

## **Christian Hülsmeier and about the early days of radar inventions**

a survey

### **Synopsis**

The objective of this publication is to recall some aspects of the course of history with respect to early radar developments.

It was on the 9 June 1904, just a hundred years ago, that the twenty-two-year-old Christian Hülsmeier demonstrated his radar-like apparatus on board the ships-tender Columbus in the harbour of Rotterdam. His audience was, in the first place, the technical representatives of the main Atlantic shipping companies which at that time were from Holland, Britain, France and Germany. The demonstration was arranged to take place during a Nautical Conference, which was hosted by the Holland-Amerika-Lijn (HAL) shipping company. The conference chairman was Mr Wierdsma, the CEO of that shipping company, whom, by his personal involvement, made it possible for Hülsmeier to demonstrate his “anti-ship-colliding system” to an international gathering of shipping experts. We will also look briefly at Hülsmeier’s inventions and the commercial implications.

It was believed until recently, that Hülsmeier’s revolutionary Telemobiloskop apparatus came too early, as technology could not yet cope with the very technical difficulties. This may well be true though, recent discoveries in a Dutch archive, allow us to get an unprecedented inside view as to what the circumstances were in those days.

To understand the course of this brief story, we have to start in 1864 with Maxwell’s famous theoretical equations and consider its scientific proof, between 1884 and 1888, by Heinrich Hertz.

Then we will follow Hülsmeier’s struggle to establish a commercial market for his radar-like inventions.

Additionally, we continue with some significant inventions in the 1920s and, finally, we enter the 1930s when the time became right for innovating radar technologies. We will omit, on this occasion, the many well-known radar stories as these have been dealt with by so many others.

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### **Theoretical context**

To understand the course of early developments (neglecting Faraday and others), we have to go back in time to 1864, when James Clark Maxwell<sup>1</sup> published his most important mathematical equations for the first time. These proved, that electromagnetic waves in free

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<sup>1</sup> Born in Edinburgh on 13 June 1831, died in Cambridge on 5 November 1879.

space consist of electrical and magnetic components, which are linked and directed in two perpendicular planes. And, consequently, their given ratio in free space is  $120 \pi$ .<sup>2</sup> Maxwell considered, that electromagnetic (EM) waves displaced (travelled) transversely in dielectrics and in free space. He also linked the velocity of EM waves, in free space, with the speed of light i.e.  $3 \cdot 10^8$  m/s.<sup>3</sup>

For us today it is hard to understand why Maxwell's theories encountered quite such animosity from some of the academic communities. Most of these men, probably, did not understand the full implications of Maxwell's theories. It took several years before a serious attempt was undertaken to resolve once and for all, these scientific disagreements.<sup>4</sup>

For a better understanding of how Heinrich Hertz<sup>5</sup> became involved in proving Maxwell's theories, we will follow the late John Bryant's publication on: "Heinrich Hertz, the beginning of microwaves".<sup>6</sup>

*Helmholtz had been trying to understand Maxwell's theory of electromagnetism and to compare it with a theory, based mostly on Newtonian mechanics, attributed especially to Fritz Neumann and Wilhelm E. Weber in Germany. Helmholtz called for an experimental validation of Maxwell's theory and had it published as a prize problem of the Prussian Academy of Science (Berlin) in 1879, often referred to as the Berlin Prize.*

The content of the competition text is difficult to understand and, due to this disadvantage, has been omitted.<sup>7</sup>

*We continue with the guidelines of this prize: Answers to this question have to be submitted by March 1, 1882. Submissions may, at author's discretion, be written in German, Latin, French or English. Each submission has to bear a motto which must be repeated outside of a sealed envelope containing the author's name. The prize of 100 ducats = 955 marks will be awarded at the public meeting of the Academy on the Leibniz<sup>8</sup> anniversary in July 1882.*

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<sup>2</sup>  $Z_{FS} = E/H = 377 \Omega$  ( $Z_{FS}$  = impedance of free space in ohm, E = electric field component in V/m; H = magnetic field component in A/m)

<sup>3</sup> It is interesting to notice, that Maxwell calculated already in cgs (metric) measures. Consequently, he used metres instead of inches.

<sup>4</sup> According Ludwig Boltzmann, are Maxwell's equations the most interesting facts of the history of Physics. [Fraunberger, p.551]

<sup>5</sup> Born 22 February 1857 in Hamburg, died on 1 January 1894 in Bonn.

<sup>6</sup> 1988 IEEE/MTT-S centennial celebration [Bryant, p.7]

<sup>7</sup> We have to consider, that the full implications of Maxwell's theory were just the subject of this prize, and that, for us today, curious descriptions had been used.

<sup>8</sup> Gottfried Wilhelm Freiherr von Leibniz. Born in Leipzig on 1 July 1646, died in Hannover on 14 November 1716.

Helmholtz<sup>9</sup> soon thought of Hertz as the man to solve these intriguing problems. However, it was not until 1884 that Hertz published a significant paper “*On the relations between Maxwell’s fundamental equations of the opposing electromagnetics*” .<sup>10</sup>

What followed between 1884 and 1888 had been explained already by many others, and will not be the subject of this publication.

Nonetheless, it is of interest to know what Hertz thought and explained shortly after his famous papers in 1888. Let me quote from some lines of Hertz’s lyric speech given, in 1889, at the Heidelberg University.<sup>11</sup>

“Light is an electric phenomenon. I have to be thankful that I could work on Maxwell’s theory, he who was so bright to link electricity and magnetism together. We are now acquainted with Maxwell’s publication of 1865, on electromagnetic light theory. One cannot study these theories, without getting the feeling, that the mathematical equations express their own mind, as if these formulae have more intelligence than us and its inventor”.<sup>12</sup>

This latter statement explains a lot about how Hertz approached his task. First he had to work out the electromagnetic phenomena and then, some time later, he proved that electromagnetic waves also conform to optical laws. For instance, reflection of EM waves at metal objects, and the polarisation of EM waves (with all its implications). He also proved, that EM waves can be focussed by means of dielectric-lenses and, that refraction, like in optical prisms, can be observed. He used for his dielectric-lens experiments ordinary pitch or asphalt materials, which were shaped to various curvatures.<sup>13</sup>

To close this chapter we notice that, in the strict sense, Hertz did not fulfill the obligations set by the “Berlin prize contest” as he missed the deadline of March 1882. However, he certainly would have received a Nobel Prize if he had been alive, after the inception of the Nobel Prize.<sup>14</sup> This, of course, can only be awarded to living individuals!

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<sup>9</sup> Hermann Helmholtz was born on 31 August 1821 in Potsdam, he died on 8 September 1894 in Charlottenburg (now Berlin). After he was ennobled in 1882, he could add “von” prior to his family name.

<sup>10</sup> [Bryant, p. 8]

<sup>11</sup> Licht und Elektrizität. Lecture given (20 September 1889) at the German Society of Natural Scientists and medical doctors, meeting in Heidelberg [p.5] [Bryant, p.44]. Abbreviated translation.

<sup>12</sup> ...man kann diese wunderbare Theorie nicht studieren, ohne bisweilen die Empfindung zu haben, als wohne den mathematischen Formeln selbständiges Leben und eigener Verstand inne, als seien diesselben klüger als wir, klüger als ihre Erfinder,..[Hertz Heidelberg lecture, p.14]

<sup>13</sup> [Hertz Heidelberg lecture, p.25]

<sup>14</sup> Since 1901

## The early days of wireless

The discussions about who might have invented radar, in the strict sense, has been an ongoing story for decades. We may say, that there never has been a “one off” inventor! It was more the case of the addition of many small steps which created the circumstances to engender practical radar-technologies in the nineteen thirties.

We have seen that our approach started with Maxwell and Hertz’s theoretical considerations. However, it is interesting to know that neither of these famous men ever considered that EM waves could be used for signalling at a significant distance. Hertz regarded distances of tens of metres to be the maximum obtainable. Why could he not imagine that EM waves should be detected at further distances? The reason is very simple, he did not have an appropriate detector facility! Hertz employed, as detection verification, the excitation of very tiny sparks between a relatively narrow spark gap (< 0.3 mm).<sup>15</sup> The gap had, for obvious reasons, to be adjusted with a micrometer screw and the spark gap had to be observed by an optical magnifying lens system.<sup>16</sup> It is, of course, evident that the location in which Hertz did his experiments, had to be kept quite dark during these kinds of observations.

Many scientists, who knew about Hertz’s work, soon started seriously experimenting with Hertzian waves and investigating the various implications. But, they were still hampered by the lack of sensitive signal detectors despite the fact that Ferdinand Braun<sup>17</sup> had already discovered, in 1874, that galena<sup>18</sup> crystals conducted currents differently depending upon the direction of the applied voltage. However, he did not utilise this phenomenon practically until he constructed his crystal detector-receiver in 1906. This device became very popular until about 1914 when valves could take over the job more reliably.<sup>19</sup>

The device which could not rectify alternating currents but, which could discern that an electrical signal existed across its two contacts, was invented by Edouard Branly<sup>20</sup> in 1890. It was Oliver Lodge (1894) who finally called Branly’s signal detector a ”coherer” (which the Germans called also a Fritter). How it really worked remained a mystery for a rather long time. All sorts of theories were being ventilated, but most of these could hardly stand up to scientific criteria.

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<sup>15</sup> [Bryant, p.22]

<sup>16</sup> Anthony Constable, paper: Message Received - Signal Hill. According Fraunberger, this spark-gap was named after Reiss, and in Germany known as Reiss’sche Funkenmikrometer. [p.567]

<sup>17</sup> Karl Ferdinand Braun born on 6 June 1850 in Fulda, died on 20 April 1918, in captivity, in Brooklyn (New York) USA. [Tübingen University on Ferdinand Braun p.1-14]

<sup>18</sup> Is chemically, Lead Sulphide. The German word is Bleiglanz.

<sup>19</sup> [Tübingen internet publication on Ferdinand Braun p. 5, 11]

<sup>20</sup> Edouard Branly was born on 23 October 1844 in Amiens France, he died on 24 March 1940 in Paris.

Likewise there were others who were very much interested in Hertz's work, the Italian Augusto Righi<sup>21</sup> conducted experiments with quite some success thereafter at Bologna University.<sup>22</sup> [Dragoni, p.221-270]

Marconi who lived in Bologna as well, came in contact with Righi and was very much impressed by Hertzian wave experiments at the local University.

Marconi is of course of significance as he introduced (in 1895) practical wireless to the world communities with his magic black box. He cleverly did what other scientist had refused to consider - to communicate by means of electromagnetic(EM) waves.

Hertz had once been asked by the German engineer Huber of Munic if one could not telegraph by means of magnetic waves?<sup>23</sup>

Hertz responded, that the frequencies would be too low to be focussed in a parabola, because the focussing point would need to become as big as a continent!<sup>24</sup>

It can be said, that Marconi deserves the honour to be the first one who linked EM waves and wireless communications together. However, there are some claims by others who might have come up with similar thoughts earlier. But, Marconi made it a success! Be it, not always with fair business practices!

## Christian Hülsmeier

As we have seen, Marconi introduced his wireless system in 1895 and from that year onwards many scientists, commercial businesses, but also fortune-hunters, started a competition to gain key positions by means of various patent applications. Even illustrious scientists were amongst them, like Ferdinand Braun and Oliver Lodge.<sup>25</sup>

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<sup>21</sup> Augusto Righi was born 27 August 1850 in Bologna, he died 8 June 1920 in Bologna.

<sup>22</sup> ...Negli anni tra il 1892 e il 1895, infatti, il giovane Guglielmo Marconi, che aveva una preparazione da autodidatta ed era fortemente interessato ai fenomeni elettrici e a quelli magnetici... [Dragoni, p.245]

<sup>23</sup> ... damals im Haag in Holland, bei Hertz an, ob man mit magnetischen Wellen in folgender Weise telegraphieren konnte: "Auf der einen Station würde im Brennpunkt eines Hohlspiegels ein Pol eines Elektromagnets mit Wechselstrom erzeugt. Die Magnetlinien (das magnetische Feld) wurde dann vom Spiegel der andere Station aufgenommen... [Fraunberger, p.642-643]

<sup>24</sup> ..Hertz antwortete am 3 Dezember(1889): ...Gewöhnlicher Wechselstrom hätte eine viel zu kleine Frequenz. .... [Fraunberger, p.643]

<sup>25</sup> Oliver Lodge, born on 12 June 1851 in Stoke-on-Trent Staffordshire, he died on 22 August 1940 in Normaton House near Salisbury.

Wireless communication was triggering the imaginations of many men and, we have to consider that the young Christian Hülsmeier<sup>26</sup> was amongst them.

He was born on 25 December 1881 in the very small village of Eydelstedt<sup>27</sup> at house number 40, situated near Barnstorf<sup>28</sup> (south from Bremen about half way between Bremen and Osnabrück) in Germany. Christian was the youngest of five children born to Johan Heinrich Ernst Hülsmeier<sup>29</sup> and his mother was Elisabeth Wilhelmine Brenning.<sup>30</sup>

From 1887 up to 1895 he attended the local primary school and was especially looked after by his school master Rudolf Knüppling who was already impressed by Christian's clever mind. Between Easter 1895 and 1896 Hülsmeier attended the elementary school in Donstorf near Barnstorf. We have to consider that, in the 1890s these still were quite rural places. Consequently, lessons at his elementary school were given by only a few teachers. His teacher for English, French and German language was Mr Bartels, who took special care of Hülsmeier.<sup>31</sup> It soon became apparent that Christian had talents for physics and he was eventually advised to apply for an entrance examination at the Teachers' Training College<sup>32</sup> in Bremen. In April 1896 Hülsmeier was allowed to start his study at this College. The new physics laboratory at the College was equipped for Hertzian-wave experiments. It is most likely that Christian Hülsmeier became intrigued by the implications of Hertzian phenomena.

No doubt with encouragement from his physics teacher:

*Richard Klimpt who encouraged him to carry out experiments in his new field, allowing him the use of the laboratory after normal college hours. Hülsmeier's daughter Annelise recalled a story from that period (of course, recalled from here fathers' recollections, AOB)*

*A large oven, something like a kitchen range, occupied one end of the laboratory and my father used its metal surface for his reflection experiments, during which the whole room would be filled with crackles and discharge of sparks from his apparatus. By this means he*

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<sup>26</sup> According a Hülsmeier family document, his birth name was: Johann Christel. However, he might have used soon the name Christian. But, his official school papers of the 1890s, still mentioned "Christel". [ZM 1812d]

<sup>27</sup> Grafschaft Diepholz

<sup>28</sup> Most of the historical details had been gathered by one of Hülsmeier's granddaughters for her school-theses, in the 1960s. Hülsmeier-Hecker archive Düsseldorf

<sup>29</sup> Who was a professional carpenter and, to increase his family income, he farmed around his house.

<sup>30</sup> Here family name. Curious is, that a recently found family document quotes "Dorothee Elisabeth". [OAN ZM 1812d]

<sup>31</sup> Since recently we have got some copies of his "Zeugnishefte" over the years 1891 - 1896. A final school certificate dated 19 February 1896 was signed by his teacher Bartels. The average mark was between "gut and sehr gut" (good and very good). [OAN ZM1812d]

<sup>32</sup> Lehrer Seminar, as it was called in the Diepholzer Kreiszeitung, 31 March 1904, and VDI Vortrag K. MaueI on 19 January 1982 [OAN ZM 1812a]

*proved to his own satisfaction that Hertzian Waves could be easily reflected from distance metallic objects.*<sup>33</sup>

In June 1900 he left the Teachers training College in Bremen (much against the wishes of his parents).

A number of suggestions have been put forward for the reasons Hülsmeier left college. How true they are is a matter of conjecture. It has been said that he was impressed by the death of someone from his village who died sadly during a ship collision at the Weser river. Another story told was, that he was interested in the way bats could navigate without colliding with trees around his family home. If these really were the causes why Christian quitted from College, we will, presumably, never know. However, these circumstances fit rather well with his future career.

Soon after he left college, Hülsmeier took up a post as a technical trainee at the Siemens-Schuckert factory in Bremen.<sup>34</sup>

His father died in August 1900 in Eydelstedt.<sup>35</sup> In January 1901 Christian became an "independent" electrical technician.<sup>36</sup>

His mother died in July 1901 in Eydelstedt.<sup>37</sup> Two months later, on 10 September 1901 he acquired, by a special Royal Court decision, his adulthood at the age of 20.<sup>38</sup>

In April 1902 he left the Siemens-Schuckert company in Bremen and he moved to his brother Wilhelm in Düsseldorf, who was engaged in the local textile business.

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<sup>33</sup> The italic text passages are of David Pritchard's hand. [Pritchard, p.14-15] Hülsmeier's daughter Annelise Hecker-Hülsmeier was born on 6 February 1911 in Düsseldorf and she died on 20 October 2000 in the same city.

<sup>34</sup> According an article on Hülsmeier, *...einige Jahre das Seminar in Bremen besucht hatte, sich aber dann dem elektrotechnischen Fache zuwandte und eine Stellung an der Wollwäscherei in Delmenhorst fand, ...* [Diepholzer Kreiszeitung 31 March 1904.] If Hülsmeier had been stationed there, on behalf of Siemens Schuckert company of Bremen? [OAN ZM1812a]

<sup>35</sup> 18 August 1900 [OAN ZM 1812d]

<sup>36</sup> Engaged in electrical household installations and maintenance on excavators. Later he became involved, under supervision of electrical engineer (who in Germany is always someone who is a graduate), in preparing electrical drawings for navy cruisers.

<sup>37</sup> Officially on 12 July 1901 in Twistringen [OAN ZM 1812d]

<sup>38</sup> Königliches Amtsgericht (Royal Court), file number 2.XI.6-13, date 10 September 1901. According this document he lived at Molkenstraße 14 in Bremen. His profession was, according this document, "Mechaniker" (mechanics technician) [OAN ZM 1812d]

According to Pritchard and Hülsmeier's daughter Annelise, he only had two marks in his pocket<sup>39</sup>:

*In April 1902 my father left the Siemens Company and made his way to Düsseldorf with only two marks in his pocket. There his brother had a thriving textile business and financed Christian in setting up of an electrical firm that enabled him to carry out further research into reflection techniques, and to build a transmitter and receiver for the purpose he had in mind. But this needed more money than was available. In the end he placed an advertisement in a local paper for a financier to back him in an 'epoch-making discovery'. A Cologne leather merchant saw it and showed interest.*<sup>40</sup>

Let us follow the traceable facts. Notice also the separate chapter later in this paper.

Christian Hülsmeier applied for a German patent for the first time on 20 March 1902. This patent description (claim) is very vague and hardly covered what it was supposed to do.<sup>41</sup> Let us look at the description of his "Telephonogram apparatus" as was being used in his patent US766355 which he applied for on 13 October 1902 (granted 2 August 1904).<sup>42</sup>

*This invention relates to apparatus for the conversion of variations in the intensity of electric current into variations in the intensity of light.*

*In the device hitherto known for the conversion of variations of current intensity into variations in light intensity there have been used either polarized, dispersion, or throttle devices.*

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<sup>39</sup> [Pritchard, p. 15]

<sup>40</sup> According to a newspaper interview from 29 December 1956: after he arrived in Düsseldorf, he encountered financial problems. Because his brother (Wilhelm) had just married and was unable to support him financially. Due to these circumstances, he had to put a newspaper advertisement, by which a Leather dealer responded. He offered the Telemobiloskop-GmbH allegedly 5000 Gold marks. We will later prove that this story is in several respects nonsense! Recent findings (October 2004) forced me to add a separate chapter on this subject. [OAN ZM 1812]

<sup>41</sup> Vorrichtung zur Übertragung von Stromintensitätsschwankungen in direkt oder umgekehrt proportionale Lichtintensitätsschwankungen. Granted with DE146879 on 13 November 1903. Formally were these pre to WW II patent numbers also known as DRP xxxxx (Deutsches Reichspatent) In this publication we shall use the contemporary international nomenclature for patent registration, as DE....., US.... or GB....., without a break between country code and numbers.

<sup>42</sup> On 11 September 1902 he applied also for a British patent, which got GB19901/1902.

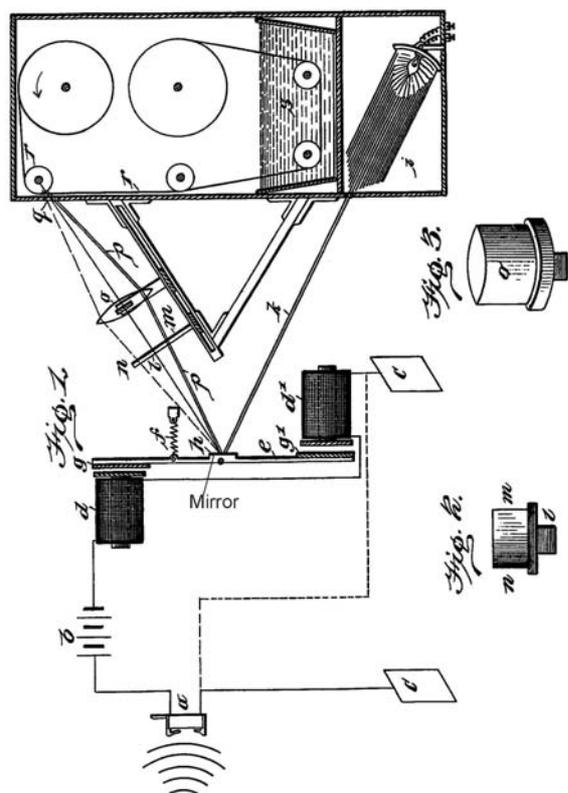


Figure 1

The principle behind it is quite easy to understand. A light source *i* is sending a small beam which reaches the movable mirror *h*. The light beam will be reflected and passing through an optical system *n*, *o*, and a resulting light spot *q* will illuminate the film tape *r* which is covered in a dark cassette (container). The exposed film strip will be developed in the integrated chemical (developer) basin *s*. After development it was rewound on to a second bobbin.

The mirror *h* was moved or vibrated around a centre position by means of the voice modulated current. The symmetrically mounted electro magnets *d* and *d'* were placed in push-pull, which configuration was compensated for its dc bias currents, by means of loading spring *f*.

However, what was it supposed to do? The answer lays in the US patent application. He called his invention a TELEPHONOGRAM. In which, TELE stands - for far off or covering a distance; PHONO for - sound or voice; GRAM - is the abbreviation of a TELEGRAM. Consequently, the purpose of his apparatus was “a sonic (sound) telegram”. Soon thereafter, he applied for a modification of his TELEPHONOGRAM apparatus. Apart from a modified image modulator, he employed the radiation temperature of the light bulb *i* (the light source) to warm up a rotating drum the purpose being to enhance the drying procedure of the film tape.<sup>43</sup> This apparatus was, according an article in a mechanics magazine, called a “Diktierphonograph”<sup>44</sup>, which might be translated to the word Dictaphone. Albeit, the latter became a brand name in the USA and elsewhere. According to a letter from an American friend, it was supposed initially to be called a “Telephotoption”.<sup>45</sup>

On 7 September 1902 he and his brother Wilhelm applied for a patent<sup>46</sup>, which claimed an optical projection system, by which means a film-tape can be projected onto one or several glass windows. A special curved mirror had been incorporated in the equipment by which means the light was focussed correctly on to the projection screen(s).

<sup>43</sup> DE147591, application date on 8 October 1902.

<sup>44</sup> Leipziger Uhrmacher-Zeitung (Watch maker-magazine) p. 293-294. Its date is unknown. [HAD]

<sup>45</sup> Dated 18 April 1903, by Carl Sauer, Chicago. [HAD] [OAN ZM 1812a]

<sup>46</sup> DE150190, granted 11 April 1904

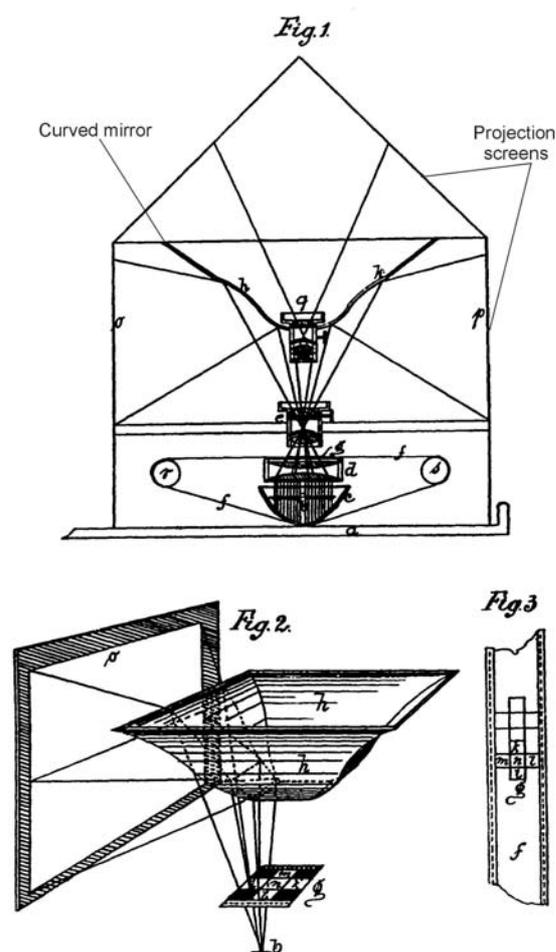


Figure 2

Their idea was, that it could be built inside an advertising-van, containing one or more frosted glass projection windows.

It is not my objective to discuss all of Hülsmeier's patent applications in this paper. There would be too much ground to cover, as he had 160 of them!

What may we conclude so far, from Hülsmeier's early patent applications, regarding the recollections of Hülsmeier's daughter Annelise? In my opinion, given the circumstance that he was said to arrive in Düsseldorf (April 1902) with only two marks in his pocket; we must take this with a pinch of salt. Nevertheless, in a just recently discovered sound recording (interview), he confirmed that he was a "poor" inventor (armer Erfinder). As we know, he had applied just a couple of weeks before for his first patent on 20<sup>th</sup> March. However, let us bear in mind that a patent application needs the proper guidance of a patent agent and that one has to pay for such an application (presumably even in advance)!

From the historical point of view, we may be very lucky that Hülsmeier's daughter Annelise wrote a letter to the German Patent Office in 1981. The reply<sup>47</sup>, from this office, gives us information about facts that would not otherwise have come to our attention. It lists, among many other details, the file numbers of patent applications that had been rejected! This information cannot be found in the regular patent index, as it was never granted a patent number.

The first rejected patent was dated 9 May 1902.<sup>48</sup> His second refused application was on 9 September 1902.<sup>49</sup> The next rejected patent application was dated 6 September 1902.<sup>50</sup> Considering the classification of this latterly rejected patent application, it might well be related to patent DE150190, which he shared with his brother Wilhelm. (see figure 2)

<sup>47</sup> From Deutsches Patentamt, Dienststelle Berlin, date 5 August 1981. [HAD] [OAN= file ZM 1812]

<sup>48</sup> Filed H 28 099 Kl 21a, subject Tele-Mikrophon.

<sup>49</sup> File H 28 860 Kl 21a, subject Telephon-Relais. A copy of the line drawing is available in [HAD] [OAN ZM 1812a].

<sup>50</sup> H 28 862 Kl 54g, subject Reklamefahrzeug (advertising van).

On 5 November 1902 he filed successfully DE152141, which was a premature claim, however, its improved successor was granted later US810150. And will be discussed later on in this chapter.

The next year started on 6 January 1903 also with an upset for Hülsmeier, as his application for a vibration-indicator had been rejected.<sup>51</sup>

The following patent application which failed, was also dated 6 January 1903. The subject of this application might have been, according to the reference, for a system which could transfer the Telephonogram film tape (light)modulations into acoustical signals.<sup>52</sup>

The last application to be turned down was filed on 7 December 1903. It had to do with a kind of signalling storage system.<sup>53</sup>

### First steps to early radar developments

We have learned about Hülsmeier's first attempts to obtain patents in various fields. Until now we have noticed that these covered, with one or two exceptions, optical and/or sound related technologies.

The second<sup>54</sup> wireless associated patent application that Hülsmeier applied for was called: **Telemobiloskop**<sup>55</sup>, which was filed on 21 November 1903.<sup>56</sup> As we have seen before, TELE stands for: - far off or covering a distance and MOBILO stands for: - capable of moving or being moved; SKOP is equal to SCOPE which refers to the area covered by an activity.

What we see here is the first description for a radar-like patent application. This indicates that Hülsmeier must have been working on a kind of radar-like apparatus. However, we may assume that it was rejected either because his claims were infringing existing patents or, that it

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<sup>51</sup> Filed H 29 688 Kl 21a, subject Schwingungs-Indikator. [HAD] [OAN= ZM 1812]

<sup>52</sup> Filed H 29 689 Kl. 21a, subject Vorrichtung zur Übertragung von Strom-Intensitätsschwankungen in Luft-Intensitätsschwankungen (Zus. zu DRP 146879). As we know, this was Hülsmeier's first granted patent. In Hülsmeier's remaining archive, we have found some information on old selenium photocell. This could have been associated with the latter application.

<sup>53</sup> Filed H 31 962 Kl 21a, subject Vorrichtung zur Fixieren und Reproduzieren von Nachrichten Signalen usw. [HAD] [OAN file ZM 1812]

<sup>54</sup> Recently we discovered an earlier patent 152141, which was filed on 5 November 1902. The subject is: Vorrichtung zum Auslösen bestimmter Mechanismen mittels elektrischer Wellen. Kl.21a. It claimed: to prevent from signal interference in conjunction with remote-controlled ignition of explosives at distance. It was succeeded by the improved specification of US810150 of 14 March 1904.

<sup>55</sup> In German it means: Fernbewegungsseher

<sup>56</sup> Filed H 31 800 Kl 21a

failed to be considered as a genuine invention. There are, regrettably, no papers and/or drawings left from this latter patent application. Without the correspondence between Hülsmeier's daughter Annelise and the Berlin Patent Office branch<sup>57</sup>, we wouldn't have known about these rejected claims.

In the coming two years 1904-1905, Hülsmeier became heavily involved with all sorts of wireless related technologies.

On 14 March 1904 he claimed a "wireless transmitting and receiving mechanism for electric waves".<sup>58 59</sup> Let us follow the line of some part of its original specifications:

*The object of this invention is to provide apparatus by which the further application of electrical waves may be had not only to the transmission of communications, but may also be had for actuating mechanism placed at distance, for instance closing circuits and releasing clockworks &c., for the purpose of turning on and off all kinds of lights, the lighting of mines, for putting motors into and out of circuit, for the service of gates, switches or signaling on railways. And in all such cases it is necessary that no other waves save those from the proper transmitter should ever actuate or in any manner affect the working of the same.*

Anyhow, patent language is not always easy to understand. Nevertheless, the purpose of this latter invention is clear. It was to prevent remote-controlled wireless systems for being corrupted by unauthorised signals.

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<sup>57</sup> Here's being dated 14 July and was replied on 5 August 1981. [HAD]  
[OAN ZM 1812]

<sup>58</sup> US810150, the patent was granted on 16 January 1906.

<sup>59</sup> We are facing a contradiction again. From the Hülsmeier archive in Düsseldorf [HAD] we got a handwritten letter by Mr. Wg. v. Kettler, dated 9 March. Mr. Kettler mentioned that he is supposed to arrive in Düsseldorf on Thursday 19 March.... Thanks to Adri de Keijzer we found out that this must have been the year 1903. On top of this letter was written, in a different handwriting, No.810150. All who read this, would think of the 1904 patent US810150, but this was applied for one year later on 14 March 1904! The meaning of this letter is, that von Kettler has bought the US rights of a patent, and had applied to a notary publique to attest his rights, that these rights should to be granted on the name of Gerhard Carl Wilhelm von Kettler in New York. However, it might very well have dealt with Hülsmeier's Telephonogram Apparatus patent, which was granted with US766355, since 13 October 1902. This fits very well together, as Hülsmeier might have needed (necessitated) some living expenses. [HAD] [OAN ZM 1812a]

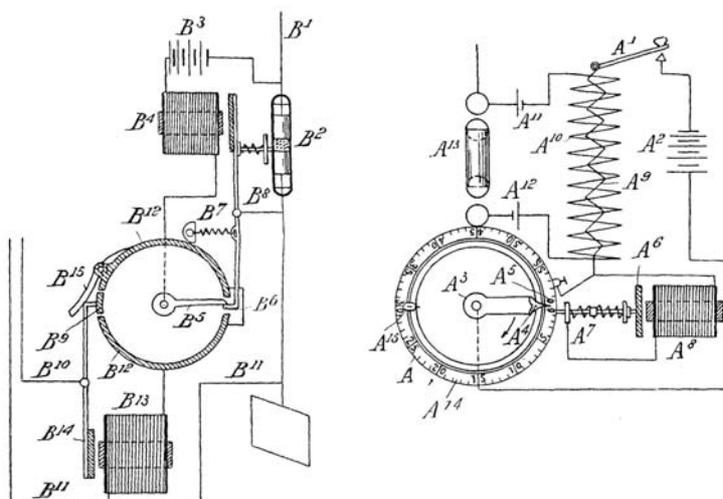


Figure 3

Let us consider the right-hand figure first. This circuitry represents a transmitter, whose signal transmission will be switched on by key A1. The Ruhmkorff inductor will start producing a high voltage pulse which cause sparks in the gaps system A13. At the same time, relay A 8 will be triggered and consequently the rotating arm A 4 will be de-blocked and start a steady rotation. This will (immediately there after) interrupt the primary current through the inductor and the

transmitter spark will be extinguished, preventing further radiation of a signal.

The transmitted pulse (burst) reaches the antenna circuit shown on the left-hand side, and the coherer will, as we may expect, decrease its resistance thereby conducting a current through it. Consequently, relay B 4 will become magnetized. The arm B8 will move towards the core of B4. In a similar manner to what happened in the transmitter, the rotor mechanism will be set free and start to move. The consequence is, that the current through the coherer B2 and relay B4 will be disconnected. The spring loaded hammer mechanism attached to B8 will knock (tapper) on the glass envelope of the coherer B2. This causes an increase in its resistance<sup>60</sup> resulting in an interruption of the current flowing through B4. The receiver is once more ready to respond to new RF signals.

Hülsmeier's considered that two (or more signals), strictly controlled in a relatively long time domain, would avoid coincidence with interfering signals. In those days they distinguished two kinds of wireless signals, one of which was caused by lightning bursts and the other by regular morse signal transmissions.

For this purpose he utilized, on both sides of the system, a synchronous clock mechanism, which rotated 360 degrees in 5 - 10 seconds. Exactly half way (180 degrees), he placed contact arms. At the transmitter represented by contact A15 and in the receiver by B9. Only when the second burst arrived just when the rotating contact-arm and A4 and B9 were in a similar position could a trigger signal be passed on for signalling.

One wonders why he designed such a complicated circuitry for this simple task? However, let us continue following the patent diagram again.

What would happen if a signal should trigger the receiver outside the controlling time frame? In this case relays B4 and B13 will become magnetized, which will force arm B9 to be pulled out of the contact ring (because it moves towards the core of electro magnet B13). This

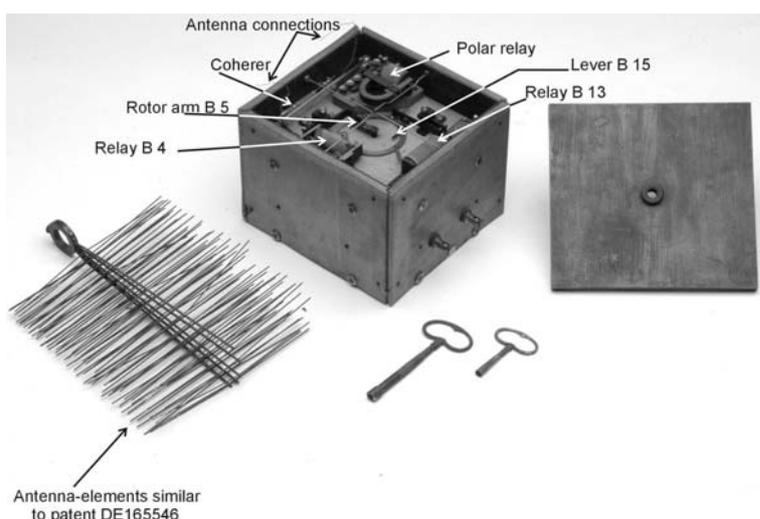
<sup>60</sup> By this means lowering its conductivity.

drawing is not entirely clear about the interactions between the mechanisms. But from other drawings I was able to reconstruct what should occur.

The relay arm B14 will touch the metal core of B 13. In my opinion, very cleverly, Hülsmeier created by doing this, a considerable amount of magnetic remanence. Either by means of a little bit of magnetic metal inside core B13 or by means of a magnetic disc mounted at the moving arm. Consequently, when B13 had pulled arm B14 to touch the core of the electro magnet, it was kept in mechanical contact with both part, even if current ceased to flow in the current circuitry.

Let us follow the course of rotor arm B 5. When it reaches the position of contact B9, it cannot pass a current on to it. But the rotor arm will steadily continue its movement. It will reach lever B 15 which is made from insulated material. The moving force pushes it outwards and, subsequently, forces the arm B9-B14 to be detached from the electro magnet B13. The rotor arm will be stopped at the starting point of rotation, as it is held by the small finger(lock) of B6. Only after a new triggering signal has reached the receiver, can the whole procedure start again.

A curious item in this patent drawing is *fig. 3* (not shown here). It was claimed that it could optimally adjust the sensitivity of a coherer device. If it could do the job in practice is hard to day. Nevertheless, it is rather curious that this German patent application was not made before 30 October 1904!<sup>61</sup> I think, that it is a later addition to this (improved) patent application. A second strange thing is, that he never has applied for an equivalent German patent (except for the device covering latter *fig. 3*). However, he did so in Belgium, France and several other countries. Regarding the correspondence between his daughter and the Berlin patent branch<sup>62</sup>, she persisted in saying that her father never applied for a foreign patent before he had made applications in Germany.



I would not have spent so much time in investigating this system, had it not been necessary to unravel what others have misinterpreted.

Figure 4

Looking at this receiver, it is easy to recognize the similarity between the system claimed in US810150 and that of this receiver. The main difference being that he added an additional, so-called, polar-relay which took

<sup>61</sup> DE165079 Kl 21a, filed 30 October 1904, subject: Verfahren und Vorrichtung zur selbständigen Festhaltung eines bestimmten Empfindlichkeitsgrades eines Kohärers oder Antikohärers.

<sup>62</sup> 14 July 1981. [HAD] [OAN file ZM 1812]

over the function of relay B4 (see previous figure 3). The purpose of which was to enhance the overall sensitivity (performance) of the receiver.

In the remaining Hülsmeyer archive I have found a Xerox photocopy<sup>63</sup> which, shows this receiver module under the following heading:

DER HÜLSMEYER - ECHO - EMPFÄNGER  
mit Fremdsignal-Sperre

translated  
Hülsmeyer's - Echo - Receiver  
with interference blocking

Who was responsible for it is not known. One has to say that it hardly could have functioned as a radar receiver, in the strict sense. Considering that it should not respond on to incoming without particular time frames! I believe, that it might have been done either by the grand old man (Hülsmeyer) himself or, by his daughter Annelise who took care until she died in the year 2000, of her fathers intellectual heritage.<sup>64</sup> Even David Pritchard fell in to this trap!<sup>65</sup>

He published the appropriate electrical diagram of this receiver. But then he described it as a part of Hülsmeyer's final radar apparatus, which, in my opinion, it certainly was not! I have to assume that Pritchard had no knowledge of the content (and implications) of US patent 810150.

However, we will see later, that he used such kind of apparatus during his first public demonstration in the Domhotel of Cologne on 17 May. But, in my opinion, more to attract the attention of his audience, then that it should represent a set-up of his future Telemobiloskop apparatus.

### **The origin of the first radar apparatus**

Considering what we have learned so far about Hülsmeyer's engagements, I have decided that, in this chapter, it is essential to delve into its very complex implications.

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<sup>63</sup> This photo had been printed in a left-right interchange. [HAD] [OAN ZM 1821a]. According recent information, the receiver shown in figure 4 has been donated by Annelise to the Schiffahrtsmuseum of Bremerhaven in 1990!

<sup>64</sup> Hülsmeyer's daughter Annelise was married to Erich Hecker. Therefore here name has changed to Annelise Hecker-Hülsmeyer.

<sup>65</sup> Regard his books: The Radar War at p.15 and Durch Raum und Nacht p.18, 66.

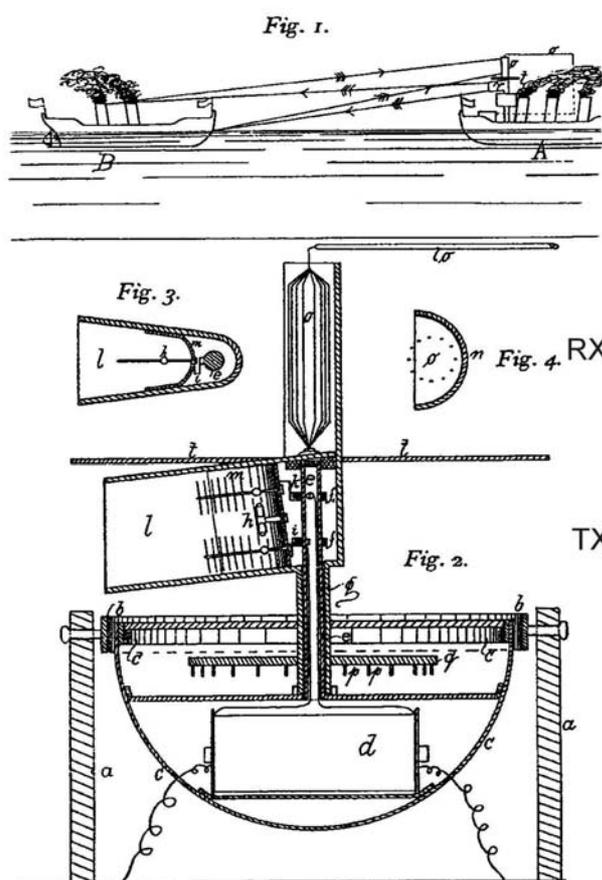


Figure 5

On 30 April 1904 Hülsmeyer applied for a patent for his epoch-making **Telemobiloskop**.<sup>66</sup> In spite of the many promising reactions, it nevertheless finally failed to become a commercial success. This did not stop him applying, shortly thereafter, in other European countries for equal patents as well.<sup>67</sup> Let us follow the course of the circumstances of these, intriguing, early days of radar.<sup>68</sup>

On this occasion, we follow Hülsmeyer's pretensions as these had been worded in his British patent specifications applied for on 10 June 1904. This was remarkably quickly granted with GB13170, on 22 September of that year.<sup>69</sup>

Its genuine specification (claim) was:

***Herzian-wave Projecting and Receiving Apparatus Adapted to Indicate or Give Warning of the Presence of a Metallic Body, such as Ships or Train, in the Line of Projecting of such Waves.***

<sup>66</sup> DE165546 Klasse 21g Gruppe 50/10 (previously KL 74d). Claiming: Verfahren, um entfernte metallische Gegenstände mittels elektrischer Wellen einem Beobachter zu melden.

Most articles in which they make use of the front page of this latter patent, they show figure 1 just at the front page. This might have been done by Hülsmeyer himself for the first time, in the early years of the 1950s. In contrast to US practice, in Germany and many other countries, the drawings are always placed at the end of a patent paper.

<sup>67</sup> To know: Belgium, Britain, Danmark, France, Italy, Norway, Portugal and Spain. Consider also the later chapter on the "notary document of 12 August 1904".

<sup>68</sup> Radar stands for: **R**adio **D**etection **A**nd **R**anging. This word originates from the US. In Britain they used before and during the first years of WW II RDF, which stands for **R**adio **D**irection **F**inder.

<sup>69</sup> Britain used a rather odd patent system, as they started every year from record number 1 again. Consequently, one needs to know the year in which it had been granted (not essentially the year of its application). This unpractical system had been changed in 1920. Britain, sadly, is one of the curious countries who do not report their pre 1920 patents on the internet. However, sometimes one gets a foreign link to a British patent number, which might then be accessible.

Some lines below he continued:

*My invention is based upon the property of electric waves of being reflected back towards their source on meeting a metallic body, and will be readily understood by imagining a transmitter and a receiver station such as indicated placed side by side at the same point and so arranged that waves projected from the transmitter can only actuate the receiver by being reflected from some metallic body, which, at sea, would presumably be another ship. ....*

*My apparatus comprises a transmitting and a receiving station similar to those used in wireless telegraphy, with this difference that the two stations are situated in close proximity to each other and are so arranged and constructed that they cannot directly influence one another.*

What can we learn from this quite clear description?

First of all, it would appear that he did understand the basic principles of radar very well. And, secondly, that one had to adequately separate the transmitter from the receiver installation. The drawing shows clearly how he thought that this could be accomplished.

The transmitter antenna was placed in the focus of a kind of parabolic reflector, which was placed at the far end of a conical horn arrangement. The receiver antenna was placed in the focus of a parabolic cylinder.<sup>70</sup>

Let us continue further down the specification text:

*In view of the fact that ships are at times subject to considerable rolling, pitching and like motion, which might otherwise render the apparatus practically useless. I mount both the transmitter and receiver similarly to a compass-box, about as shown in Fig.2a, so that they are maintained by action of gravity in an approximately vertical position. ..*

This kind of construction is also known as Cardan-suspension.<sup>71</sup> He had obviously thought carefully about the need for a stable platform for the instrumentation.

So far, the specifications of his apparatus sound rather good, but his ultimate objective was after all to create a system to prevent ships colliding. As the danger of collision is, more or less, equal from any quarter, he thought that it was obvious to look at all directions. Consequently, he provided on his Telemobiloskop system a continuously rotating mechanism.

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<sup>70</sup> The transmitter antenna arrangement looks like what later became known as Yagi (Uda-Yagi) antennae. Which was based upon phased elements, mounted in similar planes. The antenna fragments (parts) shown in the Deutsches Museum and Deutsches Schiffahrtsmuseum of Bremerhaven (see figure 4), certainly do not represent a Yagi like configuration. Particularly regarding the element spacing and their mutual length. He might have thought to increase the capacitive loading of the antenna radiators. But, these latter would have been mainly outside the focus of the reflector and, consequently, would cause a wave interference pattern. It may be regarded that Hülsmeier, at that time, possessed no realistic concept of antenna design!

<sup>71</sup> Girolamo (English Jerome) Cardano (Cardan = Latin) Born on 24 September 1501 in Pavia, he died on 21 September 1576 in Rom. For the Cardano suspension see <http://es.rice.edu/ES/humsoc/Galileo/Catalog/Files/cardano.html>

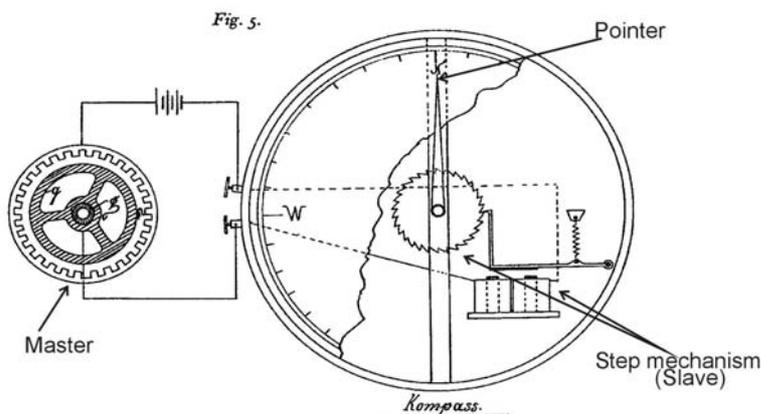


Figure 6

Although, the British patent drawing does not show these details, several other patent applications abroad did so.<sup>72</sup>

The “Kompass” employs a rotating pointer, which rotates in concert with the real detecting beam. Its continuous movement is synchronized with that of Hülsmeier’s platform.<sup>73</sup>

What we can learn from this drawing is that Hülsmeier had invented, already in the year 1904, the basic ideas of which became later well known as PPI.<sup>74</sup>

It is obvious that real radar needs to measure distance as well. This was clearly understood, and Hülsmeier quite soon, thereafter, applied for an additional patent.

His first effort had been rejected<sup>75</sup> but, a few months later he acquired DE 169154.<sup>76</sup> Less than two weeks later, Hülsmeier filed its British patent application.<sup>77</sup>

Hülsmeier’s thoughts are best interpreted by considering the main lines of the original patent specification.

### ***Improvement in Hertzian-wave Projecting and Receiving Apparatus for Locating the Position of Distant Metal Objects.***

Few lines below

*In the Specification of the British Patent No. 13170/1904, an apparatus is described which is indeed to be used for indicating the presence of a metal body such as a ship, but such an apparatus only indicates the direction in which the metal body or object is situated. It would without doubt be*

<sup>72</sup> I don’t know why he left this claim out. But, it might have been that it was rejected by a British Patent clerk. Although, this is not quite likely, as the British and American Patent Offices did not look very critically at patent applications. Their general point of view was that these questions had to be settled by legal arguments between competitors.

<sup>73</sup> Contemplating a kind of ‘mother and slave’ system.

<sup>74</sup> **P**lan **p**osition indicator

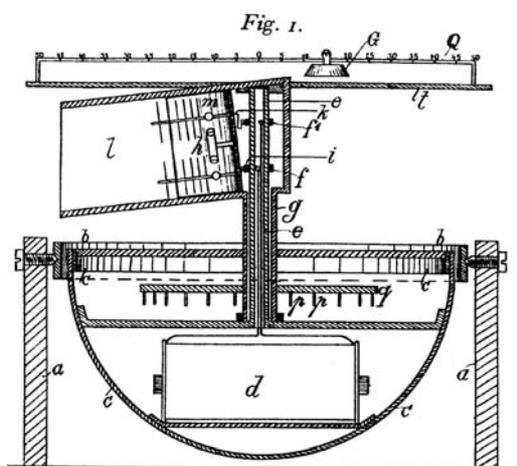
<sup>75</sup> H 33 222 Kl. 74d, date 16 June 1904. Called: Telemobiloskop (Zus. zu DRP 165546) [HAD] [OAN, ZM 1812]

<sup>76</sup> Verfahren zur Bestimmung der Entfernung von metallischen Gegenständen (Schiffen o.dgl.), deren Gegenwart durch das Verfahren nach Patent 165546 festgestellt wird. It was granted on 2 April 1906. It should expire on 29 April 1919.

<sup>77</sup> GB 25608 filed on 24 November 1904, granted on 23 March 1905.

most useful if it were possible to also ascertain at what distance from the point of observation the metal body is located, and the object of my invention is to enable such a result to be obtained.

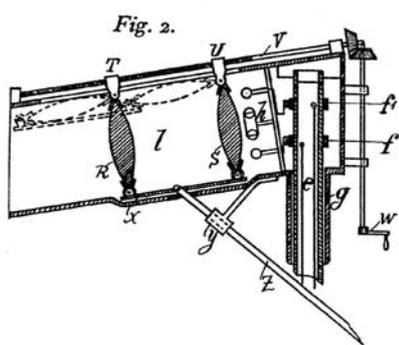
For this purpose I employ a projector which throws the electric waves in the form of a powerful cylindrical bundle & it is sufficient to move the projector up or down in a vertical plane (said projector having been first turned in the direction of the metal body) until the particular angle is found at which the action of wave reflected from the metal body to the receiver is strongest. The angle which the projector at that time makes with the horizon is read off & by this aid the distance of metal body can be easily calculated or ascertained from a prepared table. The movements of the various parts as well as the ascertaining of the correct angle may be accomplished in various ways of which I hereinafter describe two. In one of these the projector, containing the reflector etc., whereby the electric rays are concentrated, is provided with an adjustable weight whereby the projector, which is appropriately mounted, is inclined. In the other form, I project parallel rays by means of a pair of lenses, which latter are adapted to be moved relatively to the projector casing, whereby the angle of inclination of the wave beams to the horizon can be varied.



We jump now to the last paragraph of his patent claims The combination with an apparatus for projection electric rays, of a fixed or rotatable housing made of wood or other suitable non-metallic material which will permit the electric waves or rays to pass through its walls and which serves to protect said apparatus against injury by heavy sea and the like.

Figure 7

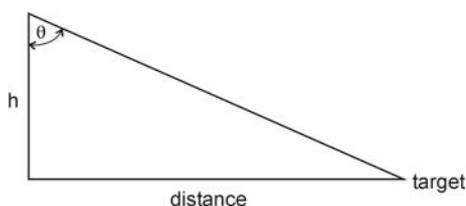
It is interesting to note that, first of all, he is fully aware of the shortcomings of his first Telemobiloskop application, as it could not provide information as to distance. More importantly, he has given due thought to several solutions as to how to obtain sufficient data. One, is to vertically lower the entire installation, by which means the electrical horizon is changed. Second, he suggests tilting the angle of the central mounting mast against the horizon which, logically, is also varying the electrical horizon of the system.



The angle could be simply read from an indicator (with or without using a conversion table). The distance may be trigonometrically calculated:

$$\text{distance} = h \tan \theta$$

Figure 8



The last paragraph of his patent application is also very interesting. He proposed to cover the entire installation, inclusive of its antenna systems, by means of low-loss non conducting material, so as to protect it from environmental influences.<sup>78</sup>

*Fig.2* (see figure 6 at previous page) in his patent drawing seems to be a bit strange. How could such a lens system cope with EM waves? Here we have to go back to what Hertz explained in his famous speech at the Heidelberg University in 1889 (I have neglected his scientific contributions in this field). That EM waves and light waves are principally of equal nature, as both are electromagnetic waves.<sup>79</sup>

It can, however, be practically proven that EM waves can be focussed by means of dielectric lenses. Nonetheless, it is evident that the wave lengths with which Hülsmeier was working at that time were unsuitable for a dielectric lens system. The ratio between the geometry and its related size of a (dielectric) lens versus the maintained wave length, is the limiting factor here.<sup>80</sup> But, if he could have generated sufficient powerful energy say at  $\lambda < 10$  cm, such a focussing system should have been practical.

### **Hülsmeier's commercial approach**

During my historical survey on Hülsmeier's commercial activities, I have encountered some quite confusing information. Recalling, for instance, what his daughter Annelise said:

*In April 1902 my father left the Siemens Company and made his way to Düsseldorf with only two marks in his pocket. There his brother had a thriving textile business and financed Christian in setting up of an electrical firm that enabled him to carry out further research into reflection techniques, and to build a transmitter and receiver for the purpose he had in mind. But this needed more money than was available. In the end he placed an advertisement in a local paper for a financier to back him in an 'epoch-making discovery'. A Cologne leather merchant saw it and showed interest.<sup>81</sup>*

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<sup>78</sup> Like a radome

<sup>79</sup> Of course, ignoring the dualistic nature of visible light.

<sup>80</sup> The velocity of EM waves in dielectrics is always  $< 3 \cdot 10^8$  m/s. Beam forming, by means of dielectric lenses, is the result of refraction (owing to the velocity of EM waves in dielectrics versus in free space, is always  $< 3 \cdot 10^8$  m/s, sometimes even up to 60 % lower) and it causes a phase shift pattern behind the lens (their moduli and arguments). Consequently, at relatively long wave lengths, such systems are inefficient.

<sup>81</sup> For instance, in a West German newspaper dated 29 December 1956: *..Mit zwei Mark in der Tasche war der junge Mann von Bremen zu seinem Bruder nach Düsseldorf gekommen. "Such dir einem Geldgeber", riet der Bruder, der nicht helfen konnte, da er gerade geheiratet hatte. ...Die langten für eine Annonce in der Zeitung. Ein Lederhändler beteiligte sich mit 5000 Goldmark an der Teleskope-GmbH und förderte alle Erfolgsmühungen bis zum bitteren Ende....* (consider also the later chapter on the notary publique (hereafter called: notary) agreement of 12 August 1904 these contradictions!)

However, we will see later, that this kind of recollection of the Hülsmeier family members, often does not match with the facts we have get across during our survey.<sup>82</sup>

Let us continue to disclose the available sources, as we hardly can find relevant papers (such as letters) in the family archive in Düsseldorf.

We have comprehensively searched in the HAL archives, which are kept in the Municipal Archives of Rotterdam<sup>83</sup> and we have found the correspondence between Hülsmeier and the board of directors of the HAL company.<sup>84</sup> However, only two letters of those known to exist have been untraceable. It was most significant that we have been able to get an inside view as to what were the chief concerns of the HAL company. Consequently, we have been able to get a much broader view of Hülsmeier's activities at this time.<sup>85</sup>

At the same time as Hülsmeier filed his famous Telemobiloskop patent, on 30 April 1904, he was also in need of financial backing. As we have seen, the course of this story is not quite straight forward! Most sources of the 1950s explained that Hülsmeier, after he came to Düsseldorf in 1902, advertised for someone to invest in a future company.

There appeared, fortunately for us, after I had closed my survey on this subject, an unknown notary document which allows us to determine exactly when Hülsmeier and his business partner Heinrich Mannheim of Cologne made an agreement for the first time. In which they declared that Heinrich Mannheim would share in 20% of their profits, this settlement goes back to 15 March 1904.<sup>86</sup> The details of this notary agreement will be dealt with in a separate chapter. Notwithstanding, that on 7 July 1904 they received an official document from the Royal Court in Cologne, that the Telemobiloskop - Gesellschaft Hülsmeier & Mannheim had been registered.<sup>87</sup> This document also declared that the company had started its business on 5

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<sup>82</sup> Adri de Keijzer (Delft, NL) and myself (AOB).

<sup>83</sup> Gemeentearchief Rotterdam. Directiearchief HAL. The research had been started by Adri de Keijzer, later I have shared with him. Some of the papers showed severe water damage, but we could luckily reconstruct its content.

<sup>84</sup> This company was officially named: Nederlandsch-Amerikaansche Stoomvaart-Maatschappij Holland-Amerika Lijn NASM. Though, abbreviated HAL was mainly used. For a few years now it has had nothing to do with shipping business anymore. It remained as an investment entity, legally located in Monaco.

<sup>85</sup> From nearly all documents, which we have relied upon, are copies available in our archives too. Most of these are being stored in the files: OAN ZM 1812 - 1812a - 1812c.

<sup>86</sup> [OAN ZM 1812e]

<sup>87</sup> Königlichen Amtsgericht in Cöln (=Cologne). Die - offene Handelsgesellschaft Telemobiloskop - Gesellschaft Hülsmeier & Mannheim Eintragung im Handelsregister Abteilung A eingetragen worden ist. Als persönlich haftende Gesellschaftern eingetragen worden... Über die Rechtsverhältnisse der Handelsgesellschaft ist folgendes eingetragen worden: Die Gesellschaft hat vom(am?) 5 Mai 1904 begonnen. ... It was also recorded, that both partners were legally fully liable. In a West German newspaper article (29 December 1956), they described the

May 1904. This was just about one week after Hülsmeier had filed his Telemobiloskop specifications. Nevertheless, these details do not fit entirely with the later discussed notary document of 12 August 1904.

In fact, we could not trace, in Hülsmeier's remaining family archive, any advertisement which had been placed by Hülsmeier, in this respect. Therefore we have to rely on what is available in print such as newspaper and magazine articles from the early years of the past century.<sup>88</sup> Amongst these are also some official documents.<sup>89</sup>

### Christian Hülsmeier and the Hohenzollern bridge contradiction

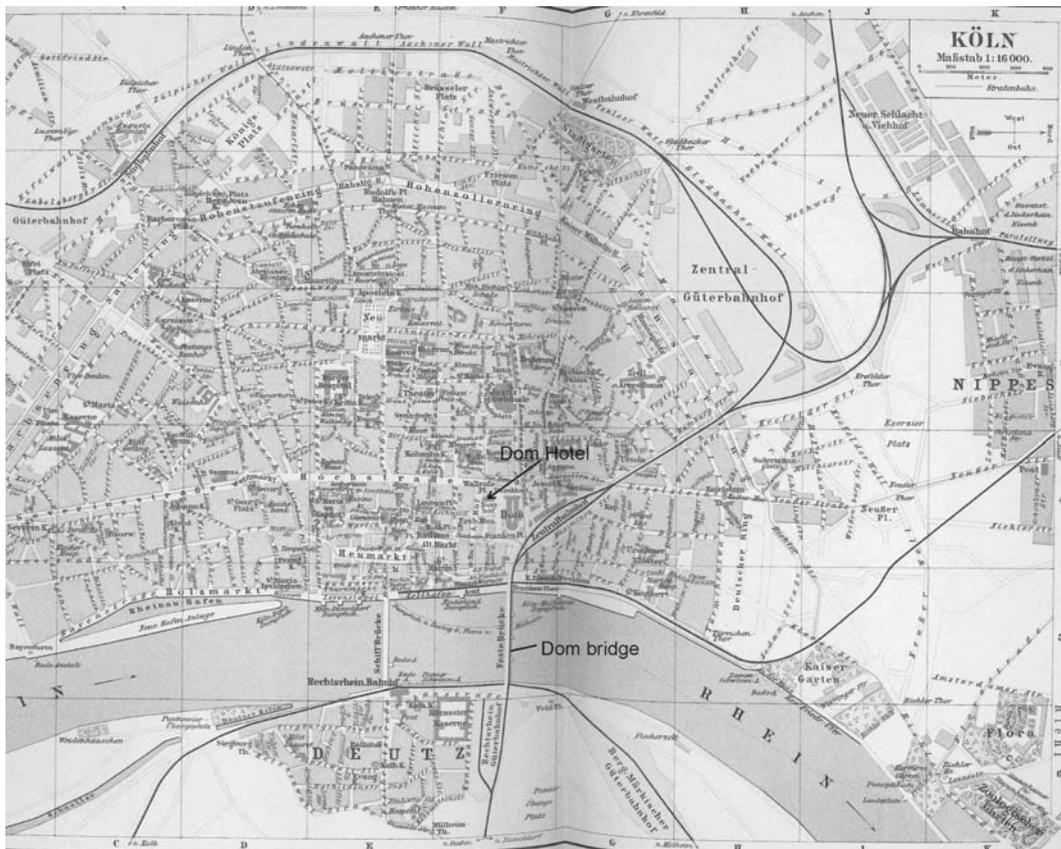


Figure 9

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company as: Telemobiloskop-G.m.b.H. This is nonsense! A **Gesellschaft mit beschränkter Haftung** (=GmbH) is, briefly, translated: a company with restricted liability. Such company type is normally a subsidiary branch of another company. [HAD] [OAN ZM 1812-ZM 1812a]

<sup>88</sup> Most of these, luckily, being available in Hülsmeier's "suitcase" in Düsseldorf. In this publication called "HAD"

<sup>89</sup> At the "Radar2004 Conference" held in Toulouse (France, October 2004), I met three Hülsmeier family members. Reinhard Dellenbusch (Germany) told me, that his father died five weeks ago, and that they found a notary document copy, which might throw a new light on Hülsmeier's financial commitments. Which has to be dealt in a separate chapter.

Before continuing my Hülsmeier's survey, we have to judge a historical contradiction. Reinhold Liebich brought to my attention (1 October 2004) the fact, that the Hohenzollern bridge did not exist in 1904. Christian Hülsmeier spoke during a radio interview of 1954, about a demonstration "unter der Rheinbrücke". Notwithstanding, that in post war years many mentioned "a demonstration under or at the Hohenzollern bridge". To by-pass discussions, I have implemented the city map of Cologne of the year 1895 (see figure 9).<sup>90</sup> The bridge named "Feste Brücke", was known as the Dom bridge (Dombrücke), and was built in the late 1850s. However, its capacity could no longer cope with the increasing railway traffic of the early 1900s.<sup>91</sup> And, had finally been replaced by the Hohenzollernbrücke, in 1911.

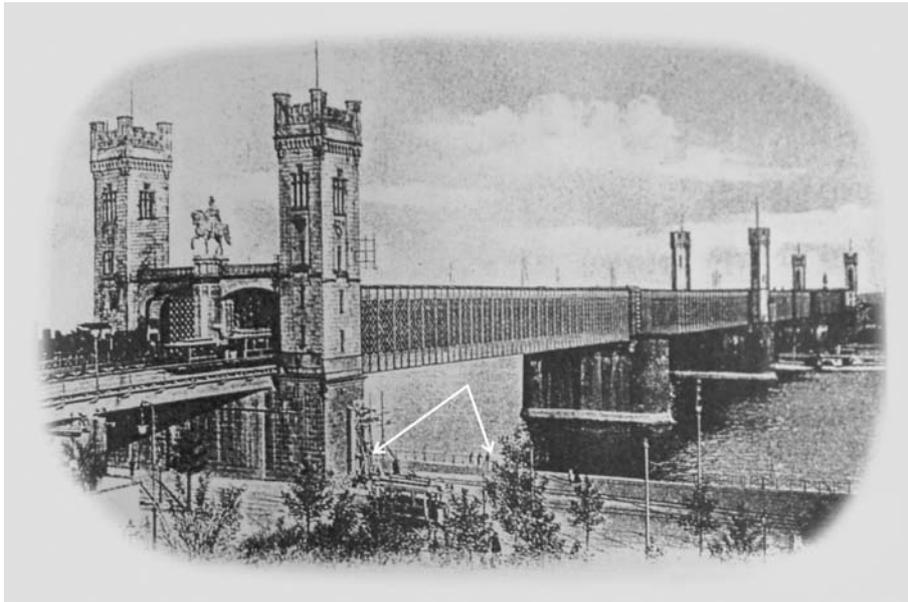


Figure 10

We are looking from the Cologne side of the bridge on the west bank of the river Rhine. It is easy to understand why the locals called this bridge the "Mouse trap"(Mausefalle), being on the bridge ways, one hardly could escape from it.

The white arrows are pointing at the pedestrian way, connecting the north side (the latter not visible) with the south side of the bridge. We may presume that, within  $\pm 50$  metres, Hülsmeier and his business partner must have positioned somewhere on this path, during their radar demonstration ("unter der Rheinbrücke").<sup>92</sup>

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<sup>90</sup> Meyers Konversations-Lexikon (Fünfter Auflage) Band 10, 1895

<sup>91</sup> The early bridge was built before the creation of the German (Imperial) Empire or "Reich" in 1871. The successor bridge carried the lineage name of the Emperor Wilhelm II, "Hohenzollern".

<sup>92</sup> Under the river Rhine bridge.

Let us continue with the Hülsmeier survey:

Heinrich Mannheim was a leather merchant of Cologne.<sup>93</sup> According to the information printed on their letter-heading, we may presume that Mannheim was responsible for the commercial activities of the company and that Hülsmeier took care of the technical aspects.<sup>94</sup>

Mannheim contributed to their mutual company a capital of 5000 marks (has to be 2000, as will be proved later). In the various articles reference is made to 5000 Gold marks. In my opinion, the Gold mark was a regular currency and has to be regarded as equal to the mark.<sup>95</sup> We will, nevertheless deal, in an additional chapter, with the circumstances and prove that these kinds of figures are incorrectly!

The first evidence that Hülsmeier and his business partner gave a public demonstration of his radar- like apparatus appeared in a Cologne newspaper report, which was dated 18 May 1904.<sup>96</sup>

*Das Telemobiloskop, eine Erfindung des Ingenieurs Chr. Hülsmeier in Düsseldorf, wurde gestern vormittag um 11 Uhr im Domhotel (consider figure 9, AOB) vor Vertretern des Norddeutschen Lloyds, der Seedampfschiffarts-Gesellschaft Argo in Bremen und anderen geladenen Herren vorgeführt. Die Erfindung beruht auf dem Grundsatz der drahtlosen Telegraphie und bezweckt, Schiffe sowie sonstige metallische Gegenständen auf dem Meere zu sichten. Der Unterschied zwischen der bereits bestehenden Anwendung der drahtlosen Telegraphie und dieser Erfindung beruht neben den konstruktiven Neuerungen lediglich darin, daß während man bei der drahtlosen Telegraphie Geber und Empfänger auf verschiedenen Schiffen getrennt verwendet, man beim Telemobiloskop Geber und Empfänger auf einem und demselben Schiffe anordnet. Die vom Geber ausgesandten elektrischen Wellen*

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<sup>93</sup> According recent findings on microfilm in the Municipal Archives of Cologne (Köln), we could examine the so-called "Greven's Adressbuch" (address book). It gives a different picture on the occupations of Mannheim and his wife Elli Mannheim - Becker. We searched firstly at the address Hohestraße 77 and 84. Mannheim was officially registered at nr. 77 as "Bankvertreter und Finanzier" (bank representative and financier, investor?). In 1907 Mannheim lived in the opposite house at number 84. For the first time a leather business had been mentioned (H.Mannheim Kaufmann). It might well be, that Mannheim's wife Elli had been involved in some kind of business (L.Hanne Nflg?) before that year. In 1905 (only that year) the Adressbuch mentioned at Hohestraße 77, Mannheim Finanzier, siehe Telemobiloskopgesellschaft. [OAN ZM 1812d]

<sup>94</sup> Alle Correspondenzen sind an Herrn Heinr. Mannheim, Cöln, Hohestrasse 77 zu adressieren. At the left-hand side of the letter: Verwertung der dem Ingenieur Chr. Hülsmeier zu Düsseldorf geschützten Vorrichtung zur Verhütung von Schiffs-Zusammenstößen - Geschützt in allen Union-Staaten

<sup>95</sup> Particularly during the devastating inflations of 1923, the "Gold Mark" gained importance, as it had some value against the international gold standard. The RM or Reichs Mark had been introduced after this inflation period. Joachim Goerth commented in a letter of 9 December 2004: that legally since 9 July 1873, the unit of one mark was equal to 0,358423 grams of "Feingold". [OAN ZM 1812e] However, there existed also golden coins, which represented the mark. This circumstance might well have caused confusion in later years (AOB).

<sup>96</sup> Kölnische Zeitung, Städtische Nachrichten [HAD] [OAN ZM 1812]

*können den Empfänger nicht direkt erreichen, sondern müssen von einem metallischen Gegenstand auf dem Meere (also von Schiffen) zurückgeworfen werden und so auf Wege zum Empfänger gelangen. .... Der Versuch mit den kleinen Apparaten, die nur für kleine Entfernungen berechnet sind, gelang vollkommen. Zur Ausnutzung der Erfindung hat sich eine Gesellschaft unter dem Namen Telemobiloskop-Gesellschaft Hülsmeier u. Mannheim gebildet.*<sup>97</sup>

I have reproduced the major part of this newspaper article, as it might be the first public explanation of the basic principles of radar.

The last two lines of the article (not shown) indicate, however, that the partnership had recently been established.

Briefly, the article reports that Hülsmeier had publically demonstrated, in Cologne, his radar-like apparatus to representatives of two Northern German shipping companies.<sup>98</sup> The fundamental difference between wireless telegraphy and his Telemobiloskop apparatus had been explained. Wireless telegraphy necessitates stations on two different places. Whereas, in contrast his apparatus consisted of a transmitter and a receiver positioned next to each other though, in such a way, that the transmitted signal could not be directly picked-up by the receiver. Only after the signal had been reflected at a distance by means of a metal object (e.g. by a ship) could it activate an alarm signal. The article also mentioned that his apparatus was of a simple construction, with only a limited detection range. It was noted that the demonstrations had been very successful.

However, recent (additional) findings on microfilm in the Municipal Archives of Cologne, reveals to us today, among other things, more precisely what happened during Hülsmeier's radar demonstrations in the Dom Hotel on Tuesday afternoon 17 May 1904 and how Hülsmeier approached his lay audience.

Let us refer, briefly, to some of the newspaper reports:-

The gathering in the venue (the courtyard of the hotel)(consider figure 11) started at 11 o'clock. Present were representatives (Oberingenieure = senior engineers) of Norddeutsche Lloyd and the Steam-ship Company Argo (both of Bremen) and, presumably, several other individuals as well. One newspaper issued the well-known text about the principles and the expected performance (range) of three to five kilometres. One might get the impression that the text contents of most articles originated from one source as their mutual similarities are striking!

There is, however, one exception and that is the account found recently in the Kölner Tageblatt of 18 May 1904. The introductory paragraphs are, small wonder, similar to the well known reports. Nevertheless, the Tageblatt reporter showed far more understanding of Hülsmeier's technology than his colleagues did.

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<sup>97</sup> Thus, this event took place on 17 th May 1904 (gestern).

<sup>98</sup> They might also have went for a demonstration to the banks of the Rhine, as this was only a few minutes walk away from the Dom Hotel.

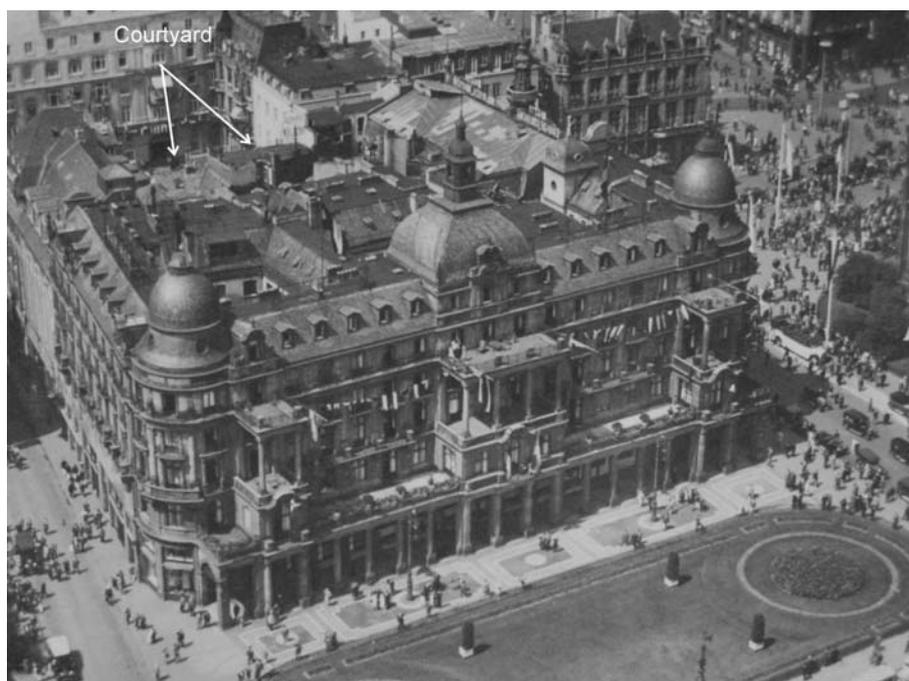


Figure 11

Continuing the observations of the eyewitness:-

The receiver was placed on top of the transmitter and both had been separated by means of a metal plate. By this means it was ascertained that the receiver could not pick-up the transmitted signal directly, but only after the EM waves had been reflected back towards the receiver. It seemed to be a relatively small apparatus (*soweit sich diese nach dem kleinen Modell-Apparat beurteilen läßt*).

The main gate into the courtyard<sup>99</sup>, at about 10 metres distance, was used to demonstrate the reflecting phenomenon on metal bodies. During the demonstrations, a curtain was placed in the path of the EM waves so as to prove that such kinds of waves could travel through non-conducting materials. Thereafter, Hülsmeier placed his apparatus behind a brick wall (*Sockelmauer*) in the Hotel courtyard and showed, that his signals still could travel freely through this type of obstacle.

The reporter continues (a briefed translation):-

After the transmitter had been activated, and the waves returned to the receiver after reflection at the gate door, the receiver switched on a light bulb which also initiated the activation of a small motor-mechanism (*Laufwerk*). This motor mechanism rotated and triggered the explosion of a few cartridges!

It seems that Hülsmeier used the receiver type similar to the one we already have considered, which was similar to, or derived from, either the receiver he had patented in 1902 or, the

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<sup>99</sup> Figure 11, shows the situation of 1927. This photo may well represent the situation of 1904. The arrows are pointing at the courtyard which had been used then (the venue was, of course, at street level). This latter information was, on 19 October 2004, collected during an interview with Mr Madaus of the Domhotel (Reinhold Liebich, email [OAN ZM 1812e]).

modified version of 1904 (US810150). He might have chosen this kind of set-up to excite the attention of his audience.

It is also interesting to know that Hülsmeier had already discussed the application of his system in future warfare.

The conclusion of the newspaper reporter was, that the apparatus being demonstrated worked in a very precise manner.

The newspaper reports did not mention the demonstration near the banks of the Rhine but, it is likely that Hülsmeier's guests went to the river Rhine banks after the introduction in the Dom Hotel, as this was only about five minutes walk away.<sup>100</sup>

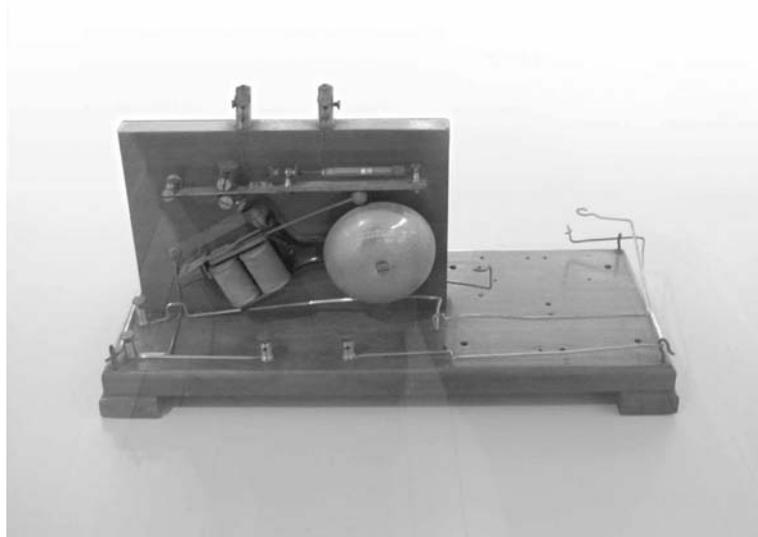


Figure 12

This photo was send to us (late August 2004) by courtesy of the Deutsches Schifffahmuseum of Bremerhaven.<sup>101</sup> The receiver device is more or less similar to the one displayed in the Deutsches Museum in Munic. On the right-hand side the polar-relay is missing.<sup>102</sup>

We noticed that Hülsmeier had combined, for this occasion, his Telemobiloskop system with his wireless remote-control apparatus. These historical circumstances might have caused, in

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<sup>100</sup> In the radio interview of 1954, Hülsmeier said: "...Ich habe dann auch noch in Köln die Apparate unter der Rheinbrücke auf dort vorbeifahrende Schiffe vorgeführt, in Beisein des Professors Bernbach (Dernbach?)... It is not clear, whether or not he meant the demonstration of 17 May. [HAD] [ZM 1812d]

<sup>101</sup> Both artefacts had been donated by the Hülsmeier family. The one on display in Munic was handed over 1958 (shortly after Hülsmeier's death) and, DSM got theirs from Hülsmeier's daughter Anneliese in 1990 (clearing here attic). We may presume, that the Deutsches Museum Munic received the best preserved set. [HAD] [OAN ZM 1812a]

<sup>102</sup> Although I cannot prove it, we may postulate that it represents Hülsmeier's state of the art of about 1904/05. And, that it is likely that he employed these kinds of coherer receivers during his Telemobiloskop experiments.

post war years, quite some confusion as many thought that the wireless remote-controlled apparatus (with its interference suppression system) had been similar to Hülsmeyer's radar receiver. Which, in my opinion, it certainly was not!

However, as we have seen in the previous paragraphs, the description is more or less similar to that of his patent application. In my opinion this is quite significant, as this was the first public explanation of what would become the principles of radar.

It is obvious that Hülsmeyer and his business partner were looking for opportunities to contact possible future customers. From contemporary information we can see how they went about it.

It is likely that Hülsmeyer and his business partner had contacted, in the first place, Germany's two major shipping companies: - the Norddeutsche Lloyd and the Hamburg-Amerika Linie. We have already seen that one of those attended the demonstrations held on 17 May 1904 in Cologne. But these companies had just installed Marconi Wireless installations on board their Ocean Liners. As Marconi, in these early days, had monopolized the entire wireless industry, there existed no real competition. Consequently, wireless onboard ships became a rather expensive affair.

Soon after, however, Hülsmeyer and his business associate received a letter from Mr J.V. Wierdsma, the president (CEO) of the Holland-Amerika-Lijn in Rotterdam.<sup>103</sup>

The letter shown below, is from Hülsmeyer and is the first we could trace in the HAL archives, which was dated 25 May 1904 and was addressed to General Director. J.V. Wierdsma.<sup>104</sup> The text had also been reconstructed by Adri de Keijzer, owing to severe water damage.<sup>105</sup>

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<sup>103</sup> We haven't found this letter in the HAL archives. We have browsed thought all director Wiedsma's correspondence, but have not found this particular letter. It must have been dated 20 or 21 May 1904. GAR, HAL Directie V inv. V 58 volumes 20-22

<sup>104</sup> Rotterdams Gemeentearchief, Directiearchief HAL Index Nr.318.01, file number 1239. Hereafter, abbreviated GAR.Directie HAL.....

<sup>105</sup> GAR, HAL Directie inv.nr. 1239. Both copies are also available in our archive [OAN ZM 1812/a/b/c]

# TELEMOBILOSKOP-GESELLSCHAFT

VERWERTUNG DER DEM  
INGENIEUR CHR. HÜLSMEYER  
ZU DÜSSELDORF  
GESCHÜTZTEN VORRICHTUNG ZUR  
VERHÜTUNG  
VON SCHIFFS-ZUSAMMENSTÖßEN.  
*Geschützt in allen Union-Staaten.*

HÜLSMEYER & MANNHEIM.

*Alle Correspondenzen sind an Herrn  
HEINR. MANNHEIM,  
Cöln, Hohestr. 77 zu adressiren.*

*W 27 5.04 gm*  
*Cöln*, *25. Mai* ..... 1904  
*Düsseldorf*  
*General-Director J. T. Wierdsma*  
*Rotterdam.*

Sehr geehrter Herr !

In höflicher Beantwortung des an unseren Herrn Chr. Hülsmeier gerichteten Schreibens vom 21. er gestatten wir uns Ihnen ergebenst mitzuteilen, dass wir die in den Zeitungen besprochenen Versuchen mit einem kleinen Probeapparat ausgeführt haben, welcher die Richtigkeit des Prinzips & der hierauf aufgebauten Funktion beweisen sollte. Die Versuche sind uns durchaus gelungen & sind wir sehr gern bereit Ihnen in den nächsten Tagen unsere Erfindung ebenfalls ad voulders zu demonstrieren, damit auch Sie sich von der Nützlichkeit des Apparates überzeugen können.

Wir sind gern bereit die Erfindung auf der von Ihnen einberufenen Versammlung vorzuführen, möchten dies aber im Interesse der Sache nicht eher tun, ehe Sie sich nicht persönlich von der Funktion des Apparates überzeugt haben.

Wir sehen Ihren geschätzten Nachrichten wann wir Sie hier erwarten dürfen gern entgegen & wäre es uns sehr lieb dieses 2 oder 3 Tage vor der Besichtigung durch Sie zu wissen, da wir immerhin noch einige Vorbereitungen zu treffen haben. Auch wäre es uns angenehm zu hören, wann die von Ihnen einberufene Konferenz stattfindet.

*Hochachtungsvoll*  
**Telemobiloskop-Gesellschaft**  
*Chr. Hülsmeier & Mannheim*

Figure 13

We can learn from it, briefly, that Wierdsma must have responded to the newspaper article in the Kölnische Zeitung of 18 May 1904. And, that Wierdsma knew about the existence of Hülsmeier's experimental apparatus from this latter newspaper article. We learn also, that he has invited the Telemobiloskop-Gesellschaft to provide a demonstration of his apparatus at a Nautical Conference in Holland. Albeit, an experimental apparatus (*Probeapparat*). They also kindly invited Wierdsma to attend "ad voulders" a special demonstration in Cologne, before coming to Holland.

However, some confusion has arisen in that an article dated 12 June 1904 appeared in a Düsseldorf newspaper suggesting, that the Rotterdam event (which will be discussed here after), was due to the invitation of the Hamburg-Amerika Linie.<sup>106</sup> Adri de Keijzer has suggested that

<sup>106</sup> General-Anzeiger für Düsseldorf, Sonntag 12 Juni 1904. Apparat zur Verhütung von Schiffszusammenstößen, von der Telemobiloskop-Gesellschaft Hülsmeier & Mannheim in Köln, wurde am 10 Juni auf Einladung des Hamburg-

this newspaper editor misinterpreted the abbreviation HAL. Instead of Holland-Amerika-Lijn, he might have thought of it was **Hamburg-Amerika-Linie**.

The diagonal, hand written, abbreviation Ba 27 5.04 stands for: replied on 27 May 1904.<sup>107</sup>

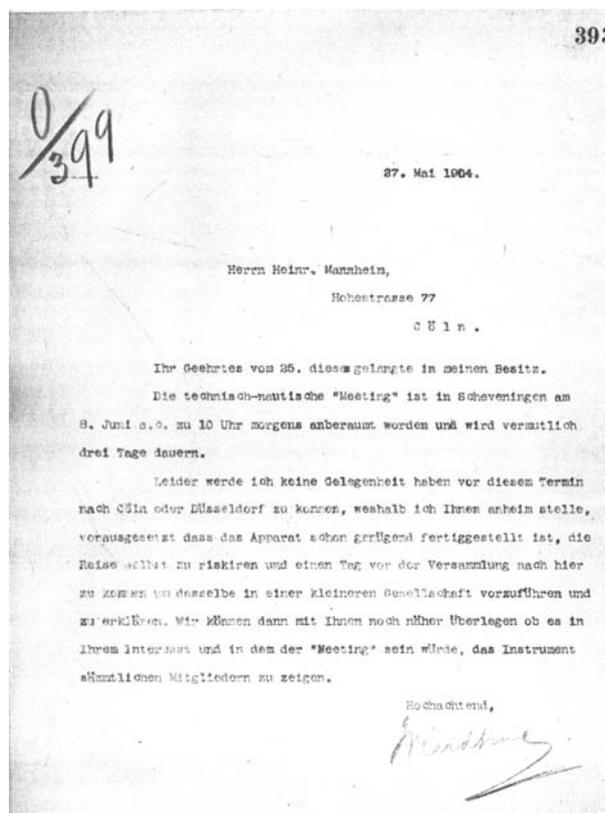


Figure 14

He replied, that the Nautical Meeting is due to be held in Scheveningen on 8 June at 10 o'clock in the morning and that it, presumably, should last three days. That he regrets, not to be able to come to Cologne or Düsseldorf. He suggests that it might be a good idea, to arrive one day before the conference meeting and to show his apparatus to a small group of people. To discuss whether it is, ultimately, of interest for the conference delegates to proceed with a demonstration.<sup>108</sup>

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*Amerika-Linie in Gegenwart der technischen Vertreter der Amerika-Linie, Atlantique Transport Linie, Holland-Amerika-Linie, des Norddeutschen Lloyd,..... [HAD] [OAN ZM 1812a]*

<sup>107</sup> Beantwoord

<sup>108</sup> GAR, HAL Directie V, inv.nr. V 58 volume 21

## TELEMOBILOSKOP-GESELLSCHAFT

HÜLSMEYER &amp; MANNHEIM.

VERWERTUNG DER DEM  
INGENIEUR CHR. HÜLSMEYER  
ZU DÜSSELDORF  
GESCHÜTZTEN VORRICHTUNG ZUR  
VERHÜTUNG  
VON SCHIPPS-ZUSAMMENSTOSSEN.  
Geschützt in allen Union-Staaten.

Alle Correspondenzen sind an Herrn  
HEINR. MANNHEIM,  
Cöln, Hohestrasse 77 zu adressiren.

Coln, 29. Mai 1904  
Düsseldorf  
General-Sprecher J. V. Wardema  
Roth-Lamm.

In höflicher Beantwortung Ihres Geehrtens von .... teilen wir Ihnen ergebenst mit, dass wir gern bereit sind Ihnen am 7. Juni unserer Probeapparat, welchen wir auch hier vorgeführt haben, dort zu demonstrieren. Wenn dieser Laboratoriumapparat naturgemäss auch nicht die Wirkung erzielen kann wie der nach unserer neukonstruktion noch zu bauende grosse Apparat (den wir so bauen lassen werden, wie derselbe auf einem Seedampfer .... ist) so lässt sich immerhin das Prinzip & die Wirkung unserer Erfindung vollständig klar erkennen, sodass wir mit unserem Probeapparat in der Lage sind entgegenfahrende Schiffe auf kleinere Entfernungen zu sichten.

Sollten Ihnen die Versuche wie wir solche hier getätigt haben genügend Interesse bieten, so bitten wir höflichst um Ihre umgehende Antwort..

Da unsere zu den Versuchen notwendige Accumulatoren Batterie schwer zu transportieren ist, so benötigen wir dort zur Vorführung eine Batterie von 20 Volt, 6 zellig oder falls derselben dort nicht zu leihen ist, ein sogen. Tauchbatterie von 20 Volt Spannung, wie dieselben in höheren Schulen zu Versuchszwecken gebraucht werden. Ausserdem benötigen wir 4 Stück 1mm starke Metallplatten (Zinkblech) die jedenfalls sogar auf Ihrer Werkstätte vorrätig sind.

Wir hoffen bestimmt, dass es Ihnen möglich sein wird eine Accum. Batterie leihweise dort zu erhalten & wäre es uns sehr angenehm, wenn dieselbe bereits am 6. Juni Mittags zu unserer Verfügung stehen könnte.

Ihrer geehrten Rückäusserung entgegen sehend, zeichne

beobachtungswoll  
Telemobiloskop-Gesellschaft  
Hülsmeyer & Mannheim

Figure 15

The content of the next letter has also been reconstructed by Adri de Keijzer, again due to severe water damage.<sup>109</sup>

They agreed to arrive on 7 June in Holland and to show their laboratory apparatus (*Probeapparat*). And that the specifications, of course, cannot be compared with those for a future sea-going vessel (*Seedampfer*).

Curiously among other things, they asked for a 20 volt battery consisting of 6 cells! I presume, that Mannheim who wrote this letter had misinterpreted what Hülsmeier had called for. That Mannheim wrote this letter can be seen in the signature at the end of it which he had also signed on behalf of Hülsmeier.

In addition, they also asked for four zinc plates of 1 mm thickness. Regular metallic plates might have been sized 2 x 1 metres. I presume, that these had to be used to screen off the transmitter system from the receiver apparatus.

<sup>109</sup> GAR, HAL Directie, inv.nr. 1239

On 31 May Wierdsma replied, that he has scheduled them for a demonstration during a tour through the harbour of Rotterdam, on Thursday afternoon 9 June on the “passagiertender Columbus”.<sup>110</sup>

The peculiar nature of the battery requirements posed some questions! Wierdsma suggested, after consulting others, that they might have meant a 12 volt battery having 20 ampère hours capacity.

What had happened after Hülsmeier and Mannheim received Wierdsma’s letter from the 31th, is not exactly known. According to a West German newspaper article of 29 December 1956, which was based on an interview held shortly before Hülsmeier died on 31 January 1957 (in Ahrweiler) due to heart insufficiency.

*Große Hoffnungen setzte Hülsmeier und sein Geldgeber auf die Schiffahrtskonferenz in Rotterdam. Delfter Studenten halfen beim Aufbau des “Fernbewegungsseher”. Hülsmeier erinnert sich noch genau an den Herbsttag des Jahres 1904.*

The substance of this text is that firstly, Hülsmeier and his business associate had great expectations of the Nautical Meeting to be held in Rotterdam.

Secondly, that some students of Delft (Polytechnische School)<sup>111</sup> have assisted with the installation of Hülsmeier’s system on board a ship of the HAL.<sup>112</sup>

Thirdly, it is strange that he clearly remembers a day in Autumn! We know that the event took place on Thursday afternoon the 9<sup>th</sup> of June. Hülsmeier’s recollections might have been a bit mixed-up but then he was not in the best health! We have got copies of the data which Mr van Wijngaarden, chief librarian of the Municipal Archives of Rotterdam (GAR), had sent to David Pritchard, in which he mentioned: *About the weather at 9 June 1905. Wind: north-east, 2 Beaufort. Atmospheric pressure 757,3 Mb (has to be mm Hg, AOB).*<sup>113</sup> *Temperature at 12 o’clock 16 ° C. Heavy cloud.*

This weather type does not really look like a rememberable Autumn day. Never mind, we have to comeback later on this “contradictio in terminis”.

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<sup>110</sup> Meant is a: ships-tender

<sup>111</sup> On 10 July 1905 Queen Wilhelmina opened the Technische Hogeschool Delft. Nowadays, it is called Technische Universiteit Delft or TU-Delft.

<sup>112</sup> However, we got recently a list of students between 1903 and 1905, though, could not match their names to those found in the HAL archives.

<sup>113</sup> Here Mr. Wijngaarden may have misinterpreted the data. As 757,3 millibar is most unlikely! What he, presumably, meant was: 757.3 millimetre mercury (Hg), which is equivalent to 1009.65 millibar. This sounds much more healthy. [OAN ZM 1812]

Let us continue with the course of history: -

We know from Wierdsma's letter that he invited Hülsmeier to demonstrate his ship-colliding-prevention-apparatus during a tour through the harbour of Rotterdam on board the ships-tender Columbus.<sup>114</sup>



Figure 16

We may assume that Hülsmeier first introduced himself and his apparatus to the audience of technical ship experts with an introductory talk. What did he tell these laymen? That we don't know, but he, certainly, handed out a leaflet which is shown below.<sup>115</sup>

Briefly the leaflet (see next page) explained that his apparatus aims to detect, by means of EM waves (wireless), ships at distances of three to five kilometres. He regards it as a kind of electrical eye. The basic principle relied upon reflection. In this case not by the reflection of visible light, but by reflection of electrical waves. Which respond in a similar way to light rays (*analog den Gesetzen des Lichtes*). He then explains the principles of his apparatus as he did for his principle radar patents<sup>116</sup>, emphasising in particular, the convenience for the captain at the bridge, who could distinguish from which direction a vessel might approach.

Finally he declares that, his invention is of great importance as it allows the detection of ships in the neighbourhood independently of prevailing weather conditions. Whether they be in the form of a hurricane, fog or mists (where light signals normally fail).

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<sup>114</sup> The s.s.Columbus I, was built by Bonn & Mees, Rotterdam, in 1893. Sized: 70 tons; L x B x H = 27 m x 5.5 m x 2.4 m. Compound 2 cylinder steam engine made by N.V. Wilton's Scheepswerf & Machinefabriek Rotterdam. Power 130 i.h.p. Delivered on 15 October 1893. Did service for the HAL until 19 October 1910. When it was sold to the City of Rotterdam. Later the HAL purchased Columbus II [Boer, p.234]

<sup>115</sup> GAR, Directie HAL, inv. nr. 1239. This document has also, necessarily been restored in regarding its content, by Adri de Keijzer, due to water damage.

<sup>116</sup> Like: GB13170/1904

Das Telemobiloskop.

Vorliegende Erfindung hat ihren Namen nach dem von ihr erfüllenden Zweck und den in den betr. Apparaten sich abspielenden Vorgängen erhalten und soll die Aufgabe lösen mittelst elektr. Wellen also drahtlos auf ca. 3 - 5 km. auf See von einander befindliche Schiffe den mit derartigen Apparaten versehenen Schiffen zu melden bzw. zu sichtbar machen, ohne dass die gesichteten Schiffe mit derartigen Apparaten ausgerüstet sind; die Erfindung hat daher gewissermassen die Wirkung eines elektr. Auges. Sie beruht wie das Sehen auf der Reflektion und zwar nicht der Licht- sondern der elektr. Wellen, welche von allen Metallen reflektiert werden, analog den Gesetzen des Lichtes.

Stellt man daher Geber- und Empfänger-Apparate einer elektr. Wellenstation auf ein und demselben Schiff so auf, dass die Wellen des Gebers den Empfänger direkt nicht bethätigen können, sondern erst durch Metalle auf reflektiertem oder gebrochenem Wege zum Empfänger desselben Schiffes gelangen können. Solche metallische Gegenstände sind auf See nur fremde Schiffe, welche somit gemeldet werden. Es wird nun mit Hilfe dieses Apparates ein Umkreis von 3 km. von dem schnellfahrenden Schiffe sektorförmig abgesucht bzw. abgeleuchtet und sobald ein Schiff sich in diesem Umkreis befindet, spricht der Empfänger an und meldet durch hör- oder sichtbares Zeichen das Vorhandensein eines Dampfers. Nicht allein dies, der Kapitain auf der Kommandobrücke kann auch sofort die Richtung feststellen, wo sich das fremde Schiff befindet und darnach rechtzeitig seine Befehle erteilen und Massnahmen treffen. Wir haben es daher mit einer Erfindung von allergrösster Bedeutung für das Verkehrswesen zu thun, da die Schiffsmeldung ganz unabhängig von dem stärksten Orkan und dem dichtesten Nebel, wo sonst Licht- und Nebelsignale versagen, mit einer unbedingten Sicherheit vor sich geht.

*Chr. Hülsmeier*

Figure 17

There are, in existence, two reports on Hülsmeier's demonstrations on the 9<sup>th</sup> of June. The first one is the minutes of Meeting of this Nautical Conference held in Scheveningen on June 8<sup>th</sup>, 9<sup>th</sup> and 10<sup>th</sup> 1904.<sup>117 118</sup>

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<sup>117</sup> Attendees were representing the: American Line, Leyland Line, Dominion Line; Atlantic Transport Company; Hamburg-American Line; Norddeutscher Lloyd; Red Star Line; Holland-America Line. Note that the White Star Line was absent who, as we know, owned (some years later) the Titanic!

<sup>118</sup> A description of what the Nautical Conference attendees in Scheveningen and Rotterdam did on 9 June 1904, is briefly described in the Telegraaf newspaper of 11 June 1904 in its morning edition. Notwithstanding, that Hülsmeier's demonstrations only had been mentioned in the evening edition. [KB krantenarchief, Den Haag] [OAN ZM 1812]

### ***The Telemobiloscope***

*During the visit of the delegates to the establishment of the Holland-America-Line at Rotterdam, a trial was given on board the tender Columbus to the Telemobiloscope, an invention of CHRISTIAN HULSMEYER Esq. Engineer at Düsseldorf.*

*This apparatus is based on the principle of wireless telegraphy and is intended to ascertain when at sea, the direction and also the distance of an other vessel.*

*In wireless telegraphy the distributor and the receiver are part of different places, in the Telemobiloscope they are placed together on the same spot. The electrical currents of the distributor however cannot be caught by the receiver directly but must strike an object of metal (in this case the other vessel) before returning to the receiver. The opinion of the inventor is that vessels fitted with his apparatus, can discover at night or in a fog etc., at a distance of up to 3½ miles, other vessels and ascertain the position of these vessels. The trial on board of the Columbus, though on very limited scale and with an unfinished apparatus, proved that the principle of the inventor is correct. Every time when, even at certain distance, a vessel passed, the apparatus operated immediately.*

*The apparatus used in this trial was not yet arranged for determination of the distance.*

These minutes very clearly explain the implications of Hülsmeier's invention. Interesting is the last sentence: - The apparatus used in this trial was not yet set up for the determination of the distance. We can draw the conclusion that they must have discussed the necessity of measuring distance. And that, as we already know, he applied for a distance measuring extension (Zusatz) to his DE165546, just one week after he returned home from Rotterdam.<sup>119</sup>

The second report on what happened about the 9<sup>th</sup> of June, appeared in two similar articles in Dutch newspapers. Due to similarities in the minutes of meetings and the text shown below, it is quite likely that Wierdsma himself forwarded the following statement to the Dutch newspapers.<sup>120</sup>

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<sup>119</sup> H 33 222 Kl. 74d, date 16 June 1904, which had been rejected firstly. Called: Telemobiloskop. He ultimately obtained on 11 November 1904 DE169154. [HAD] [OAN ZM 1812] It is quite curious, that he had applied for it earlier in France, namely, on 7 October 1904. Which latter application got the same patent number as his earlier application on 10 June 1904 FR343846. The Germans called this: Zusatz zu.. The different time schedules might indicate us, that Hülsmeier's rejected distance measuring application H 33 222 was associated to the way it had been edited.

<sup>120</sup> De Telegraaf (avond-editie = evening edition) of 11 June 1904. And in Dagblad voor de Scheepvaart, Saturday 11 June 1904. It is likely, that Wierdsma wrote this dispatch on the 10<sup>th</sup>. But that it had been received in Amsterdam on the 11<sup>th</sup>. The Morning edition of the Telegraaf newspaper dealt with the Nautical Conference and the boat tour in the harbour of Rotterdam. Though, this article emerged in the evening edition of the 11<sup>th</sup>. Telegraaf available at Rijksarchief in de Koninklijke Bibliotheek (KB)den Haag. Dagblad voor de Scheepvaart, in krantenarchief at Gemeentearchief Rotterdam (GAR)

### De Telemobiloskoop.

Men schrijft ons:

Gisteren, Donderdag, werden te Rotterdam op uitnoodiging van de directie der Holland-Amerika-lijn door de Telemobiloskoop maatschappij Hülsmeyer en Mannheim te Keulen, in tegenwoordigheid van 8 verschillende Trans-Atlantische scheepvaartmaatschappijen (n.l. de Hamburg—Amerika-lijn, de Nordd. Lloyd, de Red Star line, de Holland-Amerika-lijn, de Leyland line uit Liverpool, de Dominion line van daar, de Atlantic Transport line uit Londen en de American line uit Liverpool) proeven genomen met haar apparaat, waarmede de richting van onzichtbare metalen, voorwerpen b.v. schepen in mist, kan worden aangeduid.

Het apparaat werd op den tender Columbus der Holland-Amerikalijn opgesteld en op een tocht door de haven voortdurend beproefd. De proeven slaagden volkomen en de aanwezige ingenieurs waren allen zeer ingenomen over deze uitvinding die wellicht leiden kan tot resultaten van groot practisch nut.

De uitvinding is van den heer Chr. Hülsmeyer en berust op het beginsel der draadloze telegrafie. Zij heeft ten doel schepen maar tevens ook alle andere metalen voorwerpen op zee te ontdekken.

Het onderscheid tusschen de reeds bestaande aanwending der draadloze telegrafie en deze uitvinding berust behalve op verbeteringen in de constructie, hierop dat men bij de Telemobiloskoop niet als bij de draadloze telegrafie den zender en ontvanger op verschillende schepen plaatst, maar beiden op een en hetzelfde schip.

De door den zender uitgezonden elektrische golven kunnen den ontvanger niet direct bereiken, doch moeten daartoe door een zich op zee bevindend metaal voorwerp, in casu een schip, gereflecteerd worden en op die wijze onderbroken hun weg naar den ontvanger volgen.

Het groote voordeel dat deze uitvinding biedt ligt vóór alles ook daarin, dat schepen, welke met zender en ontvanger naar dit systeem zijn toegerust, elk ander schip, al heeft dit ook geen apparaat, ontwijken kunnen. De kapitein op de commandobrug krijgt op 3-5 K. M. afstand aanwijzing van de richting waarin zich het tegemoet varende schip bevindt, zoodat, zelfs waar licht- en nevelsignalen talen, men nog steeds tijd genoeg heeft om zijn vaartuig in den juiststen koers te brengen en daardoor een groot onheil tijdig te voorkomen.

Wanneer deze uitvinding, waarvan de proeven op kleine schaal en geringen afstand gelukten, leidt tot de praktische aanwending van een toestel op dat principe berustend, waarmede op schepen in nevel, zwaren regen of dikke sneeuw de richting en afstand van tegemoetkomende schepen kan worden aangegeven, dan zal daarmede de veiligheid op zee in hooge mate zijn bevorderd.

Daar zoowel door zich boven als onder water bevindende metalen voorwerpen de golven worden teruggekaatst, zal deze uitvinding wellicht voor oorlogsdoeleinden eveneens een toekomst hebben.

### Figure 18

Even for those who cannot read the Dutch language, the first paragraph needs no further explanation. The rest is somewhat similar to the minutes of the meeting we have discussed before. But, the last four lines indicate a very futuristic vision which suggests that they were fully aware of the impact of Hülsmeyer's invention! It pointed out that:

**Because, above and under water metal objects reflect waves, this invention might have significance for future warfare.**

It is likely that no one before had linked the application of radar with warfare.<sup>121</sup> Some science fiction authors might have suggested deadly rays or waves or something similar before, though "non of these men" would ever have imagined the significance of real radar in future warfare!

How did his audience respond to Hülsmeyer's, for those days, very spectacular demonstrations?

According to Hülsmeyer during an interview:<sup>122</sup>

*Die Zuschauer meines Vortrages schüttelten mir wiederholt die Hände. Nur die drei englischen Reedereigesellschaften verhielten sich passiv.*

*Einer sagte, meine Erfindung sei nur ein Embryo. Ich antwortete ihm: "Aber einer, der gesund ist".*

What can we learn from this statement?

Firstly, that Hülsmeyer gave a talk before the representative of the shipping companies. We may assume, that he handed out his leaflet shown in figure 17.

Secondly, there was an enthusiastic response and much shaking of hands!

Thirdly, that the British attendees responded quite reluctantly. One said to him: Your invention is like

an embryo. He responded, but one which is healthy and capable of growth.

<sup>121</sup> However, the newspaper reporter of the demonstration on 17 May in the Domhotel in Cologne, also mentioned the eventual implications for future warfare.

<sup>122</sup> West German newspaper article 29 December 1956.

I have studied the HAL direction files between 1903 and 1907 thoroughly. This kind of British attitude was typical of them. What is “not invented here” will be quite often rejected. We will see some evidence of this attitude in a later paragraph.

**A curious notary document of 12 August 1904**



Figure 19

During the radar conference at Toulouse in October 2004, I met a cousin<sup>123</sup> of the Hülsmeier family who was attending accompanied by two of the grandchildren. He told me that his father died recently, and that he found copies of a hand written notary document, which might throw a new light on Hülsmeier's financial expectancies.

Let us follow, briefly, Reinhold Liebich's translation of this in a "Sütterlin" handwritten document (notice figure 19).<sup>124 125</sup>

Present in the notary's office on 12 August were:-

First, the Banker Hermann Gumpel of Hannover, who represents the Trading Company Z.H. Gumpel (hereafter to be called: Z.H. Gumpel Company),

Second, the Engineer Christian Hülsmeier of Düsseldorf and,

Third, the businessman Heinrich Mannheim. (the German called it "Kaufmann")

The Königliche (=Royal) public notary (Mr Lasker) acknowledged that he knew the persons noted as first and third above and that the third person confirmed the identity of the second person.<sup>126</sup>

What information may we derive from this legal "prelude"?

It would seem that both, banker Gumpel and Mr Mannheim have met Mr Lasker already. We may presume that they have already discussed the legal details of their new business agreement with him. We might also consider that an earlier business link between Messrs Gumpel and Mannheim existed.

Continuing with the agreement (briefly),

### § 1

Mr Hülsmeier is the inventor of the Telemobiloskop, which is claimed to be a ship-collision-prevention-apparatus..... Patents had already been claimed in France, Belgium, England, Austria, Sweden and in the USA.

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<sup>123</sup> Reinhard Dellenbusch

<sup>124</sup> Thank to him were we able to understand the content of this old fashioned "gothic handwriting".

<sup>125</sup> I have preferred, for this occasion, to explain very briefly the content of this agreement, as legal language is very formal and often rather difficult to translate. The original German text is attached in footnotes.

<sup>126</sup> *Vor mir, dem Königlichen Notar Justizrat Leo Lasker zu Hannover erschienen:*  
 1. der Bankier Hermann Gumpel, wohnhaft zu Hannover, als Teilhaber der offenen Handelsgesellschaft Z.H. Gumpel daselbst,  
 2. der Ingenieur Christian Hülsmeier, wohnhaft in Düsseldorf, Grabenstraße 3,  
 3, der Kaufmann Heinrich Mannheim, wohnhaft in Cöln, Hohestraße No. 77,  
 zu 1 und 3 mir von Person bekannt, zu 2 mir von Person nicht bekannt, jedoch durch den Erscheinen zu 3 recognosciert, wodurch ich über die Person des Erscheinen zu 2 Gewißheit erlangte.

New patent applications in other countries will follow.<sup>127</sup>

All legal patent claims whatsoever derived from this invention should be transferred without any delay and be registered in the name of the Z.H. Gumpel Company.<sup>128</sup>

## § 2

Mr Hülsmeier is obliged to transfer to Z.H. Gumpel Company, as soon as possible, all future inventions, drawings, experimental sets and whatsoever else is related to the "Telemobiloskop system".<sup>129</sup>

## § 3

The Z.H. Gumpel Company is authorized to dispose of all existing and future patents, or grant licences in its own rights. Nevertheless, in case of "selling off" his (Gumpel's) rights, a total sum of 1 million Marks must be achieved.<sup>130</sup>

## § 4

Considering the circumstances that, for what ever reason patents have been rejected, the Z.H. Gumpel Company is still entitled (at will) to apply for legal protection of designs.<sup>131 132</sup>

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<sup>127</sup> *Herr Hülsmeier ist der Erfinder eines Telemobiloskops, welches den Zweck hat, Schiffe, Eisenbahnen und sonstige metallische Gegenständen auf drahtlosem Wege zu sichten.....Gleiche Hauptanmeldungen sind für Frankreich, Belgien, England, Oesterreich, Schweden und die Vereinigten Staten von Nordamerika erfolgt und soll noch für andere Staten angemeldet werden.*

<sup>128</sup> *Alle Ansprüche aus dieser Erfindung insbesondere auch die Ansprüche auf Erteilung des Patentos und Rechte aus den angemeldeten Patenten überträgt Herr Hülsmeier ohne jede Einschränkung auf die Firma Z.H. Gumpel...Dass die Uebertragung der Ansprüche des Herrn Hülsmeier aus seiner Erfindung und auf Erteilung der Patente in der Rolle vermerkt werden.*

<sup>129</sup> *Herr Hülsmeier verpflichtet sich ferner, der Firma Z.H. Gumpel alle weiteren von ihm etwa noch zu machenden Erfindungen, soweit solche das Telemobiloskop in irgend einer Weise betreffen, zur Kenntnis zu bringen und die erforderlichen Beschreibungen, Zeichnungen, Modelle u.s.w. mitzuteilen und alle Rechte aus diesen späteren Erfindungen zu übertragen, damit die Firma Z.H. Gumpel auch diese Erfindungen, soweit sie eine gewerblichen Verwertung in irgend einer Form gestatten, schützen lässt. Die gesamten Kosten, welche durch die Erwirkung von Schutzrechten für derartige später zu machende Erfindungen entstehen, hat die Firma Z.H. Gumpel allein zu tragen. (cfr §5.)*

<sup>130</sup> *Die Firma Z.H. Gumpel ist berechtigt, die zu erteilenden Patente ganz oder teilweise zu veräußern, oder nach ihrem Ermessen Lizenzen zu verteilen. Im Falle einer Veräußerung müssen insgesamt eine Million Mark erzielt werden, vorbehaltlich anderweitiger Abmachungen.*

<sup>131</sup> *In Germany well known: D.R.G.M. = Deutsches Reichsgebrauchsmuster, which may be compared with "Trademark registration".*

<sup>132</sup> *Sollten die angemeldeten oder noch anzumeldenden Patente für die Erfindung des Herrn Hülsmeier nicht erteilt werden, so ist derselbe damit einverstanden, dass zum Schutze seiner Erfindung die Firma Z.H. Gumpel nach ihrem Ermessen in anderer Weise als die Patente die Erfindung schützen lässt, sei es durch Gebrauchsmuster, Musterschutz oder wie sonst zulässig.*

## § 5

The Z.H. Gumpel Company reciprocates as follows:-

The company pays Mr Hülsmeier, for future patent applications and construction of experimental sets (*Probeapparaten*, AOB) a maximum sum of 5000 Marks. This without refunding, in so far as Mr Hülsmeier can validate the expenditure.

The profit(s) made by his inventions of Mr Hülsmeier will be, after deduction of expenses, paid nett in cash at a rate of 45%.

After Mr Hülsmeier has provided proof of the usefulness of his invention, the Z.H. Gumpel Company is obliged to establish a Consortium in order to commercialize the invention. This to be carried out within six weeks.

In the circumstance that the newly established Consortium or the Z.H. Gumpel Company would start production in its own right, Mr Hülsmeier should be their technical production manager. A minimum salary of 500 Marks per month will be paid plus an additional bonus of 5 % of the nett profit.<sup>133</sup>

## § 6

Mr Hülsmeier is obliged to pay the Z.H. Gumpel Comany 100,000 Marks in compensation (*Schadensersatzansprüche*, AOB), should he act contrary to the terms of this agreement.<sup>134</sup>

## § 7

The Z.H. Gumpel Company notes that an agreement had been signed previously, between Mr Hülsmeier and merchant (Kaufmann, AOB) Heinrich Mannheim, at the notary Krebs' office in Cologne, on 15 March 1904 and additionally on 17 May 1904. This agreed, that Mr Mannheim should get 20% of the profits of Mr Hülsmeier's invention (the Telemobiloskop, AOB). However, it is now noted that this new agreement (of 12 August, AOB) supersedes the previous agreement which is therefore now obsolete. It is also noted, that Mr Mannheim's previous payment of 2000 Marks, to Mr Hülsmeier, does not have to be refunded.

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<sup>133</sup> Die Gegenleistungen der Firma Z.H. Gumpel sind die folgenden:

- a. sie gewährt Herrn Hülsmeier für noch anzumeldende Patente sowie zur Herstellung von Probeapparaten einen Betrag von nach Bedarf bis insgesamt 5000 Mark,...unter Verzicht auf Rückgewähr unter der Bedingung, daß ihr Herr Hülsmeier die Zahlung der Beträge durch Beläge nachweist.
- b. Von dem durch die Verwertung der Erfindungen eingehenden, nach Abzug aller Unkosten verbleibenden Nettoerlöse erhält Herr Hülsmeier bar 45% sofort nach Eingang eines jeden Betrages ausbezahlt.
- c. Wird der Firma Z.H. Gumpel von Herrn Hülsmeier der Nachweis der praktischen Brauchbarkeit seiner Erfindung erbracht, so verpflichtet sie sich, binnen 6 Wochen nach Erbringung des Nachweises ein Konsortium zur Verwertung der Erfindung zu bilden.
- d. Falls das Konsortium oder die Firma Z.H. Gumpel die Fabrikation der Telemobiloskops selbst ausübt, so wird Herr Hülsmeier als technischer Leiter der Fabrikation gegen ein Gehalt von mindestens monatlich 500 Mark angestellt und erhält außerdem 5% Tantiemen vom Reingewinn.

<sup>134</sup> Herr Hülsmeier verpflichtet sich, der Firma Z.H. Gumpel vorbehaltlich weiterer Schadensersatzansprüchen eine Konventionalstrafe vom 100.000 Mark...für jeden Fall zu zahlen, falls er der Firma Z.H. Gumpel gegenüber sich einer Verletzung der Bestimmungen der ...dieses Vertrages schuldig macht.

Nonetheless, Mr Hülsmeier has to safeguard Mr Mannheim against any (legal) claims which might be brought by the merchant (Kaufmann, AOB) Arthur Höing in respect of their agreement of 4 July 1904.<sup>135</sup>

Paragraph 8 simply explains the manner of document registration and, who got which numbered copy.

On the last page, the notary's office declared that the considered amount of this agreement (contract) was 1,000,000 Marks. The fee for this legal certification amounted to 130 Marks (including Mr. Lasker's expenses, AOB).

### **What does this tell us?**

Considering paragraph 1, we notice that Hülsmeier must also have applied for a patent in the United States of America. However, it may have been rejected or, that Hülsmeier had retrieved it during the course of the application procedure, as, in the meantime, he had failed with his Telemobiloskop system in Europe. From some patent files we know that Hülsmeier refused payments, which automatically cancelled the patent registrations.

Of interest also is, the information that Hülsmeier's and Mannheim's first settlement was dated 15 March 1904, six weeks before he applied for his Telemobiloskop patent (30 April). It is no wonder that in the light of events, the business associates went to notary Krebs the same day after the first (successful) public demonstrations were given in the Domhotel of Cologne (17 May).

Let us go back to the successful demonstrations in Rotterdam harbour on 9 June 1904. The, mostly, positive response of his audience may have encouraged Hülsmeier to apply (immediately) for a British patent (or speeding up its already started preparation). We know that Hülsmeier's application was dated 10 June 1904 and that his claims had been granted extremely quickly within less than 10 weeks! For those acquainted with patent affairs, this was an unbelievably fast process!<sup>136</sup>

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<sup>135</sup> Der Firma Z.H. Gumpel ist bekannt, daß vor dem Notar Krebs zu Köln (the writer used some grammar inconsistency) unterm 15 März 1904, bezw. Nachtrag vom 17 Mai 1904 zwischen Herrn Hülsmeier und dem Kaufmann Heinrich Mannheim eine Vereinbarung geschlossen ist, nach welcher Herrn Mannheim 20% der Ausbeute der Erfindung des Herrn Hülsmeier zu gewähren ist. Unter Beitritt des Herrn Mannheim zu diesem Verträge wird der unterm 15 März 1904, bezw. Nachtrag vom 17 Mai abgeschlossene notarielle Vertrag seinem gesamten Umfange nach aufgehoben, jedoch ohne daß Herrn Mannheim ein Anspruch auf Rückgewähr der von ihm Herrn Hülsmeier gezahlten 2000 Mark zugesteht. Andererseits übernimmt es Herr Hülsmeier, Herrn Mannheim wegen aller Ansprüche schadlos zu halten, welche etwa der Kaufmann Arthur Höing aus einem unterm 4 Juli 1904 mit Herrn Hülsmeier und Herrn Mannheim abgeschlossenen Verträge gegen den Letzteren herleiten könnte oder sollte.

<sup>136</sup> Consequently, there must have been no legal objections (claims) which obstructed the acceptance of Hülsmeier's claims.

He may well have been impressed by the possibilities of future markets for his Telemobiloskop apparatus. It is obvious, that they (their company) needed a broader financial base. Considering paragraph 7, we see that they must have involved Mr Arthur Höing, to some extent, in their (financial) business schemes (4 July 1904).

Hülsmeier might have, in the light of Marconi's commercial success, considered the possibility of an important market becoming available as a sum of 1,000,000 Marks was considered in the agreement (*Im Falle einer Veräuserung müssen insgesamt eine Million Mark erzielt werden*)!!

Very significant is paragraph 5, as is also paragraph 7.

We notice here that Mannheim's ominous "5000 Marks" is apparently no longer valid. Remember what they said (the grand old man as well): "*Ein Lederhändler beteiligte sich mit 5000 Goldmark an der Teleskope-GmbH..*".

It is evident, that the precise sum was 2000 Marks! However, at least we know now where the 5000 Mark figure entered into the discourse, as this was the amount that the Z.H. Gumpel Company might have provided Hülsmeier for his technical expenses (At least in the period between 12 August and Hülsmeier's failed experiments near Hook of Holland, somewhere in Autumn 1904, which circumstances will be dealt with in a later chapter).

This document also shows, that Mannheim should earn 20% of the nett profit (*Ausbeute*) in respect of their mutual participation. Looking at the situation at the end of Hülsmeier's radar involvements, we know now that Mannheim, actually, never received a "penny" from this engagement.

To some extent Hülsmeier must have been worried, on the one hand he desperately needed money and, on the other hand, he had handed over the legal rights of his (Telemobiloskop) inventions to the banker Z.H. Gumpel in Hannover. It is also rather curious, that Hülsmeier should, in case the Z.H. Gumpel Company themselves would start production of the Telemobiloskop (be it in form of a Consortium with or without other enterprises), he (only) should be their managing director of production. In my opinion, had they gone into production this might have caused a lot of future controversies.

The limitations of this agreement is also pointed out in paragraph 5, notice point d. (see footnote): Hülsmeier had to bring the practical proof that his invention works. They certainly intended that it should be commercialized.

Paragraph 6 is also of significance for us. Its intention was to guard against any possible breach contract by Hülsmeier.<sup>137</sup> As we will see later, Hülsmeier did not sign, for the time being, letters on behalf of the Telemobiloskop-Gesellschaft Hülsmeier & Mannheim.

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<sup>137</sup> If he should earn say 6000 Marks per annum as production director or manager, it then involved an equivalent of about 16 years of salary payments. Even for today's standards, an enormous amount of money (responsibility). He might have been rather desperate, to accept such kinds of conditions.

### **Hülsmeyer is facing accumulating difficulties**

Previously we have noted that Hülsmeyer had tried to approach a wider market. Considering the very short time span between the application of his patent on 30 April 1904<sup>138</sup> and the exceptional chance he got to demonstrate his experimental apparatus to an international audience of chief technicians of leading shipping companies, he had been very fortunate. National as well as international newspapers and magazines reported, very positively, Hülsmeyer's demonstrations in Cologne and in Rotterdam.<sup>139</sup> Nonetheless, he was faced with the task of convincing future customers that his invention created a versatile navigational aid.

Most historical essays on Hülsmeyer and his radar-like inventions, closed their chapters with the conclusion that the technology and the time had not yet been right. Some of them also suggested that his potential customers did not really understand the difference between Marconi's wireless telegraphy system and Hülsmeyer's Telemobiloskop.

We have been very lucky that Adri de Keijzer has found significant material in the HAL archives.<sup>140</sup> Some of which indicates that the "Hülsmeyer radar story" did not stop in June 1904, but that it continued for some time thereafter. Hülsmeyer himself, in his later years, never spoke about what had happened then, almost as though he had shut it out of his memories. Our survey is it to reconstruct what might have occurred, based upon the information that has since become available.<sup>141</sup>

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<sup>138</sup> DE165546

<sup>139</sup> For instance: Belgium, England, Germany, The Netherlands, United States

<sup>140</sup> GAR Directie V HAL, inv.nr. V 4-1

<sup>141</sup> Even the remaining Hülsmeyer papers in Düsseldorf, give not the slightest clue about what had happened in the second half of 1904!

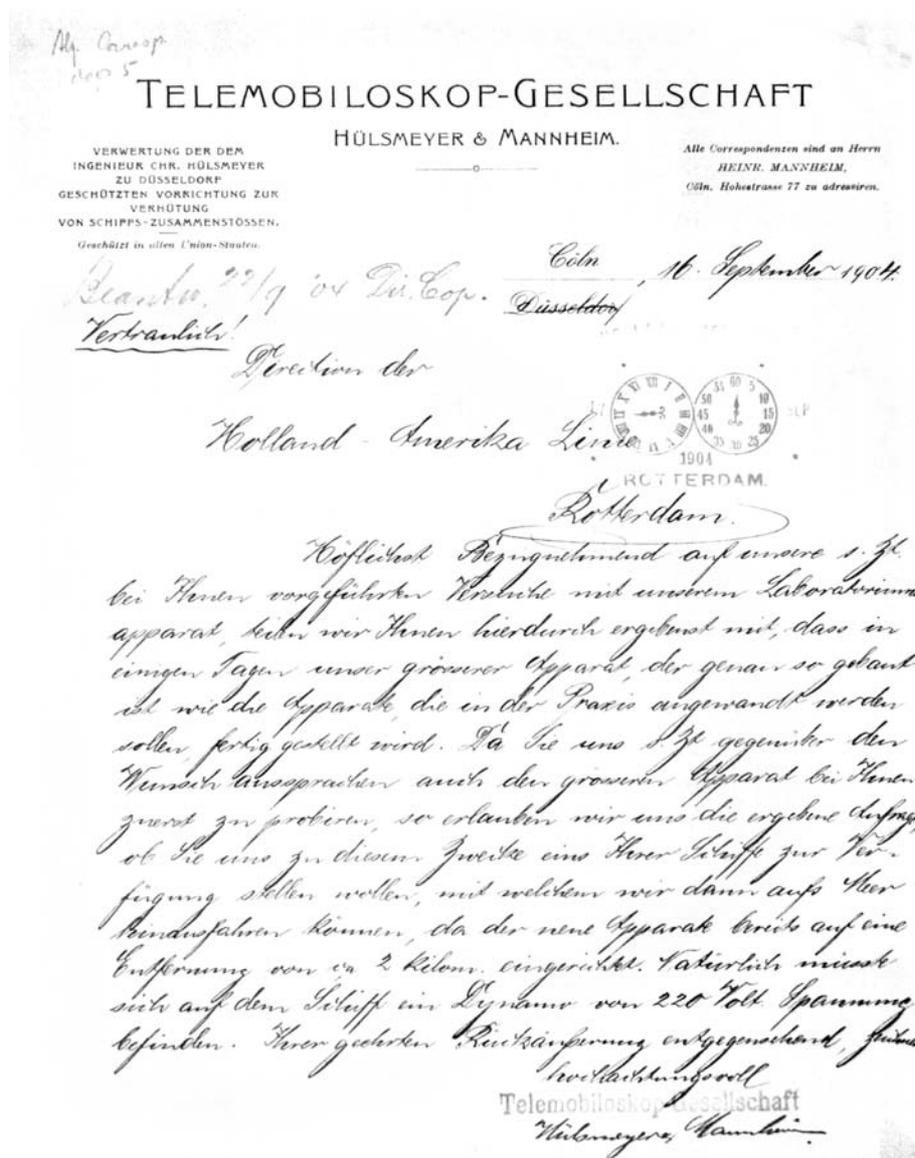


Figure 20

It is clear that, after he had returned home, he took immediate action to extend his patent claims on distance-measuring-techniques. We have also seen that he failed with his application on 16 June. It is also evident, that he would try to enhance the performance of his ship-colliding-prevention system. It is very plausible that Hülsmeier had built, between mid June and the second week of September, a more sophisticated system (using Gumpel's money). They lost no time in letting the HAL know of these improvements.

Let us follow the meaning of it briefly.

Mannheim, addressed this letter to the management of the HAL company.

He considered that they knew about their "laboratory" apparatus already. He then respectfully informs them that in a couple of days, their new more powerful apparatus will be ready for demonstrations. This will be the version for their future commercial installation.<sup>142</sup>

<sup>142</sup> ...unser grösserer Apparat, der genau so gebaut ist wie die Apparate die in der Praxis angewandt werden sollen, fertiggestellt wird.

As you (Wierdsma?) have suggested, we should first test our apparatus in your ships.<sup>143</sup> He then respectfully asked them if they could provide one of their vessels, for their second practical trial but now to take place at sea (*aufs Meer*).

Mannheim further points out that their apparatus could now cover a range of circa 2 miles.<sup>144</sup> In my opinion, this also indicates, that the newspaper articles of May and June 1904 were exaggerating the actual Telemobiloskop range!

What followed sounds a bit strange. *Natürlich müsste sich auf dem Schiff ein Dynamo von 220 Volt Spannung befinden.*

Translated: Of course the vessel must have a dynamo providing 220 volts. What does that mean, 220 volts direct current (DC) or alternating current (AC)? As we know, there existed no standardisation at all, in those days.

Though Mannheim had written the letter he had, nonetheless, signed it on behalf of both Hülsmeier and himself.<sup>145</sup>

A few days later Wierdsma replied to Heinrich Mannheim. We have received your letter of 16<sup>th</sup> of this month. We are willing to assist with your second trial of the Telemobiloskop on board of the same ship-tender Columbus but, in waters in which we may expect larger distances between ships. Should this experiment be successful, then we could install the Telemobiloskop on board of one of our sea-tenders. Or, on one of our steam liners (Dampfer). In the latter case during the trip to and from New York (*im letzteren Falle während einer hin und Rückreise nach New York*). As you may already know, the Columbus is provided with an electrical capacity of 40 volts at 40 amps.<sup>146</sup>

We have not been able to trace any further correspondence between Hülsmeier cs. and Wierdsma (on behalf of the HAL company). Consequently, we may presume that there had been no further communication at board levels.

Nevertheless, we have found a very significant reference, which could lead to the final evaluation of Hülsmeier's commercial Telemobiloskop endeavours.

As we have seen, Wierdsma and the HAL company organized the first Nautical Conference in Scheveningen in the Netherlands. The setting up process took several years of intensive

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<sup>143</sup> *Da Sie uns s.Zt. gegenüber den Wunsch aussprachen auch den grösseren Apparat bei Ihnen zuerst zu probieren, so erlauben wir uns die ergebene Anfrage ob Sie uns zu diesem Zwecke eins Ihre Schiffe zur Verfügung stellen wollen, mit welchen wir dann aufs Meer Einausfahren können,....*

<sup>144</sup> This figure can cause confusion. On the continent, one distinguish between land and sea miles. A land mile is equal to mi, and 2 miles is equal to 3.218 km. A sea mile, is known as a Nautical Mile and 2 nmi is equal to 3,704 km.

<sup>145</sup> We know now, that this might have been the consequence of the notary agreement of 12 August, between Mrs Gumpel, Mannheim and Hülsmeier.

<sup>146</sup> GAR Directie V HAL, inv. nr. V 58-volume 21

interactions between various trans-Atlantic shipping companies. The main target of this conference was to share their mutual concerns in respect to the technical aspects of maintaining ocean liners.

These included: -

General Keeping up, repairs, outfit, provisions<sup>147</sup>

Fresh and Saltwatertanks

Deep tanks

Tanktops

Ships sides in holds and 'tweendecks

Accommodations for Officers and Crew

Storerrooms

Disinfections

External keeping up

Hull under water, Drydocking etc.

Hull on the waterline

Hull above the waterline

Repairs Own workshops.

Loading

general cargo, usual an mechanical way, despatch cost

coal,

Passenger-service

Pantries, Galleys, Bakeries, Butchershops, Sculleries.

Cooling and Freezing rooms

Engine Room

Firemen and Coalpassers,

Navigation

Steamship Lanes

Influence of dynamos upon compasses

Wireless Telegraphy

**Submarine Signalling** (we will come back on this issue)

General

Triple or Quadruple expansion

Turbines

Propellers

Watertight doors

Electric lighting, single or double wire system. Voltage of Searchlights.

Safety was one of their major objectives as well. We must take into account the involvement of Wierdsma and the Holland-Amerika-Lijn in this respect. Wierdsma contacted Hülsmeier after he got notice of the existence of an apparatus which might be able to prevent ship collisions.

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<sup>147</sup> These were some of the topics (based on the text of the minutes of meeting) which had been discussed during the Technical Nautical Meeting, at London, on June 8<sup>th</sup> and 9<sup>th</sup> 1905. Held at the DeKeyser's Royal Hotel, Victoria Embankment (Blackfriars) London. GAR HAL Directie, inv. nr. 1470

The mutual correspondences between the managers of the major Atlantic shipping companies, about the turn of the century, were often concerned with safety problems. Hence, that is why Wierdsma had invited Hülsmeier to demonstrate his apparatus in Rotterdam.

An account of the Telemobiloskop was recorded in the minutes of the Technical Nautical Meeting of 1904.

However, it is evident that Wierdsma gave a report on that subject during the second Nautical Meeting held in London, in the year 1905.<sup>148</sup>

Following the minutes:<sup>149</sup>

***The Telemobiloscope***

*A new trial at the Hook of Holland had been a failure. One of the Delegates reported also that the principle on which the apparatus is based has been proved to be an error, so that probably nothing more will be heard of it.*

We may assume that these few lines imply the termination of Hülsmeier's ambitions in the field of what became known as radar, although, Hülsmeier might not have been aware that these words had been spoken in London in June 1905.

We know now that he has failed with his elementary apparatus somewhere between the end of September 1904 or at least before June 1905.

As no further documents could be found on this subject, we have to rely on the available secondary sources.

Let us again consider the German newspaper article dated 29 December 1956.

*Hülsmeier erinnert sich noch genau an jenen Herbsttag des Jahres 1904.....*

He remembered clearly the day in Autumn of the year 1904. Consequently, there is a very reasonable probability that Hülsmeier's second trial at Hook of Holland did take place in the Autumn of that year.

The second curious fact is:

*Delfter Studenten halfen beim Aufbau des "Fernbewegungssehers" ..*

Translated:

Students of Delft assisted with the installation of the Telemobiloskop.

As we have seen, Hülsmeier had been invited to arrive on the 7<sup>th</sup> of June and that no provisions for any assistance had been made. Nobody knew what to expect from him. Why should they

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<sup>148</sup> Wierdsma was forced to be the chairman again during the Nautical Meeting of 1905, because the British hosts were not prepared to do so.

<sup>149</sup> Minutes of meeting, page 19. GAR HAL Directie inv. nr. 1470

have engaged Delft Students for this vague occurrence?<sup>150</sup> In my opinion, is it not very likely that these students became involved at that time as he only used a relatively small apparatus. Nevertheless, he had asked for some zinc plates and these had to be prepared for some section of his radar-like system.

However, in my opinion it is more likely that the students might have been involved during Hülsmeier's trials at Hook of Holland. A second indication might be that, as he was now known to some of the personnel of the HAL company someone might have brought in these boys, to assist Hülsmeier with the preparations of his larger apparatus in the Autumn 1904. In my opinion, this fits better with the circumstances of which we know for sure that is that Hülsmeier had been in the Hook of Holland and that his demonstrations had, ultimately, failed.

Anyhow, this option is only a presumption, but we have to judge all the circumstances and facts which we have been able to unravel after the hundred years that have since passed.

The last few lines of the minutes of the 1905 London meeting expressed some considerable amount of scepticism about Hülsmeier's invention albeit, it is not known who had said these denigrating words: - *the principle on which the apparatus is based has been proved to be an error, so that probably nothing more will be heard of it.* We may, however, think of some of the British attendees who, already in June 1904, had expressed their scepticism. It is not clear to me, if these minutes really reflect the course of what might have been discussed during this conference, considering the circumstances resulting in the trial at Hook of Holland proving to be unsuccessful.

Nevertheless one thing is important, that this person, whoever he was, has completely misjudged the implications for the future!

### **Why did Hülsmeier ultimately fail?**

If we examine Hülsmeier's wireless related patent applications, then we can conclude that he had made no provisions for selectivity. This, of course, was not too much of a problem in the early days of wireless technology. However, this proved to be a downside which soon became quite a major obstacle for improving the specifications of his apparatus. Why had he not simply added some provisions onto his patent applications in order to keep-up with the selectivity concerns?<sup>151</sup>

There were two very major (fundamental) obstacles. One was Ferdinand Braun's patent DE111578 from 14 October 1898 in which he introduced a primary tuned circuit which is inductively coupled with the secondary antenna circuitry. This principle enhanced the transfer

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<sup>150</sup> We have found the names of lectures (hoogleraren) and students over the period 1903-1905. But, I could not correlate these names to HAL board and staff members, as far as we found the names in the papers (GAR). This does not mean, that there could not have existed another connection (link).

<sup>151</sup> He sometimes vaguely explained that wave selection could be considered. See, for instance, DE177670, Kl.21a4/Gr.52, d.d. 25 January 1905. Die Abstimmung durch die Wellenlänge und deren Wirkungsweise war ...

of energy enormously.<sup>152</sup> Notwithstanding that Oliver Lodge had already claimed tuned circuits some month earlier, though Lodge did not claim the insertion of a transformer circuit, between the spark-gap and the antenna.<sup>153</sup>

The second severe obstacle was Marconi's famous patent 7777, which is also known as the Syntony patent. He had applied for it on 26 April 1900. It claimed:

***Improvements in Apparatus for Wireless Telegraphy***

Technically speaking, it had much in common with that of Ferdinand Braun which was claimed in 1898 except that, Marconi had added the tuning of the primary and secondary transformer circuits.

The early days of the wireless industries were quite cut throat! The Marconi company tried, by whatever means, to monopolize the world's wireless industry. They started with claiming everything related to the transfer of electromagnetic (EM) waves. Objections, which pointed out that Hertzian waves were not invented by him, he countered with the statement that, that his wireless system did not rely on Hertzian waves but were of a different nature!<sup>154</sup>

Marconi's business attitudes generated a lot of animosities worldwide. Marconi, for instance, manipulated the markets by not selling his systems to them, but only leasing out. Even the wireless operators were employed by the Marconi company.<sup>155</sup> These business policies allowed him to manipulate worldwide communications. Consequently, his wireless system should only communicate with Marconi's stations. They sabotaged, systematically, state owned and non Marconi communication systems.<sup>156</sup> Large files on this subject can be found, for instance, in the

<sup>152</sup> Patent-Anspruch (Claim). Schaltungsweise des mit einer Luftleitung verbundenen Gebers für Funkentelegraphie, gekennzeichnet durch einen Leydener Flaschen und eine Funkenstrecke enthaltener Schwingkreis, an den die die Wellen aussendende Luftleitung entweder unmittelbar oder unter Vermittlung eines Transformators angeschlossen ist, zum Zwecke, mittels dieser Anordnung grössere Energiemengen in Wirkung zu bringen. (Leydener Flasche = Leyden Jar = a capacitor) (Schwingkreis = a tuned circuit) (Funkenstrecke = a spark-gap)

<sup>153</sup> Such as, for instance, his German patent DE111618, Klasse 21a, date 23 January 1898

<sup>154</sup> According Sungook Hong [p.39] ..Somebody had coined and publicized the term "Marconi waves"and Marconi approved of it. In an interview with McClure's Magazine, Marconi remarked that his wave from the vertical antenna was not same as Hertz's wave. He emphasized that his wave could penetrate almost anything. No further comment is necessary to prove Marconi's arrogance and his scientific incompetency.

<sup>155</sup> Though, sleeping facilities, food and drinks and that like, had to be provided onboard ships without charge. [HAL archives, GAR]

<sup>156</sup> In a letter from Lloyds to the HAL dated 31<sup>st</sup> March 1904,...I understand that you inquired whether Lloyd's Signal Stations in the English Channel could accept wireless messages from vessels equipped with other than Marconi apparatus. I beg to confirm you, in reply, that under a agreement entered into between Lloyd's and the Marconi International Marine Communication Company, which exists until September 1915, Lloyd's is

HAL archives in Rotterdam.<sup>157</sup> Amongst these is a wide range of ministerial complaints on Marconi's wireless practices. After the ratification of a treaty at the international Conference in Berlin on 3 November 1906, Marconi was forced to change his business practices. From now on wireless should be handled by both state owned and commercial enterprises.<sup>158</sup>

In Germany the situation followed a different path. It is said, that the German Emperor Kaiser Wilhelm II was embarrassed that Marconi's system had refused to exchange messages with his own (Imperial) wireless station. He forced the German electrical industry to cooperate together and to establish a German equivalent of the Marconi company. Involved were the large industrial companies AEG<sup>159</sup> and Siemens & Halske.

The Telefunken leaflet on the next page, was issued on 20 January 1904.

Its content is briefly:-

After the merger on 15 June (1903) the systems: Slaby- Arco<sup>160</sup> and Braun - Siemens<sup>161</sup> have amalgamated . They have formed a new company named: Telefunken.

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*precluded from using any other apparatus than the Marconi apparatus at, or in connection with, Lloyd's Signal Stations* [GAR HAL directie inv.nr. 1239] [OAN ZM 1812c]

<sup>157</sup> GAR, Hall Directie V inv.nr. V 58 volumes 20-22, GAR Hall Directie V inv. nr. V4-2 + V5-1, GAR Hall Directie inv. nr.1516

<sup>158</sup> However, legal patent battles between Marconi, Telefunken and others continued for a long time to come. Sometimes, it looked if these had been settled, but again and again new conflicts aroused.

<sup>159</sup> AEG = Allgemeine Elektrizitätsgesellschaft. Its meaning is: General Electric Company. However, in those days it had nothing to do with that latter US company (GE). Emil Rathenau, the founder of AEG, had, however, quite strong business relation with US corporations. In the 1920s GE owned about 40% of the AEG's shares.

<sup>160</sup> Adolf (Adolphus ) Slaby, was born in Berlin on 18 April 1849, he died in Berlin on 6 April 1913. Georg Graf von Arco was born on 30 August 1869 in Grossgorschütz(?). He died on 7 May 1940 in Berlin. Graf von Arco was formerly Slaby's assistant.

<sup>161</sup> The British Siemens Brothers Company was, de facto, owned by Siemens & Halske in Berlin. This situation remained until the start of WW I.

Gesellschaft für drahtlose Telegraphie  
m. b. H.

**System „Telefunken“.**

BERLIN S.W., den 20. Januar 1904.  
LINDEN-STRASSE 3  
Industrie-Palast „Berlin“.

Seit der am 15. Juni v. J. erfolgten Fusion der früheren bekannten deutschen Einzelsysteme für drahtlose Telegraphie:

**SLABY-ARCO und BRAUN-SIEMENS**

zu unserem vereinigten neuen System:

**„TELEFUNKEN“**

ist es uns jetzt durch rastlose und erfolgreiche Arbeit in unseren Laboratorien und Versuchsstationen, sowie dank der erfolgreichen wissenschaftlichen Unterstützung seitens der uns nahestehenden deutschen Gelehrten Prof. Braun und Prof. Slaby gelungen, unsere technischen Leistungen ganz wesentlich zu vervollkommen. Unser jetziger Fortschritt ist von ähnlicher Bedeutung wie derjenige, welcher durch die Einführung der abgestimmten Schaltungsweisen im Jahre 1900 gegenüber den bis dahin üblichen nicht abgestimmten und minderwertigen Anordnungen erzielt wurde.

Diese Thatsache versetzt uns von heute ab in die angenehme Lage, bei allen unseren bisher installierten Stationen durch Einbringung bestimmter Abänderungen **entweder den Sicherheits-Coëfficient verdoppeln zu können, oder aber unter Beibehaltung des bisherigen die maximale Reichweite auf das zweifache zu bringen.**

**Nicht eine einzige Verbesserung, sondern eine durchgreifende Veränderung der Schaltungsweisen und Konstruktionen** fast sämtlicher Apparate hat diese Leistungserhöhung gezeitigt.

Die Grösse der überhaupt jetzt von uns erreichbaren Entfernungen hatten wir bisher festzustellen noch keine Gelegenheit. Durch die Vermehrung der Empfindlichkeit des Empfängers sowie durch die Möglichkeit, die Geberenergien auf das Vielfache steigern zu können, sind die Reichweiten in ihrer Grössenordnung erhöht.

Unser neuer Prospekt wird unsere neuen Methoden zur Darstellung bringen. Wir sind augenblicklich beschäftigt, die zahlreichen Verbesserungen zu Patenten in allen Kulturstaaten anzumelden, und müssen daher das Erscheinen desselben bis etwa zum Sommer dieses Jahres hinausschieben.

Unser bisheriges technisches Können hat dazu ausgereicht, uns trotz schärfster Konkurrenz in zahllosen Wettbewerben den Sieg zu verschaffen. Etwa 250 Stationen des Systems „Telefunken“ sind bereits heute im praktischen Betrieb. **Ohne Uebertreibung dürfen wir heute behaupten, dass wir mit unserm jetzigen wesentlich gesteigerten technischen Können alle Systeme der drahtlosen Telegraphie der Gegenwart weit überholt haben.**

Gesellschaft für drahtlose Telegraphie  
m. b. H.

Figure 21

Since we are successfully working in our laboratories and testing fields, with the scientific support of the famous German scientists Prof. Braun and Prof. Slaby, we have been able to improve, successfully, the technical achievements. Our achievements today may be compared with the improvements about 1900, when tuned circuits replaced the inferior un-tuned systems. (We will close here the text explanation).

The last sentence is, regarding the state of the art of Hülsmeier's wireless systems, of significance. Telefunken made the distinction between tuned and the inferior un-tuned circuits. In this respect, Hülsmeier's technologies represented the state of the art of the late 1890s!

He still used obsolete Righi type spark-gaps for transmissions in combination with un-tuned antenna circuits.<sup>162</sup> The only selectivity that he could count on was the one created by the

<sup>162</sup> Curious is, that it radiates in two spectra, one excites in the cm range, which is determined by the geometry of the centre gap dimensions, the second frequency band is dependent upon the geometry and the inductance

resonance of his antenna arrangements. This was also done by Hertz during his experiments between 1886-1888 in Karlsruhe. Hertz employed two dipole segments each of 13 cm length, which generated a half wave length of  $2 \times 13 = 26 \text{ cm} \Rightarrow \lambda = 52 \text{ cm}$ , however, some considered it was 60 cm (500 MHz).<sup>163</sup> But Hertz working range was supposed to be a few metres only, as all his experiments took place inside his laboratory and/or a lecture hall.

That Hülsmeyer must have been aware of these shortcomings can be seen in the drawings shown in figures 5. He clearly implemented small sized directional antenna arrangements to obtain directional bearings. But, this also created problems for his wireless techniques. Small antenna arrangements could be very elegant but how could spark energy be effectively transferred into an ultra high frequency antenna arrangement?

The fact is that antenna theory and technologies were not very well understood in those days.

Let us consider a half wave dipole, of which the physical length allows for a favourable resonance. The two leads of the secondary windings of a Ruhmkorff inductor are directly connected onto a spark-gap arrangement.<sup>164</sup>

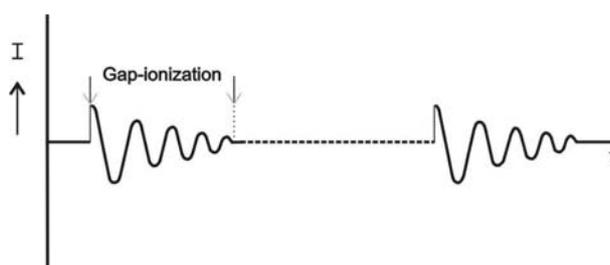


Figure 22

The process can be briefly explained as follows:-

When the inductor is building up its potential, which is loading (charging) the two dipole limbs, then, at a certain point, the spark-gap will become ionized.<sup>165</sup> In this state, the path between the spark-gaps may be regarded as a shorted circuit which will bridge the different potentials between the two dipole sections. Consequently, an equalisation current will start flowing. This current will create a magnetic field component which will be displaced into free space. This

of the outer antenna elements. Graetz considered the practical range of the so-called "Righi oscillator" (against a coherer device) about 100 metres (*..unter günstigen Umständen kaum 100 m übersteigen*)! [Graetz, p.636]

<sup>163</sup> Interesting is, that the great Man himself sometimes interpreted  $\frac{1}{2} \lambda$  being  $\lambda$ . This is, to some extent, understandable, as in both cases a field maximum does occur. It was Henri Poincaré who discovered this contradiction. [Comp. Rend. 111, 1891]. See also, [Fraunberger, p.575] and [Bryant, p.31]

<sup>164</sup> We neglect the influence of the Ruhmkorff inductor and its leads. Hertz and others sometimes used small chokes in both connecting leads.

<sup>165</sup> The static energy stored in the arrangement:  $E_{\text{ant}} = \frac{1}{2} C \cdot U^2$  joule. As C is often (VHF-UHF) very small (in the order of  $5-50 \cdot 10^{-12}$ ) it is obvious that, to create sufficient energy, one necessitates very high tensions!

results in a decreasing amount of available energy in the tuned circuit (e-function), which an antenna, in fact, represents. These damped currents (e-function) cause (unfortunately) considerable sidebands, with a rather broad spectrum.

In dry air, we consider that sparking occurs above 3 kV/mm. On old photos we see often spark-gaps of > 10 cm, which implies that they working at > 300 kV.

According to Mael's paper, Hülsmeier used (for his small apparatus) 5 cm spark-gaps and for his heavy installation 50 cm gap space!<sup>166</sup> Hence, he used either 150 kV or 1500 kV (1.5 million volts). The latter figure sounds to me most unlikely, because its insulations would have broken down instantly.

Ratcliffe proved that Marconi's relatively big transmitter at Poldhu with a 15 kW input, must have generated 36 MW pulses!<sup>167</sup> But, he had operated only in the kHz range.

It is obvious, that Hülsmeier, would have generated large spark-trains in his transmitter apparatus. As he had to bridge the distance twice, transmitter ⇒ reflector (obstacle) ⇒ Telemobiloskop receiver.<sup>168</sup>

We have seen previously, that Hülsmeier's objective was to separate transmitter and receiver system (adequately) from each other so that only reflected signals could reach the receiver apparatus. We have also learned, that the physical ratio between the mechanical size of a focussing arrangement and the maintained wave lengths must obey certain physical laws.

However, Hülsmeier's receiver utilized a coherer detector arrangement in conjunction with a wide-band-antenna-circuitry.

Consider the situation which would prevail in today's environment with a sensitive coherer connected to open circuitry, bearing in mind that the coherer was permanently in "switched-on" mode! Today's pollution of our radio spectrum would lead to unsurmountable difficulties!<sup>169</sup>

In my opinion, regarding Hülsmeier's patent drawing, he was not fully aware of the fact that it is most sensible to use equal sized and polarized antenna arrangements.

<sup>166</sup> K. Mael gave a lecture at the VDI Centre in Düsseldorf, on Radar History and its developments. Celebrating, that a hundred years ago Hülsmeier was born in 1881.

<sup>167</sup> J.A. Ratcliffe, Scientist's reaction to Marconi's transatlantic radio experiments. Proc. IEE, 121, p.1033, 1974. These signals were used for Marconi's first trans-Atlantic experiments on 12 December 1901.

<sup>168</sup> It is evident, that the reflection coefficient of the small or broad side (face) of a vessel can differ significantly. Here again, the physical size of an object in respect to the utilized wave length is an important parameter of a radar-like system. The radar equation incorporates also a fourth root term.

<sup>169</sup> Be it, GSM signals, TV and broadcast signals of all kinds, high-power grid lines, neon lights and/or that like.

But what could have happened in Autumn 1904 at Hook of Holland, when his trials ultimately failed?

There were several coastal wireless stations in existence not too far away from the site which he might have used for his experiments.<sup>170</sup>

These environmental conditions might have played a significant role in respect of Hülsmeier's wireless experiments near Hook of Holland. Hülsmeier should have been able to generate sufficient RF energies, such that his rather broad-band signals could very well have interfered with other wireless signals. He might well have been banned from the air, by legal measures. From about 1903/1904 onwards the national authorities started to generally licence wireless systems.<sup>171</sup> Particularly after the 1906 Berlin Conference, all systems onboard ships had to be built according the "State of the Art" requirements of those days.

Why did Mannheim ask for a 220 volt power source? Was it because Hülsmeier wanted to apply that, relatively high, voltage on to his Ruhmkorff inductor straight away? We don't know.

One possibility Hülsmeier could have considered, was a screened directional antenna arrangement, using a relatively lower frequency band. However, as we will see, this then (at Hook of Holland) was not the case.

Once again the picture becomes confused due to a number of conflicting reports.

In 1982, K. Mauel gave a lecture at the VDI Centre in Düsseldorf, on Radar History and its developments. Celebrating, the centenary of Hülsmeier's birth.<sup>172</sup>

After the usual introduction, he started to describe the apparatus that Hülsmeier (allegedly) had used for his Rotterdam demonstrations. In my opinion, it is doubtful where all these detailed figures came from, e.g. as we have encountered in his reference on the 50 cm gap space.<sup>173</sup> Anyhow, Mauel also noted that Hülsmeier had used a special antenna arrangement, consisting of a 30 m long wire, bent zigzag between two insulated planes, which were mounted inside a cylinder of 3 m long.<sup>174</sup>

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<sup>170</sup> Mainly, the coastal stations at: Hook of Holland and the lightship Maas and Scheveningen-Haven. The latter changed its name in the 1910s in Radio Scheveningen. Call-sign PCH... Koomans [Gedenkboek N.V.V.R. 1916 Maart 1926, p. 221-227]

<sup>171</sup> Telegraaf en Telefoonwet of 1904.

<sup>172</sup> Veranstaltung des Vereins Deutscher Ingenieure (Organization of German Engineers), 19 January 1982. VDI Haus Düsseldorf, K. Mauel.

<sup>173</sup> Which should have delivered, consequently, 1.5 million volt sparks!

<sup>174</sup> ...die Länge der Sendeantenne war etwa 30 m und sie war in Zickzack-Anordnung in einem zylindrischen Körper von 3 m Länge untergebracht. ..

In figure 23 we can clearly see what the construction of Hülsmeyer's directional antenna should look like.<sup>175</sup> However, I doubt that it ever could have provided sufficiently directional EM waves. Hülsmeyer considered that the signal phase between the wire and the cylindrical housing must be correct. But when we think of the EM field components of the zigzag wire in respect to the cylindrical counterpoise it is my opinion that this arrangement couldn't have worked at all (to say with some efficiency). It is interesting to note that he mentioned in his specifications: - that Blochmann had used very short waves in combination with a dielectric-lens (refraction). That due to this, only short ranges could be covered.<sup>176</sup> It is clear that Hülsmeyer was aware of the difficulties to be encountered when very short waves had to be considered.

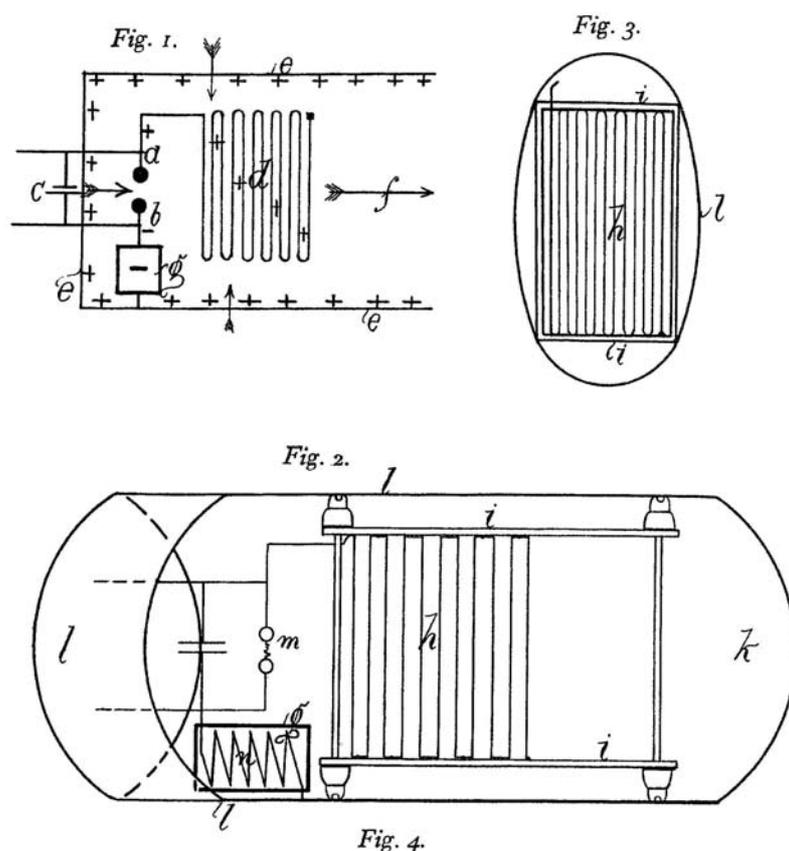


Figure 23

More significantly, it is my opinion that Hülsmeyer could hardly have used such an antenna construction around Rotterdam, as the patent was applied for on 2 August 1905. That is to say, one year after the alleged Rotterdam event took place!

<sup>175</sup> DE193804, Kl. 21a, Gr 67, applied for on 2 August 1905. Einrichtung für Richtungstelegraphie (directional telegraphy).

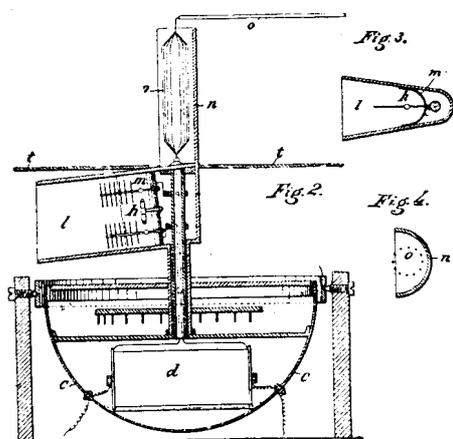
<sup>176</sup> DE193804, (lines 23-34 p.1). Bei der bekannten Einrichtung von Blochmann wird eine Funkenstrecke von einem Metallkasten isoliert eingeschlossen, der an einer Seite eine Linse aus brechendem Material trägt. Da Blochmann nur kurze Wellen anwendete, um eine exakte Brechung zu erhalten, konnten nur kurze Entfernungen überbrückt werden. Senderdrähte wurden nicht angewandt. Weiter trat die Erscheinung auf, daß sich die Wellen durch Interferenz vernichten.

## SCIENCE AND

which the distance of the reflecting object is known.

The apparatus represented in Fig. 2 is shown installed on the foredeck of the vessel *A* in Fig. 1. The electrical waves issuing from the sender *r* strike the vessel *B*, and, after being reflected, strike the antennæ *o* by which the receiver at the observer's station is operated.

Tests conducted under auspices of the Government of the Netherlands in the



DETAILS OF TELEMobiloscope.

Harbor of Rotterdam, have given proofs of the efficiency of the invention. An accurate reflection was insured up to a distance of nearly two miles, with sending apparatus including four condensers of .00188 microfarad, the outer armatures of which were connected. The antennæ were a little over 16 feet long, suspended from a bamboo rod. By combining the receiving antennæ with the reeling, the inventor hopes to extend the range to nearly twenty miles.

The apparatus is also to be tested by the French and Italian Governments.

*Rotterdam, had given proofs of the efficiency of the invention, sound, in respect to the Dutch Government, somewhat exaggerated.*

Not quite clear is, ... *with sending apparatus including four condensers of .00188 microfarad, the outer armatures of which were connected.* Why did he utilize four capacitors? Two could

Another confusing description had been published in an American technical magazine, of which we only have one column copy at hand. Its header suggests that it must be: - Science and ? Luckily Hülsmeier's granddaughter separated this piece from its paper carrier and we discovered that at its back page was headed "World Magazine". Hülsmeier's daughter Annelise thought that the title therefore must have been "Science and World Magazine". However, such a title was not existent around 1904/1905. Never mind, Tom Going found out that the content of the text almost certainly originated from the US as it used the word harbor instead of harbour (as used in England). We are following up on this subject at present. We might have found the source, but it cannot be traced in British or continental libraries. The Library of Congress catalogued data on the publication Technical world Magazine. This magazine had been published in Chicago and, its front cover was found on internet. This would seem to fit very well together with the handwritten letter we have found, which Hülsmeier had received from his friend Carl Sauer, who lived in Chicago. He must have been a good supporter of Hülsmeier, as he wrote: - that I shall initiate a publicity campaign, in your interest.<sup>177</sup>

## Figure 24

We may presume that figure 1 and 2 are equal to that which had been used in Hülsmeier's 30 April 1904 specification.<sup>178</sup>

The phrase: *Tests conducted under auspices of the Government of the Netherlands in the harbor of*

<sup>177</sup> Jedenfalls werde ich nicht verhehlen die Reklame-Trommel in Ihrem Interesse gehörig zu rühren. [HAD] [OAN ZM 1812a]

<sup>178</sup> DE165546 and its equivalent British GB13170/1904 date 10 June 1904. Notice, that the latter was filed just one day after his Rotterdam demonstrations. However, it is likely that he had sent his papers to his patent attorney Charles Bauer in London, some time (days?) earlier.

have done the job or, equally, by connecting the secondary (two) connectors of the Ruhmkorff inductor with each side of the spark gap. What he might well have considered was to install two capacitors of 940 pf in series with each side (limb) of the spark-antenna arrangement.<sup>179</sup> The circuitry will than be similar to the one shown in figure 3 ( $A^{11} - A^{12}$ ).<sup>180</sup>

The text continues: *The antennae were a little over 16 feet long, suspended from a bamboo rod.* Did he really utilize 16 feet long wires? This would consequently mean, that a natural resonance can occur at estimated  $\lambda = 4,87$  m (or 5.11 m, when considering the velocity decrease in a copper wire of about 5 percent), which is equal to 61.6 (58.7) MHz.<sup>181</sup> This sounds quite realistic. However, how these wire arrangements could have been shielded off from each other effectively, considering the vessel's environment, is not yet clear to me.

Then the text continues: *By combining the receiving antennae with te reeling, the inventor hopes to extend the range to nearly twenty miles.* In my opinion, this make no sense, as the reeling (UK railing) will be, most likely, pick-up energy scattered from the transmitter aerial on to the metallic parts of the ship structure, such as masts, decks and the like. In addition, there would also be signals from regular wireless communications. He would thus be interfering heavily with his own radar like signals!

We may, however, consider that this data originated from Hülsmeier's friend Claus Sauer, who lived in Chicago, and who might have been a laymen in this field.<sup>182</sup>

However, we have found, just recently, a German contemporary reference on Hülsmeier's experiments which, presumably, took place near Hook of Holland.<sup>183</sup> It mentioned the "allegedly" used cylindrical antenna arrangement shown in figure 23, which was mentioned by K. Mauel in his 1982 speech in Düsseldorf as well. However, these details does not always fit with those we have discussed before such as, for instance, the employment of a 65 volts battery.<sup>184</sup> In this article the transmitting antenna was mounted inside the cylinder and, the

<sup>179</sup> .00188  $\mu$ f is equal to 1880 pf (pf =  $10^{-12}$  Farad). Two capacitors in series give 940 pf. If these capacitors are of equal electrical value, than the working voltage shall double.

<sup>180</sup> Hülsmeier consequently neglected, in his principle circuit drawings, a capacitor across the interrupter-contact whose purpose is to tune the primary windings (section) of the Ruhmkorff inductor. Its capacitance value is mostly between 0.1 and 1  $\mu$ f.

<sup>181</sup> Of course,  $n \times 4,87$  m has to be considered as well. Whereby n can be  $\frac{1}{4}$ ,  $\frac{1}{2}$ , 1, 2 ... .We also have neglected the length between the antenna wire and the spark-gap arrangement.

<sup>182</sup> *Who wrote: -Jedenfalls werde ich nicht verhehlen die Reklame-Trommel in Ihrem Interesse gehörig zu rühren.* [HAD] [OAN ZM 1812a]

<sup>183</sup> Witt Otto N., in the periodical: Prometeus, Jahrgang XVI, 1905, No 825, p. 705 - 709. [OAN ZM 1812c]

<sup>184</sup> Whereas, Mannheim had asked for a 20 volts battery and, Wierdsma who mentioned in a letter of 22 September 1904 "As you may already know, the Columbus is provided with an electrical capacity of 40 volts at 40 amps". And, on 16 September Mannheim applied for provisions of 220 volts.

receiver used a antenna system consisting of a 5 metre long wire mounted between bamboo rods. These details match, to some extent, with those of the Technical World Magazine article, shown in figure 24. It is evident, that many authors have based their knowledge (relied to some extent) on the Prometheus article of 1905.

Two major circumstances might have significance, and have to be discussed.  
Firstly:-

*...Der Abschluss der Versuche findet in Kürze statt, da bei den letzten Versuchen sich Erscheinungen herausstellten, denen nunmehr durch stossfreie Aufhängung des Empfängers u.s.w. Rechnung getragen wurde....*

Briefly, the final test has been planned for the near future. However, it seemed that Hülsmeier had encountered problems with his coherer detector. He thought that this was due to (ship?) vibrations and that it required an improved coherer suspension (mounting).

Secondly, we read some lines lower in the text:-

*...Was die Entfernung bezw. Reichweite anbetrifft, so gelangen die Versuche auf 3 km Entfernung mit einem kleinen an Bambusrohr angeordneten Antennensystem sehr gut. Bei Vereinigung der Aufhängdrähte mit der Takelage hofft der Erfinder die Reichweite bis nach Bedarf auf 10 km ausdehnen zu können....*

Briefly, the “bamboo antenna(e)” worked well at a 3 km range. To increase the range up to 10 km, he suggested to mount the antenna(e) in the ship-tackles (*Takelage*).

This latter suggestion, certainly confirmed that Hülsmeier had no realistic understanding of the signal scattering implications.<sup>185</sup>

### **What was Hülsmeier doing in the meantime?**

It is little wonder that Hülsmeier and his business partner wanted to involve the newly established Telefunken company.<sup>186 187</sup> In my opinion, I don't think they considered this step in the early stages of the Telemobiloskop company but, they decided to give it a try after they had failed to commercialize their Telemobiloskop apparatus (about late 1904). Of course, it

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<sup>185</sup> We have noticed previously Hülsmeier's suggestion, in the Technical World article, to employ the ship's-railing as a receiving antenna, which was a similar (unrealistic) line of thought.

<sup>186</sup> GESELLSCHAFT FÜR DRAHTLOSE TELEGRAPHIE m.b.H

<sup>187</sup> As we have seen, their mutual agreement with banker Z.H. Gumpel of Hannover must have been made redundant, after Hülsmeier failed at Hook of Holland, in Autumn 1904.



Dear Sir,

Please find enclosed the patent specifications you kindly offered us short time (some time ago, AOB) ago for A System of Reporting Distance Metallic Objects to an Observer and the addition to Patent No 32910 VIII/74d by Christian Hülsmeier of Düsseldorf.

We return these with our best thanks as we have no use for the above discovery (invention, AOB)....

On the lefthand side the initials Li/Dr.N. are curious. Dr. N could stand for Dr. Nesper, who later became one of Germany's well known radio pioneers.<sup>190</sup> However, he did not sign this letter himself, presumably a secretary did so on his behalf.<sup>191</sup>

To some extent it is understandable that Telefunken did not respond positively. We have seen, from Telefunken's introduction leaflet (figure 21), that this recently established company had so many commitments in the field of wireless, that Hülsmeier's invention might have been outside of their business targets.<sup>192</sup> On the other hand, it is possible that the Telefunken representatives, given the task of judging the Telemobiloskop subject, didn't grasp the implications of Hülsmeier's basic principles.

According to Annelise Hülsmeier's daughter, they also approached Felten & Guilleaume and other companies but, without any positive results.<sup>193 194</sup>

Hülsmeier's ambitions, to commercialize his radar like inventions, must have come to an end on 11 October 1905. On this day he, certainly disillusioned, went to the Royal Court of

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<sup>190</sup> Eugen Heinrich Josef Nesper was born on 25 July 1879 in Meiningen, and he died on 3 May 1961 in Berlin.

<sup>191</sup> Curiously is, that in such case they would mention: Im Auftrage (i.A.). In a post war interview Nesper admitted that Dr. N. was his company designation.

<sup>192</sup> In contrast, in later years Telefunken took nearly every opportunity to obtain, in such cases, the legal patent rights world wide. Even if the intellectual authors were not engaged with the Telefunken company at all.

<sup>193</sup> Pritchard p.24-25

<sup>194</sup> Just recently we received a copy (from the Royal Netherlands Navy, Institute for Naval History, Ministry of Defence in the Hague) of the German periodical "Hansa, Deutscher nautische Zeitschrift" of 26 August 1905 (Jahrgang 42, p. 409) [OAN ZM 1218c]. In which they wrote:- *Mit dem auf Seite 269 besprochenen Telemobiloskop, des Apparates mit der Eigenschaft, das Herannahen entfernter metallischer Gegenstände (Schiffe) zu signalisieren, haben an der Hook von Holland Versuche stattgefunden. Das Ergebnis war, wie auf der in Juni d.J. in London abgehaltenen Konferenz technischer Vertreter großer Dampferlinien mitgeteilt wurde, ein Fehlschlag....* It is clear, that this information was based upon the minutes of meeting of the June 1905 conference, in London. We may consider, that this have been the opinion of the German trans-Atlantic shipping companies, since!

Cologne to erase the name of the Telemobiloskop-Gesellschaft Hülsmeier & Mannheim, from the business register.<sup>195</sup>

We have not found any information on what other work Hülsmeier had been engaged on between April 1904 and October 1905 apart from his Telemobiloskop commitments.

We also don't know from where he may have derived his income (maybe the 2000 marks he received from Mannheim?). However, during one of my early patent searches some years ago, I noted that Hülsmeier had applied for a non wireless related patent on 2 August 1904. It concerned a method and machinery to reduce the diameter of metallic tubes or massive rods and may well have provided some finance.<sup>196</sup>

Why he did so, during his engagement with his Telemobiloskop -Gesellschaft, is not known to me, but it definitely reflects Hülsmeier's later successful technical commitments.

### **Some aspects of the Rotterdam HAL company.**

Before entering the final conclusions, we have to evaluate some of the backgrounds as to why the HAL company in Rotterdam had been interested in Hülsmeier's ship colliding prevention apparatus (system).

Let us follow the explanation outlined in the following article (see next page).

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<sup>195</sup> Königliches Amtsgericht III/2, HR Amts 3706/6 ... *Die Gesellschaft ist aufgelöst. Die Firma ist erloschen.*

Hülsmeier went alone without his business partner Heinrich Mannheim, who must have been very disillusioned as well.

<sup>196</sup> Verfahren und Vorrichtung, um Rohre oder Vollkörper durch absatzweises Ausstrecken vom größten nach kleinsten Durchmesser hin konisch zu ziehen oder zu walzen. Applied on 2 August 1904, and was granted DE180009 Kl. 7b, Gr. 18 on 3 January 1907.

### SAFETY SIGNALS AT SEA.

#### Ships to Be Apprised of Approach of Other Vessels Ten Miles Off.

The submarine signal system invented by Professor Gray and Arthur J. Mundy to reduce to a minimum the danger of collision at sea has just been subjected to a service test of marked rigorousness and demonstrated its efficiency. By means of this system the master of a vessel, standing at the wheel, can have instant knowledge of the approach of another ship even when from six to ten miles separate the two, and will know when he is near perilous shoals or reefs long before any whistling or bell buoy could send warning through a heavy fog.

The Gray-Mundy apparatus looks much like an ordinary house telephone, without the transmitter. It was hung in the pilot house of the James S. Whitney, within easy reach of the pilot. The connection between the sending and receiving stations is wireless under the water, the sea itself constituting the transmitting medium. In sending signals a bell is sunk fifteen feet, and the wires of the receiving station run to an equal depth beneath the hull.

The receiving instrument picks up the vibrations when the sunken bell is tolled. All the experts on the steamboat were astonished at the simplicity of the device. They realized, though, the secret of the invention lay in the chemicals used in the receiver. Professor Gray and his associates would not divulge the nature of the agents they employed, but admitted carbon played an important part in the composition.

Figure 26

This principle can be quite simply explained. A bell which, on demand, can be submerged sends out a sonic (acoustical) signal into all directions. Such bell signals can travel easily over ten miles, and it can be picked-up by means of a directional acoustical listening apparatus.<sup>197</sup> The text needs no further explanation, as it is self explanatory.

Incidentally, the first scientific sonar research was undertaken in Switzerland in 1826, by Colladon and Sturm in the Lake of Geneva. Using an underwater bell, they observed how sound travelled, over a distance of 14 km, and computed a velocity of 1435 m/s.

In 1902 Gray and Mundy designed, in the US, the first water tight underwater microphones (or hydrophones as these are called) which proved to be a revolutionary improvement. Initially, this was registered as US patent 162600, owned by the Submarine Signal Company, of Boston.

The German company: "Norddeutsche Maschinen- und Armaturenfabrik" of Bremen, obtained a licence<sup>198</sup>, in 1905, to use the US patents and sold their products in Germany, Holland, Belgium (France?) and Russia. Later on, the market was extended to the Austro-Hungarian Monarchy and also to the Scandinavian countries.<sup>199</sup>

The Norddeutsche Maschinen- und Armaturen-Fabrik GmbH of Bremen became very active in this field of underwater signalling. Already in 1905, they signed agreements with the HAL company to lease out underwater signal installations made by the Submarine Signal Co.

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<sup>197</sup> GAR, HAL directiearchief inv.nr. 1239

<sup>198</sup> Konsessionäre der Submarine Signal Co, Boston U.S.A. [GAR, HAL Directiearchief inv.nr.0289. Also in: Technisches Ueberall, Beiblatt zu "Ueberall" Illustrierte Zeitschrift für Armee u. Marine. [GAR] [OAN ZM 1812c]

<sup>199</sup> Paper given at Bournemouth University at the CHiDE Sonar Colloquium in September 1996. Title: Some hardly known aspects of the GHG, the U-boat's group listening apparatus. [Bauer, p.1] This company became later well known as the Atlas Werke of Bremen.

We have selected, for illustration, the contract concerning the installation onboard of the Potsdam ocean liner, which is visible in the background of figure 16.

It bore the designation contract number 25 and was signed on 13 January 1907. It is interesting to notice that its annual lease cost 3360 marks.<sup>200</sup>

They equipped all their vessels with underwater signal systems, until the HAL company, finally, cancelled all such leasing contracts, on 18 December 1934.<sup>201</sup> However, the smaller (cargo) vessels were only equipped with listening facilities, whereas the passenger-liners had been equipped with a bell sound source and a listening device as well.<sup>202</sup>

Let us consider briefly, the principle points from 1900s onwards for both, Hülsmeier's and Gray & Mundy's ship collision prevention techniques.

Both used a signal source, one being of EM nature and the other utilized sonic waves. Hülsmeier relied on the phenomenon of reflection at electrically conducting mediums (such as on metallic objects).

Whereas, Gray and Mundy, presumably not aware of the reflection aspects, relied on a system which had something in common with wireless communication having a separate transmitter and receiver system for the emission and reception of sound waves.

The basic strategy was to equip particular lightships with a bell sound transmitter. Similarly, like lighthouse-beacons, which used (and still do) slow on and off recognition sequences, the bell sound had to be modulated in a recognisable manner as well.<sup>203</sup>

When visibility decreased to a certain level, the bell had to be submerged and activated. On board vessels, they had to employ their listening facilities as to listen for, and take bearings on, these sonic beacon signals. According to some publications, about 1904-1907, it was possible to take accurate bearings of about 1 - 1.5 degrees. However, position could only be determined when one was able to take cross bearings. Which, for instance, had been done near the port of Cherbourg at the most northerly point on peninsula of Normandy.<sup>204</sup>

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<sup>200</sup> Mietvertrag 25, Die Norddeutsche Maschinen- und Armaturen Fabrik G.m.b.H. installiert fertig zum Gebrauch und in tadelloser Ordnung an Bord des D. Potsdam von 12500 brutto Tonnen ... The contact had been signed by Wierdsma himself on behalf of the Holland-Amerika Linie.

<sup>201</sup> Handwritten notice on the file. GAR HAL directiearchief inv.nr. 0418

<sup>202</sup> The transmitter may be considered to be an active system, whereas the receiver being a passive system.

<sup>203</sup> *each bell give out a different number of strokes in a certain time..* cited from a letter of the Norddeutsche Lloyd of 9 September 1905. [GAR, HAL Directie V inv.nr. V4-2]

<sup>204</sup> GAR, HAL Directiearchief, various files.

The German shipping company Norddeutscher Lloyd wrote on 9 September, in a letter addressed to:<sup>205</sup>

*the Trinity House  
London*

*Sirs,*

*Re:Submarine Signalling Apparatus.*

*For some time past we have paying considerable attention to a system of Submarine Signalling invented and constructed by a Boston Company.*

*We thoroughly investigated all about it and then fitted one of our fast steamers with a receiving apparatus thro' which our officers and others have been able to exactly locate a submarine bell..... Practically speaking we have decided to place hearing apparatuses on board of all of our steamers going to the United States of North America but of course this will more or less depend on the steps the British Lighthouse Board will take with regards to adopting the system.*

*We understand however that trials with the system have also been made by your goodselves and that the results have been to your entire satisfactions. ....*

*The lightships regularly sighted by our steamers are the following:*

*North Goodwin  
East Goodwin  
Varne  
Royal Sovereign Shoals  
Owers and Nab  
Shambles*

*We should therefore feel obliged if you would kindly use your influence.....*

*Signed by Norddeutscher Lloyd*

Trinity House replied with a letter refusing to implement the Submarine Signal Bells for nautical safety, on 5 April 1906, the HAL received the following text:

*Trinity House, London, E.C.*

*Sir,*

*With reference to your communication of 13 September 1905, suggesting the establishment of Submarine Signal Bells at certain Light Stations in this Country, and to reply thereto, of 23<sup>rd</sup> September 1905, I am now directed to inform you that the view of the fact, that a Conference held at the Board of Trade, the Representatives of the Shipping Interests of this Country discouraged the adoption of this form of Fog Signal, the Board are not proposing at present to establish Submarine Signal Bells at any Light Station under their jurisdiction.<sup>206</sup>*

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<sup>205</sup> There must also have been a HAL letter on this subject, dated 13 September sent from the HAL company.

<sup>206</sup> The Secretary, Trinity House, Tower Hill, London E.C. Number B.3933/1905. [GAR, HAL Directie V inv.nr. V5-1]

This negative British standpoint, regarding the implementation of acoustic safety apparatus might to some extent, also have been affected by Marconi's business attitudes and influence. As Marconi might have felt that acoustic signalling could infringe its British wireless signal monopoly.<sup>207</sup>

## Conclusions

As an introduction to my survey on Christian Hülsmeier and the Early Days of Radar, we have followed very briefly the course of history, from Maxwell's essential equations to its proof of validity, by Heinrich Hertz, between about 1884 and 1888. Then on to Branly's coherer, and Marconi's black box from 1895, as the origin of wireless radio communications.

In the early years of Hülsmeier's life we noted that he was particularly interested in Hertzian wave technologies and in electrics.

From March 1902 onwards, we encounter a clever young man who had confidence in his own capabilities and who had just applied for his first patent on a Telephonogram apparatus, on 20 March 1902 in Berlin.

We also have discussed the contradictions between the (aural) histories, in respect to his occupations and commitments. It is questionable whether he arrived in Düsseldorf with only two marks in his pockets, after he had just applied (not yet three weeks before) for a patent in Berlin. It has to be said that most of these early stories are a bit fuzzy. It has been repeatedly told that Hülsmeier, just when he arrived in Düsseldorf, had to place an announcement in a local paper calling for a financial partner who would be willing to support his future Telemobiloskop projects. We have made it clear, that it is not very likely that this had been effected before, at least, the end of 1903 when he applied for his first Telemobiloskop patent (which was rejected soon thereafter).<sup>208</sup> Luckily, we found recently a copy of the "notary agreement" of 12 August 1904, from which we derive that Heinrich Mannheim, his future business associate, engaged in the Telemobiloskop project on 15 March 1904. The second legal document found is, the registration in the business register at the Royal Court of Cologne on 7 July 1904.<sup>209 210</sup>

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<sup>207</sup> The author's opinion is: That "being not invented here", may have played a considerable role as well.

<sup>208</sup> Application number H 31800 date 21 November 1903

<sup>209</sup> Geschäftsnummer III2/R A 3709/1, date 7 July 1904. Über die Rechtsverhältnisse der Handelsgesellschaft ist folgendes eingetragen worden: ...Die Gesellschaft hat vom(am?) 5 Mai 1904 begonnen.

<sup>210</sup> Which details do not fit entirely which the details mentioned in the 12 August agreement in Hannover.

We have also seen that, it was likewise not realised that before Hülsmeier successfully applied for his famous radar-like patent on 30 April 1904<sup>211</sup>, he had already filed a patent in the US on “Wireless transmitting and receiving mechanism for electric waves”.<sup>212</sup> We have learned that it had nothing in common with his radar-like basic patent, as it was concerned to protect wireless remote-controlled systems from interference. We have also seen that its circuitry had been ascribed to Hülsmeier’s radar receiver.

Furthermore we also have learned how, and why, Wierdsma the CEO of the Holland-Amerika-Lijn (HAL), had contacted Hülsmeier and his business partner Mannheim about 20/21th of May 1904. Wierdsma had got to know about Hülsmeier’s demonstration on 17 May, in Cologne.

In addition we have followed the correspondence between Wierdsma (on behalf of the HAL company) and Hülsmeier’s business associate Heinrich Mannheim leading, eventually, to demonstrate his Telemobiloskop apparatus to an audience of international technical-nautical experts on the afternoon of 9 June 1904 on board the ships-tender Columbus. However, we have also learned that Hülsmeier’s experimental (small) apparatus had, surprisingly, very little in common with the specifications put down in his famous patent claims.

These claims could possibly be described as the worlds first comprehensive fundamental principles of what became known as RADAR. If we consider both Hülsmeier’s first and second patent applications on measuring the distance between his Telemobiloskop apparatus and a target, then it, it could be said to cover nearly all requirements of modern radar.

i.e.

basic principle of reflections of EM waves on conducting objects, in combination with split RX-TX

360 degrees, synchronous, area coverage for targets around the system, this technology became several decades later known as PPI

Measuring the distance of a target

Platform stabilisation for his system

Implementing the idea of a kind of system isolation from hostile environments, without limiting the abilities of his system (one would call this today a kind of radome)

Following the text in both patent applications, one has to come to the conclusion that, Hülsmeier was very well aware of the impact and implications of his inventions. As we have seen, for instance, in the last sentence of the Telegraaf article (figure 18) of 11 June 1904

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<sup>211</sup> DE165546, Verfahren, um entfernte metallische Gegenstände mittels elektrischer Wellen einem Beobachter zu melden.

<sup>212</sup> US810150 filed on 14 March 1904, granted on 16 January 1906.

(evening edition): - Because above and under water metal objects reflect waves, this invention might have significance for future warfare.

There is hardly any doubt, that this aspect had been mentioned, or even discussed, during Hülsmeier's afternoon demonstrations of 9 June. We may presume, that it was Hülsmeier himself who had engendered this visionary thought.<sup>213</sup>

We have also looked at the circumstances which led Hülsmeier, ultimately, to fail with his system concept.

Nevertheless, Hülsmeier was a very clever technician, though he was definitely not a scientist. His wireless technology has to be considered as odd and out dated after about 1900.

Furthermore, two fundamental patents had been filed, one in the name of Ferdinand Braun<sup>214</sup> and the second one, about two years later, on behalf of Guglielmo Marconi.<sup>215</sup> These basic patents were, for both companies<sup>216</sup>, of very great value as they were thus able to block all competitors in the fields of wireless technology.

Although it had not yet been the subject of this paper, we have to bear in mind that Marconi and Braun both received (shared) the Nobel Prize for Physics in 1909. Marconi was credited with the introduction of wireless communication technology in 1895, and Braun received the

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<sup>213</sup> It is most unlikely that the British attendees had come up with this reflection, as they had expressed their scepticism concerning Hülsmeier's invention and considering their comments at the London 1905 meeting. It previously was also mentioned in one of the Cologne newspapers of 18 May.

<sup>214</sup> DE111578 from 14 October 1898

<sup>215</sup> GB7777, filed on 26 April 1900

<sup>216</sup> Telefunken and Marconi

honour for enhancing its selectivity, in 1898.<sup>217</sup> It is regrettable that this latter facet has, so often, been ignored.

We have also noted that Hülsmeyer, according his patent specifications, had to consider very high frequencies (short wave lengths) and that it was very difficult to do this in a practical (realistic) manner.

We also know, that the available signal detectors were based on Branly type coherers and that these devices were rather insensitive, compared to modern equipment, as RF signal amplifiers were not, at that time, in existence.

Hülsmeyer was also forced to rely on broad-band circuits thus, it was rather likely that his receivers would respond on all sorts of wireless signals. We have already seen that Hülsmeyer had filed a patent on a system designed to prevent interference. But, we have proved that it is most unlikely that this technology had been incorporated in his Telemobiloskop apparatus as it de-blocked the receiver only in a very narrow specified time window. When, due to whatever reason, a false signal was received the entire system would be kept blocked for about 5 to 10 seconds. One doesn't even know if, in the meantime, the wanted signal (such as from a target) had arrived at the antenna!<sup>218</sup>

We have seen that Mannheim had sent a letter to the board of the HAL company to ask for their support for a second trial session. We know that Wierdsma responded very generously and that they were allowed to use one of their ships (vessels).

We also know that this trial, ultimately, proved to be a failure. Why and when these tests took place could not be discovered but, there is an indication that it might well have been in

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<sup>217</sup> ..... The development of a great invention seldom occurs through one individual man, and many forces have contributed to the remarkable results now achieved. Marconi's original system had its weak points. The electrical oscillations sent out from the transmitting station were relatively weak and consisted of wave-series following each other, of which the amplitude rapidly fell-so-called "damped oscillations". A result of this was that the waves had a very weak effect at the receiving station, with the further result that waves from various other transmitting stations readily interfered, thus acting disturbing at the receiving station. It is due above all to the inspired work of Professor Ferdinand Braun that this unsatisfactory state of affairs was overcome. Braun made a modification in the layout of the circuit for the despatch of electrical waves so that it was possible to produce intense waves with very little damping. It was only through this that the so-called "long-distance telegraphy" became possible, where the oscillations from the transmitting station, as a result of resonance, could exert the maximum possible effect upon the receiving station. The further advantage was obtained that in the main only waves of the frequency used by the transmitting station were effective at the receiving station. It is only through the introduction of these improvements that the magnificent results in the use of wireless telegraphy have been attained in recent times.... [a part of the motivations (speech) of the Nobel Committee, download from internet]

<sup>218</sup> US810150, 14 March 1904

Autumn 1904 as Hülsmeier stated in a newspaper interview, just some weeks before he died, that he remembered clearly the day in Autumn of the year 1904.<sup>219</sup>

We also have discussed the possibility that he might have been banned from transmitting, by Dutch officials, as he might have interfered with their wireless communications located in the neighbourhood due to the lack of his system selectivity.

He might also have interfered with his own system, as his increased transmitter power might well have resulted in swamping his receiver with spurious signals due to scattering signal phenomena at the ship's structure.

We have also noticed that Hülsmeier had tried to overcome this problem and that one of his proposals had been filed<sup>220</sup> two months before he erased his Telemobiloskop - Gesellschaft Hülsmeier & Mannheim from the business register at The Royal Court of Cologne on 5 October 1905 i.e. long after he was involved with his radar-like trials near Hook of Holland.

We have also recorded Telefunken's letter of rejection, from 21 August 1905, addressed to his business companion Heinrich Mannheim of Cologne. This rejection might have been caused by either, the lack of understanding of the significance of Hülsmeier's Telemobiloskop or, that this was beyond the objectives (business plan) of the just recently established Telefunken company.

We have also learned about aspects of safety concerns of the HAL and other companies. It was not Hülsmeier who took action, but it was the CEO Wierdsma of the Holland-Amerika Lijn who wanted to enhance the safety of their steam liners. After Hülsmeier's system had ultimately failed to be a safety asset, they became engaged with the sonic technology of the Submarine Signal System of Gray and Mundy of Boston of the US. The HAL company had used this acoustic technology onboard most of their steam ships right up to 1934 surprisingly, in Britain, they responded most reluctantly to this new promising technology. Although, to be fair in our survey has only considered the very early days of this technology.

Concluding after all we have learned in this Hülsmeier survey:

**We must, in my opinion, give credit to Hülsmeier for having specified the first basic elements of radar, as well as showing that its elementary principle could work.**

Nevertheless, the Germans, sometimes in the 1950s, regarded Hülsmeier's radar-like apparatus as the "Ur-Radar" type.<sup>221 222</sup> Even though it was Heinrich Hertz who used, during

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<sup>219</sup> *Hülsmeier erinnert sich noch genau an jenen Herbsttag des Jahres 1904.....* Recently a new article appeared, in which similarly was stated. [Rheinischer Kurier 11 DECEMBER 1948]

<sup>220</sup> DE193804, filed on 2 August 1905

<sup>221</sup> Ur = prehistoric, it consequently means, that it existed already a very long time ago.

<sup>222</sup> It is, in my opinion, significant to bear in mind that what Hülsmeier did in fields of radar-like technology, had nothing to do with "serendipity". In contrast to most of those famous names in radar history!

some of his scientific experiments in Karlsruhe (1886-1888), the phenomenon of EM wave reflection at conducting objects for the first time. But, the “grand man” never considered an application to patent his discoveries!

## Epilogue

We have come to the final section of this chapter. However, it is interesting to know how Hülsmeier continued with his career after the disaster of his commitments with electricity and wireless technologies. If he made any money out of his early patent commitments is very doubtful as, by the way, is the experience of most inventors! It is no different today to what it was in the past!

Let us briefly examine the outline of his career as had been explained in the school thesis of one of Hülsmeier’s granddaughters.<sup>223</sup>

In 1906, Hülsmeier successfully established, in Düsseldorf, an agency for machinery incandescent lamp production, and production tools for iron and steel. Although, the exact details are not quite clear, he had financial success with one of his 160 patents. We may consider that it had been related to patent DE180009.<sup>224</sup>

In January 1907 he established the company: Christian Hülsmeier, for boilers (cauldron) and system construction.<sup>225</sup>

About 1910, Hülsmeier bought a factory site in Düsseldorf-Flingern. He married Luise Petersen of Bremen<sup>226</sup> and, between 1911 and 1924 they produced six children.

The photograph<sup>227</sup> on the next page, was most likely taken between 1907 and 1910 (when he was between 26 and 29 years old). Obviously a man expressing considerable self confidence.

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<sup>223</sup> Of one of the sons of Hülsmeier. [HAD] [OAN ZM 1812]

<sup>224</sup> Verfahren und Vorrichtung, um Rohre oder Vollkörper durch absatzweises Ausstrecken vom größten nach kleinsten Durchmesser hin konisch zu ziehen oder zu walzen.

<sup>225</sup> *Gründung der Fa.: Christian Hülsmeier, D'dorf, Kessel- & Apparatebau & Eintragung i.Handelsregister.*

<sup>226</sup> 29 October 1910 [OAN ZM 1812d]

<sup>227</sup> [HAD]



Figure 27

His company was particularly active in the fields of steam and water apparatus and provided equipment for scaling prevention together with anti-rust-filters, high pressure gauges and water cleaners for heating systems.<sup>228</sup> His, so-called, “Rostex” filters were also successful money spinners!

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<sup>228</sup> *In seinem Betrieb stellte er Maschinen & Apparate nach eigenen Patenten her und zwar auf dem Gebiet von Dampf und Wasser. (Kesselsteinverhütungsapparate, Rostschutzfilter, Hochdruckarmaturen, Wasserreinigung, Heizungswesen.)*

His company flourished until 1953, with only minor interruptions due to the 1923 inflation catastrophe and the Second World War.

During World War One he was called for service, but due to his heart problems he was never actually called up to serve with the military. The heart problems were owing to rheumatism, resulting from his involvements in the cleaning of steam boilers.<sup>229</sup>

After the Nazis came in power, Hülsmeier was imprisoned for some time in 1934. His passport had been confiscated and was not returned before the war had finally come to its end, in 1945.

After the war his house in Düsseldorf was taken over (confiscated) by American special forces for about three years and was occupied by about thirty men. He had no alternative but to live in office rooms at his factory site.

In 1948, the historian Franz Maria Feldhaus of Wilhelmshaven discovered in his card index a reference of 1904 regarding a Telemobiloskop in the name of Hülsmeier. He concluded that Hülsmeier must be regarded as the first radar pioneer. He published an article in the newspaper "Rheinische Post" on 10 November 1948, which triggered an argument as to who had to be regarded "the father of early radar"?

An embarrassing correspondence concerned with who invented radar, between Hülsmeier's daughter Annelise and her husband Mr. Hecker, versus Churchill's decision to grant Watson-Watt a peerage and the response from the British Patent Office in Southampton, is well documented in David Pritchard's book *The Radar War*.<sup>230</sup> The Patent officer answered, in a letter to the Hülsmeier's family, that radar incorporated the measuring of distance, and that hence Hülsmeier's patent does not cover radar-like claims. As we have proved in this publication, this argument makes no sense, and that it is pure nonsense!

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<sup>229</sup> *Bei der Mobilmachung (1. Weltkrieg) wurde Hülsmeier zum Landsturm gemustert, mit jährlich. Nachmusterungen. Wegen seines Herzleidens, das er sich durch Rheuma bei Dampfkesselrevisionen zugezogen hatte, wurde er nie eingezogen.*

<sup>230</sup> Pritchard p.24-25 All letters are kept in [HAD], copies [OAN ZM 1812a]



Figure 28

During a radar conference held in Paul's Church (Pauls Kirche) in Frankfurt in 1953, Hülsmeyer and Watson-Watt were both honoured guests. And, Watson-Watt had ultimately to admit that he was not the exclusive father of radar. We have recently found a photo (see previous page) on which Watson-Watt is looking in Hülsmeyer's folder, the modest smile on Hülsmeyer's face gives the impression that this could have been one of his finest hours!<sup>231</sup>

#### Wierdsma

I don't think that we should close without saying a few words about Mr Wierdsma of the HAL company. I think that he was a very generous man, who was imbued with deep concerns over ship safety and, who gave Hülsmeyer an exceptional opportunity to introduce himself to, and to step into, a future market. At the same time he always bore in mind that his main concern was safety of ships and the passengers.

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<sup>231</sup> It is said, that Watson-Watt has by-passed, during that occasion, further discussions by stating: "I am the father of radar, whereas you are its grandfather".



Figure 29

Jan Volkert Wierdsma was the director<sup>232</sup> of the Holland-Amerika Lijn between 1880 and 15 May 1916. He was born in Oisterwijk on 5 February 1846, and he died on 5 April 1917 in Oosterbeek. His first occupation was an Officer in the Royal Netherlands Navy.<sup>233</sup>

In a newspaper obituary we encounter an active personality who represented, for instance, The Netherlands at a Ships Safety Conference in London and who was also engaged in numerous public functions and duties.<sup>234</sup>

### **For the acknowledgement and related subjects, please consider Radar II**

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<sup>232</sup> Later known as: President Directeur

<sup>233</sup> Graduated "Adelborst" (navel cadet) of the Royal Dutch Navy Academy, in Willemsoord. [GAR, Vollenhoven archief 85/73]

<sup>234</sup> GAR, Vollenhove archief 85/63. GAR micro fiche: Stamkaart archive on: Jan Folkert Wierdsma (the registration card (1880) used Folkert instead of Volkert)