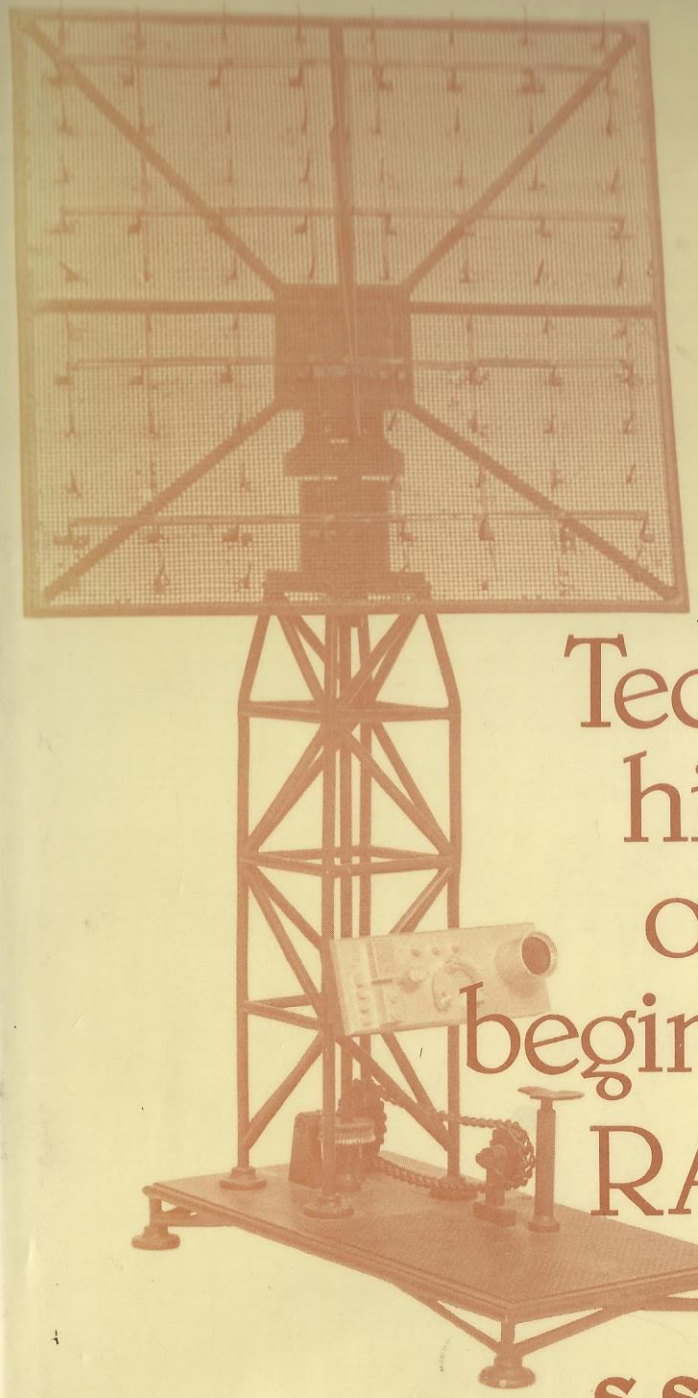

Technical history of the beginnings of RADAR

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Chapter 3

Precursors of radar

3.1 Introduction

In a paper [1] 'A terrain clearance indicator' read before a Chicago meeting of the Institute of Aeronautical Sciences on 19th November, 1938, and published in the *Bell System Technical Journal*, the authors Lloyd Espenschied and R. C. Newhouse made what is considered a key observation. Discussing the FM type of radio altimeter and referring to early efforts in this area, they said:

> The evolution of this method is interesting because it illustrates how one art is built upon another, and also the familiar story of separate inventors arriving at the same answer almost simultaneously, actually somewhat in advance of the existence of instrumentalities having the characteristics required to make the invention practically serviceable.

No more apt comment could be made today of the proposals, the patents and the experiments which preceded the actual development of radar in the various countries in the 1930s. In this regard, one thinks of the proposal of Christian Hülsmeyer in Germany in 1904, of the observations of A. Hoyt Taylor and Leo C. Young in the United States in 1922 and of the specifications of L.S.B. Alder at the Royal Navy Signal School in 1928, to mention but a few. A reader of radar history might well regret the apparent lack of interest shown by their superiors to the suggestions of A. Hoyt Taylor to the United States Navy in 1922 or to the reports of W. A. S. Butement and P. E. Pollard to the British Army in 1931. On reflection, however, he might consider it just as well that proper development programmes were not undertaken with the technology of the time. Each reader must eventually form his or her own judgement and one can do no better than record events as accurately and as objectively as possible. In appreciating technological events of the past, hindsight from the present has indeed its value, but it is essential to regress to the past where one's horizon becomes that of the time in question.

3.2 Christian Hülsmeyer

Mention has been made already of Nikola Tesla and of his conception in 1900 of the possibility of employing radio waves not only to detect, but also to measure the movement of distant objects. The man and the date are at least worth noting. Whether his words reflect only the wishful thinking of a visionary or whether they are in some measure based on knowledge obtained in his experiments at Colorado Springs is difficult now to assess. The history of radio technology might benefit from a critical study of the Colorado Spring's epoch of Tesla's life.

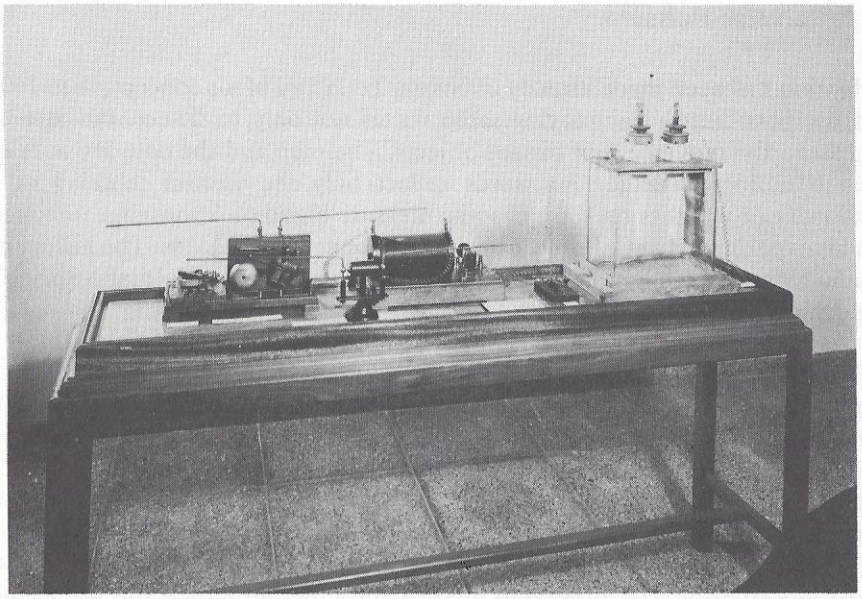
As we move along the years, and, of course, with our present hindsight, the 30th April 1904 is the next significant date. On that day, Christian Hülsmeyer in Düsseldorf, Germany, applied for a patent for his 'telemobiloscope' which was a transmitter–receiver system for detecting distant metallic objects by means of electrical waves [2]. Two significant features about the telemobiloscope are that the apparatus was designed principally as an anti-collision device for ships and that it did work quite successfully [3–7].

Christian Hülsmeyer was the son of a farmer. His interest in collision prevention arose after observing the grief of a mother whose son was killed when two ships collided. After a period teaching in Bremen, where he had the opportunity of repeating Hertz's experiments, he joined Siemens. In 1902 he moved to Düsseldorf to concentrate on his invention. He became acquainted with a merchant from Cologne, was given 5000 marks and founded the company 'Telemobiloscop-Gesellschaft Hülsmeyer und Mannheim'. The first public demonstration of his apparatus took place on the 18th May 1904 at the Hohenzollern Bridge, Cologne. As a ship on the river approached, one could hear a bell ringing. The ringing ceased only when the ship changed direction and left the beam of the apparatus. All tests carried out gave positive results. The reaction of the press and public opinion were favourable. Nevertheless, neither the naval authorities nor public companies showed any interest.

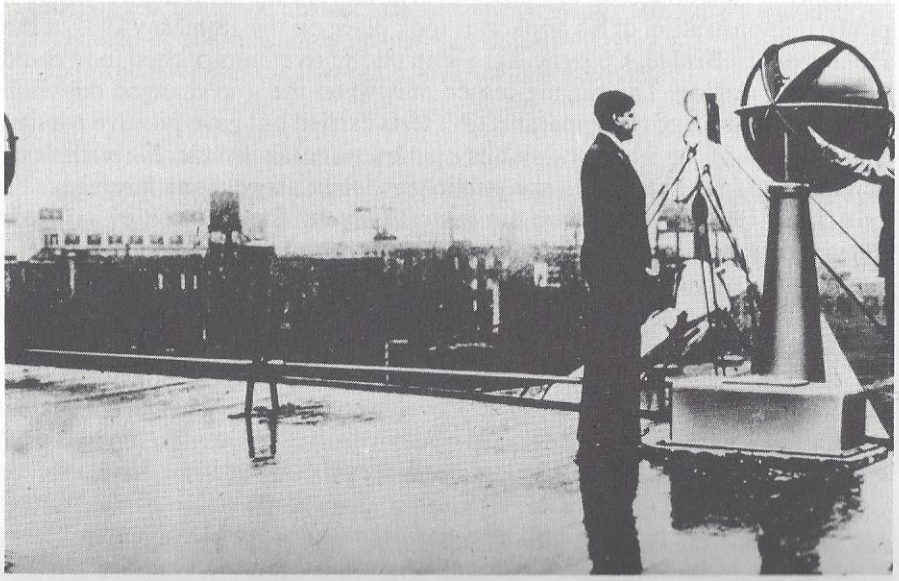
In June 1904 he was given the opportunity by the director of a Dutch shipping company to display his equipment at various shipping congresses at Rotterdam. At this stage his equipment was detecting ships at ranges up to 3000 m, and he was planning new apparatus which would function up to 10 000 m. He took out a fourth and final patent on the 11th November 1904 [8], but after this no further publicity was given to his work and no further experimentation was carried out. He seems to have become somewhat embittered by the apathy of the experts, particularly during the First World War, when he felt that his invention could have been put to so much use.

Later he was successful as an engineer in Düsseldorf, where he died at the age of 75 in 1957. In 1955, although too ill to attend, he was honoured at a congress in Munich on Weather and Astro-Navigation (Flug-Wetter-und Astro Funkortungs-Tagung).

A brief description of his apparatus would say that it probably operated on a



Christian Hülsmeyer's equipment of 1904 on display in the Deutsches Museum, Munich.



French (SFR) 16 cm obstacle detector CW radar on the deck of the S.S. NORMANDIE, New York harbour, 1935.

wavelength of 40–50 cm. The transmitter used a Righi-type spark gap (part of which was immersed in oil) fed from an induction coil. The radiated pulses were beamed by a funnel-shaped reflector and tube which could be pointed in any desired direction. The receiver used a coherer detector and a separate vertical antenna, which, because of a semi-cylindrical movable screen, was also directional. Basically, the apparatus was designed to detect the presence of an object in a particular direction. The question of determining distance was later solved, in principle anyway, by a modification which aimed at beaming the radiation at any desired angle of elevation or, rather, of dip. Knowledge of the height of one's own transmitting antenna above the surface of the water and of the angle of vertical dip at which an object was detected would, by simple calculation, give the range of the object. Perhaps the most ingenious aspect of the inventor's later apparatus was his awareness that the equipment might respond to other than its own transmissions and his safeguarding against it by a time limiting electromechanical mechanism. The receiver responded to a first transmission's signal only if, after a predetermined interval, it received the signal from a second transmission.

Most of his apparatus was destroyed in 1919 but some, principally a receiver, is on exhibition at the Deutsches Museum, Munich.

3.3 Hugo Gernsback

The next person of note must surely be Hugo Gernsback, who published in 1911 his romantic story RALPH 124C 41+. Gernsback was born in Luxemburg in 1884, went to the United States in 1904 and died in 1967. Among his achievements he launched a monthly magazine *Modern Electrics* which later became *The Electrical Experimenter*; he designed batteries and he marketed home radio sets. However, his fame lies in the world of science fiction and today just as there are Oscar awards in the world of the cinema, so are there Science Fiction Achievement Awards, which are named Hugos in his honour [9].

RALPH 124C 41+ was subtitled 'A romance of the year 2660' and was published in *Modern Electrics* in issues from April 1911 to March 1912, inclusive. The serial was later published in book form [10]. In the story there are several quite accurate predictions other than that of radar, and, unlike those of other writers of fantasy such as Jules Verne, they are all physically plausible.

Gernsback breaks the narrative of his tale to describe the detection apparatus used by the hero, Ralph. Here, but without the diagram in the text, is the description:

> A pulsating polarized ether wave, if directed on a metal object can be reflected from a bright surface or from a mirror. The reflection factor, however, varies with different metals. Thus the reflection factor from