# Alan Dower Blumlein

**Of the men who were responsible for the development of the Marconi-EMI high-definition television system in the early 1930s, the name of Alan Dower Blumlein stands out. He was one of the most remarkable and significant engineers of the twentieth century. Yet, following his death in 1942, his work was shrouded in secrecy. He received neither obituary nor tributes. This article is based on Robert Alexander's book, which is the first comprehensive Blumlein biography**

*Bernard Greenhead with the prototype Emitron camera at EMI Hayes, 1935.*

Shortly after 4.20 in the afternoon on Sunday, 7 June 1942 – a glorious summer's day, clear skies, warm sunshine and perfect visibility for flying – a Halifax bomber crashed into the steep hillside of a valley just north of the River Wye near the village of Welsh Bicknor in Herefordshire. All of its eleven occupants were killed in the enormous fire that engulfed the aircraft on impact.

Of the scientific personnel who died that day, Alan Dower Blumlein stands out as possibly the greatest loss. "A national tragedy," one of his colleagues would call it. At a time when rapid advances were being made in many fields of science, Alan Blumlein was, without doubt, one of the most brilliant research and development engineers.

Born in Hampstead in June 1903, Blumlein had graduated from City & Guilds in 1921 with a first-class degree in heavy electrical engineering. This in itself would not bear mention were it not for the fact that, by the age of thirteen, the precocious and often eccentric young Blumlein could still not read or write.

He simply found no need to be able to write. As with all things in his life up to this time, if he saw no need, he showed no interest. It was only through sheer determination that Alan Blumlein set himself the task of learning to read detailed reference books on his chosen subject, realising the need for this in order to advance his passion for everything electrical.

### After a slow start...

Blumlein's career initially took gradual steps. In 1925, he co-published an elementary paper on electrical principles in *Wireless World*.

Though presented the following year to the IEE, and subsequently awarded a Premium for the work, Blumlein would only return once to the printed word to enlighten the world about his thinking.

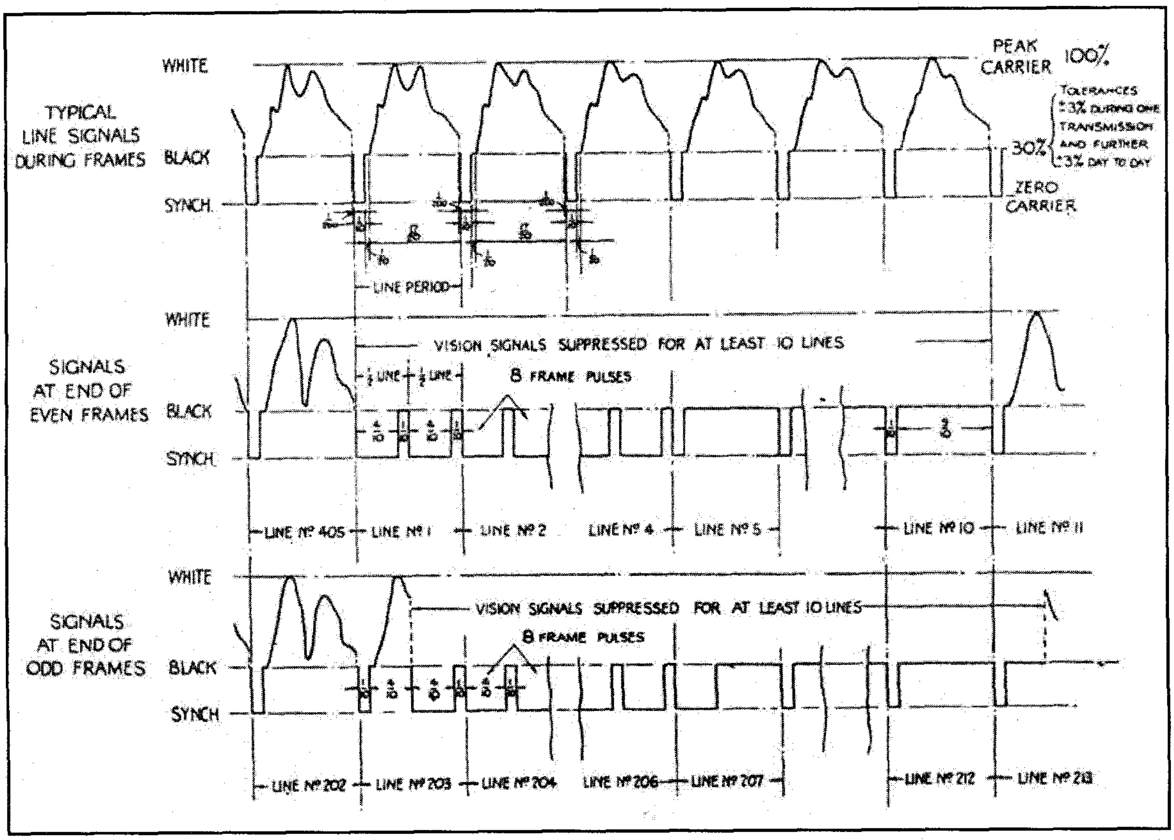
Following a short but eventful career with Standard Telephones & Cables, during which he applied for the first of his 128 patents, Alan Blumlein applied for a position at The Columbia Graphophone Company. This was in early 1929. While at STC he would meet his employer, mentor and later friend, Isaac Shoenberg, who subsequently became Sir Isaac.

Shoenberg was looking for an engineer to design and construct a recording mechanism that would overcome the patent that Bell Laboratories was imposing on everybody in the record making business.

Blumlein set about designing the elements of a recording and reproducing system. By 1930, this system had successfully bypassed the Bell patent and went on to earn Columbia a fortune.

One day in 1931, while at the

*The Marconi-EMI high-definition television system transmitted waveform.*




cinema with his fiancée Doreen, Blumlein enquired of her if she had noticed how the voice of the person on the screen only ever came from one place. Not being of a technical nature, Doreen said that she had not. "Well, I have a way of making the voice follow the person", Blumlein replied.

This casual remark was the first indication of the train of thought which would lead to Alan Blumlein's 'Binaural Sound' patent – arguably his best – and certainly to become one the most important advances in audio engineering of the twentieth century.

## But humans have two ears!

Binaural Sound is of course known today as stereo. It works on the basis that human beings have two ears which, because of their position at each side of the head, receive sound at slightly different times.

Alan Blumlein ingeniously accommodated the basic concept of binaural sound using electronic circuitry and two loudspeakers. Unfortunately, it was so far ahead of its time, in 1931, that many of his colleagues at EMI did not realise its full potential. EMI had been formed earlier the same year when Columbia and HMV had merged.

Blumlein continued with this work for several more years. He made the first stereo recordings and also the first stereo films before binaural was shelved for technical reasons.

## Quest to develop TV

By this time, EMI had become involved in the quest to develop a television service.

In 1934, the government formed a committee to investigate the potential of television. This committee concluded that a British television service should be developed by the end of 1936.

Two companies stood out among those tendering systems for the television service. Baird Television, founded by John Logie Baird, was one of them. He had persisted with a mechanical projection method. Despite its ingenuity this system produced poor quality pictures and was inflexible.

The other company, Marconi-EMI, had decided to work with an all-electronic method of picture transmission and reception. It involved cathode-ray-tube technology, which was then still in its infancy.

Several seemingly insurmountable problems presented themselves to these pioneers. Not least of these was that in many cases the entire electrical circuitry of the system needed to be invented from scratch.

Luckily, EMI possessed an extraordinary set of individuals who, as a engineering team, managed to invent, construct and demonstrate a fully working television system in the now quite unbelievable period of just fourteen months.

As leader of the team in charge of developing the circuitry for the new system, Alan Blumlein had possibly the most exacting task. Yet from this period of his life more than half of his 128 patents were to emerge, with many of them critical to the eventual 405-line television system that the BBC adopted.

November 1936 saw the start of a

## Chain Home

Chain Home was a series of 300-foot high radio transmission and reception towers which started to appear at strategic points along the coastline of Britain from late 1937. Eventually they stretched from Scotland in the North right around the coast as far as Cornwall.

Constructed during the last few years of peace, the Chain Home system was finished just in time for the outbreak of war in September 1939. It played a vital role during the Battle of Britain the following summer.

The system gave enough of an early warning for the RAF Spitfires and Hurricanes to intercept with great accuracy and speed the attacking German aircraft as they approached.

three month trial involving transmissions from Alexandra Palace. The Baird and Marconi-EMI systems transmitted on an alternate basis.

By spring 1937, following the conclusion of the trial, the government and the BBC chose the Marconi-EMI system which had proved far superior to Baird's.

## Who invented television?

It is a curious irony that to this day many consider John Logie Baird to be the inventor of the television. Baird never actually claimed this. His mechanical television technology proved to be impractical for a high-definition system.

It was the team at EMI, whose numbers included Alan Blumlein, that should be given the credit for the 'invention' of what we know as television.

As a testimony to the team's work, 405-line transmissions actually continued until 1986, much as they had during those first trials at Alexandra Palace some fifty years earlier. Originally, the 405-line service was only intended to run for a few years before being updated.

With war in Europe looming, much attention was being directed towards a method of early warning against attack from the air.

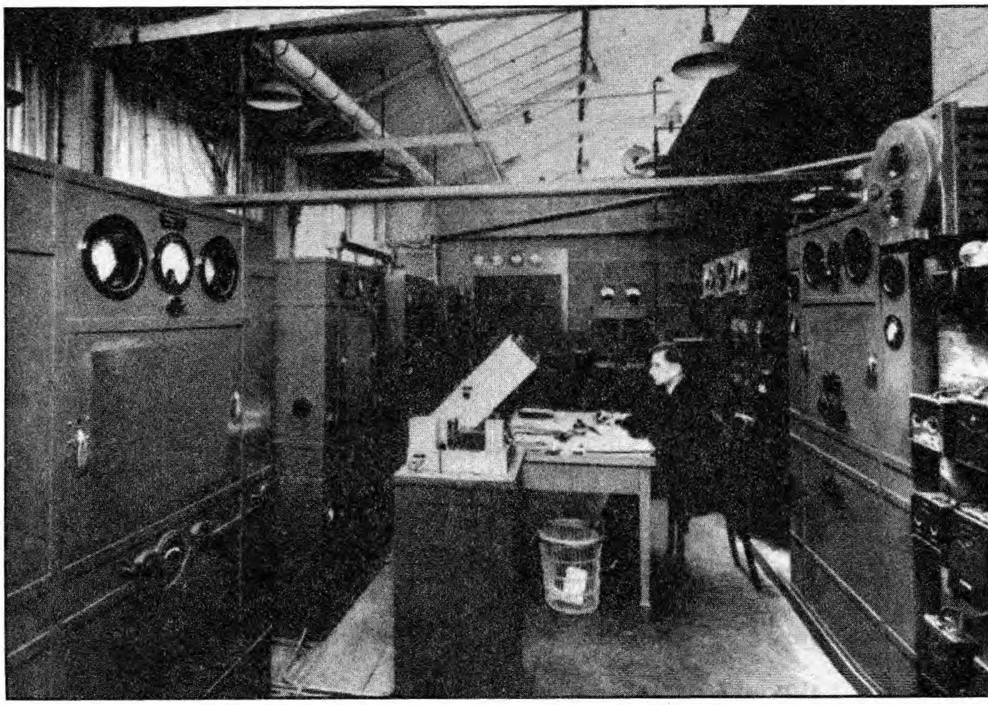
The first practical method of electronic radio detection finding – or Radar as it would eventually be known – had been demonstrated by Sir Robert Watson-Watt in early 1935. These experimental radio detection finding systems were shrouded in great secrecy. They, and their subsequent developments, had led to the construction of the Chain Home system described in the panel.

## Yet no obituary followed his death

Following his death, Alan Blumlein's work was shrouded in secrecy. No obituary appeared and no tribute was given. For many years, various people promised a biography of this most extraordinary engineer, but none was forthcoming. As time passed, those who knew him personally grew old and died; and today but a few remain.

Imagine a world that did not have a record of Faraday, Whittle, Maxwell, Edison or Bell. Given time, Alan Dower Blumlein will receive the credit he deserves. It was for this reason that I wrote his biography.

Without a doubt, Alan Blumlein is one of the most brilliant engineers of the twentieth century, and one that the twenty-first century will finally recognise.



*The prototype Marconi-EMI transmitter being assembled at EMI Hayes, 1935, before installation at Alexandra Palace.*

*The Marconi-EMI system at the opening of the London Television Service, Monday, 2 November 1936. Left to Right: Lord Selsdon, chairman of the Television Committee; Major Tryon, Postmaster-General; R. C. Norman, chairman of BBC; Alfred Clark (standing) chairman of EMI.*

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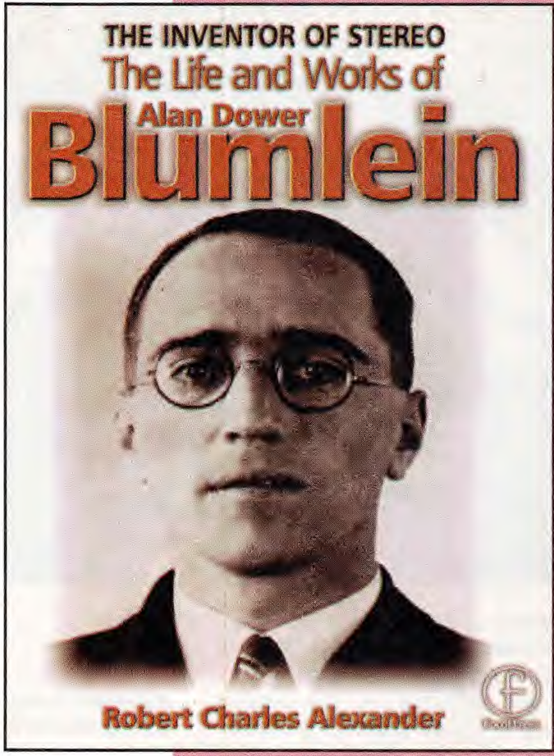


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This book is the definitive study of the life and works of one of Britain's most important inventors who, due to a cruel set of circumstances, has all but been overlooked by history.

Alan Dower Blumlein led an extraordinary life in which his inventive output rate easily surpassed that of Edison, but whose early death during the darkest days of World War Two led to a shroud of secrecy which has covered his life and achievements ever since.

His 1931 Patent for a Binaural Recording System was so revolutionary that most of his contemporaries regarded it as more than 20 years ahead of its time. Even years after his death, the full magnitude of its detail had not been fully utilized. Among his 128 patents are the principal electronic circuits critical to the development of the world's first electronic television system. During his short working life, Blumlein produced patent after patent breaking entirely new ground in electronic and audio engineering.

During the Second World War, Alan Blumlein was deeply engaged in the very secret work of radar development and contributed enormously to the system eventually to become 'H2S' – blind-bombing radar. Tragically, during an experimental H2S flight in June 1942, the Halifax bomber in which Blumlein and several colleagues were flying crashed and all aboard were killed. He was just days short of his thirty-ninth birthday.

For many years there have been rumours about a biography of Alan Blumlein, yet none has been forthcoming. This is the world's first study of a man whose achievements should rank among those of the greatest Britain has produced. This book provides detailed knowledge of every one of his patents and the process behind them, while giving an in-depth study of the life and times of this quite extraordinary man.

**Contents**

*One of the most brilliant, and perhaps least known, of British scientists was Alan Dower Blumlein, killed tragically in a bomber crash during World War II. A prolific inventor, he gained 128 patents in 15 years and made key contributions to television, sound reproduction and radar... by C. L. BOLTZ*

# Blumlein: unsung British genius

Setting a commemorative plaque into the wall of a building is traditional in Britain. It is a modern alternative to the once popular statue. Statesmen, artists, scholars and the like have been so recorded, but not many scientists or engineers have been given such treatment. That the Greater London Council has agreed to a plaque for Alan Blumlein is a sign of his revived repute among engineers. Until recently, very few British people had ever heard of him and during his life he received no public honours or membership of societies of high prestige.

So who was he, this unknown genius? First, he was British, born in London in June 1903. His father, a mining engineer, had been born in Alsace but became a naturalized Briton. Alan's mother was the daughter of a Scottish missionary in South Africa.

Alan Dower Blumlein (1903-1942).

Second, he was an engineer and prolific inventor. In 15 years he gained 128 patents, that is, one every six weeks on average. Everyone in Britain sees evidence of at least one of his inventions every day when looking at a television screen. Every ship's navigator watching his radar picture of the coast and ships around him is seeing something to which Blumlein made a key contribution.

He was born in Hampstead, a North-West suburb of London, and he attended in succession two of the small private schools that flourished by the dozen at the time in that neighbourhood. One of these was "progressive", so the boy learned very little and all his life was weak on spelling. At 12, it has been said, he could hardly read but was adept at quadratic equations.

Desperate measures were taken and he was sent to a "cramming" establishment to force-feed him with the basic knowledge needed to enter a public school, where he soon showed his interest in science. He matriculated, that is, he qualified for London University, and went to the City and Guilds College (part of the Imperial College of Science and Technology) on a governors' scholarship. In two years he gained a first class honours degree in electrical technology. He was just 20.

The year was 1923. The word "electronics" had not been coined. Telephone engineering was at an exciting stage, with problems of long-distance transmission, speech quality, interference through cross-talk and so on. Radio engineering existed, with circuit devices being rapidly invented without much fundamental theory of the behaviour of waves and inductive and capacitative circuits at the new "high" frequencies involved. Broadcasting had begun.

It is in this context that Blumlein's first contribution to technology must be seen. His professor was E. Mallett, specialising in telephony. Together they invented a new way of measuring the resistance of a coil at high frequencies. The first paper was so badly written and spelled that it was returned for revision. It was at last published in the "Journal of the Institution of Electrical Engineers" in 1925, and was entitled "A New Method of High Frequency Resistance Measurement". It was original enough to cause considerable discussion and was awarded a premium by the Institution.

At the time it was written, Blumlein was 21 and a demonstrator at his college. Professor Mallett had invented a graphical construction to arrive at a way of measuring the natural frequency of a telephone diaphram. This same geometry was now applied to the measurement of high-frequency resistance.

It is reasonable to assume that Professor Mallet had given the problem to his brightest student, who then did the creative research with the advice and supervision of the professor. The ensuing paper was long and very advanced and showed a mastery of fundamental principles (which word he continued for some years to mis-spell as "principals").

His academic career was soon over. He joined a firm that is best known under its present name, Standard Telephones and Cables. At that time he reeled off, with a collaborator, a series of articles on wireless theory for "Wireless World," which was then, and still is, the most popular British periodical on radio and television.

The substance of the articles showed Blumlein's strong point — he was a theory man. His genius lay in the creative way he used his complete understanding of fundamental principles, applying them to practical problems. He was not an innately practical man with apparatus and gadgets, intuitively arriving at a new device. He boasted that he had never made a radio receiver. Therein lay an arrogance of intellect that upset some of his colleagues at first, though it was softened by his sense of humour and generosity of spirit.

His first important invention shows his methods clearly. He needed to measure very small impedances (the equivalent in alternating circuits of resistances in direct-current circuits). The best way of measuring resistance was a circuit called a Wheatstone bridge, wherein a known resistance could be varied to balance the unknown one until no current passed through a measuring instrument, usually a galvanometer.

With alternating current, however, inductance and capacitance are unavoidable however well we construct the devices, and they add or subtract opposition to the current. (The opposition they present is known as reactance.) Moreover, they 'shift' the current wave in relation to the applied voltage wave. These effects became very troublesome at higher frequencies, making it impossible to use an ordinary bridge to measure very small impedances accurately. So Blumlein's invention was a special alternating-current bridge. It was patented provisionally in 1928, when he was 25 years old, and he continued to adapt it for his experiments for years. It was a key invention, No. 323 037 of the British Patent Office.

With such a bridge Blumlein could measure accurately the small capacitance, for example, between two telephone lines near each other. It was a seminal invention and after his death a further unpublished paper on it was found among his effects.

Using the bridge, he solved the problem he had been set — that of cross-talk in telephone loading coils. The company awarded him a bonus of £250 because of his accurate analysis. Between 1927 and 1930 some eight patents on telephony or telegraphy came from him.

By this time he had advanced himself. In March 1929 he joined what was then the Columbia Graphophone Company, now EMI, where he remained for the rest of his life. There he became one of a remarkable team of creative engineers and scientists who contributed a great deal to the reputation and success of the company.

Blumlein's first task was to devise a sound-recording system that would enable EMI to avoid having to pay royalties to Western Electric, which held the main patent for recording. In recording on a disc, a cutting device carves out a "wavy" groove in a spiral from periphery to centre. The "waviness" corresponds to the audio-frequency electrical signals coming to the cutting head. The signals produce vibrations of an iron armature holding the cutting tool, but unfortunately this armature has a natural resonance, and so have many other parts of the mechanism. So without corrective devices the cutting will not correspond faithfully to the electrical signals; some are exaggerated, some reduced.

One way to overcome this difficulty was to make the armature heavy enough to damp out any resonance. Blumlein's technique was to apply fundamental electromagnetic principles and use suitable circuits to modify the resonances. This was at once successful and the company gave him a bonus of £200; they made awards to his collaborators, too, a fact which he acknowledged gracefully. EMI was freed of royalty payments and, as everyone knows, has gone on to become the biggest producer of discs in the world.

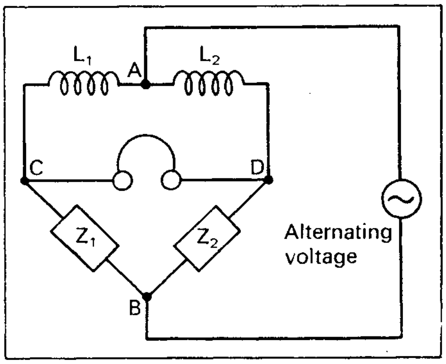
This was by no means all. From March 1930 to March 1933 he secured, sometimes with colleagues, ten patents, one of which was so advanced that it was not given due recognition until 1958. It was Patent No. 394 325 of December 1931.

Its title does not at first show what the substance of the invention was: "Improvements in and relating to Sound-transmission, Sound-recording and Sound-reproducing Systems." What it was really about was the achievement for a listener of three dimensional sense of a sound source, in other words, stereophony, quadraphony and all-round sound, though these words were not used at all. It covered talking pictures, disc-cutting and reproduction, and radio transmission. It looks as if Blumlein intended this to be master patent.

Over a quarter of a century later, in 1958, the Audio Engineering Society devoted one issue of its journal to stereophony and said of Blumlein's patent, "It is of historic importance in the development of stereophony . . . When it is realised that many of the ideas, psychoacoustic, mechanical and electrical, set forth in this document of 1931, are only now gaining wide popular currency, one may reflect on the magnitude of the economic forces which control the viability of inventions."

It was true comment. By the time the recording industry was prepared to put capital into stereo the Blumlein patent had run out. He followed it in 1933 and 1934 with other patents on the same topic. Only recently did the BBC begin to make experimental quadraphonic transmissions.

But his dynamic energy was given a new channel. It was television, in which EMI was very interested. In this he really changed from electrical engineer to electronics engineer, making full use of thermionic-valve circuitry. Inventions leaped from his mind — 17 in 1935 alone, including a few associated with television.




*Blumlein's alternating-current bridge resembles the direct-current Wheatstone bridge. When the impedance Z2, a standard used for measurement, is adjusted to balance the unknown impedance Z1, the voltage at C equals that at D and no current flows in the cross-arm; balance is detected by a null in the tone in the headphones. But when measuring small impedances, there is danger of serious error through stray capacitances between parts of the apparatus and from them to earth. To overcome this, L1 and L2 are wound on the same former so that they are inductively coupled. This means that any voltage developed across L1, due to the current flowing in it, is cancelled by a voltage induced in that winding by the current flowing in L2, and vice versa. Therefore, when the bridge is balanced, points A, C and D are all at the same potential. There is then no voltage across the stray capacitances, so no current flows in them to cause error.*

The television story is well known. In the 1930s, especially after the brilliant historic pioneering invention in 1933 of the iconoscope by Zworykin of RCA in the USA, EMI was stimulated to a most exciting period of invention. It led to the first real camera and the world's first public TV service by the BBC in 1936. Blumlein was one of the team of outstanding men responsible for this.

RCA would not share its knowledge except at a price, so EMI raced on independently, to such good effect that in 1937 RCA was glad to share its know-how freely with the company. It was Blumlein who went to the USA to negotiate (winning a prize for pistol shooting on the ship going over). The original unrefined iconoscope, which was the basis of a possible TV camera, had weaknesses. Blumlein, together with McGee (later professor at Imperial College), presented a provisional patent specification, No. 446 661, in August 1934, for a TV system (including a camera tube later called the Emitron), less than a year after Zworykin's paper of 1933. It was an achievement of fan-

## Blumlein: unsung British genius . . .

tastic speed, in a technology that now covers the world.

Meanwhile circuit inventions continued to flow from Blumlein's fertile brain. It has been suggested (by B. J. Benzimra in "Electronics and Power" in 1967) that he was the first to use negative feedback, a technique now common in automation and radio sets. He invented a new valve voltmeter of very high input impedance, important because it did not noticeably affect the operation of the circuits to which it was connected to measure high-frequency voltages. Enthusiastically he seized on the possiblities of new types of thermionic valves for practical devices.

His enthusiasm was also evident in his private life. He learned to fly and gave his bride-to-be their first outing in a two-seater aircraft. He learned to ride a horse and to play golf. He was well off, could afford six weeks' holiday a year, played bridge, and was an ardent theatre-goer.

Then came the war. His acoustic direction-recognition (of his 1931 "stereophony" patent) was applied to detecting submarines. His old remarkable inductive bridge (patent of 1928) was applied as an altimeter for low-flying aircraft, depending on the measurement of the capacitance between aircraft and earth.

EMI was soon caught up in the war effort on radar, or radiolocation as it was then called, in which Britain had an outstanding early lead. Blumlein was in the thick of it. With Dr F. C. Williams (later famous for the first practical computer memory, a modified cathode-ray tube), he invented a way of locking on to a radar reflection so that a fighter aircraft could pursue the target like a guilded missile. This was not patented until 1943.

He continued to get patents throughout 1940 and 1941 and into 1942, dealing with pulse techniques for radar, with oscillatory circuits, and so on, including variations on his old inductive bridge.

One important technique in which he was concerned was code-named H2S, a subject of many schoolboy jokes. It was a technique whereby a radar beam from an aircraft was swept circularly over the ground beneath, while a cathode-ray tube had a time-base rotating in synchronism. Because of the different intensities of reflection, a "map" was generated of the terrain underneath. It is now a standard technique in ship navigation, using a horizontal beam. The Telecommunications Research Establishment made apparatus. So did EMI, and of course Blumlein was involved. It was intended as an aid to navigation and to precise bombing.

On June 7, 1942 the first equipment was installed in two Halifax bombers for test runs. Flying in one of them were Blumlein and two EMI colleagues. One engine caught fire and the aircraft crashed, killing everyone on board, including Alan Dower Blumlein, who was not quite 39. The loss was catastrophic, and much intense effort was needed to bring H2S into service. But it was introduced, and shipping losses were reduced by nearly 90 per cent within three months through the ability to find the positions of submarines. Churchill made special mention of it in his account of the war.

After the war a radiolocation convention was held at the Institution of Electrical Engineers in London. In an introduction to circuit techniques Dr Williams added a footnote. "First and foremost the author wishes to express his indebtedness to the late Mr A. D. Blumlein, whose contributions to circuit technique were very great, and from contact with whom the author derived enormous benefit during the early days of the war." It was the only obituary he obtained until the plaque was unveiled at his former home in West London on 1 June, 1977.