Item No.1
CIOS file No. III-1

Philips Works at Eindhoven

Combined Intelligence Objectives Sub-Committee

Inspection of Philips Works at Eindhoven
September 23-26, 1944

Reported by:
Sir Robert Watson Watt, (Deputy Chairman, Radio Board).

CIOS Target Number 1/42.

Combined Intelligence Objectives Sub-Committee
G-2 Division, SHAEF (Rear) APO 413

Personnel of Inspection Team

Valves:	Dr. H.G. Stever	- O.S.R.D.
	Mr. Carleton Dyer	- M.A.P.
	Dr. D.B. Langmuir	- O.S.R.
	Dr. J. Thomson	- Admiralty
Radar:	Dr. W.B. Lewis	- M.A.P.
	Maj. C.B. Linstrand	- A.S.A.A.F.
	Lt. Cmdr.C.G. Mayer	- U.S.N.
	Cmdr. C.H.S. Murphy	- U.S.N.
Communications:	Maj. N.J. Ferguson	- Ministry of Supply
	Lt. H,W. Jones	- U.S.A.A.F.
	Maj. E.G. Goodhew	- War Office
Infra Red:	Dr. C.E. Waring	- O.S.R.D.
	Dr. A. Elliott	- Admiralty
	Maj. Knowles	- War Office
Forward Target Data:	Cmdr. W.H. Dickinson	- I.S.T.D.
	Mr. P. Brightwill	- M.E.W.
Metallurgy:	Dr. W.R. Bode	- Alsos
Components:	Dr. K.R. Spangenburg	- U.S. Signal Corps
	Mr. Carleton Dyer	- M.A.P.
Lamps:	Mr. Carleton Dyer	- M.A.P.
Air Technical Intelligence:	Flight Lieutenant Nutting	

Eindhoven field team
Report by the team leader

The Field Party, comprising the numbers listed left London on September 21st, reached Philips Works, Eindhoven at 0900 September 23rd, left Eindhoven 0930 September 26th and reached London 1600 September 27th (the Team Leader, leaving Eindhoven at the same time, reached London 1900 September 26th). One member of the party visited Philips Louvain on September 26th and rejoined the main party in Brussels.

The Party was organized into sections by techniques, the normal composition of sections is shown although the ground to be covered and the width of interest of each member necessitated great fluidity in the hour-to hour compositions.

The Philips personnel with whom discussions were held are listed in Appendix J which is roughly divided to interest and technique.

The reports of the separate sections, which are available for independent circulation in lieu of reports by individual members and are thus to some extent overlapping, are submitted as Under:

1. report of valve section
2. Report of Radar section
3. Report of Communication Section
4. Report of Infra Red
5. Radio Component Section

The general findings of the Field Party are summarized below.

Scale of use by Germans of Philips Eindhoven Works and Laboratory.

The Germans clearly did not entrust to Philips and secret project or even any element of a project large enough to be discernible as part of a secret. Thus they made substantially no use at all of the exceptionally fine laboratory organisation before mid-1942, and failed to get two percent of its potential usefulness after that date. In the production field the German policy, was equally, to entrust the routine and "hack" work on old established components and equipment to firms in the occupied territories, retaining work on confidential and secret equipment within the Reich itself. This is shown by the scale of broadcast receiver and normal valve making work put on Philips.

In particularly Philips was completely unused on infra-red, in which they were well advanced pre-war, and on radar, of which they still have not even a rudimentary knowledge.

Auto-sabotage in the German Organization

The German system of allocation and control was, as the Philips management said, the most effective sabotage agency known to them.

The proliferation of papers, the failure to devolve responsibilities, the refusal to exercise initiative, the appointment of technical incompetent supervisory and progressing officers, and the concentration of attention on clearing the documents rather than the materials, sufficed in themselves to impede production. Exploited by an expert and ingenious body of non-cooperators, this system lent itself to a double frustration.

The attempt on Hitler's life was followed by the first really vigorous efforts to squeeze more production and more development out of Philips. Only after the late date did production for German Government rise to and above 30% of the total Eindhoven production.

Production Details

The Field Party was provided with full details of production programmes for German agencies, and with a monthly production analysis, listed in Appendix II of this report.

Development Details

The laboratories were engaged on projects allotted to them in 1942, and reported on (effectively for the first time) in a document prepared in September 1944 but not handed to the Germans before they withdrew. The two key documents, together with other research and development notes handed to the Field party, are listed in Appendix III.

Elements of the German Organization

Undoubtedly the main harvest gathered by the Field Party was a mass of information about individuals in the German organization, about establishments and plants of importance to the German radio industry and about bottlenecks affecting the radio and other industries.

Appendix IV contains notes on (a) key person, and (b) German visitors to Einthoven, Appendix V on key factories, establishments, and depots.

German Relations with Japan

There was no evidence obtainable in Eindhoven of any intimate cooperation between Germany and Japan. They had had no Japanese visitors, and many of the German visitors spoke in most disparaging terms of the nationals of their remaining Axis partner.

Attitude of Philips Staff

The Field Party was wholly satisfied that the Philips Staff generally had been most stubborn and successfully non-collaborators, and that they did their utmost to give the Party all possible help and information; legitimate nervousness as to post-war application of some of the work originated in Philips dod not substantially restrict their freedom of speech. An assurance was given by the Team leader that the same efforts to safeguard legitime commercial rights would be applied to disclosures by Philips as to the interchange of information between U.S. and U.K. The Field Party desires to record its sense of the cordiality and cooperative spirit with which it was received.

6th October 1944 /s/ Robert Watson-Watt

Report by Valves Sub-Section on the Eindhoven Visit

1. Introduction.

The valve Sub-Section of the CIOS Team met with approximately fifteen Philips valve experts in both the production and research fields on September 23, 24, 25, 1944. It is clear from these conference that the Germans did not reveal interesting projects or results of their own in valve research and manufacture to Philips. A few isolated problems were presented to Philips research team, but the Germans never disclosed the intended military application of this research. Some information of value was obtained by Philips through indiscreet conversations of visiting German technicians.

The Germans assigned valve manufacturing of routine nature to Philips. Most products desired by Philips were the standard articles manufactured by Philips before the war.

The outstanding projects of interest were those on short wave oscillators, method of increasing the pulse emission from cathodes. In addition, a large number of miscellaneous facts, small isolation but worthwhile collective, make up to useful portion of the findings. Information obtained concerning personalities, priorities and organization of the German radio field should be of assistance of future field teams.

II. Detailed Information Obtained.

1. Oxide Cathodes for High Pulse Currents

Dr. H.C. Hamaker described work done on the project, which was first proposes in very general terms to Philips Co. by the Germans about one year ago. (September 1943) (maybe this originated from work done on getting the maximum energy out of the CV64 magnetron copy LMS 10, AOB). It was on the list of research problems undertaken by the company for the Germans at that time. No detailed requirements were provided until about six weeks ago (August 1944) when Dr. Busse and Professor Todt said that pulse on microsecond long at a rate of 10000/xec were desired. Cathode diameter was stated to be 2 mm, anode diameter 8 mm, and anode pulse voltage 24 KV. The Germans said they had obtained 20 amps/cm² from average Ba-Sr cathodes of their own manufacture, and 38 amps/cm² in some special cases. They wanted Philips to produce something better.

No sample valves or cathodes were provided, but the Germans said the cathode was desired for a diode, and that they used a copper anode (this might well have concerned a magnetron, AOB!). In samples to be provided by Philips a molybdenum or nickel anode would be satisfactory if smooth, but not aluminated iron. No mention was made of secondary emission, magnetic field, back bombardment, or any heating features of unconventional nature. With regard to secondary emission, Hamaker said the Germans appeared not to be interested in the subject.

Hamaker tried some experiments with barium azide coating. Measurements on ordinary coatings with pulses considerably longer than 1 microsecond and variable anode spacing showed the current to be limited, at high current densities, by the internal resistance of the coating. Various schemes for reducing the resistance have been considered, but have not yet been tried.

Work was hampered by the lack of pulsing equipment at Eindhoven for testing cathodes under conditions stated. Samples had to be sent to Germany for test. Busse and Todt said that the equipment used for test would fill half a room. Several were said to be under construction and it was implied that Philips might be able to get one if necessary.

Work on this project appear to have gone with deliberate slowness. Hamaker said he had spent considerable time building small radio sets, which seem to have been very popular among people of Eindhoven.

2. Phosphorescent Screens with Controllable Afterglow

Dr. H,A. Klasens described work on this problem which was also assigned by the Germans about a year ago (may also be related to radar work, such as for PPI displays, after the Germans laid their hands on a H2S apparatus, after 3 February 1943, AOB). He was found a method of control of afterglow by means of an electric field, using a screen of zinc-cadmium sulphide activated with copper. A field of 20,000 volts/cm applied during the afterglow period causes a burst of light to be emitted, the intensity and duration of which can be controlled. The maximum intensity obtainable is about 10% of the intensity of light emitted just after bombardment ceases, and can be as much as 100 times the intensity of phosphoresense existing just before application of the field. Klasens explained that practical application of the phenomenon might be complicated by the fact that an appreciable amount of moisture is necessary in the screen. Dry phosphors show almost no effect. He used only X-rays for excitation, having avoided cathode ray investigations for fear that they might be useful to the Germans. Detailed result are shown in a report by Klasens which is available.

The Germans showed interest in the results about 6 weeks ago. Their visit to Klasen's laboratory only lasted five minutes, however, as it came at the end of a stay in Eindhoven and they had to leave for the airport. Those present Prof. Schrenkgaen, Major Streimer, Dr. Busse and Prof.

Todt. They were principally interested in a means for producing an intensity of afterglow which is constant over a finite interval of time.

The Germans gave no indication that they were interested in F centers, or cathode ray applications of other special types. It was stated that Philips made no cathode ray tubes for Germany. (I doubt that this is entirely correct, as their Valvo division in Hamburg certainly did so, AOB).

3. 25 Watt Reflex Klystron for 10 Centimeter Range.

This development was discussed with Dr. Coeterier, who has been responsible for the work. He had been interested in velocity modulation tubes, with the publications of Hahn and Metcalf as a starting point. About 1½ years ago Philips was asked by the Germans to develop a tube for wavelengths below 15 centimeters. As it was known that the enemy was interested only in pulses, Cortetier continued to work on CW problems

His tube uses a Lecher system for the tuned circuit, the chief feature of the design being a focussing system designed to keep fast and slow electrons in phase for several transits from cathode to reflector and back. He says electrons make on the average 5 transits (2½ complete oscillations), thus permitting the use of a low impedance Lecher system. The construction of the tube and its operating

FiG.-1.25 Watt Reflex Klystron

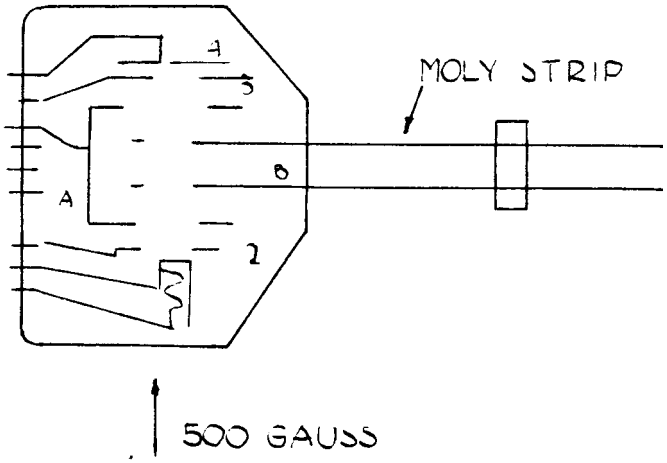
1. Indirectly heated cathode.
   Filament about 4 volts.

2. Control grid; 0-50 V.

a. Anode; 1800 V.
b. Lecher system; 1800 V.

3. First reflection electrode -) V

4. Second reflection
   Electrode -600 volts



For a wavelength of e.g. 14 cm. the bridge on the Lecher-system is fixed near the end and above voltages are applied. Tuning is accomplished by varying the anode voltage..

The proper strength of the magnetic field, which is critical, can be attained as follows. The steel is magnetized as strongly as possible. With two small coils around the poles the strength of the field is diminished so far as to give the best efficiency of the valve. Then the coils are removed and the magnet will keep its correct field strength for several months.

The right position of the valve (magnetic field exactly coaxial with the openings in the electrodes) must be carefully maintained.

The base end of the valve is free of h.f. currents and need not be screened off. If the energy is measured by the brightness of an incandescent lamp it is necessary to prevent radiation from the Lecher system.

An approximate formula, connecting the anode tension with the wavelength, is

$3100 = n \cdot \lambda \cdot \sqrt{v}$
$n = 1, 3, 5 \ldots$
λ = wavelength (in cm)
v = anode tension

Note: The same general type of construction has been used to make a radio frequency amplifier. The electron beam passes successively through two Lecher systems, a buncher and a catcher. A virtual cathode is formed at the aperture in the first Lecher strip. A power gain of 12 was attained at 10 cm with output 1.2 watts. No noise measurements have been made.

The tube has delivered 25 watts at 30% efficiency at a wavelength of 14 centimeters. Oscillators have been obtained at 10 centimeters. The most efficient mode of oscillation is that in which the transit time is 5/2 T (when T equals the period of one r.f. oscillation), as the highest transconductance is obtained in this mode. By varying the position of the shorting bar oscillations have been obtained in the 5/2 mode from 11 to 19 centimeters. Loss of efficiency results when the glass seal is not at the first voltage node, but Coeterier stated that the efficiency at 11 centimeters could be 25%.

The powdered glass seals used in the base of this tube are a novel feature of construction. The technique is described below in section 5.

A critical feature of the design of the tube is the spacing of the focussing and reflecting electrodes, which are constructed so as to cause the slow electrons to overtake the fast ones upon reflection. (The fast electron travel a greater distance against the retarding field and so tend to fall behind). This feature is essential when multiple transits are desired. A further critical point is the anode shield surrounding the space-charge region. When the sides of this shield were left open it was necessary to surround the entire tube with a copper shield, the adjustment of which was extremely critical. Later wire mash was used to close off the sides of the shield, and the external shield became unnecessary.

Some interest was shown by the Germans in this tube during the visit of July-August 1944. Dr. Huschka, Dr. Labusz, and Dr. Busse saw the device and are familiar with its performance, but shortly after their visit the contract for further research was cancelled because the tube was not adapted for pulsed operation.

4. Magnetron – Allied and German

Dr. Huschka, a Czech, gave Coeterier some information about the American 3 centimeter magnetron. He said it had a multi-cavity construction and a 3KW output. He also said that the Germans had the same kind of tube, which they manufactured in Hamburg (this must most likely have concerned Valvo, which is owned by Philips, AOB), and that the American device was so similar to the German that he believed the Americans had copied the German development. He promised to bring a sample American tube to Philips, but none had been delivered before Eindhoven was liberated. (these 3 cm magnetron samples should have been meant for the German Bremen radar set that was tested in early 1945, AOB).

Dr. Posthumus later quoted the German scientist, Dr. Busse, that the American X-band magnetron, working at 3.4 cms. gave 120 KW peaks and 800 watts average at 30 KV.

Mr. Koudijs (Koudys), who had been factory manager at the Philips plant in Hamburg, knew of no magnetron manufacture in that city, although he mentioned that some might exist at the Mueller plant there (Mueller was Philips affiliation and produced X-ray tubes. It is likely that Müller was involved, as Sanitas, also a X-ray manufacturer produced Telefunken magnetron type LMS10, AOB).

Throughout the discussions of cavity type magnetrons it was not clear whether the German scientists had referred to Allied magnetrons which had been studied in German laboratories, or to German-made copies of these. Dr. Kretzmann of German Air Ministry had mentioned these X-band cavity magnetron about three months prior to the CIOS visit, and at that time implied that the captured gear had been reconstructed.

Dr. Staal of Philips, reported that a laboratory assistant in Berlin had written to him about 6 month ago mentioning that the Germans had found a 9 cm magnetron apparatus used for blind bombing. Upon questioning, no evidence was available whether the magnetron was from Oboe or H2S system. The analysis of the magnetron was probably done in the Muggelturm at Muggelsee near Köpenick (Berlin). The place has been mentioned as a probable site of magnetron research and development.

Concerning magnetrons of German origin, Dr. Busse had told the Philips people that the Germans were interested in wavelengths of 9, 3.5 and 1 cm. Lorentz (wrong Lorenz, AOB) was said to have made 5 cm magnetrons. Mr. Van Boumeester had seen a display board of conventional magnetrons in an army headquarters in Berlin, but there was no evidence there of a multi cavity magnetron.

5 Metal-to-Glass and metal-to-Ceramic seals

The fact that the Germans were far more interested in receiving tube than in transmitting tubes from the Philips Company led to a neglectable interchange of information on metal-to-glass seals. Philips had developed very little of significance on copper-to-glass seal. They had done nothing on glass-to-copper coated iron seal as used in the GE lighthouse tubes, but had gained some experience with the soldered vacuum seal described by GE.

For sealing in the pins of their receiving tubes Philips normally use molybdenum or Chrome-iron to glass seals. During the war they were forced to use German chrome iron instead of American chrome iron. The German material had too much nickel in it so was very poor for metal-to-glass seals. The German use of tungsten with hardglass is believed to result from poor quality of their chrome iron.

Philips has developed a very interesting lass powder seal for tube bases. The powder Is pressed in a mold which is heated to melt the powder together. The metal pins are held in the mold. The resulting glass base is filled with air spaces. The coefficient of expansion of this spongy but vacuum tight glass does not need to be matched vary carefully with that of the metal pins. Unfortunately, Philips has not yet found a suitable mold material other than carbon, which last only a short time in mass production. They are trying to find a more durable mold. This technique is well suited to tube development work in which design is often changed and comparatively few samples need be produced from a single mold.

Ceramic-to-metal seals where sufficiently well developed by the Germans as they did Not call on Philips for any. The Hescho Company in Hermsdorf, Thuringen, is the manufacturer of most of the ceramics used in German valves. Dr. Tromp said that this factory is absolutely vital to German electronic industry.

German patents for silver-to-glass seals and silver-to-ceramic seals exist, taken out by Siemens and Telefunken respectively.

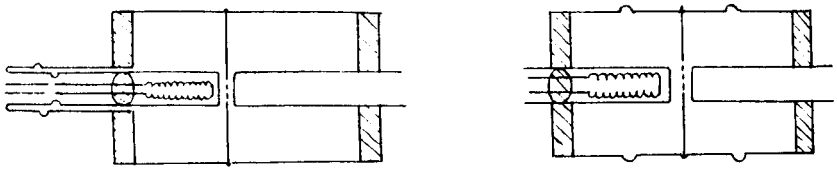
6. <u>Rugged Valves</u>

Dr. Tromp said that the Luftwaffe had placed an order for valves capable of withstanding for five minutes accelerations of 100 g longitudinally and 20 g transversally. The valve of particular interest was the LG6, a full-wave indirectly heated rectifier with was already in production, but which required modification to meet the specifications mentioned. 3000 per month were desired, and the project was extremely urgent on July 27, 1944 (the date of a letter concerning this project which was shown.

The Philips' engineers considered 100g to be an extremely high acceleration. They sent their samples to Germany for testing because of lack of equipment at Eindhoven. Dr. Thyle, in Cologne, did some of the testing, and frequently sent back valves which had failed mechanically with requests that design be modified for greater strength.

7. German Concentric Short-Wave Triode

Dr. Kretzmann described a concentric grounded grid short-wave triode in which the grid plate and grid cathode spacing could be varied after the tube was sealed off (must have concerned a LD10, AOB). Philips did not know any production valve of this type thought the tube was in the experimental stage in 1943. It was designed to operate between 10-50 cms., perhaps even from 5-50 cm.



The crimps can be pinched mechanically to vary the grid-plate and cathode-grid spacings after the tube is sealed off. Presumably this type of tube can be used as an amplifier, oscillator or detector, although no performance figures were given.

Dr. Holst learned in Berlin at the end of 1943 that the Germans were becoming interested in grounded grid triodes. In general the Germans gave the impression to Philips that they considered triodes applicable down to 20 centimeters, preferring velocity modulated tubes at lower wavelengths.

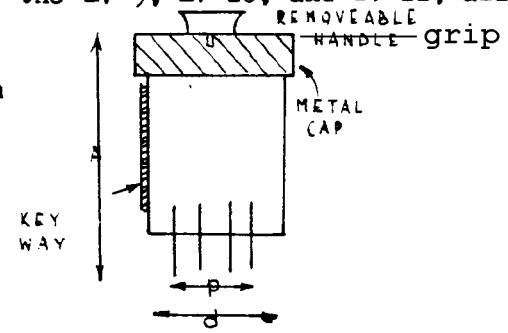
8. Small Valves

There were no German miniature valves known to the Philips group which were of a particularly rugged construction. 10 g tests were demanded by the Germans, but such tests are to be expected for valves to be used in military apparatus of conventional variety.

A new line of receiving valves has been developed by the Germans using a new construction, trhe principle advantages of which are greater compactness and greater mechanical security in installation (consider one this website 'Die Einheitsröhre'). The principle space-saving feature is that the pins are sealed parallel to the axis instead of radially. The valves is inserted into a metal container so as to be held rigidly at both top and bottom, and a catch at the top locks it in place. A key is also molded into the glass to prevent insertion in the wrong position. The sketch shows the construction, and dimensions are given in the table. Samples of LV-9, LV-10, and LV-12, all of this construction, were obtained.

sions are given in the table. Samples of the LV-9, LV-10, and LV-12, all of this construction, were obtained.

Series	A	18^{d}mm	11.5^{p}mm	50,60,70^{h},80mm
"	B	25	14.5	50,60,70,80
"	C	30	21	50,60,70,80
"	D	38	25	60,70,80



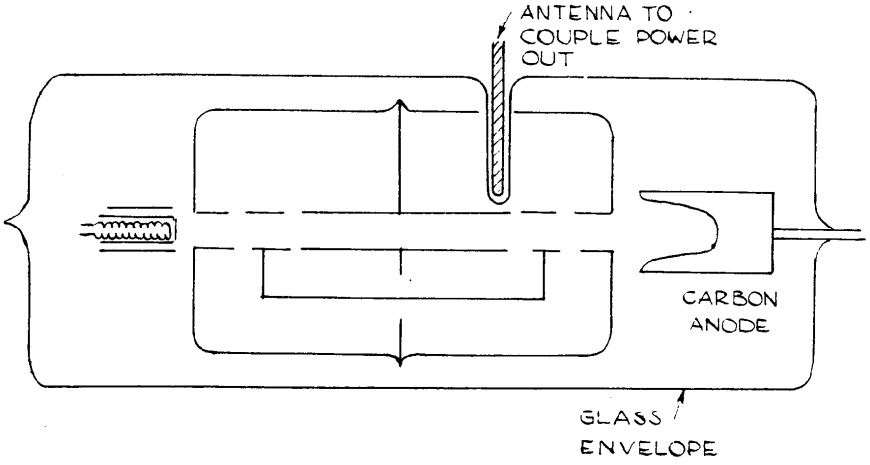
As mentioned in a later section, acorn valves have recently been given very high priority by Germans, but no indication was given of the intended application.

The Wega factory in Würtemburg (Würtemberg, AOB) has used a large number of small Philips valves. They were particularly interested in the DDD25 directly heated double triode, which they were building without bases into receivers. Philips had no definite information, but they believed that the valves being soldered into bombs. The first order, in February 1944, called for 80,000 valves without bases, at the rate of 8000 per month. Subsequent orders raised the number to a total of 217,000 ordered up to July 1944.

9. Velocity Modulated Tube Development by Dr. Penning

This tube gives about 30 watts output in the 10 centimeter region with 5 KV and 50 ma beam current. It is shown schematically below. Penning has also made a sealed-down version of the same tube to work in the 5 centimeter region, but it has not yet been tested.

Two interesting points about this tube are the method of subtracting the useful power, and the tight coupling between the two cavities. The power is withdrawn from the cavity by a rod antenna inserted into the resonant cavity through the reentrant glass tube shown in the diagram, the antenna being outside the vacuum. The tight coupling is obtained by a rod connecting two cylinders, one each placed in the gap in the buncher and catcher cavities.



10. Sendytron Pulse Modulator

The Germans expressed a need for pulse-mulator with a variation in time-lag less than 10^{-7} seconds. No power requirements were mentioned except that outputs higher than those obtainable with hard valves were needed. Some work was done at Eindhoven on the sendytron for this application. This valve is an ignitron the trigger electrode of which consists of glass tube filled with

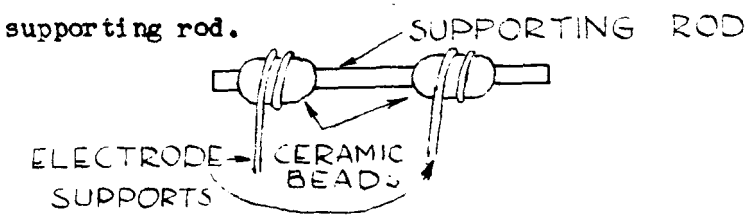
mercury dipping into the main percury (meant probably mercury, AOB) pool. The trigger pulses initiated the discharge by capacitive reaction through the glass dielectric. (PL5??) A 10 KV control impulse gives a time-lag less than 10^{-7} seconds. Almost any value of current can be obtained, 40 to 100 amperes being quite practicable.

11. Small receiving Triode for Cm Waves

Mr. Schmidt, who left Philips hurriedly when the Germans retreated, had worked on a small receiver triode for centimetre waves. This was interesting primarily because of a scheme of temperature compenstation to keep constant the inter-electrode spacings.

Valves with small electrode clearances.

Philips have developed a technique for constructing electrode systems with very small and stable clearances. In one form of this the electrodes' supports are fused on to ceramic beads which are fused on to a suitable supporting rod.



Magnified Sketch about 4 times full size.

Terminal expansion of the supporting rod may by suitable geometry be made to compensate for thermal expansion of the electrodes.

12. General Information Covering the German Situation

The following general picture of the German radio industry and Philips' relasionship to it was given by Mr. Le Clerq, head of the commercial department.

The whole electrotechnical industry in Germany is organized in "rings" under Dr. Speer consisting of groups of key manufacturers, which were formed after Stalingrad. The radio ring is headed by Dr. May, Director of the Telefunken Sickingenstrasse plant. On the next level above is is the ring of Elektrotechnische Einzelteile und Messgeräte, headed by Dr. Loifer, member of the board and director of Siemens-Schuhert (wrong Schuckert, AOB). The general ring which is over both of others is under the leadership of Mr. Lüschen, one of the principal bosses of Siemens.

It is reported that in May, 1944 the state of disorganization in the electrotechnical industry in Germany was such as to have come to the attention of the Führer himself. Luschen and twelve others were summoned to Bechtesgarden to discuss the situation. After a protracted period of waiting they were shown a room where the audience was to be held, and waited another half hours. Hitler then entered, read a speech on some matter entirely unconnected with the electrical industry, and departed. Lüschen was then presented with the highest award of the Führer, and the party went home. Le Clerq said he heard this story from Lieutenant Colonel who was one of the twelve men mentioned. His conclusion was that the Führer was so disturbed about something he had recently learned that he was unable to carry on his normal business.

Negotiations between Philips between Philips and the "ring" were conducted principally by Mr. Rzechulka, a manufacturing executive in charge of the Telefunken factories at Erfurt-Heuhaus and Litzmannstadt (now Polish Lodz, AOB). In November 1943 he came to Eindhoven with a scientist named Zickermann to review the production situation and to determine Philips' capacity to produce valves for German consumption. As a result a demand was made upon the company to

produce 3,6..,000 special valves for the Wehrmacht. The firm agreed to accept orders for 1,200,000 of these, to be made between November 1943 and November 1944. Production dragged, however, and July 1 only 450,000 had been completed.

Mr. Rzechulka returned to Eindhoven last March armed with documents from Milch and Speer giving him authority to control production at the plant. He stayed until September. In March the highest importance was attached to the P2000 and P700 valves (= RV12P2000 and RV2,4P700, AOB). It is estimated that the Germans used 1,000,000 of these per month.

Receiving and transmitting valves development for the Wehrmacht was conducted for a time in a laboratory located in Berlin near the zoo. This establishment was called WaPrüf 7 and was under the direction of Oberstleutnant Krause. After having been bombed in November 1943, the group was moved to GBN (General Bevollmächtigung für Technische Nachrichtenmittel), the chief of which was General Fellgibel (Fellgiebel, AOB), until his reported arrest about July 20, 1944. Krause remains an important figure in the German valve development. He developed before the war the P4000, NF2A, LF1A, and LG1 valves(P4000 = RV12P4000, AOB), the latter of which has become particularly important during 1944.

The Luftwaffe had an independent development agency under the Reichsluftministerium, LC4 division of which is particularly important. The chief of the division changed about every two months for political reasons, but Dr. Kretzmann seems to have throughout as the key technical man.

The various German services have exchanged development information and drawn upon each other supplies of materials quite freely since the war situation critical for them. During April and may Rzechulska made efforts to have Philips prepare for a program to make P2000's at a rate of 120,00/mo and P700 at 35,000/mo, in addition to the above orders. The company refused to accept the proposition.

In May acorn tubes suddenly acquired top priority. 100,000 of these wanted in 1944. Kretzmann is reported to have said they were needed for the fighter program, although one of Philips engineers said demand came largely from the navy. It is believed that the only factories in Europe where the technique of acorn manufacture is known are those controlled by the Philips organization. (this in not correct, as Lorenz made them as well, be it, that they provided 2 volts and 12 V versions, whereas Philips made the 4 and 6.3 V types AOB)

Le Clerq estimated that the Germans consume 30,000,000 valves per year.

The Philips staff is much impressed by the high pressure recently placed by the Germans upon valve production. They say that the urgency rating assigned to their orders (1Z470) was one of the highest they had heard of, and exceeded that applied to tanks. With this in mind they wonder why no attack upon valve production has ever been made. Telefunken Sickingenstrasse plant has never been bombed, they say. Their opinion the most important targets would be:

1. Telefunken: Sickingenstrasse, Berlin
2. Telefunken: Erfurt_Neuhaus
3. Telefunken: Litzmannstadt (Lodz)
4. Telefunken: Prague
5. Telefunken: Milan
6. Telefunken: Lorenz Berlin
7. Loewe : Steglitz, Berlin
8. Tungsram : Kreminetsky, Vienna

In addition, the Hescho ceramic factory at Hermsdorf, Thuringen is stated to be absolutely essential to German valve industry. They say that if it could be put out of action, German valve

production would virtually cease. The factory incidentally, is located in an open field and presents an excellent bombing target.

Appendix A-2

Name	Location Employer	Remarks
Dr. Bouman		German formerly by Philips. Was in Eindhoven to supervise research (late 1943?)
Dr. Buse Busse?		Formerly worked in Philips Roentgen Development. Visited Eindhoven at frequent intervals. Assistant to Prof. Esau. Technical expert whose speciality seemed to be valves of all types
Prof. Esau		Described as most influencial technical man in German radio development
Dr. Huschka		Czech who visited Eindhoven with Labusz and Busse. Told some details about 3 cm magnetrons. Ordered 10 of Coeterier's CW klystrons
Oberst Leutnant Dr. Krause	GBN Heereswaffenamt	Formaly head of Wehrmacht valve laboratory in Berlin (WaPrüf 7) Frequent visitor to Philips
Dr. Kretzmann	LC4 Division of RLM	Key technical man on valves in Luftwaffe, in opinion of Philips'engineers. Frequent visitor to Eindhoven. More talkative than average. Seemed to be angling for a post war job. Claimed to have invented cavity magnetron, while formerly employed at Telefunken. Resigned to work for Luftwaffe because ideas not favourably received.
Labusz	Munich	Associated with Busse in visits to Eindhoven
Dr. Leiffer	Siemens Schuchert Director & Board Member	Heads ring for Elektrotechnische Einzeilteile and Meßgeräte
Dr. Luschen	Siemens Director and Board Member	Heads General Elecrical ring. Top industrial man German Electric industry
Dr. May	Berlin, Director of Telefunken Sickingenstrasse	Heads radio ring
Dr. Rottgardt	Director of Telefunken	Boss of all army production

		for Telefunken
Dr. Rzechulka	Telefunken, Director of factories at Erfurt-Neuhaus and Litzmannstadt (Lodz)	Put in charge of Philips' production from March to September 1944
Prof. Schenk	Plendl (Luftwaffe)	Nazi, apparently non-technical
Maj. Steimer	Plendl(Luftwaffe)	
Prof. Todt		Visited Eindhoven with Busse. Technical expert
Dr. Weth	Telefunken Sickingenstrasse Plant	Has been at this plant for 10 years in high executive capacity. Philips say he is still there
Mr. Wiegand	Telefunken Sickingenstrasse	Philips say is one of the key executives
Mr. Zickerman(n?)		Technical man, assistant to Rzechulka during visit to Eindhoven, Nov. 1943

Appendix A-4

Production

Philips highest pre-war production of all types of valves was 12 million, but their average over the four years up to 1940 was about 8 million.

The Germans took away some of their plant, but new machinery is already under construction. They estimate their present capacity (when power and gas supply are restored) at about 6 million a year, and their additional capacity to bring them back to 8 million.

Receiving valves (Miniature)

The production of E types was discontinued last January.

They are preparing to produce American type miniature in 1.4 volt and 6.3 volt ranges. Their last samples from R.C.A. were back in 1939, but they have continued development along their own lines and are about ready to produce.

I was informed that these miniature valves would be high slope with pins spaced further apart than USA/UK types, and therefore told Otten, Dijksterhuis and Tromp that they should bring themselves up to date on American types before embarking on this trend. (These new valve types my be equal to the later "Rimlock" types. This valve type, might perhaps to some extent being a spin-off the work they had done for the Germans. Regard also 'Die Einheitsrühre' on this website, AOB)

When security permits, and only if we are likely to need Eindhoven as a source for miniature valves, I would recommend that either Pratt, Clark or Kloppert of Mitcham be allowed to visit Eindhoven to set them straight.

I have one copy each of Philips handbook on transmitting and receiving valves, which is available to anybody interested.

..

War Time Production

58% of lamp production went to Germany, branded Osram, Pintsch (Berlin) and Radium (Wupperfurth??). The orders placed by Osram Berlin, by Dikow commercial manager of Osram, who kept pressure on Philips for delays in deliveries.

10% of production was direct orders for the German forces, largely special 24 volt lamps for aircraft, etc.

32% was mainly for Dutch consumption, and some continental export. The basiis of exports was a monetary quota (Clearing, AOB) dictated by the German authorities at the Hague.

Tungsten and Molybdenum Wire Stocks and Diamonds.

On evacuating Eindhoven, the Germans carried away considerable plant, and also considerable stocks of tungsten and molybdenum in bar, rod and drawn wire. They also took many cutting diamonds. However, sufficient stacks were concealed to permit continued production (with certain improvisations at the above rate for about six months more.

Steps should be taken by DDLP to consider the forward problem, and it may well prove that Philips London can provide the needed assistance in supply of these materials.

2. Report by Radar Group

This report by the Radar Group amends the first report already circulated, which should now be destroyed.

Summary

Philips were found to have no work specifically towards German Radar. Most of the staff had no knowledge of German Radar with the exception of general impressions of the small Würzburg and Freya equipments, they were also aware of aircraft serials which might be related to radar.

German requirements relating to cm. wave apparatus were only submitted to Philips after it is known that Allied equipment in these bands had fallen into enemy hands.

No information was available of any technical collaboration between the Germans and Japanese.

Such information as was obtained deals with contacts with German individuals and organizations which may prove useful for further CIOS investigations in Germany. In addition Philips independent scientific research and technical development is of interest.

Philips reluctance to cooperate with the Germans appears to have left them out of contact with up-to-date technical progress.

This report is in two main sections with appendices covering detailed points.

Part I covers information of German interest and organization.

Part II covers technical progress achieved independently by Philips.

Part I.

1. Pre-war Radar

Dr. von der Pol (should be 'van der', AOB) referred to the Dutch Government Committee on Physical means of Warfare, of which he was a member. This Committee before the war sponsored the radar system worked on von Weiler (now with A.S.E.). It is assumed that this system became known to the Germans.

He also mentioned a CW experimental system by Philips using 10 watts for a magnetron on 11 cm. Aircraft ware observed at ranges up to about 3 km. The Germans experimented with this system on the coast.

2. Research laboratory problems

Until August 1943 no problems of immediate application to the war effort were set to Philips by Germans. At that time 11 research problems were set, which are of a fundamental mature, probably connected with technical problems. These are listed in Appendix B-1.

Prof. Holst stated that items 7 the Thyratron for vary rapid rise of current, was considered very important by the Germans, we have, however no clear idea of its purpose.

Item 8 the megawatt pulse generator on 7 m. was probably for jamming G, but Philips were allowed to attack this as a long term programme.

3. Recent Revival of German Interest in cm. Technique.

After the attempt on Hitler, July 20th 1944, and his speech on the importance of scientific aids to warfare, interest revived and a commission, including Streimer, Schrenkhagen and Prof. Todt, visited Eindhoven. Philips gained the impression that these men were mainly concerned to clear themselves. They however stressed the importance of cm. wave work below 20 cm. and particularly below 3 cm. (this was the spectrum that the Germans expected best for future radar systems, AOB) About this time also Busse (working with Esau, formerly of Philips Valve factory at Hamburg (= Valvo, AOB) visited Eindhoven Eindhoven and talked about the American X-band magnetrons and indicated operation on 3.4 cm. He appears to have quoted operation at 30 kV and 800 watt mean power dissipation and figures of 3 kW 9Also stated by Houschak) and 120 kW were quoted for the output. The strapping was interpreted as means of improving the output coupling. Van der Pol and Prof. Holst quoted some statement that the Americans were believed to be working at 1 cm., 3.4 cm. and 9 cm. The Germans were interested in these bands where magnetrons were most suitable. Above 20 cm. it was considered that triodes were preferable. Lorenz had developed experimentally a magnetron on about 5 cm., no details were known. Dr. Staal reported information in a letter from a friend working as a laboratorium assistant at Muggelturm near Muggelsee, that the Allies used 9 cm. apparatus for bombing through cloud. Such an apparatus was working experimentally six months ago there. Philips had never seen or been asked on such magnetron.

Van der Ziel reported from his visit to Berlin October 1943 and later information that the Germans considered crystal mixers superior to diodes below 20 cm., and quoted a noise level of 200 kT for the crystal at 20 cm., and 300 – 400 at 10 cm. The crystal had a tungsten point on silicon in distrene capsule (= trolitul, AOB), and would stand shock of being dropped.

He also referred to German concentric line type triode reported to have a noise level of 2000 kT at 10 cm., 500 kT at 20 cm., and 10 – 20 kT at 1 m.

4. Listening Receiver

G. de Vries said the Germans asked for the development of a receiver to cover 20 cm. to 2 m. Philips produced 4 or 5 using a diode mixer. No signal noise ratio was specified. Later the German Army took an interest but said it was no good. Dr. Rindfleisch followed this work for the German Army (I believe that Rindfleisch was engaged to NVK instead, AOB)

5. Radio Frequency Measurements.

Philips had no means of measuring power output on cm. and dm. λ other than matching filament brightness, and said the Germans also seemed to lack good methods and made enquiries.

Van der Ziel reported that the Germans were short of standard signal generators. Early 1944 the Germans said they had a signal generator ready to 500 Mc/s. ready and up to 800 Mc/s. in an advanced stage of development. Philips had done no work on this for the Germans nor on wavemeters.

German interest in measuring instruments is described in Appendix B-2

6 Beacon Transmitters

Philips delivered 3 transmitters of 80 kW using oil cooled valves. Originally designed for 20 m. then changed to 6 m. believed to be for Africa and Russia as a navigational aid to bombing. (Knickebein?, AOB)

Philips developed a 20 kW beacon for the Germans but had not delivered any of the 20 ordered, although completed. These consist of two transmitters, originally on 7 m. (20 kW. Each). Mounted in a truck to rotate on rails. (Bernhardine?,AOB) The transmitters differed in frequency by 500 c/s. to 2000 c/s., this being variable. Later at German direction the wavelength was altered to 6 metres. It was presumed that the equipment was used as a beacon transmitter and possibly for navigational beams. The Telefunken Company was charged with mounting of equipment in the rail cars. The German specifications for this equipment were obtained by the Mission. (Kurze Angaben der K.W. Bake Sendeanlage. Baumuster B.R.A. 30/20).

7 Ionosphere Research

Philips constructed transmitters and receivers fort the Germans for Ionosphere research. These tuned automatically and continuously from 15 m. 100 m. Pulses at 50 c/s. recurrence, 100 μ.sec. long were used.

8 Frequency Modulation

Seic, then with the Luftwaffe, asked early in the war for a general investigation of all aspects of D.M. believed to be for broadcasting. No direction was given or interest shown until the arrival of Thrum and Weires one month ago, they were not very capable and nothing resulted.

9 C.R.D.F.

Dr. Posthmus reported that Philips had C.R.D.F. apparatus operating at Hilversum on 15 m. The Germans had expressed an interest in the development of a similar equipment below 50 cm.

10 Decimetre Communications

Philips did no work on decimetre links for the Germans.

11 Television

Early in the war the Germans had asked if Philips had done any work on the use of ionoscopes for I.R., which they had not. In 1942 an unidentified commercial firm in Hamburg had asked concerning a video television system which Philips believed was for some underwater application. No formal work was done on this request..

Neither Van der Mark nor Haanji (Haantje?,AOB) could give any specific information relative to German interest in television for military uses.

12 General.

Miscellaneous German contacts are listed in Appendix B-3

Permission to transmit was granted by the German on the frequencies listed in Appendix B-4. In general there was freedom for operation below 1 m. avoiding a band round 52 cm. (owing to Würzburg signals, AOB)

Philips have done no work on waveguide technique.

Appendix B-1

List of 11 problems set to Philips Research Laboratories August 1943

1. High frequency properties (low dielectric constant desired) of Ceramics which can be easily worked after firing.
2. Loudspeakers of high Electrostatic efficiency from 200 to 300 c/s.
3. Velocity Modulation tubes for receivers for wavelengths below 20 cm.
4. Primary and Secondary batteries of light weight, avoiding manganese and scare materials.
5. Substitute for Quartz for stable oscillators.
6. Under 20 cm. λ technique including voltage measurement, variable voltage division and matching.
7. Thyratrons for very rapid rise of current (10^{-7} sec.).
8. 6-7 m. High power pulse generator 1000 kW peak duty cycle 1:10.
9. High emission azide cathodes.
10. Velocity Modulation transmitter tubes for wavelength und 15 cm.
11. Controllable decay time Cathode Ray Screen.

Appendix B-2

1. Philips Berlin Kemma in charge of
   (a) Factory in Frankfurter Strasse.
   (b) Laboratory in Alexander Strasse.

   Believed now both bombed out.

   Formerly Steinkühler (who could only talk Blok) (probably is Mr. Blok meant here, AOB) in charge of (b) now Leichthäuser (known to Holst who does not think very important) and moved to country.

2. Philips Valves Hamburg (= Valvo, AOB). Busse originally there moved to Aachen (Sets factory) on measuring instruments but there he finished nothing. Was returning to Jobst in Hamburg on special decimetre wave work.
3. Moller (Möller?, AOB) who came to Eindhoven August 1943 (Van der Pol). Was in Philips Berlin (a) until bombed out. He is a working engineer as district from Kemma who "only talked"(Blok).
4. Germans asked Philips to make a valve voltmeter working down to 40 cm.
5. Kiel laboratories for Navy were important but now probably bombed out.
6. Only field test gear asked for by Germans was a Field Strenth meter for ordinary wavelength 10 – 1000 m.
7. Germans also interested in wavemeter accurate to 1 in 10^5 working up to to to 40 Mc/s.
8. Brandenburg Motoren Fabrik interested in indicators and vibration testers for engine development. Veldhuijzen visited in connection with Philips pressure indicator, which operates by varying a capacity. The pick-ups of these devices are good for several hours and do not use water cooling. Pressure indicator reads directly in atmospheres, operates to 6000 r.p.m. Philips also have drawings available of a detonation meter in connection with the same German interest.
9. Philips vivration pick-ups:
   (a) for relative vibration was of interest to Schenck of Darmstadt who were working on U.S. patents believed to G.E. for balancing boards, measuring unbalance on both sides.
   (b) For absolute vibrations was of interest to Heinrich Hertz Institut.
10. Germans appeared short test gear generally in particular of signal generators.

    Philips Prague have copied U.S. GR instruments in particular a Standard Signal Generator, their copy is bad. (Philips Elektrospezial PHP22, AOB).

    Rhode und Schwarz in South Germany – München 9, Tassiloplatz 7 Tele 42821 (catalogue published trough Buro Berlin W50, Augsburgerstrasse 33 Hochfrequenz Meßgeräte) are making good test gear and quickly fort he Luftwaffe, e.g. 1-1 Om. Signal Generator.
11. Philips Eindhoven produced numbers of good Beat Frequency Oscillators 30 c/x. – 16 kC)should be respectively c/s and kc/s, AOB). (= GM 2307, known as 'Blokfluit' as Mr. Blok was its designer, AOB) 2 scaled 0 – 1000 c/s., 0-16 kC provided, readings of which are added. Germans bought for use in factories etc. 3rd Harmonic < 0,3%. Frequency accuracy 0.2% (?).

Appendix B-3

Org. or Firm	Place	Personnel	Remarks	Reliability & Source
Rhode &	Munich 9	Dr. Rhode	Make HF	A1 Philips

Schwarz	Tassiloplatz 7. Tele 42821	Dr. Schwarz	measurement Esp. for Luft-waffe. Trade Mark	Eindhoven
Buro Berlin	Berlin W50 Augsburger Strasse 33		Publish Technical Catalogues	A1 Philips Eindhoven
Brandenburg Motoren Fabrik			Aero engine development	B2 Veldhuyzen Philips Eindhoven
Schenck	Darmstadt		Work on mech-anical balancing	
Philips	Berlin	Kemma	Factory bombed out from Frankfurter Strasse. Also Lab. formerly in Alexander Strasse Leichthäuser in charge following Steinkühler.	
Philips	Prague		Copy G.R. H.F. Measuring Instruments	B Blok Philips Eindhoven
Julius Pintsch	Constanz (evacuated from B (= Berlin?, AOB)	Dellenbacher (= Dällenbach, a Swiss, AOB)		
Gov. Personnel	Sonnewalde Kreis Luckau Schloß	Esau Busse Knollte	Head German Radar development Director of A.E.G. Directed Philips, E.	
	Austrian Lake, Nuclear Physics Esteblishment	(Seic Houtermans)	Seic. Formerly interested in F.M. for Luftwaffe now Nuclear Physics	
		Thrum Weires	Interested in F.M. sent to Philips.	
		Baumann Allerich Dourmer	Sent to Philips	
		Von Wranzel Rindfleisch	Army) German Navy (NVK, AOB) Went to Philips on F.M.	
		Houschak	(with Busse)	

		Kretzmann	Luftwaffe Knew 3 cm. Mag.	
		Teiler	Valves to withstand shock	
		Lotze Wehrwaffenhaus Analysis of sound. Sept. 1941		
		Moller (Möller, AOB)	Sent by Plendl to Philips Aug. 1943 Formerly Philips Berlin factory.	
		Streimer) Schwenkhagen Prof. Todt) Dickmann	Visited Philips, August 1944 In charge of Oberffaffenhein??	

Appendix B-4

Frequencies given to Philips by the Germans for experimental work.

Nat. Lab. 19.12.40

For F.M.

33.8 Mc/s.
43.2 Mc/s. permission already received
55.4 Mc/s.
70.0 Mc/s.
100.0 Mc/s.
140.0 Mc/s.
270.o Mc/s.

(s) J. van der Mark.

Part II.

1. Cavity Resonators.

Von Lindern and de Vries have worked on cavity resonators mainly variants of the rhumbatron, and have used shapes for which exact calculations of modes and Q values can be made. Their work is published in Philips Technical Review Vol. 6. p. 217, 1941 and Vol. 7, p. 197, 1942.

Van der Pol suggest that work on the Theory of Numbers should have application to resonant modes.

2. Propagation

A transmission on 43.2 Mc/s. modulated at 246 kC, has been used for observation of propagation, differential fading etc. This was operating daily except Sundays and not at night, until April 1944 when this was given up.

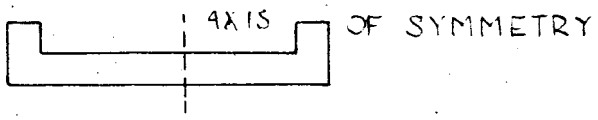
Van der Pol has made calculations relating to propagation and differentiation round a spherical earth and copies of his resulting curves were supplied. "Theoretische resultaten over de voortplanting van radiogolven."

3. Ceramics with special magnetic and electrical properties.

Problem 1 set by Germans to the research laboratories was for ceramics which could be easily worked after firing.

Work called for odd shapes of good insulators and low dielectric constant. Unity if possible and losses not important. Mechanical permanence was important.

Work done actually in Philips own interest by Verwey was on shaping special ceramic magnetic material in the form



Separation of the particles from a liquid suspension by settling is aided by double layer forces which have a lubricating action resulting in very high density material.

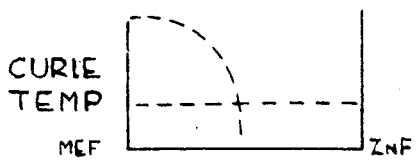
Germans at one time when asked shout interest in high dielectric constant materials expressed an interest in high permeability material such as ceramics, but Philips did not tell of their work on this subject. This work was described by Snoek who had done some years of research on mixed Ferrites.

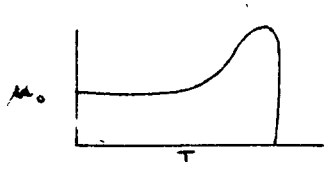
Formaly worked on "Ferricube", a material which was satisfactory up to 10,000 ?? in a thickness of 60μ. This material includes nickel. In 1939 he stated work on dust cores with a high specific resistance and was led to investigate materials similar to Fe_3O_4 which has / = 10^{-2} ?? which is sufficiently high to give low losses.

Writing $Fe_3O_4 = FeO.Fe_2O_3$ the bivalent Fe can be replaced by Mg – Cu – Mn – Zn or Ni. These materials are known as Ferrites. Some have *P*as high as 10^8 but not good insulators for which *P*would be of the order 10^{+18} .

These might be suitable to replace dust cores as μ can be high. Required to be stable at low temperatures, and magneto-striction to be small.

When a Ferrite is mixed with Zinc Ferrite (which has low μ), the Curie temperature is reduced.





Since μ is highest just below Curie Temperature Zn Ferrite is added to bring the Currie Temperature into normal temperature range.

First he tried Cu + Zn Ferrite but later found Mn + Zn Ferrite more successful at high frequencies about 1000 kC.

Heat to 1100 – 1150° C rather than to 1200° C to retain porosity (tested by sticking to tongue). Particle size is of order 1 μ. Losses above 1000 kC were still due to after effect and not eddy currents.

So far he had avoided FeO. $Fe_2 O_3$ in attempt to avoid hysteresis but this was wrong because all Ferrites except $Fe_3 O_4$ have negative magneto-striction. Mn + Zn Ferrites has a low negative magneto-striction; if mixed with a few % of $Fe_3 O_4$, which has positive magneto-striction, a material is formed with zero magneto-striction and very low hysteresis losses. This mixed material is prepared by first heating in oxygen to ensure oxidation and then sintered in Nitrogen.

The best solution obtained so far the problem of substances for frequencies > 1000 kC is Ni+Zn Ferrite.

The non-linear properties of these ferrites have been used for frequency modulation. So far Cu+Zn Ferrite has been used but Ni+Zn Ferrite should be better.

4. Attainable Permeabilities

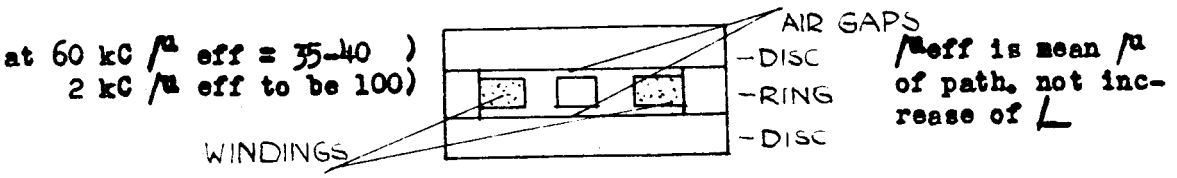
If high μ is the only object μ = 4000 is the maximum attained, = 2000 can be guaranteed.

Adopting as arbituary limits tan δ < 6% and tan δ /μ_0 < 10^{-4} .

Mn+Zn Ferrite gives μ = 2000 suitable up to 60 kC
Cu+Zn Ferrite gives μ = 200
Ni+Zn Ferrite gives μ = 100 suitable for higher frequencies.

5. Applications

(1) Loading and filter coils have been made in the form



(2) Rods sliding in tubes give control of mermeability.

Ceramic Dielectrics.

A new material using CeO_2 has K of 35 and can have +ve – ve or zero temp. coeff. Has low dielectric losses.

6. Materials of Large temperature Coefficient of Resistance.

Germans are known to have worked on a material known as Urdox based on UO_2 . Later known to have used a material based on MgTiO slightly reduced, but manufacturing difficulties have been encountered. (probably work by Osram, AOB)

Philips have worked with a mixture of $Fe_3 O_4$ with $ZnTiO_4$ or $MgCr_2O_7$. These have high negative temperature coefficient of resistance.

7. Radio Systems

Beacon.

Philips at Hilversum made a beacon of their own design. Two aerials at right angles (crossed loops) are fed in phase quadrature with transmissions modulated at frequencies f and nf. At the receiver the relative phase of the modulations is compared by multiplying the frequency f by n and comparing with the received modulation at nf. The presentation of this relative phase is made direct reading. There will be ambiguities if n is large, but it is supposed that the navigator would have some idea of his position and n would be chosen to obtain the best compromise between accuracy and ambiguities.

Pulse Telephony

A system of phase modulated pulse telephony has been developed. The modulation is first translated into a stepped form, stepped regularly at the mean pulse recurrence rate. The transmitter is triggered when a sawtooth voltage, also recurring regularly at a pulse recurring rate equals the voltage of the stepped modulation.

8. Television

Philips had a 567 line single frequency (40 mc/s. band) system before the war. They are planning a 1200 line system, but are limited at present to 800 lines by amplifiers.

9. Special Techniques.

D.C. Amplifiers

A simple cylindrical magnetron with a screen grid close to the anode has been used close to cut off field to detect changes of magnetic field as low as 2×10^{-4} gauss. The magnetic field change may be due to aa current in a coil. A magnified current change in the magnetron anode circuit results.

Frequency Modulation Modulator

Use of the non-linear properties of mixed Ni and Zn Ferrites for frequency modulation is mentioned under ceramics in this report.

Velocity Modulation Oscillator

The Lecher line – V.M. type oscillator giving 30 watts output at about 25% efficiency from 11 – 19 cm. is mentioned in the valve report.

C.R. Tube image storage

The work by Klasens on image storage by high electric fields, which may have application to P.P.I. flicker anti-clutter presentation is mentioned in the valve report.

Audio Spectrum Analysis

Schouten method using a sound film recording as an optical diffraction grating has been developed a little further. P.T.R. Vol. 9 p.110, 1941

Schmidt Projection System

The application of moulded gelatine films to correct for aberration of spherical mirrors, has been developed to be a promising cheap method of making large aperture projectors. Details are given in the Infra Red report.

Powdered Glass to Metal Seals.

This technique has been developed to a stage very satisfactory for laboratory use. Carbon moulds have insufficient live for production, but development is proceeding. This is reported in valve report.

High Speed Cutting of Quartz Crystals.

Philips consider their practice of using a diamond band-saw is an advanced on previous techniques.

10. Measuring instruments.

Philips developed the following instruments in their own interest.

(1) Diode voltmeter for D.C. or A.C. 30 c/s. to 100 Mc/s.
Ranges

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.
.
.
.

(8) Coil self Capacity Meter
(9) Self Inductance meter. Accuracy 0.2%
.
(10) Frequency selective voltmeter
Free from hum sensitive to 100 db down.
(11) Spectrum Analyser
Range 400 c/s. to 100 kC
Sensitive to 70 db down

3. Report by Communication Group.

1. Introduction.

The team made contact and held discussions with various members of the staff of N.V. Philips Gloeilampenfabrieken, at Eindhoven, Holland between 25-27 September 1944.

The purpose of the mission was to discover, by investigating the activities of the Philips Works during the period of enemy occupation, information on scientific weapons in use by the enemy, and thereby to enable suitable ones to be converted to allied use, and to prepare counter-measures for those in use by the enemy.

2. Line and Carrier Equipment.

Philips were asked to develop and manufacture two equipments named Link and Mohring after the engineers responsible for the designs. The latter was more important and had been allocated a high priority (SS) number. Mohring visited Eindhoven from Poland in connection with this work and left Eindhoven about 3 months ago. It was known that one of these equipments was in use between Crete and Derna.

The R.F. carrier wavelength was between 2 and 4 metres, and the terminal equipment provided 9 channels covering a range between 4 and 72 Kc/s. The channel width was 4 Kc/s, the odd channels being omitted.

During his visit, Mohring disclosed that similar link, using the same terminal unit, but having a R.F. carrier wavelength of 50 cms. Had been used in Norway. (to my knowledge, the Germans used in the link between Crete and Derna in North-Africa Siemens & Halske “Krabbe” apparatus. The same apparatus was also used between Denmark and Norway, AOB)

This equipment is apparently not the W.T.Z. unit, since it used Philips’ F. series valves (6.3 v heater; side contacts)(= known as ‘P’ series, AOB)

By misunderstandings of the priority accorded to this equipment, Philips managed to spread the work over the whole 4 years from the time of the original order to the date of liberation, and produced no working model. The transmitter was to be developed and made at Hilversum, and the state of progress is not known.

Link was a bastard equipment, providing music, speech and telegraph channels, No equipment was produced.

Dr. Baume (late director of TEKADE) visited Eindhoven in company with Dr. Winschstein and Dr. Umayer in Aug. 1944. The object of their visit was to discuss with Philips the possibility of working out a third system (i.e. in addition to those of Siemens and AEG)(= MG15 and MEK8, AOB) of carrier telephony. The activities of the visitors during their brief stay suggested to Philips engineers that possibly their main purpose was to obtain a supply of Dutch currency.

A reciprocal visit to TEKADE at Nuremberg (German Nürnberg, AOB) had been arranged for September 24,1944.

Dr. Baume's laboratory was situated about 10 miles East of Berlin. It was heavily bombed by R.A.F. Some apparatus was saved and has been set up 60 miles from Nuremberg, where the laboratory staff are working 60 hours per week.

2. Radio Transmitters and Receivers.

Development of aircraft and ground transmitters was done at Hilversum, but certain German sets were copies of Eindhoven. (I don't believe this statement. I don't know of any Philips copy. NSF was owned by Philips, and they made sets which were designed by NSF, but sold under a Philips nomenclature (label), AOB) (When we consider the next paragraph, then we can see that the inverse took place. Philips manufactured Lorenz and Telefunken apparatus. This was also known as 'assemblage', AOB)

The sets copied were: 100WSa: Torn Fu.b 1: Torn Fu.k, information on all of which is available in U.K.

The receivers made at Eindhoven were:
ER1 (for forces entertainment)
WR1 Modified to use Philips valves.
CR101 receiver of normal commercial design covering 10-200 metres
CR 105

(the latter two receivers really originated from Philips Eindhoven design. Though, were not particularly of high standard compared to Lorenz and Telefunken products, AOB)

These were made for the German Navy. Do84 an F.M. receiver 36-48½ Mc/s.) and part of the complete equipment DR85 for which the transmitter (output 100 w) was being developed at Hilversum (thus at NSF works, AOB). It is understood that this set was originally designed to work between the islands of Greece.

Philips were asked to develop an Antenna Amplified to enable several receivers to be connected to one Antenna. The wavelength coverage was 1.6 – 3.2 ms. (= MHz, AOB) with a gain of 6db. The input and output impedance was 150 ohms This was for air force use but there was no urgency. No samples or drawings were available at Eindhoven.

Eindhoven made some units for an equipment known as GERA. The parts made gave no clue as to the use of the equipment or to its frequency range, but engineers concerned thought it might be radar. The Germans on evacuation removed all samples.

It is understood that the most important work being carried out at Hilversum is connected to Jager programme (meant is 'Jäger' = fighter, AOB). In September, 1943 an urgency was placed on the production of FuG 16 (assemblage, as the original design originate fro Lorenz, AOB). Philips were to make 4200 of a total programme of 30,000 – 40,000 required by August 1945. (FuG 16 was a air-to-ground transceiver, which also allowed distance measuring FuG16ZY, AOB)

The BRA 30/20 is a beacon transmitter consisting of two separate transmitters R.F. carrier 6-7 metres, but differing mutually in frequency by 500-2000c/s. The assembly was on a railway mounting and could be rotated. (This was for the navigational beacon Bernardine, regard also the contribution on this website "Navigational Aids" , AOB) Assembly to this mounting was carried out by Telefunken, who held details as secret documents.

The DR85 is an 85 kw Beacon, mounted in a "car", and originally intended for Afrika. It was reconstructed for Russia, but was apparently too late, and was transferred to Fighter programme. (we have the entire DR85 documentation in our archives, AOB) It originally operated between 9 and 10 metres, but this was later changed to 6-7 metres. It was continuously modulated (AM).

The first one was oil cooled, and on test the oil caught fire. The last information was that the Germans were trying to find a substitute for oil as cooling medium.

It was recently proposed to develop an FM version of this equipment.

The DR83a was developed by Philips at Hilversum as a portable sender/receiver for the German police. It operated at about 50 Mc/s., but no other information was available in Eindhoven. It was understood that no deliveries were made.

DR87 was developed at Hilversum as a 350 watt. F.F. transmitter working on 150-134 Mc/s. It may possibly be the transmitter for Mohring equipment. No information on progress or deliveries is available.

The STEINHAGE gear was developed it is thought by Lorenz and some unimportant parts were made at Eindhoven. It is understood to be probably a D.F. set for use in Africa, but so far as Eindhoven is concerned, the matter was dropped some time ago. Production was subsequently undertaken by GEMA of Berlin and the trade name of equipment changed to Erstwart and some parts were used. 1500 Steinhage (Steinhäge?, AOB) and 300 Erstwart are believed to be the total production figure.

The committee were told that a pulse modulated transmitter is in course of development at Tilburg. This does not tie up with other statements on Tilburg's activities, namely that a component factory only exists there.

3. Aerials.

The only work carried out by Eindhoven in this field was the development Of a diamond aerial with no terminating resistance. The results appeared to be good on paper but disappointing in practice. The scheme used dipole as the matching impedance.

4. Miscellaneous.

Philips did some work on LIP MICROPHONES of the ribbon type. The one model sent to Berlin was bombed. It was designed for use in aircraft and with its transformer to have cut-off at 400 c/s. It was possibly used also for sound ranging.

In October 1943, Philips were asked to develop a LOUD SPEAKER having a reasonably linear response from 200 c/s. to 3000 c/s, with special limitations on magnet material, which had to be nickel-free. It is believed that this work was cloak by the Germans for the development of magnets to be used for anti-tank mine destruction.

Engineers from Telefunken visited Eindhoven to discuss Tropical Finishes, but it was believed that no work was intended at Eindhoven and the interest was merely that of a rival company in the work which had been done by Philips. The conditions now considered important are -50° C and altitudes up to 1200 metres.

An ALTITUDE MEASURING EQUIPMENT developed by a laboratory at Oberpfaffenhein (Oberpfaffenhain?, AOB), south of Munich, was given to Philips for the production of 100 development models (This certainly was the FuG102, AOB) The instruction was later changed to the manufacture of exact copies of the original design, but these on test were completely useless. The job transferred to HUTH, who, it was proposed were to make 4000 per year, but after about six months HUTH was destroyed by R.A.F. The equipment, of which a sample was obtained, uses a 0.3 micro sec pulse, and the receiver which measured about 15 cms cube, including the cathode ray tube, had an I.F. of 20 Mc/s and a bandwidth of 10 Mc/s. The valves used were RV12P2000.

A conference had been arranged at Potsdam late September 1944 to discuss SYSTEMS OF MODULATION, bur due to the liberation of Eindhoven, Philips' engineers were unable to attend. There had been interest in Pulse Modulation, and Dr. Busse had visited Eindhoven about Christmas 1942 to discuss this. He had asked for no work to be done, but Philips has made a laboratory model.

Philips have not been asked to any work on QUARTZ CRYSTALS, WAVEMETERS or NEW COMPONETS.

Philips carried ot no work for the Germans on TELEPHONE CABLES but HIKKERTHAL (Hickerthal or Hackerthal? , AOB) near Hanover made a Copper Covered Steel Assault Cable.

No official interest had been shown by the enemy on TELEVISION but enquiries had been made by BRENDEL of the Air Ministry and WEISS of the Reichspost (G. Weiss, AOB).

There is no knowledge of H.U.V. curves used by the enemy.

A large valve work exists at Erfurt, and the navy stores depot is now in THALE IM HARZ.

It is clear that manufacture use code name for equipment different from that used by Wehrmacht, and in some cases the latter name was unknown to them. The marking used by Eindhoven on their equipment was FEX (for example caw was NSF/Philips Hilversum; bou was Telefunken, dmr was Lorenz, AOB)

Conclusion

It is clear that Philips' have been kept out of the picture on anything secret or novel, but clues picked up at Eindhoven may well repay following up at Hilversum and at HERTOGENBOSCH (pre to it should stand 's , AOB), a place about 20 miles from Eindhoven, which has been used as a Receiver factory since accommodation at Eindhoven became acute.

28 September 1944

5. Report by Infra-Red Group.

Development in the Infra-Red at Philips Lamp Factory, Eindhoven.

Discussions on the above subject were held with Messrs. Teves, Couterier and van Alphen.

These gentlemen described the construction and use of Philips infra-red telescope of the kind supplied to the British Admiralty in 1940, and stated the one such instrument had been delivered to Dr. Kotecki of the Polish Government at request of the British Admiralty. No instrument had been delivered to Germany before the occupation of Holland.

After the German occupation, development on infra-red projects was practically stopped, and twenty tubes awaiting delivery to the British Admiralty were broken to prevent their falling into German hands. A few improvements of minor nature were made, but knowledge of this was withheld from the enemy.

In the summer of 1940 the Germans asked Mr. Six of the Physics laboratories at Eindhoven to construct a multiplier with a caesium surface and an amplifier which was to give constant output under illumination conditions varying from 1-10,000. Dr. Teves believed that it was to be used at audio frequencies and that it may have been for an infra-red telephone. One model was made, but no production was undertaken, so far as is known.

In June 1940 a German (name unknown) who had been an employee of Philips at Hamburg visited Eindhoven. He knew of Philips transactions with the Polish and French Governments, and with the British Admiralty, and that the Dutch Army were interested. The instrument belonging to the Polish Government had been found by the Germans but they did not find those sold to the French, which were believed to have been removed by the B.E.F. (= British Expeditionary Force, AOB)

In August 1940 several Germans from Reichs Luftfahrt Ministerium visited Eindhoven and asked for samples and demonstrations of the infra red telescope. They were shown some inferior samples. They expressed interest and requested an experimental set. An inferior set was supplied. The Germans said it was very interesting but not sensitive enough.

In December 1940 Schonwald (Schönwald?, AOB) and Lagguth of the Research Division of the German War Office (= most unlikely, probably meant OKW or Waffenprüfamt, AOB) visited Eindhoven and discussed possible improvements in the equipment. Weiss of the German Post Office (= RPZ, AOB) also discussed the use of multipliers. A report on these improvements, of a rather discouraging nature was made by Teves at the request of Weiss, who offered full facilities, and forwarded, via the Philips Company in Berlin. Hereafter virtually no further interest was expressed until about two month ago.

Shortly after the invasion of Normandy, a party of flustered and anxious Germans visited Eindhoven, to enquire about an infra red apparatus reported to have been made by an Italian called Del Vecchio (Director of Philips Monza Works near Milan. This apparatus had reached Berlin in a broken condition. The Germans were chiefly concerned to clear themselves of responsibility for what they believed to be an important project, and were relieved when Teves represented that the instrument was of small importance.

Though not coming under the heading of infra red work, it is of interest to note that Hanle from Göttingen visited Philips a few months ago, accompanied by Dr. Baumann. They were interested in cells with multipliers for the region of 3000 - 3500Å. It is believed that they were required for sound track reproduction, for commercial purposes. No work resulted from this enquiry.

Conclusions.

1. No useful work in the infra red field has been done by the Philips Laboratories for the Germans.

2. The impression gathered by the research workers at Eindhoven was that the Germans had little interest in the electronics device for the detection of infra red. It is concluded that the Germans placed no confidence whatever in the firm.

3. Confidence is felt in the trustworthiness of the statements made by Philips employees, which are believed to have been complete and accurate.

Note on a hot air engine under development in the Research Laboratories of Philips of Philips's Factory, Eindhoven.

The principle of the hot air engine (also known as 'Stirling' engine, AOB), which is not new, has in recent years been applied by Philips to develop a prime mover which has considerable potential military value.

Experiments concluded on a 2 H.P. motor were promising and a 10 H.P. motor was recently completed and particularly tested. Unfortunably, before the tests were completed the machine was removed by the Germans at the end of August. The available data are given below:

Approximately 8-10 H.P.
Efficiency 15 % on half load. This figure is the ratio of available work to fuel energy expended. The figure could be improved by employing waste heat of the exhaust gases.
Speed 1500 r.p.m. but could go up to 300 r.p.m.
Number of cylinder – 4.
Capacity of each cylinder 80 cc.
Overall dimension (very approximate) 15" x 9" x 9".
Fuel – any method of heating which does not produce much smoke may be employed.
Water cooled.
Weight not known.
Working temperature 600 – 700° C.

Special Advantages.

High efficiency at low load, the characteristics being similar to those of a series motor or a steam engine.

Quite running – no exhaust noise. Noise depends on workmanship.

Long life expected after certain development has been successfully completed.

Little attention required on maintenance.

High acceleration due to lightness of moving parts. The flywheel may be dispensed with.

Absence of ignition troubles and interfering with radio.

Totally enclosed and can therefore be operated und adverse conditions.

Lends itself to manufacture of very small units, for example, battery charging units.

Ease of starting.

Smooth running when made in four-cylinder form.

Possibility of increasing the speed and power by using gases such as helium or hydrogen in place of air.

Use virtually no oil, other than fuel.

Problems to be overcome.

Lubrication is not yet entirely satisfactory, and associated with this is the development of a satisfactory regenerating unit. The difficulty is that vapour from the lubricant clogs the pores of the generator.

Speed control entails some form of compressor, which may be inconvienent.

The lowest speed is controlled by gas leakage past the piston which depends on manufacturing accuracy.

Means of heating may require development.

Attempts to deal with problems.

A regenerator has been designed of fine guage nickel-chrome non-corrosive steel wire, corrugated by passing between two wheels before winding on a coil.

To withstand the high temperatures, non corrosive alloy steels have been used (Krupps V2A)(= kind of stainless steel, AOB) which have poor thermal conductivity but were available. Materials of better conductivity may perhaps be found.

Recommendations.

In view of the probable value of this device in a wide variety of circumstances it is recommended that immediate steps should be taken to manufacture two motors of the 8-10 H.P. size, (one U.S.A.

and one for U.K.) so that tests can be carried out. It is further recommended that development of smaller unit (say 1-2 H.P). be undertaken.

It is understood that Philips are anxious to proceed with development, but the state of their laboratories precludes for (probably) some months. As, however, all the personnel are available, it would appear to be desirable for the work to be undertaken either in the U.K. or U.S.A. where better facilities are available. It is understood that this would probably be acceptable to the Philips Company.

Schmidt Lenses

Mr. Rinia and Mr. Van Alphen described a novel and simple method of making Scmidt correcting plates for spherical mirrors, which should be useful if these components are required in numbers.

The procedure is to make a polished metal mould, the contours of which are from for to ten times as high as those of the required plate. Gelatine solution at 400° C is poured into the mould, and a flat glass plate is placed on the gelatine solution. The whole is cooled, when the semi-solid gelatine can be separated from the mould. It is however, left in contact with the glass plate.

Complete and suitably controlled drying of the gelatine follows, when shrinkage due to loss of water brings the plate to the desired form.

It is to be noted that the errors in the final gelatine surface will be less than those in the mould, the factor being due to the shrinkage of the gelatine. The strength of the gelatine solution is suited to the scale factor for the mould contours (10 – 20%).

Specimens of the Schmidt plates were shown and one was handed to the Mission.

The definition of photographs taken with the help of these Schmidt plates were very good. It appears that relative apertures of f/1 or less can be employed as when using glass plates figured by hand.

For certain types of infra red equipment, and possibly for photography at night, these plates may be useful.

28 September 1944.

Appendix D.

List of Correspondence given to the C.I.O.S. Mission By Dr. Teves

1. Nat.Lab.
Dr. T/CS.
18.1.1941
Results likely to be obtained from further research on the luminoscope with a view to a tenfold increase in the brightness of the image.

Dr. M.C. Teves.

2.

Philips-Electrospecial Co. (Elektrospezial, AOB)
Kurfürstenstrasse 126,
Berlin, W.62.

Wirless 11 appendices
Ki/CS
D.693

(for Mr. Benndorf) 10th December 1940

Concerning, Luminoscope.

p.p. Philips Valve Factory
P.A. Zwartendijk

3.

K.A. Wireless
19.12.40 Ki/CS.

Note on negotiations regarding the luminoscope carried out on the 19th December.

Present:

Dr. Schondwald (Schöndwald?, AOB) – Research branch of the Army Ordnance Department (= Waffenamt, AOB), Berlin
Mr. Langguth – Research branche (Waffenamt, AOB)
Eng. Kingma (Ir Kingsma?, AOB) of Philips
Dr. Teves Philips
Eng. Verff Philips

4.

Eindhoven. 19th December, 1940
K.A. Sendewesn (Wireless)
Jip/RS. 27.11.40

Memorandum relating to negotiations with Dr. Rindfleisch and Dr. Grosskurth of the Naval Signalling Research Department (NVK?, AOB). Luminoscope (subject).

5.

Wireless V. Accessories.
Ki/CS D 898.
Re: - Luminoscope.

Philips-Electro-Special Co.
Kurfürstenstrasse 162.
Berlin, W.62. (for Mr. Benndorf)
23 January 1941
pp. Philips Valve Factory
P.A. Zwartendijk.

5. Radio Components.

1. A previously prepared questionnaire was distributed first to the research laboratory and later to Mr. Dyksterhuis (Dijksterhuis?, AOB) on the production side. This questionnaire is reproduced at Appendix "E", and covered enquiry on the complete division of major components, associated materials and techniques.

At the first general discussion with the research staff, on Saturday September 23rd, the following team was selected to handle components:

For C.I.O.S.	For Philips
Dr. Spangenberg (leader)	Snoek
Charleton Dyer	Verwey
	Bienfait
	Six
	Vermeulen

Only Six and Vermeulen were available that day, and it was plain from our talk and examples of developments that the last for years of work in the field of condensors, speakers and microphones had not produced anything comparable with the progress in America and Britain over the same period. Later conversations with the rest of the Philips team confirmed the first impression, while a tour of the factory and detailed examination of components production and equipments, and a final meeting with Mr. Dyksterhuis, completed our decision that no meritorious progress had been made in Eindhoven, of value to the radio industry in America and Great Britain.

In fact, as the main mission report will show, the Philips organization had worked as hard as possible against progress, apart from their basic isolation from America and British sources of technique. German demands for development and production were treated to long and arduous approaches so successfully that without exception the standard range of components and materials were decidedly of the cumbrous vintage of 1939/40.

There was no real knowledge of the extent to which miniaturization and associated improvements has progressed on our side and without exception, all the research and production leaders with whom we talked expressed a fervent hope that an early opportunity would arise when they could visit Britain and America to bring themselves up to date.

2. Production facilities.

Certain components should be of interest to the Director of Communications Production (DCCP) in M.A.P., to provide relief on known shortages in British capacity.

(i) Vibrators.

The Philips vibrators have been made since 1937 and were based originally on the Mallory principle. Present production is 1,000 per week, but this can be increased on short notice to 2,500. The following types are made, and samples of each are for the moment retained by DGCE for examination.

Type No. 7946	6 and 12 volt
" " 7948	6 and 12 volt
" " 7936	6 volt
" " 7934	110 and 220 volt DC.

Philips do not make the tungsten contacts. They are imported from the firm Volt and Molybdenum.

(ii) Selenium Rectifiers.

Producable in large quantities. These are standard types identical with those made in America by Federal (I.T. & T.) and in Britain by Standard Telephones and Cables. Samples are with DGCE.

3. German Contacts.

Philips depended on Germany for considerable material, such as ceramics and selenium. They received some manufactured components from Germany, and likewise shipped their own components to German orders.

Here follows a list of German firms and names of key personnel with whom Philips had dealings.

All of the firm listed, it was urged upon us time and again that production of ceramics was concentrated in the one firm of Hescho at Hermsdorf, Thuringen. The eradication of this factory by bombing would effectively cripple all German radio production. (noticing this strong point, Bomber Command and U.S.A.A.F. both did not pick up this very wise advice. They did not bomb Hescho!, AOB)

(i) Ceramics, Ceramicon Condensors.

(a) Hescho, Hermsdorf/Thüringen. – This firm makes the bulk of all radio cermicons. There is a ceramic "ring" in Germany., of which Director Scheid of Hescho is present. Philips marked Scheid for special attention, also his Chief Engineer, Dr. Gans. Of lesser importance were Dr. Haase, and the Commercial Manager and his assistant Umlauf and Seiler. A complete cataloque of Hescho products accompanies this report. (consider on our website: Hescho guide 1939, AOB)

(b) Stemag, (Der Steatit-Magnesia Aktiengesellschaft) at Berlin, etc. This company is a relative small producer, operating under a patent interchange and working arrangement with Hescho. All ceramics ceramics production is concentrated in Hermsdorf. A catalogue is attached.

(ii) Small Metal Parts for ceramics Condensers.

The main Supplier to Hescho is Metalwaren Fabrik Stocko (Metallwarenfabrk?,AOB), at Wuppertal, Eibersfeld, of which Hafenacker the Works Manager was singled out as most important. The Director is Hankels, and the Commercial Manager Nonvertie (?, AOB). The location of the plant is plainly marked on the accompanying map.

(iii) Glass Insulators.

Genaer (incorrect should be Jenaer!, AOB) Glasswerk, Schott and Gen. at Gena (wrong is Gera, AOB).

This factory was reported only slightly hit and production not affected.

Chief Engineer	- F. Blumenstein
Factory	- Netter
Commercial	- Piersdorff
"	- Wachter
"	- Reitmeier

(iv) Condenser Tissue.

The most important producer is Schoeller and Hoesch, at Gernsbach, Baden. The works are intact.

Director	- Hoesch
Chief Engineer	- Baumlein
Production	- Ziegler

(v) Aluminium Foil, Paper Condensors, Electrolytic Condensers.

(a) Aluminium Waerwerk, Erbtwerk, Grevenbraich (Grevenbräuch?, AOB) – The main producer of foil. The works are intact.

(b) Siemens & Halske, Berlin. A catalogue of this firm's full range of condensers is attached.

(c) Willibald Bohm (Böhm, AOB) at Wolkenstein (South of Chemnitz). This firm produces small electrolytics for Philips, Vienna. A sample condenser is attached, of 50 μF, 6/8 v, -40° bis 70°. The factory looms large in the small village.

(vi) Selenium Rectifiers.
Philips obtained selenium from Germany under permits issued by the Bureaux given at the end of this list. There were three German producers of rectifiers, and an official German report on their products is attached.

(a) A.E.G., Berlin. The key individual is dr. Bruncke, and the commercial representative Kugler (Kügler?, AOB).

(b) S.A.F. (Süddeutsche Apparaten-Fabrik, G.m.b.H.).
Nürnberg 2, Schließfach 282 (= P.O. box, AOB).
It is important to note that of the key men, Stegmann and Heier also controlled the German Government Control Division on selenium at Nürnberg and once at Berlin; it caused a temporary shortage but the works were rebuilt and are now at full capacity.

Director	- Stegmann
Chief Engineer	- Dr. Kiphahn
Engineer	- Dr. Schweikert
Commercial	- Schumann
"	- Heier

(c) S.S.W. (Siemens-Schuckertwerke, Berlin) (Nürnberg, AOB)

4. German Government Offices Dealing with Components.

(i) G.B.N. (General Bervelmacht (wrong! Bevollmächtigter, AOB) für Technische, Nachritenmittel) Berlin.

Chief	- Major Dahmen
Assistant	- Lt. Bense

(Philips applied here for allocation orders)

(ii) Z.A. (Zentral Antragslenkungsstelle, beim Arbeitsring „Trockengleichrichter, housed in S.A.F. Technical Bureau, Berlin W.3, Martin Lutherstrasse 90.1)

Selenium Controller – Heier (also Comercial Manager of S.A.F.)

(iii) Arbeitsring Trockengleichrichter at Nürnberg. This was the main office of the Government's selenium control, housed in the office of S.A.F.

Controller	- Stegmann (also Director of S.A.F.)
Assistant	- Heier
"	- Seitz

(iv) There was a local representative of G.B.N. resident in Holland – Major Heyde.

5. Components supplied by Philips to German Firms.
The principal orders on Philips for all classes components were for supply to the following firms. The key men are marked 'x'.

(i) Anschutz & Co. G.m.b.H. Kreiselgeräte, Kiel (Neumulen)(Neumühlen?, AOB)

x	Schofer
x	Dr. Schiemer
	Riedel
	Thoss

(ii) C. Lorenz A.G., Berlin Tempelhof, Lorenzweg.

Dr. Johansson and
Hoffmann, Eng. Dept.

(iii) Siemens & Halske, Wernerwerk, Berlin

x	Kaiser
x	Weiden Hammer
x	Gellinek (Gellineck? AOB)
	Manz
	Kassel
	Director Piemel
	Daniels
	Seide
	Eilers
	Dangelmaier

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6. Report by Foreign Office and Ministry of Economic Warfare (Economic Advisory Branch) on Eindhoven Visit.

Section 1.

German Organization at Philips, Eindhoven

All German order for Philips, Eindhoven, came into the Projektburo in the Verwaltungsamt, an office with German personnel who were only permitted to make contact with Philips management. More recently German officials were placed in the set and valve factories with supervisor duties, but Philips management were still successful in insisting that any directives or complaints should be made through their intermediary.

Dr. Rohrer, who went to Philips in November 1943, was the first organizer to achieve any degree of success. He cut down all production except that for military nature and ordered that production of non-military equipment in any period could only be permitted after a certain specified minimum of production for the German armed forces had been realized. Baumann from Philips' Hamburg factory was sent to Eindhoven as supervisor and left about the end of August this year. Particulars of German administrators and technicians, most of whom had visited Eindhoven is given in Appendix I.

Reports were submitted by the Verwaltungsamt to B.H.F. (Befehlshaber für die Hochfrequenzforschung, AOB) Abt. 2, Berlin-Gatow 2. Kladowar Damm.

All military equipment made by Philips fort he enemy had to pass through the B.A.L. (Bauaufsicht Luft) German Final Inspection Departments; these were, however, dismantled on December 6th 1943 and the standard gradually became muck slacker. There was a German test laboratory at Eindhoven for sets, another at Oss for valves and another at Hilversum. (at the NSF works, AOB)

The Germans were in telephonic communication with Germany but use of this service was forbidden to Philips officials.

Goods were frequently dispatched by road and any case were never shipped direct to their final destination.

German organization was good on the whole but enemy officials were disinclined to take any responsibility upon themselves, always preferring to refer queries to higher quarters; in consequence, the administration was not flexible and was totally unable to improvise. This provided Philips management with good opportunities for delaying and go-slow tactics.

An example, German drawings had to be modified to form suitable for Dutch use and Philips were constantly raising queries on these, especially regarding tolerances where Philips had always worked to a standard different from the Germans. Another trick consisted in destroying the original of letters written to German concerns and retaining the copy as evidence to support the assertion that the letter had been as correspondence with Berlin recently took three weeks each way, this led to considerable delay.

The success of these tactics is reflected in the production figures which could only be regarded by the enemy as extremely unsatisfactory.

Section 2.

German Treatment of Philips Personnel

Philips lost a total of 3,000 workers to Germany; the first large batch was taken away at the beginning of 1942 and the second in May of the year. Toolmakers and other skilled men were Specially required by the Germans but all types of labor (labour, AOB) were taken including female labor.

It was stated that approximately 40% of the total of 24,000 workers employed by Philips throughout the Dutch organization in 1942 were women.

The percentage of spies or persons collaborating with the enemy was estimated at 1%.

Philips had employed up to 1,000 workers from the concentration camp at Vucht, 30 km. from Eindhoven, and in this way had been able to provide these people with a better existence, and, in many cases, prevent their removal to Germany. Any strikes or mass disobience were rigorously punished, individuals being taken at random and publicly shot as an example.

Section 3.

Review of Departments visited during tour of Philips Strijp factory on 25th September 1944.

No attempt will be made to describe here exact location of the various department visited; for information on the factory layout the plan attached to this report should be consulted. (E.A.B. was accompanied by M.A.P. (Mr. Carleton Dyer) and U.S.S.C. (Dr. Spangenberg).

The first department visited (first floor in main block) was the resistor and potentiometer section (Philips made rather poor quality potentiometers, which were most "noisy" after a short while!, AOB) which appeared to quite undamaged. Various types or resistor were inspected including some on which the ohmic value is finely controlled by the length of a spiral groove which is cut while checking the resistance. Samples of there were obtained. An official stated that they made their own end-caps. Nothing however, of a novel nature was seen in this department.

The party then visited the research and development departments (2nd floor) which, in accordance with recommended practice, were separate altogether in working liaison. The life-test laboratories were on the same floor.

The party was then shown (3rd floor) the production line for the A3 (I do not know what the actual set type-number was, AOB) a small transmitter that had been made for the Germans. About 600 workers had been employed on this line. The Bauaufsicht (BAL) (German Final Inspection Department) was located on the same floor.

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The party then entered another block containing the transmitting valve section. A sample of the P.35 (=RL12P35) was seen and it was stated that the Germans asked for 9,000 of this type monthly and got about 6,000 monthly. The enemy had taken the all machinery suitable for valves up to 100 w. size, the party passed to the section producing water-cooled valves and saw the transmitters used for test purposes.

The Emmasingel factory was also visited but there was not sufficient time …..

Section 4.

Development and production by Philips, Eindhoven under German control.

Radio equipment for fighter aircraft had the highest priority except for the Adolf Hitler programme – a secret programme of which the exact significance was not known and which involved code names of animals and stars.

Practically no new devices of importance were developed for the enemy.

The German Air Force and Army wanted their own designs but the Navy had to be content with what was easily available, consequently the Navy received the bulk of supplies and approximately 16,000 transmitters were delivered to them.

The Army and Air Force insisted at first on die-castings for communications apparatus but these had to be sent from Germany and caused great delay. Later to obviate delays they changed to a "built up" construction, chassis being made of aluminium and, more recently, of iron. Copper wire was substituted by iron wire with copper coating.

Many small AC/DC domestic type radio receivers were made at Eindhoven for German troops, Philips supplying complete with valves.

Philips also made components for the Gera transmitter-receiver an infantry pack set. (I don't know what it actual type number should be, maybe Torn Fu.g?? AOB) Although the order placed in July 1940 was given very high priority, nothing was delivered until 1943.

The enemy placed orders with Philips for large numbers of 100 w. transmitters of 1933 Lorenz type A3K, designed by Tomasari. (A3K might be regarded a code-name, as this transmitter was known as 100 WS, AOB) Philips Eindhoven did not, however, complete and the balance of these orders was finished by Philips. Aachen, and Telefunken, Erfurt.

Philips supplied the enemy with components for searchlights, including cooling sets, transformers, lamp fittings and lamps.

Herr Plendel (Plendl, AOB) of the Physikalische Reichsanstalt gave orders to Philips for research and development work but serious work on this programme was never begun. The field of research was to cover:

> Amplifiers, P.M. loudspeakers, rectifying apparatus, measuring apparatus for use below 30 cms. Valve volt-meters, thermocouples, velocity modulation, apparatus for wavelength below 15 cms and 20 cms. Fluorescent screens for cathode ray tubes, ceramic materials for H.F. applications, synthetic crystals and light-weight accumulators.

It is interesting to note that apart from receiving sets for the troops only apparatus for civilian use was produced until 1942.

In the years 1941/44 the percentage of production consigned to the Wehrmacht was as follows:

1941 – 20% 1942 – 25% 1943 – 35% 1944 – 60%

With regard to valve production, after the raid in December 1942, the enemy insisted that all manufacturing capacity should be dispersed. Plants were installed at Tilburg, Oss, Venlo and Lent

near Nijmegen but these never became self-supporting. 30% of valve production was thus dispersed away from Eindhoven.

When the Germans recently withdrew from Eindhoven, they took with them nine large old-type bulb-blowing machines which they sent to Weisswasser. Production capacity had thus in theory been halved, but it was explained that this deficiency could be largely made up by increased production on the remaining machines. Normal total capacity was stated to be 6 million valves of all types with a maximum capacity of 8 million annually. Half the valve making machines had also been taken away from Tilburg but this was only a small factory.

Regarding lamps, it was stated that two-thirds were made at Eindhoven and one-third at small dispersal factories. 38% of production went to Germany. Philips made 90 million lamps in 1938 at Eindhoven and in France (Compagnie des Lamps) in addition to 200 million lamp parts.

Mr. Carleton Dyer (M.A.P.) obtained further information on lamp production which he offered to put at the disposal of E.A.B.

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Section 5.

Apparatus and Research Establishments of Particular Interest

It was reported that there is a German set of great importance and secret design at Louvain laboratory.

Philips have a complete Altimeter from the German Forschungsanstalt. (= FuG102, AOB) It is a laboratory model on the basis of which the enemy wished to place a large order, however, the Germans placed the order with Huth, Hamburg.

The Germans were particularly interested in a small vibrator of short life. This vibrator had to withstand operation three times only. Firstly when tested as a component, secondly when tested in associated apparatus and thirdly its expected life which was two seconds only. It was thought to be for use in some tuning device at 3,000 ~ and samples are available at Oss.

It was mentioned that the Germans showed general interest in 10 cms. Work at first but later focussed their interest on magnetron development, especially after Dr. Kretzmann, of the Luftwaffe valve research department, had inspected radio equipment from crashed Allied aircraft. Reports from other field party groups provide fuller information on this point.

It was thought that the enemy intended to set up laboratories at Munster (Münster, AOB) Dachteichen?, the latter under control of a Capt. Bottcher (Böttcher?, AOB) who took away apparatus from Amsterdam and Leiden (Universities? AOB) for these laboratories and visited Eindhoven on September 16th, 1944 in company with Lieut. Burger his subordinate and Major Fischer to whom he was responsible. He and his associates remained at Eindhoven for twenty-eight hours and systematically looted the laboratories, removing test apparatus and any work completed for the Plendel (Plendl, AOB) programme. (to my knowledge, Plendl was then already about more than one year out-of business!, AOB)

Section 6.

Forward Target Data

On several occasions Philips officials strongly recommended that German ceramic factories should be bombed as they considered this would be a most effective method of disorganizing the whole German radio industry. (they certainly focussed on Hescho. It is known, that Bomber Command did not paid attention to these strong recommendations! AOB) Addresses of German manufacturers producing ceramic and other H.F. insulators were given and exact locations marked on maps and plans handed over to the leader of the Mission.

Further potential bottlenecks mentioned were die-casting, fluorexcent coating for cathode ray tubes and selenium.

Some of the more important targets suggested by Philips officials are given below.

Name of Firm	Address	Products
Hescho Isolatoren Gesellschaft A.G.	Hermsdorf (Thur.) Also a works at a Gera. Saxony	H.F. Porcelain & Ceramics
Steatit-Magnesia AG	Lauf on the Pegnitz, Nr. Nürnberg, Bavaria	As above
Elektro-Isolier Industrie A.G.	Wahn Nr. Cologne Rhineland	Insulating Materials (plastic insulating tubing, pertinax, e.t.c..
Dielektra A.G. (formerly Meirowsky A.G.)	Porz, Nr. Cologne, Rhineland. Head Office Hallesches Ufer Berlin	
Schott & Genossen	Jena, Saxe-Weimar (Saxen!, AOB)	Glass parts, Glass rings, for condensers.
Stamm	Berlin	Fluorescent coating for cathode ray tubes.
Gossen	Erlangen-North of Nürnberg Bavaria	Electric meters & instruments for radio.
Venditor	Troisdorf, Rhineland	Plastics & insulating materials.
Schollerwerk G.m.b,H.	Hallenthal, Rhineland	Nickel tubing for radio valves.
Prevag.	Oberwill Nr. Swiss Frontier	" " " " "
W.C. Heraeus G.m.b.H.	Hanau (Main)	Precious metals for radio valves
Deutsche Gold- und Silberanstalt	Frankfurt (Main) Weissfrauenstr. 9	Like above

Section 7.

Information obtained on other European Radio Firms.

Philips Radioröhrenfabrik, Hamburg. The Address of this firm was given as Horst Wessel Allee, Lockstedt, Hamburg; it was managed by Mr. Bauman who was later sent in a supervisory capacity to Philips Eindhoven. It is entirely separate from Muller (should be Müller) factory at Hamburg,

where X-ray apparatus and possibly small quantities of valves are manufacture. The factory was not thought to have been seriously damaged by bombing and the number of employees was given as approximately 1,500 made up chiefly of women, a large number of whom were Russian.

Radioröhrenfabrik was stated to be making military receiving tubes and the output from the main production groups in the factory was estimated to total 3 million valves yearly. A small number of transmitting valves were also produced and probably about 10,000 small cathode ray tubes, annually, which were required by the German Air Force and Navy (submarines) as well as for laboratory apparatus (the latter is more likely than the first statement, AOB).

The factory is practically self-supporting in that it manufactures all its own parts; glass is obtained from Weisswasser. Power is taken from the public supply system, the factory having no installed capacity.

There is a small satellite location at Horneburg, the other side of the river in Hamburg.

Philips Schrack Wiener Radio Werke. The address of the Philips valve factory was given at Attegasse, Vienna. It was thought that this works had not been damaged by bombing and output was estimated at 2 million receiving valves, annually, there being 12 main valve production groups. The number of employees was given as approximately 1,000 and it was stated that part of the factory was devoted to the production of other radio apparatus. This factory was practically self-supporting in respect to valve manufacture, making all its own parts and obtained its glass supplies from Weisswasser.

There was stated to be a satellite location at Krems, near Vienna, where valve parts and complete assembles were manufactured.

Another Vienna factory of this group was mentioned as manufacturing radio apparatus and electrolytic condensers for operation at high altitude. These condensers which had been developed in Vienna were housed in a special container and wete of (were, AOB) of great urgency.

Philips Prague factory: This factory of this group was stated to have six main valve production groups employing 500/600 employees. Output was estimated at approximately 1½ million receiving tubes annually and small number of transmitting valves. This works was also said to be self-supporting.

Philips Warsaw factory. This factory, it was said, had been practically totally destroyed, only 12 employees remaining out of 2,000. The valve-making machinery had been taken out and sent to the factory of Stein, in Austria, but had been badly damaged, left exposed for long periods in transit, and was likely to be useless.

Philips Works at Monza, Italy. This work is located north of Milan and had in peacetime production capacity of 750,000 receiving and 2,000 transmitting valves yearly, but it was emphasized that it might now very considerably less in view of the difficulties they were likely to be experiencing in obtaining raw materials.

Philips Aachen factory. The laboratory for this factory is at Membach near Eupen.

Philips Tilburg factory is still making parts for radio sets, also Gera apparatus (is most likely Torn Fu.g., AOB) and a small number of valves. There are approximately 1600 employees.

Philips at s'Hertogenbosch. Development work is carried on this factory.

Weisswasser Glass Factories. This very important group located S.E. of Berlin supplies all the glass required by Vienna, Hamburg, and Prague factories mentioned above. There were also two main groups for receiving valve production with an annual output of approximately 200,00.

Telefunken. It was stated that Telefunken development laboratories and technical offices at Zehlendorf, employoing approximately 10,000 had been bombed out, unfortunately, not with great success and up to February 20.1944, work was proceeding normally.

The Telefunken factory at Erfurt received Gera parts (most likely Torn Fu.g., AOB) parts from Philips, Eindhoven, for assembly and also equipment for tanks and electrotechnical apparatus.

Telefunken was stated to have a large receiving tube factory at Lodz (German name Litzmannstadt, AOB).

Total Telefunken output was estimated with reserve at 12 million radio valves of all types annually.

Lorenz. It was stated that Lorenz works in Berlin near the Oberstein tower had not been bombed. Special valves for high frequency use are among the products of this factory. Another Lorenz factory was located Mulhausen (Mühlhausen?, AOB) (Thuringia) and the name of the manager was Heydrich. Total Lorenz valve production was estimated at 2 million annually.

TeKaDe. The Research and Development Department was first situated in Berlin at Kaulshof with object of maintaining close contact with the German "Reichspost" organization. Research and Development are carried on up the stage of providing production models. Despite their wide separation close contact was maintained between the departments, the works at Nürnberg and Messrs. Felten & Guilleaume at Cologne by regular telex communication and frequent meetings. The number of employees at Berlin was normally 150 of whom 30 had received higher training. At present there appears to be great shortage of personnel with higher academic qualifications and the whole research staff may consist only of Dr. Baum and a Mr. Schmidt whereas in normal times may appear very small it must be borne in mind that the research is confined to specific objects and therefore good results may be obtained in limited sphere.

Development orders are dealt with in the following manner. The German Government places research and development orders and pays for the cost of such work; for this reason no charge for laboratory expenses is made in TeKaDe quotations. Competition is not aliminated by this method as firms putting up good orders suggestions are more likely to receive research and development orders.

The present research position at TeKaDe as given by one of Philips Laboratory officials is as follows:

Television: Stopped for the time being.

Multichannel Systems: Practically stopped. Work has been done on a 100 channel system for concentric cable and beam transmitters. Difficulty with regard to distortion has been experienced with the last named. It is believed that practical results have been achieved with up to 10 channels and similar systems have been used for some time by the Russians. The Germans considered this system particularly applicable to barren areas such as in Africa.

Cuprox cells: It is highly probable that this work comprises the greater part of their present activities. It is hoped to dispense with selenium which has to be imported and

also to use home-produced copper. It was thought that good results had been achieved and production would be considerably increased in the near future.

Condenser Dielectrics: Research is proceeding with the object of using artificial materials, especially in condensers of high capacity. It is said that they have been successful in reducing the temperature coefficient to one-third of the value given for styroflex by Siemens. This research way well have been conducted in collaboration with Felton & Guilleaume. (Felten, AOB)

Magnetic material for use in coils: Extensive research work is being done in this field, again, probably in collaboration with Felton & Guilleaume (Felten! AOB).

Bandwidth: It is mentioned that Dr. Baum, late of TeKaDe, expressed the same opinion as Dr. Kluge of A.E.G. when he visited Eindhoven, namely that future development will result in a bandwidth of 3000 c.p.s. and that an increase to 4000 c.p.s. would given little improvement. He stated that for high quality (music) a double channel, i.e. 6000 c.p.s., would be taken and improved results were expressed by reducing the lower limit from 300 c.p.s. to 200 c.p.s.

General: More recently they appear to have altered their research programme to the extent that, instead of searching for new systems and devices, they are now attempting to develop components which can be manufactured easily with the raw materials at their disposal. The question of raw materials has become of paramount importance.

A central institute provides the research departments with any technical literature required, providing extracts from practically any technical journal or loaning the original publication.

The Berlin factory, it was stated, had been severely damaged but most of the apparatus had been salvaged and a move made to Hof, northeast of Nürnberg. Sixty-nine hours a week are worked from 6 a.m. to 7 p.m., Saturday 6 a.m. to 5 p.m. If power fails at Saturday noon, the five hours lost are recovered on Saturday from 7 a.m. to 12 a.m. Personnel errands, even visits to the doctor, are forbidden and punished by forfeiture of a day's pay.

The TeKaDe factory is situated in Nürnberg near the buildings of the "Parteitag". Main products were given as apparatus for long-distance telephony. All work on radio sets and cables was said to have stopped. The management was stated to consist of the following individuals.

Dr. Winstein	Commercial Director
Dr. Goes	Technical Director
Dipl.Ing. Oeser	Factory Manager
Herr Konig (König? AOB)	Financial Manager
Rechtsanwalt Hutter (Hütter? AOB)	

The personnel consisted mainly, perhaps 80%, of women, most of whom were Russian. It was added that 1943 the reception and control buildings burned down and all measuring apparatus in it destroyed and not yet replaced.; the factory is now dispersed over six other works but it is not yet in full working condition.

Huth: were said to have a factory in Hamburg to which the Germans gave a large order for altimeters. It was mentioned that they had also converted a textile factory a Werda (Saxony).

Hatmann & Braun (H&B, AOB)were stated to be the producers of the best instruments, remote controls, scientific apparatus and wires in precious metals in Germany but recently no supplies had been obtainable from them. This might of course only indicate that Eindhoven had not the necessary priority.

Siemens: The Siemens location in Berlin, Askanischer Platz 4, was working in close collaboration with Askania on Scientific and electrical apparatus for the German Air Force. A catalogue was obtained of the products of this location. Siemens were also reported to have a condenser factory at Neuhaus.

Askania-Werke A.G. were located in Berlin Friedenau, Kaiser Aller (Allee? AOB) 86/89.

Paul Moser: A sample was examined of a combined valve-holder and screening can which this firm is producing in large quantities at its factory in Düsseldorf. (regard on this website "Die Einheitsröhre" article, AOB)

Astro G.m.b.H. This had been a small firm in 1939 manufacturing scientific apparatus but had grown very considerably and greatly increased its range of products and output. Location was given as Berlin Neu-koln (Neuköln, AOB), Lahnstrasse 30.

The following addresses and information were supplied by Philips officials:

F.Fuess, Berlin-Steglitz, Duntherstr. 8. Manufacturers of scientific and technical apparatus. Short history of the firm obtained.

Robert Abrahamson G.m.b.H. Berlin-Steglitz, Nicolaistr.7.
Teleg. Address Exactitude. Electrical measuring instruments. A comprehensive catalogue was obtained giving photographs of the factory and interior.

Felten & Guilleaume, Koln-Muhlheim (Köln-Mühlheim, AOB), Catalogue of scientific and electric-technical apparatus obtained.

Dennert & Pape. Hamburg-Altona. Manufacturer of mathematical and scientific instruments.

Norma Instrumentenfabrik, Bonwitt & Co., Wien Xi, Fickeysstrasse II.
Electrical measuring apparatus. Leaflet retained with photos of the factory.

Leppin & Masche. Engel-Ufer 27, Berlin SO 16. Factory for scientific instruments.

Dr. Phil. Max Ulrich G.m.b.H., Leipzig, Sophienstrasse 27.
Tel. Add. Luxor Leipzig. Factory for electro-technical apparatus.

Josef Neuberger, München 25, Steinerstr. 16. Factory for electrical measuring instruments. Tel.Add. Voltmeter, München.

N.V. Molybdenum Company. Reute (Tyrol), Austria(is most likely incorrect, as and N.V does not exists und German law, maybe A.G. is meant, AOB). Te.Add. Schwarzkopf Reutte Tyrol. Precious metal for radio valves.

Leybold und von Ardenne. Küln-Bayenthal, Bonnerstrasse 500. Oscilloscopes.

Thomsen & Schwarzkopf, Kiel-Wik. Projensdorferstrasse 9. Electro-technical apparatus. (this compnay might have produced the prototype of the 3 channel Watson-Watt type receiver, based on Wächtler's and Schellhoss' design. Activate on this website "NVK-Research", AOB)

Joh. Kremenetzky. Vienna XX, Dresdnerstr. 55-57. High value resistors.

F. Kurt Retsch. Düsseldorf, Birkenstr. 2. Electrical Measuring Apparatus.

Richard Jahre. Berlin SO 16, Köpenickerstrasse 33. Tel.Add. Superblock Berlin. Condenser manufacture. (not entirely correct Jahre also made resistors, AOB)

Paul Braun & Co., Berlin-Reinickendorf-Ost. Kopenhagener Strasse 48. Factory for electrical measuring apparatus.

E. Leybold's Nachforlger. Köln-Bayental, Bonner Strasse 504. Berlin N.W.7. Friedrichstrasse 110-112. Frankfurt a.M. Savignystrasse 26. Measuring instruments.

The following addresses were obtained from the Deutsches reichspost Verzeichnis der Fernschreibteilnehmer, a copy of which was loaned to M.E.W. for a very short period. This directory was dated March 1943, but included supplements to June 1943. It also contained a special notice dated July 1944 stating that the services had been extended to Posen (Polish Poznan, AOB) and Kalisch for the benefit of subscribers transferring from Berlin.

E. Lorenz A.G. (should be 'C'. Lorenz, AOB), satellite location at Mülhausen (Thur) Mackensenstr.75.

Radio Werke E. Schrack A.G. Vienna 89, Abbegasse 1

Schrack-Ericsson. Vienna 87, Pottendorferstr. 25/27.

Kapsch u. Sohne. Vienna XII/87, Johann-Hoffmann Platz 9.

Watt Glühlampen und Elec. A.G. Vienna 20, Dresdnerstr. 57.

New subscribers, Supplement 25th September 1943.

Blaupunktwerke, Berlin-Wilmersddorf, Fockenbeckstr. 9/13.

Siemens & Halske, Wernerwerk für Funkgeräte, Betrieb Wien, Vienna-Ottekring.

New subscribers. Supplement July 25th 1943.

Telefunken-Werk, Erfurt, Rudolfstr. 47.

Appendix IX F.

German Personalities

Herr Plendel (has to be Plendl, AOB) was in charge of the Physikalische Reichsanstalt but was replaced by Prof. Esau who now supervises radio research in Germany. Prof. Esau, unlike many of his subordinates, never visited Eindhoven. (This is an interesting statement, as Esau was charged in

post-war days for that he was responsible for "looting Philips Eindhoven. But was finally found to be not guilty, AOB)

Dr. Rohrer was stated to have managed the Osram factory in Berlin and arrived in Eindhoven in November 1943.

Dr. Kratzmann (Kretzmann? AOB) had been employed before the war by Telefunken on magnetron development work but had left because, it was thought, of some disagreement and became representative of the valve division of R.L.M. (= Reichsluftfahrt Ministerium, Air Force Ministry, AOB)

Dr. Strainer was stated to be physicist with administrative functions. He visited Eindhoven.

Prof. Labins was described as a radio engineer who dealt with planning and production problems. He had been in Eindhoven.

Prof. Schrenkhagen described as a high power engineer had also visited Eindhoven.

Luschen was mentioned as being a men of importance in the Siemens organisation. He is obviously Dr. Luschen the head of the Wittschaft (Wirtschaft, AOB) Gruppe Elektroindustrie in Sperr's Ministry.

The following information was supplied by Philips on German officials who visited Eindhoven.

Appendix I.

Philips Personnel Participating in Discussions.

Valves:	-	Bakker Penning Hamaker Klazens Bienfait	Lamps:	-	Lokker Deenen Elenbaas Schouwstra
Valve Production:	-	Tromp van Sluyters			
Radar:	-	v.d. Ziel de Vries Bakker Voogd Posthumus v.d. Mark Haantjes			
Communications:	-	de Vries Posthumus Six Voogd v.d. PoI (=v.d. Pol, AOB) v.d. Mark Mayers			

		Schouten
Infra Red:	-	Teves Couterier van Alphen
Forward Target Data:	-	Dyksterhuis Oosterhuis Verff Jansen Wildeboer Leopold van Sluyters Noordzy Haan Bles Scholten Wafelbakker
Metallurgy:	-	Meerkamp-v.-Emden

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Appendix IV (a).

Key Persons in the German Radio Organization.

Name	Function	Address	Remarks
Esau	Had of for	Rector of Jena Univ. now Reichsstelle für Hochfrequenzforschung Berlin SW 68, Jerusalemerstrasse 65 and Sonnewalde Krs. Luckau Schloss	
Werner	President Industrierat	of Bussing Automobiles	Advisory Council to Speer.
Luschen(Lüschen,AOB)	Member of Industrierat	of Siemens	
May	Member of Industrierat	of Osram & Telefunken	
Rothgat (Rottgart, AOB)	Member of Industrierat	of Telefunken	
Heine	Member of Industrierat	of Autounion	
Busse	Deputy of Esau		
Labus	Magnetron research		
Pfister	Researcher on anomalous propagn.		

Brendel	Television	R.L.M.	
Weiss	"	Reichspost	
Dallinbacher (Dällenbach, AOB)		Pintsch	
Rothe	Valves for ultra short waves	Telefunken	
Steimel	" " " " "	"	
Lammchen (Lämmchen, AOB)	" "	Pintsch? (x Blaupunkt, AOB)	
Franz	Valves for ultra short waves	Telefunken	Well informed
Weissfloch	" " " " "	Telefunken	
Kleen	" " " " "	"	
Baumann	" " " " "	?	
Muller (Müller, AOB)	" " " "	Telefunken	
Liebl	Engines	Speer organisn.	

Appendix IV (b)

Persons Visiting Eindhoven from Germany of Leaving Eindhoven for Germany

Name	Came From	Arrived in Eindhoven	Departed from Eindhoven
Flugzeugbauingenieur E. Harmenig	Reichsluftfahrtminis-Sterium Berlin	June 1940	August 1940
Diplomingeneur E. von Hauerschild	idem	idem	idem
Maj. J.W. Kolkwitz	idem	idem	idem
Mrs. Christel Wehrse (may have been a male instead, as Christel is a boy name in northern Germany, AOB)	idem	idem	idem
Diplomingenieur Link	idem	idem	idem
O.J. Merkel	Focke Agaelis Focke Wulff, Bremen	May 1940	May 1941
Dr. O. Bormann	Pintsch, Berlin	May 1940	May 1941
Dr. Nolte	Allgemeine Elektrizitäts Aktien Gesellschaft, München	May 1941	Sept. 1944
Dr. Neye	Lawyer, Berlin, and Reichs-Luftfahrt-ministerium, Berlin	1942	April 1944
Dr. K. Kitzke	R.L.M.	May 1941	Sept. 1944
Name	Came From	Arrived in Eindhoven	Departed from Eindhoven

Dr. Herrmann	General Electric, Paris and R.L.M.	1943	Sept. 1944
Dir. Rzehulka	Telefunken Berlin	1944	Sept. 1944
F.W Müller	Philips Valve Werke Berlin	1944	Sept. 1944
Dr. Kemna	Philips Electro Special, Berlin		
Dr. A. Voskamp	Maj.of the Air Force	May 1941	Sept. 1944
Ingenieur H. Tirler	Philips, Eindhoven (X-ray Department)		Sept. 1944
Weissmann	Philips, Eindhoven	1941 and 1944	1943
Oberstleutnant Krause	Heereswaffenamt WA Prüf 7 G.B.N.		Sept. 1944
L. Boller	Philips, Eindhoven (E.T.F.)		Sept. 1944 to Bavaria
H. Mayer	Telefunken, Berlin (Rundfunkdispositionsabteilung)		
Junghans Jr.	Philips, Eindhoven (Machine factory)		Sept. 1944
Oberingenieur Weidenhammer	Siemens, Berlin		Sept. 1944
Miss Bringmann (Brinkmann? AOB)	Heerlen	1941	Sept. 1944
Miss Friedl	Philips, Eindhoven	1941	Sept. 1944
Mrs. Ginzinger-Friedl	Philips, Eindhoven		Sept. 1944
Miss Kraus	Philips, Eindhoven		Sept. 1944
Mrs. Hoffmann	Stabshelferin		Sept. 1944
Miss Weidig			Sept. 1944
Mrs. Krüger	Berlin		
Miss Nohr	Philips, Berlin		Sept. 1944
Miss Konig (König?, AOB)			
Mrs. Klebaum			Sept. 1944
Miss Weidenhammer			Sept. 1944
Miss Lichtenstein	Philips, Berlin		Sept. 1944
Miss Joppien	idem		Sept. 1944

Name	Came From	Arrived in Eindhoven	Depatrted from Eindhoven
Miss Schnepper			Sept. 1944
Mrs. Weinert			Sept. 1944
Miss Kroth			Sept. 1944
Miss Forkel			Sept. 1944
Schadlich	Pintsch, Berlin		
Dr. Walther Gaze	Ministrialdirektor Finanzministerium		
Miss Helmcke von Gablenz			
Dir. Hubmann	Reichsrundfunkgesellschaft		
Dr. Rohrer	Osram, Berlin		
Dr. Wilcke	Osram, Berlin		
Dr. Stiebing	Osram, Berlin		
Maj. Konig (König? AOB)	Rüstungsinspektion		
Dr. Greve Ostermann	Osram, Berlin Phiips, Berlin		

Dr. Wolff	Telefunken, Berlin		
Dr. H. Engels	Telefunken, Berlin		
Dr. Zickermann	idem		
Dr. Maas	idem		

Name	Came From	Arrived in Eindhoven	Departed from Eindhoven
Oberst Gladow	Rüstungsinspektion Niederlande		
Wedershoven von Stutterheim	Rectron, Berlin		
Dahlmeier	Karger, Berlin		
Heinrich	Wiener Radiowerke, Wien		
Oberst beckmann	Reichsluftfahrtministerium L.C.4. Berlin		
Dominique	Propagandaministerium Berlin		
Dr. Markau	Vorprüfstelle, Berlin		
Becker	idem		

Documents secured at Eindhoven and mentioned in this report may be inspected on application to: -

Mr. F. Brightwell,
Room 208,
Landsdowne House,
Berkely Square.
W.1.

Tel: GROsvenor 4060, Extn. 3714.

Appendix V (a).

Manufacturers of radio Apparatus and radio Tubes

Roland Brandt	Berlin S.O.36	
Graetz Radio G.m.b.H.	Berlin S.O.36	
Lorenz Radio Vertriebs-G.m.b.H.	Berlin N.W.7	
Opta Radio A.G.	Berlin-Steglitz	Teltow Kanalstrasse 1-4
Opta Radio A.G.	Leipzig	Volbedingstrasse
Siemens & Halske	Berlin-Siemensstadt	
Telefunken Gesellschaft für Drahtlose Telegraphie m.b.H.	Berlin S.W.11	
„ „	Lager Bad Blanckenburg Thüringen	

Ing. Nilolaus Eltz	Wien V	
Eumig Elektrizitäts-und Metallwarenindusrie	Wien X	
Radio Ingelen, Ing. Ludwig Neumann G.m.b.H.	Wien XVII	
Kapsch & Söhne	Wien 87/XII	
Nora Radio G.m.b.H.	Berlin-Charlottenburg	
Braun Radio G.m.B.H.	Frankfurt a.M.	
Lumophon-Werke Bruckner und Stark	Nürnberg-O	
TeKaDe	Nürnberg II	
Radio H. Mende & Co.K.G.	Dresden N 15	
Safa (Saba, AOB) Schwarzwälder Apparate-bau-Anstalt August Schwer Söhne	Villingen	
Sachsenwerk Licht- und Karft A.G.	Niedersedlitz	
G. Schaub Apparatenbau G.m.b.H.	Forzheim (Pforzheim, AOB)	
Korting (Körting) Seibt	Berlin?	
Algemeine Elektrizitäts- (gesellschaft (= AEG, AOB)	Berlin/Reinickendorf 10	Hollanderstrasse 31-34 (Holländerstrasse, AOB)
„	Friedrichsthal bei Bensen/Südgau	Drontheimerstrasse
„	Litzmannstadt C2 (Polish Lodz, AOB)	Wassering 2
Minerva Radio	Wien	
Apparatenbau Falkensee G.m.b.H	Falkensee bei Berlin	
Stassfurter Rundfunk G.m.b.H.	Stassfurt	Leopoldshall
Blaupunktwerke A.G.	Berlin	Forckenbeckstrasse
Wurtemburgische Radio-gesellschaft (Wega) (Würtembergische, AOB)	Stuttgart	Wilhelmsplatz 13A
Huth Apparatenfabrik	Hannover/Linden	Göttingenchaussee

Appendix V (b).

Important Supply Stores for Army, Navy and Air Forces

Oberkommando des Heeres	Berlin-Charlottenburg	Fasanenstrasse 19
Luftnachrichtenzeugamt	Teltow bei Berlin	Ruhlsdorferstrasse
„	Schwerin in Mecklenburg	
„	Kolleda in Thüringen	
„	Erding bei München	
„	Heindorf/Isergebirge	
Marinestandortverwaltung	Wilhelmshafen, Zweiggeräte-lager Buhl/Elzas (Bühl?,AOB)	
Marinenachrichtenwaffen-arsenal	Thale/Harz	
Gerätelager Marinenachrichten-waffenarsenal	Halle/Saale	
Luftnachrichtenzeugamt Waffen S.S.	Oranienburg	
„	Beneschau bei Prag	
Gesellschaft für Luftfahrt-bedarf	Berlin W.9	Tirpitzufer 20
Siemens & Halske A.G.	Arnstadt/Thüringen	
„	Berlin/Siemensstadt\ und Spandau	
„	Berlin/Charlottenburg	Salzufer 6/7
Frieseke & Höpfner	Potsdam/Babelsberg	
Deutsche Lufthansa	Berlin/Staaken	
Askania Werke	Kirschberg	Greifenburgerstr. 82
Getewent	Reichenberg bei Gablenz/ Neiße	

Focke Wulf	Bad Eilsen	
Braun & Jungman	Salach/Würtemberg	
Fernseh G.m.b.H.	Ober Tannwald/Isergebirge	
Zentralstelle für Röhrenforschung	Tannwald	
Zentrallstelle für Hochfrequenzforschung	Wien/Leobersdorf?	
Zentralstelle für Funkberatung	Wien/Leobersdorf	
Robert Bosch	Stuttgart	Militärstrasse 4
Flugfunkforschungs-institut (FFO, AOB)	Oberpfaffenhofen Post Wesseling	
GEMA	Rubenzahl/Leignitz Rübenzahl? AOB)	
Reichspostzentralamt	Berlin/Tempelhof	Schönenbergerstr. 11/15
Lohenholdt & Schmidt	Zittau/Sachsen	
Heersezeugamt	Wien	
„	Ingelstad (Ingolstadt? AOB)	
Heimat-Artilleriepark	Karlshagen in Pommern	

(This is most interesting, as it formally was know as "HAP", but what is more interesting, is that without knowing it, they pointed at the V2 research and test site!! AOB)
My friend Helmut Liebich (DL1OY) told me some years ago, that when he was engaged at Peenemünde late 1944 or early 1945 at some day a huge bulk of more than 100 Philips oscilloscopes arrived. Far more than the could be deployed! They used those devices for all sorts of measurements, which no one formally would ever have dared to use scopes for befor.

Oberkommando der Wehrmacht	Belzig/Mark (Brandenburg, AOB)

Appendix VI.

Permanent Magnets by Philips Plant – Eindhoven, 22 September, 1944. Conference with Meerkamp Von Emden (van? AOB), on general Metallurgy.

1. Permanent Magnets: Philips made a i-Al alloy steel for permanent magnets about 3" x 3"x ½" which were incorporated into a yoke as indicated below in trips for magnetically operated mines for action against tanks. Philips made only the center block and the yoke, and usage

were not directly disclosed. Dr. Van Emden thought that the German who disclosed this latter information to them was later shot for this and other indiscretions. (see Fig. 1)

Philips made 100,000 of these and it was thought they were for use on the Russian front. The shipment of these was completed seven months ago. It was thought that more of these were made at Bochum in the Ruhr, probably 1,000,000 in all. The order was placed about 1½ years ago and shipment was made to Krehl (The Deutsche Edel Stahl Werke).

The Germans recently (6 months ago) requested prices on 50,000 permanent magnets in the form of ¼" diam. And 1"" long. No deliveries were made. (Fig. 2) They were also interested in a cast star magnet which was evidently intended for an air speed motor (Fig. 3). Von (van! AOB) promised to look up details of requested parties of these last items.

2. High Frequency Hardening: Van Emden mentioned a method developed by Philips for high frequency hardening of shells for armor piercing. The Dutch used this with success against German armor. Their equipment for this hardening process was taken to Vienna but the Germans could not make it work. Von Emden (! AOB) felt that Philips in England (at St. Helens) would know about this process.

3. Tropicalization and protection of equipment – he did not think any special plastics or finishes had been developed – a special steam and spray was given certain equipment – cadmium plating was utilized to avoid corrosion and porcelain enamel preferred to plastic for insulation protection.

Dr. Wallace A. Brode
Expert Consultant.

(Regarding the way in which this text is being spelled, I believe that he was an American citizen, AOB)

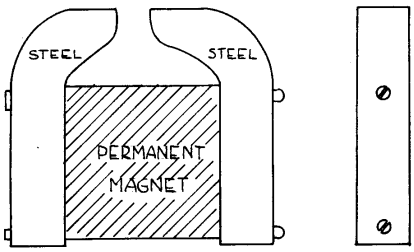

FIG 1

FIG 2

FIG 3

A4788 Fosh & Cross Ltd., London.

My final comment to this report is, that it might not be of scientific standard, as too many spelling errors and inconsistencies occurred. It certainly carries many signs of being rush-rush fabricated. It contains, nevertheless many interesting details, so that it is still a valuable contribution to those interested in WW II history. Occasionally, I have changed the spellings of German names, as to simplify web-searches, but not always.