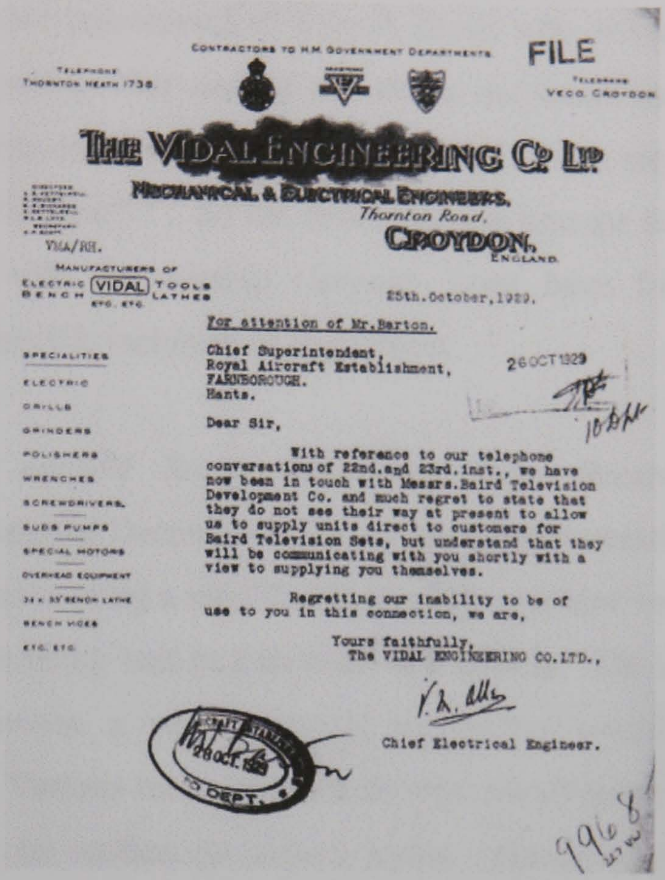


Fig. 3.4 *A Fultograph Machine photographed at the Amberley Chalk Pits Museum.*
Source: Author's personal collection

In 1928 there was much interest in the Fultograph facsimile machine. This machine was designed by Otto Fulton and marketed by his company Wireless Pictures Limited. The BBC became enthusiastic about the technology and broadcast various Fultograph signals between 1928 and 1932.[xxi] There was also interest in the

Fultograph from the Air Ministry, who used the system to assist in airship navigation.


CONTRACTORS TO H.M. GOVERNMENT DEPARTMENTS

FILE

TELEPHONE THORNTON HEATH 1738

TELEGRAMS VECO. CROYDON

THE VIDAL ENGINEERING Co. LTD.

MECHANICAL & ELECTRICAL ENGINEERS.

Thornton Road,

CROYDON,

ENGLAND.

VMA/RH.

MANUFACTURERS OF ELECTRIC VIDAL TOOLS BENCH LATHES ETC. ETC.

SPECIALITIES: ELECTRIC DRILLS, GRINDERS, POLISHERS, WRENCHES, SCREWDRIVERS, SUDS PUMPS, SPECIAL MOTORS, OVERHEAD EQUIPMENT, BENCH VICES, ETC. ETC.

25th. October, 1929.

For attention of Mr. Barton.

Chief Superintendent,
Royal Aircraft Establishment,
FARNBOROUGH.
Hants.

26 OCT 1929

Dear Sir,

With reference to our telephone conversations of 22nd. and 23rd. inst., we have now been in touch with Messrs. Baird Television Development Co. and much regret to state that they do not see their way at present to allow us to supply units direct to customers for Baird Television Sets, but understand that they will be communicating with you shortly with a view to supplying you themselves.

Regretting our inability to be of use to you in this connection, we are,

Yours faithfully,
The VIDAL ENGINEERING CO. LTD.,

Chief Electrical Engineer.

28 OCT. 1929

DEPT.

Fig. 3.5 *Letter from Vidal Engineering to the Royal Aircraft Establishment, Farnborough*

Source: PRO AVIA 13/294

The great hope for passenger air travel in the late 1920's was the enormous dirigible airships then gliding majestically through the skies. Weather information was essential for the long overseas journeys flown by these behemoths. Considerable investigative effort was expended upon sending facsimiles of meteorological maps to the two primary British airships, the R 100 and R 101. In the summer of 1929 the R 100 was equipped with a Fultograph facsimile machine and received weather maps on it broadcast from a nearby transmitter whilst attached to the Cardington mooring tower. Similar experiments took place the following year using Marconi equipment. PRO File AVIA 13/294 which records these and other Fultograph experiments, also contains a singular letter from The Vidal Engineering Company Ltd. Apparently the RAE had requested parts for Baird Television sets; Vidal Ltd stated that the Baird

Television Development Company would be contacting the RAE directly.[xxii] Coincidentally, McArthur and Waddell (1990) suggest that Baird Television equipment was fitted to the R 101 prior to its flight to India.[xxiii] The book *Vision Warrior* quotes newspaper correspondent Joseph Bisset who wrote to the authors stating "*We heard a rumour that one of the Baird machines was in a capsule (gondola) slung below the R101 when she left for India…It was supposed to be for trying out as an aid in the dark*"[xxiv]. So far, investigations into the Baird company at the PRO as well as with the Airship Heritage Trust have found no further information to explain this file inclusion or suggestion.

DSIR 36/4408 *entitled Radio Research: Radio Receiving Apparatus Facsimile Telegraphy*, opened December 1929, offers some interesting details. The file reports that experiments using a modified Fultograph machine were conducted at Aldershot with messages being sent to a receiver in a vehicle. The use of land lines was specified, as otherwise a very powerful transmitter would be needed to overcome interference. Various receiver concepts were investigated including strips of paper, which would be written on with a stylus. No mention is made of a typewriter.

Fig. 3.6 *The Baird Telewriter*
Source: R.W.Burns

Coincidentally, the Baird organisation developed and patented a system similar to those patented by Telefunken and experimented with at Aldershot. This system also included a tape with character information passed in front of the scanning section of television type apparatus. In order to give the invention, which J.L.Baird called 'Telelogoscophy',[xxv] a broad commercial base the Baird organisation broadcast 'Television Screen News' as early as 1929, during their 30-line public broadcast.[xxvi] It must be noted that these news items were distinct from the text captions used as an editing technique for discontinuous shots during the 30-line broadcasts.[xxvii] The patent issued for this system was GB 299 076 and entitled Improvements in or relating to Facsimile Telegraphy. The patent suggests the use of a lensed Nipkow disc, but as the image on the left below shows, the lenses were discarded and replaced with simple holes.

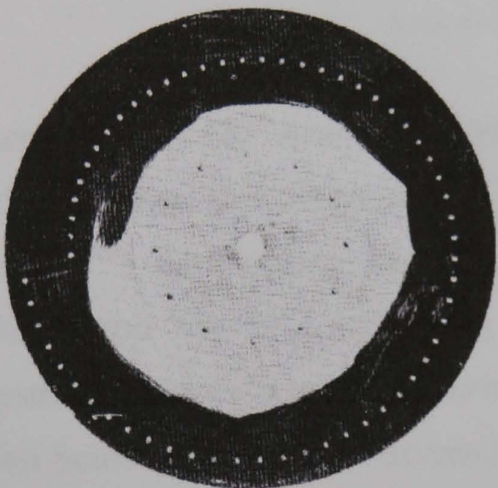


Fig. 3.7 *Baird Television Ltd*
Source: *Television*, September 1932.

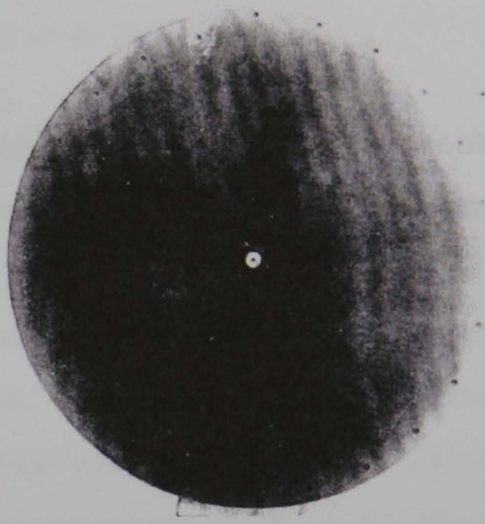


Fig 3.8 *Signals Experimental Establishment*
Source: PRO AVIA 23/553

Nipkow discs used for sending images of text

Meanwhile, the Signals Experimental Establishment continued their research into television signalling using a 30-line Nipkow disc system closely related to that used in the contemporary public television broadcasts. The S.E.E. report 566 of December 1932 reported that their signalling system produced "*…images [which] were clear and easily legible, even small spots and commas being easily seen*". A method of encryption was proposed which involved drilling pairs of discs so that scanning was not in the conventional sequential manner.[xxviii]

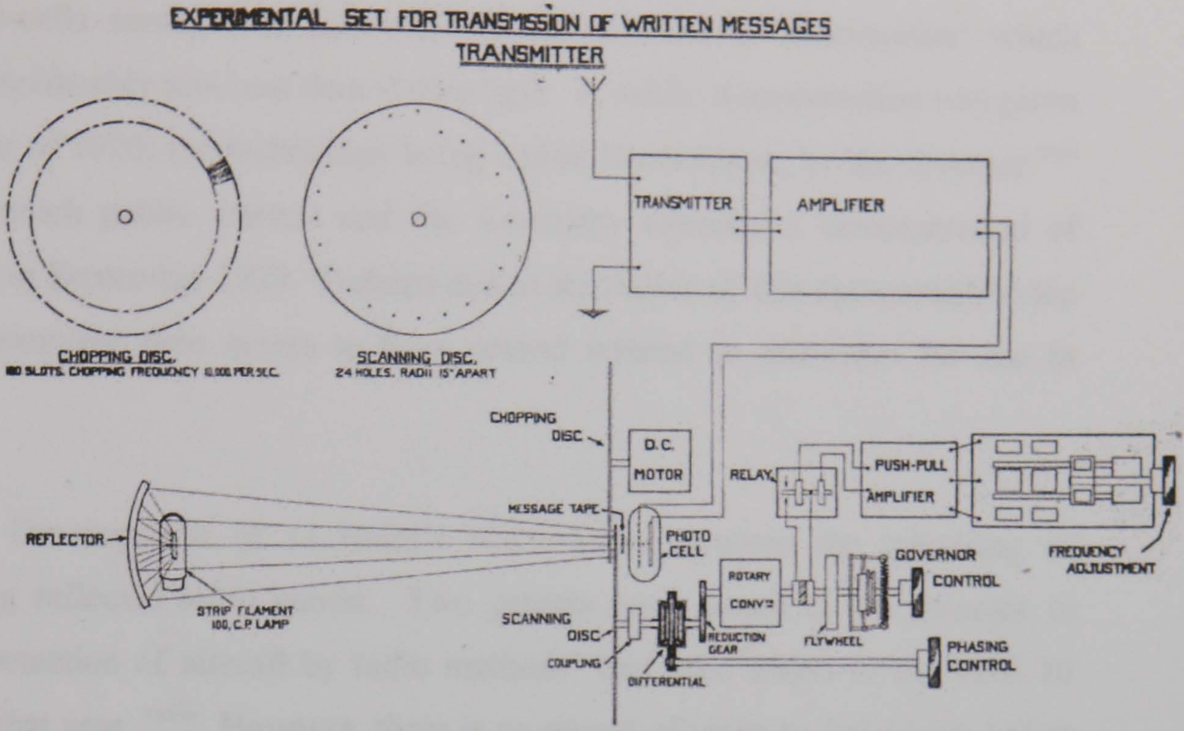


Fig 3.9 *S.E.E. system as recorded in their report of December 1932*

Source: PRO AVIA 23/553

According to Mc Arthur and Waddell (1990) in 1935 two books were published which state that television was being used for signalling of Morse 'secret code' and text.[xxix] Furthermore, the journal *Television* of September 1932 published a letter from Baird Television Ltd stating that they had conducted experiments with special systems for sending text via television.[xxx] This article probably referred to the 'Television Screen News'. The 'Screen News' was the public manifestation of the technology whilst the military experiments could remain secret and yet benefit from the contemporary research. Advancement into television signalling had an influence in future investigations into television reconnaissance and for many years superseded conventional television as a method for disseminating information due to the latter's lack of quality.

3.5 Television for use in Darkness

During John Logie Baird's earlier investigations into television he had to overcome the insensitivity of his light cells, which forced him to illuminate his subjects with intense amounts of light. The heat produced from such illumination became too strong for a human subject to withstand. After various experiments he chose photo-cells sensitive to infra-red and the associated 'illumination' which produced considerably less heat than visible light. A public demonstration was given in November of 1926; the technology being called Noctovision, by the inventor.[xxxi] There was much public interest and the Admiralty attended a demonstration of Noctovision in September 1929. Perhaps due to the failure of this demonstration the British Government then seems to have ceased interest in television for use in darkness.

One Development of J.L.Baird's Noctovision involved the televising of objects using reflected radio waves. Two patents were issued to the inventor in 1928.[xxxii] 'Detection of aircraft by radio methods' had been added to the RAE 10 department that year.[xxxiii] However, there is no record of visits to Television Ltd to investigate this phenomenon such as happened when the RAE and Admiralty were interested in television reconnaissance.

3.6 Summary

From the beginning of investigations by the Admiralty to the end of the one peaceful decade between the two World Wars, television was investigated in many different applications for military use. Television for aerial reconnaissance was the subject of much further investigation by the British Government who used Baird Television Limited and Marconi-EMI to produce equipment. This investigation is described in detail in chapter six. Signalling using television was part of the same group of investigations and is also given detailed attention. Television for use in conditions of darkness had much public interest, but by the beginning of the 1930s was no longer considered a useful military tool. Detection of objects using radio waves was to become an entire new technology known as radiolocation or now in common parlance as radar. The involvement of John Logie Baird and his companies with these technologies is discussed below.

3.7 References

[i] Devereux, A. (1991). *Messenger Gods of Battle*. UK: Brassey's. pp. 4.

[ii] ibid. pp. 7-8.

[iii] Gernsback, H. (1924, November). The Radio Controlled Television Plane. *The Experimenter*. pp. 22-23.
Aeroplane With Eyes (1924, November 18.) *Daily Express*. np.
Five years later C.F.Jenkins was reported as about to pilot his Stinson aircraft for aerial reconnaissance experiments. It is not known whether these experiments were successful, although considering the low definition of his television image, it is unlikely. 'Air Pictures to go on Radio', *Detroit Free Press*.

[iv] W. Sydney Smith, (1924, November 25) PRO AIR 2/269
Burns, R.W. in Early Admiralty and Air Ministry Interest in Television follows a similar opening discussion and goes on to discuss his subject based on enclosures from AIR 2/269 concluding in 1929.

[v] PRO AIR 2/269

[vi] McArthur and Waddell in *Vision Warrior*, pp 216, suggest that there was an inter-service rivalry with regard to television research. A close reading of file AIR 2/269 as well as AIR 2/2743, suggests that there was active co-operation between the services rather than a rivalry.

[vii] PRO AIR 2/269

[viii] Wells, H.G. (circa 1921) *The History of Mr Polly* and *War in the Air*. London: Odhams. pp. 167.

[ix] McArthur and Waddell in *Vision Warrior*, pp 215, include an image of one of the communications from AIR 2/269 regarding this demonstration.

[x] Burns, R.W. 'Early Admiralty and Air Ministry Interest in Television' pp 7.

[xi] Patent GB 295 210.

[xii] Mc Arthur, T. and P. Waddell (1990). *Vision Warrior*. Orkney: Orkney Press. pp. 265-266

[xiii] Burns, R. W. 'Early Admiralty and Air Ministry Interest in Television' pp. 8.

[xiv] Mc Arthur, T. and P. Waddell (1990). *Vision Warrior*. Orkney: Orkney Press. pp. 218.

[xv] PRO AIR 2/2743

[xvi] PRO AIR 2/269.

[xvii] Facsimile Telegraphy. (1947 January 1). *Cable & Wireless Ltd. Occasional paper No 2 Engineer-in chief's Dept.* pp. 2.

[xviii] PRO AIR 2/269 Report by Chief Superintendent Hall of RAE on visit to S.E.E, November 1st 1929.

[xix] Mc Arthur, T. and P. Waddell (1990). *Vision Warrior*. Orkney: Orkney Press. pp. 219.

[xx] Hills, A. R. (1999) *Visions: The Life and Legacy of John Logie Baird*. CD-ROM. Glasgow: SCRAN

[xxi] Leggat, P. (1998, March 12). The Fultograph. British Vintage Wireless Society Bulletin. pp. 24-25

[xxii] Hills, A. R. (1999) *Visions: The Life and Legacy of John Logie Baird.* CD-ROM. Glasgow: SCRAN 1999.

[xxiii] Mc Arthur, T. and P. Waddell (1990). *Vision Warrior.* Orkney: Orkney Press. pp. 227

[xxiv] Bisset, J. (1983, November 11) Letter to Dr. Peter Waddell.

[xxv] Burns, R.W. (2000). *John Logie Baird, television pioneer.* London: MPG Books Ltd. pp. 191.

[xxvi] Burns, R. W. (1979, July). Early Television Development in the Marconi Company. *7th IEE Weekend meeting on the History of electrical Engineering.* pp. 97-114.
Mc Arthur, T. and P. Waddell (1990). *Vision Warrior.* (Orkney: Orkney Press) pp. 267.
The was GB 324 029 and applied for on the 3rd of October 1928

[xxvii] Robb, E (1934, June). Putting Vision on the Radio Programmes. *Television*, pp. 242-245.

[xxviii] PRO AVIA 23/553

[xxix] Mc Arthur, T. and P. Waddell (1990). *Vision Warrior.* (Orkney: Orkney Press) pp. 265.

[xxx] Layzell, R. E. (1932, September). "News" by Television. *Television.* pp. 270

[xxxi] Hobson, P. (1988 July/August). The Story of Noctovision. *Television.* pp. 166-167.

[xxxii] British Patent 292 185 "Improvements in or relating to Apparatus for Transmitting Views or Images to a Distance" Applied for December 21 1926, accepted June 21 1928.
British Patent 297 014 "Improvements in Apparatus for Vision by Invisible Radiation" Applied for March 10 1927, Accepted September 10 1928
American Patent 1 699 270 applied for May 4 1928, accepted January 15 1929.

[xxxiii] H.E.Wimperis, minute 48 6.12.27, and minute 50 18.1.28. PRO AIR 2/2743

CHAPTER 4

Noctovision
and the
British Military investigation of Infra-Red Radiation

Fig. 4.1 *J.L.Baird and Philip Hobson with a Noctovisor*
Source: Philip Hobson

4.1 Abstract

Infra-red (IR) technology was first pressed into service for military purposes during World War I. In the mid-nineteen twenties J. L. Baird investigated the use of infra-red for television. The success of these experiments resulted in his creation of Noctovision, a system for detecting objects using infra-red radiation. There was much interest from various nations' Governments as well as from the British public in the potential military use of Noctovision. The British Admiralty had an ongoing research interest in the technology and J.L.Baird demonstrated two types of

Noctovision to them. After an unsuccessful second demonstration in 1929 the Admiralty postponed their interest in this form of the technology. The 1930s saw great advances in television related technologies some of which produced image converters which could resolve a visible image from IR radiation. A patent issued in 1936 to Baird Television Ltd foreshadowed some important facets of television aerial reconnaissance systems that were later to occupy much of the company's development work.

At the beginning of World War II the Admiralty liased with Baird Television Ltd over the development of an image converter. However, IR technology had only limited operational use by the British during the war even though it was developed to a greater extent in Germany. J.L.Baird, separated from the company he created during the war, may have rekindled his interest in the technology but there are no more available details. His company's infra-red technology developments did however benefit from the inventor's pioneering efforts.

4.2 First use of Infra-Red Imaging for Military Purposes

According to Professor R. V. Jones, Dr H. Gaertner of Germany detected British torpedo boats using infra-red (IR) at a distance of 10 kilometres during World War I. This event was, according to Jones, the first military use of detection by electronic infra-red systems.[i] Similar work was conducted in America for the detection of people and aircraft using infra-red. In particular, the Case Research Laboratory used a Thalofide cell based system that could send "*... signals over an 18 mile (29 km) range in 'average' weather.*"[ii] This system was reduced in size and used operationally for guiding aircraft to landing strips as well as keeping formations together. In Britain and Germany similar communication systems were also investigated.[iii] There then followed a series of investigations by the British Admiralty, and it was this fighting service that took an interest in the infra-red investigations of J.L.Baird.

4.3 John Logie Baird's Noctovision

In 1925, J.L.Baird had problems with the insensitivity of his light cells, which forced him to use a very intense light source. The associated heat of this light was almost unbearable for his human subjects. Baird had noticed that certain photo-cells reacted to non-visible wavelengths of the electromagnetic spectrum. He decided to investigate this reaction in the hope that it would reduce the heat generated by illumination. His first area of investigation used ultra-violet rays, but he found that this area of the electromagnetic spectrum produced *"...a most unpleasant effect upon the skin"*[iv] He then investigated the infra-red region of the electromagnetic spectrum.

Baird's first attempt at producing infra-red rays was to use electric fires (portable heaters). In his autobiography he writes, "...[at first] *I could not get any result and added more fires until Wally* [Baird's assistant] *was nearly roasted alive, then I put a dummy's head and added more fires and the dummy's head went up in flames*"[v]. The inventor's next attempt at producing infra-red rays was to place ebonite panels over his electric light source. These panels successfully cut out all light except for the infra-red rays, and eliminated the excessive generation of heat. Baird could now televise people in what to the naked eye was complete darkness.

4.4 Initial Public and Government interest in Noctovision

Realising the potential of this new television method, both for civilian and military applications, J.L.Baird gave demonstrations of his invention. According to Philip Hobson the first demonstration was to Dr. Alexander Russell FRS and Sir William Crookes in November of 1926[vi]. A further demonstration of Noctovision was given to representatives of the British *Daily Mail* newspaper on the 15th of December. According to the *Daily Mail* report Baird's business partner Captain Oliver George Hutchinson stated that, *It is difficult... to estimate what may be the importance in war of this invention. It becomes feasible to follow an Enemy's movements when he believes himself to be in darkness. Attacking aeroplanes approaching under cover of night will be disclosed to the defending headquarters by the electric eye of the 'Televisor'.*[vii]

The *New York Times* in America also echoed this enthusiasm noting that previous to this demonstration "*Secret tests of the invention have been held before naval, military and air force officials*".[viii]It is therefore unclear when the first demonstration of Noctovision occurred or who was in attendance. Later on the penultimate day of the year a public and very popular demonstration was given to members of the Royal Institute, the same scientific body who had witnessed the first television demonstration in January.[ix] Of note also was a demonstration to members of the British Association in Leeds during September of 1927. Mc Arthur and Waddell (1990) record that representatives of British, French, German and American Governments visited the December 1926 demonstration.[x] The Japanese were also reported to be interested in Noctovision.[xi] A New York Times article offered the following commentary,

Such Rays, [J.L.Baird] *states, will pierce fog. By means of them it will be possible for a general in future wars to see every movement, even in the darkness, of enemy troops, and an airplane can be watched without the aviator realizing that his presence is detected. In a fog at sea a beam of invisible light sweeping the water in front of a vessel will pick up any object ahead of it, such as another vessel or land*[xii]

This type of commentary captured the public imagination both in Britain and abroad. The British journal *Television* published articles entitled 'Television in Warfare: the Battle of the Ridge' and 'The Triumph of the Noctovisor'. Both fictional accounts of possible uses of Noctovision reinforced public enthusiasm for the technology. [xiii] There was also much serious public discussion of the use of infra-red rays for object detection and fog penetration.[xiv] An assesment of the properties of infra-red was given by A. Dinsdale in one of these articles. He Writes,

> *The most intense light, it will be noticed, shows through fog as a dull red colour. The thicker the fog the duller the red which shines through.*
> *This phenomenon is not due to any change in the characteristics of the original source of light. The fact is that any given light source emits not one single colour of light, but several, which combine to give the effect of a single colour. By means of filters which allow only certain component colours to pass, all other colours can be eliminated. Fog acts as a filter which will only pass red light.*
> *The penetrating power of light varies as the fourth power of the wavelength, so that red light penetrates some 16 times better than blue light, and infra-red light some 16 to 20 times better still.*[xv]

This was a simplistic understanding of the penetrative powers of infra-red radiation, and as will be shown later, not wholly correct.

Mc Arthur and Waddell (1990) comment on a 1927 article in *Nature* by J.L.Baird which states that due to the potential wartime uses of Noctovision, he was told by the British Government to *"...withhold publication of technical details of his equipment"*[xvi]. However, as mentioned in the previous chapter, Television Ltd patent GB 295 210 and American patent US 1 781 799 both contained specifications for signalling using infra-red a technology of direct interest to the military. The two authors also record that during June 1927 there were to be tests of Noctovision on the passenger ship SS. Perth. Although there was much public announcement of these tests, there is no record of whether they were actually carried out.[xvii] Technical details of Noctovision, for both object detection and signalling were freely available. Therefore, it is probable that J.L.Baird's invention was not significantly original as to withhold publication of details. If this is the case then it is probable that the tests on the SS. Perth were not undertaken, otherwise they would have been reported.

4.5 Admiralty interest in Noctovision

There were two methods of Noctovision for object detection, one 'active' and the second 'passive'. Active Noctovision involved the illumination of an object with infra-red rays and the subsequent detection or 'televising' of the object. Passive Noctovision involved the detection of objects by the objects own infra-red emanations.

Fig. 4.2 *J.L.Baird and assistant with Noctovision apparatus on top of Motograph House.*
Source: Dr Peter Waddell

Mr Ray Herbert notes that the first confirmed Noctovision demonstration to the Admiralty was at the Baird Television laboratories in Motograph House during April 1927.[xviii] This demonstration involved the 'active' form of Noctovision. Motivated by the initial burst of publicity and Government interest, the Baird organisation then developed Noctovision so that it was capable of 'passive' detection. A detailed account of Admiralty interest in the various potential uses of IR technology is provided by Burns (2000).[xix]

To assist in the development of Noctovision Mr Philip Hobson was seconded to the project in June of 1929. Hobson's involvement required that he live near to J.L.Baird's home 'Swiss Cottage' on Boxhill, Surrey. This Hobson did, and he lived for a short time with a Mr G. B. Banks, to whom he was assistant, in caravans parked near to Baird's house. The remit of the two technician's investigations was to produce a navigational version of Noctovision which could locate the position of objects, i.e. passive detection.[xx]

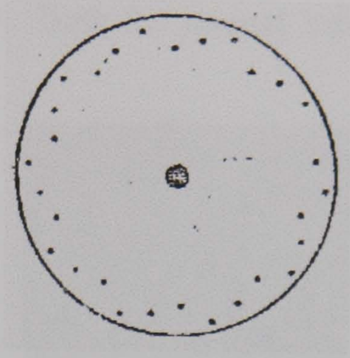


Fig. 4.3 *Noctovision Nipkow disc*

Source: Dr Peter Waddell

The technology of the passive detector device was similar to that of the contemporary 30-line television. However, instead of a lensed disc, a disc with holes was used, the holes being placed in groups rather than in a spiral[xxi] as depicted in the above diagram. The requirement for the greatest amount of 'light' detection dictated the hole arrangement as well as their large size. As detection of a point of emission was the only requirement the low definition associated with the large and few holes was not a problem. Once the general direction of a point of emission had been established, then the precise direction could be ascertained by centering the point in the object display. The images of Baird's Noctovisor clearly show that it was designed to rotate vertically and laterally to assist in object location. Azimuth and elevation of the object could then be read from scales of gradations attached on the exterior of the Noctovisor casing.

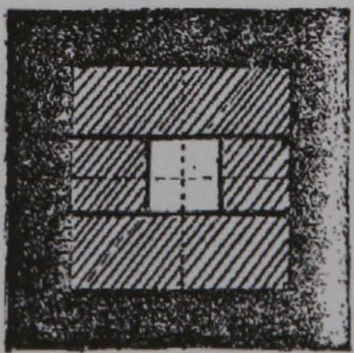


Fig. 4.4 *Representation of Noctovision viewfinder*

Source: Dr Peter Waddell

By August of 1929 the equipment had been developed enough to give a demonstration to the press. For this demonstration Hobson's Rover 8 car was driven at night and at a suitable moment had its headlights covered with a filter to extinguish all the visible radiation. The position of the car was then successfully obtained using the Noctovisor. Both the journal Television and a local newspaper recorded this success.[xxii]

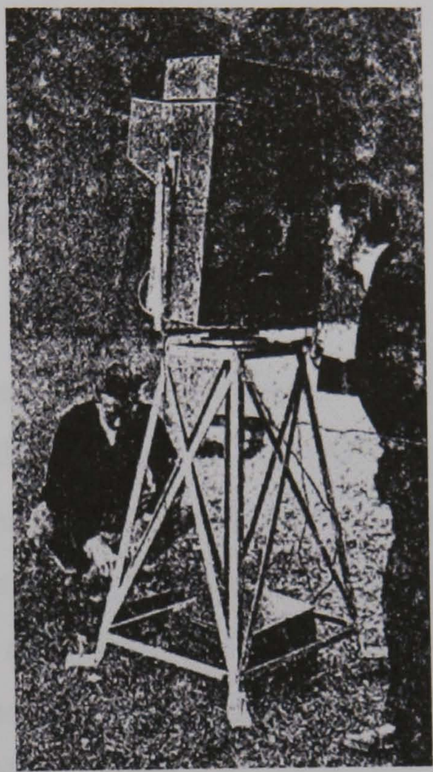


Fig. 4.5 *Noctovisor showing viewfinder*
Source: Dr Peter Waddell

A few weeks later a demonstration was organised for the Admiralty which was less successful. For this demonstration, and so as not to leave anything to chance, a powerful light with suitable filter was attached to a hotel. A fixed object of known direction was considered easier to find than a mobile vehicle. Unfortunately, that evening a fog formed and even with prior knowledge of the direction of the 'light' source, no reading registered on the Noctovisor.[xxiii]

Fig. 4.6 *Mr G. B. Banks with the Noctovisor overlooking Dorking from 'Swiss Cottage'.*
Source: Philip Hobson

The difference between the first public demonstration and the second Admiralty demonstration was the presence of fog. Although radiation in the infra-red region of the electromagnetic spectrum is more energetic than in the shorter regions of visible light, as mentioned by Dinsdale in *Television*, it is nevertheless attenuated by water droplets to a similar degree to that of visible light. This fact was noted by J.A. Sanderson of the American Naval Research Laboratory in 1940.[xxiv] Therefore, although Baird's Noctovision may have had certain applications for observation of infra-red radiation, it was only useful in clear air. As described earlier, large holes were required in the scanning disc of the Noctovisor as the photo-cell used, although specified to react to the wavelengths of light used, was less sensitive than ones suited to visible wavelengths. Therefore, in foggy conditions it would have been better to use a system of greatest visible light sensitivity unless only an infra-red emission source was to be detected. The Admiralty then ceased their interest in Baird's Noctovision, as at that time the most sensitive light detector was the human eye. R.W.Burns provides a similar conclusion in *John Logie Baird...* and states that results of research by the Air Ministry and National Physical Laboratory was consistent with the Admiralty and that current technology could not provide useful applications for IR.[xxv]

In 1930 Hobson was charged with the task of finding out why Baird's equipment didn't work in fog. The equipment was taken back to the Baird laboratories at Long Acre where outdoor tests were conducted from the roof. These tests were not useful and Hobson required more controlled conditions. He then built and developed, with the cunning addition of a car radiator, a laboratory apparatus for producing fog and thus testing Noctovision. Assistance in production and specification of this machine was provided to Hobson by the National Physical Laboratory. Hobson concluded in a report that Noctovision in its present state did not work and would require expensive adaptations as well as more sensitive photo-cells which were yet to be developed.[xxvi] According to the notes of Mr Hobson a Mr Mc Ewan of Baird Television Ltd also experimented with Noctovision in Portsmouth during April of 1931, but his investigations were unsuccessful.[xxvii]

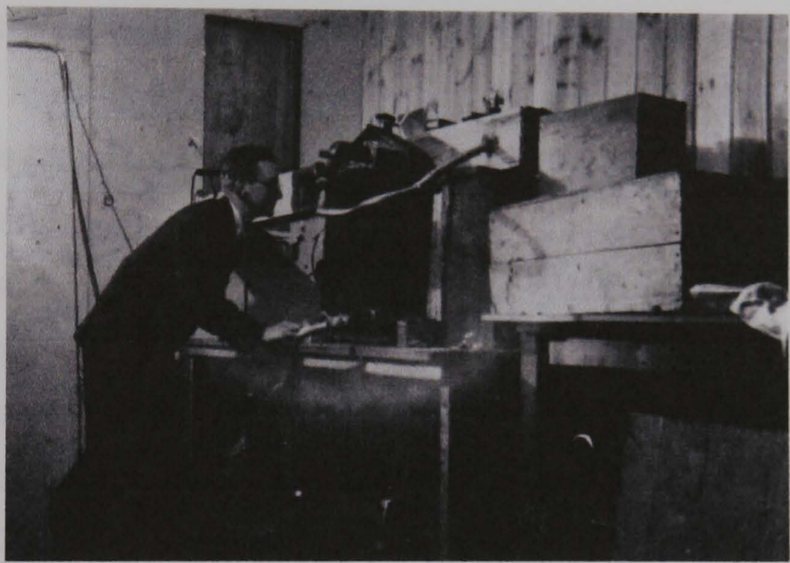


Fig. 4.7 *Philip Hobson with car radiator equipped Noctovision smoke generator.*
Source: Philip Hobson

This may have been the end of the specific interest in Noctovision by the Admiralty, but they returned to the Baird company for image converters suitable for use with infra-red. This Admiralty interest which occurred in 1940 may have been the result of similar work initiated for the Air Ministry. Burns (2000) suggests that it was.[xxviii] In a letter from Professor R.V. Jones to Dr Peter Waddell, Jones Writes, *My visit to Baird TV took place on 1st March 1937, and I was accompanied by Mr Samuel Hecht,*(1) *who was civilian Radio Engineer in the Department of Communications Research and Development in the Air Ministry. The purpose of our visit was to see whether Baird could make an image transformer with a cathode that would give enough thermionic emission to be used as a thermionic image converter in which the emission would increase at a sufficient rate with temperature to convert thermal images into visible ones. The Air Ministry had taken out a patent on my behalf in the hope that it might prove practicable.*[xxix]

Hecht notes after an earlier visit to BTL on the 11th of February that the invention of Dr Jones could be manufactured by BTL and paid for by the Air Ministry. [xxx] Further details concerning the proposed March visit are provided in a letter of 26th of February 1937 from H. Wimperis DSR Air Ministry, to Captain A.G.D West of Baird Television Ltd. Wimperis notes that during his forthcoming visit (2) Mr Hecht would be interested in discussing improvements to photocells, photographic film and photo–electric surfaces specifically related to use with infra-red. He would also be interested in electron cameras, i.e. the Baird Image Dissector, which were capable of viewing infra red radiation from both natural sources and artificial illumination.[xxxi] These items had been the subject of discussion and report by Hecht from as early as the 17th of July 1936.[xxxii]

During 1937 Baird Television Ltd were developing the Image Dissector camera which had been invented by American Philo Farnsworth and which the company were manufacturing under licence. A way of increasing the sensitivity of this camera was to attach to it an electron multiplier. Via its German subsidiary Fernseh Aikten-Gessellschaft, Baird Television Limited were issued patent GB 516 785 on the 11th of January 1940 for an electron multiplier design. The electron multiplier technology investigated by Jones was part of developments already being undertaken by BTL for a variety of military organisations. For instance, on 20th of July that year Captain

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1 A letter from BTL to the Air Ministry on 19th August 1936 from AIR 2/ 1775 notes Mr Hecht's christian name initial as N. It is therefore unclear what Mr Hecht's first name was.

2 This visit was part of a series of regular visits made by Samuel Hecht to both BTL and M-EMI Arrangements for commencement of these visits were made on the 30th of June 1936. AIR 2/1733.

West and Chief Engineer Banfield of BTL visited the Royal Signal School to discuss this organisation's purchase of electron multipliers.[xxxiii] As early as 1936, and at other times,[xxxiv] the Air ministry noted that television cameras, enhanced for use with infra-red radiation, would be useful for aerial operation. An Air ministry file discussing this subject notes,

> *If it is found possible to combine the penetrative power of the infra-red ray with the visible reproduction of images on a screen to an extent which will enable a pilot to obtain a continuous view of the ground otherwise obscured by clouds or fog, the possibilities are enormous, both in connection with bombing visible objectives and with operating aircraft in mist and fog, or vice versa for seeing aircraft for A/A* [Anti-aircraft] *fire.*[xxxv]

Baird Television Ltd were issued patent GB 441 235 which provided a cine film method of IR reconnaissance in the year of this suggestion. The topic of reconnaissance using television including details of this patent are provided in chapter six. In 1940 the Admiralty visited BTL to inspect image converters and electron multipliers developed for similar use for Naval purposes.

4.6 Development of image converter tubes in Baird Television Limited, 1940.

The Baird Television Ltd interest in image converters is recorded in Public Record Office file ADM 204/1432 *Baird Television Ltd: image converters, 1940.* This file contains a report by Dr. E. Lee and Mr L.E. Mayes who visited Baird Television Ltd at their Worsley Bridge Road factory on 25th of January 1940. It is noted that a previous visit was made on the 6th of December the previous year and that this was a progress report of work undertaken since then. It was considered that Mr Samson of BTL had considerable experience with this type of technology as he had to date made '*...about 150 Farnsworth image dissector tubes*'.[xxxvi] Dr Samson was of German extraction and in chapter seven it will be described how he and fellow foreign national Dr Sommer were excused from wartime internment due to their exceptional skills with this technology.[xxxvii]

The first image converter tube investigated by BTL was the German Philips type which had been manufactured since the previous visit. This tube of between 8-10 inches (20-25 cm) long used a cassegrain type system in which light was taken from one end, then reflected back to the original end and then viewed from behind the reflecting surface. Unfortunately, this system reduced incident light by 20%, which was a significant loss if the tube was to be used for imaging in low light. In ADM 204/1432, no specific purpose is stated for the application of any of the image converters investigated. However, the file states that future developments required a wider angle of view and *"... the desirability of direct vision and of having a facepiece or eyepiece to enable the eye to be directed towards the anode without difficulty in complete darkness."* It is possible that this requirement referred to the night navigation system discussed below.

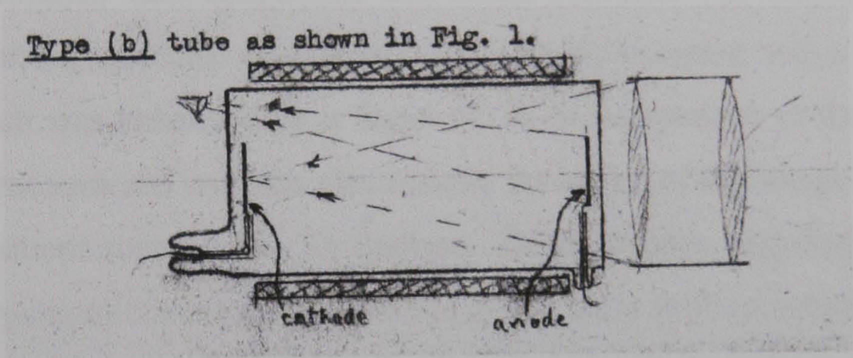

Fig. 4.8 *Cassegrain type image converter tube.*

Source: ADM 204/1432

To overcome the light loss problem a second tube was produced and designed without the cassegrain system.

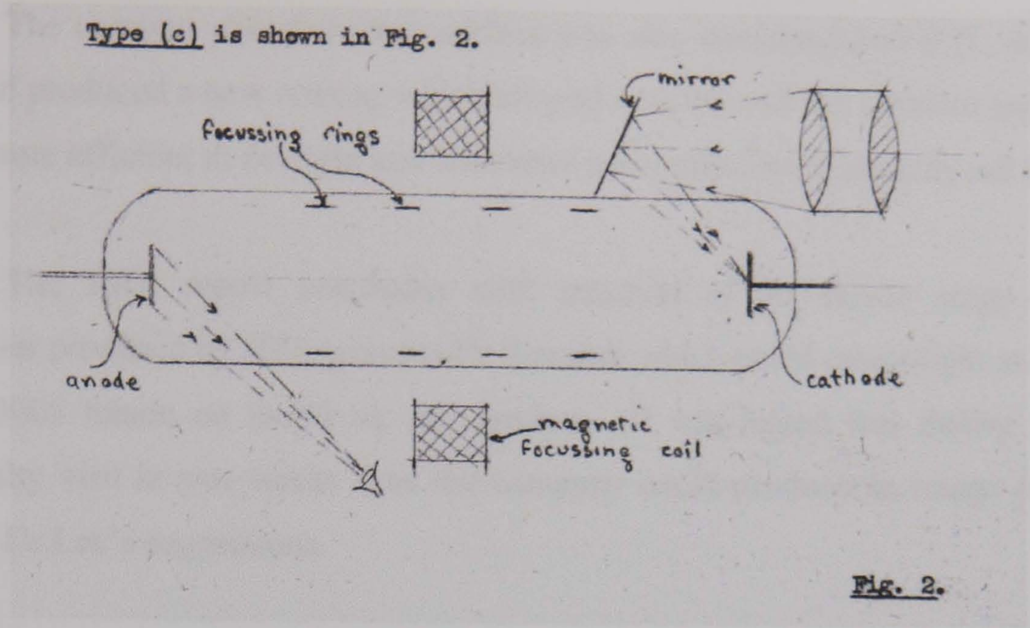

Fig. 4.9 *Development of image converter. Note mirror above anode installed to overcome problem of occlusion of image by anode.*

Source: ADM 204/1432

After 10 minutes 'dark adaptation' this image converter was demonstrated to be capable of resolving an image equivalent to 0.01 lux illumination with a f/2 lens, a performance which was enhanced by a factor of 10 in comparison to the previous tube. Problems encountered with the electrostatic focussing of the image were also discussed and solutions suggested by Dr Samson. Developments suggested were the inclusion of a viewing microscope which would give a more brilliant image as it was focussed over a smaller area. To produce a tube which fulfilled all the requirements Dr Lee of the ARL suggested a design of the configuration illustrated below.

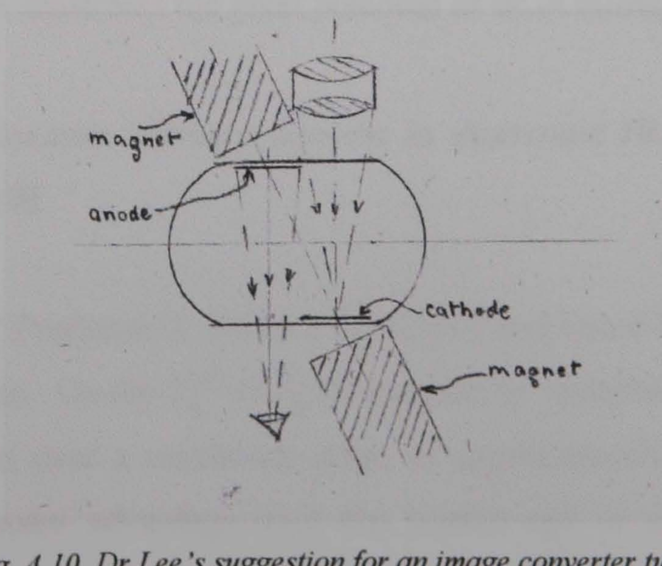

Fig. 4.10 Dr Lee's suggestion for an image converter tube.

Source: ADM 204/1432

The caesium photosensitive surface was also discussed and BTL stated that they had produced a new coating which alloyed a metal with the caesium and was 30 times more efficient in daylight and 300 times more efficient to mercury arc light.

The ARL report concludes with mention of an eleven stage electron multiplier produced by BTL scientist Dr Sommer which could detect light as weak as 0.000 0005 lumen on its 15 sq. cm. surface. It was hoped that during the next Admiralty visit in two weeks time the company could produce an image converter tube to Dr Lee's suggestions.

Unfortunately, the PRO file does not indicate the results of any further meeting. According to Arnquist (1959) J.D McGee of EMI Ltd also completed a similar design of image converter. This cell was placed into limited production "*...and used in night driving and other equipment to some extent*". [xxxviii] Elliott (2001), states that manufacture of image converter tubes was undertaken by the Gramophone Company Ltd, an associate of Marconi-EMI at Hayes, Middlesex.[xxxix]

The detection of objects using image converters and infra-red apparatus was part of British, German, American and other nations investigations during World War II. Britain undertook various investigations but made little use of the technology operationally. Germany on the other hand, put IR technology to various uses, a description of which illustrates the great potential of IR in military service.

4.7 British and German military interest in electronic IR based technologies during World War II

During 1937 Professor R.V Jones developed and tested some basic apparatus for air to air detection. On the 27th of April that year he installed the equipment in an aircraft and tested it over a maximum range of approximately 500 metres.[xl] This apparatus offered scant advantage over the human eye or ear, would not work through cloud and offered no measurement of range. For these reasons the technology was pursued no further and the apparatus did not see active airborne service during the war. Jones (1961) observes that although the Government dropped this investigation in March 1938, they were aware of the direction future developments should take. Jones notes, "*We believed that the ultimate solution would probably lie in a fusion of the 1.5m radar and infra-red philosophies, leading to a system using a wavelength long enough to penetrate cloud, and short enough to be focused.*"[xli] Since 1938 technology has advanced dramatically particularly in the field of information technology. In September 1999 a conference was held in Britain that discussed techniques currently under development which used both radar and infra-red imaging combined into one display for guidance of aircraft.[xlii]

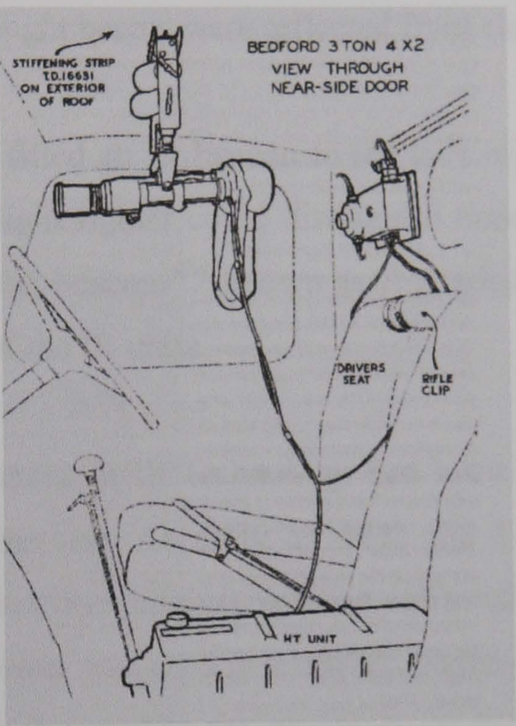

Fig. 4.11 *Infra-red binocular installation for British truck*

Source: Windscreen, spring 2001.

As mentioned above there may have been modest British operational use of infra-red techniques.[xliii] The night driving system mentioned by Arnquist, part of a series of systems code-named 'Tabby',[xliv] involved the covering of vehicle headlamps with filters which only let through infra-red emissions. The driver would then operate the vehicle using a binocular receiver fitted with a suitable image converter. The system allowed convoys to move "*...at night over roads or open country at speeds about equal to normal daylight convoy speeds*".[xlv] The advantage of this system was that unless enemy aircraft had infra-red imaging apparatus they would be less likely to see the convoy which would normally betray its presence by its headlights.

The British Admiralty used IR emissions from beacons on 'mother' ships so that suitably equipped reconnaissance craft could return safely. These systems were first used in the Mediterranean in 1941. [xlvi] Craft attacking the formidable German battleship Tirpitz in Alte Fjord also used this system. Elliott observes that LVTs (Landing vehicles tracked i.e. amphibious tanks etc), were fitted with Tabby night driving systems for crossing the Rhine in 1944-45. However, although the equipment was fitted it was not used as the crossing was illuminated using 'artificial moonlight', where searchlight beams were reflected from clouds.[xlvii]

The Air Ministry fitted an IR beacon to the tails of aircraft in 1942. In this application a 'friendly' night fighter could distinguish between its own aircraft and hostile intruders.[xlviii] Radar beacons[xlix] known as IFF, Identification, Friend or Foe were later used in place of the IR units.

In Germany advances in IR technology had been made in the late 1930's which lead to its wartime use. As early as 1941 the Luftwaffe equipped some Messerschmit Bf 110 *Zerstörer* aircraft with an infra-red detection system called *Spänner Anlage.* This system was used in a similar manner to that of the Leigh light, i.e. the aircraft would be directed to the proximity of its target by radar and then 'home in' using IR. It is likely that this system would have been particularly effective if the allied aircraft used its IR IFF system, the beacon being in this situation an extremely hazardous attachment. A similar situation occurred with radar IFF. As with the system developed by Jones, the German IR equipment had limited range and development was postponed. The Luftwaffe later renewed interest in this technique when their Liechtenstein airborne interception radar was being jammed by allied countermeasures.[l]

Fig. 4.12 *German tank equipped with Infra-red imaging system*
Source: Trevor Snyder

In Germany there was also development and limited use of IR telescopes that assisted night time operation of vehicles. Another application of IR echoed some of the earlier British stories written in *Television: Journal of the Royal Television Society* about Noctovision. A German armoured squadron had a special half-track vehicle fitted with an IR night driving system and also a large IR 'searchlight'. The light could then illuminate a battlefield and another device would be able to observe enemy vehicles and direct fire onto them. This is very similar to the proposed use of Noctovision 15 years earlier. According to Chapman Pincher the special squadron under the command of Major Graf von Werthen-Beichlingen destroyed 67 Russian tanks on the eastern front.[li]

'Noctovision' had, in Germany at least, finally lived up to its expectations so enthusiastically suggested when it was first demonstrated by J.L.Baird. This inventor's early systems were never used, but through his company there was operational use in Britain of Baird Television developed technology. Whether J.L.Baird himself was aware of these developments is unknown; it seems in 1940 he had been apart from the day to day running of his company for some years. This division between J.L.Baird and Baird Television Limited is discussed in more detail in chapter seven. However, in John Baird's personal diary he noted "Noctovision" in December 1942 and then again in January 1943 and 1944. The reason for these entries is as yet unknown. Within the company formed by Baird there was, during the war, a continued development of imaging apparatus for dark conditions, although this investigation was based more on the companies work with film rather than electronic image enhancement. Baird Television Ltd changed its name to Cinema Television and in June 1943 is recorded as being *"... engaged on development work for night photography"*[lii]

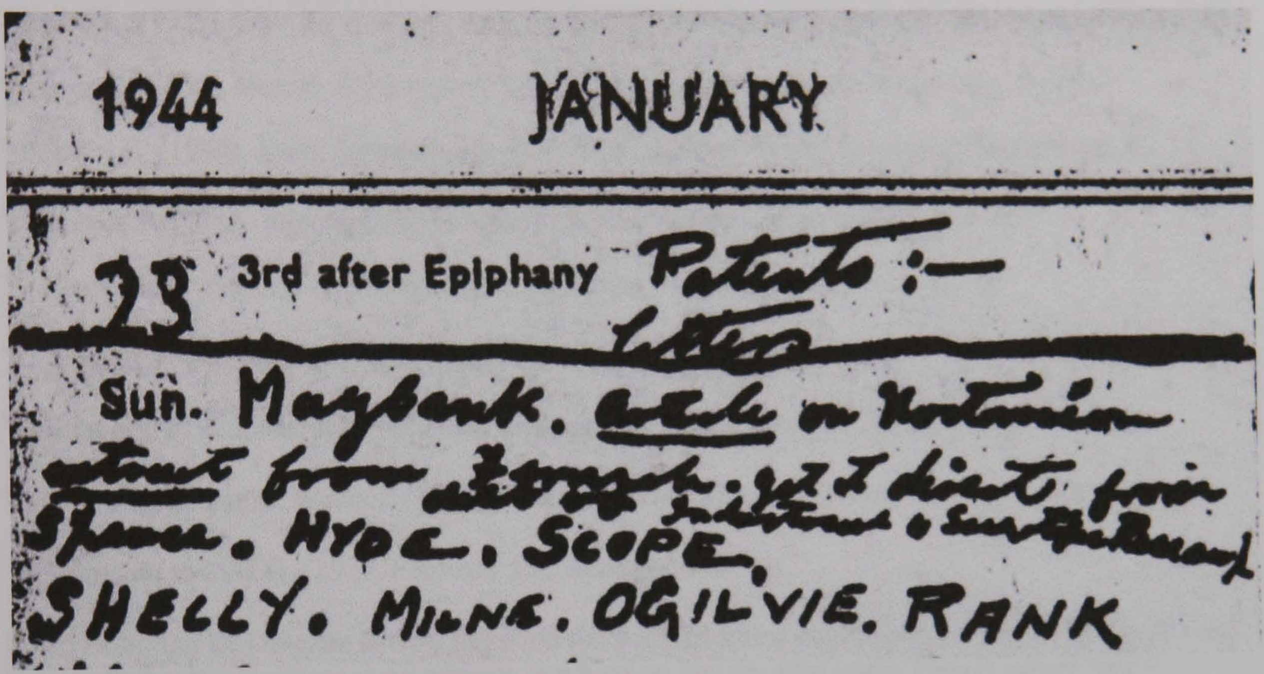

Fig. 4.13 *An extract from J.L.Baird's diary. Note, '<u>Article</u> on Noctovision'.*

Source: M.H.I. Baird

4.8 References

[i] Jones, R.V. (1972). Some Turning-Points in Infra-Red History. *The Radio and Electronic Engineer*. Vol. 42, No. 3. pp117-126.

[ii] Arnquist, W.N. (1959, September). Survey of Early Infrared Developments. *Proceedings of the IRE*. pp. 1420-1430.

[iii] ibid.

[iv] Baird, J.L. (1927, April). Television. Third lecture, January 6 to the Physical and Optical Society. *Journal of Scientific Instruments*. Vol. 38. pp. 138-143.

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Tiltman R. (1928, March). Noctovision: Seeing in Total Darkness. *Television*. pp. 40-41.

[v] Baird, J.L. (1990). *Soap, Sermons and Television*. London: Royal Television Society. pp. 65.

[vi] Hobson, P. (1988, July/August) The Story of Noctovision. *Television* pp. 166-167.

[vii] Searchlight that Can't be Seen (1926, December 16). *The Daily Mail*, pp. 9.

[viii] Sees in Total Darkness. (1926, December 16). *New York Times*, np.

[ix] Tiltman R. (1928, March). Noctovision: Seeing in Total Darkness. *Television*, pp. 40-41.

[x] Mc Arthur, T. and P. Waddell (1990). *Vision Warrior*. Orkney: Orkney Press. pp. 222.

[xi] Ultimatum to P.M.G. (1927, February 13). Sunday News. np.

Baird Historian Dr Douglas Brown has cited the notes of Baird employee Dr Constantin Szegho and has stated that the Japanese were actively working on Noctovision under Baird's patent name. Douglas Brown, personal interview, 20 December 1995.

[xii] Television in Dark Room (1926, December 31). *New York Times*, np

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Ironside, D.(1928, December). The Triumph of the Noctovisor, *Television*. pp 36-38.

[xiv] Seeing Through Fog. (1927, June 4) *Peking & Teintsin Times*. np.
Inventor Coming to U.S. to Show "Invisible Light". (1927, June 21). *Roanoke News*,(Virginia, U.S.A.) np.
Bailey, L. (1927, October 1). Noctovision. *Amateur Wireless*. pp. 418.
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Darbyshire-Monteath, J. (1928, April) Invisible Rays-the Infra Red: Experiments and Applications. *Television*, pp. 11-13
Crawley, C. (1928, October). Navigation by Invisible Rays. *Television*. pp. 45-46.
Luke, C.F. (1929, October 6). Britain's Miracle Eye. *Tit Bits*. pp. 228.

[xv] Dinsdale, A. (1927 April). Seeing in Total Darkness. *Wireless Magazine*. np.

[xvi] Mc Arthur, T. and P. Waddell (1990). *Vision Warrior*. Orkney: Orkney Press. pp. 223.

[xvii] ibid. pp. 226.

[xviii] Herbert, R.M. (1997). *Seeing By Wireless*. Second Edition. Croydon: PW Publishing Ltd. pp. 11.

[xix] Burns, R.W. (2000). *John Logie Baird, television pioneer.* London: MPG Books Ltd. pp. 114-117.

[xx] Hobson, P. (1988, July/August) The Story of Noctovision. *Television* pp. 166-167.

[xxi] Noctovision (1929, October). *Television.* pp. 377.

[xxii] Hobson, P. (1988, July/August) The Story of Noctovision. *Television* pp. 166-167.

[xxiii] ibid.

[xxiv] Sanderson, J. A. (1940) The Attenuation of Infra-Red Light by Fog. American Physical Society, *Physical Review* (USA). pp. 1060.

[xxv] Burns, R.W. (2000). *John Logie Baird, television pioneer.* London: MPG Books Ltd. pp.117.

[xxvi] Hobson, P. (1988, July/August) The Story of Noctovision. *Television* pp. 166-167.

[xxvii] Hills, A.R. (1999). *Visions: The Life and Legacy of John Logie Baird.* CD-ROM. Glasgow: SCRAN.

[xxviii] Burns, R.W. (2000). *John Logie Baird, television pioneer.* London: MPG Books Ltd. pp.117.

[xxix] Jones, R.V. (1995, December 11). Letter to Dr P. Waddell.

[xxx] Hecht, N. (1937, February 16). Visit to Baird Television Company. PRO AIR 2/1775.

[xxxi] Wimperis, H. (1937, February 26). Letter to Captain A.G.D. West of Baird Television Ltd. PRO AIR 2/1775.

[xxxii] West, A. G. D. (1936, August 19). Letter from Baird Television Limited to N. Hecht, Air Ministry. PRO AIR 2/1775.

[xxxiii] Report on visit to Royal Signal School by BTL staff (1937, July 20). PRO ADM 1/18581.

[xxxiv] Leedham. (1937, February 19). Minute 20. PRO AIR 2/1775.

[xxxv] The Potential Value of Television in Air Operations. (1936, July). PRO AIR 9/32.

[xxxvi] Hills, A.R. (1999). *Visions: The Life and Legacy of John Logie Baird.* CD-ROM. Glasgow: SCRAN.

[xxxvii] Electron multipliers for licence built Farnsworth image dissectors cameras were the subject of investigation by Fernseh A.G. A German company in which Baird Television Limited had a quarter share. Another quarter share owning company was Loewe who submitted patent GB 512 711 for an electron multiplier on February 16 1937. Loewe were later taken out of Fernseh A.G. due to their Jewish connections.

[xxxviii] Arnquist, W.N. (1959, September). Survey of Early Infrared Developments. *Proceedings of the IRE.* pp. 1420-1430.

[xxxix] Elliott, C. (2001, Spring). Tabby Tales. *Windscreen: The Magazine of the Military Vehicle Trust.* Issue 90. pp. 39.

[xl] Jones, R.V. (1972, March). Some Turning Points in Infra-Red History. *The Radio and Electronic Engineer.* Vol 42, No. 3. pp. 117-126.

[xli] Jones, R. V. (1961). Infrared Detection in British Air Defence, 1935-38. *Infrared Physics*, Vol. 1. pp. 153-162.

[xlii] Whitby, B. (2000, November 13) personal interview with the author.

[xliii] Arnquist (1950) states that there was modest operational use of IR for night driving whereas Elliott (2001) states that there was "...no record of operational use of Tabby" pp. 39.

[xliv] Elliott, C. (2001, Spring). Tabby Tales. *Windscreen: The Magazine of the Military Vehicle Trust*. Issue 90. pp. 32-40.

[xlv] Pratt, T.H. (1948, September). The Infra-Red Image Converter Tube. *Electronic Engineering*. pp. 274-316.

[xlvi] ibid.

[xlvii] Elliott, C. (2001, Spring). Tabby Tales. *Windscreen: The Magazine of the Military Vehicle Trust*. Issue 90. pp. 39.

[xlviii] Pratt, T.H. (1948, September). The Infra-Red Image Converter Tube. *Electronic Engineering*. pp. 274-316.

[xlix] IFF beacons both infra-red and radio produced a simple signal. They did emit complex signals with abstract meaning and were therefore not 'secret signalling' as suggested by Mc Arthur and Waddell in *Vision Warrior* pp. 297.

[l] PRO AIR 14/850.

[li] Pincher, C (n.d.) The Black searchlight.

[lii] Head of Photographic Division, RAE. (1943, June 17). Air Ground Television System. PRO AVIA 13/1263.

CHAPTER 5

John Logie Baird and Radar ?

Fig. 5.1 *A Reconstructed Chain Home High Transmitting Tower*

Source: EMI

5.1 Abstract

Since 1976 Dr Peter Waddell has published suggestions that John Logie Baird was personally involved in the development of radar.[i] This publication was followed ten years later by a book that had this suggestion as a central thesis. Since then, there has been a revised edition of the book and various newspaper articles making similar suggestions. As a result of these publications the question of the link between J.L.Baird and radar has been the source of much debate.

The evidence for a link between J.L.Baird and radar is not great. One associate of John Baird has suggested he assisted the inventor around 1923-4 with basic reflected radio wave experiments. Later, in 1928 two patents were issued to the Scotsman for an object detection system using radio waves. There is no other evidence to substantiate the assistant's statements or experimentation by J.L.Baird with his patented system. Much later in 1943 the inventor's diary records his

intention to seek work from a person he notes as directly involved with the wartime radar programme. The diary also records patents issued to Baird involving stereoscopic imaging which he associates with radar.

During the 1930's and '40's Baird Television Limited (BTL) developed and manufactured radar technologies for transmission, reception and to counter jamming. At this time John Logie Baird personally had a decreasing involvement with his company and its activities. There is no conclusive evidence to suggest the Scotsman was personally involved with any of his company's radar activities or any other direct involvement with the radar programme.

5.2 Norman Loxdale, J.L.Baird and reflected radio wave experiments

Mr Norman Loxdale was one of J.L.Baird's first assistants in Hastings. During a 1981 interview with the respected television engineer Thornton Bridgewater, Loxdale stated that as a boy, sometime between late 1922 and late 1924, he helped J.L.Baird by pushing a cart with heavy experimental equipment up to the feature known as 'the Lady's Parlour' on West Hill, in Hastings. The equipment included a 'Stirling amplifier' and *"...a long camera thing which* [J.L.Baird] *focussed onto the East Hill lift*". The East Hill lift is a rack railway which takes a carriage to the top of the hill. No result was obtained from directing the camera to the railway or out to sea. However, after pointing the camera vertically the inventor *"...seemed to be quite pleased*" and showed the boy a brown coloured image on a screen, which he describes as like iron fillings, excited by magnets. The image would change with relation to movement of the camera. J.L.Baird's explanation for the equipment was that it involved *"the third dimension"* although in the 1981 interview Loxdale suggests it may have been radar. Loxdale also suggested that other experiments were conducted from J.L.Baird's laboratory in the upper part of 8 Queen's Avenue, Hastings. In this experiment a dish-shaped aerial was directed from the window of the laboratory through the arcade to the road outside. [ii] This experiment was not possible, as there is no clear line of sight from the window of Baird's laboratory to the road due to the curvature of the arcade.

McArthur and Waddell (1990) add that the metal dish, which was large, had a spike in the centre and was taken to West Hill after nightfall in early 1923.[iii] The interview conducted by Bridgewater offers no information as to the size of the dish, whether it had a spike, time of day or year for the experiments. In a recent interview Dr Waddell suggested that this supplementary information, recorded in his book *Vision Warrior*,[iv] was derived from a series of interviews with Loxdale during1985 and he was unaware of the interview with Bridgewater.[v]

In the Bridgewater interview Victor Mills, another contemporary assistant to J.L.Baird stated that he was not aware of these experiments. Unlike later formative experiments by Baird into television, Noctovision and Phonovision, this experiment received no press coverage. However, Baird did make passing reference to the possibilities of reflected radio waves when he noted in a May 1924 television article,

> *The system described above, in common with other systems advocated at present, consists essentially of a method of rapid telegraphy, the transmitter being actuated by light. It is possible that at some future date means may be discovered of sending out energy from a point A, bringing it to bear on an object at a distant point B, and causing the object to radiate from its surface energy which, penetrating intermediate obstacles, can be brought to focus at A, rendering it visible. This would be radio vision in a very different sense.*[vi]

Unfortunately, there is no other evidence to corroborate Loxdale's claims. But the above statement and the following two patents indicate that John Baird had some interest in reflected radio wave technology.

5.3 Two patents issued to J.L.Baird for reflected radio wave systems

There are on record two patents issued to J.L.Baird and his company Television Ltd which combine to make a system designed for detecting objects using radio waves. Although J.L.Baird usually constructed apparatus on which he based his patents[vii] no evidence has yet been discovered that these systems were constructed. The first patent GB 292 185 *Improvements in or relating to Apparatus for Transmitting Views or Images to a Distance*, accepted 21st of June 1928, specifies a complete system for sending and receiving radio waves. Patent GB 297 014 *Improvements in Apparatus for Vision by Invisible Radiation*, specifies an improved system for displaying visibly a reflected radio wave signal. The term radar means radio detection and ranging. Patent GB 292 185 was capable of both detection of an object as well as recording its direction with relation to the transmitter. However, the patent was not capable of recording the distance or range of an object and therefore could not deliver both attributes of radar. Professor R.W. Burns in his recent book *John Logie Baird, Television Pioneer* has also assessed the validity of GB 292 185 and has formed a similar opinion that this is not a primary radar patent a subject also mentioned in a letter to the author.[viii]

In consultation radar historian Doctor Sean Swords has stated that in his opinion J.L.Baird's patent was in fact capable of providing range as well as direction. The author then consulted Professor Burns to clarify his opposing statements. He Writes;

My Views on radar are as given in my book 'John Logie Baird, television pioneer'.

1. *A single antenna radiating unmodulated continuous electromagnetic waves can be used with a receiver to determine the radial velocity (but not the instantaneous position – to the best of my knowledge) of a moving target.*
2. *Two antennas, placed a known distance apart, radiating unmodulated continuous electromagnetic waves can be employed with receivers to find the range of a target. (The bearing of the target from each radiator position is measured. Then, from the known separation distance, the target range is calculated.)*

3. A single antenna radiating modulated (e.g. pulse or f.m.) c.w. does, of course, permit the range of a target to be continuously recorded.

(The above remarks exclude the trivial case where the range of the target is less than the wavelength of the electromagnetic wave being propagated).[ix]

Patent GB 292, 185 specifies a region of wavelengths to be used but is ambiguous as to whether the radio emission should be modulated or pulsed. The patent is also unclear as to possible use of two antennas. Whether this patent could provide for both direction and ranging is therefore a matter of interpretation of the ambiguous wording of the patent.

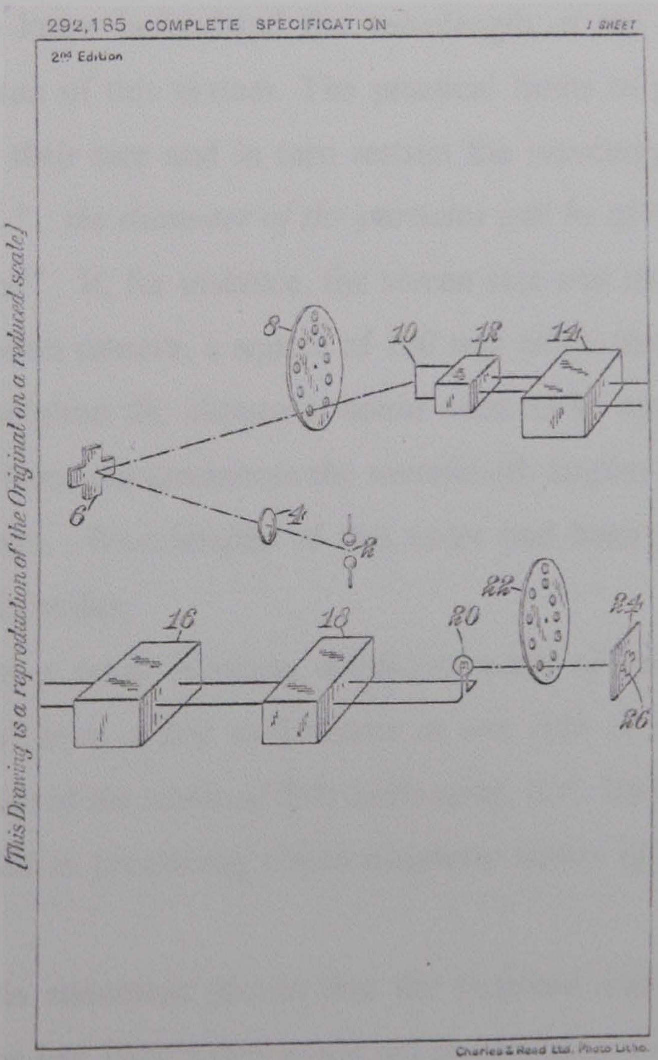

Fig 5.2 Source: Patent GB 292 185

A close examination of patent GB 292 185 with relation to GB 297 014 offers a description of the proposed systems. The second patent specifies a screen consisting of individual elements which, it must be assumed, are fixed rigidly to an insulating base and separated from each other in a glass envelope which is evacuated or contains an inert gas. On reception of a reflected radio wave signal there would be a discharge between the particles. Each particle pair or group would be potentially excited by the direction of electro-magnetic energy on to its position. An image would be formed depending on the diameter of the particles which in turn would have been determined by the radiated and then reflected electro-magnetic waves. McArthur and Waddell (1990) suggest that variations in the brightness of discharge of the sparks between screen elements would create an image of the object detected.[x] Without reconstructing the apparatus it is not possible to determine exactly how it would work.

The need to know beforehand the wavelength of the received signal is a fundamental limitation of this system. The practical limits of production of screen elements determine their size and in turn restrict the wavelength to be used. The patent specifies that *"... the diameter of the particles will be of the order of twice the wavelength employed"*. If, for instance, the screen size was similar to that used for the passive Noctovision camera, a square of 100 mm sides, then in order to gain an image of useful resolution the elements would need to be approximately between 3mm to 0.5 mm. In these circumstances the wavelength employed would be between 1.5 mm and 0.25 mm. Wavelengths of this order had been produced as early as 1923, Doctor Swords writes,

> *"By using a small Hertzian oscillator made of two tungsten sliders varying in length from a few millimetres to one fifth of a millimetre and separated by a gap of the order of 0.01 millimetre, E.F. Nichols and J.D. Tear in 1923 succeeded in producing electromagnetic waves of 1.8 millimetres in length."*[xi]

Although this statement proves that the required wavelengths had already been produced by the late 1920's they could not be produced with sufficient power to be useful for reflection from distant objects.

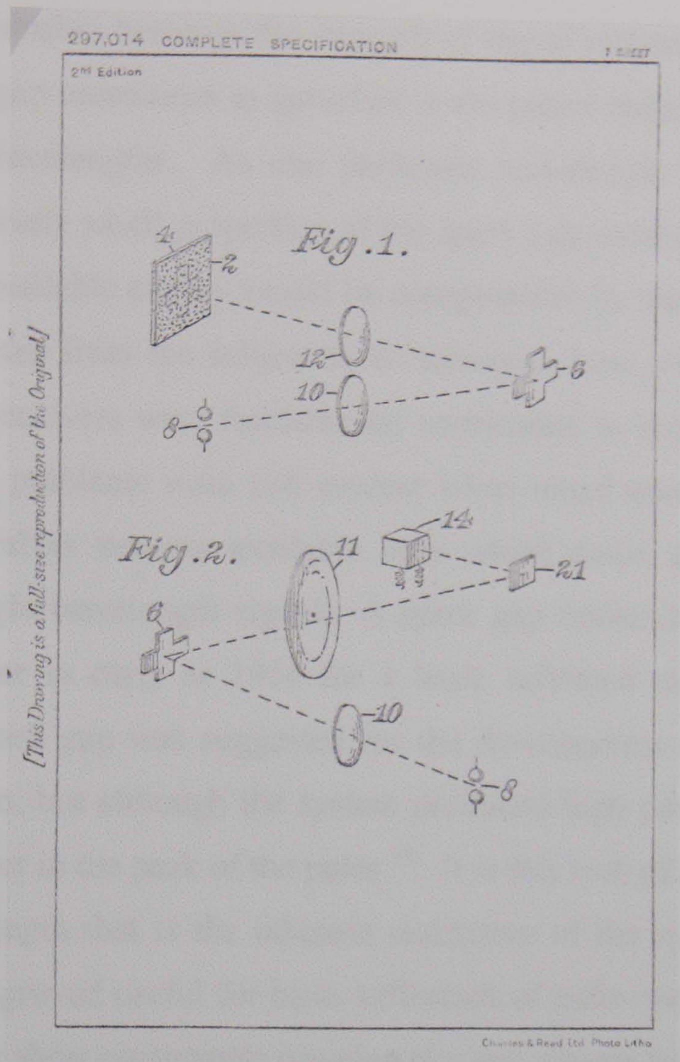

Fig. 5.3 Source: Patent GB 297 014

The patent also notes that *"... the distance separating the particles will be appropriate to the strength of the signals to be received by them"*. In order for the display to produce an image through electrical discharge it is important that the particles are separated and held in position. If they were able to move some would inevitably be in contact with each other and current would flow freely between without emanating a discharge. It can therefore only be assumed that the distance between the particles is predetermined and hence the strength of received specified wavelength also predetermined. Therefore, if the signal were too weak it would not create the desired Hertzian discharge. In turn this would also require the designer of the apparatus to know the likely strength of signal received from whatever conductor was to be televised using this system.

Another problem affecting the performance of this radio wave television system is the relationship between the strength of signal radiated and that which is received. A spark gap transmitter as specified in the patent radiates a wide variety of electro-magnetic wavelengths. As one particular wavelength is required for this system only a relatively small proportion of the spark gap radiation would be useful. This reduction in available energy would be compounded by the scattering effect of the radiation reflected from the subject to be televised. Low power of transmitters and sensitivity of receivers were fundamental restrictions to radio wave systems of the 1920's. These problems were still evident when tuned transmitter components such as klystron valves became available later which could deliver considerably more powerful single wavelength signals. A spark gap transmitter was patented by Christian Hulsmeyer as early as 1904 for a basic reflected radio wave system.[xii] Later in 1937 a spark gap was suggested for the development of the Chain Home British radar system, but although the system produced high power economically it produced little power in the peak of the pulse.[xiii] It is this lack of power at peak pulse and desired wavelength that is the inherent restriction of the spark gap transmitter even though it had proved useful for basic reflection of radio waves. Tuned circuits which could deliver short centimetric wavelengths had already been demonstrated by the mid-1920's and would certainly deliver more power at a specified wavelength than a contemporary spark gap transmitter.[xiv] Wavelengths of the order of a few millimetres or less, as is likely to have been required by the patent, could not be radiated in any useful strength. Therefore a spark gap was not the best contemporary method to use for production of the radio waves. The spark gap would therefor have been an unnecessary restriction which would compromise the function of the apparatus specified by the patent.

Regardless of the capabilities of this system it did gain public interest. A contemporary report in *Popular Wireless* noted that J.L.Baird's patent GB 292 185 for "Daylight Television" would be very 'problematical' for televising humans as the radio waves would not be reflected by flesh and instead suggested the system could be used for televising metallic objects[xv]. A correspondent in the *Wireless Constructor* noted, "*It is not stated how the ultra-short ether waves are to be produced except* *that the generator may consist of two metal spheres across which a spark discharge is set up.*"[xvi] Joseph Bisset, a newspaper correspondent visited J.L.Baird in 1929 and questioned the inventor about the system. He has written in a letter to Dr Waddell,

> *I did enquire about it* [reflected radio wave television] *when he and I met at the* [Science] *Museum 1929. I had been reading in the Patent Records about the ideas and was curious about what he* [J.L.Baird] *was doing with them. As there was no sign of him using the idea to improve his TV signals those who were reporting etc. were all wondering why he was not putting the idea into practice... When I mentioned the invention he* [J.L.Baird] *said it works but there is interference from waves which have gone beyond the building and reflecting back from vessels in the river.*[xvii]

Bisset continues in his letter and stated that J.L.Baird, who was experimenting in a disused riverside wharf, was working to overcome interference problems. This correspondent, although having written the previous quotation regarding patent GB 292 185, made no mention of the research activity in contemporary publications. At the age of 87 and with failing health, Mr Bisset kindly replied to an enquiry by the author regarding the above statements but could offer no further information.[xviii]

In his American version of the reflected radio wave patent J.L.Baird noted that the system had similar advantages to those already stated for Noctovision. The patent states that the system was capable of "*...transmitting the [radio] waves without the risk of detection by the object on which they are projected , and the method is thus extremely valuable in case the invention is used during a war...*"[xix]. Later in 1945 an article in *Wireless World* mentioned the fact that patent GB 292 185 involved scanning an object with radio waves, a method in principle similar to the contemporary H_2S radar carried on aircraft.[xx]

In the specified form patent GB 292 185 has so many technical restrictions that it would be virtually impractical. This situation may explain why there was no active publicity of investigations using this patented technology, or why it was not used instead of infra-red imaging for the object detection demonstration given to the Admiralty in late 1929.

Contrary to the suggestions by McArthur and Waddell in *"The Secret Life..."* and *"Vision Warrior"*, J.L.Baird may have had, at this time, only a brief and cursory interest into reflected radio waves for object detection. As reported by these authors, Baird's associate E.V. Appleton used a Baird Televisor in 1930 to measure the height of the ionosphere.[xxi] One of J.L.Baird's assistants on the Noctovision experiments, Philip Hobson, also noted in the same year that the height of the ionosphere could be measured using Baird Televisor equipment.[xxii] As both of these people were associated to J.L.Baird he could have easily pursued this area of investigation. But there remains no large body of information to suggest that reflected radio wave technology was of major interest to the inventor.

This lack of interest in reflected radio wave technology may not have continued throughout the inventor's life. On December the 24th 1945 J.L.Baird noted in his diary "*B.W&T RADAR RENEWALS*". B. W &T referred to Boult, Wade and Tennant who were J.L.Baird's patent agent. It is possible that J.L.Baird read the Wireless World article and thought that it might be useful to renew patent GB 292 185.

5.4 'General Whittaker' and 3D radar displays

There are some entries in the wartime diary of J.L.Baird that are worthy of consideration as they refer to radar. John Baird started his wartime research with capital of approximately £15 000[xxiii] and in 1941 was paid £1000 annual consultancy fee by Cable & Wireless but by 1943 he was in desperate need of further finance.[xxiv] On the 20th of January that year he entered the following in his diary; "*Gen.*

Whittaker Supreme charge of Radar Location", and J.L.Baird hoped to obtain work from this person.

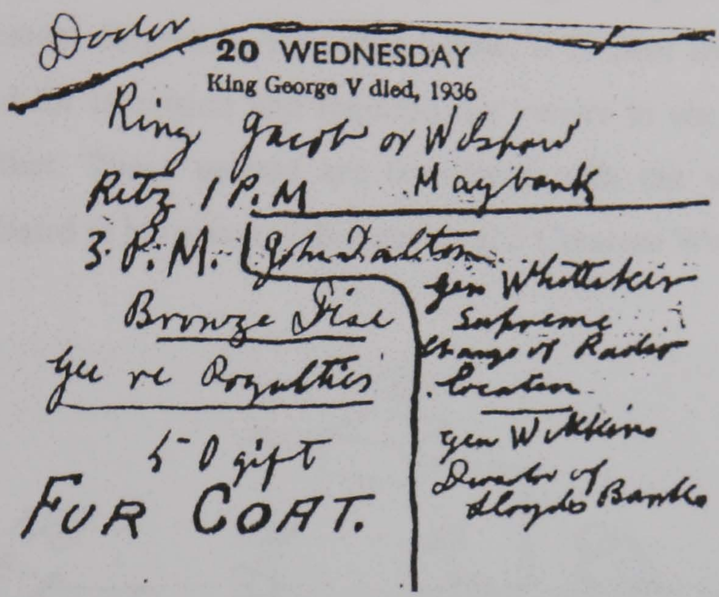

Fig. 5.4 *A selection from J.L. Baird's diary*
Source: M.H.I. Baird

In the months following this entry J.L.Baird attempted to gain work as a consultant from Whittaker as well as Robert Watson Watt and Sir Edward Wilshaw of Cable and Wireless. He later suggested that some of this work could also involve glass blowing. Watson Watt had been responsible for the creation of the British radar chain and it seems that J.L.Baird may have had lunch with him on June the 9th at the inventor's club. The interaction with Wilshaw is detailed in chapter eight. However, it has not been possible to trace who 'General Whittaker' was. There is no known General connected to the radar programme and consultation of *Who's Who* and the *Dictionary of National Biography* offer no further information. Professor Malcolm Baird suggests "*Maybe JLB just got the name wrong, it has happened before.*"[xxv] McArthur and Waddell (1990) report the Whittaker diary entries and add an entry for March 1944 which they report as "*Submit re-entrant cathode ray tubes, radiolocation apparatus and direction finding apparatus.*"[xxvi]

There are diary entries in 1945 which provide precise details of two of J.L.Baird's patents that he related to radar.(1) Both patents, USA 234 9071 Canada 429 352 refer to the same system for producing an image that gives the impression of depth. From the patent diagrams, illustrated below, it is clear that the system was originally designed for television and required the viewer to use special glasses to create the 3D effect. These patents are consistent with the variety of systems developed by J.L.Baird in his private laboratories at 3 Crescent Wood Road.

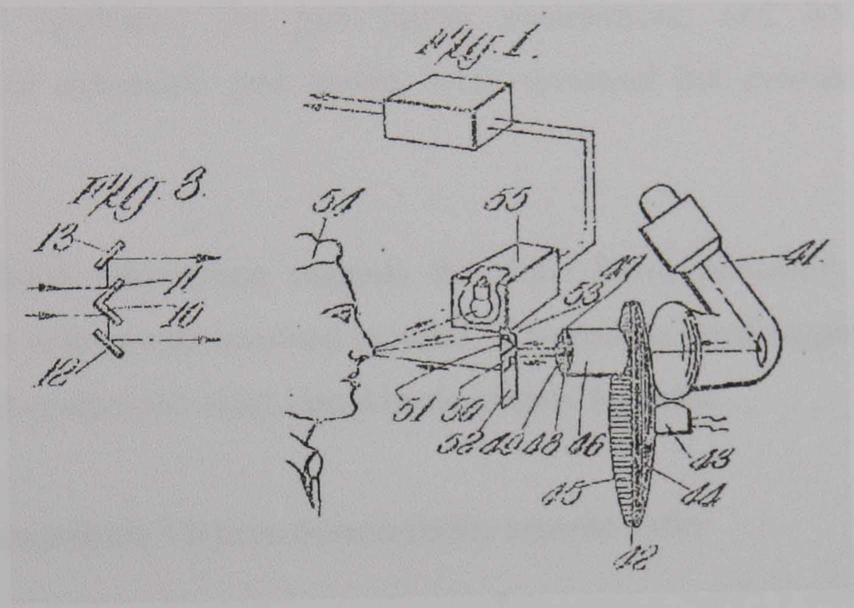

Fig. 5.5 Source: Patent Can 429 352

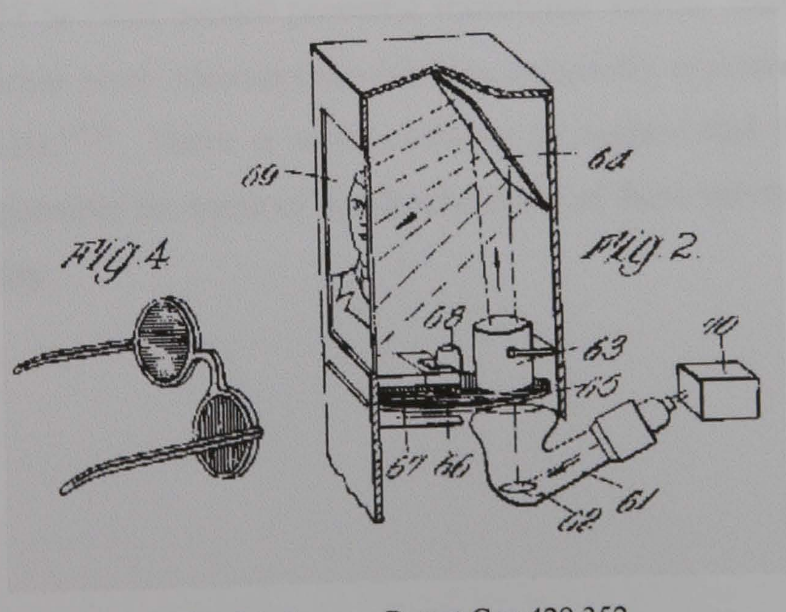

Fig. 5.6 Source: Patent Can 429 352

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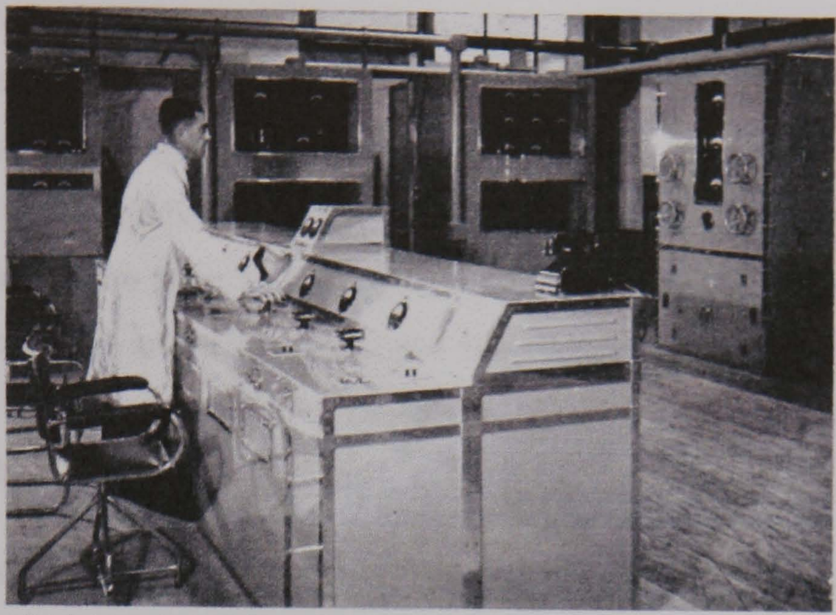
1 On January 13th 2001Leo McKinstry of the Daily Mail reported that two PhD students working under Dr Waddell, i.e. this author, '*...have so far not been able to trace...*' the radar patents mentioned in J.L.Baird's diary. The journalist did not consult this author and has therefore reported something which is clearly incorrect.

No information has yet been discovered to inform the historian why these particular patents should be related to radar. Informed conjecture suggests that this system may have been proposed for display of radar plots that were affected by jamming.[xxvii] Both Britain and Germany investigated systems which would display a radar plot in two colours. Fast moving objects, such as aircraft, would be displayed in one colour whilst slow moving objects such as 'window' foil jamming strips would be displayed in another. With reference to this concept PRO files AVIA 12/140, *RDF equipment for gun laying transmitters*, and AVIA 22/1383, *Development of automatic gun laying*, were reviewed but provided no further information.

The above information suggests that John Baird personally sought work during the war with people involved in radar. The patents cited suggest that he may have produced equipment which could be developed for radar.

5.5 The Metropolitan-Vickers demountable tetrode valve

The Chain Home radar defence system which was built around the coast of Britain from 1937 to 1940 needed powerful transmitter valves. Some of the valves used for this system were Metropolitan-Vickers constantly evacuated demountable tetrodes type 431B.[xxviii] There is some evidence to suggest that Baird Television Limited was responsible for some of the development of these valves as well as their associated circuitry.



Baird vision radio transmitter. Control desk—foreground; modulation amplifiers—background; Power output stage on right.

Fig. 5.7 *Baird Television Limited vision transmitter installed at Alexandra Palace.*
Source: Television and Short Wave World, November 1936, pp. 632.

In a letter to the editor of the *Glasgow Herald* on the 30th of September 1994, Douglas Brown stated that E.G. Bowen working on radar development, used *"...the linear output stages of Baird's T.V. transmitter from the [Alexandra] Palace"*, for Watson-Watt's first attempts at detecting aircraft with radar from 31 August to 11 September 1936. The letter from Brown did not specify whether these components came from the sound or vision transmitter at Alexandra Palace. Since writing this letter Brown has stated that the first tetrode valved transmitter used by BTL was installed at the Crystal Palace for use in their 180-line tests.[xxix] According to civilian scientist Mr N. Hecht, who was responsible for reporting BTL television reconnaissance activities to the Air Ministry, the company was in April of 1936, *"...building a new transmitter with a power of 500 k.w. using Metrovick demountable valves".*[xxx] This power output is very high in relation to the recorded output of the Baird Vision transmitter which was between 40 to 50 kW.[xxxi] This power output may have referred to the peak of an intermittent pulse. It must be noted that there is no other record of BTL using pulsed radio waves apart from for the purpose of instantaneous transmissions of individual frames for signalling.

Dr Waddell has informed the author that he has information concerning a 500 kW demountable tetrode from Metropolitan Vickers, which is contemporary with the above statement. According to this University of Strathclyde historian this information came from Metropolitan Vickers files held in Manchester which have now been destroyed[xxxii] and he will publish further information at a future date.[xxxiii] Dr Waddell has shown the author a photocopy of a line drawing of a Metropolitan Vickers valve which is labelled as capable of producing 500 kW. A very similar line drawing is featured on page 137 of the *Biographical Memoirs of FRS*, November 1984. The text of this article states that this 500 kW Metropolitan Vickers valve was constructed in 1931 for use on a wavelength of 2,500 metres in the Post Office radio station at Rugby.[xxxiv]

Further information about these valves is provided by past Baird employee Ray Herbert in an article in Transmission Lines a publication of the Centre for the History of Defence Electronics (http://chide.bournemouth.ac.uk). Herbert quotes a personal letter from Donald Priest who was involved in Watson Watt's radar experiments. Priest says, " *It is almost certain that the design of these transmitters was done by the same people who designed the Baird transmitter you mentioned. There were not many people around who knew how to do such things.* " In the same article he notes "*Undoubtedly the 24 months of development work by the Baird Company must have had a significant influence on the CH radar transmitter design*".[xxxv] PRO file AIR 2/2618 provides information as suggested by its title "Selection of Firms and Provision of Finance for R.D.F.". This file records a meeting held at Savoy Hill House on the 22nd of January 1937 and attended by various individuals including Wimperis, Watson Watt and Rowe. No mention is made of Baird Television Limited as a company selected for supply, at a time when the decision was being made to discontinue use of the company for broadcast television. The initial specification for the Chain Home transmitters involved the ability to switch rapidly between wavelengths from 6 to 26metres.[xxxvi] It is of note that the wavelength specified for transmission of television at Alexandra Palace was within this waveband. Watson-Watt would have been aware of this similarity, as he was also involved in the Selsdon committee involved with the public broadcast television trial at Alexandra Palace.

Fig. 5.8 *Sir Robert Watson Watt*

Source: R. C. Alexander

Research for this thesis has uncovered no other information, at the Public Record Office or elsewhere connecting Baird Television Ltd to development for Chain Home radar transmitters.

5.6 Baird Television Limited and radar during World War II

Whereas there seems to be no evidence connecting John Logie Baird personally with the British development of radar for defence <u>during</u> the Second World War, the situation was very different for his company.

At BTL research was undertaken on the transmission of electronic information using radio waves and their display on cathode ray tubes – for in basic terms that is what the technology of television involves. Within the company there were therefore specialists in radio transmitters as well as much expertise in the design and production of cathode ray tubes. These attributes of television technology were also required for radar and shortly after the outbreak of war many employees of Baird Television Limited were seconded to work for the war effort on radar. As early as 1935 Mr R. Vince, originally involved with Baird-Natan the French BTL associate company, left to work on the radar development programme at Bawdsey Manor. Later C. J. Oxbrow left the company to work for the Royal Aircraft Establishment on radar.[xxxvii] These staff were then followed by many others from BTL.

It has been suggested, by Lord Orr-Ewing amongst others, that television in Britain had its development accelerated so that scientists could learn techniques which would rapidly be utilised in radar during the inevitable war. The presence of Watson-Watt as technical consultant of the Selsdon Television Advisory Committee as well as being the most important personality behind the rapid creation of the Chain Home radar is therefore ironic if there is any truth in the above statement. According to Ben Clapp, Watson Watt visited the laboratories of BTL/CTL during the war, he wrote,

...the company at Lower Sydenham [Worsley Bridge Road site] *developed in conjunction with Watson Watt the Skiatron radar Cathode Ray Tube. I met Watson Watt a number of times at Sydenham but do not recollect any mention of* [J.L.] *Baird in this connection...*[xxxviii]

Ray Herbert has also recorded, "*I saw one of my old colleagues the other day and he remembers Watson Watt visiting the School of Arts* (Crystal Palace) *in 1937 to examine a small transmitter.*"[xxxix]

There was another connection between television and the Chain Home radar system. Public Record Office File AVIA 7/561 entitled *Use of RDF chain for television purposes*, literally suggests that the radar (RDF) transmitters could be used to relay various television images. One suggestion was to commence transmission from the Alexandra Palace and then use the radar transmitters to relay the images around the country. An alternative use of the Alexandra Palace transmitter was also proposed. Metropolitan-Vickers could modify the transmitter and use it to detect radio interference from inland flying aircraft. This activity was to be undertaken clandestinely. It must be stressed that this file only records a proposal for activity rather than recording something that actually happened.

One military application of the Alexandra Palace television transmitter that did happen was the jamming of a German bomber guidance system called Y-Geräte. Brian Johnson in his 1978 book *The Secret War* describes this activity,

> *A receiving station at a BBC site in Swains Lane, Hampstead, picked up the ranging signal from the aircraft: it was sent by an existing land-line to the powerful, but until then dormant BBC television transmitter at Alexandra Palace a mile or so away. This powerful transmitter was designed to work on 45 mHz and that was soon converted to the Y-Geräte ground-station frequencies and reradiated the ranging signal from the aircraft.*[xl]

Before the outbreak of war in September 1939, the radar programme in Britain was put into rapid development. It was realised that war was an inevitability and that Britain did not have the production facilities to rapidly manufacture fighter aircraft for defence against enemy aerial bombardment. Therefore, the promising technology of radar, which could give advance warning of approaching enemy aircraft and therefore more efficiently utilise the few fighters available, was given a high priority.[xli] A radar research station was established in 1938 at Bawdsey Manor in Suffolk with A. P. Rowe as superintendent.[xlii] And it was Rowe who was to write to the Air Ministry in November 1938 regarding interest by his establishment in some of the technologies developed by Baird Television Limited.

5.7 Bawdsey Manor, Baird Television Ltd and the Rapid Processing Camera Projector.

PRO File AIR 2/2877 entitled "Report and drawings on rapid processing camera projector, Baird Television Ltd" which details BTL equipment and their communications concerning the radar programme, has not previously been noted in any literature regarding the company. The file was opened on the 17th of November 1938 and specifically concerned the "*Mitigation of jamming by means other than* *wavelength change"*. This investigation was given an 'A+' priority rating and included four methods of investigation.

a) Special screen characteristics used in conjunction with a stroboscope and filters.
b) Photographic methods.
c) Receiver methods.
d) Spaced aerial systems which aim at laying a zero on to a jamming aircraft.

It was assumed that frequency change would counter constant wave jamming but other methods were required to counter "*...jamming signals consisting of discreet waveforms, e.g. spark*". It was suggested that a series of photographs of receivers taken once per second was the most convenient method because photography of radar CRT's had already proved useful. The ability of the Baird Television Limited intermediate film system to take a series of images and rapidly display them made this company an obvious choice for further investigation. (Further details of the development of the intermediate film system as well as its adaptation to signalling is provided in chapter six).

Initial interest by TRE Bawdsey in a camera for rapid processing is recorded on the 9th of December 1938 in a letter from A. P. Rowe. It was suggested that of four companies considered W. Vinten Ltd (2) would be most suitable for production of certain requested equipment. Ten days later a further letter from Rowe suggested that he required a subsidiary receiver with relatively few high gain stages. Evidently, the system currently being used involved delaying the signal to the receiver which had the result of attenuating the signal. It was stated that Baird Television Limited had produced an experimental "*...complete television amplifier embodying two hot cathode, grid controlled, electron multipliers*". (3) Similar units were also available from GEC and Rowe hoped to obtain equipment from both companies.[xliii]

2 W. Vinten Ltd is still in business and are now producing equipment for television recording and reconnaissance as well as electronic countermeasures.

3 Electron multipliers produced by Baird Television Ltd were also subject to Admiralty interest a year later as documented in the previous chapter.

It was noted that Baird Television Ltd had a projection system which used 16mm film at the rate of five inches per second.[xliv] At a rate of five inches per second with 16mm film, only approximately eight frames per second could be shown, a rate too slow to give the impression of continuous movement. Therefore, this system must have been designed for something other than public entertainment such as the Baird signalling system described in the next chapter. Mr Ray Herbert, who worked on the Baird television reconnaissance system for the French Government has stated that a 35mm mobile projection system was included in his project.[xlv] An identical system is described in the correspondence of the file under discussion.[xlvi] After a visit to Baird Television Ltd it was stated that the company could produce a new complete system to the specification required more quickly than modifying the extant equipment. The time suggested for this construction was four weeks.

There was great interest in this system from the Research establishment at Bawdsey and they were prepared to pay one thousand pounds for a non-secret contract for development as one system was *"... urgently needed for anti-jamming"*. Initially the camera was described as having the following attributes;

1) Capacity of 400ft (122 metre) film magazine providing for 5 hours use and associated chemicals in stainless steel tanks.
2) Intermittent gear advancing film ¼" (0.6 cm) per second, each exposure measuring 1"x ¼ " (2.5 x 0.6cm)
3) Dallmeyer 2" (5cm) f1.9 Super Six anastigmatic lens for camera and 6" (15 cm) f2.9 lens for projection which provided an 8 X magnification and was illuminated by a 250 Watt bulb.

The lamp was arranged to illuminate the film passing over a glass covered aperture in the base of the fixing tank. Each image, which was projected ten seconds after exposure could be viewed for a period of 30 seconds. The machine was so arranged as to make ten images visible on the screen simultaneously.

After much development an improved system was offered by Baird television in February of 1940. Initial apprehension regarding speed of development stated in January 1939 about the 16mm film based system had been overcome and after testing over 500 types of emulsion the total exposure to projection had been reduced to ten seconds. Advancement of this facet of the process was aided by parallel investigations by BTL into recording on to paper as an alternative to film as well as facsimile transmission and reception. BTL facsimile technology will be discussed in detail in the following chapter. It was also noted that this system was "*...designed for the purpose of photographically recording changing waveforms or signals produced by means of cathode ray oscillograph tubes or similar devices.* [xlvii] It is likely that this system was later incorporated into the Government ballistics contract 294/A/982 issued on the 22nd of April 1940 to Cinema Television Limited, who had taken over operations of Baird Television Ltd.[xlviii] More details of this contract are provided in chapter seven.

BTL suggested using a continuously fed film rather than intermittent feed in order to speed up the entire process. It was also possible to reduce the length of film between exposure and projection gates. With these modifications total processing time could be reduced to six seconds. BTL had also undertaken much development with metol and hydroquinone as a developer heated to 80 Fahrenheit (26.7 °C). This chemical had good storage properties, provided a good monochrome image and reduced the development time to three seconds. A non-poisonous fixative had also been used, as an alternative to the original sodium cyanide solution, which reduced this part of the process to just one second.[xlix] Further details of the BTL rapid processing camera are provided in the next chapter.

Whether the technologies developed by Baird Television Ltd for Bawdsey Manor were ever operationally used is not recorded in the PRO file under question. However, fortunately Richard H.G. Martin has been able to complete the history of this investigation. Martin has published an article entitled 'Radar Photographic Display System 1498' for *Transmission Lines*, a publication from the Centre for the History of Defence Electronics. Martin writes, *The origins of the RPDS may be traced back to the first use of radar photography, for operational purposes, at the CHL station at Walton-on the-Naze in February/March 1940. At the time, enemy aircraft, under cover of darkness, were causing problems by laying mines in the approaches to the Thames Estuary. An experimental Baird camera, with integral processor and forming part of the Company's development of television displays, was used to photograph the amplitude modulated trace (together with time and bearing information). The film could be immediately processed and be ready for collection by the Admiralty the following morning for assistance in mine sweeping operations.*[1]

The article continues and offers an excellent concise history of this particular technology.

5.8 Cathode Ray Tube production for radar by the Baird organisation.

The popular success of Chain Home in the 'Battle of Britain' as well as the ongoing research into other applications for radar technology provided an increasing need for the components which made up the systems. An essential component was the display of radar intelligence which was almost exclusively shown using cathode ray tubes. As a company with a wide body of experience and development of CRT's Baird Television Ltd were particularly well suited to supply this essential radar component. Manufacture of CRT's for the radar programme commenced in the Baird company, now called Cinema Television Ltd (CTL) in January 1942. By the end of the year one hundred units per day were being produced. From the beginning a variety of tubes for different applications made up the production numbers and CTL assisted in development as well as manufacture. As Cinema Television Ltd undertook this work, it is given further and more comprehensive attention in chapter seven.

5.9 Conclusion

It has been established in the introduction of this thesis that J.L.Baird was not directly involved in all activities of his company from 1933 and by 1940 had little contact with it apart from board meetings. This statement strongly affects the suggestion of John Baird's personal link with radar technologies. Information obtained about the radar activities of Baird Television Limited offer no indication that J.L.Baird was personally involved. In 1995 Mr Ray Herbert stated that, as Baird's staff were working at the various radar establishments, they would have readily recognised Baird if he had visited these places. Herbert further stated that he has contacted various other people who worked at the radar establishments and not one of them ever saw Baird[li]. In a letter to Ray Herbert Professor R.V Jones has written,

> *I am fairly sure that before the outbreak of war in 1939 Baird had not been brought into the radar effort and I myself know of no connection between him and the radar establishments during the war.*[lii]

W.B. Sayer, an assistant to J.L.Baird from 1935 to 1940 has written "*I have no knowledge of Mr Baird's connection with radar development and would be most surprised if this were so.*"[liii]

Paul Reveley another assistant to J.L.Baird from February 1932 to late 1938 has written, "*I can assure you that no work on radar was done by me for J.L.Baird, either at Crescent Wood Road, The South Tower of the Crystal Palace or anywhere else.*"[liv]

In 1980 I.M. Rennie a senior partner of Boult, Wade and Tennant, J.L.Baird's patent agents wrote to Tom McArthur, co-author of *The Secret Life...* regarding enquiries made about Baird and radar. Rennie stated that he was inducted into the company shortly after the war to deal with the large body of radio and radar patents, as he had experience in these technologies. He writes, *I think I am right in saying that Mr Baird was not in any way associated with the main stream of development of radar and, during the war, was not therefore aware of the extensive work done by other people in the field.*[lv]

Professor Malcolm Baird, J.L.Baird's son has also made enquiries. In a recent communication he wrote,

I wrote to Sir Bernard Lovell (March 1977) and to Dr. W.B. Lewis (Sept. 1979), both eminent people in the field, asking them about JLB radar connections. Both replied that they knew about his TV work and respected it, but had no recollection of him being involved with radar effort. I also sent Lewis a list of some of the names in the JLB diaries (Plugge, Sommer, Szegho etc.) but he did not recognise any of them.[lvi]

In comment to the suggestion that his father was personally involved in the radar programme he added.

I have always thought that if [J.L.Baird] *had been seriously involved in radar in the war;*

(1) he would have been PAID.

(2) he would have had to reduce the amount of time he put in at Crescent Wood Road on colour/stereo.

(3) he would have visited the establishments at Worth Matravers or Malvern.

(4) he would have been remembered by the people in radar that he met.

(5) he would have told my mother about it after the war was over, when radar was no longer a secret.[lvii]

There continues to be published in newspapers, statements suggesting that J.L.Baird was deeply involved in radar development. In July 1999, Martin Hannan of *Scotland on Sunday* produced an article entitled "John Logie Baird's Secret Role in Helping to Win Second World War" subtitled "Strathclyde researchers uncover evidence of Scot's inventor's key part in developing radar technology"[lviii]. The picture accompanying the article, which measures 20 x 27 cm, shows J.L.Baird superimposed on an image of a radar array with aircraft flying above. This article has mis-quoted myself and stated that I have found information in the PRO "*... that Baird and his company worked extensively on some of Britain's then secret electronic weapons.*" The journalist has made the common mistake of suggesting that J.L.Baird was personally involved in radar activities undertaken by Cinema Television Ltd, which during World War II had no direct connection with J.L.Baird. There have also been other newspaper items, reinforcing the popular idea that J.L.Baird played a significant role in radar development. Some of the other newspaper articles include the following statements,

> *The Television inventor John Logie Baird played a major role in the development of radar ten years before the history books say it was invented, startling new research has claimed.*[lix]

> *However, what Waddell, along with journalist Tom Mc Arthur, have revealed in their books, 'The Secret Life of John Logie Baird' and 'Vision Warrior', is that before and during the war, he [J.L.Baird] was making a significant contribution to the development of radar, usually attributed largely to Sir Robert Watson-Watt, who knew Baird.*[lx]

> *...there is strong evidence that he [J.L.Baird], rather than Sir Robert Watson-Watt, was the driving force behind the invention of RADAR.*[lxi]

> *It is like leaving Edison out of a history of the light bulb. A government backed exhibition honouring the pioneers of one of Britain's greatest technological achievements* [radar] *has been condemned for ignoring the key role played by Scotland's John Logie Baird.*[lxii]

Unfortunately, none of these journalists provide supporting evidence for their statements. To provide an alternate interpretation in publication the author has recently stated in *Transmission Lines*, a publication from Bournemouth University, that John Logie was not heavily involved in radar.[lxiii]

The information here suggests that J.L.Baird had some form of interest in reflected radio waves for television as a means for defence in times of war during the 1920s. However, this interest whether actively pursued or not seems not to have had an influence. Radar historian Doctor Sean Words has written,

"*The first point is the possibility that someone may claim that radar-type experiments (other than those of Butement and Pollard in 1931) were carried out in Britain prior to the developments of 1935. This is certainly possible, but there is no evidence that they affected or influenced in any way the main stream of development.*"[lxiv]

J.L.Baird also had some interest in radar during World War II, but this evidence is inconclusive. No information has been found that suggests J.L.Baird personally had an active involvement in British airborne or defence radar from its development in 1935 to his death in 1946. The company originally formed by J.L.Baird, but independent of him, were investigated for technologies useful to radar and manufactured many cathode ray tubes for radar displays which assisted in the defence of Britain.

Note 1

'Radar' and related items in J.L.Baird's wartime diaries

1943

20 January: "Gen Whittaker Supreme charge of Radar Location".

27 January: John Dalton Gen Whittaker Supreme Charge of Radar Location---Gen Wilkins Director of Lloyds Banks.

17 March: Watson Watt: G.E.C.

15 May: {Dalton Ediswan? Whittaker}.

26 May: Dalton: Ediswan int [?] Will General Whittaker give me some work to do Glass Blowing? Or consultancy?

14 April: General Whittaker ask Dalton, Wilshaw, Marconi - Get Work

3 June: Dalton Consultancy work from Whittaker or Watson Watt.

4 June: Spence Re Tom King Watson Watt?

7 June: Usher Dalton Watson Watt (consultancy work) Ring C. Watson Watt.

9 June: 1pm Caledonian Watson Watt? General Whittaker consultancy Ediswan.

14 June: Watson Watt: Ogilvie

1 August: General Whittaker: Dalton.

1945

17 August: Ring Parr Radar Patent.

1 October: Radar Maybank Pocock Cooper Nature Telegraph Wall Angwin

16 October: B.W &T Depth Rawlings list Secret patent Radar.

29 October: B.W&T Radar Depth USA 234 9071 Canada 429 352

24 Dec: B.W&T RADAR RENEWALS

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CHAPTER 6

TELEVISION AERIAL RECONNAISSANCE

Fig. 6.1 *Marcel Bloch 200 aircraft used for television trials by BTL*
Source: R. M. Herbert

6.1 Introduction

Unlike radar, the early history of television aerial reconnaissance has been virtually ignored in publications of both articles and books. Both technologies are an electronic means of object detection now in common military use. However, perhaps because television for aerial reconnaissance (TV/AC) did not play an active role during World War II, the early history of this fascinating subject has received little attention. Radar history has been almost romanticised for its use in "The Battle of Britain" and therefore most readers are likely to have some understanding of the subject. This prior knowledge cannot be assumed for TV/AC and for this reason the following is a comprehensive account of the subject.

John Logie Baird's work on television in 1924 stimulated public and government interest into the potentials of this new technology for use in reconnaissance by aircraft. When television became a reality the British military seriously considered this possibility. As television technology developed, the military kept pace with these developments and modified their requirements to suit. Through the production of apparatus by both Baird Television Limited and Marconi-EMI a solid base of research was formed. Modern aerial reconnaissance owes a direct legacy to these early experiments. From the beginning of British military interest there were two distinct methods investigated for sending aerial intelligence to ground receivers. One method was to use 'live' television, a picture of the ground as if viewed by an observer. The second method that sent individual images of information was also developed to a high level of refinement. Both companies developed these technologies for the British as well as foreign governments. The influence of foreign TV/AC interests had a direct bearing on the initiation, development and even truncation of British activities.

The early history of this technology is obviously complex. In order to deconstruct this subject and provide an understandable description it is here divided into six sections.

Section 6.2. Inception of aircraft reconnaissance by television

As detailed in the first chapter as soon as television had become a reality the British government took an active interest. Various other activities relating to sending individual images were also undertaken. In chapter two it was detailed that BTL was co-issued an aircraft guidance patent with someone living in France. This in turn may have stimulated French interest in television for reconnaissance.

Section 6.3. International interest in television for use by reconnaissance aircraft

In early 1936 the Russian government indicated to the Marconi-EMI Company that they were interested in TV/AC. This interest was pursued and later in the year the French government also became interested. The foreign interest into TV/AC stimulated the British government to undertake their own investigations.

Section 6.4. Baird Television Ltd and French Television Aerial Reconnaissance

Equipment for Russia seems not to have been pursued whereas the French government had equipment supplied to them by both the Baird and Marconi-EMI companies. Tests were undertaken but activity ceased when the German army overran France and the test aircraft were lost.

Section 6.5. The British Trials: Marconi-EMI or Baird Television, Facsimile or Television

From the first British TV/AC investigations in 1926 there was continual discussion as to whether a constant view of the ground or individual images would be the most effective way of transmitting aerial intelligence to the ground. This search was re-addressed many times during tests of equipment from both BTL and M-EMI in both aircraft and ground demonstrations of equipment.

Section 6.6. The Wellington enigma

In December 1940 a television equipped Wellington aircraft was delivered to Odiham airfield. Information of this activity comes from one Public Record Office file and cannot be corroborated from any other source. The choice of a Wellington aircraft, then an important front-line bomber, suggests that the planned for tests may have been of great importance. It is therefore unusual that there should be no other evidence chronologically before or after this test.

Section 6.7. Wartime revival of interest in TV/AC

Influenced by appraisal of the 1940 tests of TV/AC equipment, the British Government once again renewed interest in television for reconnaissance. The general opinion stated was that a facsimile system based on BTL's Intermediate film technique should be used. Due to the contemporary investigations by America it was decided to wait for the results of these foreign developments before proceeding further.

Section 6.2

Inception of aircraft reconnaissance by television

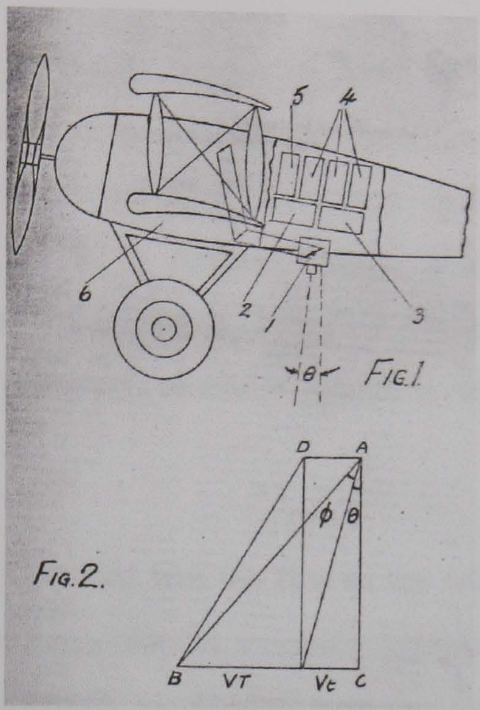

Fig. 6.2 *Diagrammatic description of patent GB 441 235 issued to Baird Television Ltd and Anatole Stoyanowsky*

Source: Patent GB 441 235

Television for aerial reconnaissance was the first military application suggested for the infant technology. For this reason the period of investigation from 1924 to 1929 is discussed in detail in the first chapter. In order to understand the concept as a whole, a brief summary of the aforementioned details are given below.

After publication of two 1924 articles regarding television for aerial reconnaissance, the British Air Ministry took an active interest in the subject. The British Admiralty made various unsuccessful attempts to produce television during this period. When John Logie Baird achieved television in 1926, a representative visited him from the Admiralty. The report of this visit resulted in direct co-operation between the Admiralty and Air Ministry regarding television research. During another visit in June 1926 to J.L.Baird, Lt. Col. Lefroy of the Air Ministry addressed directly the question of television for use in aircraft. In October Baird offered to the Air Ministry apparatus for spotting fall of shot using a map indicator system. Although patented, the system was not utilised by the Air Ministry, who, along with the Admiralty reduced their efforts in television investigation.

In 1929 the Air Ministry conducted tests with a modified Fultograph facsimile machine for sending maps to and from British airships R100 and R101. In September of 1930 the Marconi-EMI Company also demonstrated facsimile equipment for use with the R100 airship. Similar tests were conducted by the Admiralty using HM ships Renown and Barham. [i] Television could not offer the image definition of the Fultograph machine, which is why it was chosen for this purpose.

From 1926, when J.L.Baird was the first in the world to show television, all successful systems included mechanical scanning systems. The cathode ray tube, which was eventually to supersede mechanical scanning and display systems, had not reached a sufficient degree of development. It was soon realised that the CRT had a greater potential for producing images of a higher definition and would be an essential part of future television systems. For this reason the main investigators, including Baird Television Ltd, invested great effort in CRT research. Another means of increasing definition was to scan a cinematograph film with a flying spot television scanner. This was an early method for displaying a high quality television image without the fundamental drawbacks of television cameras then available.

6.2.1 The Baird Intermediate Film Technique.

The flying spot method of scanning was later used in the Intermediate Film system (IF), a system which was of central importance to later TV/AC investigations. The Intermediate Film system consisted of a cine camera, developing, washing, fixing tanks and flying spot scanner to transduce the image into an electronic signal, all combined in one unit. The film that had been exposed and developed could then be displayed electronically within a minute or two. The first suggestion of an IF system seems to be that described in patent GB 297 078 applied for in March 1928 by two Americans.[ii]

The next major developments were those undertaken by the German Company Fernseh A.G. in 1930. Fernseh was a consortium of which Baird Television Ltd had one quarter share. Dr Schubert of this company developed a system that was demonstrated at the 1932 Berlin Radio Exhibition.[iii] Following this demonstration the Baird company in Britain developed their own IF system. The first experimental apparatus used 9.5 mm film in a 180-line definition system. The sprocket holes were between frames of the film and the light shining through adversely affected the scanning photocell. For this reason 35 mm stock was split to 17.5 mm and installed in a system in the new Baird television studios in the Crystal Palace. This equipment was demonstrated to the Television Advisory Committee in 1934.[iv]

Bruce Norman (1984) has commented that the Intermediate Film technique was 'leaky and immovable' and contributed to the downfall of Baird Television Ltd in the trial for television at Alexandra Palace. Norman was correct in stating the limitations of the system for public television broadcasting, but this was not the case when military applications were considered.

6.2.2 The development of the Intermediate Film system as recorded by Gordon J. Craig OBE

One of the primary Baird Television Ltd technologists who developed the intermediate film system was Mr A. C. Banfield, F.R.P.S. One of his assistants Gordon J. Craig[v] recorded some of the developments of the Baird IF system in his paper *The development of an Ultra Rapid Processing Technique for Motion Picture Film*. This unique record which is held in the Special Collections department of the British Film Institute has previously escaped analysis by other Baird historians. [1]

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[1] The author wishes to thank Mr Ray Herbert who provided information about this record.

Craig's investigations started in August 1934 and concern the use of various chemicals for developing, washing and fixing a variety of film stocks. By this time 240 lines had been established as the scanning definition at 25 fps and 35 mm film was used both in its entirety and split to 17.5 mm for reasons of economy. In order to produce a positive image a reversal of the relative densities of the film was selected and incorporated in the electrical amplification stage.

Initially the progression of the 17.5 mm film was chosen at 45 feet (13.7 metres) per second as this provided the best compromise in reducing flicker, quality of sound track and economy of film stock. This speed in turn dictated the rate of movement of the film through the various film baths. Shorter runs of film through the baths were preferred as the film in the bath at the time of a stoppage was wasted. This wastage occurred because processing time could not be exceeded as this damaged the edges of the film due to the high concentration of the chemicals involved. The special conditions of rapid processing also affected the solutions that could be used. Unlike other photographic processes the IF system only required its various solutions to be stable for a period of twelve hours maximum. This condition provided a wider variety of solutions for the investigators who used this freedom to their advantage.

Initially special apparatus were constructed to investigate the effects of different solutions on film development time. Impellers within the apparatus helped to ensure that the temperature of the bath could be kept at a consistent temperature between 20 to 40 degrees centigrade with a deviation from set temperature of no more than 0.2 degrees.

6.2.2.1 Developer refinement

In order to achieve rapid development, the investigators increased both temperature and concentration of the developing solution. It was found after investigation that temperatures above 85 Fahrenheit (29.4 °C) produced fogging of the image, and this effect combined with associated softening of the film substrate, limited maximum temperature. Softening and abrasion problems, particularly on the soundtrack of the film, were encountered when the chemicals were tried in the experimental intermediate film machine. Solutions suitable for high concentration were chosen notably pyrogallol and pyrocatechin. Using these solutions it was found that concentrations greater than theoretical limits could be used. Very fast development times were later achieved when metol and hydroquinone were used. These developing chemicals are specifically noted when the radar research establishment at Bawdsey Manor request a rapid processing camera in 1940 as mentioned in chapter three. In order to overcome the aforementioned softening problems, formalin was introduced as a hardening agent. This chemical reacted badly with pyrogallol which then had to be removed from the investigations. A solution was then developed using pyrocatechin and referred to as D1, but this was superseded in performance by a similar solution that used a metol hydroquinone mixture, D2. This second mixture was then abandoned when the formalin hardener was introduced. The cunning addition of pyrocatechin with hydroquinone, solution D3, finally overcame the problem of adverse reaction to formalin. Another problem encountered by the researchers was the depression of film sensitivity, or 'film speed', by rapid processing in comparison to conventional processing. Initially this problem was overcome with solution D3 which had its pyrocatechin concentration increased to equal that of hydroquinone. This produced the final stage of developer evolution and was known as D4, a solution that was patented. 6 000 feet (1830 metres) of 17.5 mm film was developed using this solution, which fulfilled all design requirements.

Table 6.1

Formula for developing solution D4.

A)	
Pyrocatechin	45 gm.
Hydroquinone	45gm.
Sodium Sulphite (anhydrous)	70gm.
Potassium Metabisulphite	10gm.
Water to 1 Litre	
B)	
Sodium Hydroxide	112 gm.
Water to 1 litre.	

Solutions A) and B) mixed in equal quantities with 4% formalin added.

6.2.2.2 Fixative refinement

The first attempt at obtaining satisfactory results used non-standard film with thinly coated emulsions, which was fixed in ten seconds using hypo. As there was no requirement for a permanently stable film image, fixation was reduced to the point where the creamy silver halide no longer obscured the image. It was found after investigation that properly washed film was stable for at least a year. The use of thin emulsions reduced the film speed and grain quality, a problem countered by increase in rate of fixation in the solution bath. This speed was achieved by increasing the concentration of hypo as well as temperature. Like the development process the maximum temperature was found to be around 85 °F.(29.4°C). Change in concentration of the Potassium Metabisulphite component of the developer solution had a profound effect on fixation time. An increase in concentration would produce a decrease in time for fixing.

In order to reduce fixation time from the minimum of 9 seconds, hypo was replaced with sodium cyanide and the time reduced to 2 seconds. This hazardous chemical also allowed for thicker emulsions which had the benefit of increasing film speed and image quality. A supersensitive panchromatic film[2] was tried but discarded when it required fixation times back up to ten seconds. A medium sensitive panchromatic film was eventually chosen as offering the most advantages with the least disadvantages. Fortunately, four years after this report by Craig the cyanide based fixative had been replaced by a non-poisonous chemical, as mentioned in chapter three.

6.2.2.3 Design of Intermediate Film Machine

According to Craig, by March of 1937 four Intermediate Film machines had been constructed, the final machine being installed at Alexandra Palace. The following description involves the Alexandra Palace machine.

Washing of the film was done by water spray for two and a half seconds between development and fixation and for ten seconds after fixing. Because the water reservoir became contaminated with cyanide, a squeegee, or longitudinal rubber edged orifice, was fitted after the fixation bath. Success with this fitting resulted in further squeegees being fitted after the developer and wash process, before the fixing bath. Not only did these attachments reduce loss of the expensive chemicals, but they also reduced contamination of the bath following the squeegee action. By cleaning the squeegee lips no abrasion of the film was noticed from possible squeegee lip contamination.

Research produced an optimum temperature of 83 ° Fahrenheit (28.3 °C) plus or minus 0.5 degrees, for both the developing and fixing baths and this was the temperature at which they were kept. It had already been noticed that agitation of the fixing solution increased the effectiveness of the chemical. It was not necessary to add a system for this agitation as suitable turbulence was obtained from the rapid movement of film through the bath.

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[2] Monochrome panchromatic film rendered all colours with equal intensity. Orthochromatic film, also in common usage at this time had the deleterious effect of rendering reds and yellows dark. Military aviation historians of WWII who view orthochromatic pictures of British trainer and prototype aircraft encounter this problem. These aircraft were painted with yellow undersides and yet appear to have black undersides in such pictures.

Once developed, the film was rolled onto a 2 000 foot spool that was half submerged in water. If the film was to be preserved it would be wound off the drum dried and then washed by repeating the process through the IF machine. For this second process the camera would be removed and a 5% hydrochloric acid solution poured into the developer bath in place of the original solution. At the time of cessation of Banfield and Craig's activities in March 1937, there was a stipulation for a separate washing and drying machine, but this was never installed. It will be noted that the tender to Russia for TV/AC intermediate film equipment included this facility also as a separate item. The Russian tender is discussed in the next section.

High quality sound recording was never properly achieved. Initially a standard neon recording tube was used, this later being replaced with a special mercury vapour cell and finally a specially designed neon tube was selected. Sound recording took place immediately after the vision scanner. As this position was under water the objective lens was chosen to overcome refraction by the water and the light source sealed from ingress of moisture. An electrical amplifier was introduced that increased the quality of the sound but this component was not fully developed.

In conclusion, Craig summarises the reasons for the rejection for public broadcasting of the intermediate film system,

> *The final rejection of the intermediate film process as a television system was due primarily to the immobility of the equipment. A sound proof operating room was essential, as also was a good water supply. An almost equally important objection lay in the necessity for using recorded sound. It can be truthfully said, however, that the photographic side of the equipment attained a high degree of efficiency, and remained very constant throughout the period that the machine was in use.*

The developments of the IF technique within the Baird company provided for a high definition television system at a time when CRT technology could not match the clarity of the IF image. Furthermore this system was to be adapted repeatedly for various applications for signalling.

John Logie Baird in his private laboratory at 3 Crescent Wood Road personally applied for a patent for an improvement to the IF system. Patent GB 559, 549 entitled *Improvements in Film Processing Tanks for Television Apparatus*, provides for a simple modification of the developing tank which afforded monitoring of the developing image and adjustment of processing time. It is important to note that this patent was applied for on August 18th 1942 and accepted on February 24th 1944. J.L.Baird at this time was removed from his company now entitled Cintel, and may have needed this adaptation for his investigation into signalling using the IF technique for Cable and Wireless. This subject is discussed further in chapter eight.

The advancement in technology afforded by the IF process was used by the Baird Company to put forward in a patent, a system for use in guiding aircraft. Although not containing any electronics, this patent is a clear example of continued interest in airborne equipment by the Baird Company.

6.2.3 J.L.Baird, Anatole Stoyanowsky and the infra-red aircraft guidance system

Anatole Tola Stoyanowsky was a Russian National living in Paris[vi] and a founder member of Baird-Nathan, the French subsidiary of Baird Television Limited. The Nathan was added to the Baird name after the Pathe Nathan cinema organisation co-sponsored the formation of the television company.[vii] This situation is similar to that in Britain Where the Gaumont British Picture Corporation financed Baird Television Limited (described in the following chapter). On the 15th of January 1936 Stoyanowsky, along with Baird Television Ltd. were issued patent GB 441 235 entitled 'Improvements in or relating to Methods of and Means for Observation from Mobile Units'. The patent description involved a method of guiding an aircraft at night or in fog using special cinematic film equipment. The principal of the patent was that an aircraft would be equipped with a cine camera loaded with infra-red sensitive film. The camera would survey the terrain below and forward of the aircraft. The film would then be rapidly developed so that it could be viewed in the same manner as the IF system developed by Banfield and Craig at BTL. It was hoped that the rapidly developed film would then show what was immediately under the aircraft, i.e. the forward motion and height of the aircraft would be balanced with the time taken for development. The advantage of this system was that it offered an aircraft navigator information he could not obtain simply by looking out of his cockpit. According to the patent, crew in the aircraft could also use this system to drop either postal packets or bombs at their leisure.

Mc Arthur and Waddell (1990) have commented that BTL 'mysteriously' held this patent in conjunction with Stoyanowsky. The authors do not refer to J.L.Baird's memoirs which record Stoyanowsky, referred to as Stoyanovisky, or PRO file J 13/16536 both of which state this person was a member of the Baird organisation. It is also stated by the authors, in reference to this patent, that J.L.Baird would "*Transform the infra-red waves, as was Baird's custom, and one has what looks like H2S, the airborne radar mapping guidance system...*".[viii] This author cannot establish any connection between a reflected radio wave system which scans ground based objects and a cine film based system which photographs these objects to produce a series of images.

A fundamental restriction of this patent is the infra-red film. Although the film would be useful at night, it would not resolve an image through cloud. Hence, the aircraft would either have to fly on a clear night or under the cloud where it may be vulnerable to enemy fire. Another problem might be thought to be the speed of development of the film. In 1935 Baird Television could develop, fix and wash a film in 30 seconds.[ix] Clearly, this would require the aircraft to fly very slowly otherwise the camera would have to point so far ahead that no clear resolution of image could be obtained. However, just three years later in 1939, and after testing '*500 types of emulsion*', a much more rapid development speed was obtained by BTL. Using Metol Hydroquinone BTL suggested that they had reduced the entire processing time to just four seconds. [x] By this time the basic principle of the patent had been developed to include an electronic component.

Although the Stoyanowsky patent was not used in this form, it provided the seminal concept of the IF system for television aerial reconnaissance and, coincidentally, introduced an interest from France. Later in this chapter the IF television aerial reconnaissance system, which was developed for the French government, will be discussed in detail. The Stoyanowsky patent also affected the 'winding up' process of Baird Television Limited. As will be described in chapter seven, BTL could not distribute its assets during the war as some of these assets, specifically those held by Mr Stoyanowsky in Paris, were in enemy occupied territory.[xi]

6.2.4 References

[i] PRO AVIA 13/294

[ii] Herbert, R. M. (1987, May/June). The Baird intermediate film process. *Television: Journal of the Royal television Society.* pp. 134-137.

[iii] ibid.

[iv] ibid.

[v] Gordon Craig obtained his OBE for work with photographic aerial reconnaissance during World War II. He used his skills gained from research into the IF technique to increase the quality of aerial photographs. Leaf, E. (1997). *Above All Unseen.* Yeovil: Patrick Stephens Ltd. Craig left BTL in 1938 and was not aware that developments of his research were later investigated for use in television aerial reconnaissance. Craig, G. J. (2001, March 19). Interview with Ray Herbert.

[vi] Mc Arthur, T. and P. Waddell (1990). *Vision Warrior.* Orkney: Orkney Press. pp. 236.

[vii] Baird, J.L. (1990). *Sermons Soap and Television.* London: Royal Television Society. pp. 93.

[viii] Mc Arthur, T. and P. Waddell (1990). *Vision Warrior.* Orkney: Orkney Press. pp. 236.

[ix] West, A. G. D. ((1935, August). A Practical Outline of Television. *Television and Short Wave World.* pp. 464 -470.

[x] "Report and Drawings on Rapid Processing Camera Projector, Baird Television Limited". PRO AIR 2/2877

[xi] PRO J 13/16536.

Section 6.3

International interest in television for use by reconnaissance aircraft

Coincidentally, with reference to the aforementioned Mr Stoyanowsky, Russia stimulated the next stage in British development of aerial reconnaissance. An assessment of the interactions between the Russian Government, British Government, Baird television Ltd and Marconi-EMI offers an understanding of the eventual developments of the medium and in turn the influences on British TV/AC development. The British Government were happy to let the two companies tender equipment for Russia and later actually provide equipment for France, providing that the most refined equipment was reserved for the British. In other words the British wished to exploit foreign generosity. This sentiment was mentioned in Public Record Office file, AIR 2/1733 which notes, "*There is something to be said for encouraging foreigners to pay for our development work, provided we hold the firm to the proviso that important development will not be passed on without previous reference to us.*"[i] The reason for this position was that the general principles of television were available in published form from which any nation could gain knowledge. It was also suggested that equipment supplied to foreign Governments could be specially modified, for example, made to an inferior standard in order to gain superiority in this strategic technology.[ii]

6.3.1 Russia and France

The Russian interest in British television equipment for aircraft began in early 1936. On the 14th of January Isaac Schoenberg of Marconi-EMI (M-EMI) telephoned Sir Frank Smith of the Television Advisory Committee stating that the Russian Government were interested in lightweight television systems.[iii] Initially, it was decided to let M-EMI negotiate with the Russian Government. On the 11th of March 1936 Wing Commander Leedham notes, *The further point arose that the company* [M-EMI] *have been approached by the Russian Government with a view to the supply of a set capable of being carried in aircraft. Mr Schoenberg told me that the Russians have already ordered one set from America and want a competitive type from his company.*[iv]

It was decided that the British Government should not intervene in these negotiations. Later when the French Government requested similar equipment it was decided that, as the Baird company were currently in negotiations with the French, then M-EMI should be afforded similar privileges.[v]

The situation regarding permission for both BTL and M-EMI to supply equipment to Russia soon changed. This change is informed by Britain's relationship with other nations, as the supply of strategically useful equipment to foreign powers was directly related to the relationship Britain had with those powers.

6.3.2 Czechoslovakia

In early 1938 the Czechoslovakian Government requested television equipment for use in aircraft and it was stated that a reply to this request *"... would appear to be entirely dependent upon political considerations".*[vi] By the 30th of April a decision on supply of M-EMI equipment to this country had been made, it was noted,

On the supply of television apparatus to the Czech Military Authorities, I am commanded by the Air Council to state that they have no objection to your supplying transmitting and receiving equipment similar to that recently supplied to the French Government.[vii]

There is no evidence in PRO files to suggest that equipment was ever supplied to Czechoslovakia. It is possible that political events overtook technical considerations.

6.3.3 Germany

German interest in British television reconnaissance technology was directly affected by the general position on co-operation between Britain and Germany regarding television. McArthur and Waddell (1990) observe that Herr Hadamovsky, Director General of German Broadcasting requested in July 1935 that Britain should co-operate with his country on television development. On August the 6th Hitler announced that all television research was to be placed under German Air Ministry control.[viii] The situation regarding control of German television was more complex. German Government documents state that control of television in Germany was also to be distributed among the Post Office and Propaganda Ministry. This distribution happened over a protracted period due to arguments between the organisations as well as influence of the strong personalities of Hermann Göring and Joseph Goebbels.[ix] Regardless of internal argument in Germany, the British Government decided to prevent German authorities from inspecting British television equipment.[x] Due to BTL's direct relationship with Fernseh A.G. there continued to be communication between the two companies for the next two years. An agreement between the companies required that they should supply each other information on recent developments. However, this reciprocation became unstable as Captain West of BTL noted,

> *Recently, however, the Germans have taken all they could but have given nothing. The German Government has complete control over all television developments which are kept secret. The only thing that is released to the Television Broadcasting Company and to the public is the entertainment itself and the apparatus used in its immediate production. Thus Baird's are on the point of discontinuing their business agreement unless the reciprocal facilities are given.*[xi]

6.3.4 Japan

The supply of television equipment to Japan, by BTL in particular, was expressly forbidden. After mention that this company received frequent visits and applications for information from the whole of Europe and elsewhere, an Air Ministry report notes, "*The only important country which is not catered for is Japan, there being a strict rule that the Japanese are told and shown nothing at all and are not to be admitted onto the company's premises.*"[xii]

6.3.5 Suggestion that Italians had TV/AC equipment

Electronics and Television and Short-Wave World of October 1939 reported that an Italian squadron of aircraft was equipped with a "radio television set". The television was said to be able to see a car from a height of 6000 feet (1830 metres), and have a range of 100 miles (160 km). Ray Herbert, who brought this article to the attention of the author, states that this report may be spurious as there is no evidence of the Italian air force working on television systems. He also states that prior to WWII Italian television was in a very primitive state of development, which makes the magazine statement even more dubious.

6.3.6 Baird Television Ltd tender for supply of TV/AC equipment to Russia

The situation regarding supply of equipment to Russia was not as clearly stated as that with Japan or Germany and seems to have been different between M-EMI and BTL. A week after clearance had been given to M-EMI to supply equipment to Russia, this freedom was withdrawn, a fact recorded in both Air Ministry and Cabinet Registry files.[xiii] This withdrawal is noted when M-EMI re-applied for permission to supply equipment exactly a year after it was removed. [xiv] However, rather than truncate all interaction, the Air Ministry, influenced by Admiralty opinion,[xv] changed their position and noted "*It is proposed to restrict trading with Russia to the provision of apparatus not specifically designed for, and limited to, military use.*"[xvi] Further to this restriction it was also decided to review publication of all patent specifications before submission.[xvii]

Baird Television Limited seemed to have less problems in tendering TV/AC equipment to the Russian Government. On May 26th 1936 West of BTL visited the Air Ministry Research Department and was there given permission to deal with foreign Governments regarding television as long as any equipment produced was not specifically for military applications.[xviii] Below is an assesment of the details of the BTL tenders for equipment to Russia. Details of the equipment supplied and tested for the French Government are given special attention in the next section. Public Record Office file AIR 2/1775 provides much information on the British TV/AC interaction with both Russia and France, but, like the entire subject of television reconnaissance, has never been fully documented by historians. It is from this file that the following information is provided.

The first description of the equipment proposed for the Russian Government is supplied in a report by N. Hecht after one of his regular visits to BTL on the 11th of February 1937. This equipment included,

Table 6.2

1. Light weight Intermediate film equipment for aircraft.
2. Aircraft transmitter of 250 watts on 10 metres wavelength
3. Intermediate film equipment for ground station. Both IF systems to function at between five and ten images per second with a time delay for processing of 30 seconds.
4. A second transmitter of 150 watts on 2 metres wavelength to be incorporated in a mobile station with a 4 by 3 feet (1.2 x 0.9 metres) direct view screen.
5. 25 Electron multipliers.

Hecht also notes, *"The Russians also stated that they were prepared to pay almost any price for equipment which would enable them to 'see in the dark' (i.e. infra red electron cameras)."* The contract for the above equipment was valued at £40 000. Hecht concurred with BTL in that an IF based system was the most suited for this task. By early 1936 BTL were equipped with the necessary expertise to countenance TV/AC contracts, having built experimental and broadcast IF systems at both 180 and 240 line definition. Also, as discussed at the beginning of this chapter, BTL had in January 1936 been issued a patent for a rapidly developed cine film system for aircraft guidance. This patent included use of infra-red film in order to 'see in the dark'. BTL investigated infra-red photography but according to Hecht found it not useful, he notes,

> *Infra red photography Elaborate tests have shown that as far as photographic films are concerned there is nothing to be gained by using infra red in lieu of red radiations for the purpose of overcoming ordinary mist. Red filters are equally satisfactory and a great deal faster.*[xix]

During a BTL visit two weeks later Hecht also discussed infra-red modifications to the electron camera, a subject also mentioned in chapter four. Because of BTL's inability to provide for night vision this attribute was not included in the more accurate specification supplied to the Air Ministry on April the 12th recorded in AIR 2/1775.

Table 6.3

Specification of equipment for Russia.

Aircraft installation.

Intermediate Film scanner, lenses 35mm and 105 mm focal length, 16mm film processed in 15 seconds. Scanned by electron camera or cathode ray tube at 405-line definition and 12 ½ frames per second sequential.

Image monitored on 30cm CRT

Vision radio transmitter, 5-7 metres wavelength, 250 Watts output on omni directional aerial. 40 km range.

24 volt power supply derived from aircraft engines.

Microphone and sound amplifier.

Sound radio transmitter, 5-7 metres wavelength, 100 Watts output.

Sound receiver and headphones.

Ground Station Equipment

Mobile van.

Receiver with super-heterodyne valves displaying picture on 38cm CRT.

Intermediate film system with small CRT onto 16mm film, processed in 15 seconds and projected wet onto 4 X 3 feet (1.2 x 0.9 metres) screen.

Secondary projector from same film for stills.

Aerial mast and reflector.

Sound radio transmitter, 5-7 metres wavelength, 100 Watts output.

Sound receiver with 16mm film recording facility, loud speaker monitor.

Separate film washing and drying facility.

There was also specification for two types of ground to ground systems, one using IF the other using an electron camera. The IF ground system was similar to the airborne, but differed in its provision for 50 fps scanner and wavelengths of sound and radio transmission of between 3 and 5 metres. The receiver had no IF system. The electron camera was to be based on the Farnsworth image dissector and was fitted with a 190mm lens of f/2.5. Added to the Russian proposal was another IF system which projected an image onto a 6 X 4 ½ feet (2 x 1.5 metre) screen. A facility for synchronous sound was also provided. Delivery of this equipment was expected to take 10 months and would cost £47,800. No provision was made for the supply of 25 electron multipliers as specified in the February report.

Another important attribute of the above system was the facility for radio telephone communication between the various transmitting and receiving stations. The core of the problem of television reconnaissance at this time was for the aircraft to provide the ground station with information as to what exactly it was viewing. A synchronous verbal description would assist interpretation. It will be described later that interpretation of the received image was central to the acceptance of the technology for military use. Modification of the system to send filtered plots rather than continuous images was thought to be the only way to arrest this problem. As described in chapter three Lt. Col. H.P. Lefroy made this suggestion at the inception of television reconnaissance research in 1926.

There is no indication whether or not the Russian equipment was ever built. The author has discovered no record suggesting that the Russian contract was ever rejected. The only reference to the fate of this system in the public record occurs on 17th of June 43, where a commentator simply says that they *"...don't believe it was ever built"*.[xx]

6.3.7 References

[i] AMRD (1937, April 3) Minute. PRO AIR 2/1733.

[ii] Leedham (1936, April 30). DSR minute. PRO AIR 2/1775.

[iii] Miall, L. (1936, February 26). Letter to Lord Orr-Ewing. Author's collection.

[iv] PRO AIR 2/1733.

[v] Wimperis, H. (1936, September 21) minute. PRO AIR 2/1733.

[vi] Supply of television equipment to Czechoslovakia (1938, January 27). PRO AIR 2/1733.

[vii] Self, A.H. (1938, April 30). Letter to Marconi-EMI. PRO AIR 2/1733.

[viii] Mc Arthur, T. and P. Waddell (1990). *Vision Warrior.* Orkney: Orkney Press. pp. 240-241.

[ix] German Government documents concerning distribution of control of television 1935-1936. From copies in personal collection of author.

[x] Mc Arthur, T. and P. Waddell (1990). *Vision Warrior.* Orkney: Orkney Press. pp. 240-241.

[xi] Hecht, N. (1936, July 23). Air Ministry report of visit to Baird Television Ltd by Air Ministry staff and Wing Commander Archer of M.I.5. 17th of July 1936 PRO AIR 2/1775.

[xii] ibid.

[xiii] PRO AIR 2/1775. Sub Committee on Air Defence; Development of Television for Aircraft use. (1936, May 18). PRO CAB 104/102

[xiv] Shoeubes (1937, March 19). Letter from M-EMI to Air Ministry. PRO AIR 2/1733.

[xv] Leedham. (1937, April 29). Minute 32. PRO AIR 2/1775.

[xvi] (1937, April 20) Minute. PRO AIR 2/1733.

[xvii] ibid.

[xviii] Hecht, N. (1937 March 31). Memorandum: Baird's dealings with foreign Governments. PRO AIR 2/1775 and PRO AIR 2/1733.

[xix] Hecht, N. (1937, February 16). Visit to Baird Television company. PRO AIR 2/1775.

[xx] PRO AVIA 13/1263.

Section 6.4

Baird Television Ltd

and

French Television Aerial Reconnaissance

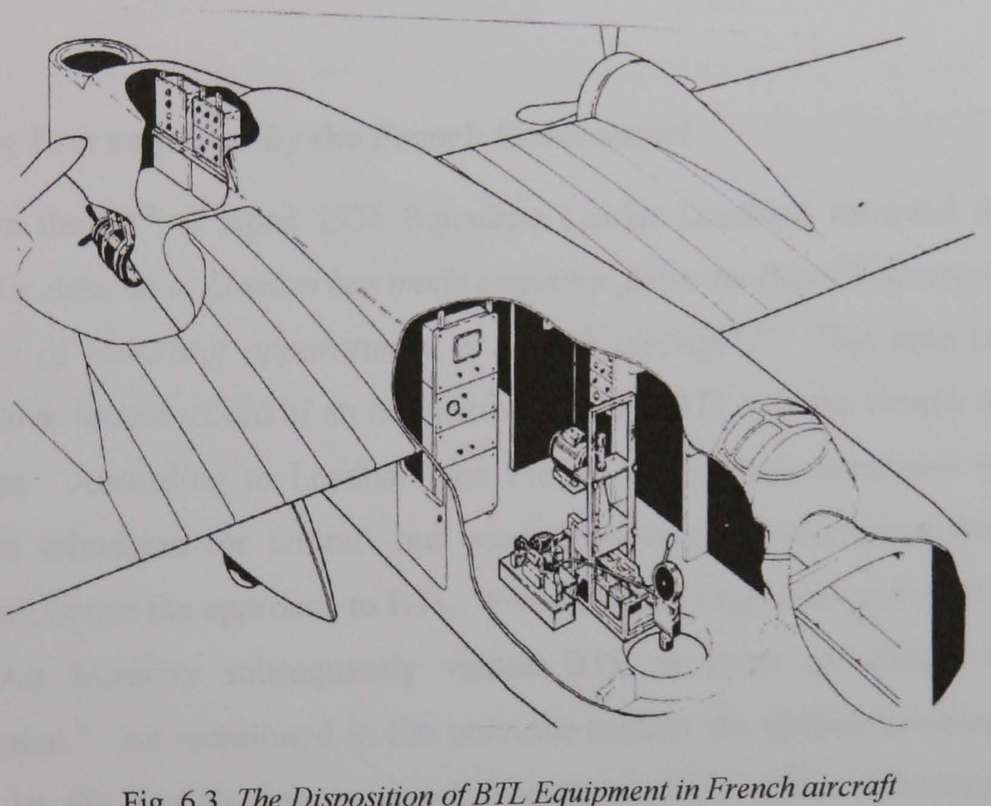

Fig. 6.3 *The Disposition of BTL Equipment in French aircraft*

Source: PRO AIR 2/1733

6.4.1 Abstract

In 1936 the French Government approached Baird Television Ltd and Marconi-EMI for the supply of television equipment to be fitted to aircraft for reconnaissance. Subsequently both companies developed, supplied and tested equipment. The M-EMI system utilised the Emitron camera. There is a comprehensive record available concerning M-EMI equipment supplied to the British Government; unfortunately the record describing their supply to the French Government is sparse.[i] Fortunately, information regarding the BTL French equipment is comprehensively recorded in public records and articles. The project has received historic attention from a member of the Baird team, Mc Arthur and Waddell (1990), Hills (1999) and Burns (2000).[ii]

6.4.2 The first enquiries by the French Government

On the 30th of April 1936 Squadron Leader Leedham recorded that " *The French Air Attaché in London has made enquiries from the Baird Television Co. with the object of installing apparatus in a French aircraft".*[iii] This note is the first British Government record of an interaction between BTL and the French for TV/AC equipment. According to Leedham the French had already attempted to develop their own television for aircraft but were dependent on equipment from British companies, hence the approach to BTL. French Radio Engineers and members of the French Air Ministry subsequently visited BTL in order to discuss equipment development.[iv] As mentioned in the previous section the British Government were keen to let the French finance developments by BTL whilst reserving the most refined equipment for their own purposes.[v] To this end Mr Hecht visited BTL in July in order to inspect the equipment being developed for the French Government. His report states that BTL would use either the intermediate film system or an electronic camera for the project that would cost approximately £10 000. Whatever system was chosen a definition of 800 lines was expected with five pictures per second being produced. It is possible that the suggestion of such high definition was influenced by the fact that BTL had already demonstrated an Image Dissector based system which had resolved 700 lines.[vi]

The reduction in frames per second (fps) would produce a stilted flickering image in relation to the 25 fps used in broadcast television. It was considered that a flickering image of high definition was better than a continuous view of lower definition. Hecht concurred with BTL on reduction in frame refresh rate and noted that this was "*... probably the best course to take for aerial observation*"[vii]

The interest by the British Air Ministry in BTL TV/AC equipment developed to the point where the company were offered a British aircraft in which they could fit equipment for demonstration purposes.[viii] This enthusiasm did not continue and in due course members of the Air Ministry were informed that they could inspect BTL equipment whilst fitted to a French aircraft. As it was now established that BTL were developing equipment for the French Government it was decided to afford similar privileges to the Marconi-EMI company. The Director of Scientific Research (DSR) of the Air Ministry H. Wimperis suggested that M-EMI should be informed of this official relaxation of attitude towards the subject.[ix] Two weeks later French Air staff Capitaine Labat, Lieutenant Vuillot and Ingenieur d'aeronautique Quenin were given a ground demonstration of M-EMI equipment which was soon to be fitted to a British aircraft for testing.[x] BTL needed longer to develop the equipment for the French and it was not until a year later that the first arrangements for testing in aircraft were made.

6.4.3 The creation of the project

In August of 1937 Captain West of BTL decided that the TV/AC equipment would soon be ready for testing in a French aircraft. He had made arrangements for supply of an aircraft by the French and contacted the British Air Ministry requesting provision of an aerodrome.[xi] The availability in November of the weights and dimensions of the French aircraft for rating landing and storage costs[xii] suggests that by this time the type of aircraft had been selected. In discussion of landing costs, file AIR 2/1775 offers one of the few examples of information which refers to the parallel project undertaken by M-EMI for the French Government. A minute written on the first of December 1937 by Sq. Ldr. Leedham suggests that BTL should be charged at the same rate as M-EMI who had already installed equipment in an aircraft for the French Air Ministry under project title CFTH[xiii]. To Supplement this information Dr Eric L. White OBE has recorded in reference to the M-EMI trials for the French, "*This time signals where radiated from the aircraft, with about 80W on about 600MHz, and on one occasion gave good pictures at Hayes when the aircraft was at 10,000 ft over Chelmsford, 80 miles away.*[xiv]

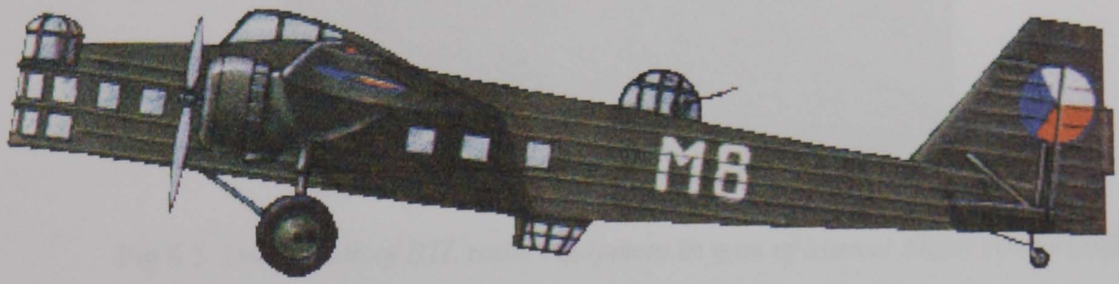

Fig. 6.4 *Marcel Bloch 200 aircraft. Unlike the aircraft used by BTL, this aircraft has Czechoslovakian national markings and is fitted with a dorsal and ventral turret.*

Source: Author's personal collection

Unglamorous, and resembling a garden shed with wings, the Marcel Bloch 200 aircraft selected for the tests, nevertheless had attributes which made it most suitable for the designated purpose. Although having a narrow fuselage there was adequate space to fit the complete intermediate film system in the rear fuselage with radio transmitters forward in the nose. The stability of this type was also advantageous for viewing the ground 5000 feet (1525 metres) distant.

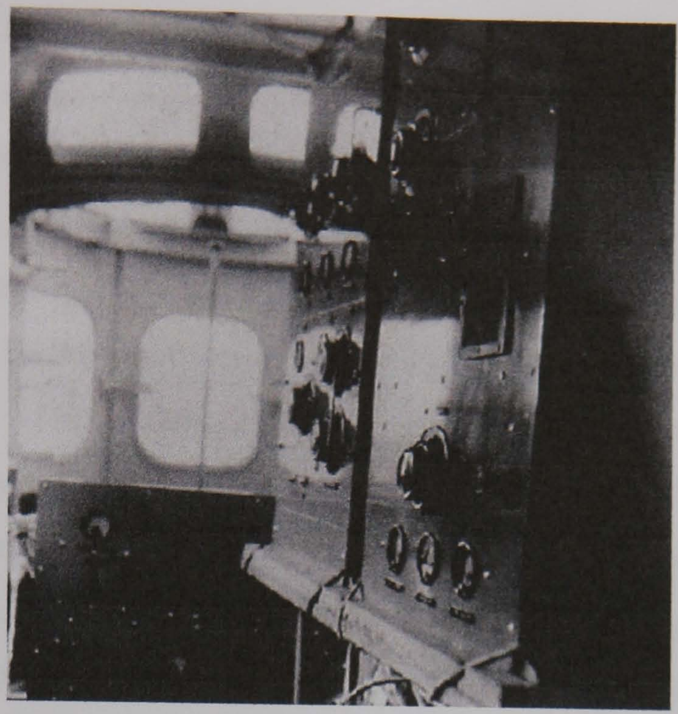

Fig 6.5 *Installation of BTL radio equipment in nose of Marcel Bloch 200 aircraft*

Source: R.M. Herbert

For the BTL tests both dorsal and ventral turrets were removed. The upper to save weight and the lower to supply a suitably positioned orifice to point the cine camera through. The ventral hole was covered with a sheet of optically flat glass in order to prevent cold drafts from cooling the operators and also the film development tank which had to be kept at a constant 28 degrees centigrade.[xv]

By the last day of October 1938 when the aircraft designated for BTL arrived at Hendon aerodrome, M-EMI had been testing their French equipment a year. Hendon was chosen for the tests because Croydon, which was closer to BTL, did not have adequate facilities for radio experts to examine the installation. Farnborough was also ruled out because it was thought inadvisable to let foreign mechanics onto a base which had other important experimental aircraft and equipment.[xvi] A year elapsed between arrangements with Hendon and the actual arrival of the BTL aircraft.

According to Ray Herbert shortly after arrival the aircraft was returned to France for the fitting of new engines. On return to Hendon in early 1939 BTL equipment was then fitted.[xvii] Equipment for the project was developed in the Crystal Palace School of Arts, which was at the south end of the complex, and hence survived the fire that destroyed the rest of the Palace. The physical separation of this project from the main Baird manufacturing facility in the Rotunda, as well as the innocuous job title of 4141, meant that the project was provided with a certain amount of secrecy from both external and internal observation. In total Eleven BTL engineers were assigned to the project under the leadership of a Mr Basil Austin. One of the engineers was Mr Ted Bray whose expertise at recording television onto film was most useful to the project[xviii], another was Mr Ray Herbert. Herbert joined the project in the Crystal Palace School of Arts in 1938. Members of the project had seen Herbert's development of a powerful transmitter in the Rotunda,[1] and they gave him the task of increasing the power of the transmitter to be installed in the aircraft. This work was urgent and the transmitter specialist doubled the transmitter's power within a week.[xix] Mr Herbert continues to investigate this subject and has provided the author with much useful information on this topic as well as other matters relating to J.L.Baird and his company.

From Mr Herbert's publications, as well as file AIR 2/1775, it is possible to describe in detail the equipment fitted to the Marcel Bloch aircraft.

[1] The transmitter developed by Herbert in the Rotunda was destined to be delivered to a Mr Wu in Hong Kong for use in an Iconoscope based television system constructed by BTL.

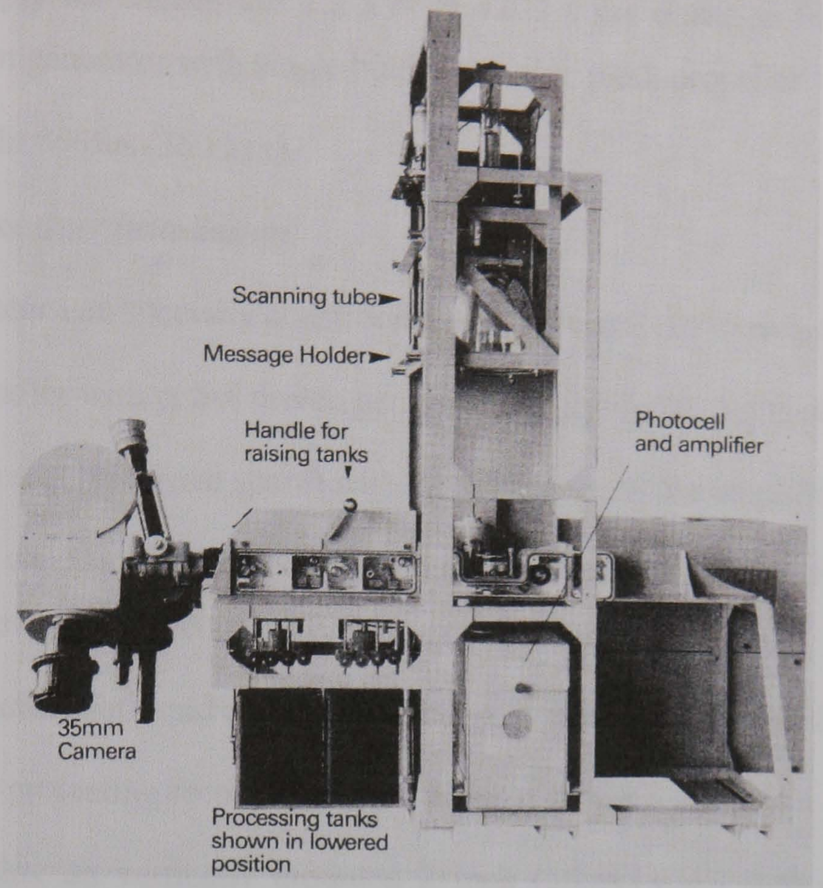

Fig 6.6 *The equipment fitted by Baird Television Ltd to Bloch aircraft.*

Source: R.M Herbert

Table 6.4

BTL aircraft installation

- Intermediate film system with 35mm camera fitted with a choice of two lenses.
- Image delivered at between 20 and 30 frames per second.
- Film scanned in aircraft with inch (18cm) high intensity CRT at definition of 400 lines.
- Developing and fixing tanks maintained at 80 Fahrenheit (26.7 ° C).
- Provision for operator to observe image on CRT in aircraft.
- Vision transmitter of 50 Watts capacity with peak power of 200 Watts. 5.8 metre wavelength, radiated from a retractable quarter wave antenna. Transmission range of 25 miles (40 km)
- Power supply for main equipment 200 volts at 500Hz obtained via rotary converter from main aircraft batteries.

- Power supply for transmitter 1.2 kW at 1200 volts obtained from an external wind driven generator with single bladed variable pitch propeller.
- Total weight 800lbs (360 kgs).

BTL ground receiver installation

- Renault motor van specially constructed with sprung floor to reduce vibration.
- Attached trailer with petrol driven generator supplying 200 volts at 500Hz.
- Two vision receivers (one spare) with three separate video amplifiers.
- Recording on 35mm film via high intensity CRT similar to that installed in aircraft. Provision to record every frame or every third frame.
- Separate facility for rapid developing, fixing, washing and drying film.
- Facility for projecting recorded film on to large screen.
- Image display on vertically mounted 2 inch (50cm) CRT with 45° mirror for horizontal viewing.

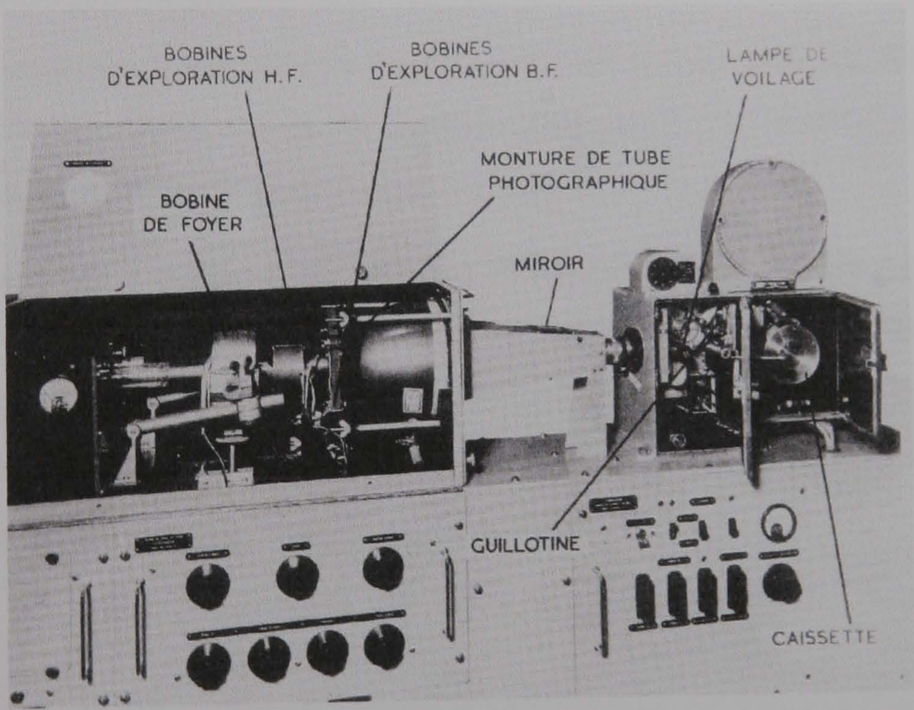

Fig 6.7 *Ground receiver equipment supplied to French Government by Baird Television Ltd*
Source: R.M Herbert

The specification of the equipment actually provided to the French government differs from that originally suggested. One of the main differences is the resolution of scanning, the delivered equipment having just 400 lines whereas 800 lines were originally specified in discussions with the British Government. The transmission wavelengths were the same as those specified in 1936. It is therefore likely that the reduction in scanning lines was necessary in order to produce 25 frames per second rather than the original specification of 5 frames per second.

Fig. 6.8 *The MB 200 at Hendon aerodrome. Note the absence of the ventral turret and single bladed generator fitted below fuselage.*

Source: R.M. Herbert

6.4.4 Equipment Testing

The majority of the proving flights in Britain occurred during the summer of 1939 with 17 transmissions from the aircraft taking place,[xx] 15 of which were in July. Herbert's descriptions of these flights is as follows,

> *The usual routine was to head north to Radlett airfield* [after taking off from Hendon] *to gain height and then start transmitting pictures of the ground during the south-westerly run towards Guildford at about 3000 ft (915 metres). The gasholder at Southall had the name painted on it which provided a useful definition check.*

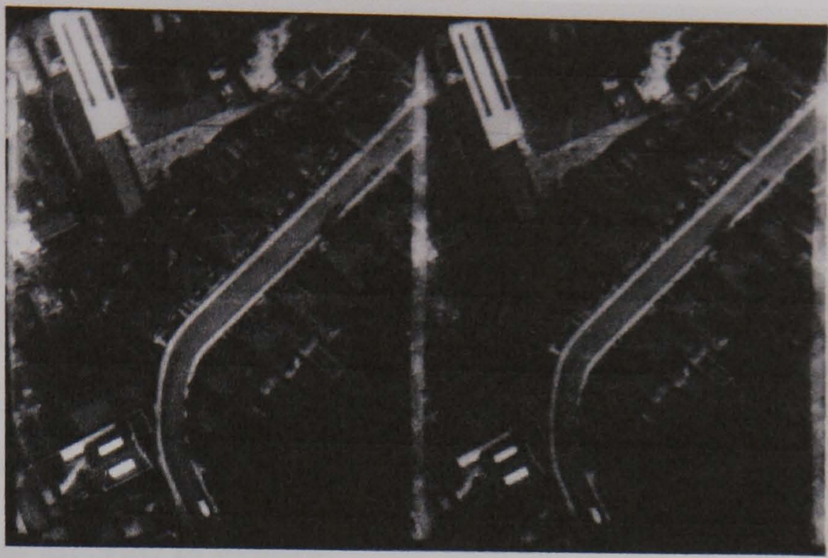

Fig 6.9 *Two frames from film exposed during aerial testing.*

Source: R. M. Herbert

The aircraft flew without mishap and the results are also described,

> *A report made by an observer on the ground stated that excellent views of the river Thames and its bridges were obtained, ripples on the surface of reservoirs, moving buses and cars, tennis court markings and names on buildings could all clearly be seen even in poor weather conditions.*[xxi]

Most of the tests were conducted at heights of between 3000 and 5000 feet (914 and 1525 metres). The aircraft transmitter supplied enough power to provide a strong enough signal at ranges beyond the specified 40 kilometres.

6.4.5 Limitations of the system

There was however, one or two problems requiring attention that were noted in a British government report of the Hendon based tests.[xxii] The image disappeared from the viewing screen too quickly due to the low height and speed of the aircraft that provided for a relatively narrow view. This problem was more related to the method of reconnaissance used rather than the design of the equipment. Until a considerably higher resolution of image was available as well as systems capable of informing the observer the location of the aircraft, this was to be a fundamental problem that plagued all television reconnaissance of this era. For the BTL system it was suggested that a higher frame rate would reduce flicker on the observation screen. As noted above there was a balance between whether to bias the available waveband to definition or frame refresh rate. And as already stated the French system was biased towards frame refresh rate rather than high definition which was an attribute originally proposed for the system. There were also problems with radio interference on the viewing screen produced by the petrol generator attached to the Renault receiving van as well as from the metal three bladed propellers of the aircraft. Interference from the aircraft propellers was also experienced with the M-EMI system.[xxiii] All problems could be overcome by replacing the offending units with ones, which were designed with interference problems taken into consideration.[xxiv]

6.4.6 Return of aircraft to France

At the end of July after testing had been completed in Britain the aircraft and BTL staff travelled to the aircraft's original base at the Centre d'Essais, in Villacoublay near Paris.[xxv] On September 3rd war broke out between Britain and Germany. The Baird engineers returned to Britain and wrote the instruction manuals for the equipment.[xxvi] Trials were temporarily stopped and resumed in early November. Wing Commander Leedham notes,

> *As regards the Baird Television system a brief memorandum is enclosed at 62A from which you will see that Service Trials of Air Television are proceeding afresh after a hold-up due to the outbreak of war before they were properly started. The trials will be conducted in collaboration with the War Office and arrangements will be made for a demonstration to Air Staff if you will let me know when this will be convenient.* [xxvii]

The aircraft was then moved to Bricy, near Orleans and then Toulouse. There are various opinions as to the eventual fate of the aircraft. In June 1943 the head of the Photographic Division of the RAE noted that the French equipment was "*...presumably captured by the enemy*".[xxviii] Constantin Aristide Sfezzo assisted the Baird engineers in France with logistical items such as finding hotels[xxix], and has provided his own comment on the fate of the aircraft. In his autobiography he writes,

> *The French Army, however, did not have the opportunity to test it* [equipment in MB 200] *in actual battle conditions. When it was parked on the Orleans military airfield, the Bloch 200 television aircraft was destroyed by the bombs*

of the Luftwaffe in May 1940 without having had the opportunity to take to the air for a warlike mission.[xxx]

Ray Herbert has discussed this matter with Mr E.D. Mc Connell, another of the Baird Engineers. Mc Connell informed Herbert that although the airfield at Orleans was bombed, the aircraft and its television equipment survived damage.[xxxi] This is why the aircraft could then travel to Toulouse, as stated by Herbert. The Admiralty were informed by Captain West at Cinema Television Ltd in 1943 that "*The* [BTL equipment in Bloch aircraft] *was captured by the enemy soon after the fall of France".*[xxxii] It should be noted that Toulouse was not occupied by the German forces. Research on the actual fate of the aircraft and equipment continues.

6.4.7 Public Interest in reconnaissance by television

During the late 1930s it was thought that television reconnaissance research in Britain was top secret. However, there are a series of references in popular publications that suggest research of some form was being conducted into the technology.

In September 1939 the *Motion Picture Daily* referred directly to a suggested activity. It states,

Lee [A.Lee, Vice President of Gaumont British] has received information from London that French planes are reconnoitring enemy lines at the western front are experimenting with television sending apparatus. The pictures are received at field headquarters and photographed as they come in.[xxxiii]

Although this report is not entirely accurate it is a public statement suggesting that the French Government had operational television reconnaissance equipment.

Fig. 6.10 *A 1939 artists impression of television aerial reconnaissance.*

Source: *Popular Science Monthly*, December 1939.

The December edition of the American publication *Popular Science Monthly* provided a graphical representation of television reconnaissance by British Aircraft in an article entitled "Television Planes Spy on Enemy Lines". The illustration for this article, above, shows an American built Lockheed Hudson aircraft in British camouflage and markings. The basic layout of this aircraft, with a single dorsal turret, is very similar to the Avro Anson aircraft actually used by the Marconi-EMI company at the time of writing of the article.[xxxiv] Development of television aerial reconnaissance systems by this Company is detailed in the next section.

6.4.8 John Logie Baird and Television Aerial Reconnaissance.

A British newspaper report of February 28^{th} 1938, which mentions J.L.Baird's recent departure to Australia, is entitled "Television in Bombers". The report states that John Baird was working at Crystal Palace on a system which would enable aircraft to see a town 50 to 100 miles away using as a display a ground glass screen. The inventor is recorded as saying that he was taking his "Electric Eye" system to Australia. The eventual fate and precise details of this equipment remains a mystery.[xxxv]

This article not only records an early breach of security of the BTL project but also may suggest that there was some connection between J.L.Baird personally and BTL. It will be noted that security about TV/AC was again breached in September 1939 in the *Motion Picture Daily* article mentioned above.

Ray Herbert has stated during various interviews with the author, that J.L.Baird did not have security clearance or free access to the School of Arts building where the French component of the TV/AC work was being carried out. Mr Herbert has also questioned Sayers, Mc Connell and Austin, about whether J.L.Baird was directly involved in the project. The general opinion of these informants is that Mr Baird was aware of the work on TV/AC by BTL, but was not actively involved.[xxxvi] If J.L.Baird was involved with either the French or British facsimile facets of the project it is likely that his name would be mentioned in the various PRO files which record other important BTL staff such as Mc Connell, Austin, Banfield and West. In 1986 R.V.Jones stated that he carried out acceptance trials for TV/AC "*and did not hear of Baird being involved*".[xxxvii] Although J.L.Baird offered and patented equipment for television reconnaissance in the late 1920's, it seems from lack of evidence to suggest otherwise, that he was no longer involved in TV/AC research ten years later.

Within BTL the French TV/AC project was titled 'job 4141' to obscure its subject. Mr Herbert, Mc Connell and Austin, although directly involved with the French project, were unaware until informed by the author, that there was a parallel project involving signalling for the British Government. It can therefore be surmised that security within BTL was very tight. This suggestion of internal security is reinforced by a parallel situation twenty years later at Rank-Cintel, formerly Cinema Television Limited in Worsley Bridge Road. The Author's father, Warren G. Hills worked for this company from 1962 to 1964 and as a research scientist was given the task of converting valved telecine machinery to transistorised electronics. Mr Hills was unaware that the Rank-Cintel building, next door to his on the site, contained a head up display system for military tactical aircraft. BTL/CTL/Rank-Cintel therefore had a culture of security. This information makes J.L.Baird's public statement about TV/AC seem to be a definite breach of security.

However, it is important to clearly interpret exactly what J.L.Baird offered for the *Daily Telegraph* article. His statement that he was working at Crystal Palace could mean one of two things. Either that he was directly involved with a BTL project at their premises on the Crystal Palace site or that he was working at his laboratory in 3 Crescent Wood Road on a system. As a native of the area, this author can state that J.L.Baird's address falls within the region known as Crystal Palace. There is no information known by this author, from such sources as the various workers J.L.Baird had at his house or any other published material, that states that TV/AC research was undertaken at 3 Crescent Wood Road.

At the time of writing a book has been prepared by Professor Malcolm Baird and Anthony Kamm called *John Logie Baird: a Life* which is a biography of J.L.Baird. If J.L.Baird was actively involved with TV/AC, or on another controversial subject, radar, it is expected that these activities will be mentioned in the book, due for publication August 2002.

6.4.8 References

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Section 6.5

The British Trials:
Marconi-EMI or Baird Television,
Facsimile or Television

Fig. 6.11 *The Blackburn CA.15.C. experimental aircraft which was fitted with Marconi-EMI television equipment in 1936*
Source: Mason, T. (1993). *British Flight Testing.* London: Putnam.

6.5.1 Television in 1936

Television in Britain was to see a great advance in 1936 both for public entertainment and for military application. Television had been given its inaugural demonstration by John Logie Baird in London in 1926. After a struggle against the BBC and the Post Master General J.L.Baird and his company Baird Television Limited began public broadcasts on the 30th of September 1929. The broadcast 30-

line system improved in quality and became a source of much public interest. On the 22nd of August 1932 the BBC assumed control of the transmissions which continued until the 11th of September 1935. At the closedown of this service there were approximately 5000 receivers in use. The 1935 closedown of television was influenced by the formation of the Television Advisory Committee under the chairmanship of Lord Selsdon in 1934. The Selsdon Committee was aware of the great improvements in television in the preceding years and decided to take it out of the laboratory and create a high definition service for Britain. In due course Alexandra Palace was chosen as the base for television studios and a radio transmitter was installed in the building.

The second of November 1936 was the day that this service was to open. Both Baird Television Ltd and Marconi-EMI were to broadcast their own systems on alternate weeks. In the late summer of 1936 enthusiasm for the forthcoming service was great. The Radiolympia show at Earls Court, which had been showing television receivers for many years, was a focus for much of this enthusiasm. Baird Television Ltd had driven forward the broadcast of television in Britain through its 30-line service and public demonstration ranging from transatlantic broadcasts to colour television. The company seized the opportunity for further publicity with a demonstration, which involved a technology they were clandestinely working on for military organisations.

6.5.2 Television in a KLM DC-2 aircraft

Baird Television had given many demonstrations of various applications of television before, and for Radiolympia 1936 they chose to install one of their T5 receivers in a KLM DC-2 aircraft. *Practical and Amateur Wireless* of the 17th of October 1936 reports this demonstration,

> *While the low definition television service was in full swing some interesting reception tests were undertaken on an LNER express train. A recent high-definition television reception test, however, was much more*

spectacular in character. It was carried out during the Radiolympia transmissions, and for the work a KLM Douglas aeroplane was employed. A standard receiving set was installed in the machine, deriving its AC power from a small alternator. With a party of sixteen Press men on board, the machine cruised over London and pictures were clearly visible on the television screen during the whole trip. This is the first time a feat of this nature has been undertaken.

To add to the patriotism of this event a film of the HMS Queen Mary obtaining the Blue Riband for crossing the Atlantic was scanned using BTL flying spot telecine apparatus.[1] The film was then radiated from the Alexandra Palace transmitting tower.

Fig. 6.12 *The last flying DC-2*
Source: www.uiverfan.nl (2001, January 25).

The DC-2 aircraft had a capacity of 14 passengers, space was also occupied by the T5 receiver and associated equipment. On its own the equipment weighed 420 lbs. (200 kg)[i] and therefore would have probably accounted for the entire luggage

[1] The Baird Company had first achieved the 'Teletalkies', the televising of films in a public demonstration of August the 19th 1929. Burns, R.W. (2000). *John Logie Baird, television pioneer.* London: MPG Books Ltd. pp. 193. This method used light shone through the film and therefore produced a higher quality image than contemporary broadcasts using reflected light. The high quality of the image was probably one of the reasons why a pre-recorded film was used rather than a live broadcast.

allowance of the aircraft or the weight of two passengers. The only way of explaining 16 pressmen is that the aircraft was very cramped, the report of 16 passengers is incorrect, or that there were two flights. Gaumont British showed this event in one of their newsreels.

6.5.3 The High Definition Television Service

The Alexandra Palace television service followed on the 2nd of November with BTL showing the first week's television. The 240-line Intermediate Film system worked well, within the limitations of its necessarily fixed position, although results with the flying spot system and electronic camera were barely acceptable.[ii] Then, on November 30th disaster struck. John Baird received a telephone call that the Crystal Palace where his company was based was ablaze. About this event he writes,

> *My house, 3 Crescent Wood Road, is less than a mile from the Palace and, looking from the window after the 'phone call, I saw a red glow in the sky. Long before I reached it the road was completely blocked with motor cars and a dense crowd of people. I managed to elbow my way through to the front of the palace, which by this time was a seething mass of flames – a wonderful spectacle.*[iii]

In this fire Baird Television Ltd lost around £100 000 worth of apparatus as well as records and equipment which they were about to install in Alexandra Palace.[iv] The comprehensive damage to BTL along with the limitations of the IF system, the Electron camera and flying spot television system influenced the Television Advisory Committee to curtail use of the Baird systems for the British television service. BTL ceased public transmission on February the 5th 1937.

On the same day that the BTL transmissions at the Alexandra Palace were stopped, representatives from the Admiralty visited BTL's Intermediate Film installation at the Alexandra Place and requested modification of the system for use in signalling. Items specifically discussed were,

1) Simplification of apparatus and improvement of definition by reducing the rate of scanning.
2) Employing the system for facsimile transmission, i.e. transmitting a diagram drawn by the observer in the aircraft instead of using direct television.[v]

The Admiralty were not the only fighting service interested in modifications of the IF system. Six days later Mr N. Hecht of the Air Ministry visited Captain A.G.D. West at BTL and was given a demonstration of amongst other items a system designed for aerial reconnaissance which delivered the reduced scanning rate of 5 frames per second.[vi] The equipment shown to Hecht was a modified form of the Intermediate Film system. During this visit it was also suggested that that BTL could be used as a research and development company for the Air Ministry as payment for developed items would assist the company to recover financially after the great loss of the fire.

During the aforementioned visit BTL also stated that they expected to receive a contract for television aerial reconnaissance systems from the Russian Government which was worth a much needed £40 000. As stated above, this contract was not proceeded with, but a parallel contract worth £10 000 for the French government was, and must have tangibly helped the company in its post-fire recovery.

The early developments of aerial reconnaissance systems by Baird Television Limited pre-dated the Alexandra Palace Television trial. Similar developments were also undertaken by the Marconi-EMI company. The Air Ministry's visit to BTL was a result of this work and their interest in high definition television for reconnaissance.

6.5.4 Early British military interest in high definition television for reconnaissance

On the 28th and 29th of April 1936 Mr N Hecht and Wing Commander Leedham visited BTL and M-EMI to *"...obtain knowledge of the state of development of these rival systems, and to form an opinion as to the likelihood of obtaining demonstrations such as would be of special interest to the Air Ministry".*[vii] In his report of these visits Hecht noted that the research by Marconi-EMI on their electronic camera, the Emitron, had overcome problems associated with mechanical scanning discs, which he considered, were heavy, bulky and prone to mechanical sensitiveness. The Emitron at this time was relatively unreliable lasting between 400 and just a few hours. Definition provided by this camera was 480 lines, 75 lines more than was later used for the public television service. It was hoped that the company could provide a scanning rate of 1000 lines for aerial reconnaissance purposes. During the visit an outdoor demonstration of the camera was given which could just resolve telegraph wires at 100 feet (30 Metres) on a moderately lit day. M-EMI were already making arrangements to adapt their system, which was estimated to weigh 400 lbs (180 kg), to fit in a 'fairly large aircraft'. For the high definition proposed it was hoped to provide for a 2.5 metre radio frequency radiated at 200 watts. A demonstration of the apparatus was expected to be available in 'three to four months'.

The visit to Baird Television Ltd provided the information that all efforts by the company concentrated on around a 7.5 metre wavelength, which negated the use of high definition. It should be noted that in February 1935 BTL demonstrated to journalists a television system using their electron camera that resolved an image of 700 lines. Therefore, there was not the lack of ability to produce high definition images, but an insistence by the company to use the waveband allocated to broadcast television, which could only carry lower definition pictures.[viii] BTL stated that they proposed to investigate definitions up to 1000 lines but would not give it high priority, as it was not useful with the allocated wavelength for television. At this time there was no electron multiplier addition to the camera and it was not demonstrated. An outdoor demonstration using an unspecified method was also given to Hecht, but both brightness of image and definition were considered poor. The transmitter available could produce 7 kW mean power with a peak of 20 kW. Hecht also notes that BTL, "*...are building a new transmitter with a peak power of 500 kW using Metrovick demountable valves*". More details of this investigation are provided in chapter five. Further radio research had produced a 75cm transmitter which could produce 20 watts, and another transmitter which could produce 200 watts. BTL were also constructing apparatus for fitting in aircraft. They could produce a demonstration of low definition equipment in a similar time to that stated by M-EMI but would need much longer for high definition apparatus. Leedham offered the opinion that these companies could produce equipment for other countries but that the most useful applications should be kept by Britain as a military secret.[ix] Details of the interactions with foreign governments by both BTL and M-EMI are provided earlier in this chapter six.

The general position of British government interest towards the television for reconnaissance is summarised in PRO AIR 9/32 a 1936 file entitled *The Potential use of Television for Air Operations*. The advantages of the technology are stated as,

1) A ground observer can see images from a remote aircraft.
2) Occupants of the aircraft can transmit instructions to ground staff.
3) Useful for tactical reconnaissance if recorded once received.

The disadvantages,

1) The image is transient
2) Photographs are higher definition and more useful for precise interpretation of the ground location.

It was also noted that television would be particularly useful to aerial reconnaissance,

...if it is found possible to combine the penetrative power of the infra-red ray with the visible reproduction of images on a screen to an extent which will enable a pilot to obtain a continuous view of ground otherwise obscured by

clouds or fog, the possibilities are enormous, both with bombing invisible objectives and with operating aircraft in mist or fog, or vice versa for seeing aircraft for anti-aircraft fire.

The ability for television technology to augment human sight was originally suggested ten years earlier when the Air Ministry approached J.L.Baird for equipment. The Russian Government were 'prepared to pay anything' for this advantage. Although an ongoing interest of British researchers, neither BTL of the M-EMI systems constructed were to be capable of surpassing human vision or what was colloquially termed 'Eyeball Mk I'.

It is clear that in early 1936, with television being developed for public broadcasting, the British government returned to an active interest in the technology for military purposes. Robert Watson-Watt who was a member of the Lord Selsdon Television Advisory Committee as well as busy creating the British radar defence system noted, *"The cathode ray tube is the basic equipment for R.D.F, visual D.F. and television, and that co-ordination off all these three factors is required."*[x] After these suggestions it was suggested that television research should be added to the remit of the Telecommunications Research establishment at Bawdsey Manor when it was fully operational.[xi]

The first mention discovered concerning the commencement of active interest into British high definition TV/AC occurs on the 18th of May when the Air Ministry Research Department notes that they wish to purchase a television receiver and '*... cut it about a bit to reduce its weight'.*[xii] On the 30th of June arrangements were made for Mr N. Hecht to make regular visits to both BTL and M-EMI,[xiii] companies which already had their patents vetted by the British military before publication.[xiv](The results of these visits are mentioned in detail at various places in this thesis). At the same time there is a suggestion to use a Vickers Valentia based at Hendon or a Handley Page TB aircraft for Research purposes. In due course neither of these aircraft was chosen and instead equipment produced by Marconi-EMI was to be fitted to an experimental Blackburn aircraft for trials.

6.5.5 Television trials in Blackburn CA.15.C. aircraft

Fig. 6.13 *The two Blackburn aircraft designed to the same overall specification*
Source: *The Blackburn Story 1909-1959* (1960). Brough: Blackburn Aircraft Limited.

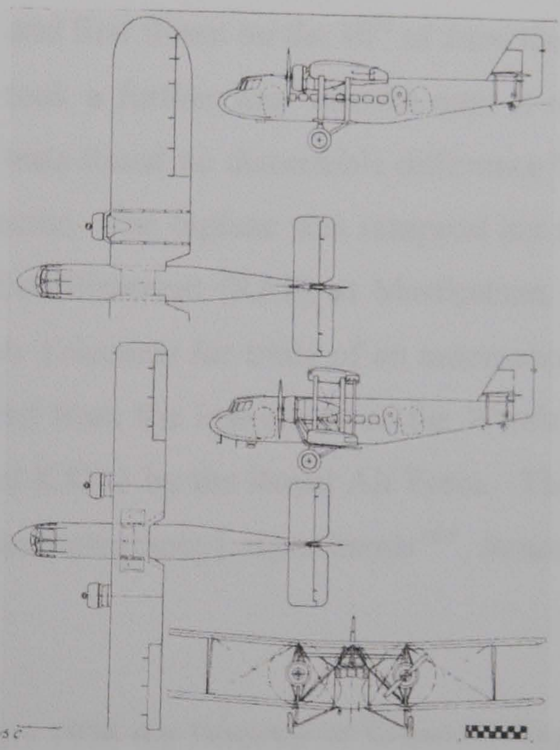

Fig 6.14 *General arrangement drawings of Blackburn aircraft*
Source: *The Blackburn Story 1909-1959* (1960). Brough: Blackburn Aircraft Limited.

This Blackburn CA 15c monoplane was chosen for TV/AC experiments as it had already been used for electronic experiments by the RAF and was still available for these purposes. The history of this aircraft is worthy of comment. In the early 1930s the British Air Ministry were convinced of the suitability of biplane configuration. However, foreign Governments were already constructing monoplane aircraft, which superseded the performance of contemporary biplanes, and therefore the Air Ministry were motivated to investigate which wing configuration was best. As part of the Air Ministry's sponsorship of designs for civilian purposes i.e. potential military transport aircraft, specification 6/29 was issued to the Blackburn Aircraft Limited in early 1931.[xv] Blackburn had already produced designs for an aircraft which could be either biplane or monoplane configuration. When the Air Ministry became aware of these designs they decided it was an excellent opportunity to investigate the biplane/monoplane controversy as well as a promising aircraft type. In order to obtain an accurate comparison between configurations the Air Ministry requested that both aircraft share as much componentry as possible. This requirement reduced the efficiency of the monoplane as it had to be built with heavy undercarriage designed initially for the biplane. The biplane, registration G-ABKW, was completed in 1932 and first flown on the 10th of June that year. The monoplane, registration G-ABKV, took a further four months until it was flown on the 4th of October. Comparative tests found no discernible difference between the two aircraft with respect to performance. The biplane was scrapped but the monoplane was sent to the Royal Aircraft Establishment (RAE) at Martlesham Heath (now a research establishment for British Telecom) for trials of an automatic pilot. In July of 1935 G-ABKV was transferred from the Instrument to the Wireless and Electrical Flight and issued military serial K4241 by the Royal Air Force. The aircraft was then used for '*various W/T* [wireless/telegraphy] *experiments*'[xvi], hence its availability for use by Marconi-EMI.

A year later in July 1936 the Director of Scientific Research H.E.Wimperis of the Air Ministry noted that M-EMI were constructing apparatus '*under conditions of secrecy*', for use in aircraft. This apparatus, which was due to be completed by late August was to be fitted to K4241, which had been made available by the RAE.[xvii] In due course the Experimental Flying Department at RAE informed 10 Department that K4241was due for a monthly inspection on the 10th of September and it was preferable that the EMI equipment could be fitted whilst the aircraft was unserviceable.[xviii] The installation did not take place until the following month's inspection and in the meantime the equipment was demonstrated to Hecht on the ground on the 17th of September. The television system was based on the parameters already specified for public broadcasting and included such attributes as an image rate of twenty five per second. Hecht was not particularly impressed by the demonstration as he reports, "*... a boy carrying two white sheets 2' X 3' at 300yds was visible as two waving white patches with a dark blur in the middle.*" [xix] The equipment was then fitted to the aircraft. RAE Instruction Form 901 of October the 19th offers details relevant to the testing of K4241.

Table 6.5

RAE Instruction Form 901. *Selected details.*

a) Occupants of aircraft; one pilot, five passengers four of which are observers and the fifth being the camera operator. Two passengers to be seated in forward cabin, the other three in rear cabin.

b) Petrol; 70 gallons (320 litres) in each of the two tanks situated at wing roots. Total 140 gallons (640 litres). [fuel capacity was limited probably to ensure the aircraft was light enough to take-off]

c) Oil; 12 Gallons (55 litres).

d) Television equipment; Supplied by M-EMI inclusive of 6 X 12 volt 40 Amp hour batteries.

e) Although Direction Finding and trailing aerials were to be fitted no other radio equipment was to be carried.

For the purpose of the demonstration, the first of which took place at 11 AM on Wednesday November the 11th, there was to be no radio link with the ground.[xx] An Emitron was fitted for the demonstration and the image from this camera was shown on a cathode ray tube with a four inch (10 cm) screen inside the cabin.[xxi] The DSR Air Min., who didn't personally attend the demonstration, submitted in a report that the aircraft flew below one thousand feet (340 Metres) due to cloud and that at this height it was possible to distinguish between a private car and a lorry. This report was directed towards the DSR of the Admiralty whom Wimperis thought would be interested in the technology for Naval purposes and invited them to a demonstration on the 19th of November.[xxii]

The Admiralty was impressed by the television demonstration and the DSR ADM stated, "... *the development shows great promise and should be pursued.*"[xxiii] It was noted that the equipment was likely to be able to transmit over a range of 30-40 miles from a height of 5000 feet (1700 metres). The Admiralty discussed the potential use of television in aircraft further and initially it was suggested to purchase television apparatus and fit it in an aircraft based at Gosport with a receiver fitted in a Signals School tender. If these trials were to prove successful a receiver was to be placed in a fleet ship.[xxiv] A demonstration at M-EMI, Hayes, of apparatus suitable for ship fitting was then given to Lieut Commander J.D.M Robinson and Dr. Smith of the Royal Signals School. Experiments with television equipment actually fitted to aircraft for transmission to the ground were eventually undertaken using M-EMI equipment,[xxv] details of which are provided below. However, after further consideration, the limitations of the M-EMI system motivated alternate research in conjunction with BTL, on television for aircraft that was undertaken contemporaneously with the M-EMI experiments. The main problem noted by the Admiralty was the continually changing view. It was suggested that a more useful method of delivering intelligence would be "*A really high speed transmission of a plan view of a battle drawn by the observer would be of considerable value*".[xxvi] Another Admiralty staff member suggested that photographs taken every few minutes could be scanned using television and immediately transmitted to the Admiral. This method was suggested to M-EMI, 'who hadn't already thought about it', along with the use of infra-red (IR) sensitive photographic film which would utilise the IR sensitivity of photocells. Recording images on film and scanning them with television apparatus was a technology in which Baird Television Limited had already gained much experience. A visit to BTL was suggested, hence the aforementioned Admiralty presence at Alexandra Palace in February 1937.

The Blackburn CA. 15.C trials had provided useful information, particularly in motivating both the Air Ministry, Admiralty and later the War Office to pursue this technology further. The final Blackburn demonstration, the last of 'about eight', was given to the War Office on the 21st of December 1936.[xxvii] The trials complete, the M-EMI equipment was taken out of the aircraft on Wednesday the 27th of January[xxviii] and the aircraft placed into storage on February the 11th. K4241 ended its career in December when it was transferred to Martlesham Heath and used for 'firing trials'. Shortly afterwards it was sold as scrap.[xxix]

6.5.6 Admiralty interest in BTL television facsimile systems for aerial reconnaissance

J.L.Baird and his company had been thoroughly aware of the importance of facsimile rather than television systems for aerial reconnaissance since the first approaches made by Hugh Lefroy of the Air Ministry in 1926. Co-operation between the Air Ministry and Admiralty regarding television reconnaissance was established in the late 1920s, as documented in the first chapter. On the 23 of July 1936 a report by Hecht of the Air Ministry, which refers to equipment being developed for the French Government, specifically mentions an image rate of five frames per second in conjunction with recording facilitated by the Intermediate Film technique. Therefore, when the Admiralty approached BTL in February of 1937 it is likely that they knew the company could provide the type of television reconnaissance system that they required.

In the same month the Air Ministry drafted a specification for purchase of television equipment for aircraft;[xxx] a specification which committed the Air Ministry to M-EMI rather than BTL equipment. This specification is discussed in the relevant M-EMI section below.

Baird Television Ltd continued their co-operation with His Majesty's Signal School, an organisation closely related to the Admiralty. On the 20th of July 1937 Captain A.G.D. West and Chief Engineer Banfield, the BTL Intermediate Film specialist, visited the Signal School.[2] During this visit there were discussions of BTL's development of a high-speed signalling system as well as Signal School

[2] Banfield was not Chief Engineer of BTL but instead Chief of the photographic Division.

purchase of electron multipliers.[3] The company had been working on this system in order to diversify the products it marketed, as there was little demand for its products in the conventional public broadcasting market.

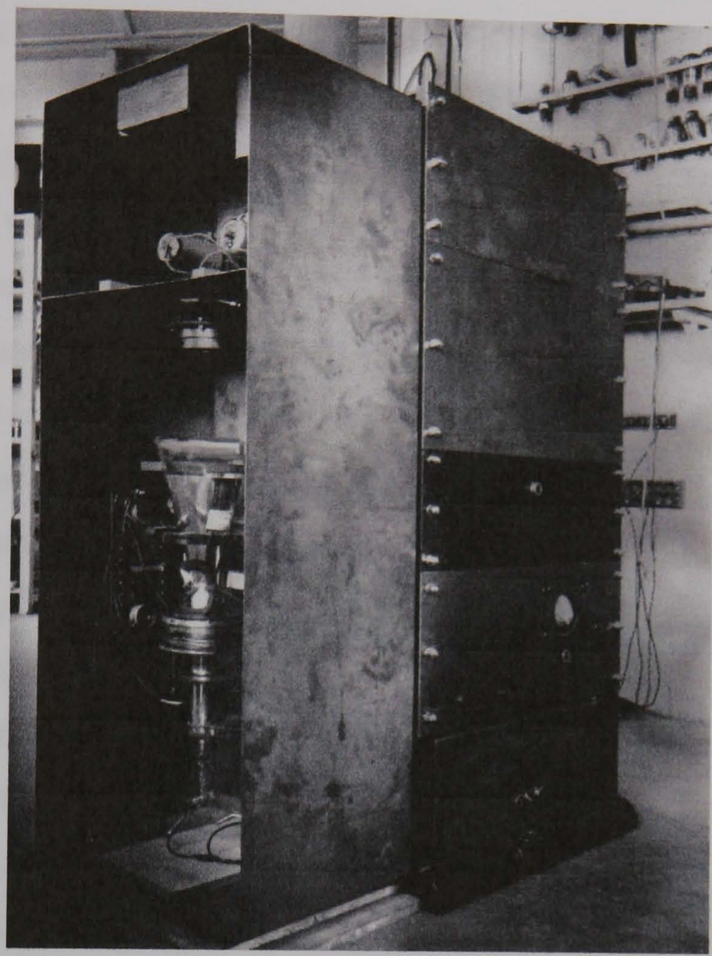

Fig. 6.15 *Baird Television Ltd High Speed Facsimile Transmitter, probably from 1937.*[4]
Source: D. Brown

The attributes of the BTL signalling apparatus, which it was hoped could be fitted to ships, were noted in detail and are as follows.[xxxi]

[3] During the visit West suggested to the Signal School that they could evaluate the BTL photocells before a purchase order was made. In due course three photocells, Type M.S., Type M.L. and Type M.T along with an associated power pack were sent to the Signal School.
[4] The BTL caption to this image does not record the date of this equipment. Of the three developments of the BTL system, the 1937 description is most similar to the image. The 1938 system scanned a cellulose transparency 3 ½" x 2 ½", the image to be scanned in the photograph is definitely larger and more like the 10" x 8" image of the 1937 system. The 1940 system is described as being 34" x 24" x 14", clearly much smaller than the equipment in the photograph.

Table 6.6

Baird Television Ltd High Speed Signalling System of July 1937.

Transmitter:

a) Dimensions 5ft x 4ft x 1ft 8 inch (1.5 x 1.2 x 0.5 metres). Cube weight 600 lbs (270 kg).

b) Diagram to be transmitted written on matt 'Baryta' paper with special carbon pencil. Paper chosen to reduce spectral reflection.

c) Black and white images with no half tones chosen to increase clarity.

d) Scanning of diagram by cathode ray tube, 500 lines per image. Projection CRT operated at 5 000 volts with expected life of about 200 hours.

e) Light tight casing of scanning equipment.

f) Area scanned 10 x 8 inch (25 x 20 cm), reduced to approximately 6 x 4 inch (15 x 11 cm). at receiver. Large area of scanning and subsequent reduction used because spot cannot be finely focussed.

g) Very sensitive photocell receiving diffused light from spot.

h) Transmitting power of 250 watts on 30 – 35 m/cs. Wavelength chosen to maximise speed of transmission. It was hoped that this wavelength would not be deleterious to range or quality of reception.

i) 30 miles (48 km) estimated range if top of ship mast used for aerial.

Receiver:

a) Dimensions 5ft x 5ft x 1ft 8 inch (1.5 x 1.5 x 0.5 metres).

b) Automatically activated.

c) *"The signals from the wireless receiver operate a cathode ray tube camera and each of the four frames transmitted are printed on a separate piece of highly sensitised paper."* [The precise method of 'writing' on the paper is unclear, possibly by flying spot].

d) Development in 5 seconds, fixing in 3. Total time including washing 14 seconds.

e) Sodium cyanide used for fixing. Final wash in zinc sulphide

The Signals School provided the following comment "*The system described, if satisfactory in operation, represents a very considerable advance in speed of working over other known facsimile methods where the time is of the order of 4 to 10 minutes".*[xxxii] The Signal School had investigated the Fultograph, Eidograph, Marconi-EMI and RCA facsimile transmission systems and it is likely that the above comparison came from knowledge of the speed of these systems. The speed of transmission was also a useful attribute of the BTL system as it reduced the possibility of jamming. Due to the wavelength chosen it was noted that transmission would be over line of sight. i.e. not beyond the horizon. Therefore, great ranges with this wavelength could only be achieved from aircraft to surface rather than surface to surface.

The Admiralty were clearly interested in the system described and requested a demonstration of the system. In the meantime the Admiralty Research Laboratory (ARL) had developed a system using an 'experimental' infra-red camera which could produce an image suitable for examination 'in about four seconds'. This system, although producing an inferior image in comparison to other methods, was deemed suitable for the purpose. An added advantage of the ARL system was that it used citric acid and potassium iodide in the fixing solution, rather than poisonous sodium cyanide used by BTL. In late December, BTL were issued patent GB 477 355 for *Improvements in or relating to transmitting images from a moving or movable station*. On March the 17th 1938, the Baird Television System was considered of such importance that it was placed on the secret list.[xxxiii]

There then followed a demonstration by Baird Television Limited of their high speed facsimile system in the Crystal Palace South Tower.

6.5.7 Demonstration of BTL High Speed Facsimile system, 26th May 1938

Members of the Admiralty Research Laboratory and Captain Glover, the Director of the H.M. Signal School arrived at the base of the Crystal Palace South Tower at 11 am on the 26th of May. Once inside the tower Captain West then demonstrated the facsimile system that his company had developed.

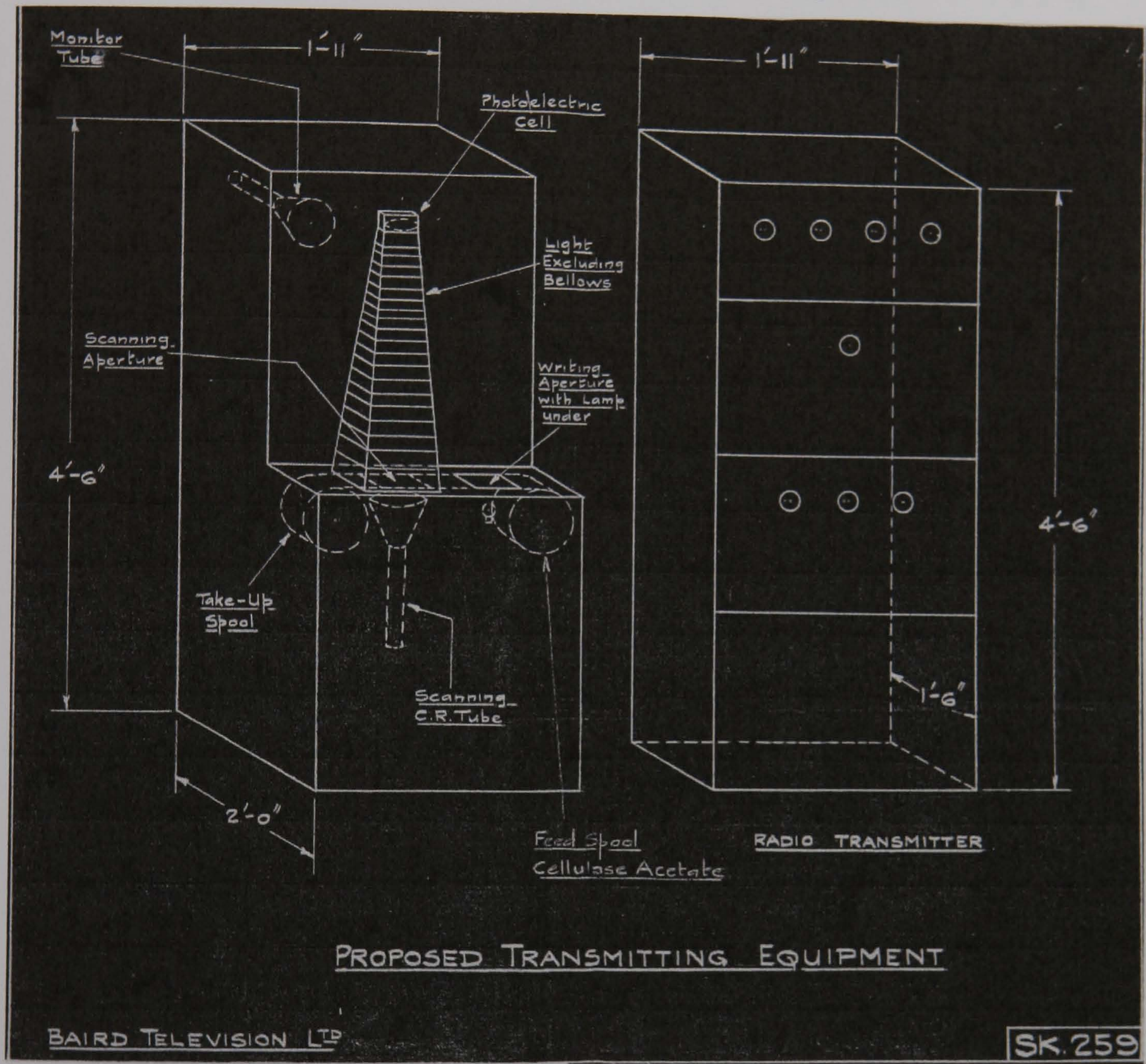

Fig. 6.16 *The general arrangement of the BTL apparatus under consideration by the Admiralty in 1938*

Source: ADM 1/18581.

A description of the equipment is provided in PRO file ADM 1/18581 and is as follows;

Table 6.7

Baird Television Ltd High Speed Signalling System of May 1938.

Transmitter:

a) Scanning of diagram by cathode ray tube, 500 lines per image.
b) Message written in black ink on cellulose acetate transparency 3 ½ x 2 ½ inch (9 x 6 cm).
c) Sequential scanning repeated four times per second.
d) Illuminated image received by multiplier enhanced photo-electric cell with associated modulation amplifier.
e) Synchronising pulse generator and amplifier.

Link from transmitter to receiver via cable.

Receiver:

a) Projection cathode ray tube for 'writing'
b) Automatic camera with sensitive paper sheets 5 x 4 inch (13 x 10 cm).
c) Exposed sheet held in carrier automatically developed, fixed and washed. No poisonous materials used.
d) Monitor CRT
e) Button operated release of four exposed sheets, delay ten seconds.

A comparison between the equipment demonstrated to the Admiralty in May 1938 and that described in a proposal offered to the H.M Signal School in July 1937 illustrates some of the developments achieved by BTL. An initial problem described in 1937 was the inability to finely focus the scanning spot in the transmitter. This problem necessitated a scanning area of 15 x 11cm. The 1938 equipment used a smaller scanning area of 9 x 6cm and therefore it is likely that this restriction had partly been overcome. Like the 1937 system the 1938 apparatus automatically developed, fixed and washed the film. In the interim year the time taken for this process had been reduced by four seconds from 14 to 10. At the 1938 demonstration, which was by cable, it was suggested that any wavelength between two and fifteen metres could be used for radio transmission.

BTL were keen to gain a contract for development of this equipment. Shortly after the visit, Captain West wrote to the Admiralty and proposed that the company finalise its design and build equipment immediately. He also said the equipment demonstrated could be improved and a production version delivered in six months. This period could be reduced to three months if funding for an increase in staff for the project was provided. He also stated that this system was *"... excellent for the transmission of maps and diagrams, it is equally useful for the transmission of messages, both from air to ship or ground, and from ship to ship."* West also provided the Admiralty with diagrams of the equipment delivered to the French Government and added that facsimile equipment would be mounted in a similar manner but would be 'less cumbersome'.[xxxiv]

In order to gauge the reaction to the demonstration as well as obtain information on improvements thought necessary for the equipment, BTL then circulated a questionnaire to the various concerned organisations. In this document the following points were raised.

Table 6.8

1) Is the definition acceptable?
2) It is possible to reduce the number of scanning lines if it was necessary to use a narrower band width.
3) BTL would prefer to use 400 lines at 5 fps, as it would enhance the system given the restrictions of the transmission band width.
4) Are four prints required for every message?
5) Are the most important points for future work reliability, simplicity, lightness and compactness?
6) Is the ultimate range from air to ground still 250 miles (400km)?
7) Future developments will include a different picture transmitter already in design stages and a CRT monitoring facility at the transmitter.
8) *"Are we* [BTL] *to take it that we are not to worry about secrecy or any special devices for that purpose."*

Unfortunately for BTL the system was not well received by either the H.M. Signal School or the Admiralty. The Signal School noted that *"...the weight, space and complication involved are out of all proportion to the value to be gained"* and that the equipment could not easily be fitted to Fleet Air Arm aircraft. It recommended that the Navy should not be responsible to BTL for any increase in staff for the development. If the Air Ministry were interested and assisted development then the Navy may reappraise their position. The H.M. Signal School provided no answer to the BTL questionnaire.[xxxv] The Admiralty did provide an answer to the questionnaire, but were equally disinterested in funding any further research on the project at this stage.[xxxvi]

6.5.8 Renewed interest by Admiralty in BTL High Speed Facsimile system 1940

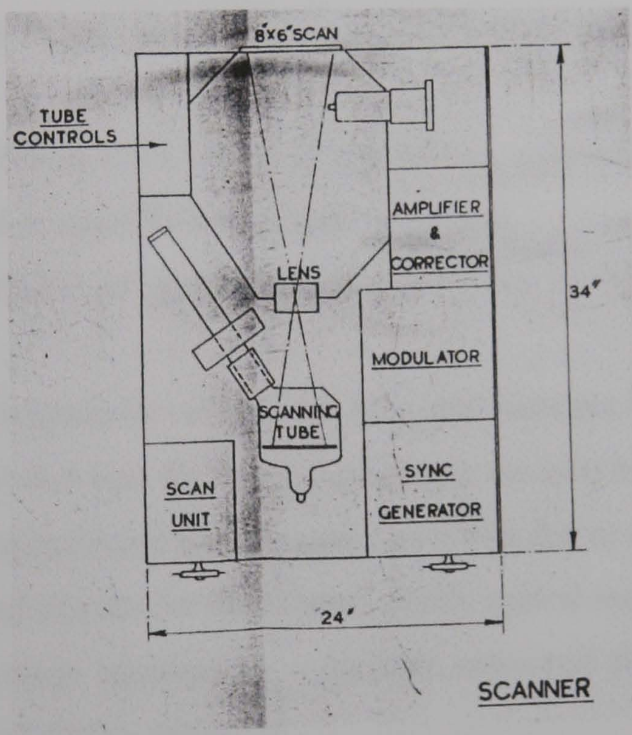

Fig. 6.17 *The transmitter section of Baird Television Ltd drawing S.204, February 7 1940, illustrating proposed dimensions*
Source: ADM 1/13764.

Later in 1940 the Admiralty record that certain suggestions for modification to BTL equipment had taken place. From the diagrams available in the relevant PRO files illustrated here, it is shown that a fundamental re-arrangement of the apparatus had occurred. Initially the 1938 system scanned a series of images, passing light through the image and on to a receiving photo-electric cell. The 1940 system shows no facility for a spool to provide sequential images and scans the surface of an image rather than passing the cathode ray beam through the object to be scanned. The earlier 1938 system, which was provided with an illuminated writing aperture would have been useful for an operator to send a series of written images. The 1940 system was designed for scanning objects opaque to light such as maps and diagrams. The difference between the two systems illustrates a fundamental change in the proposed uses of the facsimile system.

Details of the 1940 aircraft specific system, recorded in ADM 1/13764, are as follows,

Table 6.9

Baird Television Ltd High Speed Signalling System of February 1940.

Transmitter:

a) Message written in black pencil or typewritten, maximum size 8 x 6 inch (20 x 15cm), held in special clips to keep image flat.
b) Definition capable of reproducing a typewritten message of 500 words per image.
c) Scanning of diagram by cathode ray tube, 400 lines per image 25fps.
d) 4 inch (10cm) f1.9 lens for focussing cathode ray tube beam on to image.
e) CRT scanning corrected for keystone correction due to shape of tube.
f) Self correcting circuits for modulation depth, optical and electrical focus.
g) Illuminated image received by multiplier enhanced photo-electric cell with associated modulation amplifier.
h) Synchronising pulse generator and amplifier.
i) Dimensions of scanning unit 14 x 24 x 34 inch (35 x 61 x 86cm), weight 70lbs (31kg).

Power pack:

a) Dimensions of 14 x 24 x 8 inch (35 x 61 x 20cm), weight 40lbs (18kg).

Radio Transmitter:

a) 50 m/cs frequency radiated from a maximum output of 200 watts.
b) Weight 30 lbs (13kg).

Transmitter power supply:

a) 500 cycle rotary converter supplied from engine driven generator providing 1kw at 200 volts.
b) No CRT monitor for aircraft. Could supply and receive images from aircraft aerial to view quality of sent image.
c) Weight 50 lbs (23kg).

Total weight of equipment for aircraft. 190lbs (86kg).

Receiver:

a) Superheterodydne radio receiver with associated amplifier.
b) 12 inch (30 cm) CRT producing image of 9 ½ x 7 ¼ inch (24 x 18cm). [No method noted for recording image].
c) Dimensions 16 x 18 x 25 inch (40 x 45 x 64cm), weight 95 lbs (43kg).

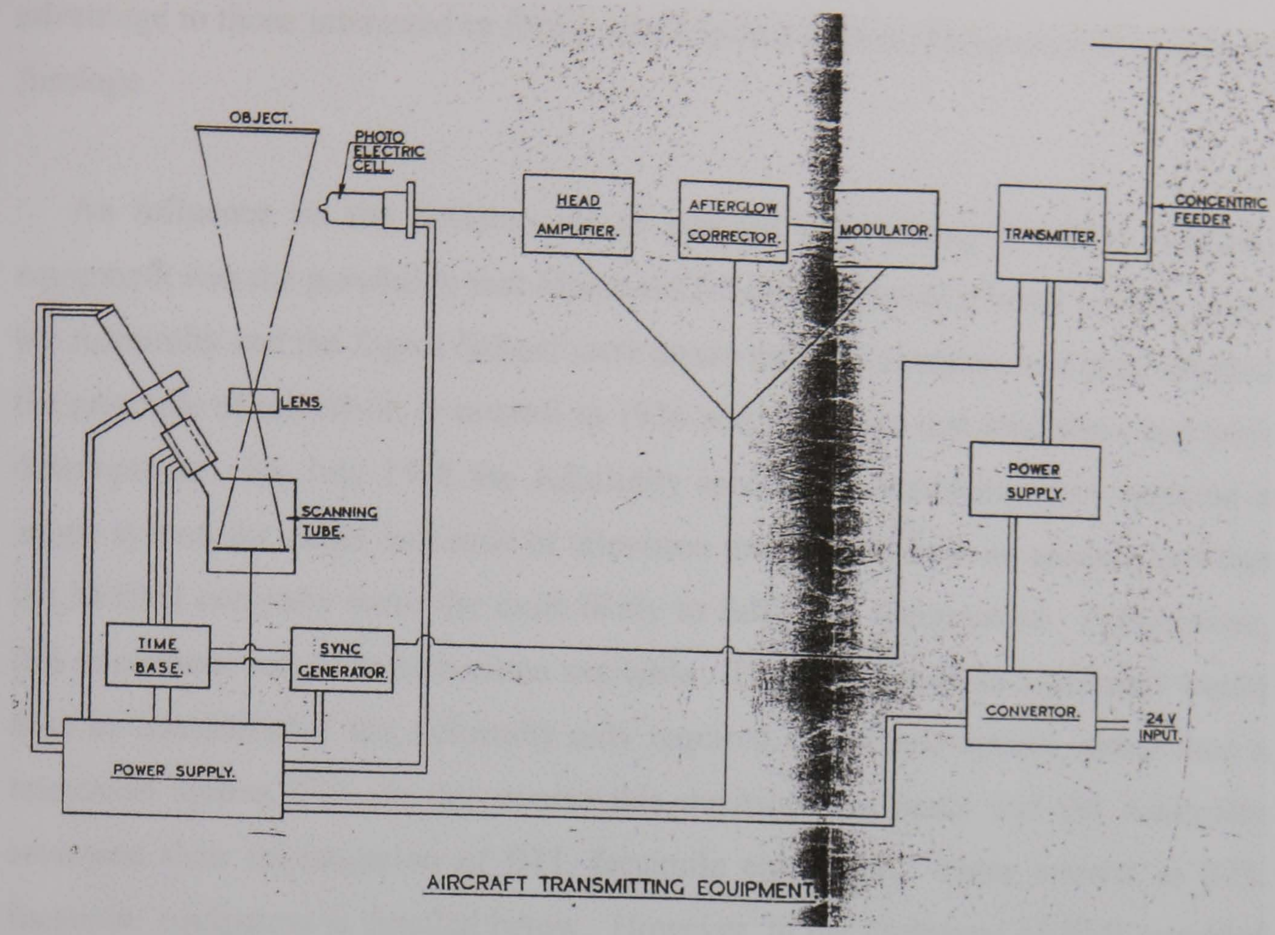

Fig. 6.18 *The transmitter section of Baird Television Ltd drawing S.205, February 20 1940.*

Source: ADM 1/13764.

The above specified system represents a departure from the two previous facsimile systems investigated by the Admiralty. Of particular interest is the increase in scanning rate from the 1938 system that used 5 fps to 25 fps. The initial reason for the slower rate of scanning was to provide for higher quality images at the specified line definition and within the available bandwidth of the transmitter. The 1940 system had now developed to a point where its definition was capable of resolving an image with 500 words and sending images at this rapid rate.

Also of note is the use of a scanning CRT which has an off-line cathode mounted in the same manner as the Iconoscope/Emitron camera tube. This arrangement of scanning would require circuitry for keystone correction due to the non-orthogonal position of the cathode in relation to the scanning surface. This positioning has the advantage of reducing the overall dimensions of the transmitter equipment. BTL drawing S.204 shows the relative sizes of the equipment which would have been of advantage to those interested in fitting small spaces such as the interior of an aircraft fuselage.

An influence on the decision not to proceed with testing the BTL facsimile equipment was the possibility that Marconi-EMI could provide a better system. Both the Admiralty and the Signal School were aware that this company had demonstrated the principle of television in aircraft in 1936 and that since that time there had been development. By July 1938 the Admiralty specifically noted that they required a single system for either facsimile or television intelligence from an aircraft, and that the M-EMI company were the most likely to fulfil this requirement. Furthermore, this equipment was soon to become available. The BTL facsimile equipment would then be considered if the Admiralty only required a facsimile system, rather than a television system.[xxxvii] In due course this decision was made and the Admiralty reviewed their investigation of BTL facsimile equipment. Later interest in BTL facsimile equipment is detailed below. However, in the meantime M-EMI provided various demonstrations of their facsimile system at their laboratories in Hayes. The equipment had been developed under contract to the Air Ministry and Mr N. Hecht of the Air Ministry and Mr Coales of the Signal School attended one of the demonstrations. The Equipment shown to these scientists provided 'satisfactory results' from a simple attachment to the television apparatus that could be fitted within five minutes.[xxxviii] Simplification of the M-EMI facsimile system was assisted by their method which was not based on the Intermediate Film system as the company had been given instructions not to proceed with this television method in March 1937.[xxxix] As far as British Government interest in television reconnaissance systems was concerned, interest was now directed again to the Marconi-EMI Company.

As early as January 1937 the Admiralty had suggested purchasing television equipment for fitting to a Fleet Air Arm aircraft for testing. If these tests were successful further tests were to take place using a carrier borne aircraft. During this year, finance for M-EMI equipment was not provided directly by the Admiralty, but instead came from the Air Ministry. In July the Air Ministry committed a sum of

£10 000 for television reconnaissance research by M-EMI. The company stated that this sum was not sufficient and requested that it be doubled.[xl] After various discussions the company was provided with contract D.T.D./787/R. for the supply and fitting of television reconnaissance equipment.[xli] Hence, when demonstrations of facsimile equipment were requested in the summer of 1938 they could be quickly provided as work at the company had already been financed and was therefore already proceeding. Equipment developed under this contract was then supplied and fitted to an Avro Anson aircraft and a variety of tests were conducted.

6.5.9 Television trials in Avro Anson aircraft

Fig. 6.19 *An Avro Anson similar to the type used for television reconnaissance trials*
Source: Author's personal collection

In order to test aerial reconnaissance equipment for potential operational use it was necessary to choose a suitable modern aircraft. The Blackburn aircraft used for the 1936 tests was antiquated in design and therefore not suitable. Initially there were suggestions to use similar antiquated aircraft such as a Vickers Valentia, Vickers Victoria or Handley Page Heyford, all aircraft being biplanes. Of modern monoplane types the Armstrong Whitworth Whitley, Handley Page Harrow and Avro Anson were also suggested.[xlii] This last aircraft type was eventually chosen for the trials.

The trials were designed to provide information for the Air Ministry, Navy and also the War Office. Military equipment chosen includes; two Avro Anson aircraft serials N. 4872 and N. 4874., one Crossley six wheel trailer and assignment of twelve service personnel. Two sets of television equipment were to be used, one transmitter set for each aircraft. Receivers were to be fitted in the prestigious battleship HMS Iron Duke[5] for the Navy whilst the other would be placed in the Crossley trailer and used by the Air Ministry and Army alternately. 22 Group, the Army co-operation organisation were to take charge of the interests of the War Office.[xliii]

Fig 6.20 *HMS Iron Duke*
Source: Author's collection

By May of 1939 one aircraft had been fitted with equipment as had HMS Iron Duke. Anson N. 4874 was not used with M-EMI equipment but was retained under Air Ministry authority for normal use.[xliv] The Marconi-EMI equipment was tested by Mr Crowther and W.T.Davies at the Hayes laboratories and proved suitable for the beginning of tests.[xlv] N. 4872 was then fitted with television equipment and flown by James Hall.[xlvi] Mr J.P.W. Houchin of M-EMI was then responsible for flight trials.[xlvii] In a similar disposition to the BTL fitting of the Marcel Bloch aircraft,

[5] HMS Iron Duke gained fame by being the flagship for Admiral John Jellicoe at the Battle of Jutland during World War I. In 1931 the ship was taken out of front line service and used as a gunnery training ship. In October 1939 the ship had returned to the British Naval Base at Scapa Flow and there was damaged by enemy aircraft. The ship was finally sold for scrap in 1946.

Anson N. 4872 was fitted with a camera forward of the cockpit and another in the rear turret.[xlviii] It should be noted that unlike the Marcel Bloch aircraft the Avro Anson had a dorsal turret and therefore images obtained from this turret were from an oblique view in relation to the aircraft. Reconnaissance whilst an aircraft flew at an angle was common practice at the time. The Anson turret equipment had the facility to point the camera 50° below the horizontal. It is not clear from the reports whether the aircraft was banked to obtain images perpendicular to the ground.

The first tests to be conducted with the Anson were those with HMS Iron Duke. Between the 21st and 22nd of June 1939 tests were conducted with the ship in harbour and between the 27th and 28th whilst the ship was at sea. The sea trials employed the ship's 16 and 13.5 inch (40 and 34cm) guns for the observation of fall of shot.[xlix] The relay of fall of shot observed from an aircraft to the surface was an original proposal suggested for television reconnaissance equipment in 1926 when J.L.Baird's equipment was investigated. Now in 1939 experiments of this type of observation were finally conducted.

The first flight of the Anson on June the 21st, provided good television pictures throughout the flight. The facsimile system was also tested. In the morning due to low cloud the aircraft had to fly below 1500 feet (450 metres), but this cloud cleared and the afternoon flights were between 3 to 4 000 feet (912 to 1220 metres). From these heights it was possible to obtain transmission ranges up to 50 miles (80 km) for television images and 60 miles (100km) for facsimiles. However, this range was seriously restricted in certain directions from the ship due to cranes and other large metallic objects in the vicinity of the ship.

The trial at sea on the 27th also used the camera in the gun turret. This camera was not fitted for the trial on the 21st. Problems were encountered manipulating the camera to follow the target, which was HMS Iron Duke. Identification of the ship at a range of four miles and a height of 10 000 feet (3050 metres) was not possible despite the fact that weather conditions on this day were considered ideal. Similar problems were encountered during a firing exercise using the ship's 13.5 inch (34 cm) guns. The target could not be seen and the shell splashes were confused by dark shadows to the right of the white spots on the viewing screen. The problem of a brightly lit image having an associated dark edge persisted in British television images for at least the first ten years of the post war public television broadcasts.

The Signal School report of these trials[l] came to similar conclusions to the suggestions by Captain Lefroy in 1926. In the trials it was difficult for the receiving observer to recognise the line of fire of the shell as well as the line of sight from the aircraft. The camera operator's difficulty of tracking the target compounded this problem, as well as recognition of the target. The definition of the received image was inferior to that which an observer in the aircraft could see with the naked eye. This last point guided opinion towards the use of facsimile. The writer of the report notes " *... there is no call for direct television for reconnaissance, but facsimile might be of value, since the observer can make a plan of what he sees and transmit this to the ship immediately.* The same opinion was also held by Naval staff [li], and later the Director of Communications of the Royal Aircraft Establishment suggested that attention could be directed again towards the system developed by Baird Television Limited, the Intermediate Film technique[lii]. The Signal School recommended that M-EMI be informed of its decisions to emphasise facsimile and that M-EMI equipment be passed on for further tests by the other services.

The next set of tests of equipment followed a further demonstration to the Admiralty of equipment at the Royal Aircraft Establishment Farnborough. [liii] Next it was the turn of the Air Ministry and War Office to evaluate the equipment. Trials were arranged for the 24th to 28th of July 1939. Unfortunately, the weather hindered these trials and the maximum height of aircraft was restricted to 3 000 feet (915 metres). The dullness of the sky also affected the television image that had correspondingly low contrast.[liv]

It was noted by the Air Vice-Marshall commanding 22 Group, the co-ordinator for Army co-operation trials, that the Admiralty demonstrations were successful, whereas the army co-operation ones were not. He recommended further trials but these were hindered by the outbreak of war and had to be rescheduled.[lv] Fortunately, the opening stages of war for Britain involved no appreciable enemy action over the mainland and trials could be rescheduled quickly for the last two weeks of November.[lvi]

During November 1939 tests were conducted over Larkhall School of Artillery where shell falls were observed. The facsimile system was utilised in these observations and like the systems proposed by J.L.Baird in 1927 (detailed in the first chapter), an image of a map was transmitted with the shell falls indicated. There was also renewed interest in the clock marker system and this method was also used at this time. Further trials were also conducted over Salisbury Plain [lvii] Aldershot [lviii]and Mytchett.[lix]

6.5.10 Assessment of television reconnaissance development and potential operational value

The results of these trials came to the attention of Mr Hecht of the Air Ministry, and his expert assesment of the utility of various television reconnaissance systems provides a useful guide to the historian. Hecht notes that the Air Ministry initially funded M-EMI research on behalf of all three services. He also suggests that all further research needs to consider whether the M-EMI electronic camera system or the BTL Intermediate Film system would be most suitable for reconnaissance. According to Hecht, the Baird system was also the most suitable for facsimile transmission.[lx] The BTL IF system also offered the advantage that should the aircraft fail to return, then a permanent record was provided. If a conventional photographic reconnaissance aircraft were lost then so would be its image record. Although, one commentator noted that if an aircraft failed to return vital photographic intelligence another could be sent in its place.

This memorandum was circulated so that various organisations could assess the potential use of television in aircraft for operational value. The general consensus of all respondents to Hecht's memorandum was that if television were to be used for reconnaissance, then the facsimile mode of the equipment would be preferred. The inability to interpret the continuously changing view was noted by many commentators. In referring to the BTL IF system the image was noted as being considerably below the quality of contemporary photography. The interpretation of a high resolution image, which could take interpreters many hours of labour, was considered far more valuable than a series of images from slightly different views.[lxi]

An example of the value of close scrutiny of photo reconnaissance images is provided by the discovery of the V1 flying bomb. British intelligence was aware that Germany was working on long range missiles. It was known that Peenemunde was a base for German aircraft research. Many photo reconnaissance sorties were flown over the area and many hours invested by interpreters on the returned images. Eventually, Constance Babington Smith, a seasoned interpreter, discovered an airframe with a 20ft (6 metre) wingspan. This discovery confirmed the reports, and Operation Crossbow, the British anti-missile programme, was established. The countermeasures destroyed the majority of the V1 missiles launched against Britain and saved many lives.

One reason for continuing research, despite the various misgivings against television aerial reconnaissance, was the possibility that television could resolve images in darkness. One commentator in December 1939 noted that Baird Television Limited had investigated this problem previously (see chapter two) and that this alone was reason for further investigation.[lxii] This suggestion had already been supplied to the Air Ministry earlier in the month by M-EMI. The company proposed the supply of a red sensitive Emitron camera which could be specially modified for aircraft.[lxiii] Although Baird television Ltd also wanted to add an infra red imaging feature to its television reconnaissance system[lxiv] neither company managed to achieve this advance before demonstrations and research were stopped in 1940. However, before cessation of television reconnaissance research, further daylight demonstrations were arranged.

6.5.11 The London Television Reconnaissance Trials

Initially it was suggested that the trials resume in January of 1940 and that Sir Henry Tizard and Mr Watson-Watt were to be amongst those invited to attend.[lxv] There is no record of the result of this demonstration other than reference to in the Operational Record book of 22 Group[lxvi] and by the AVM commanding in March who stated the demonstration had occurred.[lxvii] For the purpose of the demonstrations it was arranged to tow the Crossley trailer to Horse Guards Parade[lxviii] whilst the aircraft was to fly over Heston or Croydon. Due to the possibility of hostile aircraft directly over London it was considered unwise for test aircraft to be in this vicinity.[lxix]

The second series of demonstrations were conducted between April the 3rd and 8th. The first day of these demonstrations were attended by members of the French Air Mission.[lxx] The last flight of the Anson equipped with Marconi-EMI television equipment is recorded by J.P.W. Houchin and occurred on the 8th of April; no further demonstrations are believed to have taken place with this aircraft.[lxxi] On the 12th of June the equipment was removed from the aircraft and trailer and the television equipment were placed in the RAE Care and Custody Stores.[lxxii]

It is interesting to note that in previous circumstances, such as with the Blackburn aircraft, once the trials had been completed then the equipment was rapidly removed. With Anson N. 4872 there was a period of two months before television equipment was stripped from the aircraft. Although the pilot noted his last flight occurred on the 8th of April, it is possible that other flights with another pilot may have taken place. Similarly in December 1940 there is only a sparse record of equipment, which was fitted to a Vickers Wellington aircraft.

Note 2

The following three figures show television based facsimile apparatus capable of sending individual images. The photographs are from the notes of Baird Television technologist Dr Constantin Szegho. Dr Douglas Brown has some notes from the files of the late Dr Szegho and provided these images for inclusion in this thesis. No text, or explanation of these images has been provided. It is possible that further information is available in the PhD thesis, at the time of writing under moratorium, by Dr Brown.

The images are included here as it is probable that they show equipment built by either Baird Television Limited or Cinema Television Limited and therefore relate to the facsimile systems discussed in this chapter.

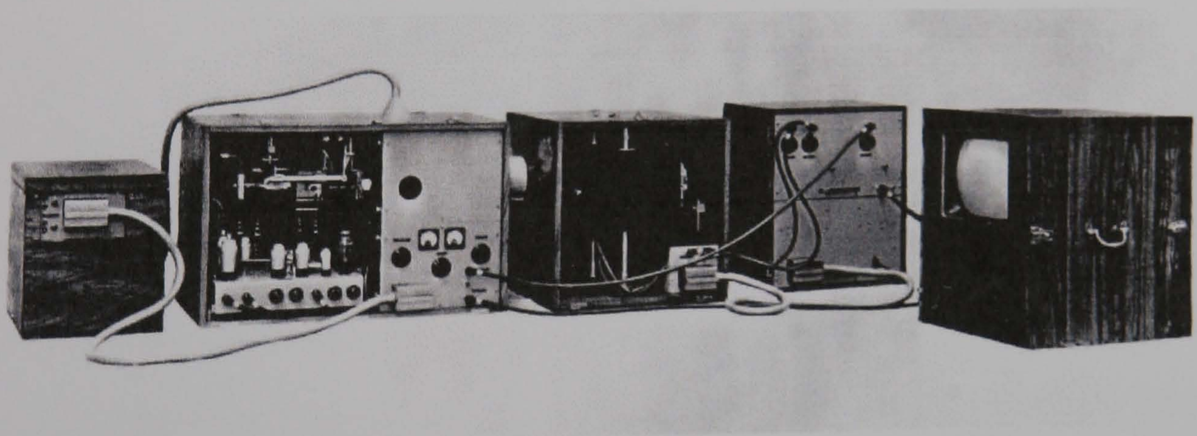

Fig. 6.21 Source: D. Brown

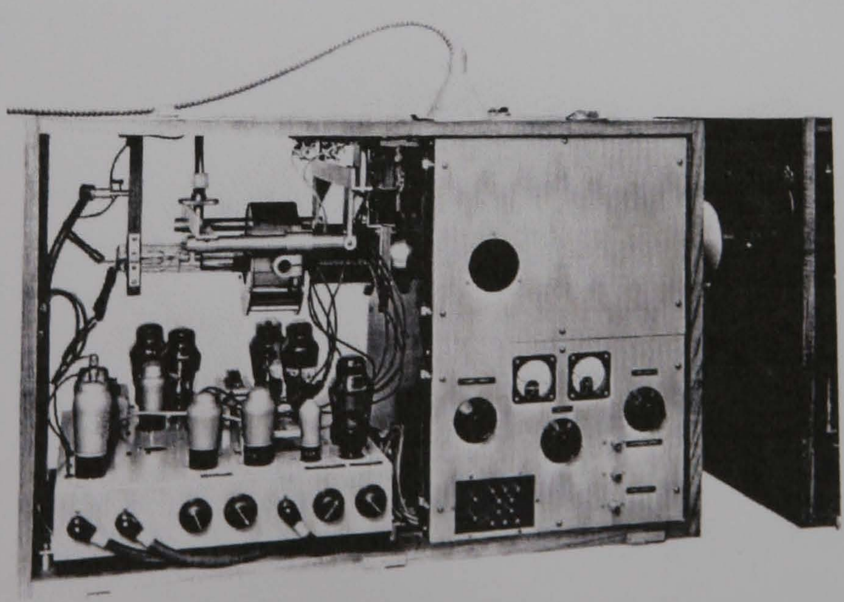

Fig. 6.22 Source: D. Brown

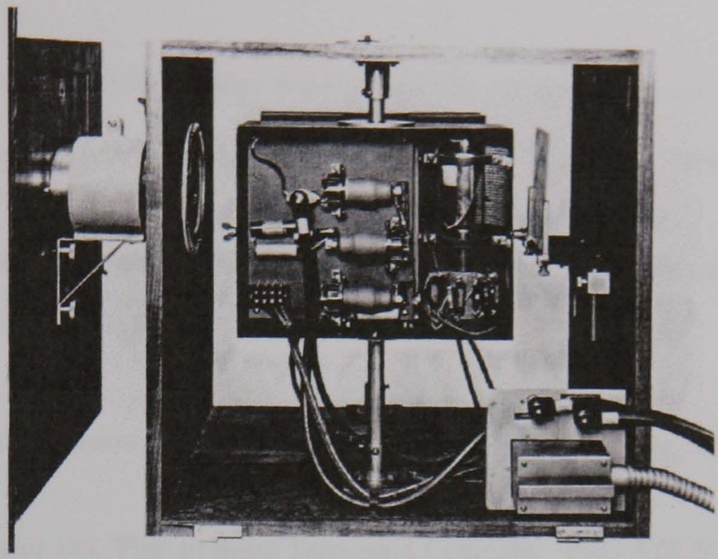

Fig. 6.23 Source: D. Brown

6.5.12 References

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[xxi] White, E.L.C. (1999). *The Birth of British Television.* London: Royal Television Society. pp. 30.

[xxii] Wimperis, H.E. (1936, November 11). Letter from DSR Air Min. to DSR Admiralty. PRO AVIA 13/1263.

[xxiii] PRO ADM 1/18581.

[xxiv] DSR Admiralty (1936, December 12). Use of Television at Sea. PRO ADM 1/18581.

[xxv] (1937, January 27). Trials of Television: Provision of Aircraft. PRO ADM 1/18581.

[xxvi] Minute (1937, February 19). Preliminary Discussion on the use of Television at Sea. PRO ADM 1/18581.

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[xxviii] PRO AVIA 13/1263

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[xlii] PRO AIR 2/1733.

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[xlviii] PRO AVIA 13/1263.

[xlix] Captain, H.M. Signal School. (1939, June 16). HMS Iron Duke – television Trials. PRO AVIA 13/1263.

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[lxiv] Herbert, R.M. (2001, February 14) Interview with the author.

[lxv] Lywood, O. G. (1940, January 22). Minute 74A. PRO AIR 2/1775.

[lxvi] PRO AIR 2/520.

[lxvii] AVM commanding 22 Group. (1940, March 28). Letter to Superintendent RAE. PRO AVIA 13/1263.

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[lxxi] Herbert, R.M. (1998, November 27). Interview with the author.

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Section 6.6

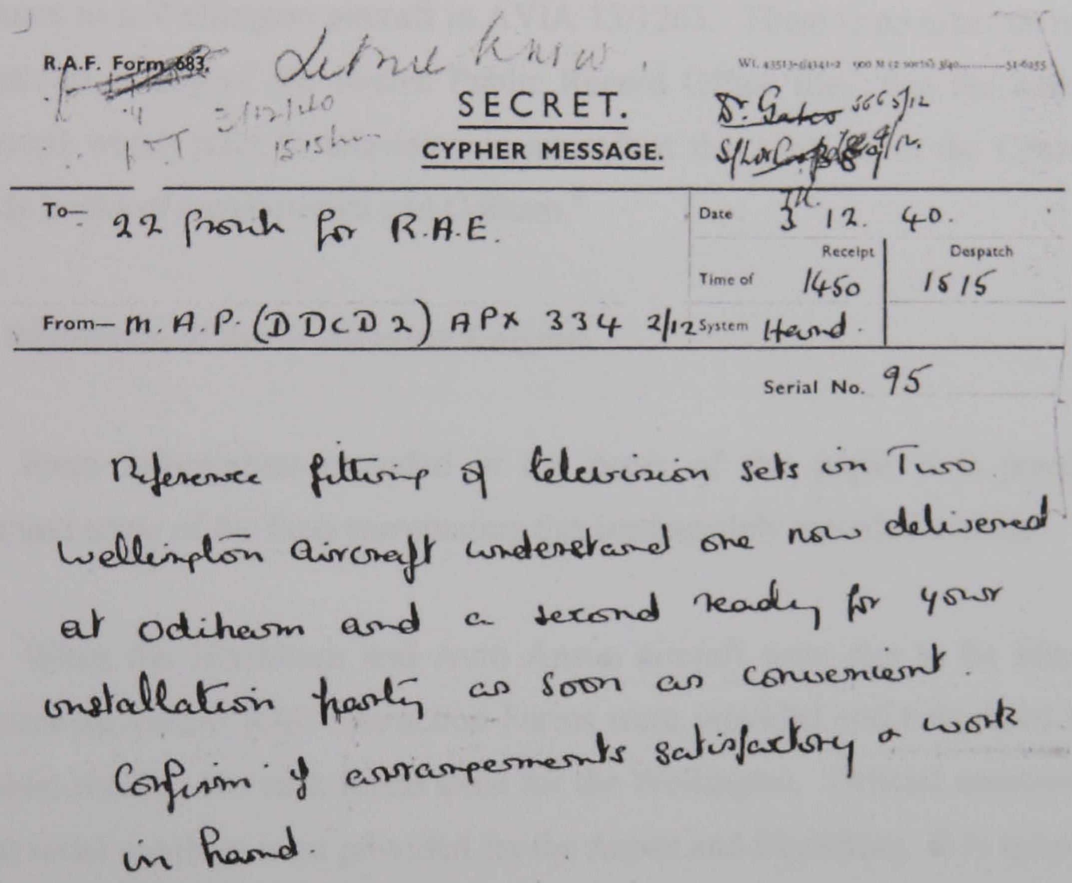
The Wellington Enigma

Fig. 6.24 *A Vickers Wellington Mk 1C aircraft*

Source: Author's personal collection

The fitting of television equipment to the Blackburn and Avro Anson aircraft are recorded with RAE instruction forms as well as various other supporting information. About the next aircraft fitted with television equipment no such records seem to have survived apart from a few communications. As stated in the previous section, once the trials with the Avro Anson were completed in April 1940 the Marconi-EMI television equipment was removed and stored in the RAE Care and Custody Stores. The next entry in the relevant PRO file records that a Wellington aircraft was fitted with television equipment.[i]

On the 30th of November 1940 W.T.Davies of the Royal Aircraft Establishment referred to "*the Wellington 'Television' job*". In his memorandum which was directed at Group Captain De Burgh of RAE 10 Department,[1] Davies stated that the aircraft arrived at the RAE without the standard fitting of guns, oxygen and radio equipment. It was suggested that either a Maintenance Unit or the Operational Unit that was to receive the aircraft could fit this equipment. The aircraft was then delivered to Odiham as shown by the below message.


R.A.F. Form 683.

SECRET.

CYPHER MESSAGE.

To— 22 Group for R.A.E.

Date 3. 12. 40.

Time of Receipt 1450 Despatch 1515

From— M.A.P. (DDCD 2) APX 334 2/12 System Hand.

Serial No. 95

Reference fitting of television sets in Two Wellington aircraft understand one now delivered at Odiham and a second ready for your installation party as soon as convenient.
Confirm if arrangements satisfactory & work in hand.

Fig. 6.25 *Secret Cypher message*

Source: PRO AVIA 13/1263

<u>Text above of Document</u>

Reference fitting of television sets in Two Wellington aircraft understand one now delivered at Odiham and a second ready for your installation party as soon as convenient.

Confirm if arrangement satisfactory & work in hand.

[1] RAE 10 Department was the division formed in 1928 to oversee radio equipment for aircraft as mentioned in the first chapter.

By the 4th of December installation of equipment had been started and Mr Tiltman of the Ministry of Aircraft Production was consulted regarding the fitting of the aforementioned service equipment. There was only enough 'special transmitter and receiver equipment' to fit one aircraft and the question of the fitting of a second Wellington aircraft was left for further consultation.

The above is the entirety of information about the fitting of television equipment to a Wellington aircraft in AVIA 13/1263. There is no other mention of this activity in any of the twelve Public Record Office files, that the author has discovered which refer to television in aircraft at this time, or in the Operational Records books of Farnborough and Odiham.[ii]

6.6.1 Discussion of the Wellington Enigma

From information provided in the pages of this paper it is possible to understand some of the facts surrounding this inadequately recorded activity.

When the Blackburn and Avro Anson aircraft were due to be fitted with television equipment RAE instruction Forms were provided and have been kept in the public record. No such forms exist for the Wellington. Official notation of the aircraft serial numbers were provided for the Anson and Blackburn. It is not possible to identify the Wellington airframe concerned, as this information has also not survived. It is important not to assume that the television equipment supplied to the Wellington was manufactured by Marconi-EMI. However, there is no record of supply to the RAE of any other company's television reconnaissance equipment. As noted in the previous section, M-EMI television equipment used in the Avro Anson tests was held in the Care and Custody Stores of the RAE and therefore would have been available for this next fitting. When questioned regarding the possibility of M-EMI equipment being fitted to a Wellington, J.P.W. Houchin, chief engineer in charge of the EMI project, had no recollection of such a fitting.[iii]

The Blackburn aircraft used for television evaluation tests was a one off experimental airframe, the Anson was a purpose built communications and training aircraft. The Wellington in December 1940 was of much greater importance because it was an operational bomber aircraft, and arguably the best bomber[2] available to the RAF at the time. This fact, combined with Davies mention of 'an Operational Unit' would suggest that the fitting of television equipment was in order to evaluate the technology within the rigours of an operational environment with a suitable aircraft.

Fig. 6.26 *Wellington Mk I fitted with Vickers Turrets*
Source: Author's collection.

A review of various histories of the development and supply of Wellington aircraft provides information as to the type of airframe used.[iv] The first Wellington type available for squadron service was the Mk I which was fitted with Vickers designed gun turrets. Due to the ineffectiveness of these turrets the Mk IA was introduced which had Fraser Nash rapidly manoeuvrable turrets. The Mk IC soon followed which had minor improvements including greater traverse of the front turret. Due to the introduction of these latter two types the Mk I was removed from squadron service during the summer of 1940. Therefore the type of Wellington used for operational testing with television equipment was likely to be one which could defend itself, a MK IA or MK IC rather than a Mk I.

[2] In the early stages of the war the Wellington was used almost solely as a bomber aircraft. As superior types, such as the four engined Lancaster superseded the aircraft, the Wellington was later manufactured as a transport and communications aircraft. During 1940 one Wellington airframe was converted as a transport aircraft and others were fitted with a large external induction loop for triggering magnetic sea mines. Cooksley, P. (1986, June). Vickers Wellington. *Scale Models International*. pp. 289-294.

Information about squadrons based at Odiham in late November to early December 1940 shows that none of them had any Wellington aircraft listed in their regular inventory.[v] The operational Record book of Odiham does not record the delivery of any Wellington aircraft in the period relevant to this activity. During 1939 and early 1940, 22 group Operations Record Books show interaction of base staff with television in aircraft activities. These entries refer to Army Co-operation manoeuvres which were televised by the EMI equipment in the Avro Anson. Ironically, with reference to the fitting of Baird television equipment to a French bomber aircraft, on the 4th of December 1940 a certain General De Gaulle visited Odiham. Air Commodore Bowen, AOC 50 Group and Flight Lieutenant De Lazelo of the Air Ministry accompanied this visit. The weather report for the day showed that the base had low cloud in the morning which cleared in the afternoon.[vi]

Tests of television equipment could have taken place on the 4th of December and also in the following days when the weather was also suitably clear. There is no record of any tests taking place under the administration of 22 Group or 70 Group to which the base converted on December 1st 1940.[vii] By coincidence, the first Wellington aircraft captured by Germany occurred on the night of the 4-5th of December 1940. 99 Squadron Wellington, serial T2501, was forced to land in enemy territory whilst on a raid to Düsseldorf. This aircraft was captured by the German forces and subsequently tested at the German experimental and test centre at Reichlin.[viii]

Since beginning research on this Wellington enigma in 1997 the author has found no other information apart from that recorded in PRO file AVIA 13/1263. Enquiries placed with Odiham, Farnborough and Vickers[ix] have provided no supplementary information. The PRO files recording the revival of interest in television for aerial reconnaissance, detailed in the next section, suggest that testing with the Wellington aircraft may never have taken place. Research continues.

6.6.2 References

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Morgan, E and Edward Shacklady (1986, September). The Basketweave Bomber. Aeroplane Monthly. pp 468-471.

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[vii] Ashworth, C. (1990). *Action Stations: Military Airfields of the Central South and South East.* London: Patrick Stephens Ltd. pp. 230. PRO AIR 25/687, AIR 25/688, AIR 25/689, AIR 25/690.

[viii] Delve, K. (1998). *Vickers Armstrongs Wellington.* Marlborough: Crowood. pp. 34.

[ix] H.E. Scrope of Vickers limited informed the author in a letter of the 10th of May 1997, that he has "*...never heard about a Wellington being used during the second world war for television experimental work*" and that "*There are no references in the Vickers Head Office archives (now at the Cambridge University Library) to any association between Vickers and J.Logie Baird during the war.*"

Section 6.7

Revival of interest in Television Reconnaissance during the War

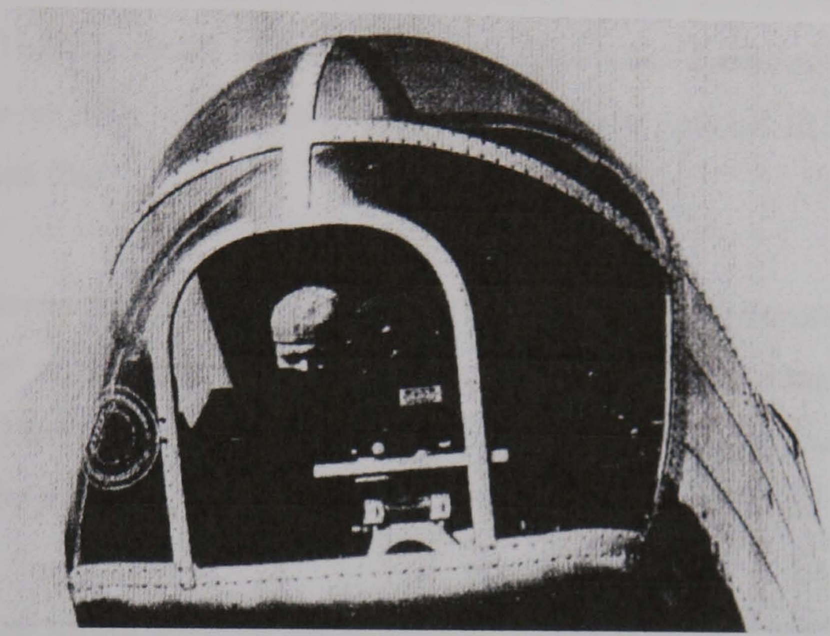

Fig. 6.27 *American aircraft fitted with RCA television equipment*

Source: RCA

6.7.1 Summer 1940

By the summer of 1940 television in aircraft trials seem to have been completed using Marconi-EMI equipment. Baird Television Ltd had focussed their attentions on the facsimile method of transmitting intelligence and at least four different systems had been produced.[1] There was some interest in the possibilities of the use of television in aircraft to resolve an image using infra-red based technology, but like with previous situations this idea was soon dropped.[i] Discounting the anomalous situation regarding the Wellington aircraft, the Public Record Office files indicate that research into television reconnaissance by the British Government was postponed until 1943.

6.7.2 American interest in British Television Reconnaissance

Late in November 1942 an urgent request for information on both the French and Russian systems was made to Baird Television Ltd. This information was to be passed on to America who already had information of the Marconi-EMI television equipment.[ii] The American Government investigated and demonstrated television reconnaissance in early 1940. In a publication simply entitled *RCA Review* this company records that,

> *Airborne television perfected by RCA has been demonstrated to reveal how an 'eye' in the nose of a plane scans the terrain while a small portable transmitter flashes the panorama to a distant screen on which observers see it exactly as the pilot.*

In due course information of the equipment supplied to the French Government was passed on to the American Government. There is no indication that the American Government was to be made aware of the company's investigation and development of the high speed facsimile equipment developed for the British Government.

6.7.3 The revival of interest in television for night imaging and reconnaissance

In January of 1943 the possible ability of television to provide target location of artillery targets at night was again discussed. Although television provided no advantage in definition of image beyond that available from night photography, the ability of television to rapidly transmit these images was considered of tactical import.[iii] As Cinema Television Ltd, formerly Baird Television Ltd had produced aerial reconnaissance equipment the company again became of interest to the British Government. In one communication it was noted that CTL were engaged in development of equipment for night photography although there is no indication in

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[1] In this chapter there is record of different BTL systems in 1937, 1938 and 1940. Chapter 3 reports a system as described in AIR 2/2877, but it is unclear from the brief description given whether this was

the letter that this was to be combined with any of the intermediate film systems already developed. Subsequently, CTL sent a brochure of their developments of night photography to the Air Ministry. The aforementioned communication also notes,

...there is a film processing unit (a modification of the F.24) just going into limited production for D.F.F. which delivers a stabilised negative every 2 minutes 5" x 5". For use in such an application a similar unit could be developed to expose say 6 negatives every 2 or 3 seconds, store these up and process during the next 12 minutes. Even more rapid techniques might be possible. [iv]

From this basic description it is not unreasonable to suggest that this system is similar to that already produced by the Baird organisation. At this point it must be noted that there is no indication as to whether CTL or the Air Ministry were responsible for production of the equipment.

In June of 1943 there was written by J. Stewart, the Head of the Radio department at RAE an interesting assesment of air to ground television systems.[v] This enclosure, although not provided from a completely informed source, gives some indication of the understanding of television reconnaissance at the time. Stewart notes that the EMI iconoscope did not suit the requirements of aerial reconnaissance. He states that the cameras were still being developed and that there was no current production.[2] By January 1945 research with the EMI iconoscope, or Emitron, had reached a stage when it could be seriously considered, but it was decided to proceed no further until results from American iconoscope systems had been properly assessed.[vi] Furthermore the image provided at a rate of 25 fps was not bright enough or of good enough definition to photograph. Reduction in scanning rate to overcome these problems would require extra radio circuitry.[3] Long

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identical to the 1938 system or a further development.

2 An AVIA 13/1263 entry by B. P. Gates of the Radio Department of RAE in October 1943 states that "EMI have about a thousand Iconoscopes in stock, over a hundred of these are in perfect condition".

3 There is in file AVIA 13/1263 record of discussion of a slow scanned Iconoscope system proposed by a certain R.L Aspden. Like Stewart, Aspden was not thoroughly aware of all investigations undertaken in the previous reconnaissance trials and further discussion of these communications will only serve to confuse the reader.

afterglow receivers were not recommended as the American company RCA had already investigated and rejected this technique. The emphasis in this enclosure was to record sent intelligence and Stewart was emphatic in his conviction that an Iconoscope based live system was not suitable for this purpose.

As an alternative to the Iconoscope Stewart suggested the use of the Cinema Television Ltd Facsimile system adapted with mechanical scanning supplanting electronic scanning. He writes,

The Cinema-Television facsimile system is unnecessarily complicated, but nevertheless does show signs of feasibility. The complication is largely due to the use of electronic scanning, as opposed to mechanical, thereby involving the use of scanning circuits and E.H.T. generators. By the use of mechanical scanning two of the units of the C.T. equipment would become redundant and the scanning unit reduced in complexity.

Furthermore it is suggested that a high definition image could be obtained by mechanically scanning repeatedly and by alternating the scan through right angles. Stewart states that the system should therefore consist of a night photography camera with its images mechanically scanned at 1000 line definition in the reconnaissance aircraft. This image should then be sent at the rate of one picture in ten seconds with scanning repetitions depending on level of radio interference and quality of image required. The radio frequency specified is 50 kHz, similar to that used for domestic broadcast television.

These suggestions were not undertaken during the period of war and interest concerning this application of television was again postponed.

There is another application of television for the Air Ministry which whilst not actually concerning the transmission of television from aircraft, nevertheless was a direct result of these investigations. It was suggested that images from fighter base plotting rooms could be sent to other places using television or alternately target plots from ships could be sent to other members of the fleet. This investigation, recorded in PRO ADM 1/13764, is included here because one of the main companies concerned was Scophony, which had certain ties to Baird Television Limited and Cinema Television limited as discussed in the next chapter.

6.7.4 Transmission of Air Control Plots by Television

Interest in the transmission of air control plots by television was initiated by a suggestion from Lieutenant-Commander Bleasdale of the Royal Navy Air Service (RNAS) in January of 1943. To investigate equipment capable of communicating this information Bleasdale first visited Captain West at Cinema Television Ltd on the 10th of April 1943. Bleasdale was informed that CTL no longer had suitable equipment as that fitted to the Bloch aircraft for the French Government had been captured shortly after the fall of France.

Two days after this visit Bleasdale approached the Scophony company to see if they could produce apparatus for transmitting and receiving diagrams over a distance of 30 miles. Scophony stated that it was possible to produce a system from equipment they had in stock and that they could construct the apparatus in eight weeks for the sum of £1200. It was added that the company could provide secure communication by disguising the transmission.

Fortunately, the company already had interests in television transmission systems which could be made secret. Two patents GB 530 776 and GB 577 670 had been applied for by Scophony originally on March 6th 1939 and April 22nd 1938 respectively. The former patent had been accepted by December 1940 and the latter in 1946. The pre-war investigations that lead to these patents no doubt assisted the developments for the RNAS.

A further visit to the Telecommunications Research Establishment by Bleasedale provided the information that the RAF was having developed similar equipment. The format of transmission was to be by land line with another system being developed by Pye Ltd for transmission via 10cm radio waves. These signals could also be scrambled in the manner of previous experiments with radio telegraphy.[vii]

Following the visit by Bleasdale, John Gale, Chief of Research at Scophony Ltd provided a brief outline of the system the company proposed to develop. The facsimile apparatus could send one 100-line definition picture per second using the normal broadcast channel of 5 kHz. This system is broadly similar to that suggested by Baird television Ltd (although no mention of this company is made by Scophony), and had such attributes as a monitoring CRT and a similar arrangement for scanning. The receiver would be a Skiatron dark trace tube, with limiter units to avoid noise. It was noted that there was a line of sight between the Scophony laboratories in Wells and the Royal Naval Air Service base in Yeovilton. This situation could provide for secure test transmissions using a fifty watt radio transmitter.[viii]

The receiving cathode ray tube specified for this system was a product of the Scophony company. It was invented in 1938 by Dr Alfred Heinrich Rosenthal of Scophony, sister company to Baird Television Limited. The main attribute of the Skiatron was an alkali-halide screen which, instead of a conventional phosphorescent screen, would become darkened when bombarded with electrons and remain so until irradiated with light or heat rays. The original application of this tube was for conventional television, the time lag of image erasure offering a muting effect to the flicker produced by successive field displays. Unfortunately, after experimentation with a 405-line television picture, this property was seen to reduce the contrast of the image. [ix] This property was however most useful in this proposed application. The tube was available in quantity as at this time the Baird organisation were manufacturing a variety of Skiatrons for use in the radar programme. An activity discussed in the following chapter.

After initial consideration Scophony requested a development contract of £2000. G. Wikkenhauser, Chief Engineer and General Manager of the company stated that his company was particularly well suited to production of this equipment as they had,... *already undertaken a great deal of development work for the Ministry of Aircraft Production and Ministry of Supply... [and that]... more than 60% of the contracts [Scophony Ltd] hold are on the Secret List.*[x]

The system proposed by Scophony seems to have been constructed as it is referred to as having been under investigation for 5 months in a minute of August 1943 written by the Director of Scientific Research for the Admiralty.[xi] The Admiralty interest in a facsimile system for transmitting plots also included investigation of a system produced by EMI as well as from America. EMI demonstrated their system to the Admiralty on the 19th of November 1943 and Isaac Schoenberg stated that the company under his directorship was prepared to develop specifically designed apparatus. A report was also submitted by A. Hoyt-Taylor and others of an American Plot Room Television system using an Iconoscope camera with display on 6 Kinescope CRTs. It was noted that this equipment suffered problems from interference from shock blasts and other sources even when coaxial cable was used.[xii]

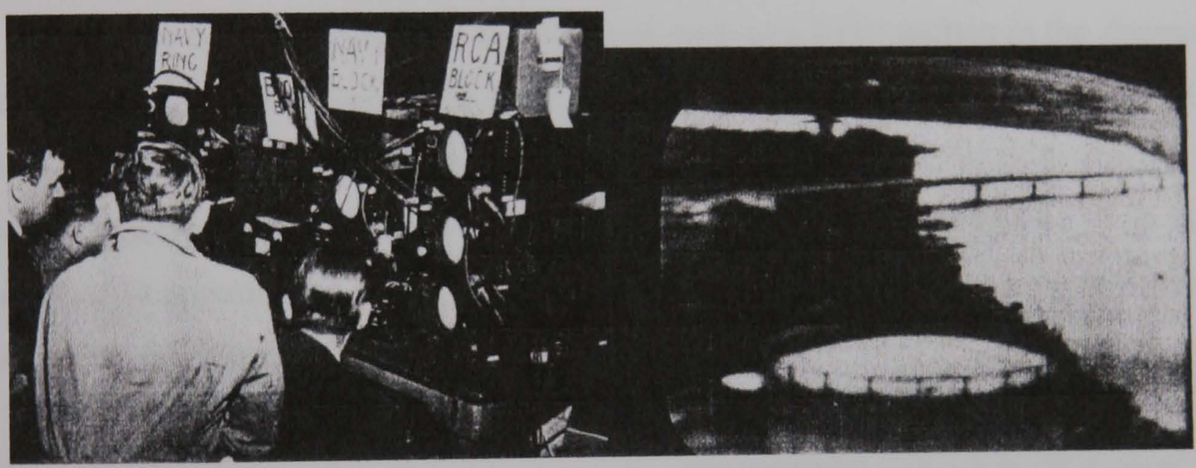

Fig. 6.28 and 6.29 *Ground receiving equipment for American aerial reconnaissance tests and a photograph of image received*

Source: RCA

American systems were again placed under investigation in November of 1944 when the Chief of Combined Operations Representative British Joint Staff Mission reported on "Amphibious Aircraft Television Reconnaissance". The purpose of the American equipment was to assist intelligence transmission to ships during the landing phase of amphibious operations as well as spotting for gunfire. A demonstration had been provided but the results were not good due to interference from 'electrical disturbances'. The amphibious carrier borne aircraft flew at a height of 400 ft to optimise the quality of image and could transmit up to a maximum range of 10 miles. The receiver ship, the U.S.S. American Legion, was fitted with CRTs for display and had a facility for recording images on film which like the British system could be rapidly processed, only at the somewhat slower rate of 90 seconds.

Although the American television system was specified for a unique use, that of assisting amphibious landings, the susceptibility of the transmissions to jamming required that information on the technology be regarded as top secret.[xiii] During this period of the war the American forces were conducting various amphibious landings in the Pacific Theatre of Operations and a system such as this would have been most useful to the invading force. However, the technology was not developed to operational status before fighting stopped and Japan surrendered.

Mc Arthur and Waddell state in *Vision Warrior* that the Scophony company undertook investigations with the Skiatron tube.[xiv] These authors cite notes prepared for a lecture by Solomon Sagall of Scophony as well as a letter written in the *Journal of the Royal Television Society* in 1984. There is no reference to the relevant PRO files. Later in the same chapter of *Vision Warrior* it is stated in reference to a Skiatron based signalling system *"That such a system was used is certain"*.[xv] In the Journal of Economic and Social Intelligence, two years after the publication of this book Dr Waddell stated

> *By Using special memory tubes* [the Skiatron], *a world first, Baird and Baird associated companies, in particular SCOPHONY owned by Solomon Sagall, who still lives in New York, could send several hundred line T.V. image messages many thousands of miles along the underwater telephone cables of, say Cable and Wireless in World War II.*[xvi]

In reviewing the release of *Vision Warrior*, Graeme Stewart stated that the book raised the question "*Did Churchill and Roosevelt communicate with each other during the Second World War via television by submarine cable*".[xvii]

Research for this paper, including a personal visit to the Royal Signals Library, has discovered no use in Britain during World War II, apart from experimentation, of a Skiatron based television system for sending messages.

The British Television reconnaissance systems also, did not see active service before the end of hostilities. In January of 1945, three months before the end of war in Europe, Wing Commander Leedham noted that although various British parties were interested in developing TV/AC technology it was not pursued due to lack of operational requirement as well as interest by all three services.[xviii] With America entrenched in Britain as an ally it was decided to wait until their tests reached conclusion.[xix]

6.7.5 Post Script

Reconnaissance using television is now a part of many Nation's military intelligence gathering activities. Seventy years after John Logie Baird first offered the British Government a crude system for reconnaissance using television, a company which manufactured modern systems paid tribute to this legacy. On March 12th 1997 there were celebrations in Hastings to mark that day's unveiling of a blue plaque on a house where J.L.Baird lived in 1924 whilst working on television. A lecture given at this time by W. Uttley-Moore of Computing Devices illustrated how J.L.Baird's technologies had benefited future generations. According to Mr Uttley-Moore, Computing Devices was moved to Hastings because it was by the sea and had links to the famous inventor. This company had manufactured modern television aerial reconnaissance systems using techniques which had their ancestry in Baird Television Ltd airborne film recording and developing systems.[xx]

6.7.6 References

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CHAPTER 7

CINEMA TELEVISION LTD 1937-1946

Fig. 7.1 Source: *Practical Mechanics*, March 1938.

7.1 Abstract

Cinema Television Limited (CTL) was formed by the Baird Television Limited (BTL) and Gaumont-British picture Corporation (G-BPC) in 1937 to design and market television equipment for use in cinemas. This division of the Baird organisation gave various demonstrations in cinemas and gained contracts for equipping some London cinemas in 1939. The outbreak of war in September of that

year caused these contracts to be cancelled. At this time John Logie Baird seems to have become 'estranged' from his company and continued television research in his house near to the main Cinema Television factories. The company was then creatively manipulated and put to work on a series of projects to assist the war effort. Some of these projects were based on research already undertaken by the Baird organisation and others were initiated by the exigencies of war. This situation continued throughout the period of war and afterwards the company continued making military related equipment as well as returning to its original raison d'être of television for use in public cinemas.

7.2 Baird televisions in cinemas; the pre-history of Cinema Television

Currently in the year 2001, television technology is not used in cinemas for general public entertainment. To explain the creation of the Cinema Television company in 1937 it is first important to understand why there was initial emphasis on large screen television and how the Baird organisation investigated the technology.

As early as 1882 the French artist Albert Robida produced drawings "...in which pictures were transmitted onto the walls of people's living rooms"[i]. Before the end of the 19th century audiences in various parts of the world had the opportunity to view images of this kind in the earliest cine film presentations. The collective viewing experience had been born. However, these images were recorded on cellulose nitrate film and not instantaneous as suggested by Robida's drawing. It took television, the technology which could deliver instantaneous pictures, another thirty years to show the most basic image. Television in this primitive form was not yet able to resolve an image of adequate size and clarity to entertain any but the smallest audiences.

It is fortunate that the inventor of this new technology, John Logie Baird, was aware of the shortcomings of his small image. Professor R.W.Burns even suggests that "*Cinema television was a form of television which was always foremost in Baird's mind during his work in the 20-30 decade...* "[ii]. J.L.Baird used a modification of his first television patent, GB 222 604 issued July 26th 1923, for his first large screen presentation. The patent proposed a Nipkow disc connected to a display system made up of an array of light bulbs. The Nipkow disc camera explored the scene to be televised and transduced the image into an electric signal. At the receiver a rotating commutator disc sent current to each individual light bulb of a mosaic screen which then reconstituted the image.

Britain's first demonstration of large screen television was given by J.L.Baird at the London Coliseum Theatre on July the 28th 1930. The screen used for this demonstration was approximately six feet high by three feet wide (2 x1 Metres), contained an array of 2100 light bulbs, and was simply an enlarged form of that proposed in his 1923 patent[iii].

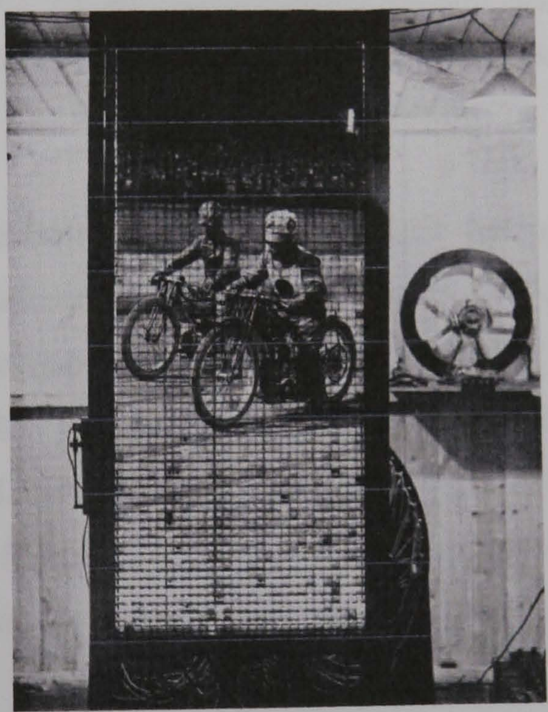

Fig. 7.2 *The Screen used for the first cinema television demonstration (image is added)*
Source: Moseley, S. (1952). *John Baird: The Romance and Tragedy of the Pioneer of Television.* London: Odhams

J.L.Baird demonstrated three shows a day until August 18th [iv] and a collection of famous people were televised which included the Lord Mayor of London; the First Lord of the Admiralty; Frederick Montague, Under secretary of state for Air; Young Stribling the boxer; H.W. Austin the tennis champion; Oswald Mosley, later to become the leader of The British Union of Fascists, then a Labour MP; and Lord Baden Powell[v].

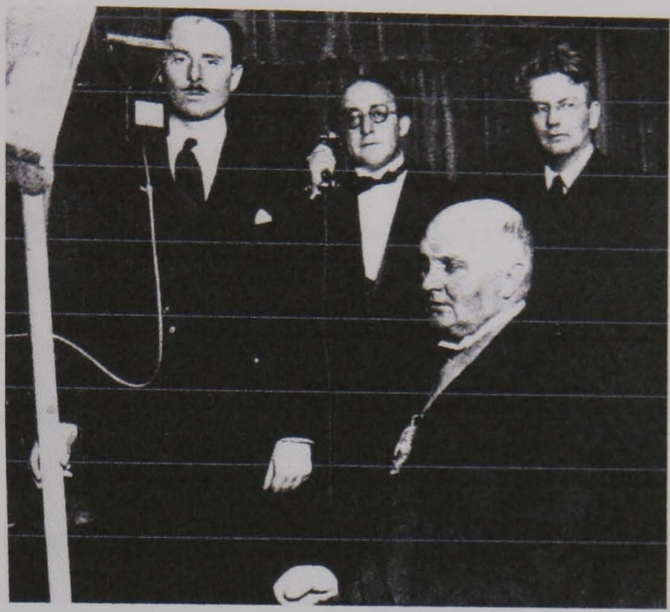

Fig. 7.3 *The London Coliseum demonstration.*
left to right, Oswald Mosley, Sydney Moseley (no relation), unknown and J.L.Baird
Source: University of Strathclyde

At this time the Baird organisation was still having problems overcoming restrictions against broadcasting television in Britain. To circumvent this problem Baird International Television Ltd had been formed earlier in June 1928. Through international links created by this company the Baird organisation took its cinema television screen from London to Berlin and gave demonstrations there at the Scala Cinema from 18-30th of September 1930. The screen was then taken to Paris where the Olympia Cinema was the chosen venue and finally to the Roda Kvarn Cinema in Stockholm[vi].

However, in this basic form television was not capable of entertaining an audience beyond that of the wonder of seeing an image at all. Even the first demonstrations of film by the Lumiere brothers in 1895 had more entertainment value as they contained a scene of a train coming into a station and a gardener being soaked by his own hose. Clearly television also had to provide entertainment as well as the instantaneous representation of a remote event.

With entertainment in mind John Baird selected the finish of the famous Derby horse Race for his next cinema television demonstration at the Metropole Cinema on June 1st 1932. In the preceding two years Baird had refined his television screen and increased its size to approximately nine feet high by six feet wide. This size increase was accomplished by sending three separate images via telephone lines to the cinema, which were then fed to three screens placed next to each other to form one image. The scanning projector was also changed and utilised a mirror drum rather than a Nipkow disc. However, the most important modification to the system was the use of a projection system rather than the original bulbed screen [vii]. Fortunately, the transmission of this outdoor event had already been accomplished the previous year, which meant that only the television transmitter and receiver were experimental. J.L.Baird describes this event enigmatically in his autobiography,

> *The night before the show we were up all night putting finishing touches to the apparatus. When the great moment drew near I remember standing beside the apparatus literally sweating with anxiety, perspiration dropping off my nose. A vast audience had gathered in the cinema, even the passages were packed, and the entrance hall and the street outside were filled with a disappointed crowd unable to get in. If the show had been a failure, which might easily have happened, the audience would have brought the house down. I would have been a complete laughing stock. However, all went well, the horses were seen as they paraded past the grandstand before the race and when Optimist the winner was seen flashing past the post, the demonstration ended with thunderous applause. I was hustled onto the platform to say a few words but was too overcome to say more than thank you.'* [viii]

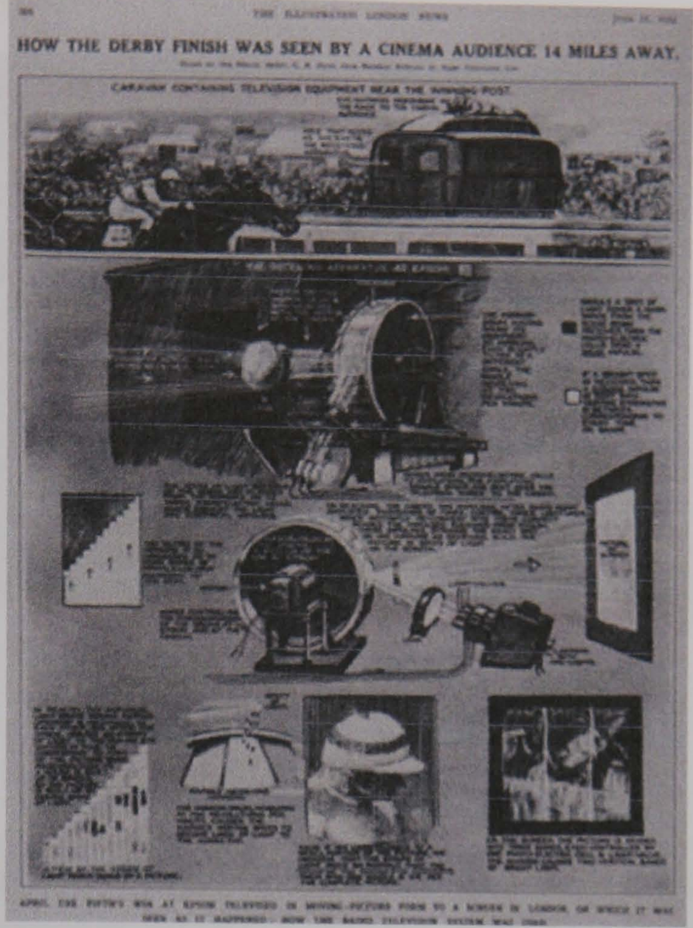
HOW THE DERBY FINISH WAS SEEN BY A CINEMA AUDIENCE 14 MILES AWAY.

Fig 7.4 *An interpretation of the televising of the Derby*
Source: *Illustrated Weekly News*

Not only was this an exciting event for the inventor, but his description also indicates that there was a great public interest in this demonstration. Again Baird television was taken abroad. The screen was installed in the Arena Theatre in Copenhagen where an entertaining programme was received from a BBC broadcast.[ix] Enthusiasm for the Baird screen in London was two fold; firstly previous publicity from both the world's first demonstrations of cinema television and the Derby, and secondly the contemporary 30-line television broadcasts also offered by the Baird company. The specialist magazine *Television*, as well various newspaper articles written about television would certainly have raised awareness of the 30-line television service. However, available receivers were either the expensive Plessey manufactured Baird Televisor or more often various units built from less expensive kits, with some completely scrathchbuilt by radio enthusiasts. Therefore, television could only be seen by the relatively wealthy or specialist audience. The 1932 demonstration offered an alternative for those that wished to view television but did not have the means to obtain receivers.

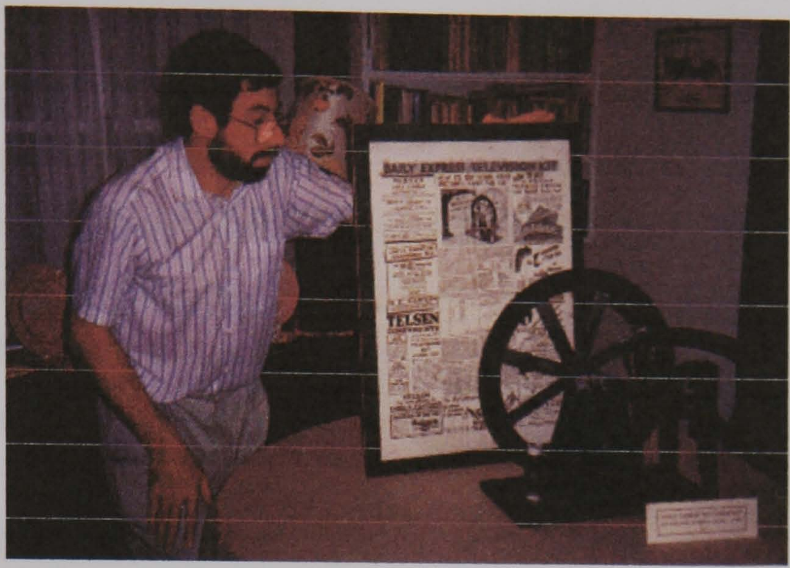

Fig. 7.5 *John Narborough with a 30-line television receiver kit originally sold by the Express Newspaper*
Source: Author's personal collection

The aforementioned 30-line format was originally chosen for public broadcasting in 1929 because it was the highest definition available within the restricted medium wave channel spacing then agreed at an international conference in Lucerne, Switzerland. However, when channels capable of higher definition pictures were made available, the BO and then the BBC which assumed control of the service on 22 August 1932, continued the narrow bandwidth broadcasts until 11 September 1935. These broadcasts provided a service to a relatively wide audience; approximately 7000 receivers were being used by the 1935 closedown[x].

Technology had moved on since 1929 and it had become clear that receivers, now likely to contain cathode ray tubes (CRT's), would be so expensive as to be beyond the means of any but the very wealthy. The 30-line service was based on a Nipkow disc system which was both cheaper and capable of being constructed by people of lesser means. The expensive purchase price of any cathode ray tube television receiver was a key element in the creation of television for cinemas. Very few could afford their own television receiver but most people could and did, regularly purchase cinema tickets.

7.2.1 Gaumont-British Picture Corporation Ltd interest in Cinema television

It was probably these early demonstrations of large screen television in a cinema that increased interest in Baird Television Limited by Mr. Isidore Ostrer of Gaumont-British Picture Corporation Limited (G-BPC). In 1931 Ostrer was already noted as a member of the investors of Scophony Limited, another television company.[xi] According to J.L.Baird's business associate Sydney Moseley, Harry Clayton a member of the Scophony board of directors, was sent to J.L.Baird's house at Boxhill in 1930 with a view to financing the Baird organisation[xii]. It is therefore evident that G-BPC already had an ongoing interest in television technology, as Clayton was also involved with this film company. When Baird Television Limited was re-financed with the assistance of G-BPC in 1932, Harry Clayton became Deputy Chairman. Below it will be demonstrated that there were further links between Scophony and the Baird organisation even after G-BPC relinquished control of Scophony in 1936.[xiii] In 1932 Captain A.G.D. West became a member of the board of directors of the Baird Company. Captain West was later to become an important personality in this organisation particularly with regard to the liaison with the British Government during the period of war.

Fig. 7.6 *Captain A.G.D.West*

Source: R. W. Burns

Gaumont-British initially became financially involved in Baird Television Limited in 1932, at a time when the television company had severe financial difficulties. Sydney Moseley, in his book *John Baird: The Romance and Tragedy of the Pioneer of Television*, describes the Baird organisation's problems. In brief summary: Television Limited, J.L.Baird's original company had been liquidated and a successive company Baird Television Limited formed. The cumulative effect of the Wall Street crash and over expenditure had reduced the share price of this public company to a nominal level. Moseley and associates obtained control of a block of 997,300 shares at the low market value of £16,500 (1). This purchase was motivated by the dominant voting power of these shares which exercised a central control over the company, and that this control should remain under British ownership. Moseley writes,

> *...with the shares quoted at fairly nominal prices, several American business men began to prick up their ears when they learned of the crisis in our affairs. In fact, I had inside knowledge that one American group was quietly working for an opportunity to snap up the whole million-share block.*[xiv]

Moseley states that he gained his initial finance for Baird Television Ltd when his old school friend Isidore Ostrer paid the sum of £5,800 into his personal bank account to assist in this re-financing. This money was paid "*...without any contract whatever; indeed, without a document of any kind*".[xv] After a great struggle to obtain the balance of £10,300 in America, Moseley was fortunate to obtain a British financier. Once the initial purchase had taken place Moseley then sold his controlling interest to Isidore Ostrer.

That is the story according to Moseley. In reality the acquisition of BTL by G-BPC was more complex. A Précis of documents from PRO file BT 58/249, which offers an explanation of this acquisition, is given below. In January 1932 G-BPC advanced £10,000 to International Acoustic Films Ltd (IAF) to purchase 800,000 deferred shares in BTL. Sydney Moseley and others formed a company, called LVT Syndicate Ltd, in 1932 in order to purchase these 800,000 shares. IAF were then

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1 In 1931 the Scophony company was financed by, amongst others, Isidore Ostrer and Harry Clayton

allotted shares in LVT. G-BPC along with IAF then acquired all outside shareholdings in LVT. In 1936 Moseley then sold 249,000 shares to G-BPC which gave G-BPC the majority and therefore controlling interest in LVT. This act resulted in LVT becoming a subsidiary of G-BPC. IAF was placed into voluntary liquidation in March 1938.[xvi] The process of liquidation of LVT gave G-BPC direct ownership of 513,015 of a total of 2,400,000 deferred shares in BTL. By June, G-BPC is recorded as owning 32.4% of the preferred shares and 39.6% of the deferred shares. Further shares were owned by a variety of members of the Ostrer family. Hence it was not until as late as 1938 that G-BPC, being the largest singular shareholder, could be considered to have a direct controlling interest in BTL

* * *

Television technology underwent considerable development during the early 1930s, as did the cinema television equipment of the Baird organisation. As a result of this development the Television Advisory Committee, formed on 9 April 1934, decided to promote the development of public broadcasting using better methods than the original 30-line broadcasts. Eventually a trial between Baird and Marconi-EMI systems for British public broadcasting by the BBC was initiated at the Alexandra Palace on 2 November 1936. Twenty eight days later a disastrous fire wrecked the Crystal Palace and along with it a large proportion of Baird equipment and records. The trial period was shortened from two years to two months and on 2 January 1937 the Marconi-EMI system was chosen.

Much has been written about this trial and the reasons for the choice are still debated amongst historians[xvii]. The fact remains that the Baird system was not chosen and after pioneering public television in Britain since 1929 the main outlet for transmitting equipment was closed. John Logie Baird took this decision pragmatically and stated,

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of Gaumont-British for a similar amount of capital.

It seemed to me that now, being out of the BBC, we should concentrate on television for the cinema and work hand-in-glove with Gaumont-British, installing screens in their cinemas and working towards the establishment of a broadcasting company independent of the BBC[xviii]

The inventor continues and says that he soon contacted Isidore Ostrer of Gaumont-British and enthused him to fund further research into cinema television and eventually form a specialised company[xix].

7.3 Cinema Television Limited as a civilian company before World War II

John Logie Baird states in his autobiography that shortly after the disappointment of the Alexandra Palace television trial he personally installed a cinema television screen in the Dominion Theatre in Tottenham Court Road. It must be stressed that this installation was a private venture for J.L.Baird and did not involve the usual facilities or conventions of BTL.[xx]. According to the autobiography Isidore Ostrer soon became increasingly interested in this form of television and in late November of that year the company Cinema Television Limited was formed as a subsidiary of BTL.[xxi] However, the author has found no evidence of the actual creation of this company and its connection with GB. Official records of the Minister of Trade record that there was no such holding in Cinema Television Limited by the Gaumont British Picture Corporation.[xxii] Although the installation of television screens in cinemas would have been directly financed by CTL, if it was an active subsidiary, the name of Baird Television Ltd was used for the demonstrations in cinemas. Evidence of this usage as late as 1939 is seen in Figure 7.9 where Baird Television is written in lights on the front of the Marble Arch Pavilion cinema. Although placed into receivership on 4th of November 1939 the Baird Television Ltd name continued into 1940. The company title is used by Admiralty Research personnel during a visit on the 25th of January to the Worsley Bridge Road factory for investigation of image converters.[xxiii] A description of this visit is mentioned in chapter two.

The first demonstration of cinema television after the formation of the specialist company occurred on 7 December 1937. A television programme which originated from the BBC at the Alexandra Palace was projected onto a large screen which had been installed at the Palais-de-Luxe Cinema in Bromley.

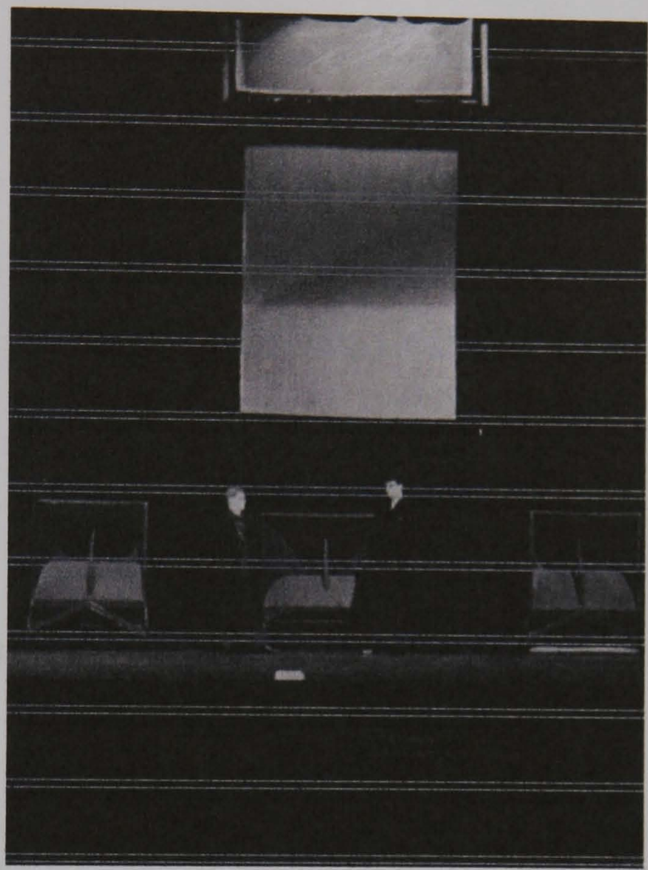

Fig 7.7 *The screen on the stage of the Dominion Theatre, Tottenham Court Road, either December 1937 or February 1938.*
Source: R.M. Herbert

The demonstrations at the Dominion theatre were not the direct business of the Baird organisation, but were directed by John L. Baird acting independently. Colour was added to the television screen on February the 4th 1938. This event came as a surprise item to the cinema audience of 3000 people who were there to watch the large 12 by 9 feet (4 x 3 metre) screen[xxiv]. The programme originated from a studio in the base of the Crystal Palace South Tower and was broadcast from aerials on the top. The colour camera was taken out onto Anerley Hill and televised street scenes such as red trolley buses at the top of the hill. At the theatre in London a large projector was used which had a mirror drum spinning at 6000 rpm and which projected through a slotted disc with coloured filters, which was itself spinning at 500 rpm.

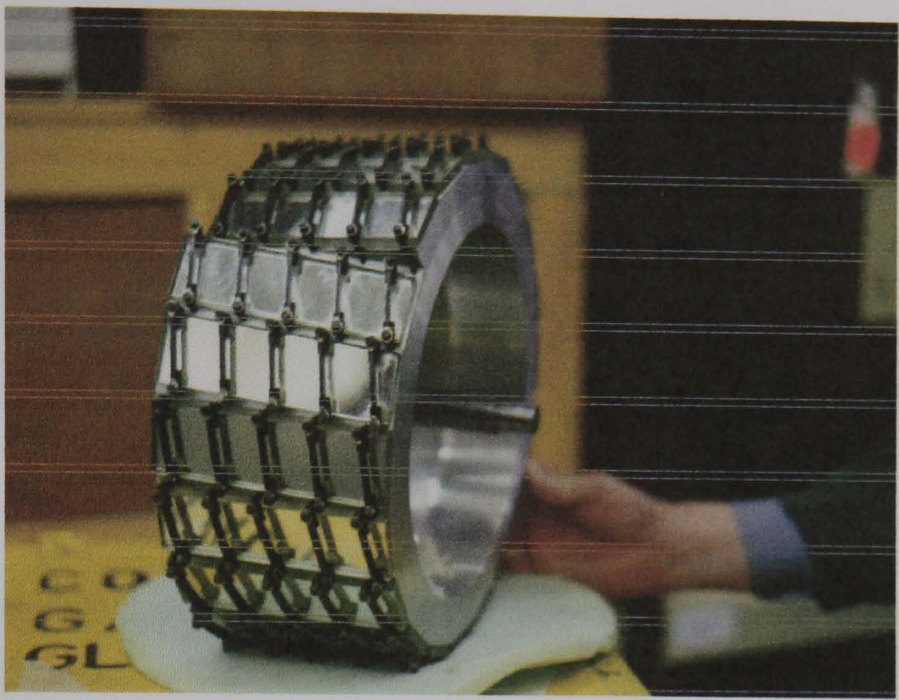

Fig 7.8 *This mirror drum still exists and is currently in the collection of the National Museum of Photography, Film and Television at Bradford.*
Source: Author's personal collection

The next main event for the Baird organisation under the direction of Captain West was the televising of the Derby horse race. Anyone amongst the specially invited audience at the Tatler newsreel cinema in Charing Cross Road who had seen the first cinema programme of the Derby, now had the opportunity to see what technical advances the Baird organisation had made in six years. The Scophony company also showed the 1938 Derby on a screen installed less than a mile away in the Derry and Toms department store in Kensington. The Derby was again shown by the Baird organisation in 1939. This time the demonstration was shown via the BBC to the public in the New Victoria Cinema, the Marble Arch Pavilion and the Tatler. The quality of the image was considered to be quite acceptable with the only problems occurring during tracking shots and occasional double images due to a fault with the Super Emitron camera.[xxv]

Fig 7.9 *The theatres which televised the Boone V. Danahar fight*

Source: M.H.I. Baird.

Another notable demonstration by both companies was the cinema showing of a boxing match between Eric Boone and Arthur Danahar on 23rd February 1939 at Harringay stadium. After much debate regarding payment by both the BBC and Gaumont-British to the boxing promoters over televising the fight this event was publicly televised.[xxvi] The programme was shown at Marble Arch in the Monseigneur News Theatre by Scophony[xxvii] and next door in the Pavilion by the Baird Organisation. The Charing Cross Road Tatler cinema was also used by the Baird Organisation for this event, all three cinemas were packed to capacity by the enthusiastic audience.[xxviii] Past BTL employee Ray Herbert watched the BTL demonstration, and in a recent interview stated that *"... the illumination of the screen was somewhat dim"* and that he *"... would not be prepared to watch a film on such a screen"*. Mr Herbert was fortunate to gain a glimpse of the Scophony demonstration next door and discovered that *"... the screen illumination was somewhat better"*.[xxix] A report the following day in an American magazine quoted J.L.Baird's own reaction, he said,

> *Little did I think when I made television an accomplished fact in 1924* [?] *that I would attend a fight in a cinema house and see before my eyes everything that was going on in the arena where the contest was being staged. I just never*

dreamed of a night like this when I would sit, with thousands, looking-in on a big fight far away. [xxx]

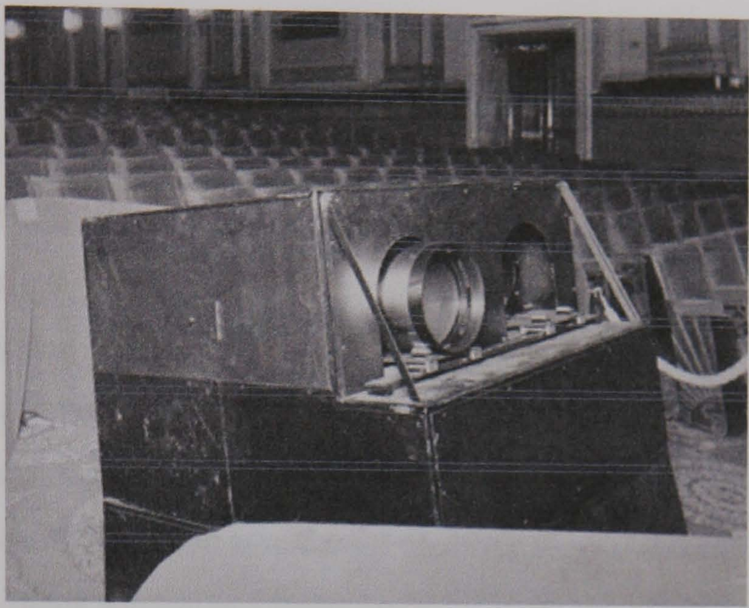

Fig. 7.10 *Front view of the Baird Television projection machine showing the double projector as installed in the Marble Arch Pavilion, London*
Source: D. Brown

The competition between BTL and Scophony fuelled positive developments to both companies' equipment. Soon London was to have 120 cinemas equipped with television screens, from BTL, Scophony and EMI who were also developing a cinema television system.[xxxi] Oscar Deutsch announced that Scophony would install 60 screens in his Odeon Cinemas.[xxxii] Burns (2000) has stated that the Boon-Danahar fight motivated Isidore Ostrer to invest in the Baird organisation further to provide these screens, even though at the time the company was in a bad financial situation.[xxxiii] By the 31st of August 1939, the Baird Organisation had installed five large screen systems in London cinemas and had orders for 55 more at an average cost of £2 700 each. Unfortunately, the following day Britain cancelled all broadcasting of television. Two days later Britain declared war on Germany. The order for the cinema television equipment was cancelled and the demand for television receivers, the Baird organisation's other main source of income, totally collapsed. Cinema Television Limited now had to become a very different company.

7.4 Cinema Television Limited as a Military organisation.

Cinema Television Limited was created by the Baird organisation with funding from Gaumont-British specifically to place television screens in cinemas. All of the activity of this company was towards this aim. And yet, in the months following the declaration of war, Baird Television Limited, the parent organisation, was put into receivership and the specialist company Cinema Television Limited assumed all ongoing military activities. Earlier, in March, Isidore Ostrer had decided to invest further in the Baird organisation to place him and his company G-BPC in a strong position to provide television screens for cinemas.[xxxiv] The coming of war and the curtailing of such plans were also a bitter blow for these investors.

A notice of dismissal was handed to most BTL staff on October 20th, a day known to the staff as "Black Friday". Mr Ben Clapp had his pay cheque of November 1st later returned to him from his bank, with writing on it indicating that a receiver had been appointed. Mr W. Harrison, of Price Waterhouse, had been appointed as Manager and Receiver to Baird Television Limited on 4th of November.[xxxv] Because the liquidated company could not pay their staff, and it was desired to continue activity in the company, Isidore Ostrer guaranteed the pay cheques of the remaining staff although generally at 90% of their original salary. [xxxvi]

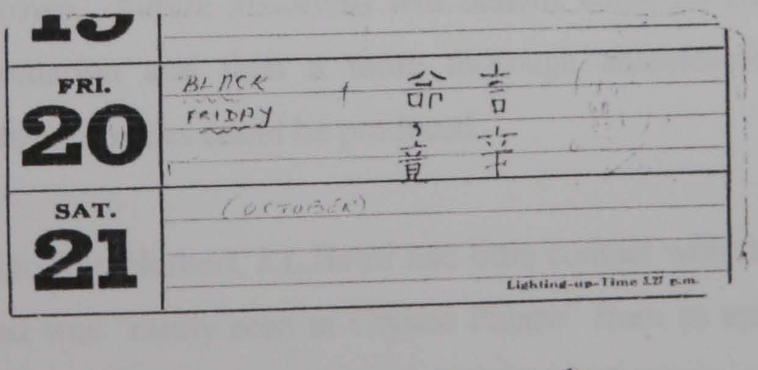

Fig 7.11 *Note from Ray Herbert's diary*

Source: R. M. Herbert

It has already been stated that John Logie Baird personally tendered for work from the British Military shortly after his first public demonstration of television.

From the earliest years of television to 1939 J.L.Baird and his organisation had investigated and developed the military technologies of Noctovision, Television Aerial Reconnaissance and Signalling. However, the inventor himself became subject to the dismissal notice and had his contract with the company he created terminated. This process, like the winding up of BTL may have taken some time. On the 17th of October 1941 J.L.Baird notes in his diary "*Ring solicitor, can I be forced to resign from BTL and what constitutes residence*".2 Whether J.L.Baird then continued work on contracts useful to the military is discussed in the next chapter. The estrangement of J.L.Baird from the organisation he created, has been, and remains an enigma. Research for this work has found no singular reason why there should have been such a split.

There is some suggestion that there was a personality clash between J.L.Baird and Captain A.G.D West, the man centrally involved in the organisation's military activities. A personality clash on its own is not enough reason for this split. It is also important to note that J.L.Baird's war diaries have repeated mentions of West's name including a note to have dinner with West [xxxvii] These mentions would suggest that at least the two people had some form of relationship. It is possible that these communications may have related to the supply of electronic equipment to J.L.Baird from BTL via Dr Constantin Szegho. This information was derived from an interview with Dr Peter Waddell on the 24th of May 2001. Dr Waddell stated that he obtained this information from the notes of Dr Constantin Szegho in the possession of Dr Douglas Brown. Future historians will benefit when Dr Brown decides to publish this information and then a more thorough assessment of J.L.Baird's interaction with the companies could be produced.

According to Ray Herbert, J.L.Baird had little contact with the direct running of his business and was "rarely seen at Crystal Palace" from as early as 1933.[xxxviii] This statement is reinforced by others from staff members as mentioned in the

2 It is possible that this comment by J.L.Baird refers to his desire to move abroad to avoid the hostilities. Margaret Baird, his wife, suggested South Africa whereas John had already discussed possibilities of moving to America. Hills, A.R. (1999). *Visions: The Life and Legacy of John Logie Baird*. CD-ROM. Glasgow: SCRAN.

introduction. In 1937 J.L.Baird was issued the non-executive role of President rather than the title of Managing Director which he had held since 1928. The note written by J.L.Baird, probably in the summer of 1932 and reproduced in the introduction, illustrates that he wished to be removed from the tedium of board meetings and left to concentrate on his research. The Inventor also refers to this desire in his autobiography. A combination of the above events may have been a convenient excuse for completion of a process initiated six years earlier.

In his autobiography J.L.Baird states that, through his relationship with BTL Director A.G. Church, he forged a relationship with Chancellor Breuning, the man who was supplanted by Reichschancellor Hitler.[xxxix] Knowledge of this relationship could lead to the supposition that the inventor's link with Germany was too strong, making him a threat to the Crown. However, J.L.Baird clearly states his distaste for Hitler's regime and as described below, Cinema Television employed two key personnel who had very close links with Germany. Further, it should be noted that an important financier of the Baird Organisation, Isidore Ostrer, was Jewish and probably disliked the current German regime more than most.

It is the opinion of this author that those around J.L.Baird thought he would be more useful working independently in his own laboratory with a small team. This method was used for his first achievements in television, and a large research team may have restricted the abstractions necessary for J.L.Baird's particular method of investigation. Perhaps he was not estranged at all, but happy to become "*a free agent*"[xl]

Baird historians Douglas Brown and Dr Peter Waddell have suggested that the 1936 destruction of the Crystal Palace and BTL equipment, may have been used by the British Government to indicate to Germany that BTL was no longer functional. Their theory states that, as television had potential military use for among other things radar, it would have been good to indicate to the Germans that

Britain was behind in their military television research.(3) If this theory is correct, then it may similarly explain why J.L.Baird was effectively removed from his company and that the liquidation of BTL was published in contemporary financial journals.[xli] To the external observer, such as the German Government, Baird Television Ltd may have seemed to be non-existent. A possible desire to keep this active military company secret may explain why workers in the Rotunda factory, such as Mrs Elsie Thomas, only knew that they were working for the British Government and had no knowledge that the company originally had any connection with Baird Television Limited.[xlii]

* * * *

The effective taking over of operations by CTL did not happen immediately but was a process that continued for 9 months after the outbreak of war. An application for the winding up of Baird Television Limited was placed before the High Court of Justice on the 17th of December 1940. This application included precise details of all material holdings as well as shareholdings of BTL, which were to be transferred to CTL. However, due to the inability to accurately assess certain French holdings of BTL, the process was halted. It was hoped that these holdings could be clarified when the country they were in was no longer under enemy control. In the meantime a further eight unsuccessful applications were made to the High Court before the BTL was finally wound up on the 26th of December 1945.[xliii]

Immediately after the initiation of liquidation proceedings for BTL in October 1939, staff morale was at a low ebb. It was possible that that the company may have been disbanded, or even placed under Government requisition.[xliv] Captain West wrote to the Ministry of Labour requesting that half the complement of staff be exempted from the general call-up and be retained for projects of military importance

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3 Peter Waddell has written three as yet unpublished articles about the events surrounding the Crystal Palace fire, these are: 1. "John Logie Baird and the Crystal Palace Connection"; 2. "Pre-war Alexandra Palace Television, a Cover for Radar, T.V. Aerial Reconnaissance and T.V. Secret Signalling"; and 3. "Could It Have Been the British Government?", (co-written by Douglas Brown).
This idea is also published in Dr Waddell's book *Vision Warrior* page 243.

such as the television aerial reconnaissance contract. The TV/AC activity continued within the company, however, up until Easter of 1940 there was little other activity.

In this interim period the surrounding park was used for other activities. Mrs Cecily Foulger recalls assisting refugees from Holland, Belgium and Luxembourg who were housed for a short time in Canada House and "possibly the Rotunda".[xlv] The Rotunda was abandoned by the Baird organisation shortly after the beginning of hostilities and not re-occupied until the summer of 1940.[xlvi] However, space in the Rotunda was very limited as much of the original production equipment remained. Despite this restriction the Crystal Palace refugee centre is recorded as having housed "many thousands of refugees"[xlvii].

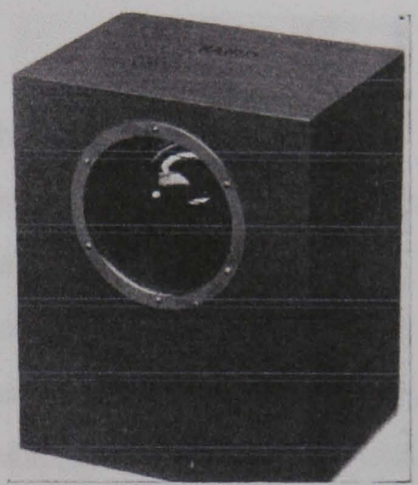
The Baird photo-electric incendiary bomb detector.

Fig. 7.13 *The Baird photo-electric incendiary bomb detector*
Source: Electronics and Television and Short Wave World, November 1939, p. 634.

Those left within the Baird organisation seem to have used their inventiveness to gain some business from a safety device. Two magazines of late 1939 contained an article about an incendiary bomb detector referred to as the Baird Photo Electric Cell Drill, manufactured by BTL. Four models of the patented device were produced. The various devices could detect the initial flash of light from an incendiary bomb explosion, detect smoke and warn of power cuts.[xlviii] The threat of aerial bombardment was prevalent in the initial stages of the war and this device would have provided civilians and businesses with a certain peace of mind during a frightening time. Whether many units were sold is unknown. Fortunately, by April of

1940 minor development contracts issued by the Government, along with the promise of a major contract for production of photo-electric cells, offered Baird organisation employees some hope of non-combat employment for the future. Already in January 1940 the Admiralty had given clearance for a modest payment to be made to BTL to assist in image converter development.[xlix]

Most of those that had already left BTL were inducted into research and production of radar. Mr Ray Herbert suggests that as BTL was involved in transmission and reception of radio waves as well as their display on cathode ray tubes, it is surprising that this company was not more fundamentally involved in the radar programme before the outbreak of war. [l] This subject is discussed more thoroughly in chapter five.

The precise nature of the division between Baird Television Limited And Cinema Television Limited has not previously been given historic consideration. Fortunately, this information is available in Public Record Office file AVIA 22/2719 *High-speed and pressure recording apparatus: design and production by Cinema-Television Ltd., London, Contracts: Policy, Conditions, Capital Assistance, 1940-1942.* This file records that the Managing Director/chairman Sir Harry Greer of CTL wrote to the Director of Contracts of the Ministry of Supply on the 3rd of May 1940 and finalised agreements for company manipulations,

> *It was finally decided that the best way to handle the position was for an agreement to be made between Gaumont-British Picture Corporation Limited, The Receiver of Baird Television Ltd, and a subsidiary Company of Baird Television, namely Cinema Television Ltd under which Cinema Television Ltd would take over the working of the factory, and the whole of Baird's staff, and Gaumont-British would appoint Directors and look after the necessary finance.*

It was reported in the August 1940 edition of the publication *Wireless World* that after this manipulation the name of Baird Television was to be used. It is evident that this was not the case.[li] Greer had already attempted to obtain Government work for the Baird Organisation in July 1939 with particular reference to television reconnaissance equipment.[lii] As described in the previous chapter this work was not forthcoming.

A second quote from a report of 9th February 1941 in AVIA 22/2719 concerning CTL suggests that the company was simply a manufacturing organisation for military purposes until cessation of hostilities.

> *The Company state that 'by arrangement between the receiver of Baird Television Limited, Gaumont-British Picture Corporation Ltd. and the company it is made clear that the company has been formed and financed for the purpose of carrying out Government work at the request of the Ministry of Supply and the Admiralty...*
>
> *...The Company state that after cessation of hostilities they will incur the expenses of re-organising their business for normal commercial production. They consider such expenditure should be 'borne by the Government as part of the cost of utilising the Company's business for war work' and seek guidance as to how such expenditure may be recovered.*

As already stated Cinema Television Ltd was formed in late 1937 as a subsidiary of Baird Television Ltd, and with the express remit of promoting television screens in cinemas. Therefore, either CTL was a dormant company, BTL taking responsibility for televisions in cinemas, until placed into action by the demands of the Government; or the original purpose for its formation was a military company under a purposefully concealing name. It should be noted that Britain at this time was constructing air raid shelters and distributing gas masks. From 1938 onwards the activities of British society indicated that war was probably inevitable and it was only a question of when it would happen. Various Public Record Office files consulted for this paper indicate that the announcement of war was part of an ongoing process for which the military services were already in preparation.

The original agreement made on the 3rd of May 1940 continued, stating that CTL were now in a position to undertake a previously arranged contract. This contract originally authorised on 22nd of April 1940 and costing £4750 was for the design and production of;

a) One prototype high speed pressure recording apparatus.
b) One prototype piezo electric two cathode ray tube oscillograph apparatus.
c) One prototype synchronous recording apparatus.[liii]

The equipment required for this contract was used along with a calculator system for recording various properties of a military shell. Further details are given later in this chapter.

The commitment of Gaumont-British to its military responsibilities is clearly demonstrated by a letter from them dated 29th of May 1940. Here the company states that it will indemnify the work of CTL against breach of contract. This indemnity was precipitated by the G-BPC statement of the 9th of May which emphasised that CTL was a subsidiary of BTL and dependant entirely on G-BPC, BTL held assets and CTL, being initially a research company, had none.[liv] Sydney Moseley describes Isidore Ostrer of G-BPC as *"...one of the few millionaires who are still idealists"*[lv] Mr Ostrer may have been an idealist, and was honourable in his offer of support for CTL; however, the possible reason for this support are complex.

As already stated G-BPC did not gain direct control of BTL until March 1938. The reason a record of G-BPC financial dealings of this period were kept is because the company was placed under investigation by the Minister of Trade. The preserved records include an assessment for the purposes of invocation of section 135 of the company's act 1929. However, trial of G-BPC was not due to start until October of 1939.[lvi] With no available evidence of the outcome of this trial, it is assumed that world events may have postponed or cancelled the matter. Perhaps a 'gentleman's agreement' was arrived at in which the Gaumont-British Picture

Corporation would indemnify various Government military projects undertaken by CTL in order to placate the situation.

Whatever the reasons for its creation, the indemnity offered by Ostrer probably advanced the Baird organisation and helped it gain a large contract for the development and production of a photo-electric cell for a missile proximity fuze.

7.5 The photo-electric cell as a light proximity fuze

The fear of aerial bombardment of Britain was clarified in a speech made in the House of Commons on 10 November, 1923 by Stanley Baldwin. He stated, "*I think it is as well for the man in the street to realise that there is no power on earth that can protect him from being bombed. Whatever people may tell him, the bomber will always get through.*"[lvii] There were many suggestions and investigations to combat this threat and a light proximity fuze for an anti-aircraft shell was amongst these. The early investigations into this technology, recorded in Public Record office files, give an indication of the background behind the final issuing of a production contract to the Cinema Television Ltd company. Professor R.W.Burns has included some of these files in his two seminal papers *Early history of the proximity fuze (1937-1940)* and *Factors affecting the development of the radio proximity fuze 1940-1944.* [lviii]

AVIA 13/874 a *Note on the possibility of designing a P.E bomb to detonate at small heights above the ground* was opened in 1937. This file stresses the use of a photo-electric cell to detonate short distances of around 5-25 feet (1.2- 6.4 metres) above the ground. Although this file mentions air dropped bombs, it also indicates that "*The photo-electric bomb is intended for the bombing of enemy aircraft*". The Spanish Civil War had illustrated the devastating effect of aircraft flying at low level in close co-operation with ground forces. Part of the suggestion was to attack such low flying aircraft from another aircraft using these specially fuzed bombs. Another method was to fire the bombs vertically, the whole idea being to make "*... life extremely difficult for low flying aircraft*".[lix] There was also initial interest into rocket propulsion for anti-aircraft shells, then known as Unrotated Projectiles (UP), instead of on ballistic shells. This idea, like many others, underwent various fortunes. Initially investigated in 1939, the idea was dropped later that year and then revitalised in 1941.[lx] In April a demonstration to Winston Churchill at Aberporth was unsuccessful, but despite this the Prime Minister expressed a strong interest.[lxi] A demonstration a month later was noted as showing *"conclusively the superiority of the U.P. type cell from the point of view of freedom from change by vibration"*.[lxii] According to Gerald Pawle in his book *Secret Weapons of World War II*, a light proximity fuzed shell was tested along with a Harvey rocket projector. The author gives no date for this experiment but notes that the trial was undertaken at sea on HMS Alleghany. This trial was unsuccessful due to unreliable rocket projectors as well as lack of determining whether the missile, which had not been fired, was rendered live by the fuze.[lxiii]

Fig. 7.14 *A trial recorded in AVIA 13/874 on the 14th of March 1939 of the photo-electric cell mounted in the nose of a Bristol Blenheim aircraft, serial L.1254. The aircraft being detected has the distinct outline of an Armstrong-Whitworth Whitley, although this type is not mentioned in the file.*

Source: PRO AVIA 13/874

Metropolitan Vickers produced 200 P.E. bombs for trials. Unfortunately, the bombs did not perform as expected. Sir Henry Tizard notes in a letter of the 11th of November 1939 to Professor G.T.R Hill, of University College, Exeter, that the bombs burst around 200 feet from the ground. The main problem affecting the photo-cell in use as a proximity fuze was the insensitivity to the type of object detected. Early fuzes were triggered by clouds and in some cases trees near the ground; for this reason a variety of photo-cell types were initially investigated. Other types of proximity fuze investigated involved sound and difference in the earth's magnetic field as well as the use of reflected radio waves. When the service problems of all other methods of projectile detonation became insurmountable, the radar detonated fuze was placed into high quantity production. [lxiv]

In the first few months of the war boffins at University College, Exeter, were investigating a photo-electric cell produced by the Baird organisation which was simply referred to as "Baird Cell no 12". Mr E. Bolton King refers to the Baird cell in a letter of 27th of April 1940 to Mr Norman Coles of the Exeter College, and states that "*Baird's are still making unrealistic claims about cell's sensitivity to light*". Further investigations on May 1st note that "*Bairds are still making vague promises without much material proof. They now more or less confess that their factor of 50* [improved sensitivity] *is a lie and that the factor of 8 is nearer the mark, but whether they can ever produce a cell to this* [sic] *seems very doubtful...*"[lxv] A major improvement in the photo-electric cell must have been achieved at Exeter in a short time, as the college saw fit to demonstrate the cells to members of the cabinet as well as senior officers in most ministries. A letter from King to Coles on 13 May states "*I think it is probably on account of this model that... enquiry's are being made today for a rate of production of 2000 per week to be reached early in July.*"[lxvi]

By July of 1940 the British Air Force fighters had been decimated over France, particularly in defending Dunkirk. At Dunkirk much of Britain's army, under the title of the British Expeditionary Force, had also been destroyed. At this crucial time Britain was not in a strong position to defend itself either in the air, or in the event of invasion on land. Prime Minister Winston Churchill was fully aware of Britain's desperate situation and insisted on the rapid development of anti-aircraft defenses. For example, during this desperate time, the Miles company produced their M.20 defense fighter aircraft and flew their first production prototype nine weeks and two days from the issue of authority to proceed with development.[lxvii] This desire for rapid developments were no doubt central factors affecting the immediate production of the special fuze for another form of defense against bombing aircraft. According to the two articles by Burns on shell detonation, by the time the PE PF was placed into production it had already been proved that this form of shell would not work. It is possible that Winston Churchill's vehement insistence on production overruled the practicalities of whether the shell was useful.(4)

7.6 Development and production of Photo-Electric Cells for Proximity Fuzes by CTL

And it was on the 16th of July 1940 that the Admiralty issued a development contract to Cinema Television Ltd for prototype proximity fuzes including PE Cells. The Admiralty provided sample cells and Proposed £2,200 maximum expenditure for the development contract and drawings. PRO file AVIA 22/2752 *Development of P.E. cell. Cinema Television Ltd., London, Contracts: Policy, Conditions, Capital Assistance, 1940-1941* discusses whether the CTL PE cell infringed the patent of the aforementioned Mr Bolton King. It was the opinion of Professor R.V. Jones that the CTL cell was based on Bolton King's work.[lxviii] However, at that time it was decided that the CTL cell was unique and raises the question whether the patent for this cell should be withheld from publication, as annexation of patents was part of the original contract.

The Gramophone Company, a subsidiary of Electrical Musical Industries Ltd (EMI) was also given orders for development, design and manufacture of prototype proximity fuzes by the Admiralty. The initial tender for this project No 594906, was the same as that issued to CTL. A letter from CTL to the Director of Contracts for the Ministry of Supply records that previous rivalries had been set aside in order to work towards a common goal of defense of the realm. The letter states " *As you know, we are working in collaboration with Electrical Musical industries Limited.*" The close relationship is reinforced by the attendance of CTL personnel at a conference held on 19th July 1940 at the EMI works in Hayes. This conference

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4 A parallel can be drawn between Winston Churchill and his Government and Adolph Hitler and his. Hitler is almost legendary for his insistence on impractical war machines or inappropriate applications, such as the use of the excellent ME 262 fighter for bombing. Britain also had a long history of such stupidity. Certain 1930s fighter developments insisted on the attachment of drag inducing turrets, which made them useless, as was later proved in combat. The Armstrong Whitworth Whitley, a most lamentable airframe, was rushed into production before the prototype had flown. British mass production of the PEPF may have also been such an avoidable mistake.

agreed the induction of further glassblowers to the production lines in order to meet a request by Brigadier Younger of the M of S for the production of 6000 photo-cells by August 18th.

One problem that arose for CTL and occupied much paper work as well as the attention of M.I.5, was their employment of two registered aliens. CTL employees Dr Kurt Arthur Richard Samson and Dr Sommer, one a pure blooded German and another with German connections, would under other circumstances have been subject to internment. Fortunately, five days before the initial July development contract, both CTL staff were issued indefinite internment exemptions by the Admiralty as they were essential to the rapid development of the P.E.Cell. Both scientists were described by CTL as "*...probably the world's chief experts on photo-cells of this type...*"and Dr Samson was the patented inventor of tendered cell. The various interested parties then gave CTL permission to retain the employees and placed the technicians under "*...strict surveillance outside their employment.*"[lxix]

CTL were issued a production contract, 294/U/193 of 12th of September 1940 that required a total of 30,000 photo-cells. Six days later CTL proposed a patent for "Improvements in or relating to Photo Electric Cells". The document refers to co-pending patents; 9996/40 of 7th June 1940, 10358/40 and 10340/40 of 14th June 1940, 10359/40, and 11919/40 of 19th July 1940 and adds that this application offers a response to illumination over a large solid angle.[lxx] The issuer of the production contract was the Ministry of Supply which took over the Admiralty order. In October the production contract had to be modified to take account of developments to the photo-cell and contained the order that CTL had to immediately manufacture this new product.[lxxi] By 18th of December a Mr Pitman of the M of S refers to CTL in a note which states "*Today the company has two factories fully engaged in carrying out war work...*"[lxxii] The two factories mentioned were the Rotunda in the Crystal Palace grounds and the other two miles away in Worsley Bridge Road, Lower Sydenham. Secrecy during production was reinforced by not telling the newly inducted workers at the Rotunda that CTL had any other factory.[lxxiii]

Production of the P.E. Cells came under the direction of Mr Moon who had been attached to the organisation in a commanding role over Captain West.[lxxiv] Mr Gilbert Tomes and a Mr Daniels were subordinate to Mr Moon and assisted production to achieve expected delivery dates. There details of P.E. production recorded in the personal diary of Gilbert Tomes, an engineer responsible for the project in the Baird organisation. This diary is in the possession of various Baird historians including Mr Ray Herbert, Dr Douglas Brown, and the author's supervisor Dr Peter Waddell. However, after repeated requests, this author has not been granted permission to use any information contained in the diary of Mr Tomes.

Fig. 7.15 *Some of the female staff who worked in CTL during WWII.*
Source: Mrs Elsie Thomas.

Staff inducted into the Rotunda for PE production contract were civilians from the local area. One of these workers, a Mrs Elsie Thomas, recently described the production process,

> *We made the photo-electric cells. We had a pump. We sat at a bench*... [with] *a manifold and we started out with six, I think it was, on long, thin stems. We had liquid air underneath, the air was pumped out*... [and had] *a tesla to test it with.*[lxxv] *It was electric, it was like a rod with metal on the top and when you switched it on you put it over the manifold and if came up blue*

light you knew you had a leak... We knew we were doing well because... they started out with the manifold with six and they timed us and found that if we were careful and lucky I suppose, they could put on another row... making it twelve... we ended up with about twenty four or thirty... cells [lxxvi]

The rapid production continued without delay, and sometimes the workers continued working during air raids, being given a small bonus for their bravery. The stoicism shown by the staff was recognised when Captain West wrote a report of the wartime activities of Cinema Television Ltd. He wrote, in this instance referring to land mine locator production,

Even after D-Day and when Flying Bombs were continuously passing overhead – no less than twelve fell within a quarter of a mile from the factory the pace was maintained, and a large proportion of the staff, including many undaunted women, refused to go to shelter when the Imminent Danger Signal was sounded, but carried on with their work and just ducked under their benches when the Bombs were directly overhead. Thus the output figures were maintained at a vital moment of the War. [lxxvii]

A potential delay whilst demolishing the North water tower seems also to have been avoided.

Professor Frederick Lindemann (Lord Cherwell)5 and Robert Watson-Watt were both consulted about the potential interference to the nearby anti-aircraft gun laying radar, from the metallic structures of both remaining Crystal Palace water towers. This interference was found not to be a problem, but for various other reasons, such as potential guidance to hostile aircraft as well as the insistence of Winston Churchill, it was decided to demolish both towers.[lxxviii] However, the initial order to demolish the towers was rescinded. Sir Henry Buckland, the General

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5 According to Dr Peter Waddell in an interview on the 24th of May 2001, Frederick Lindemann organised scientific think-tank meetings at BTL premises in the early years of the war. This information is derived from the notes of Dr Constantin Szegho in the possession of Dr Douglas Brown. Further details about this activity may be in Dr Brown's thesis which is under moratorium at the time of writing.

Manager of the Crystal Palace site was given "*confidential instructions by telephone from the War Office to stop all demolition work on the towers as they would be requisitioned by them*".[lxxix] In *New Scientist* of the 25th of November 1976 Felix Levy, an employee of the demolition contractors, stated that "*... the reason for the demand by the ministry was that J.L.Baird was working on top secret projects on which one of the towers was used.*" Melvyn Harrison of the Crystal Palace Foundation questioned the Ministry of Defence as to what these projects might have been. The reply of the 14th of August 1992 was "*... unable to offer any further information*". Fortunately, Public Record Office file CAB 120/835 offers an explanation. A paragraph from a letter in this file is recorded below as it also indicates the contemporary attitude to such matters.

The North Tower is, I gather, being used for an extremely " hush hush" matter by the Military; in fact it is so secret that the branch which requisitioned the tower could not find out whom to approach with a view to discovering whether they would be prepared to give up their occupation of the tower if pressed to do so. It was suggested that D.M.I. should be consulted on this matter.

Fig. 7.16 Source: PRO CAB 120/835

The reply to this letter dated on the 22nd of November from the Wireless Telegraphy Board to the Cabinet Office, is as follows,

The request was originally made by the Ministry of Supply on behalf of the War Office, acting on behalf of the Radio Countermeasures Committee. It was first intended to use these towers for Army purposes, but when it was found impracticable to use them for this, The Air Ministry representative requested that the requisition should be kept in being so that the towers might be used as a reserve transmitting tower. As I said above, this has now been waived, and instructions for the immediate demolition of the towers can go ahead.

Mc Arthur and Waddell report a statement by a Mrs Griffiths who informed the authors that J.L.Baird worked in the basement of the Crystal Palace North Tower on '*scanned scheme radar*'. [lxxx] However, research for this paper has not found any further substantiation of any of these suggestions.[lxxxi] It is possible that the "reserve transmitting tower" suggestion could have referred to either the two meter or original sound transmitters of BTL remaining in the South Tower. Mr Ray Herbert, who was involved with the transmitters, informed the author that a Mr Sayers personally removed BTL equipment from the South Tower before the request for military utility in November 1940. However, Mr Herbert is unaware if these transmitters were removed at this time or of their eventual fate.[lxxxii]

When permission for the destruction of the towers was finally resumed it was decided to demolish the North tower using explosive charges. This tower was apart from the local population by such a distance that precautions taken with the South Tower need not be repeated. However, after a visit by the Government Signals School and Admiralty to CTL to inspect photo-cell production, the company informed the Ministry of Home Security on 1st April 1941 that the tower demolition had to be postponed due to possible damage to delicate production apparatus. [lxxxiii] Initially it was suggested that the North Tower be demolished in the same manner as the South, brick by brick, in order to avoid equipment damage. It seems that an alternative suggestion of delaying production and removing equipment during explosive demolition was acceptable as CTL "*... were well ahead in their work, and the components which they produced were much in advance of others which go to make up the same projectile*".[lxxxiv] The efficiency of CTL photo-cell production is explained by Elsie Thomas' aforementioned statement regarding increased output contingencies.

According to the CTL records concerning this matter they had a factory "*... not far from the tower*". The picture below shows the physical distance of the Rotunda in which photo-cell production took place, and the North Tower. "Not far", either indicates relative terms of distance, the distance is approximately 1 kilometre, or the fact that CTL production equipment may have been extremely sensitive. Mrs Thomas does not remember any delay in photo-cell production and other locals do not remember a delay in the destruction of the North Tower.[lxxxv] It is therefore possible that no such removal of equipment, or delay in production ever took place.

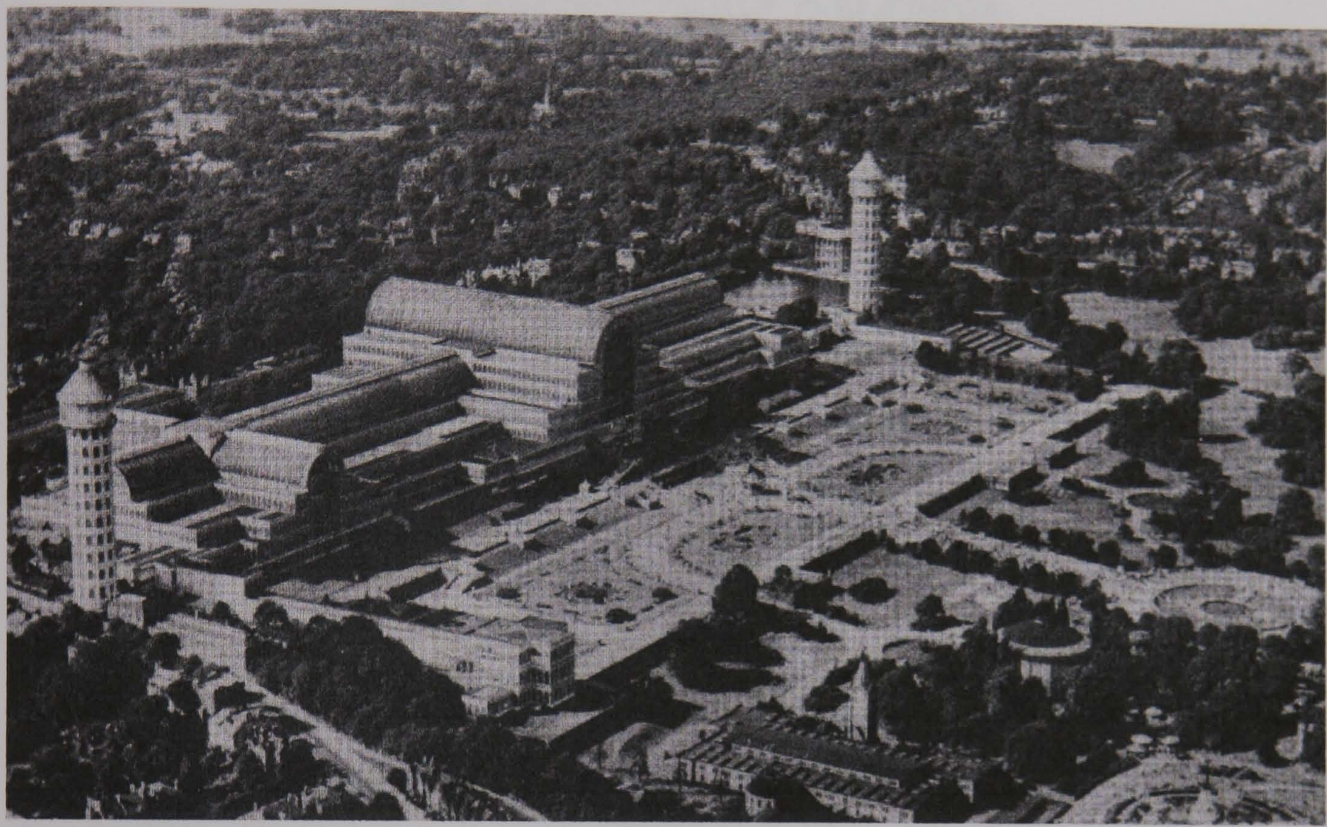

Fig 7.17 *The Crystal Palace with water towers*
Source: The Crystal Palace Foundation

Other problems threatening production of the photo-electric cells as well as other CTL activities were the effects of enemy bombardment, 109 bomb craters being recorded by the 15th of January 1941.[lxxxvi] Because of this threat, in May it was suggested that a "…*new factory* [was] *to be erected or acquired outside the London area for the manufacture of these cells…* [and is]... *useful to guard against interruption of supply*." [lxxxvii]

According to CTL employee Ben Clapp a 'shadow' factory was created in the disused Rink cinema not far from the other two in Sydenham.[lxxxviii] Clapp states that the Rink was used for production of land mine locators, a subject discussed below. The next major occupation of Cinema Television Limited was the production of Cathode Ray tubes of various types for use predominantly in the radar programme.

Fig. 7.18 *Conventional bombs were not the only problem that the Crystal Palace site had to endure. Note the cluster of four impacts at the North end of the site. It is very unlikely that gyroscope guided missiles launched from around a hundred miles away would fall so close to each other.*

Source: The Crystal Palace Foundation

7.7 Cathode Ray Tubes including the Skiatron Dark Trace Tube.

Shortly before the disastrous fire of November 30th 1936 the BTL cathode ray tube production plant was moved from the main Crystal Palace building to the Rotunda, a circular building initially used to display dioramas. This fortunate move saved a production facility that was capable of handling a wide variety of vacuum physics activities, and which could readily be changed from the photo-cell to cathode ray tube manufacture.

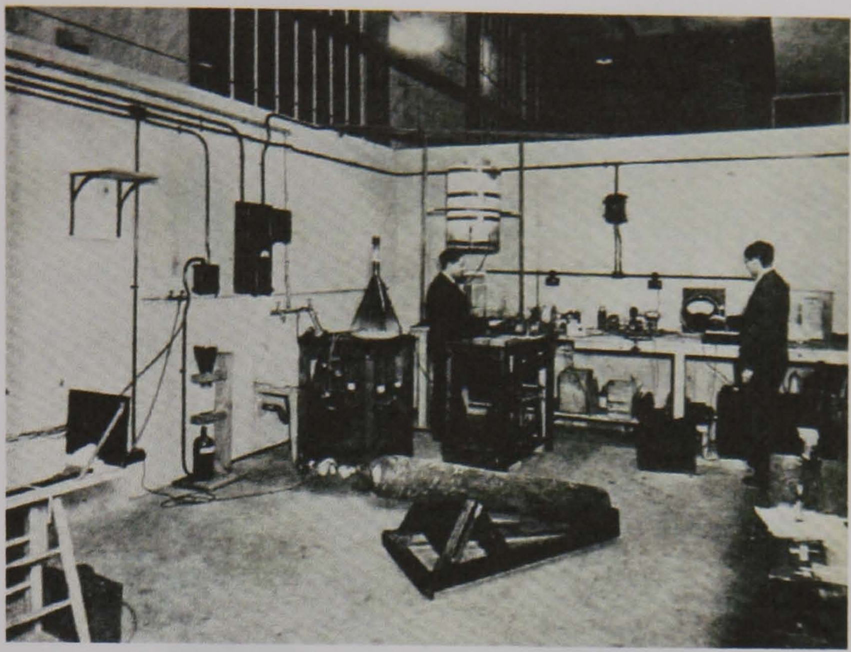

Fig. 7.19 *The BTL CRT development laboratory in the School of Arts at the Crystal Palace*
Source: Moseley, S. (1952). *John Baird: The Romance and Tragedy of the Pioneer of Television.* London: Odhams

As early as October 1939 William Sholto Douglas suggested that BTL could be utilised for *"...production of RDF equipment"*.[lxxxix] It is likely that Douglas was referring to CRT production for RDF (radar). The precise details of the change from photo-cell production to series CRT production are unclear. According to Ben Clapp the first wartime contract received by CTL was for cathode ray tube production.[xc] The remaining public records indicate that this was not the case and that first CTL contract was for ballistic properties of military shells. However, it must be understood that not all information on this subject remains in the public record. Testimony from Elsie Thomas suggests that, in the Crystal Palace complex at least, photo-cell production was supplanted by CRT manufacture.

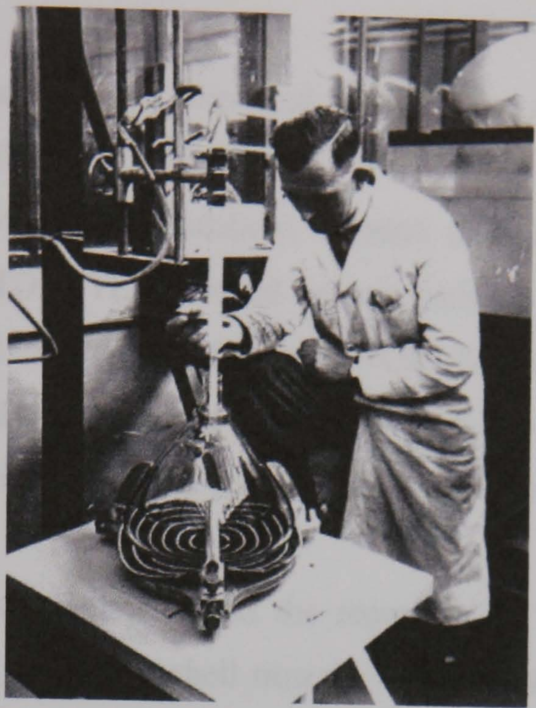

Fig. 7.20 *Depositing a phosphorescent coating using the dusting technique at the Worsley Bridge Road Baird Television Limited factory*
Source: D. Brown

CTL had CRT production facilities at both major factories at Worsley Bridge Road and the Rotunda. Various techniques were used to manufacture CRT's including the depositing of the phosphorescent coat. This technique is mentioned by Elsie Thomas in recounting her employment at the Rotunda factory and surrounding buildings,

> *…and some of us were sent over to the other building to make the radar screens, to put the screen on the tube. We used…silicon…it was on a turntable with three sort of brackets up because when we first started we were making the big tubes, doing the big screens. They were quite hefty. I would say about an eighteen inch.*

The knowledge gained from pre-war production of CRT's for broadcast television meant that the company was capable of producing not only a large quantity of CRT products, 110,000 by the end of hostilities,[xci] but also a wide variety.[xcii] Because of this adaptability CTL were members of the Committee for the Co-ordination of Cathode Ray Tube Development (CCCRTD). T.M.C.Lance was the main CTL representative at this committee's meetings.

The minutes of these meetings, recorded in PRO files AVIA 7/1231 and AVIA 7/1232 offer an indication of some of CTL's CRT production. A variety of companies including EMI, Cossor, Mullard, Ferranti and Cosmos, were involved in meetings of the CCCRTD. CTL produced various cathode ray tubes, namely VCR 139A, VCR 140, VCR 516, VCR 522 and VCR 97's among others.[xciii] This company also developed and produced dark trace tubes known as Skiatrons or VCR 520's.[xciv] A description of this tube is provided in the previous chapter.

One application of the Skiatron was the recording of "transient non-recurring electrical phenomenon", such as a shell muzzle velocity recording using the image holding capabilities of this particular CRT.6 This image capacity was also useful for the Scophony company investigation into signalling using television technology as discussed in chapter four [xcv]. Another main application of the Skiatron was the projection of images and in particular for showing radar plots in the Plan Position Indicator (PPI) system. The CCCRTD were particularly interested in this application. CTL had investigated Skiatron tubes as early as 1941 when Mr Bob Bartle a CTL vacuum physics specialist obtained patent GB 614 261 appertaining to this tube.[xcvi]

On 22nd of February 1943 CCCRTD minutes note that CTL projection Skiatrons were now of suitable quality and that similar work at GEC and Cossor could be dropped. The decision was made after investigation of CTL Skiatron tubes which had already been delivered to an RAF maintenance unit. Post-delivery units were chosen as it was thought more likely to represent standard production quality rather than carefully selected units. Once CTL production quality had been verified the company used its large production capacity to meet fresh demands for Skiatrons from the Admiralty. The Government then ceased taking delivery of American made units. Within Skiatron production, which proceeded at the rate of approximately 50-60 units per week, there were also a variety of types, which varied in size from nine inches to two inches (23 to 5cm) screen diameter. [xcvii] The small tube was developed by CTL after they were issued a contract for this particular purpose.[xcviii] All of these

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tubes were manufactured in CTL's Worsley Bridge Road factory and the total amount of Skiatrons production was approximately15000.

CTL also researched applications of the Skiatron such as "*The use of television techniques to superpose two displays on one PPI...* ". This reference refers to a time before 1949 and could have been undertaken during the period of war.[xcix] Indication of this possibility is recorded in AVIA 7/1232 *Committee for the Co-ordination of Cathode Ray Tube Development: minutes and papers, 1943-44.* CCCRTD 37th meeting on 26 July 1944, which refers to "double colour tubes", and that CTL "*Should have received their contract for the preparation of screens using spraying techniques.*" Presumably this preparation was to produce a screen capable of two superposed colours. Parallel development of two colour CRT radar displays was also used by Germany for overcoming jamming. The object to be detected, such as an aircraft would be fast moving and displayed as one colour, slow moving radar returns such as metal foil "window" would be displayed in the other colour. It should be mentioned that John L. Baird noted a radar patent in his diary for something which could have been used for a similar purpose. But as stated in various places in this paper it is difficult to establish any strong connection between J.L.Baird personally and the activities of CTL.

7.8 Ballistics Investigation

As mentioned above, the earliest known military development contract issued to CTL was for a ballistics project which was authorised on 22nd of April 1940 and issued on 21st of June 1940. Negotiations for this contract started some time before January 25 of 1940. In a report by members of the Admiralty it is noted that an arrangement had been made between BTL and the military establishment at Woolwich. This agreement included payment for certain developments as well as reservation of BTL staff.[c] A report of 6th February 1941 describes the accomplishments by CTL of this contract and is summarised below. The initial development contract, under the supervision of CTL staff Mr Austen and Mr McConnell, had produced various items including, a high speed pressure recording apparatus involving six cathode ray tubes which was designed to record the blast proceeding from a bomb explosion. The CRT's displays, which corresponded to increasing distance from the blast, were projected via a system of mirrors onto a paper strip. This strip could then record the simultaneous increase in pressure at each of the measured points. Between the development for the contract and its finalisation as 294/A/982, CTL requested an increase of its fee from £2500 to £6000. This increase was to cover modifications such as the speeding up of the reaction of the apparatus by twenty five times. Another problem encountered by CTL was staffing. Initially it had hoped to recall staff originally employed by Baird Television Limited. Unfortunately, due to restrictions under the newly enacted Employment of Labour Bill it was not possible to transfer skilled staff from one firm to another.

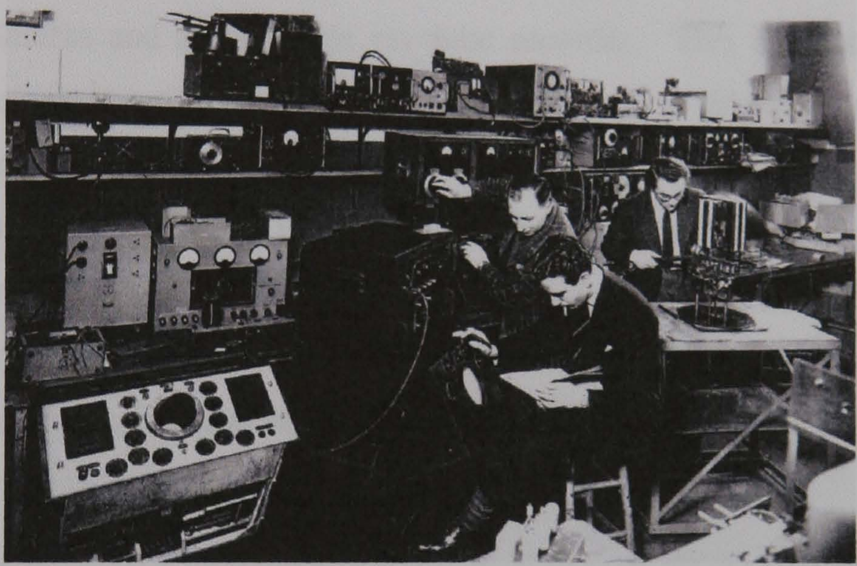

Fig. 7.21 *Probably staff of Cinema Television Ltd working on the ballistics project.*
Source: PRO AVIA 12/184.

Part of the initial development contract also required a modification of the system, which used two cathode ray tubes for measuring explosion pressures in closed vessels such as gun barrels. This requirement also cost approximately double that of the original estimate. To measure short time intervals CTL had also produced under this contract an electronic counting device using valves as opposed to the original request for mechanical apparatus. It has been stated in reference to this counting device that *"...Baird's company had a small electronic computer in the building, on which his staff may have been practising before going to Bletchley"*.[ci] The same newspaper article also records that Peter Sale, manager of the Bletchley

Park Museum has found no evidence to suggest that there was any connection between this company and the code deciphering organisation. Mr Alan Carter, an employee of Cinema Television Ltd during the 1940's was aware of the electronic counting device and suggested it was similar to a Decatron machine and definitely not associated with the Colossus computer at Bletchley Park.[cii] The PRO files concerning this BTL counting machine do not refer to the British decryption service.

A fourth development under contract 294/C/7199 probably utilised photo-cells similar to those used for the projectile fuze. These cells measured the muzzle velocity of shells by being placed perpendicular to the gun barrel end and transducing the light reflected to an electric recorder. There was also a suggestion that CTL should produce under contract 294/A/1184, various argon lamp chronographs, cameras and a 3 cathode ray tube recorder. This apparatus was to replace CTL equipment originally installed but damaged at Shoeburyness firing range. Millersford firing range is also given similar attention. This part of the public record does not indicate whether CTL produced the requested equipment. However, according to Captain West's report of CTL wartime activities, recorded in Note 4. at the end of this chapter, the company's research and development served a useful purpose, such as assisting in the development of the ten ton Grand Slam bomb.

Fig. 7.22 *A Grand Slam bomb being dropped from an Avro Lancaster aircraft.*
Source: J. R. Hills

The report concludes that the initial contracts were undertaken by CTL at a time when they desperately required work. Because of this situation the company did not fulfil its obligations as smoothly as originally expected. It was therefore decided that all further investigations by CTL be just to the "bread-board" stage, i.e. in the most basic functional form.

7.9 Land Mine Locators

Another series of investigations as well as large scale production undertaken by CTL was the development and manufacture of land mine locators. As the war progressed there was an increasing interest by the British Government on the delivery of suitably efficient land mine detectors. To choose the best equipment, detectors manufactured by various countries, including captured units, were investigated and copied by the SR.8 unit of the M of S working closely with CTL [ciii] Investigation started in 1941 and resulted in the manufacture of a wide variety of land mine locators produced by CTL, as well as Cossor, Peto Scott and other companies, including some based in America.

Land mines come in all shapes and sizes including some which contain enough explosive to destroy armoured fighting vehicles such as tanks. To combat this threat, Cossor manufactured, for a period of six weeks, tank mine detectors commencing in October of 1941. CTL were issued a similar contract, but due to "being held for information" by Cossor, were not due to start work until December of 1941.[civ] The CTL order for 25 units was dependent on further research by British Thompson Houston as well as the British Electrical and Allied Industries Research Association (ERA). On the 13th of October Polish nationals demonstrated their type of mine in Ripon, Yorkshire. The detector was described as "the best type so far tried out" and chosen for further development and immediate production by CTL. The efficiency of the CTL copy of the Polish detector was illustrated in a trial of the first production type in Richmond Park on the 20th of November. In this trial a 250Kg mine was detected at a distance of 30 inches (76 cm), half the size of mine detected by the original Polish unit over the same distance.[cv] By the 26th of July 1942 CTL are noted as capable of continuing "*...to deliver approximately 300* [detectors] *a month provided material is made available immediately*".[cvi]

To facilitate this large production quantity CTL requisitioned the disused Rink Cinema and built a factory inside. Initially the foyer of the bomb-damaged cinema was used and later moved into the main auditorium as production demand increased.[cvii] Mr Ben Clapp was involved in this project and remembered his old company's production in this cinema in a 1987 interview and said that mine detector production reached 1000 per week.[cviii] The Rink cinema and the production inside are featured in a contemporary newsreel, although for security reasons the cinema was not named. Alan Carter was employed in the cinema and has a copy of this film on video which features him providing a demonstration.[cix] The above July 1942 estimate of manufacturing capacity may have only referred to the Polish type detector. It is likely that Mr Clapp's higher suggestion included other types manufactured later, such as a "Basuto" detector which detected *"radio-active emanation of the order of 5 µC or more"*[cx] and "Dinah" UHF types.[cxi] Captain West noted that by the 4th of June 1945 30,000 mine detectors had been produced by Cinema Television Ltd.[cxii]

To develop and improve various mines CTL were issued a plot of land near to their Worsley Bridge road factory as the standard testing range in Richmond Park was too distant. This land was issued at the behest of the Director of Scientific Research on 7th of June 1943. A map of this site is reproduced below.

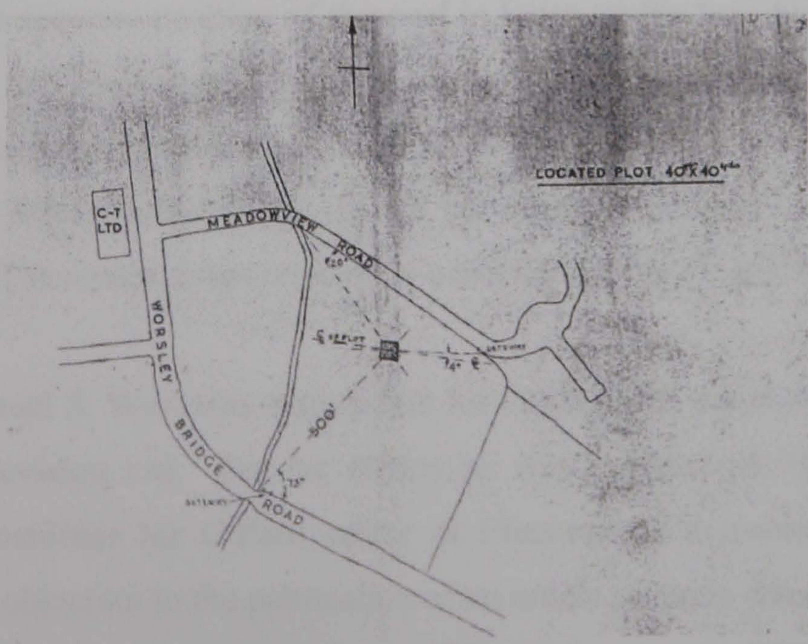

Fig. 7.23 Source: PRO AVIA 22/862

It is possible that testing on this land assisted Mr C.R.Bannister of CTL in the modification of a wide sweep mine detector, which he offered to the M of S, free from patent restrictions, four days after being issued the test site.[cxiii] Detection of mines was not the only thing investigated by the CTL Metal detector department.

In March of 1940 a Mr Gough of the M of S visited the Institut Poincare in Paris and noted that the French had other uses for metal Detectors. Mr Gough reports that he saw a modified metal detector "*...intended for the finding of shell splinters, bullets etc in the human body*" and that the British should look into this application.[cxiv] An identical application was suggested in a minute of AVIA 22/862 *Mine detectors: research and development, Director of Scientific Research, 1943-1946* on 31st of May 1943, and adds that this apparatus would be useful in a forward battlefield which was not equipped with conventional x-ray equipment. A year later the idea was revived and development contracts were issued to the University of Wisconsin and the Maico Company. CTL were asked also to proceed with investigation of a metal locator for surgeons under their contract 294/2/6824/Con.2A/3 which was originally for "Ad hoc investigation on mine detection". A prototype was near completion on 29th of August 1944, eight days after the instruction to proceed, and was tested for the specific purpose of finding shrapnel in lungs. Previously a Dr Adrian Haward had emphasised that x-rays did not indicate the accurate position of shrapnel in lungs, as the lung had to be deflated before surgery and the shrapnel would move, necessitating extended and damaging incisions. Unfortunately, after a year of work, CTL decided that they were unable to design a metal locator which could deliver the degree of accuracy required for this exacting task. The contract was reluctantly cancelled on the 5th of March 1945.[cxv]

Mr Samuel S. West was responsible for much of the metal detection activity at Cinema Television Ltd. For his efforts he was awarded an MBE. After the cessation of hostilities Mr G.Parr, editor of Electronics Engineering said that he would have no objection to the publication of an article on mine detection and would contact CTL and request they supply one.[cxvi] In due course CTL's mine expert

S.S.West MBE wrote a most readable article in the journal and described the technical minutiae of how metal detection was achieved. [cxvii] Further information concerning land mine locator production is included in Note 4. At the end of this chapter.

Fig. 7.24 *Testing Land Mine Detector, image from S.S. West's article.*
Source: West, S.S. (1946, March). Land Mine Locators. *Electronic Engineering*.

The ending of hostilities in both Europe and Japan did not mean an end to land mine locator production. Like so many modern conflicts there is still much 'mopping-up' to be done when the guns have fallen silent. No longer under fire, crews of workers then set about the task of clearing mine fields. For this task CTL had to continue its supply of minesweeping equipment of various kinds. Radar was no longer needed for plotting hostile aircraft or bombing, but changed its role to navigation. Cathode ray tubes continued to be required for this purpose, and Cinema Television Ltd used its excellent production capability to supply for this need.

There was much to be learned from the rapid acceleration in technology produced by the period of conflict – both on home ground and foreign soil. Various German television technologists had been captured and were interrogated. A German television company Fernseh A.G. was formed in 1929 by Zeiss, Bosch, Loewe and the Baird organisation who each owned equal shares. Because of this connection CTL, now called Cintel, stated that before the war they *"had a close working agreement with Fernseh"*, and requested that they become involved in the interrogation and re-establish this relationship. In due course this desire was satisfied and Cintel learned much from the ongoing German production, under British supervision, of Iconoscope cameras as well as the various investigations into military and airborne systems.[cxviii]

John Logie Baird, the creator of the Baird organisation, and hence the creator of Cinema Television Ltd, died on the 14th of June 1946. Shortly before his death he assisted, by telephone from his bedside, in the display of the BBC broadcast of the Victory Parade on a screen in the Classic Cinema in Baker Street.[cxix] His legacy of television for cinemas was continued by CTL in the hope of gaining acceptability for the electronic cinema. Earlier, Captain West had written to former Baird Organisation employee Dr Constantin Szegho in America requesting information on the manufacture of cathode ray projection tubes.[cxx] This information was forthcoming and CTL were able to re-manufacture pre-war projection equipment. An impressive display of a BBC Alexandra Palace broadcast was shown by CTL at the Palais de Luxe cinema in Bromley on the 21st of December 1948.[cxxi] (7) Sport was then shown in the next demonstration, only instead of the Derby Horse Race which had been shown nearly twenty years earlier, it was the Football Association Cup Final. In 1950 a selected audience sat down in the Odeon theatre in Penge and saw the football match on a screen which measured sixteen by twenty feet.[cxxii] The following year audiences in the Telekinema at the Festival of Britain were shown Cintel pictures for 15 minutes every hour over a 12 hour day between the 4th of May and 30th of September. [cxxiii] Various companies showed films at the Telekinema, some of which were in 3D and included:

Around is Around is Around is Around (British, Spottiswoodes, 1951)
Now is the Time to Put On Your Glasses (Canadian, McLaren, 1951)
The Black Swan (British, Spottiswoodes, 1951)
A Solid Explanation (British, Spottiswoodes, 1951)

Royal River (British, Spottiswoodes, 1951)[cxxiv]

However, fifty years after this event cinemas are yet to be equipped with electronic means of displaying their images.

Research on the company formerly known as Cinema Television Ltd as well as the Gaumont British Picture Corporation is being continued by this author and will be published at a future date.

7 It should be noted that the Rank Organisation acquired CTL during the war and hence this

Note 4

A History of Cinema Television Ltd written by Captain West.

Captain A.G.D. West wrote an interesting summary of the wartime work of the company under his Directorship, Cinema Television Limited. This note was written shortly after V.E. Day following a request by the Ministry of Supply to various company's who supplied electronic equipment to Britain during the war. Rather than copy images of the text recorded in PRO file AVIA 12/184, for clarity, it has been decided to retype the entire document whilst preserving the same heading and paragraph format.

....

CINEMA-TELEVISION LTD. 4TH JUNE, 1945.

HISTORY OF CINEMA-TELEVISION LIMITED'S WAR WORK.

E.10.

Baird Television Limited ceased operations in December 1939, due to the closing of the Television Service, and its factory and staff were taken over in May 1940 by its subsidiary Company, Cinema-Television Ltd., which has been throughout the war occupied solely on Government Contract work. Commencing with a staff of 40 and one factory in May 1940, it has been expanded, as contracts increased, to a total staff of 1,000 and three factories by December 1944. During the first year the Company was mainly occupied with development work on types of equipment associated with Television Technique, such as, for instance, Electronic Instruments, Cathode Ray Tubes, Photographic Recording Equipment and Radio Receivers for special purposes; but subsequently, with the help of the Ministry, it expanded its production facilities and labour so that now 95% of the employees are engaged on the production of vital equipment for the Services, and only 5% on its development. It is interesting to note that all the various types of equipment manufactured in quantity production in the factories were originally developed and designed in the Company's Development Department.

The following are some of the types of equipment which have been in production during the war :

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demonstration was recorded as being from Rank. Later CTL was registered as Rank-Cintel.

Mine Detection.

The Company has been entrusted by the Ministry with the development and the design of Detectors for locating all the various types of Enemy Mines – first Anti-Tank Mines and later Anti-Personnel Mines – from the Mk. I Detector (which was founded on ideas put forward by two Polish Officers) onwards. Mk. II was the subject of a "Crash" production programme for El Alamein when aircraft were waiting almost at the factory door to take complete sets by direct flight to Cairo immediately they came off th production line. A week after General Butler visited the factory at the end of July 1942 complete sets were leaving the factory at the rate of 100 per week, and were being used in the Desert within 48 hours afterwards. Mk. III was the Detector used for the landings in Sicily and Italy; and Mk. IV, which was a Miniature Detector, based on a new principle developed by the Company and capable of finding all the types of mine used by the Enemy in 1944, including the "Shoe" mine, was used for the Normandy landings on D-Day. Prior to that memorable date the employees had worked continuously every Sunday from March 1944 onwards, even right through the Easter and Whitsun holiday breaks to provide a sufficient number of Detectors of this type to satisfy Army's needs. Even after D-Day and when Flying Bombs were continuously passing overhead – no less than twelve fell within a quarter of a mile from the factory – the pace was maintained, and a large proportion of the staff, including many undaunted women, refused to go to shelter when the Imminent Danger Signal was sounded, but carried on with their work and just ducked under their benches when the Bombs were directly overhead. Thus the output figures were maintained at a vital moment of the War.

A further development resulted in the Mark IVA Detector which in addition can locate Mines under the Pavé of French roads, thus overcoming the difficulty that this kind of stone usually contains magnetic ore.

The Company has made 30,000 Mine Detectors to date.

The work of the Mine Detector is by no means finished at the termination of hostilities, for upwards of 10 million mines have been left by the Germans on the beaches and in the fields and vineyards of France. Detectors manufactured by Cinema-Television Ltd. are now being used by the French Government to clear up these extensive mine fields (which are still causing an average loss of life of 30 agricultural workers a day), so that the French Farmers can again be come fully productive and provide the sorely needed harvest. The French Ministry of Agriculture has paid tribute to the excellent and efficient work carried out by these Detectors for this purpose.

In addition to the normal hand operated type of Detector, special types have been devised, for example a miniature pocket type for paratroops; and a wide sweep type has been completed which fits to the front of an Armoured Car and rings a Klaxon when a dangerous mine is approached.

Electronic Recording Equipment.

The Company has developed, in association with Woolwich Arsenal Research Department, equipment for measuring, by means of high speed photographic recording of cathode ray tube patterns, the blast power of the various types of bombs, and the speed at which bomb fragments travel after the explosion. At the same time, equipment was supplied for measuring in millionths of a second the rate of detonation of various explosives. These instruments were installed in specially constructed buildings at Shoeburyness and elsewhere, and were used in the development of the super bombs, used with such devastating effect by the R.A.F. By this means it was possible to design bombs with the maximum power of blast, leading to the evolution of the blockbuster, the double blockbuster and the 10-ton Tessie.

Similar equipment manufactured by the Company recorded the pressures developed inside the barrel of guns when fired, and aided in the design of anti-tank and other types of guns.

A further application resulted from the design of an Electronic Chronometer which measures time intervals down to a millionths part of a second. This is used in conjunction with two photoelectric cameras set out at given distances in front of a gun, so that the shell in passing over the cameras generates an electric pulse from each, which is passed to the Chronometer, and from the measurement of the time interval between the two pulses the velocity of the shell is calculated. The Company manufactured a large number of these equipments for use at the Ordnance Development Establishments, and on the Ranges and Proof Buts throughout the Country, and this enabled the testing of the efficiency of guns and projectiles to be carried out with much greater accuracy and saving of time compared with the older methods. The final application of this equipment was in the form of a mobile truck which travelled over to France soon after D-Day and carried out calibrations on the batteries of guns enabling the Artillery crews to keep their equipment up to the highest pitch of accuracy and efficiency.

Unexploded Bomb Detection Equipment.

The Company has specialised in devices for finding and dealing with unexploded bombs. One of these equipments is a delicate Detector which can locate the approximate position of a bomb up to a depth of 15' below the surface of the earth. It operates on the principal of observing the change in the Earth's magnetic field, due to the presence of the bomb. Another equipment, called the Stethoscope, consists of a sensitive microphone, mounted on a magnet, which can thereby be attached to a bomb, enabling the Bomb Disposal Squad to retire to a distance to listen-in and see if the clockwork mechanism in the delayed action fuse of the bomb is still functioning. These Stethoscopes have been responsible for saving many lives.

Cathode Ray Tubes.

These have been made in large quantities for use in radio-location equipment, and a special type was developed for aiding in the location of the launching sites and tracks of Flying Bombs.

The Company has made over 110,000 Cathode Ray Tubes during the War period.

Photoelectric Cells.

These have been manufactured in large quantities for the projector sound heads for Army Film Units; in addition many special types of Cell have been developed, as, for instance, a chemical warfare research to measure the amount of poison gas in the air; in connection with anti-submarine work; for measuring the change in colour of the blood of pilots flying at an extremely high altitude; and for operating cameras used by bombers on night operations when photographing their targets at the moment that the bombs they have dropped are exploding.

Anti-aircraft Shell Fuse Timing Equipment.

This equipment was developed and manufactured for the Projectile Development Establishment for measuring and recording the time interval between the firing of the shell and the explosion of the shell in mid air. It is also used for proof testing anti-aircraft shells.

Special Radio Receivers.

A special type of radio receiver was developed which indicated on the screen of a cathode ray tube the operating frequency of any Enemy Radio Station which started transmitting. The purpose of this Receiver was to enable such steps to be taken either for the interception of the Enemy message or for the jamming of the message, as required on the occasion. The Company also manufactured tiny Radio Telephone Transmitter-Receivers which were strapped to the chest of a paratrooper and enabled him to maintain contact with his aircraft or with his Headquarters immediately after landing.

The Company wishes to express its appreciation of the continued and sympathetic help extended to the Company throughout the War years, particularly by the Director General of Signals Equipment and the Controller of Physical Development, and their Officers for their practical aid in effecting expansion of output and their encouragement and co-operative attitude during difficult times.

A.G.D. West.
Director.
CINEMA-TELEVISION LIMITED.

7.10 References

[i] Wheen, F. (1985). *Television.* London: Century Publishing Co. pp. 1.

[ii] Burns, R.W. (1985). The History of Television for Public Showing in Cinemas in the United Kingdom. *Institute of Electrical Engineers Proceedings.* 132. A. 8. pp. 553-563.

[iii] Most reports state that the screen measured 6 X 3ft whereas Moseley states that the screen was in fact 5 by 2ft. It is left to the author to decide which size is most accurate on estimation of both pictures of the screen. Moseley, S. (1952). *John Baird: The Romance and Tragedy of the Pioneer of Television.* London: Odhams. pp. 142.

[iv] Hobson, P. Archive of television investigations at library of University of Glasgow.

[v] Mc Arthur, T. and P. Waddell (1990). *Vision Warrior.* Orkney: Orkney Press. pp. 177.
Herbert, R.M. (1997). *Seeing By Wireless.* 2nd edition. Croydon: PW Ltd. pp. 16.

[vi] Burns, R.W. (1985). The History of Television for Public Showing in Cinemas in the United Kingdom. *Institute of Electrical Engineers Proceedings.* 132. A. 8. pp. 553-563.

[vii] The Baird system of projection utilised a Kerr light cell. This cell was invented by John Kerr in 1875 and was constructed from thin interleaved electrodes hermetically sealed in nitrobenzene. O'Neil, B. (1990 December 15). Baird's Clear Vision of the Future. *New Scientist.* pp. 49.

[viii] Baird, J.L. (1990). *Soap and Television.* (Second edition) London: Royal Television Society. pp. 117.

[ix] The Baird Screen in Copenhagen. (1933 January) *Television.* pp. 13-14.

[x] Herbert, R.M. (1997). *Seeing By Wireless.* 2nd edition. Croydon: PW Ltd. pp. 13.

[xi] Singleton, T. (1988). *The Story of Scophony.* London: Royal Television Society. pp. 135.

[xii] Moseley, S. (1952) *John Baird: The Romance and Tragedy of the Pioneer of Television.* London: Odhams. pp. 180.

[xiii] Singleton, T. (1988). *The Story of Scophony.* London: Royal Television Society. pp. 80. According to a 31st of March 1938 memorandum about subsidiary and associated companies of Gaumont-British Picture Corporation Limited there was no holding by this company of Scophony interest at this time. PRO BT 58/249

[xiv] Moseley, S. (1952) *John Baird: The Romance and Tragedy of the Pioneer of Television.* London: Odhams. pp. 176.

[xv] ibid. pp. 181.

[xvi] "Gaumont-British Picture Corporation", *Projected Picture Trust Newsletter,* No5 1981-82.

[xvii] For further information the reader is referred to the writings of Burns, Norman and McArthur/Waddell; various publications are noted in the bibliography.

[xviii] Baird, J.L. (1990). *Soap and Television.* (Second edition) London: Royal Television Society. pp. 140.

[xix] ibid. pp. 141.

[xx] Herbert, R.M. (2000, March 23). Interview with the author.

Moseley states in *"Romance and Tragedy..."* that before the Crystal Palace fire J.L.Baird transmitted pictures to a "twelve foot" television screen in the Dominion Theatre in Tottenham Court Road, London. p219 The fact that Moseley mentions colour as well as the information that J.L.Baird requested permission to *begin* large screen cinema television demonstrations in January 1937, suggests that Moseley's statement is too early by one year.
Burns, R.W. (1985). The History of Television for Public Showing in Cinemas in the United Kingdom. *Institute of Electrical Engineers Proceedings*. 132. A. 8. pp. 553-563.

[xxi] The precise date of the creation of Cinema Television Ltd is not known, but according to Baird historian Douglas Brown it is believed to be during the last two weeks of November and before December 7th 1937. A telephone call to Companies House on April 18 200, revealed no further evidence and a representative stated that there was no record of Cinema Television Ltd. by the author

[xxii] PRO BT 58/249.

[xxiii] PRO ADM 204/1432.

[xxiv] Television in the Cinema (1938, March). *Practical Mechanics*.

[xxv] Seeing the Derby in Comfort. (1939, June). *Television and Short Wave World*. pp. 336.

[xxvi] Marsland Gander, L. (1939, March). Telegossip. *Television and Short Wave World*. pp. 153.

[xxvii] The Monseigneur News Theatre was owned by Jack Davis who later in 1939 travelled to America to form an American branch of the Scophony company. Finestone, F. (1939, September 15). See War Shifting World Television Center to U.S. *Motion Picture Daily*.

[xxviii] Scannings and Reflections (1939, April). *Television and Short Wave World*. pp. 210.

[xxix] Herbert, R.M. (2000, March 16). Interview with the author.

[xxx] Keating, F. (1999, November 22) Way Back When. *Guardian Unlimited*. Web Edition.

[xxxi] Bell, C. H. (1939, August). Facts and problems for the cinema. *Electronics and Television and Short Wave World*. pp. 467-469.

[xxxii] Singleton, T. (1988). *The Story of Scophony*. London: Royal Television Society. pp. 92.

[xxxiii] Burns, R.W. (2000). *John Logie Baird, television pioneer*. London: MPG Books Ltd. pp. 356-357.

[xxxiv] ibid.

[xxxv] PRO J 107/164

[xxxvi] Herbert, R.M. (2000, March 21). Interview with the author.
Mr Herbert has many records pertaining to Mr Clapp, including this pay cheque.

[xxxvii] Baird, J. L. personal diary 8th of May and 16th of June 1940.

[xxxviii] Herbert, R.M. (2000, March 23). Interview with the author.

[xxxix] J.L.Baird continued his relationship with A.G. Church into the war and even made a note in his diary to buy a wedding present for Church (possibly for a son or daughter) on the 26th of March 1940.

[xl] J.L.Baird states "*...with my contract terminating with the appointment of the receiver, I became a free agent. I was in the middle of some extremely interesting and, I believed, important work on*

colour television and, rather than see this stopped, I continued this work at my own expense, keeping on two assistants and working in a private laboratory attached to my house at 3 Crescent Wood Road"
Baird, J.L. (1990). *Sermons Soap and Television.* (Second edition) London: Royal Television Society. pp. 145.

[xli] Herbert, R.M. (2000, March 21). Interview with the author.

[xlii] Elsie T. (1999, October 27). Interview with Melvyn Harrison and Adrian Hills on behalf of The Crystal Palace Foundation.

[xliii] PRO J 13/16536.

[xliv] Clapp, B. (1987, March 24). Interview by Royal television Society.

[xlv] Foulger, C. (1998, September 7). Letter to Melvyn Harrison of the Crystal Palace Foundation.

[xlvi] Herbert, R.M. (200, April 6). Interview with the author.

[xlvii] Crystal Palace Trustees. *The Second World War Minutes*

[xlviii] A Photo-Electric Incendiary Bomb Detector (1939, November). *Electronics and Television and Short Wave World.* pp. 634.
The Baird Photo-Electric Cell Drill. (1939, December 29). *The English Mechanic.* np.

[xlix] Admiralty Research Laboratory. Report on visit to Messrs Baird Television Limited., Lower Sydenham, on 25.1.40. PRO ADM 204/1432.

[l] Herbert, R.M. (2000, March 16). Interview with the author.

[li] Crystal Palace and Baird (1940, August). *Wireless World.* pp. 364.

[lii] PRO CAB 104/102.

[liii] PRO AVIA 22/2719.

[liv] ibid.

[lv] Moseley, S. (1952) *John Baird: The Romance and Tragedy of the Pioneer of Television.* London: Odhams. pp. 179.

[lvi] PRO BT 58/249.

[lvii] The speech was based on information in a seminal paper on aerial bombardment by Italian General Giulio Douhet from 1921 and was translated into English in 1923. Hence Baldwin's famous 1932 speech. Isaac Mac, I. (1976). *Strategic Bombing in World War Two.* New York: Garland Publishing. pp. 8.

[lviii] Burns, R.W. (1993, May). *IEE Proceedings,* Vol. 140, No.3 and (1996, January). IEE Proceedings, Vol. 143, No.1 respectively.

[lix] Curran, S. (1988). *Issues in Science and Education.* Lancashire: Parthenon Publishing Group Ltd. pp. 11.

[lx] Minute of Projectile Development Establishment 19th December 1939, PRO AVIA 15/49.

[lxi] Burns, R.W. (1993, May). *IEE Proceedings,* Vol. 140, No.3.

[lxii] Ministry of Aircraft Production (1941, May 20). Letter to University College, Exeter. PRO AVIA 13/891.

[lxiii] Pawle, G. (1957). *Secret Weapons of World War II.* New York: Ballantine. pp. 101-105.

[lxiv] Burns, R.W. (1996, January) Factors affecting the development of the radio proximity fuze 1940-1944. *IEE Proceedings.* Vol. 143, No.1.

[lxv] PRO AVIA 13/905.

[lxvi] ibid.

[lxvii] Green, W. (1961). *Fighters: Volume II.* New York: Hanover House. pp. 90.

[lxviii] Jones, R. V. (1995, December 11). Letter to Peter Waddell.

[lxix] PRO AVIA 22/2752.

[lxx] ibid.

[lxxi] ibid.

[lxxii] PRO AVIA 22/2719.

[lxxiii] Thomas, E (1999, October 27). Interview with Melvyn Harrison and Adrian Hills on behalf of The Crystal Palace Foundation.

[lxxiv] Herbert, R.M. (2000,May 12). Interview with the author.

[lxxv] Interestingly J.L.Baird mentions in his diary a Tesla tester on 18th of June 1940.

[lxxvi] Thomas, E. (1999, October 27). Interview with Melvyn Harrison and Adrian Hills on behalf of The Crystal Palace Foundation.

[lxxvii] PRO AVIA 12/184.

[lxxviii] PRO CAB 120/835.

[lxxix] Crystal Palace Trustees. *The Second World War Minutes.*

[lxxx] Mc Arthur, T. and P. Waddell (1990). *Vision Warrior.* Orkney: Orkney Press. 251.

[lxxxi] PRO AVIA 22/2719, AIR 2/2877.

[lxxxii] Hills, A.R. (1999). *Visions: The Life and Legacy of John Logie Baird.* CD-ROM. Glasgow: SCRAN.
Herbert, R.M. (1999, March 21). Interview with the author.

[lxxxiii] PRO AVIA 22/2752.

[lxxxiv] PRO CAB 120/835.

[lxxxv] Elsie T. (1999, October 27). Interview with Melvyn Harrison and Adrian Hills on behalf of The Crystal Palace Foundation.
Hayman, D. (1999, December 12).Interview with the author.

[lxxxvi] Crystal Palace Trustees. *The Second World War Minutes.*

[lxxxvii] PRO AVIA 22/2752.

[lxxxviii] Clapp, B. (1987, March 24). Interview by Royal television Society.

[lxxxix] Douglas, W. S. (1939, October 22). Minute 2. PRO AIR 2/1775.

[xc] Clapp, B. (1987, March 24). Interview by Royal Television Society.

[xci] PRO AVIA 12/184.

[xcii] Hills, A.R. (2002, March). Baird Television Ltd and Radar. *Transmission Lines*. Vol. 7. No. 1.

[xciii] Herbert, R.M. (2001, March 16). Interview with the author.

[xciv] The VCR code referred to Air Ministry titles. The Admiralty used NCR. Hence a Skiatron was a VCR 520 to the Air Ministry, or with slight differences, an NCR 17 to the Admiralty.

[xcv] PRO ADM 1/13764.

[xcvi] Herbert, R.M. (2000,April 3). Interview with the author.

[xcvii] Herbert, R.M. (2000,April 6). Interview with the author.

[xcviii] PRO AVIA 7/1232.

[xcix] Gough, J. (1993). *Watching the Skies*. London: HMSO. pp. 66.

[c] Admiralty Research Laboratory. Report on visit to Messrs Baird Television Limited., Lower Sydenham, on 25.1.40. PRO ADM 204/1432.

[ci] Smyth, J. (1997, June 1). Baird revealed as secret war worker. The Sunday Times. pp. 11.

[cii] Carter, A. (2001, January 23). Interview with the author.

[ciii] Cockcroft, J.D. (1943, May 11). Minute for ARDRE. PRO AVIA 22/862.

[civ] Report (1941, September 15). Report on Present Position of Mine Detector. PRO AVIA 22/861.

[cv] PRO AVIA 22/861.

[cvi] Report for Ministry of Supply by Captain Sale after a visit to CTL on 25th of July 1942. PRO AVIA 22/861.

[cvii] Carter, A. (2000, April 20). Interview with the author.

[cviii] Clapp, B. (1987, March 24). Interview with Royal television Society.
Mr Clapp communicated with the M of S referring to a Swedish mine detector on 28th of March 1942. Ibid. PRO AVIA 22/861.

[cix] Carter, A. (2001, January 23). Interview with the author.

[cx] Engineer Report on visit to Paris 21-25th of March 1945, PRO AVIA 22/862.

[cxi] PRO AVIA 74/15.

[cxii] PRO AVIA 12/184.

[cxiii] Bannister, C.R. (1943, June 11). Letter to Ministry of Supply. PRO AVIA 22/862.

[cxiv] Gough, B.H.J. Ministry of Supply (1940, March 9) Report on Meeting at Institut Poincare. PRO AVIA 22/861.

[cxv] PRO AVIA 22/872.

[cxvi] Parr, G. (1945, June 18). Letter to R.Cock of M of S. PRO AVIA 22/862.

[cxvii] West, S.S. (1946, March). Land Mine Locators. *Electronic Engineering.* pp. 69-74.

[cxviii] Lance, T.M.C. (1946, July 25). Letter to Col. French in German H.Q W.T.S.F.F., as well as other enclosures from PRO AVIA 54/1490, AVIA 22/908, AVIA 39/70 and AVIA 39/14.

[cxix] "Trade Discuss Vision Policy", Today's Cinema, 7th June 1946. PRO HO 45/24294.

[cxx] West A.G.D. (1946, June 3). Letter to Dr C.S.Szegho. From the collection of Douglas Brown.

[cxxi] Kine Television is Here(1948, December 30). *Kinematograph Weekly.*
Rank Shows His Paces With Cinema 'Vision. (1948,December 24). *To-Day's Cinema.*
PRO HO 45/24294

[cxxii] The Large screen TV Demonstration. (1950, May 3). *The Cinema.*
PRO HO 45/24294.

[cxxiii] PRO WORK 25/261.

[cxxiv] Dungate, A (2000, June 10) E-mail to author.

CHAPTER 8

John Logie Baird and Cable &Wireless

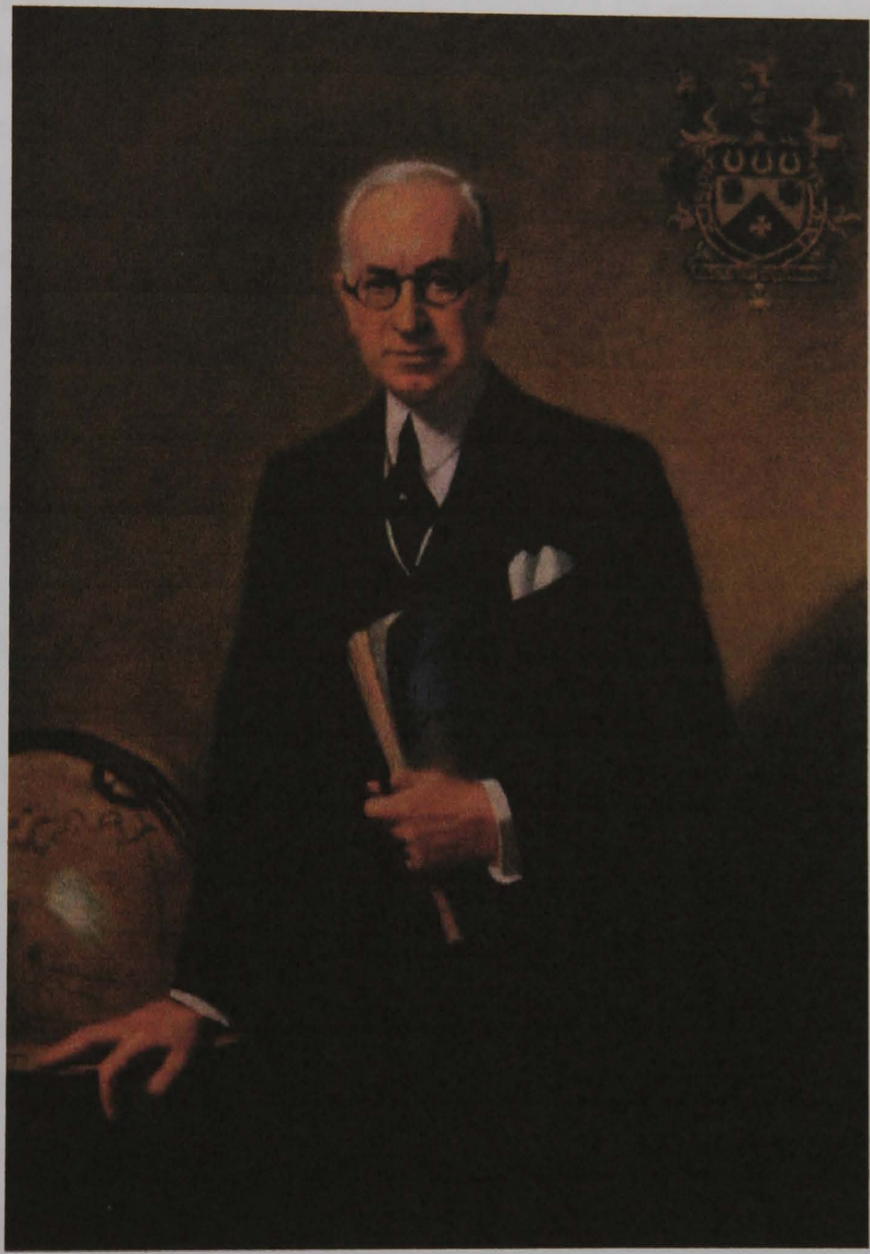

Fig. 8.1 *Sir Edward Wilshaw of Cable & Wireless Ltd.*

Source: Cable & Wireless Ltd.

8.1 Abstract

From his earliest full system investigations into television John Logie Baird sought a variety of applications for television technology. The inventor offered signalling using television within months of his first demonstration. Various systems were produced and tested, both by the inventor and the British Government. During the 1930s Baird Television Ltd continued signalling investigations in various applications. J.L.Baird seems not to have been centrally involved with these investigations and instead concentrated on television for public broadcast separately from the main company. At the outbreak of war in 1939 John Baird, now 52 years old, continued his research into television in his private laboratory in Sydenham. Later, in 1941 Cable and Wireless (C&W) funded this research and hoped to speed up their signalling using developments from the Scotsman's systems. For various reasons Cable and Wireless gained no demonstrable benefit from J.L.Baird's endeavours. However, one system known as Ultrafax, was produced after the War by the Radio Corporation of America. This system may have been derived from the wartime investigations of J.L.Baird.

8.2 British electronic image signalling, 1926 to 1939

A very early example of British Government interest in television for signalling was when they were offered a system by J.L.Baird on 2nd of June 1926.[i] Although the system was only capable of placing points of interest on a distant map, it is nevertheless an example of British interest in Television for signalling. More complex messages, such as images of individual letters shown in series was investigated in Britain during 1929. J.L.Baird filed a patent for this system and the British Government also undertook similar investigations.[ii] Also in 1929 trials using the airship R100 investigated the use of sending weather maps and similar information via a modified Fultograph image scanner. The Fultograph could scan an image in reasonable half-tone detail and send it over a period of approximately 20 minutes.[iii] These trials to and from a mobile unit were reasonably successful but were conducted over a very short distance. The Long distance capabilities of systems similar to the Fultograph had already been investigated.

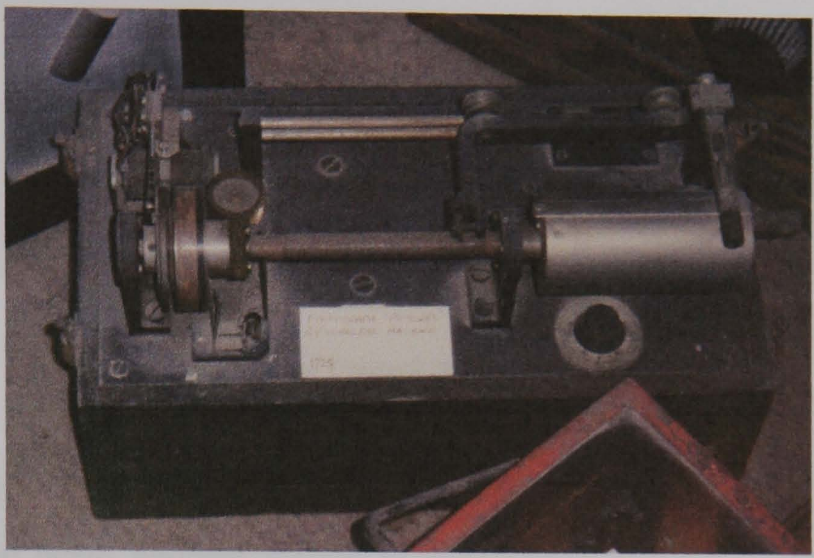

Fig. 8.2 *A Fultograph facsimile machine photographed at Amberley Chalk Pits Museum, 1998.*
Source: Author's personal collection

On the 1st of May 1926 an image from a horse race was sent across the Atlantic from New York to London via C&W underwater cables. The pictures below show the original image and the facsimile received. The quality of the facsimile along with the hour long transmission time indicates that this system, although impressive, was not capable of delivering complex information quickly. The system, a co-operation between RCA and the Marconi Company was transmitted using long wave radio and delivered an equivalent of 100 w.p.m. if compared to the long established Wheatstone signalling system.[iv] Arguably, the other contemporary systems already mentioned were capable of delivering much more useful information over a considerably shorter time. For instance if just one letter was sent per image field at 30 frames per second, then 1800 letters could be sent a minute. At an average of six letters per word the Nipkow system would therefore be three times faster.

Fig 8.3 *Original image*

Fig. 8.4 *Image after transmission*

Source: Cable & Wireless Ltd

Later on the 24th of October 1930 an individual image of an airman was sent from the Ballan beam wireless station in Australia to London.[v] Further tests using Marconi microwave transmitters were conducted using a wavelength of around 17cm for sending facsimile information between Dover and Calais.[vi] By 1934 improved systems became available increasing both speed of image delivery and picture quality. On the 23rd of October the beam system was again used and Cable and Wireless transmitted a short film clip. Showing aircraft from the England-Australia Air Race landing in Melbourne, the film was transmitted back to Britain where it was distributed to Gaumont British cinemas. Although each film frame had to be sent individually, necessitating about 20 hours of transmission, the reconstituted film was received with much acclaim.[vii] The feat of sending simple messages over this distance had already been achieved on the 6th of September 1932. This transmission involved the sending of worded phrases and not images. However, it did assist the Marconi Company to gain knowledge of complex television related transmission over this particular route.[viii]

Further very long distance broadcasts, this time from London to Japan, were transmitted during 1936. Standard Telephones and Cables Ltd co-operated with the General Post Office to install experimental radio picture equipment in the Radio Telephony Terminal in London. This equipment transmitted a total of seventy pictures to Tokyo between November 17th and December 19th. Later in January 1937 comparison tests were made using Cable and Wireless circuits to Tokyo. Other picture sending apparatus supplied by C&W as well as by the Japanese, were also tested.[ix]

Cable and Wireless had therefore directly investigated ways of increasing the speed and quality of messages sent over long distances. At the outbreak of war the need for improved intelligence transmission greatly increased. For instance in 1938 44 million words were sent via C&W, this figure increased to 354 million during 1944.[x] In May of 1941 the Cable and Wireless Central Telegraph office in Moorgate, which was responsible for handling phototelegraphy, was destroyed by fire. Shortly after this setback C&W commenced negotiations with John Logie Baird to see if the Scotsman could improve the company's intelligence transmission.[1]

As early as 13th of February 1939, when it was apparent that war was on the horizon, J.L.Baird's friend Sydney Moseley submitted Baird's as well as his own name to Captain J.H.Godfrey of the Admiralty for military employment.[xi] Neither name was accepted. However, both John and Sydney were destined to help the war effort in their own unique ways.

8.3 The Cable & Wireless Consultancy

The initial negotiations between C&W and J.L.Baird are chronicled in the inventor's diary. According to this record negotiations started with Sir Edward Wilshaw, Director of C&W, on the 30th of July 1941. At this time J.L. Baird was convalescing at Tempsford Hall in Bedfordshire after a mild heart attack and had to travel into London for this meeting.[xii] He had been at this health spa from the 13th of May and undertook a severe regime of dieting which helped him lose two stone nine pounds.[xiii] To occupy his mind he also took time to dictate his autobiography *Sermons, Soap and Television*. By the 9th of October, and now mostly recovered, J.L.B. offered Sir Edward an option to buy control of ordinary shares in a specially

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[1] Mr J. Arthur Smale, B.Sc. of C&W wrote to the then archivist of the company on December the 6th 1978. He recollected that his diary had an entry about a meeting attended at "Gauement-Baird (West)"(sic), i.e. the Baird Television Limited under the direction of Captain A.G.D.West. Smale explains that BTL requested use of C&W radio links for picture telegraphy. This request was originally declined and seems not to have been investigated until J.L.Baird's personal consultancy.

formed company for between £25 000 and £30 000. The inventor requested a yearly salary of £1500 for 5 years. His contract as "Consulting Technical Advisor" issued on the 1st of November 1941, involved no company shares and was for a lesser fee of £1000 per annum for three years.[xiv]

The precise nature of the work undertaken for C&W by J.L.Baird between the beginning of his consultation and the 26th of October 1943 cannot be established. Extensive research at the C&W archive in Porthcurno has revealed no information. The C&W minute book makes no mention between the initiation of the consultation and the 1943 date. Between these two dates J.L.Baird records in his personal diary 89 references relating to his consultation. In this time he visited the Marconi company in Chelmsford, by then a subsidiary of Cable and Wireless. This site contained some of the company's laboratories and transmitters. As Marconi was then a subsidiary of Cable and Wireless it is likely that this visit was related to the inventor's consultancy work.[xv] At the end of this chapter is a chronological list of all entries in J.L.Baird's diaries between the beginning of his consultation and his death in 1946.

Money gained from this consultancy assisted the Scotsman to develop colour and stereoscopic attributes for television.[2] It is not known if this work was included in the remit from C&W, although there was also official Government interest. A member of the Ministry of Supply along with Major Church visited J.L.Baird on the 13th of December 1941. A stereoscopic television system, probably the same as that shown to members of the press five days later, was demonstrated.

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[2] The Colour and stereoscopic work of J.L.Baird has been described by Ray Herbert in his book *Seeing by Wireless* and R.W.Burns in *John Logie Baird: television pioneer*, as well as various journals. See index for full reference.

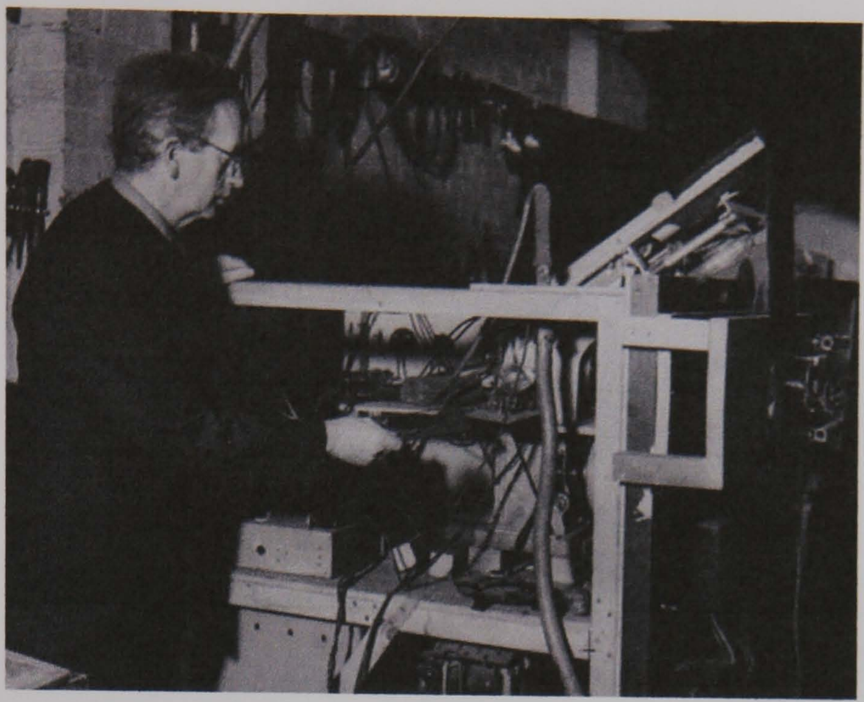

Fig. 8.5 *J.L.Baird with colour stereoscopic apparatus as demonstrated on the 18th of December 1941. Mr Baird is seen here to be relatively thin, a result of his dieting at Tempsford Hall.*

Source: R. M. Herbert

Although the public presentation also included colour, there is no mention of this image attribute in a reply from the M of S representative to J.L.B on the 19th of December. Evidently Mr Baird wished to offer the apparatus for military use. However the M of S representative noted that "*...there is nothing that would warrant the continuation of the work, even to the extent of helping [J.L.Baird] to retain the services of technical staff liable for national service.*"[xvi] Interest by C&W in J.L.Baird's colour and stereoscopic work is not recorded until January of 1944. Whether the representation to the M of S included possible adaptations for radar is discussed in chapter five.

The main directive of J.L.Baird's work was to include the speeding up of intelligence communication. Various references in J.L.Baird's diary mention the phrase 'secret signalling', and this may have been a term which the Scotsman used for this technology. The word 'facsimile' is also used and these words are included in the selected diary log at the end of the chapter. However, without any other available information it is only possible to suggest that work in this period led to the post 1943 developments of signalling, or that this technology had not been properly investigated until after that time.

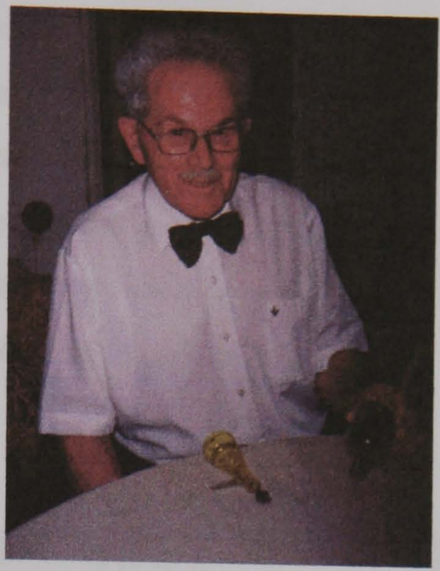

Fig. 8.6 *Mr Eric Turpin of Lewes, Sussex.*
Source: Author's personal collection

Cable and Wireless had a vast network of underwater cables throughout the world as well as a beam wireless system for communication. The underwater cables were used for telegraphic communication and therefore could not carry an audio signal for speech communication. It is therefore unlikely that J.L.Baird's visual signalling was designed for transmission over these cables. However, there were experiments in 1942 to transmit synthesised speech along the underwater cables. Mr Eric Turpin has stated that he worked at the GPO research station at Dollis Hill in 1942 with an electronic device, which was adapted for this purpose. The device used was called a Voder[3], a voice synthesis machine that would be operated in a similar manner to a church organ with hand keys and knee controls. The skilful operator, who would need a years training, could then 'play' this machine which would synthesise the human voice. In order to produce the full range of sound similar to the human voice the machine would break up the range of sound into ten facets and include an eleventh for sibilants. A second transmission line was needed for delivery of the pitch of the voice. Each part of the divided signal, having less information than

[3] The term Voder, was derived from Voice Operation DemonstratoR. It was Invented by Homer Dudley of Bell Telephone laboratories, and described in US patent 2 127 142,. He made ten machines, before modifying his system to produce the Vocoder. This was a more sophisticated machine which transduced human voice signals into component parts which would could then be transmitted in parts through a medium which was not capable of sending the signal in its unbroken form. The author wishes to thank Yumiko Urae for this information provided in e-mail dated 17th of

a full voice signal, could then be transmitted over telegraph cables such as those provided by Cable & Wireless. At the receiving end each of the ten signals were used to moderate the output harmonics of a sawtooth waveform generated locally using a neon oscillator.[xvii] However, after various investigations the idea was dropped. It is therefore clear that some investigation to send complex signals over C&W underwater telegraph cables was investigated, but it is unlikely that a complex television image would have been investigated.

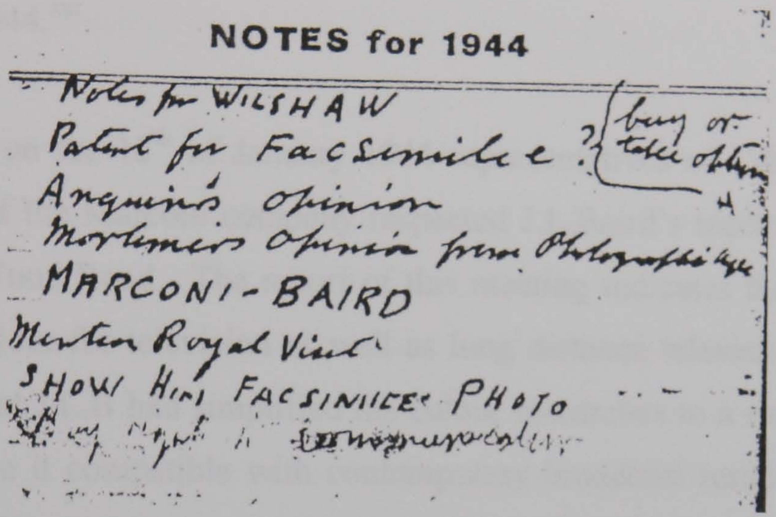

Fig. 8.7 *A selection from J.L.Baird's Diary.*

Source: Prof. M. H. I. Baird

On the 26th of October 1943 the C&W minutes make their first mention of work undertaken for them by J.L.Baird. The minute records simply that sir Edward had seen "*certain television experiments being conducted by Mr Baird*".[xviii] It is unclear what these experiments were. By the end of 1943 J.L.Baird wished to establish a television studio specifically for colour research with funding from Cable and Wireless. It is also possible that the Scotsman wished to form a company with C&W as he refers to a desire to form a company by the first of April 1944.[xix] This desire was the first of various suggestions by J.L.Baird to go into partnership with C&W. Cable and Wireless did not form a company with J.L.Baird. C&W was also offered an option to purchase patents and all rights to the Scotsman's work relating to Telegraphy and communications.[xx] However, there is no direct evidence that such a purchase was undertaken. The question of whether later technologies produced by

January 1998. Urae's information was derived from Homer Dudley, R. R. Reisz, and S.A. A. Watkins (1939, June). A Synthetic Speaker. *Journal of the Franklin Institute.* Vol 227. No 6. pp 739-764.

C&W were derived from J.L.B's work is discussed below. It was stated that J.L.Baird considered experimental colour transmission from a C&W funded studio would subvert the unpopular transmitting monopoly of the BBC, and give the company a priority when licences were eventually issued for commercial broadcasting. However, C&W replied that such broadcasts might damage the company's relationship with the British Post Office and the British Broadcasting Corporation, and hence would not directly fund a colour studio other than continuing payment of the consultation fee beyond the initially agreed termination date of the 1st of November 1944.[xxi]

At 3pm on the 13th of January 1944 representatives of C&W as well as a representative of the Marconi company inspected J.L.Baird's studio and equipment at 3 Crescent Wood Road. The report of this meeting indicates that J.L.Baird was investigating colour for television as well as long distance television signalling. It was recorded that J.L.B had simplified his colour researches to a two colour system in order to make it compatible with contemporary broadcast restrictions, a system which would also assist stereoscopic images. At this time there was also a demonstration of a version of the Telechrome two colour cathode ray tube. Although a patent application had been submitted on the 25th of July 1944 for this device it was not demonstrated to the public until the 18th of August 1944.[xxii] Generally the report indicated that although the value of colour television had been demonstrated, any further development was *"...beyond the capabilities of Mr Baird's present organisation..."*

The report also mentioned a previous visit when there was a demonstration of the intermediate film technique adapted for the transmission of facsimile messages. At that visit *"It was pointed out that no long distance radio circuit would permit the transmission unless the speed of scanning were enormously reduced...Mr Baird wanted to try it out."* J.L.Baird later conceded that the reduction in speed of transmission would make it no faster than other contemporary methods. The report finished by stating, *Consequently we conclude that no valuable contribution has been made to the direct business of Cable and Wireless i.e. to the handling of messages and pictures over a large number of short distance relay circuits working on low power at very short wavelengths, it would be worth considering such a system of facsimile transmission. Such relays are technically possible but their establishment obviously introduces non-technical questions of an International character* [xxiii]

As a direct result of this visit, and despite shortage of capital, it seems that J.L.Baird focussed on the reduction of image scanning speed in order to produce a system capable of facsimile transmission. There is no technical description of the precise system investigated but it is likely to be a similar form to that investigated by Baird Television Limited before the war as described in chapter six. It is unclear whether there was direct communication between the Baird organisation, now known as Cinema Television Limited, and J.L.Baird himself regarding this technology. However, there is a variety of mentions of members of the Baird organisation in the diaries of J.L.Baird and therefore there must have been some form of communication. Evidently further investigations by JLB were beginning to command his attention. On the 3rd of April J.L.B. wrote to Sir Edward stating that after the war he hoped to "*carry out more extensive experiments on the practical application of television to telegraphy.*" [xxiv] This was not the only thing occupying John Baird's mind. Money was beginning to become an increasing problem and he was currently in the midst of some intense business negotiations.

8.4 The Baird Holding and Development Trust

John Baird started his research during the war with capital of approximately £15 000.[xxv] However, despite receiving his consultancy fee of £1000 per annum by 1943 his funds were seriously low. There were various attempts by the Scotsman to obtain the funding necessary to continue his research. None of these attempts seem to have included involvement with his original company and instead he tried to form another company as well as requesting greater funding from C&W and further consultation work. As described in chapter five, J.L.B approached General Whittaker and Robert Watson-Watt regarding possible consultation for radar. He also approached C&W for greater funding and is recorded in the company minutes as stating that *"... he had been approached by a Syndicate with an offer of £7000 a year for 2 ½ years; the Syndicate would then have the right at the end of that period to form a company to take a fifty-fifty interest in Mr Baird's inventions".*[xxvi] After discussion C&W were not prepared to increase their financial outlay and perhaps thought that this was simply a ruse to get more money. This was not the case, as evidence recently uncovered shows that there was an interest in J.L.Baird's inventions by a syndicate.

A series of documents lot BKS 8761 sold at auction on the 19th of May 2000 record a proposal for the formation of the Baird Holding and Development Trust (HDT).[xxvii] Mr Tom King, a journalist and mentioned regularly in J.L.Baird's diaries, and Mr Irving Harris, also a journalist and owner of an entertainment business, communicated on the 18th of January 1943 regarding this proposal. Negotiations between the two then lapsed but were continued on the 21st of August when King wrote to Harris mentioning a recent Daily Mirror report that said after the war there would be *"... no BBC monopoly... "* and that *"The wings for victory are flapping stronger & stronger, let's be in ready together when the curtain falls".* Clearly it was thought that the war would soon end and that television broadcasting independent of the BBC would be possible. This fact was probably also mentioned by J.L.Baird in the various communications with King in the previous months. With this renewed enthusiasm a Mr Loftus was involved as a third financier in September.

It was proposed that the Holding and Development Trust, having as few subscribers as possible, would purchase the entirety of J.L.B's patents, past present and future. An initial investment of £50 000 would then be used to develop these patents and produce production facilities. A company would then be formed, initially titled as The New Baird Television, but after further consultation it was decided that although the name of Baird could be used, it could not directly refer to the original Baird Television. Television receivers were the first product to be investigated as it had already been proved with the original Baird Television Limited that this was the product most financially remunerative. Negotiations became more intense in March of 1944 as J.L.Baird refers in his diary to his agreements with both Baird Television Limited and Cable And Wireless.[xxviii] This note probably refers to the concern that these agreements would be affected by the formation of the HDT. Two weeks later he writes *"Ring Tom King, I think we are at the beginning of a very big thing"*.[xxix]

At this time John Baird was very ill and the day after writing this note he travelled to Bude in Cornwall to convalesce with his family during the Easter holidays. This hiatus did not help with his business negotiations and Mr King informs Harris that J.L.B had "gone into hiding". A second letter, written on the last day of the month records that J.L.B could not supply detailed written information at such an early stage in negotiations and preferred a personal interview. He was also unwilling to sign legally binding documents until all implications of such documents had been assessed. King's letter notes "[J.L.Baird] *has a strong antipathy to putting things down on paper because of his previous experiences"*. At the beginning of a new stage of business Baird probably remembered his earliest problems when he separated links with his television business partner Wilfred Lytton Day in December of 1925. The correspondence of this first television company has been purchased at much cost and is displayed in Hastings Museum.

In March of 1944 John Baird was fifty three years old, had already suffered one mild heart attack and was again suffering a debilitating illness. These illnesses, which were probably associated with deep depression, had often damaged the forward progress of his efforts. This business venture was no exception and in the only letter surviving from him about this subject he writes *"I have been far from well and am under strict medical advice"* and *"As I don't want to appear discourteous, or you to keep these other people hanging about any longer, perhaps your suggestion to discontinue negotiations is the proper course"*.[xxx]

A letter from Tom King to Baird was written the same day and demanded an explanation for John Baird's behaviour and lack of communication. An offer of a meeting between prospective financiers and J.L.B was also given. The letters 'crossed in the post' and on receipt of Baird's letter King apologised and rallied his friend with the words *"... matters are only at a standstill for health reasons and that as soon as you are better we will 'strike up the band' again"*.

In the ensuing days John Baird was very busy arranging the submission of patents as well as preparing a lecture on facsimile television by someone called Angwin on the 21st of April. [4] On the 9th of May he returned to London and had lunch on the 17th at 1pm in the famous Scott's fish restaurant with Tom King. The Grosvenor Hotel near Victoria Station was the chosen venue for a second dinner meeting on the 24th in which further detailed discussions with certain financiers were held. Television for public broadcast was not the only thing on John Baird's mind during this meeting. His diary records his intense enthusiasm for facsimile television, one of his alternate projects being developed for Cable and Wireless. He writes *"A speed undreamt* [sic] *of by other methods became possible by Fac Tele"*, *"Facsimile Television opens a new era in communication. Messages sent by television and received on continuously moving* [?]*"*, *"Communication will give us the newspaper man's dream The International Daily Paper"*.[5] [xxxi] As Tom King was a journalist it was not unreasonable to suppose that he was aware of this new adaptation of television media. Whether this fact was mentioned to the financiers is only a matter for speculation.

How or why business negotiations for the Holding and Development Trust collapsed is not known. In the autumn of 1944 John Baird formed a company to

[4] It is thought that 'Angwin' may refer to Colonel. A.S. Angwin, who prior to the outbreak of World War II was Deputy Chief Engineering of the Post Office. According to Prof. R. W. Burns in "British Television: The Formative Years" Angwin was involved with pre-war television and therefore would have been known to J.L.Baird. So far it has not been discovered to whom Angwin delivered the lecture. The author wishes to thank Prof. Malcolm Baird for the above information.

[5] The enthusiasm for the possibilities of facsimile telegraphy was echoed by Sir Edward Wilshaw on page 24 of *Wireless World* of January 1945. He is quoted as saying "...*After the war*...*Printed matter*

broadcast television now that peace was soon to break out. The company was called John Logie Baird Limited and was registered at 4 Upper Grosvenor Street.[xxxii] Jack Buchanan, John Baird's old school friend and an accomplished actor, was now his new business partner. It is not known if there was any connection between the Holding and Development Trust and John Logie Baird Limited, but as this second company was an agreement between just Baird and Buchanan, any connection is thought unlikely.

John Logie Baird Limited was created as a company specifically for the broadcasting of television to the public. Various television receivers were put into production and the company attempted to re-establish the name of John. L. Baird as a television broadcaster. To this end the company, on the 8th of June 1946, displayed the BBC broadcasts of the Victory Parade on a large screen television to invited guests at the Savoy Hotel and at the Classic Cinema in Baker Street. Six days later John Logie Baird died in his bed at his family home in Bexhill.

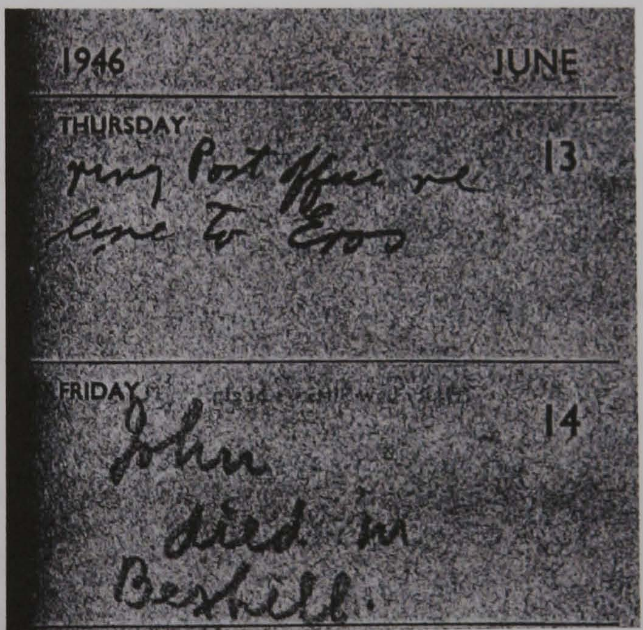

Fig. 8.8 *The last entry in J.L.Baird's diary written by his wife Margaret.*
Source: Prof. M. H. I. Baird

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in page form will be flashed across the world permitting of simultaneous publication of newspapers

8.5 Discussion of C&W consultancy

The death of J.L. Baird at the relatively young age of 57, although tragic for the family, was probably of no great surprise. He had been seriously ill repeatedly during his life. On the 2nd of February 1946 the word *"Stroke"* is written in his diary, the writing matches the last entry on June 14th *"John died in Bexhill"*, both entries being written by his wife Margaret. Cable and Wireless were also aware of the profundity of their consultant's illness and noted this fact in a minute of the 28th of May. Prior to this entry the company had noted on the 29th of January that *"...Mr J.L.Baird - whose primary interest was in television - had produced nothing of technical advantage to the company during his appointment as Consulting Technical Advisor"*. Because of this statement by Sir Edward Wilshaw, the company had decided to cease its consultation payments after a three month period of notice.[xxxiii] However, the latter minute of May 28th decided that this was not the correct action and that due to Baird's illness and determination to continue research into facsimile telegraphy, C&W resolved to continue the consultation at the reduced rate of £500 per annum.[xxxiv]

Apart from the expressed regret of the death of J.L.Baird there is no other notation in the minutes of Cable and Wireless. During a three day visit to the C&W archives, the archivist Mary Godwin gave the author freedom to search all documents held at the Porthcurno site. No other documents, in particular technical information, relating to the consultation work of J.L.Baird for Cable and Wireless was found. Contemporary newspaper reports of the facsimile telegraphy systems exhibited by J.L.Baird give some indication of their proposed capacity. *The Daily Telegraph* reported on the 18th of July 1944, that the previous day a journalist had seen a system capable of sending *"Five novels a minute"*. The suggestion was that at a rate of scanning of 25 frames per second, at one page of 500 words it would be possible to send 750 000 words or "five novels" per minute. This system was also noted in an American publication in January of 1945. The author, Leon Laden, describes facsimile apparatus for telegrams, which was recorded on a moving band.

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from blocks made from the photographs of the page form."

Unfortunately, there is no description in either article of the precise method used to produce such rapid transmission. Laden reports that *"The details of construction and operation... were not revealed...* [because of a] *...wartime embargo on technical inventions which may benefit the enemy".*[xxxv] It is probable that the writer of the British Daily Telegraph article was subject to similar restrictions.

The details of the intermediate film technology adapted for facsimile transmission investigated by J.L.Baird are subject to informed supposition. Cinema Television Limited (CTL) and its predecessor Baird Television Ltd were both contacted by the British Government who were interested in the companies' facsimile transmission system (details of this communication are provided in chapter six).[xxxvi] There is great difficulty in establishing a connection between J.L.Baird and the military activities of Baird Television Ltd in the late 1930's. There is no known direct connection between the inventor and CTL. However, it would be unwise to suggest that J.L.Baird was not aware of at least the BTL facsimile system, as the Scotsman was member of the Directorial Board of the Company during the development of the apparatus.

The high speed facsimile apparatus offered to the Admiralty in February of 1940 has similarities to that described by J.L.Baird to the Daily Telegraph, which are unlike the two previous BTL systems. In particular this equipment was capable of reproducing a page containing 500 words at a rate of 25 frames per second[xxxvii], attributes of Baird's system noted in the newspaper.

Of many other post-war systems, the Romac and Ultrafax facsimile systems reported after the war may give some indication as to what J.L.Baird worked on during the war. In 1947 Electronic Engineering offered a brief description of a Cable and Wireless apparatus designed by the Post Office Research Station at Dollis Hill.[xxxviii] However, this system was similar to the Fultograph in that it used a slowly rotating drum with synchronised scanning light to produce its image. The Fultograph's capacity of five images per hour is dramatically slower than the system proposed by J.L.Baird. The Romac system also uses a cylinder for the first stage of recording, but then like Baird's Tele-News system uses a paper tape for transmitting and receiving. Also like Baird's system it was stated that the Romac could significantly increase the speed of sending messages from the current fastest of 800 w.p.m. to 3 000 w.p.m.[xxxix] Not all commentators were convinced of the Romac's capabilities. Thomas Roddam wrote in *Wireless World* that the available transmission wavebands would be incapable of such transmission speeds.[xl] Similarly, Cable and Wireless considered bandwidth restrictions as the main problem of Baird's system as quoted above.

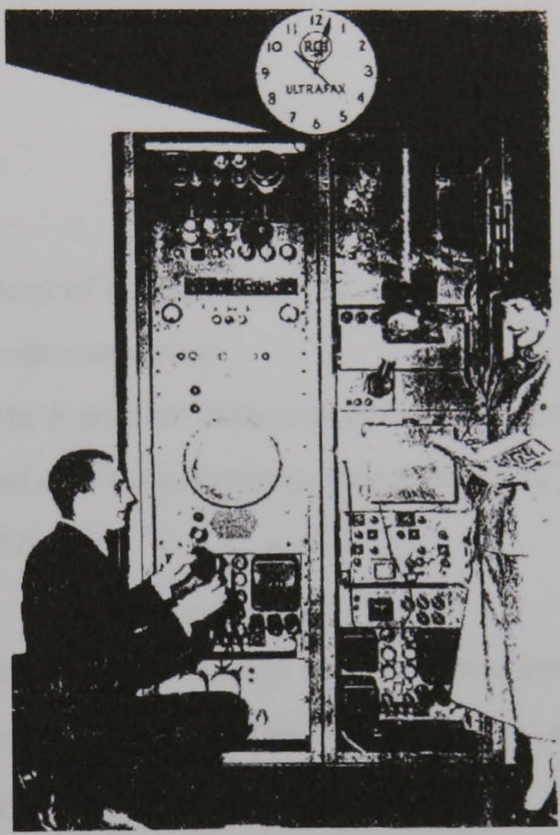

Fig 8.9 *The Ultrafax Machine*

Source: Dr. P. Waddell

The Ultrafax system of RCA is perhaps the best candidate for a post war facsimile system bearing the greatest resemblance to that produced by J.L.Baird. Ultrafax was first publicly demonstrated by RCA and the Eastman Kodak company on October the 21st 1948; previous demonstrations had already taken place for military organisations.[xli]

Margaret Baird, J.L.Baird's wife quoted her husband's wartime assistant E.G.O Anderson as writing; *"Ultrafex* [sic] *and the telerecording system, which has* *been so useful, were based on the telefilm recording technique".*[xlii] Similarly Ray Herbert has stated that in an interview with J.L.Baird's wartime assistant, E.G.O. Anderson, the scientist referred to Baird's facsimile system as Ultrafax.[xliii] Dr Peter Waddell has written that the Ultrafax system was "identical" to J.L.Baird's apparatus.[xliv] Without further details of Baird's system it cannot be stated whether his was literally identical to Ultrafax.

Waddell's statement was probably motivated by a letter dated 26th of June 1974 sent to him by E.G.O. Anderson. Anderson's comment on the Ultrafax system are reproduced here.

<u>Ultrafax</u>

To give you the past history of this process. J.L.B. undertook the development of this system of message transmission.
Really in its simplest form it was an extension of our intermediate film system used as a receiver instead of a transmitter so that a length of film was exposed to a high definition. [TV tube]

CRT with the film running synchronously at 25 frames per second and the message changing system at the transmitter was not really any concern of the electronics side of the equipment.

The photographic side was a continuous processing system etc.

E.G.O. Anderson was also interviewed for a newspaper article in January of 1976 and commented further on Baird's wartime facsimile work. The newspaper reports,

"The two men [Anderson and Baird] *worked together on a system for sending messages by television at a rate of thousands of words a second, foreseen as a start to transmitting a complete newspaper around the world in moments… "*[xlv]

The attributes of Ultrafax that are similar to Baird's method are an electronic television transmitter and reception using a bright cathode ray tube with rapid recording onto film.[xlvi] In a recent interview Dr Waddell stated that Dr Szegho delivered various electronic components including an iconoscope camera to J.L.Baird from BTL stock.[xlvii] Confirmation of J.L.Baird having an iconoscope camera is found in the inventor's diary (see Fig. 8.10). He also had access to other bright cathode ray tubes which could have been derived from cinema television projection tube technology and may have also been delivered to him from BTL stock by Szegho.

The telecine/intermediate film recording technology had since the early 1930s been an attribute of many Baird Television Ltd systems including those demonstrated at Alexandra Palace. There is also extensive evidence, provided in this paper, that the IF system was developed for signalling by BTL One patent, GBB 559 549 applied for in August 1943 and entitled *Improvements in Film Processing Tanks for Television Apparatus*, already mentioned in chapter six, suggests that J.L.Baird was directly involved in development of the IF system, most probably for facsimile purposes. The patent specifically refers to a modification to alter processing of the film in order to provide a better quality and more durable image. This attribute would not be useful if a rapid throughput of film was required for animate television images, but would particularly suite individual images for facsimile purposes. Existence of the patent does not prove conclusively that J.L.Baird was developing this system, but the corroboration of Anderson's statements reinforces the suggestion that IF technology was in fact under development.

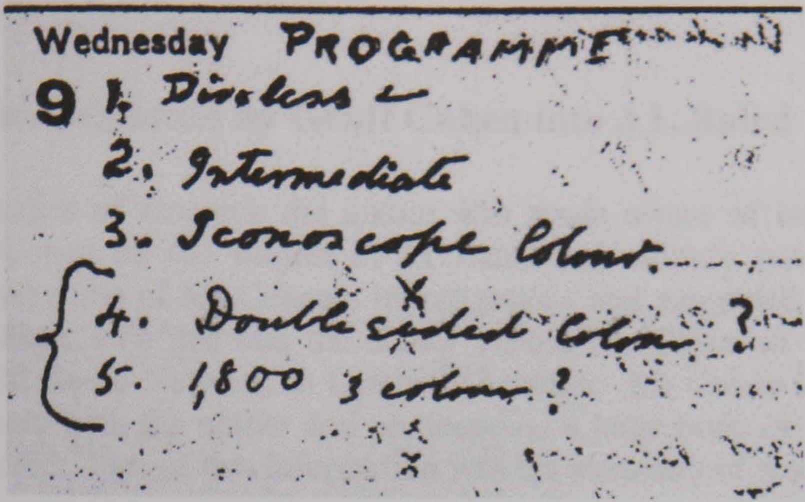

Fig 8.10 *Selection from J.L.Baird's diary*

Source. Prof. M. H. I. Baird

Further information about J.L.Baird's wartime facsimile system may be included in the notes of Dr Constantin Szego as well as wartime diaries of Mr Gilbert Tomes, a BTL technologist. Both records are held by Dr Douglas Brown and are probably included in this academic PhD thesis. Unfortunately, Dr Brown has chosen to place a moratorium on his thesis until January 2003.

With the evidence provided above it can therefore be strongly suggested that J.L.Baird worked on an intermediate film based technology for facsimile transmission during his consultancy work for Cable & Wireless during World War II.

Note 4

The investigation by Geoff Cohen into J.L.Baird

During the early stages of research the author was made aware of investigations made by Mr Jeff Cohen on the subject of J.L.Baird and military television. Dr Waddell had pursued some of Mr Cohen's investigations and suggested that further research be undertaken. To this end the author visited Mr Cohen in 1997 at his company The World Radio Network in Lambeth, London. Mr Cohen kindly spent more than three hours with the author and photocopied a large body of information which he had collected. Part of this information was his summary of research which is recorded below,

....

Here is a summary of my research into the wartime activities of John Logie Baird.

I approached Christopher Lee the BBC Defence Correspondent and asked if he had heard anything about Baird's work during the war. To my great surprise I had come to just the right person: Conversation of 14.9.86 :-

"My father-in-law, Reg Adams, was in charge of a secret project using TV and he had frequent meeting with Baird, at Whaddon Hall (the MI6 radio station in Buckinghamshire) I think. Only two other people knew about the project so you will find it hard to get anything, and you may rattle a few skeletons. My father-in-law dies two years ago but he had spoken of the project a few times, he said it had unprecedented secrecy, even as secret wartime projects went. He made two trips to RCA in Indiana in '42 and '43, I think. He flew with the family to Chicago, and had to take the cash to pay RCA for the equipment, they did not even trust a bank, my wife remembers the trip. I did not know the aim of the project but my wife or her mother may be able to tell you more, and the family still have all his papers and diaries. Reg ran an amateur radio company called Webb's Radio before the war and he was a very early TV enthusiast and knew Baird. In 1942 he and Jerry Timms were drafted into SOE to start a new radio section. James (Jerry) Timms is still alive and may be able to help."

I soon tracked down Timms, he started a company called British Communication Corporation, South Way, Wembley, Middlesex (Tel. 01 902 1212). It is now part of the Racal Group and he still works for them part-time in retirement. The company was formed by the members of the Polish radio section of SOE using designs they had perfected during the war. They only make military equipment. He was extremely unhelpful but confirmed that Baird was involved with something they were doing, he asked me how I have found out about the project and I mentioned Christopher Lee, and he expressed surprise that he knew about it. He said he would soon be seeing Mrs. Adams.

I then tried to find out more about the Polish radio section. Although nominally part of SOE it had a fairly independent status and carried up projects for various services including MI6. I spoke to John Brown who ran a radio section at SOE but he knew very little about the Polish Section, even though he has extensive knowledge of SOE's technical activities. I tracked down a few surviving members of the Polish Section (via BBC's personnel dept) but they said they knew nothing of the project I was interested in.
I had already drawn a blank and Christopher Lee now refused to help. He said his mother-in-law said Reg had told her the project must always remain secret and she must respect this.
However I picked up some information that may relate to the same project, from elsewhere.

I spoke to Bernard Rodgers (Fifield Farm Cottage, Oakley Green Road, Oakley Green, Maidenhead, Berkshire, tel 0628 26000).
He is retired Technical Director of Bush, former head of the Radio & TV Manufactures Association, and he has an extensive knowledge of TV development. He said he joined Bush just after the war ended and heard a little about what had gone on. In one corner of the factory there was a pile of TV set chassis, and he was told that TV set production has continued throughout the war. The chassis seemed to be based on the prewar design but with many additions and modifications. He was told the TV production had something to do with the Baird Company but nobody seemed to know what it was for. He said it is no surprise to him that we had secret TV project during the war as the Germans were well advanced, and he gave me much information about German TV work.

Pat Hawker (c/o IBA Engineering Information, 70 Brompton Road, London, SW3), said he knew Reg Adams quite well but knew nothing of the TV project. He said Adams had business links with the USA before the war. Hawker knew a lot about Whaddon Hall having worked in MI6 for a time.

Dame Alison Munro (Harbour Way, Elanor Lane, West Wittering, West Sussex, PO2O 8AN tel 0243 513274) was Watson-Watt's secretary for a long period during the war. She had some recollection of a TV project involving Baird and remembered typing letters to Bush about how many lines the picture should contain.

Jim Lodge the historian of the EMI company said he had heard there was a very secret TV project but knew no details. I mentioned RCA and he said that the initial communication with RCA would have been via EMI. He recommended I talk to Stanley Radford who was active at that time.

Stanley Radford (11 Station Road, Manor Vale, Thames Ditton, Surrey, KT0 0NU tel 01 398 6227) said he had a very high opinion of Baird and he was not surprised he was involved in secret work during the war. He said (and I believe him) that he knew nothing of the project but said he knew Baird in connection with 'think tank' sessions some of which were at Baird's Sydenham home. He attended one there (often referred to as 'Sunday Morning Soviets') they were run by Robert Renwick (Chairman of the London Electricity Board and Lord Bowden of Manchester

University). Radford was in a government department that vetted scientific work during the war and said Baird was one of a group of leading scientists who advised government on a variety of subjects.

My conclusions are that there was a plan to use TV in a secret operation probably inside Germany. The difficulty in gaining information is due to the fact that it involved the Secret Intelligence Service (MI6) rather than Special Operations Executive. It is possible to get information about SOE but hard to gain any from SIS. I fell the project was long in the planning but for some reason never carried out. The most likely aim was intelligence gathering from information sent in the form of a TV signal. Baird would have been indispensable for his detailed knowledge of German TV. However such a project would only have needed receivers and these were made in Britain, but RCA was known as a manufacturer of small TV cameras (they produced some 5,000 during the war but their uses have never been fully revealed). This suggested there may have also been thoughts of intercepting TV links (that were generally by cable) and putting false information on them.

It is heartening to think that this project may have brought together the various TV pioneers in the national interest, who before the war and in the public mind were implacable rivals.

Part of this author's investigation involved telephoning various people mentioned in Mr Cohen's summary. Of particular importance was Mr Christopher Lee. During the author's telephone conversation, using Dr Waddell's office telephone, Mr Lee could offer no supplementary information to that which he had supplied to Mr Cohen. Since that time Mr Ray Herbert has contacted Pat Hawker on behalf of the author and also investigated members of the Polish Radio Section. None of these contacts could supply further information. The author was introduced to Mr Harry Matthews, the late respected radio historian responsible for part of the Scottish Telecom communications museum in Edinburgh. During a visit to his house with Dr Waddell, Mr Matthews stated that he was aware of some form of wartime television investigation at the Bush company but could not provide details.

Stanley Radford has been contacted by Ray Herbert and has stated that he remembers think tank meetings at J.L.Baird's house in Chiswick. J.L.Baird never lived in Chiswick, but the fact that the house is mentioned as in Sydenham during an earlier conversation in 1986 suggests that Mr Radford's memory may be slightly in error.

At various times Dr Waddell has found various people who connect J.L.Baird with Whaddon Hall, but no information has provided conclusive evidence. Since these suggestions, Pat Hawker has stated that he knows of no connection between the radio station and the inventor.

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Note 5

Selected entries from John Logie Baird's diary

1940

19 November: Ring Church re Secret Signalling.
Ring patent office

1941

5 March: E Britain Secret Signalling? Monsignor LUBINSKY.

30 July: Lunched? Sir Edward and Admiral Grant.

Circa 24 August: Church, Halliday, J. Buchanan, (Jackson) Inglis Re J.L. Baird Ltd.? Anderson asks church to recommend patent agent and give him War Patent.

12 September: Lunch Sir E. Electra House 1pm

9 October: Sir E Wilshaw option to buy control for £25 000

Circa 9 October: option to purchase control shares for £30 000 Salary £1 500 for 5 years Buy ordinary shares in company

23 October: 3-30 Electra House

12 November: 12:30 Electra House.

17 November: Sir E. Wilshaw

20 November: Demonstration to Dean? 1pm Church 1pm Connaught rooms 50 swan Court ask re secret signalling.

25 November: Ring Wilshaw demonstrate monochrome.

27 November: 2-30 C&W who was man on my left.

3 December: Ring C&W. Spence. Church.

5 December: Mr Smith 3pm Cable &W.

10 December: 3pm Wilshaw.

19 December: ring C&W.

20 December: Call C&W.

22 December: Major Church 1pm Jacob C&W 2-30 pm.

1942

9 January: C&W? 2-30 re restoration.

6 February: Wilshaw.

16 February: Ring Wilshaw re buying ??

19 February: C&W.

27 February: 10-45 Wilshaw.

6 March: Letter to Wilshaw.

10 March: Marconi Chelmsford

16 March: 3 pm Jacob. Tell Mr Parker train for Chelmsford. memo to Wilshaw.

20 March: Wilshaw.

6 May: Ring Jacob ask to see facsimile.

7 May: Jacob see facsimile.

18 May: Wilshaw 3pm.

14 June: Wilshaw Set in house of commons?

29 June: Ring Mr Jacob (Wilshaw ?).

21 July: 3pm Sir Edward ICONOSCOPE.

12 August: Mr Kemp C&W.

19 August: Cable and Wireless material.

25 August: 3pm C&W.

2 September: C&W.

3 September: C&W ?.

4 September: C&W 3pm.

10 September: Wilshaw.

8 October: ring [??] Wilshaw.

9 October: ring Wilshaw.

18 November: 3pm Wilshaw (*crossed out*)

12 December: Photo of Wilshaw.

17 December: Photo of Wilshaw.

18 December: Photo of Wilshaw.

1943

19 January: Jacob?

20 January: Ring Jacob or Wilshaw.

22 January: Jacob.

27 January: JACOB.

28 January: JACOB FRI or SAT

1 February: Ring Wilshaw.

18 February: JACOB? [crossed out] Demonstration. Spence Jacob

19 February: Ring Jacob.

22 February: Ring Wilshaw or Jacob.

19 March: See Wilshaw [crossed out] & Jacob. Brains Trust.

21 March: Tom King Chancery 5491

22 March: Has Sir E Wilshaw any objection to publishing his photo.

30 March: Jacob.

31 March: Ring Parr: Worth: Jacob.

1 April: JACOB

9 April: Jacob appointment Monday.

10 April: Jacob.

12 April: <u>Jacob.</u>

14 April: General Whittaker ask Dalton Wilshaw Marconi - Get Work.

27 April: Ring Jacob.

28 April: JACOB: Maybank: Gallacher.

29 April: Ring Jacob.

30 April: Jacob [crossed out].

6 May: Phone Larkin re Wilshaw photo.

25 May: Monday see Jacob salary? Letter to Wilshaw.

2 June: Hotels : Tom King Publicity:

4 June: Spence Re Tom King Watson Watt?

6 June: Ring Tom King to confirm Friday.

11 June: Jacob:

15 June: Jacob? Dalton: Plug Godfrey --Ultra

6 July: Jacob.

7 July: Lunch Spence? Tom King? Jacob.

13 July: Show facsimile.

17 July: Wighton: Doar (?) : Church : Smith: Tom King : Wilshaw.

23 July: Tom King.

24 July: IEE ? Parr Gallacher Jacob.

26 July: JACOB

27 July: Tom King} 2.30 RING JACOB MENTION ANGWIN

28 July: Jacob.

29 July: Facsimile 18th. RING JACOB 11 am

1 August: Appointment with Wilshaw mention ANGWIN and MORTIMER.

2 August: Tom King Tribune Article JACK HILTON.

3 August: Ring King "Tribune wanted did he find author article for Britannia [Britanova?]? filters/ mirrors? Big tube?

4 August: Facsimile Patent.

5 August: FACSIMILE: RING ILLUSTRATED { TRIBUNE BRITANOVA or Tom King}

6 August: Ring Tom King.

9 August: ring Wilshaw.

16 August: Oscillation MIRRORS // Bank King JACOB CHAPPLE

18 August: Chapple Gallacher JACOB BANK

20 August: <u>King {Tribune article}</u>

24 August: Jacob 12 noon.

30 August: Tom King who wrote letter? TRIBUNE?

6 September: SLIDES: BANK: WILSHAW.

7 September: Slides, bank, Wilshaw

18 September: Article for Tom King SUNDAY DISPATCH

23 September: Jacob

27 September: Jacob or Wilshaw Bank

28 September: JACOB BANK SLIDES

30 September: Jacob bank slides

21 October: 11AM Wilshaw.

30 October: Salary due from C+W.

5 November: Write Wilshaw.

7 November: 2 Weeks Wilshaw Rank Jarret.

15 November: Tom King: Gee

16 November: C&W 1pm.

17 November: SPENCE ring Carstairs: Tom King

20 November: Spence 12:45 take in letters to Wilshaw.

22 November: Carstairs re Wilshaw.

13 December: JACOB HALF SILVERED MIRRORS

14 December: Jacob

16 December: Jacob 12 noon

Notes at end of 1943: Cable and Wireless Tem 1222 Show photos to Wilshaw February 14. Decision from Wilshaw March 14. Company formed April 1.

Notes for Wilshaw patent for facsimile? Angwin's opinion Mortimers opinion from photograph MARCONI-BAIRD Mention Royal Visit SHOW HIM FACSIMILE PHOTO.

Notes at end for August 1943: Tom King Malden 0694.

1944

1 January: C&W Hud?? Visit.

8 January: Ring Wilshaw.

12 January: Ring WILSHAW 11-30? Wilshaw.

13 January: C&W 3pm.

1 February: JACOB

3 February: Ring Mrs Park re appt with Wilshaw. Visit JACOB

6 February: Facsimile.

20 February: JACOB

21 February: Jacob 3-30

7 March: 3-30 C&W.

10 March: C&W?

13 March: My agreement with B.T.L. My agreement with C&W

14 March: Ring Tom King

15 March: Tom King, Hudson, Maybank.

23 March: Ring Tom King

24 March: T. King

26 March: Ring Tom King "I think we are at the beginning of a very big thing"

28 March: Half Silvered mirror Ring Tom King

13 April: SPENCE DIED

20 April: Prepare lecture for Angwin.

21 April: Jacob ANGWIN (facsimile/lecture). KING

24 April: King.

30 April: Write King

10 May: Jacob Tem 1222

12 May: Jacob 11.30 AM

15 May 44: Ring King

16 May: RING KING / GEE

Above 22-25 May: A speed undreamt [sic] of by other methods became possible by Fac Tele

21 May: send letter to patent office Sir E Wilshaw.

23 May: Television Facsimile

25 May: Communication Facsimile Television opens a new era in communication. Messages sent by television and received on continuously moving [?]

27 May: Communication will give us the newspaper man's dream The International Daily Paper.

30 May: WILSHAW.

2 June: write TOM KING??

6 June: 11am S.E. Wilshaw Show him BBC report
3pm Young publicity man at 3 Crescent Wood Rd
12-30 see Sir Edward and Young BBC report agreement with Hudson

14 June: appointment Wilshaw ? Marconi

15 June: Sir Edward 11 AM.

4 July: Tom King? Depth / renewals

10 July: 1pm Mr Young C&W take in report to committee & publicity for two sided tube Lisbon

30 July: Post letter to King

22 August: Phone[?] Tom King

24 August: Tom King

25 August: Tom King? Ogilvie

27 August: Tom King.

14 September: Wilshaw. Jacob. Young.

16 September: Letter to Jacob

20 September: Jacob Ring EAGLE

25 September: File Patent Wilshaw?

11 October: T King

14 October: Ring Tom King? See matinee

18 October: C&W Mr Young Smiths Article Ring Elik

23 October: Possibilities ?? Rank C&W GEC

1 November: Oliver ? Give him copy of report to ? Photo of Wilshaw.

2 December: C&W : Parr Re ?

6 December: Laden C&W

12 December: Photo of Wilshaw and Message.

13 December: Show M.S.S. to C&W Larkin has negative get him to improve message

End 1944 Notes: Notes for Wilshaw. Patent for Facsimile (buy or take option). Angwin's opinion. Mortimer's opinion from photograph..? MARCONI-BAIRD. Mention Royal Visit. SHOW HIM FACSIMILE PHOTO.

1945

1 January: C&W

23 January: C&W 1pm

14 May: Wilshaw

24 May: 11 am Wilshaw

31 May: ring Wilshaw

5 July: Write T. King etc ring West

12 July: C&W - see Higget

16 July: C&W ? Higget

18 July: ? C&W.

24 July: appointment Wilshaw

25 July: Ring King. West. Parr. Young

15 August: 3-30 Wilshaw

23 August: 10-30 Wilshaw Higget

30 October: ? C&W

25 December: C&W Higget pulses YOUNG pictures

8.6 References

[i] PRO AIR 2/269

[ii] This information is more thoroughly described in chapter 4. J.L.Baird's patent was GB 324 029. British Government investigation of this type is mentioned in PRO Files DSIR 36/4408, AVIA 23/476 and AVIA 23/553. A Letter sent to Helensburgh library by a James Heath as well as Mc Arthur and Waddell's book *Vision Warrior* (p218-19) suggest that J.L.Baird was directly involved in this Government investigation but there is no other information to substantiate this claim.

[iii] PRO File AVIA 13/294. Professor R.W.Burns reports the early history of the Fultograph in "Wireless pictures and the Fultograph", IEE Proceedings, Vol. 128, Pt. A, No.1, January 1981

[iv] Facsimile Telegraphy. (1946 January 1). Cable and Wireless Ltd occasional paper No 2. pp. 2.

[v] Pictures by Wireless from Australia(n.d.), Zodiac, Vol. XXIII. P115. The same volume of Zodiac also reports on page 83 that a television image had been received in Britain from America.

[vi] Young, P. (1986, July). *The History of STC*. IEE Proceedings, vol.133, Pt. A, No. 5.

[vii] England-Australia film telegraphed by Marconi facsimile system. (1934) *Marconi Review*. pp. 27. Jesty, L.C. (1952). Television as a Communication Problem. *IEE Proceedings*. Vol. 3, Pt. A, paper No 1336. pp. 768.

[viii] Television: London to Australia. (1932, September 7). *Sydney Morning Herald*.

[ix] PRO DSIR 36/2257.

[x] Barty-King, H. (1979). *Girdle Round the Earth*. London: Heinemann. pp. 265.

[xi] Moseley, S. (1952). *John Baird: the romance and Tragedy of the Pioneer of Television*, London: Odhams Press. pp. 226.

[xii] Baird, M.H.I. (1996) Eye of the World: John Logie Baird and Television. Kinema, Fall edition. Canada: University of Waterloo. pp. 38.

[xiii] Baird, J.L. (1941) personal diary.

[xiv] Cable and Wireless minute book 4-6 minute, 28 October 1941, 2080

[xv] Baird, M.H.I. (2000, December 15). E-mail to the author.

[xvi] Letter from Ministry of Supply to J.L.Baird 19th December 1941. From the private collection of Professor Malcolm Baird.

[xvii] Personal interview with Mr Eric Turpin 15th April 1997.
Riches, M. (1997, September). Speech Production and Four Historical Speech Synthesis Projects. *Experimental Musical Instruments*. pp. 4-5.

[xviii] Cable and Wireless minute book 4-6 minute, 26 October 1943, 2484

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[xxxiii] Cable and Wireless minute book 4-6, 29 January 1946, minute 3067.

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[xxxv] Laden, L.(1945, January). Television in Britain. *Radio News*. pp. 34.

[xxxvi] PRO ADM 1/13764, AVIA 13/1263.

[xxxvii] PRO ADM 1/13764

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9 Conclusion

9.1 General comments

Television is fundamentally a method of electronically sending visual information from one place to another. John Logie Baird was aware of this basic principle of television and changed attributes of the technology to suit military requirements. For instance, he used infra-red rather than visible parts of the electromagnetic spectrum to produce an object detector that he hoped would be useful for night time imaging as well as operation through fog.

When visited by British Government military representatives in the year he first demonstrated television, J.L.Baird altered his apparatus to send basic intelligence to assist in aerial reconnaissance. This was the first step in a series of adaptations of television for aerial reconnaissance for military purpose. When rejected for public television broadcasting in February 1937, Baird Television Ltd increased their efforts to produce television for aerial reconnaissance. These investigations were undertaken in a parallel, but not necessarily co-operative manner with the Marconi-EMI company. The extensive nature of British investigation of television for aerial reconnaissance introduces a new perspective on British military history as well as illustrating that there was more to the 'rivalry' between BTL and M-EMI. The two companies later co-operated during World War II in the development and production of other militarily useful technologies such as a photo-electric shell detonator.

The Shell detonator wartime contract was assumed by the Cinema Television Limited, the company which effectively took over the activities of Baird Television Limited. CTL also manufactured a large quantity of cathode ray tubes, particularly for use in radar, produced a ballistic measurement machine as well as developing and producing land mine locators.

J.L.Baird, who had a low level of involvement with his company from the assumption of financial control by the Gaumont-British Picture Corporation (G-BPC) in 1932, was, during the war, almost completely removed from the company.

Whilst a consultant for Cable and Wireless from 1941 to 1946, J.L.Baird experimented with a system of signalling which could have been of potential use for the prosecution of war. Few details are available about this system, but the brief information suggests that it may have been based on the airborne signalling systems developed by Baird Television Ltd from 1937 to 1940. There are also similarities between J.L.Baird's facsimile system and RCA Ultrafax.

9.2 An assesment of suggestions by Dr Peter Waddell

Tom McArthur and Dr. Peter Waddell were the first to suggest that John Logie Baird and his companies had any involvement with British Military Technologies when they published their book *The Secret Life of John Logie Baird* in 1986. This book and its second edition with added text *Vision Warrior* in 1990, was used as the starting point for investigation.

Research for this thesis was conducted with an emphasis on the use of files from the Public Record Office. This approach was undertaken because these books, which have created much controversy among contemporary historians, cite just two PRO files. Evidence of the controversial nature of the books has recently been published in the 2000 book *John Logie Baird, Television Pioneer* by Professor R.W.Burns.

Burns has suggested that statements made in the books of McArthur and Waddell needed to be cross referenced with PRO files. Many files from the Public Record Office were then consulted. It is evident that this approach was correct as this thesis reports a not inconsiderable number of files which specifically concern the military activities of the Baird organisation. Other files also provide supplementary information which helps to establish the military investigations of Baird television within the structure of early television investigations by the British military services.

The resulting research provides an alternate perspective of the military activities of J.L.Baird and his companies to that provided by the books of McArthur and Waddell. A close assesment of the large quantity of information available at the PRO concerning television aerial reconnaissance has resulted in the conclusion that this investigation was a dominant part of early military interest in television. This subject forms only a small part of McArthur and Waddell's books. The Scottish authors' books place stronger emphasis on the connection between J.L.Baird and radar.

Because of this emphasis, the question of J.L.Baird's personal involvement with radar has been considered in this thesis. McArthur and Waddell suggest that J.L.Baird personally conducted reflected radio wave experiments in 1923. This suggestion is based on testimony from one witness, Mr Norman Loxdale, during the authors' interviews with him in the early 1980's. Perhaps, because of the singular source of this information as well as the intervening 60 years, Loxdale's radar suggestions are not referred to by Professor Burns in his recent book. Two patents issued to J.L.Baird are considered to be primary radar patents by McArthur and Waddell. However, assesment in this thesis, as well as a similar assesment by Burns, state that these patents may not fulfil the requirement of ranging necessary for radar as their wording is ambiguous. As described in Chapter five both E.V. Appleton and J.L.Baird's assistant Philip Hobson used Baird Televisors to measure the height of the ionosphere. It is therefore interesting to note that there is no record of J.L.Baird's pursuit of improved systems for transmission and reflection of radio waves.

There is evidence that the Baird Television Limited Vision Transmitter supplied to Alexandra Palace for Public television broadcast had some similar circuitry to Chain Home radar transmitters. The valves used for both transmitters were Metropolitan Vickers demountable tetrodes. This suggestion was first published with detail by Mr Ray Herbert, although the McArthur/Waddell books initiate the basic suggestion. It must be noted that this information is based on similarities noted by Donald Priest who was involved in Robert Watson Watt's radar experiments. Dr Waddell has suggested that he has information from Metropolitan Vickers archives which corroborate the statement by Mr Priest. At the time of writing this author has not seen these files.

More conclusive evidence is provided from Public Record Office files which record the production of a variety of cathode ray tubes (CRTs) by Cinema Television Limited for radar. McArthur and Waddell have stated that CTL produced Skiatron CRTs for radar but mention no other type. They also suggest, on page 299 of *Vision Warrior*, that the Baird organisation did not have a leading role in producing equipment for radar because they did not have sufficient financial or industrial capacity. The PRO files record that CTL CRT research and production for radar was extensive and was therefore an important part of the entire radar effort.

It has been established that J.L.Baird had little personal involvement with his company after 1932. As there is little information informing the suggestion that BTL produced similar circuitry to that used for CH radar during this separation of J.L.Baird from his company , a connection between the inventor and this activity is very difficult to establish. This separation became even more significant when BTL was placed into receivership in 1939. The cathode ray tube production by CTL, who assumed control of BTL activity in 1940, began in 1942 and therefore it is very unlikely that John Logie Baird had any connection with this activity.

The statement that 'John Logie Baird invented radar' or 'was an important personality in the development of radar' has gained much public attention. Recently newspapers have published statements such as these and are discussed in this thesis. The suggestions are gaining uncritical general acceptance. For instance, *The Reader's Digest Universal Dictionary* of 1987 states that J.L.Baird undertook '*...pioneering work in the field of television, and in the use of radar*'. There is much evidence to suggest that these statements are false with little to support them.

Previously, this author has published a statement in the CD-ROM *Visions the Life and Legacy of John Logie Baird* which states "*His wartime diaries, suggestions by associates, as well as official government interest, indicates that J.L.Baird was definitely involved in radar technology.*" Since writing this statement the author has re-assessed the validity of supporting evidence. As described in Chapter five, the wartime diaries of J.L.Baird although referring to radar do not prove conclusively that he was involved in the technology. Ray Herbert has told the author on various occasions that during the war, E.G.O. Anderson has suggested Baird 'was involved with radar'. Although Anderson was a close associate of J.L.Baird, in the research for this thesis there has been no information discovered that supports the statement. The government interest in recognising J.L.Baird's wartime work was the result of a petition, directly stimulated by the publication of *The Secret Life of John Loge Baird.* Since this event there has been no government release of information suggesting that J.L.Baird was involved in the radar programme. For these reasons, among others stated within this thesis, the author has changed his opinion concerning J.L.Baird and radar.

Another technological investigation suggested by McArthur and Waddell is signalling using television based technologies. These suggestions include:

1. Early TV/AC investigations by J.L.Baird.
2. Operational use of image storage tubes for long distance signalling
3. High speed signalling experiments by J.L.Baird for Cable and Wireless.

Suggestions one and three have been investigated and a variety of supplementary information added. Suggestion two is discussed in detail from the source information used by McArthur and Waddell, which is also supplemented with a Public Record Office file. This file, PRO ADM 1/13764, clearly states that the investigations into the system were on an experimental basis, over short distances, and not used operationally. This information is significant because McArthur and Waddell suggest that the technology was supplied by either Baird Television Limited or Scophony. Scophony is responsible for the investigations recorded in the PRO file. About Baird Television Limited investigations into signalling much significant information has been discovered, although none of it suggests that there was operational usage.

9.3. A new perspective of British military television history

A variety of files have been consulted and assessed which refer to signalling activity by the Baird organisation. All but two files have previously eluded historic evaluation. The new information reported in this thesis shows that there was a systematic attempt by BTL to provide a facsimile signalling system for use by military organisations. In the first investigations of high definition television for airborne signalling, modifications of the intermediate film technique were considered. A history of BTL development of rapid processing of film for the IF system has been included here. This history is derived from an excellent report by Gordon Craig, who assisted Arthur Banfield in the development of this technology. Again, this is a source which has eluded historic consideration. Some historians suggest that the technique was a cumbersome system, which was particularly unsuited to broadcast television and therefore an unusable technology. The articles by Ray Herbert, who used the system, as well as reporting by McArthur and Waddell (1990), Hills (1999) and Burns (2000) all state that the equipment was not a failure but was successfully used for aerial television reconnaissance for the French Government.

The British fighting services were also interested in this innovative system and representatives of the Admiralty visited BTL directly after the intermediate film system 'failed' for public broadcast television at Alexandra Palace in February 1937. The Admiralty requirement was for a system which could send individual images, a distinct departure from the animate television images later supplied to the French government. Various modifications of the IF/spotlight scanning system were proposed and investigated. Images to be scanned were placed on film strips, through which light would pass, and individual transparencies were also which could be written on by an operator. Opaque surfaces, such as maps and plans were also provided for in manifestations of the BTL systems. The unique requirements of the different fighting services influenced these multiple adaptations. The extent of BTL investigation clearly illustrates the great enthusiasm among all three fighting services for this promising Baird technology.

However, the BTL facsimile technology did not see operational use during World War II and it is perhaps for this reason that the subject has not been given attention by other historians.

As stated above, there were many technological military investigations which both Baird Television Limited and Marconi-EMI had in common. M-EMI and BTL were Britain's two primary companies which had expertise in television technology. This is why they were chosen for trials of broadcast television in 1936 and were also chosen for television based military technologies. An uncritical observer would suggest that M-EMI were accepted for certain contracts when BTL were used for development but awarded few contracts. British public broadcast television is just one example, the same occurred with television reconnaissance and image converter tubes. It must be remembered that Marconi-EMI were the company proposed to assume all Britain's military radio and television research as early as 1929. However, these facts must not be considered in isolation. When CTL assumed control of BTL they were awarded a contract for photocell fuzes produced in co-operation with M-EMI. CTL were also awarded various contracts for production of cathode ray tubes for radar displays and land mine locators, both of which were produced in large quantities.

Location of anti-personnel land mines, to avoid injury to civilians after conflicts, has been the subject of much recent public interest. This emotive subject was publicised by the late Diana Spencer. Cinema Television Ltd developed and produced much needed equipment for this task and should be credited with saving many service and civilian lives during and after the last World-wide conflict.

Also provided here is a basic explanation of the effective take-over of Baird Television Limited by Cinema Television Limited. The initiation of this situation has been related to the financial control of BTL in 1932 by the Gaumont-British Picture Corporation. The complex nature of negotiations for financial control has also been considered by Professor Burns in his recent book. Neither Burns or myself can provide an exhaustive explanation of the early financial negotiations, as much research into this matter needs to be conducted. Whether a full explanation will be provided is doubtful as many of the key individuals involved are no longer living. There are some factors included in this thesis which may explain how CTL could effectively 'rise from the ashes' of BTL when it was placed into receivership; again a more complete explanation requires further research. This is a subject which falls without the specific remit of this thesis.

Cinema Television throughout the war years was not a company as its name suggests, to produce television for cinemas, but in fact a company dedicated to research, development and production of various war related products. The transformation of a civilian company into a manufacturer of war materials is not unusual. The Car manufacturer Austin Motors produced components for aircraft engines. Even civilian companies in Commonwealth countries were pressed into service. Cabinet making companies near Toronto, Canada were used for manufacturing parts of the wooden De Havilland Mosquito. The Mosquito was made of wood specifically to exploit this use of non-strategic materials and manufacture by companies not burdened by other aircraft production.

The Gaumont-British Picture Corporation were financially responsible for Cinema Television Ltd and therefore in turn responsible for production of military related products. This situation adds a new perspective to a company more commonly regarded as the source of many entertaining films and interesting wartime newsreels. The military investment of G-BPC is a subject worthy of further in depth research.

Despite exhaustive research in the Cable and Wireless archives as well in many other sources, there is little additional information available concerning J.L.Baird's facsimile research. Professor Burns has also come to a similar conclusion in his recent book. However, there is much information reported in this thesis which clearly states that Baird Television Limited designed and produced a variety of different facsimile machinery which had the same attributes as J.L.Baird's system. It should also be remembered that J.L.Baird personally applied for a patent in 1943 for an adaptation of the rapid processing system which was particularly suited to facsimile applications. The post-war RCA facsimile system known as Ultrafax is referred to directly by J.L.Baird's main wartime assistant and is also remarkably similar to the pre-war BTL system and J.L.Baird's system. RCA even suffered the same problems of transmission propagation as encountered by J.L.Baird with his system. It is important to note that it has not been possible to establish a conclusive explanation as to why these three facsimile systems have similar attributes.

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This thesis provides a critical assesment of the early military television investigations of Britain which includes direct reference to J.L.Baird, one of the technology's earliest pioneers. The military related adaptations of television by J.L.Baird and his companies pioneered a variety of useful technologies, many of which are in regular modern use. There is much detailed research on specific facets of these technologies which is for future historians. The subject of television aerial reconnaissance history is particularly unique in its lack of previous critical assesment in relation to the quantity of information available and its influence on wartime military interest in television. The early history of British Television aerial reconnaissance is worthy of publication in a book. A book which will be written by this author.

10 Bibliography

10.1 Annotation of Public Record Office Files used in this Thesis

NOTE: Where possible dates of original opening of a file is given as is the release date to the public. Where these details are not supplied it is because the correct dates were not clear from the file or that this information has not been recorded by the Public Record Office.

10.1.1 ADM

1/8740 *Reports on various forms of signalling including visual, 1930.*

Available for consultation 1981.

Specific report by Rear Admiral Forbes. A record of the general principles of wireless telegraphy communication, visual communication and associated recommendations for training.

1/9635 *INVENTIONS AND SUGGESTIONS (59): Metropolitan Vickers Electrical Co Ltd 1½m 15 kW short wave valve: development, 1937-38.*

Description of this valve, by among others Wing Commander Leedham and N. Hecht of the Air Ministry. Whether to keep valve secret and potential development for RDF transmitters.

1/18581 *ADMIRALTY (5): Naval application of high speed facsimile system and television: demonstrations, trials and Admiralty policy.*

This extensive file predominantly concerns Admiralty interest in transmission of information via television systems rather than series images. Included here is the Admiralty visit to Baird Television Ltd on the 5th of February 1937, the day BTL transmissions ceased at Alexandra Palace, at which a request was made to modify the intermediate film apparatus for facsimile transmission. Subsequent developments are recorded with supporting diagrams. Alternate Marconi-EMI equipment is also subject to record in this file.

1/13764 *Admiralty, and Ministry of Defence, Navy Department: Correspondence and Papers.*

Available for consultation 1972.

This diverse file includes a range of television signalling interests of the Admiralty. Included are investigations into high speed television based facsimile apparatus under development by Baird Television Ltd on behalf of the Air Ministry and Admiralty. There is also record of investigations into 'The Transmission of Air

Controlled Plots by Television'. This investigation, which essentially involved slow-scan television based systems transmitted by microwave links, was conducted by the Scophony Company in co-operation with the Royal Signal School.

1/26022 *Infra-red detection and telethermo destruction ray, 1940-45.*
Available for consultation 1986.

Assesment by Admiralty of potential use of various inventions including Infra-red detection and telethermo destruction ray by Mr George Baron and H. Cockcroft-Taylor. The Infra-red detection involved 'non-radio' television and was examined by Sir Edward Appleton amongst others. Includes photographs and pamphlets.

178/143 *American interest in Metropolitan Vickers 1936-37.*

Otherwise titled "Messrs. Metropolitan Vickers Ltd: Enquiry as to disclosure of confidential information with the object of utilising the firm on research and development purposes". Discussion includes employment of foreigners by the firm as well as connections with USA. Specifically the interest of the American company Associated Electrical Industries in the Met-Vick. Ltd and the possibility of removing this control.

204/1432 *Baird Television Ltd: image converters, 1940.*
Available for consultation 1972.

This file is based on a report by Dr. E. Lee and Mr L.E. Mayes who visited Baird Television Ltd at their Worsley Bridge Road factory on 25th of January 1940 and discussed development by the company of image converter tubes. Diagrams illustrate the development of the layout of various tubes and an explanation is given of the increase in sensitivity for each development.

204/1439, *Use of EMI telescope for signalling on land.*
Opened 24 April 1941.

Report ARL/N8?E.300 from Admiralty research Laboratory, Teddington. Review of various types and sizes of signalling lamps including Aldis. Reception using EMI electron telescope and image converter. Problems encountered in dark conditions associated with line-up of lamp and telescope. Capable of signalling three miles over land.

204/247, *Report on general considerations of television, 1925.*

Report by Admiralty Research Laboratory. Note of transmission of photographs by Western Electric Co. Mention of various light transducer cells including; vacuum photo-electric, gas filled photo-electric, Selenium and Thalofide. Scanning using vibrating mirror with piezo-electric receiver or cathode ray receiver. CRT had associated problems of deviation of scanning spot and distortion due to curvature on screen. Research work was conducted by Dr. R.T. Beatty assisted by Mr. J.A. Hoy. Mr A.G. Milligan constructed Thalofide cells. Includes Diagrams and general arrangement drawings.

220/67 *The Substitution of Visual Sighting by Television Systems with Special reference to Gunnery Directors, 1949.*

Opened1949. Available for consultation 1980.

File opened as a result of post-war developments in increase of sensitivity of various television cameras. Stated advantages include ability of television camera to be in position that human observer could not as well as lack of requirement for armour. Assesment of size of equipment and proposal for laboratory tests.

10.1.2 AIR

2/116 *Signalling fall of shot from aircraft, 1919.*

Opened 23 June 1919.

Part of a diverse variety of files. General discussion of the variety of methods to signal fall of shot used in service and lack of standardisation. Notes use of clock code.

2/269 *Experimental work in connection with the use of television in aircraft.*

Details of investigations by both the Air Ministry and Admiralty into television for eventual use in aircraft. Considers television systems available from 1924 onwards and various investigators including C.F.Jenkins in America and J.L.Baird in Great Britain. Details include interactions with J.L.Baird for development of airborne systems. Attention is also given to the manner in which future investigations should be undertaken and under what form of administration.

2/1733 *Air Ministry and Ministry of Defence: Registered Files.*

Opened 20 March 1936. Available for consultation 1971.

This file describes British interactions with foreign governments regarding the technology of television aerial reconnaissance. Baird Television Ltd and Marconi-EMI were both consulted by foreign governments, France and Russia in particular, and the British government provided recommendations concerning the details and manner of any negotiations.

2/1775 *COMMUNICATIONS (Code B, 25): Baird television: investigation, 1936-1942.*

This primary source for British television reconnaissance investigations includes Baird Television Ltd, but also makes reference to Marconi-EMI. Information concerning negotiations with the French and Russian governments are included and supplement information available in AIR 2/1733. Details are also provided of equipment proposed for supply to both governments as well as testing of this equipment. Government and military attitudes towards television reconnaissance technology is also recorded.

2/1844 *COMMUNICATIONS (Code B, 25): Television transmission from aircraft: design papers, 1936-1940.*

Opened 322 July 1936.

Discussions between E.V. Appleton and R.A. Watson Watt on television to improve pilots vision. A.E. Woodward Nutt and Wing Commander De Burgh of RAE 10 Department also included, as is the Royal Signals School. Includes two photographs of 4 metre aerial for installation on HMS Iron Duke. File relates directly to AIR 2/1733.

2/1969 *RADAR AND RADIO COUNTERMEASURES (Code B, 61): R.D.F. stations, 1937-1940.*

Opened 18 January 1937. Available for consultation 1971.

Includes correspondence, memoranda and minutes of meetings. Covers such subjects as scheduling the commission of RDF stations and related staffing. Finalising design of RDF receivers.

2/2228 *Radar and radio countermeasures – Provision of aircraft.*

Opened 31 December 1937. Available for consultation 1971.

Initial collection of aircraft for RDF use, including: 1 Handley Page Harrow, 2 Fairey Battles, 3 Avro Ansons, 1 Bristol Bolingbrooke, 1 Miles Magister and 3 Scapa flying boats. Air Commodore K.R. Park requests 27 Bomber Command Aircraft. Special RDF unit in process of being formed at Martlesham Heath.

2/2593 *Radar and radio countermeasures – calibration of RDF equipment, employment of balloons, 1937-41.*

Opened 7 July 1937. Available for consultation 1972.

Cited in official history of RDF. Use of a variety of balloons for calibration of RDF stations.

2/2618 *Selection of firms and provision of finance for R.D.F.*

Opened 6 January 1937.

A budget of £1 250 000 for was given for manufacture of 20 RDF stations. The companies Cossor, Marconi-EMI, Metropolitan-Vickers and Standard Telephone & Cable were considered suitable firms. The problem of secrecy was considered particularly with note to information exchange agreements that certain companies had.

2/2743 *RESEARCH & DEVELOPMENT ESTABLISHMENTS (Code B, 65): No 10 Dept., RAE, Farnborough: addition of research duties, 1926-1928.*

Opened 19 August 1926. Available for consultation 1979.

Initial duties of 10 Department include design of pilotless ramming aircraft, suppression of magneto waves and problems of television. Colonel Lefroy attached to department at this time despite a variety of discussions about his general use and personal characteristics.

2/2877 *PHOTOGRAPHY AND CINEMATOGRAPHY (Code B, 58): Baird Television Ltd. rapid processing camera projector, 1938-1939.*

Opened17 November 1938. Available for consultation 1970.

Report and drawings, including BTL diagrams SK274, SK 275, SK 280, GA 142 and GA 143, concerning Baird Television Ltd Rapid Processing Camera. Various notes include need for camera to mitigate RDF jamming and preference for long afterglow receiver. At this time BTL had no production equipment although experiments could be undertaken using experimental 16 mm film apparatus. File AVIA 13/1263 also refers to this system.

2/3023 *Radar and radio countermeasures at RDF and Air Ministry Stations.*

Opened 5 May 1938. Available for consultation 1972.

Details of accommodation at RDF and AME stations including such details as general layout and administration with provision for land line communications and toilets. Diagrams of general layouts.

2/3110 *Radar and radio countermeasures – Bawdsey papers 1939.*

A large file including a variety of subjects. Includes history of funding of RDF programme and acceptance of Metropolitan-Vickers transmitters 8th July 1938. Comment on earliest history: "RDF technique developed for work on ionosphere observation at Radio Research Station, Slough and early experimental work was done at Orfordness".

2/3378 *Gun laying equipment: Design papers, 1938-40.*
Opened 23 August 1938. Available for consultation 1971.

Correspondence concerning design, development, delivery and training for gun laying equipment Mk I and II. Companies involved include Ferranti, Metropolitan-Vickers, and Cossor.

2/3568 *AIRCRAFT: Equipment (Code B, 5/21): Aircraft television equipment: trials, 1939-1945.*
Opened 7 February 1939. Available for consultation 1972.

Specifically concerns Marconi-EMI equipment service trials. Commentary on provision of personnel for trials and associated requirement for secrecy. Involvement of 22 Group. Also assesment of demonstration of American equipment 22nd November 1944. File relates to AIR 2/1733 and AIR 2/1844.

2/4509 *Radar and radio countermeasures – employment of civilians, 1940.*
Opened 6 February 1940. Available for consultation 1971.

Relevant to both RDF chain stations and experimental stations. Concerns request for staffing in interdepartmental roles and associated advertising for necessary people. Considers place of origin as relevant to employment possibility; i.e. people from Barrow, Liverpool, Glasgow and Newcastle not required. There was therefore to be no posters or press adverts in these areas.

2/5530 *Radar and radio countermeasures – installation of Aircraft Gun Laying in Aircraft.*
Opened 28 July 1943. Available for consultation 1972.

Correspondence concerning potential fitting of airborne radar gun laying equipment stage 3 to Lancaster and Lincoln aircraft. Proposal of programme included 100 Canadian built Lancasters, 250 British and 100 Lincolns. Equipment to be fitted to Fraser-Nash type 121 turret or Boulton Paul type D. However, Rose-Rice turret preferred as was easy to escape from. Specifically for use in Path Finder squadrons. Cited in official history of radar.

9/32 *Wireless television and R.D.F., 1923-1937.*
Available for consultation 1988.

Disparate file including erection of wireless masts in 1927, a memo concerning signalling policy for 1935, Civilian aviation use of radio and a report by A.P. Rowe after a visit to Middle East to inspect RDF equipment. July 1936 suggestion that television could be used to and from aircraft for reconnaissance purposes.

10/ 4977 *Automatic high speed signalling apparatus.*

Available for consultation 1984.

Air Publication 2980 A Volume 1 prepared by Ministry of Supply. Includes general principles, morse system transmitting and receiving applications, line and power equipment. Includes diagrams and photographs.

14/850 *Countermeasures to enemy use of infra red: methods of detection, 1943 Nov.-1944 Jan.*

Opened 18 January 1944. Available for consultation 1972.

File raised in expectation that Germany was involved in infra-red research and possible operational use. British tests noted that aircraft exhaust and radiation from exhaust collector ring could be detected. If *Serrate*, a device used to detect the German FuG 202/212 family of airborne radars, was successful, it was expected that the Germans would increase their use of Spänner infra-red devices. Intelligence reports indicated that Spänner devices were used both with aircraft and for anti-aircraft gun guidance.

25/518 *NO. 22 (ARMY CO-OPERATION) GROUP, Operations Record Books, 1926 Apr.-1940 Dec.*

Brief details of activities of 22 Group during specified period.

25/520 *NO. 22 (ARMY CO-OPERATION) GROUP, Appendices, 1939 Sept.-1940 Dec.*

Brief details of activities of 22 Group during specified period.

25/687 *NO. 70 (ARMY COOPERATION (TRAINING)) GROUP, Operations Record Books, 1940 Dec.-1945 July.*

Brief details of activities of 70Group, the successor to part of 22, Group during specified period.

25/688 *NO. 70 (ARMY COOPERATION (TRAINING)) GROUP, Appendices, 1941 Apr.-1945 June.*

Brief details of activities of 70Group, the successor to part of 22 Group, during specified period.

25/689 *NO. 71 (ARMY COOPERATION) GROUP, Operations Record Books, 1940 Dec.-1941 Aug.*

Brief details of activities of 71 Group, the successor to part of 22 Group, during specified period.

25/690 *NO. 71 (ARMY COOPERATION) GROUP, Appendices, 1940 Nov.-1941 Aug.*

Brief details of activities of 71Group, the successor to part of 22 Group, during specified period.

28/265 *Operational records book, Farnborough.*

Operational base record book concerning such details as aircraft movements, fatalities and visits of V.I.Ps.

28/359 *Operational records book, Hendon.*

Operational base record book concerning such details as aircraft movements, fatalities and visits of V.I.Ps.

28/622 *Operational records book Odiham.*

Operational base record book concerning such details as aircraft movements, fatalities and visits of V.I.Ps.

65/100 *Cine Photography of low level attacks, 1944.*
Opened 15 May 1944 . Available for consultation 1972.

Photography of attacks taken from cameras mounted in rear turrets of operational bomber aircraft. Wellington XII and Halifax II aircraft used. 16mm film in camera mounted in place of gun, advanced at both 18 and 32 frames per second with and without other guns in turret firing. Considered, not a useful trial as images in all circumstances were too blurred.

10.1.3 AVIA

6/14398 *Examination of German cathode ray tubes.*

Opened April 1944.

Details include basic construction as well as chemical composition and viscosity of the glass. Also dimensions and voltage ratings. RCA valves used by Japanese. Telefunken distributed CRT's to Mullard, Cossor and Cosmos.

6/15533 *A television system for aircraft reconnaissance, 1951.*

Opened October1951.

Written by F.A. Inskip. Suggests high flying aircraft use of low flying drone with television reconnaissance capabilities with a proposed definition of 3-4000 lines. Also suggestions of recording images on film as well as production of stereoscopic pairs. Systems available include broadcast based 625 line definition or higher definition equipment with 1000 to 1200 lines. The 1200 line system was produced by Cinema Television Ltd for the Telecommunications Research Establishment. Refers to Blue Boar television guided bomb experiments and tests of equipment in Vickers Valetta aircraft using VCRX 289 Iconoscope camera. File includes images of airborne trials.

6/16427 *History of photography from air at night, 1939-45.*

Written by G.B. Harrison. Considers various perimeters of the process including light source provided by pyrotechnic flash, gas discharge, Turbinlite and Sashlite as well as measuring equipment and fuzes. Assesment of night cameras, film, processing, haze effects and laboratory equipment. Illustrated.

7/26 *Positions of aircraft by the application of television techniques.*

Opened 9 November 1937. Available for consultation 1988.

Written by N. Hecht at Bawdsey Research Station. Suggested use of television in manner similar to radar. Refers to Chapman Technique. A.P.Rowe considers system would not work as height of target could not be ascertained. Dr Pye, Director of Scientific Research for the Air Ministry refers to patent 22355/37 issued to Marconi company for similar system.

7/561 *Use of RDF chain for television purposes.*

Opened 3 August 1938. Available for consultation 1992.

Includes memo about general television development by D.C.Espley written 8th March 1938. Espley notes high frequency characteristics of picture amplifiers. File suggests that the radar transmitters could be used to relay various television images. Transmission to originate from the Alexandra Palace and then use radar transmitters to relay the images around the country. Metropolitan-Vickers proposed to modify the

Alexandra Palace transmitter to detect radio interference from inland flying aircraft. This activity was to be undertaken clandestinely.

7/1231 *Committee for the Co-ordination of Cathode Ray Tube Development: minutes and papers, 1943-44.*

Opened 1 February 1941. Available for consultation 1972.

General minutes of meetings including attendees such as GEC, EMI, Cossor, Cosmos, Osram, Telecommunications Research Establishment and Ministry of Aircraft Production. GEC and Cossor manufacturing Skiatron tubes. Meetings occurred every six weeks and lasted approximately four hours.

7/1232 *Committee for the Co-ordination of Cathode Ray Tube Development: minutes and papers, 1943-44.*

Opened 9 July 1943. Available for consultation 1972.

General minutes of meetings including attendees such as mentioned in AVIA 7/1231 as well as Ferranti, Standard Telephones & Cables, Gramophone Company and Cinema Television Ltd. Discussion of photographic and sylvania fluoride CRT screens.

7/3335 *Gun laying set MK III, 1941-44.*

Available for consultation 1972.

Correspondence with Metropolitan Vickers concerning gun laying equipment Mk. III between 3rd of May 1941 and the 25th of October 1944. Includes notes of tests of equipment in tropical conditions.

8/14 *Appointment of Radio Research Board, 1920.*

Opened 8 January 1920. Available for consultation 1971.

Radio Research Board was to be a department of the Scientific and Industrial Research Department. Appointment was to consider and advise on proposed increase to, or alteration of other establishments to form the RRB. All three services consulted. Biggin Hill suggested as suitable location.

8/513 *Invention relating to colour and stereoscopic television, 1937.*

Opened 8 October 1937. Available for consultation 1988.

File concerning patent application 18101/36 for "Inventions relating to television" proposed by Flight Lieutenant Whittle. Assesment of patent for potential use by the three fighting services. N. Hecht stated that there was no novelty in the patent. Patent refers to reproduction of motion pictures in colour with associated stereoscopic effect. Colour system achieved by use of related film images which had been taken through three coloured filters. Mirror drum and flying spot suggested as scanning method.

10/47 *Development of RDF: papers by E J C Dixon SIR ROBERT WATSON-WATT, 1937.*

Opened 1937. Available for consultation 1968.

Reports concerning various visits to valve manufacturers during March 1937 and assesment of potential use of products at Bawdsey Research Station. Manufacturers were not given details of manner of use of their products. Companies included Mullard Radio Services, Valve Company, Radio Transmission Equipment Company, Tyer & Company and Osram Valve Company. Discussion of history of aircraft detection including sound mirrors. Wavelengths considered were 13 metres with 26 metres as reserve and desire for use of 6 metres. Expected Bawdsey to be fully functional by March 1937. Suggested use of spark gap to produce 6 metre waves, although this method could not produce desired power.

10/348 *The history of radio and radar.*

Opened 29 January 1953. Available for consultation 1978.

Comments on the history of radio and radar were offered by A.P.Rowe and W.B. Lewis in 1947. W.B. Lewis, writing from Deep River, Ontario, suggested modifications to text. Rowe emphasises value of not only documents but personal recollections.

12/137 *RDF early history.*

Opened 20 April 1953.

Initial organisation of RDF programme. Army to deal directly with Metropolitan-Vickers and Cossor. This service concerned with MKII gun laying apparatus, previously concerned with sound ranging for guns. Royal Engineers and Signal Board requests that development and production of RDF equipment should take precedence over research. File includes 1936 proposal by Colonel Worledge to use pulsed short wave radio methods for aircraft detection.

12/139 *RDF equipment trials – General 1937-39.*

Opened 10 February 1953.

Brief notation of various trials including mobile RDF stations, Cuckoo radio range finder for ant-aircraft gunnery and firing trials using radar gun laying equipment with associated barrage balloon target.

12/140 *Radio Direction Finding Equipment production for Gun Laying Transmitters. 1938 – 1940.*

Relates to production of equipment by Metropolitan-Vickers and Cossor for both gun laying equipment Mk. I and Mk. II. Includes details of tropicalisation of equipment and types of valves used.

12/184 *Radio and radar production – War Histories.*

Opened 20 January 1953.

Companies involved in production include: Burndept Radio, Vidor Batteries, Plessey, Metropolitan-Vickers, Johnson and Phillips, GEC, Hale Electrical Company, Aeronautical and General Instruments Group, Multitone Electric Company Ltd, A.C. Cossor, E.K. Cole, Ericsson, Creed and Company, Pye Radio, Callendars Cable and Construction, Gramophone Company, Marconi, Ferguson Radio Apparatus. Cintel considered a major manufacturer of equipment. Also included details of visit to Westinghouse Brake and Signal factory by Her Royal Highness Queen Mary.

13/279 *Wireless Telegraphy Board – General secret matters including secret patents.*

Includes large body of diverse patents. Of note application for secret patent 25770 on 17th of September 1935 for radio system for detecting marine and airborne craft by re-radiation of radio waves by Robert Alexander Watson Watt. Also includes patents for secret signalling and communications using infra-red waves.

13/285 *Wireless and photography in French aircraft 1923-24.*

Available for consultation 1975.

Description of various radio transmitter types. Report of successful results of French trials with radio controlled aircraft. Notes French use of heating of clothing, guns, oil and radio equipment in French day bomber aircraft. Notes French intercommunication between aircraft, radio direction finding and radio navigation.

13/294 *Wireless transmission of still photographs, 1928-1935.*

Available for consultation 1985.

Record of trials transmitting photographs to and from airships R 100 and R 101. Describes Fultograph picture transmission apparatus and that available from the Marconi Wireless and Telegraph Company. Marconi equipment was also in process of development for use with heavier than air aircraft and tanks. Results of various tests. Includes photographs, diagrams and a sample of the paper used for the reception of an image.

13/384 *Philips image transformers.*

Opened 1938. Available for consultation 1989.

Information from Phillips Image Transformers Department. Includes their publication, in English " An apparatus for the transformation of light of long wavelength into light of short wavelength". Publication includes influence of magnetic fields and amplification by secondary emission. Associated diagrams. Suggestion 3rd June 1938 that equipment should be fitted to Bristol Blenheim aircraft for trials.

13/874 *Bombs: detonation by photo-electric means, 1937-1939.*

Available for consultation 1972.

This is volume 2 opened 1st January 1940. Includes notes on possibility of designing a photo-electric bomb to detonate at a small height above the ground. Discusses effects of terrain on detonation. Translation of German text of similar research. Photographs of Armstrong Whitworth Whitley used for trials and other diagrams.

13/891 *Photo-electric bomb: dropping tests, 1940-41.*

Available for consultation 1972.

Results of tests conducted at Airborne Armaments Experimental Establishment, Boscombe Down. Suggested use of both Bristol Blenheim Mk. I and Mk. IV for tests against ground and barrage balloon. Fairey Battle and Hawker Hurricane also used as carrier aircraft for trials. Associated diagrams for attack on other aircraft. Photographs of bomb dropping on ground and fitting of bombs to hurricane bomb racks.

13/905 *Photo-electric bomb: proximity fuzes, 1940-42.*

Details of investigations into photo-electric cell produced by the Baird organisation at University College, Exeter. Subsequent to developments and great increase in sensitivity of the cell demonstrations were given to members of the cabinet as well as senior officers in most ministries. This demonstration resulted in a request for large scale production.

13/1263 *Television transmission from aircraft: various papers, 1936-43.*

This large file records a variety of British television aerial reconnaissance activities during the given period and concerns both animate images as well as individual images for intelligence delivery. Equipment from both Baird Television Ltd and Marconi-EMI is included. Trials of M-EMI equipment in Blackburn CA 15C aircraft is of particular note. This file contains unique reference to fitting of television reconnaissance equipment to a Wellington aircraft in December 1940. During 1943 a certain R.L. Aspden, who was not thoroughly aware of all investigations undertaken in the previous reconnaissance trials, records his personal ideas relating to further developments of television aerial reconnaissance technology.

15/49 *Ministry of Aircraft Production and predecessor and successors: Registered Files.*

Opened 4 November 1939. Available for consultation 1991.

Alternate title "Projectile Development Establishment Committee membership and terms of reference". Includes records of trials of Unrotated Projectile (rocket) tests 29th December 1939 and 30th December 1939 for raising 1000feet of steel cable. Also refers to a 'chemical bomb'. Diagrams included

18/1826 *The evaluation of an aircraft closed circuit television channel in the role of a photographic reconnaissance sight, 1950.*

Testing of Marconi equipment for potential using with TSR 2 aircraft then being developed. 405-line definition television equipment tested Vickers Valiant Mk. I aircraft serial W.P. 205. System used roller map for map reading applications. Equipment not usable at night, in poor weather and at low level. Subsequent interest in infra-red capabilities of Vidicon camera. System considered useful to align aircraft for photographic reconnaissance purposes. Includes graphs and photographs from screen as well as of installation in Valiant aircraft.

22/861 *Mine detectors: research and development, Director of Scientific Research, 1940-1943.*

Opened 17 November 1940. Available for consultation 1972.

File predominantly concerned with detection of anti-tank mines. Consideration by W.H.Eccles of detection of wooden mines. By 7th April 1943 had assessed Polish and American mine detection equipment although at this time German equipment was not available. Note that Germany placed order for mine detection equipment with Norway. Later tests of Swedish and Soviet equipment. National Physical Laboratory involved in tests. First communication with Cinema Television Ltd on the 28th of March 1942 directed to Mr Ben Clapp.

22/862 *Mine detectors: research and development, Director of Scientific Research, 1943-1946.*

Opened 2 June 1943. Available for consultation 1972.

Includes record of series of meetings in which were discussed methods of mine detection and clearance. Foreign mine types noted include Japanese, Canadian and Italian. Note of "Wolf" system that involved the use of dogs for mine detection. Includes request by G. Parr editor of Electrical Engineering to Cinema Television Ltd for public article describing the rudiments of mine detectors.

22/872 *Detector of metallic objects embedded in the body: unsuccessful development by Cinema-Television Ltd., Director of Scientific Research, 1944-1945.*

Opened 7 September 1944. Available for consultation 1976.

Discussion of need and issue of contract 294/2/6824/Con.2A/3 to Cinema Television Ltd, which resulted in the production of a metal locator for surgeons. After prototypes were produced and tested the locator was found to be of no use and the contract was cancelled on the 5th of March 1945.

22/908 *Television equipment: development, Director of Scientific Research, 1945-1946.* Opened 1 August 1945. Available for consultation 1972.

Includes interrogation of various German scientists including Dr Möller, particularly with reference to television guided missile Hs 293 D. Description of weights and dimension of various German military television equipment. Some equipment delivered to and demonstrated at the Royal Aircraft Establishment. Note of availability of German film of television use with glider, possibly refers to Hs 293 D. Mention of 'Schnellschreiber' (fast writer) which used spurt transmission . In relation to this equipment a Mr Nowacki or Novatski mentioned. Pye company paid £ 3,500 pounds for equipment based on German single frame technology which was demonstrated on the 15th of May 1946.

22/970 *Television equipment: development.*

Opened 29 September 1945. Available for consultation 1977.

Refers directly to formation of Television Advisory Committee on 2nd of October 1945. Angwin and E.V. Appleton consulted. Suggestion to re-commence television broadcasting as soon as possible and in this connection to have television technicians released from active duty rapidly. Direct reference to American developments and discussion about the possibility of using similar system for Britain.

22/1383, *Development of automatic gun laying,*

Opened 1 July1942. Available for consultation 1974.

Description of auto following technique of anti-aircraft guns directed by radar. Mention of Gun laying Mk. IV equipment 21st of July 1943. Companies involved include British Thompson Houston, A.C. Cossor, Metropolitan-Vickers and Nash and Thompson. Includes results of various trials.

22/2719 *High-speed and pressure recording apparatus: design and production by Cinema-Television Ltd., London, Contracts: Policy, Conditions, Capital Assistance, 1940-1942.*

Opened 22 April 1940. Available for consultation 1973.

Urgent request for high speed pressure recording equipment. Direct reference to Gaumont – British Picture Corporation manipulation of Baird Television Ltd with Cinema Television Ltd. In this concern Price Waterhouse involved. Resulting manipulation gave the BTL organisation known as CTL freedom to pursue contracts issued by Ministry of Supply. CTL directors noted as Mark Ostrer and W.B. Robinson. Mr Austen and Mr Mc Connell of CTL directly responsible for M of S contract. As a result of BTL/CTL employment of foreign nationals K.A.R Sampson and DR Sommer M.I.5. conducted a series of security checks.

22/2752 *Development of P.E. cell. Cinema Television Ltd., London, Contracts: Policy, Conditions, Capital Assistance, 1940-1941.*

Available for consultation 1972.

Includes discussion of patent issued to Boulton-King for Photo-electric cell. Reference to contract 294/V/193 (Con. 6.S.). 19th of October 1940 mention that Gramophone Company and EMI Ltd have similar contract. M.I.5 interest in Cinema Television Ltd due to the employment by the company of two foreign nationals. 24th March 1941 L.M. Robinson noted as director of Cinema Television Ltd.

23/386 *Secret telephony experiments, 1928.*

Opened March 1926. Available for consultation 1979.

Includes Signals Experimental Establishment report no. 386 of March 1926. Report concerns secret telephony experiments. Discussion of use of Poulson Telegraphone principle for secret telephony. Also Dictaphone which used steel wire for recording purposes. With wire system, suggestion that length of wire could be divided using more than one pick-up to enhance secrecy. Investigation of increased frequencies resulted in recording problems. Includes associated diagrams.

23/404 *Dummy tape perforator for secret telegraphy, 1928.*

Opened June 1928. Available for consultation 1979.

Includes Signals Experimental Establishment report no. 414 of June 1928. Discusses double morse system using two tapes in which the concurrent tapes obliterate or mark. Special equipment produced for experimentation. Advance of tapes provided by cam and pawl mechanism. Use of a variety of paper of different thickness. [File seems to be incomplete].

23/476 *Superposition of telephony and teleprinter-telegraphy on earth-return lines at Aldershot, 1929.*

Opened December 1929. Available for consultation 1980.

Includes Signals Experimental Establishment preliminary report no. 488 of December 1929. Basic discussion of experimentation undertaken by a Mr Arnold amongst others at Aldershot. Note that investigation was affected by line degradation. Sparking also deteriorated line and suggestion that spark quenchers should be used.

23/553 *Area system: experiment to investigate the possibilities of the transmission and reception of written messages by some form of television, 1932.*

Opened December 1932. Available for consultation 1983.

Includes Signals Experimental Establishment report no. 566 of December 1932. Discussion of the Area System of Telegraphy which was experimented with to send text written in India ink on a transparent sheet via a television like system. Scanning device used light chopper disc and mirror drum with another mirror drum at receiver. Other scanning devices used included Nipkow disc with 20 holes of 31/1000ths of an inch in diameter. Includes a variety of diagrams and photographs of equipment used.

23/768 EMI *Infra-red telescope, 1941.*

Available for consultation 1972.

Includes Signals Experimental Establishment report no. 792. Admiralty Research Laboratory trials of infra-red telescope June 1941. Also trials using EMI electron image converter tube specifically for secret signalling. Discussion of interception of enemy infra-red signalling. Various lamps used for signalling purposes. As a result of trials it is concluded that the equipment was of no use to the army.

39/14 *Television, CENTRAL RADIO BUREAU OF GERMAN ELECTRONIC INTELLIGENCE, 1945-1946.*

Opened 3 December 1945.

Discussion of various interviews conducted with German scientists. On the 14th of July 1945 Dr Knoll suggested that a television equipped bomb sunk a ship at Salerno

[This is possibly a unique reference to television equipment used in this famous guided missile attack]. Professor Senröte was in charge of this project. 200 television systems made for Hs 293 missiles. 80 drops of missiles made over peenemünde. Also hoped to equip Fritz X missiles with television guidance system. Fernseh A.G. equipment was used for air launched missiles. Manfred von Ardenne involved in colour television experiments. 1942 German use of television to guide aircraft. Tonbild system used thinner necks of cathode ray tubes to assist in greater angles of cathode beam deflection. A wide variety of other investigations, including 'Funksehen' 3cm radar type television, sending 30-line Nipkow disc generated text images to and from aircraft, underwater television and television as an assistant to guidance of radio controlled boats and tanks.

39/70 *Television, DIGEST OF PRODUCTION INTELLIGENCE, 1945-1946.*

Very similar file to AVIA 39/14 containing same material.

54/1490 *Television in Army equipment: use, 1945-1954.*
Opened 11 November 1948. Available for consultation 1985.

Record of various interrogations of German television scientists conducted at the Royal Aircraft Establishment in 1945. Informants include Dr Moeller, Dr. Ing. Kurt Lammchen (of Jewish origin) and O. Henle from such establishments as Blaupunkt at Hildesheim and Fernseh. A.G. at Taufkirchen. T.M.C. Lance of Cinema Television Ltd informed Air Ministry that his company had pre-war links with Fernseh A.G. and wished to be involved with the interrogation. Various German equipment was lent to the Ministry of Supply and tests conducted.

74/15 *UHF mine detector for non-metallic mines, 1944-47.*
Opened 26 January 1944.

Investigation and further research with certain Polish mine detectors. Detection methods investigated include; supersonic, transient, condensation patterns, observation of hollows, dogs, transmission of DC current through ground and Gamma ray scattering. Massachusetts Institute of Technology were consulted for this investigation. Included is Post Office Engineering report no 11, 263 of 18th of July 1941 entitled "The location of unexploded bombs by acoustic methods", part II.

10.1.4 BT

58/249 *INVESTIGATIONS INTO FIRM'S AFFAIRS (Code No.13): Companies Act, 1929. Sec. 135: Investigation into the affairs of Gaumont-British Picture Corporation Ltd. 1938-1939.*

Available for consultation 1990.

Results of investigations into suspect activities by the Ostrer brothers of Gaumont-British that seemed to indicate manipulation of the company against shareholders wishes. Investigation undertaken to protect shareholders rights. Involved in this complex business was the possible merger of G-BPC with Oscar Deutsches' Odeon.

64/21 *Discussion on U.S. control of Metropolitan Vickers.*

Opened 10 February 1937. Available for consultation 1988.

Part of a selection of files under this notation which are unrelated to the Metropolitan- Vickers investigation. Interest by Board of Trade of external influences on the Metropolitan Vickers company. Statement that Associated Electrical Industries Ltd controlled Met-Vick. Suggestion to reduce American voting share to under 40%. Also suggestion to isolate Trafford Park works of the company from other parts.

10.1.5 CAB

104/102 *Air Defence Research Sub-Committee: use of television apparatus in aircraft, 1936-1939.*

Opened 24 February 1936. Available for consultation 1990.

Result of enquiry by Major General the Right Honourable Lord Hutchinson into use of television in aircraft. Baird Television Ltd and Marconi-EMI both noted as being involved with aerial reconnaissance investigations in March 1936. Record of note written to various recipients by Sir Harry Greer on the 'sadly neglected use of television'.

120/835 *Miscellaneous Crystal Palace Towers.*

File is specifically concerned with the destruction of both of the water towers on the Crystal Palace site in South London. Discussion of various reasons for destruction including the possible interference with gun laying radar by the metal frames of both towers. This problem was discussed from two different points of view by R. A. Watson Watt and F. Lindemann. Details of method of destruction of towers and the temporary cessation of activity due to military interests.

10.1.6 DSIR

36/2257 *Facsimile research, 1930-37.*

Includes "A Theoretical Study of the Multiplication of Photo-Electric Currents by means of Thermionic Valve Amplifiers" by H.A. Thomas. Also Post Office Engineering Department Radio Report no. 380 and 397. Report 380 includes the transmission of pictures from Britain to Japan between November 1936 and February 1937 by W.D. Cooper and J.C. Dudley. A.J. Gill was engineer in chief. Nippon Electric Company, Standard Telephones and Cables Ltd were involved in these experiments. File also refers to picture transmission experiments with R. 100 and R.101 (see AVIA 13/294), transmission of short film of London-Melbourne air race and transmission to RMS Olympic. Report 397 is entitled "Interference with the reception of Television signals from Alexandra Palace by Super-Heterodyne Receivers".

36/4408 *Facsimile research.*

Includes Signals Experimental Establishment report no. 489 of December 1929. Report concerns radio research, radio receiving apparatus and facsimile telegraphy. Reference is made to Captain Fulton's marketing of his Fultograph machine through his company Wireless Pictures Ltd in 1928. Experiments were undertaken by the SEE using a modified Fultograph which transmitted images from the transmitter at Daventry. Details include specification of machine, test circuits, receiving papers, transmission plates, writing styles and use of Army land lines. Includes diagrams and photographs.

10.1.7 HO

45/24294 *ENTERTAINMENTS: Television equipment in cinemas: development and draft regulations, 1939-1950.*

Available for consultation 1981.

Considerations of safety with reference to television equipment within cinemas. With film/television hybrid systems recommended use of safety film. Main electrical circuits to be screened and have failsafe mechanism. Projector to be enclosed with surrounding space clear. Reference is made to demonstration by Rank-Cintel in Penge Odeon at which Football Association Cup Final was shown on a large television screen to a selected audience.

10.1.8 J

13/16536 *Supreme Court of Judicature: High Court of Justice, Companies Court: Companies (Winding-up) Proceedings, Name of Company: Baird Television Ltd & Cinema Television Ltd, 1940.*

Winding up proceedings of Baird Television Limited commenced 17th of December 1940. This application included precise details of all material holdings as well as shareholdings of BTL, which were to be transferred to Cinema Television Ltd. Due to the inability to accurately assess certain French holdings of BTL, the process took longer than expected. Eight unsuccessful applications were made to the High Court before the BTL was finally wound up on the 26th of December 1945.

10.1.9 WORK

25/261 *Southbank Tele-Cinema, 1951.*

A large body of files all concerning activities at the Festival of Britain, 1951. Cinema Television Ltd received contract C/3/265 worth £6, 000 on 14th of November 1950 for display of television in the Festival of Britain Telekinema. Contract outlines the content of what was to be shown, material which was to be supplied by the BBC. From the 4th of May to the 30th of September 1951, during opening times there was to be demonstrations for fifteen minutes each hour for a twelve hour period.

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10.4 Patents

10.4.1 American

1 699 270
1 781 799
2 349 071

10.4.2 British

222 604
267 174
292 185
295 210
297 014
297 078
299 076
324 029
330 220
424 633
441 235
477 355
507 165
512 711
516 785
530 776

559 549
577 670
614 261
634 123
643 328

10.4.3 Canadian

429 352

10.5 Web sites

http://www.digitalcentury.com/encyclo/update/baird.html : A basic biography of J. L. Baird.

http://arts.uwaterloo.ca/FINE/juhde/hills196.htm } Part One; A description of J.L.Baird's life and work up to first demonstration of television

http://arts.uwaterloo.ca/FINE/juhde/baird296.htm } Part Two; A description of J.L.Baird's life and work after 1926, written by the inventor's son.

http://arts.uwaterloo.ca/FINE/juhde/ibair972.htm } Part Three; An interview by Gerald Pratley of J.L.Baird's grandson Iain, with special reference to television history.

http://www-royaltv.pp.asu.edu/news28.html#Baird : An article written by Professor Malcolm Baird about his father's trip to America in 1931.

http://members.attcanada.ca/~antenna1/Baird.html : A developing site produced by Iain Logie Baird about his grandfather's work, with special reference to North American activities.

http://members.aol.com/aptsarc/index.htm : The Alexandra Palace Television society homepage featuring a list of their comprehensive records.

http://www.bbctv-ap.freeserve.co.uk : Post war television at Alexandra Palace by an engineer responsible for Cintel and other equipment

http://www.1066.net/baird/index.htm : Some notes on J.L.Baird's life and work in Hastings.

http://www.atsf.co.uk/ilight/noctovision.html : Information on night photography including J.L.Baird's Noctovision.

10.6 Miscellaneous

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