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GERMAN TECHNICAL AID TO JAPAN

A Survey

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GERMAN TECHNICAL AID TO JAPAN

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GERMAN TECHNICAL AID TO JAPAN

INTRODUCTION

The following survey of German technical aid to Japan is a selected abstract of a vast amount of material available on the subject. The entire study is pointed to depict those German techniques, devices, and weapons whose use by the Japanese would have a bearing on the war in the Pacific. Logistic shipments of raw materials and ordinary commercial products and the inferences therefrom are not treated, except insofar as they affect the probable production of a particular type of weapon or equipment.

Where there is positive evidence that a particular item or its description reached Japan it is so stated. Otherwise, it must be assumed that the transfer was dependant on its bulk, difficulties of transportation and the perils of the sea.

As the intelligence exploitation of Germany proceeds, more and more material on transfers to Japan is uncovered. Although it is not believed that this evidence will change the basic implications contained herein, new details will undoubtedly be developed. These will be issued as corrections and additions as they become available.

This survey has been arranged along the lines of the Combined Intelligence Objectives Sub-Committee index of technical subjects as technical intelligence on German materiel is so maintained. Further, for the use of those who are not familiar with German equipment, a short description is given. Where possible, the probability and date of production by the Japanese are given, with any conclusions which may be drawn from the transfer.

However, it must be realized that the setting forth of the details of the exchange is only part of the picture, and that the meat of the problem, viz, the use which the Japanese are making or intend to make of German plans and prototypes, can only be answered by identification of the German origin and complete technical intelligence reports by those of our Pacific forces who encounter the Japanese version in action.

It is therefore requested that all Commands who receive this survey and who discover information which will cast light on Japanese use of German weapons and techniques send full details via regular channels to the Office of Naval Intelligence, Technical Intelligence Center, so that their implications may be assessed and those charged with countermeasures given timely warning.

A reliable P/W provides from memory an imposing list of Japanese technical liaison personnel stationed in Berlin since 1941. This is admittedly an incomplete list and not sufficiently checked for intelligence purposes. It is given here merely to indicate the level on which negotiations were carried on, and the diversified specialties represented.

JAPANESE NAVAL ATTACHES AND AIDES IN BERLIN

Rank	Name	First Name	Note
Rear Admiral, Naval Attache	YOKOI	Fadao	Member of Japanese Air Mission. Returned to Japan spring of 1943.
Rear Admiral*	KOJIMA		Remained in Berlin.
Captain**	TANIGUTT	Yasumaru	Member of Japanese Air Mission. Whereabouts unknown.
Captain*	FUJIMURA	Yosikazu	Member of Japanese Air Mission. Remained in Germany until the end.
Secretary*	SAKATO	Tikai	Member of Japanese Air Mission. Remained in Germany until the end.
Secretary*	SAKAI	Naoe	Member of Japanese Air Mission. Remained in Germany until the end.
Secretary*	YAMAMOTO	Yosio	Member of Japanese Air Mission. Remained in Germany until the end.
Commander**	FOYODA	Kumao	Aide of Naval Attache. Returned spring of 1943.

* Probably among the staff of the Japanese Ambassador OSHIMA, Hiroshi, captured in Germany by the U. S. 7th Army.

**Returned to Japan in spring of 1943 but probably were casualties.

Vice Admiral	NOMURA	Naokuni	Head of Naval Mission. Returned to Japan in 1943. Also belonged to Air Mission.
Rear Admiral	ABE	Katuo	Deputy; remained in Germany.
Rear Admiral	MITO	Yoshiko	Engine construction; returned 1943.
Rear Admiral	IRIFUNE	Nosaburo	Artillery; returned 1943.

Rear Admiral	SAKAMAKI	Mametaka	Aviation specialist; remained in Germany.
Captain	SATO	Namizo	Mines; also specialist for aviation; returned 1943.
Captain	NISHINA	Kozo	Submarines, training and command; returned 1943.
Captain	MATUO	Minozu	Artillery; returned 1943.
Captain	RAI	Zyungo	Weapon construction (mines and torpedoes); returned 1943.
Commander	AKU	Akira	Weapon construction (torpedoes and mines); returned 1943.
Commander	NAGAI	Taro	Navigation; also aviation; returned 1943.
Commander	ITO	Yuzi	Communications; returned 1943.
Commander	TUKUDA	Osamu	Artillery, explosives, gas; returned 1943.
Commander	NAITO	Takesi	Aviation; returned 1943.
Commander	YAMADA	Seizi	Engines, steam propulsion; active with Swiss companies. Did not arrive in Japan.
Commander	KIYASU	Sadao	Engines and motor propulsion; returned 1943.
Commander	NEKI	Yuitiro	Ship construction. Did not arrive in Japan.
Commander	TOMONAGA	Hideo	Submarine construction. Did not arrive in Japan.
Commander	EMI		Submarine command. Did not arrive in Japan.
Commander	KASAI	Seiti	Aviation, fuels; returned 1943.
Commander	SHOZI		Aviation; was active for a long time in Italy and Swedén. Did not arrive, however, in Japan.

MEMBERS OF THE JAPANESE NAVAL MISSION STILL IN GERMANY TODAY

Commander (Ing.)	MATUI	Tohei	Electrical devices.

Lt. Commander	IKI	Tuneyo	Armor and weapons, as well as materials and substitutes.
Naval Chief Eng.	URIO	Tonozio	Tool engines; specialist.
Naval Chief Eng.	NISI	Takeo	Materials, casting engines, and work engineer.
Naval Engineer	KUDO	Tamiziro	Navigational devices.
Naval Engineer	ITO	Sigeru	Weapon construction, artillery.
Naval Engineer	KANAGAWA	Zen	Weapon construction, artillery.
Naval Engineer	SHIMOSATO	Kazuro	Engine construction.
Naval Engineer	YAMATO	Tadao	Electrical engineering.

OTHER SPECIALISTS OF THE JAPANESE NAVAL OFFICE STILL IN GERMANY TODAY

Captain	YOKOTA	Tosio	Aviation, fuels, lubricating oils.
Naval Engineer	OTANI	Buntaro	Aviation specialist.
Commander	IMASATO		Torpedo production.
Commander	NISHIHARA		Engine construction, motors.
Commander	YSHIKAWA		Engine construction.
Naval Chief Eng.	WAKUTA		Motor construction.
Naval Engineer	NAKAMOTO		Engine construction.

1. RADIO and RADAR

GENERAL

The Japanese were seriously handicapped at the start of the war by the primitive state of all their electronic equipment. Aside from some knowledge of Allied equipment, gained through capture or through non-German sources, most of the Japanese progress in radar appears to be due to German information and equipment. The most important contribution of German liaison in the electronics field is the Wurzburg. Its use both in gun-laying (anti-aircraft fire control) and in ground control of interception, at a time when the B-29 has made both of these radar measures imperative, would greatly strengthen the Empire's home defenses. The termination of assistance from Germany may freeze the state of the art in Japan, which in its present condition of advancement includes micro-wave radar for surface search and fire control and air warning radars which may be said to be approaching the range of Allied radars.

The principal bottlenecks in the Japanese radar program, according to a combined U.S.-British report issued by the Military Intelligence Service, are believed to be the development of effective new types of radar and the manufacture of sufficient quantities of high quality vacuum tubes. Radar units can be built by most of the leading producers of radio apparatus. Facilities for the development of new equipment are scattered among many laboratories and research centers. The manufacture of tubes, however, is not only the most critical but also the most concentrated point in the entire industry. Tube production requires many skills and very specialized apparatus. One firm, Tokyo Shibaura Denki K.K., produced 58.3 percent of the recovered tubes made solely for radar, 68.3 percent of those used both in radio and radar, and 74.4 percent of those made only for radio use. That firm's tube facilities are believed to be concentrated in three factories located within an area of one square mile in Kawasaki. The tube factory of Sumitomo Tsushin Kogyo K.K., the only known maker of some of the most specialized tubes used in radar, is also in Kawasaki.

The Navy Technical Laboratory (Kaigun Gijutsu Kenkyusho), which is believed to be in the Tokyo area, directs the manufacture of Navy radar and is a large producer of units, but is not known to make any tubes. Until 1942 the Navy directed the development and production of all Japanese radar, and most models now in production and use are still known as Navy radar.

1. RADIO and RADAR

ITEM: SMALL WURZBURG (D)

INTELLIGENCE: Transfer of this equipment is known to have taken place. The earliest date of transfer is stated by a reliable P/W as 1942. Equipment for manufacture in Japan was also shipped. 100 sets were in Germany for Japan in 1943. RCM reports have disclosed interception of radar signals similar in pulse and frequency of those characteristics of the Wurzburg. Captured document confirms delivery of 3 sets in Jan/Feb. 1943.

IDENTIFICATION: The small Wurzburg appeared first in 1942, and was used to obtain range elevation and azimuth. It is equipped with IFF and an additional CRT for precision range finding. Its effective beam width is 17° and so the 2 targets must differ in slant roughly 1000' to be seen as separate targets. This type used for detecting surface vessels, flak fire control, gun-laying, searchlight control, height finding for aircraft-reporting and as stand-by in ground control of interception.

Range (miles)	1-25
Frequency Range (mc)	"A" Band 550-850 "B" Band 470-490 Intermediate band, 545-555 also reported 520-590
Pulse Recurrence Frequency (cps)	3750 (increased to 5000 when used in IFF)
Pulse Length	1-2 microseconds
Tubes	75 tubes in transmitter-receiver unit FuSE 62 1 - LS 80; 12 LS 50; 12 LS 30; 4 LD 2; 34 RV 12; 1 LV 1; 2 LG 1; 1 LG 2; 1 LB 13/40; 1 LB 7/15/ 4 neon lights - TL4; 1 quartz crystal CEK 1; 1 stabilizer STV 150/15.
Accuracy	Range accuracy approx. 11 yds. D/F accuracy ranges 0.2° Precision ranging by phase-shifter operating on sinusoidal (30 kcps crystal-controlled) deflector - voltage of the range strobe tube.

CONCLUSIONS: Photographic interpretation tentatively identifies Small Wurzburg in Japan, but conclusive evidence of its production is lacking.

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ITEM: GIANT WURZBURG

INTELLIGENCE: Transfer of this equipment is known to have been made. Special equipment for manufacture in Japan was also shipped along with

Igel which checks all parts for proper operation.

IDENTIFICATION: The giant or "Basket" Wurzburg was used to obtain data on range, elevation and azimuth. It has a large (14 times the wave length) parabolic reflector of wire mesh which is capable of giving accurate height measurements because of its narrow (7°) beam. One of its earliest functions was in fighter control stations, with crews of 120 - 150 men. It is useful as early warning against low flyers, with performance governed by elevation of site. IFF has been installed on a limited number of FuSE65.

Range (miles)	37½ to 50
Frequency Range (mc)	3 bands A,B,C between 500 & 600mc.
Pulse Recurrence Frequency (cps)	1750
Pulse Length	1 microsecond
Tubes	75 tubes in transmitter-receiver unit FuSE 62: 1 LS-80; 12 LS-50; 12 LS-30; 4-LP-2; 34 RV-12; 1 LV-1; 2 LG-1; 1 LG-2; 1 LB 13/40; 1 LB 7/15; 4 neon lights TE 4; 1 quartz crystal OEK 1; 1 stabilizer STV 150/15
Accuracy	Height down to 2.5° elevation. This limit corresponds approx. to 5000' at 20 miles, 10,000 ft. at 40 miles and 12,000 ft. at 50 miles.

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ITEM: FREYA, (GCI AND A/C REPORTING)

INTELLIGENCE: Reliable evidence of transfer on hand. (A-2). Captured document indicates that two sets were ready for delivery June 1943; Japs were to transport.

IDENTIFICATION: This is a mobile equipment which measures range and bearing, but not height of aircraft. The whole apparatus can be rotated manually or mechanically in azimuth.

Range: Maximum - 150 km. on high flying aircraft (in older 1000 pps model) in other models limited by display gear to 200 km.
Minimum - 1 km. Accuracy: range better than 1 km. probably 100 meters bearing better than 1°, relative bearings better than 0.2°.
Frequency: 116 - 146 (mcs) (nominal wavelength 2.1 to 2.6 meters)
Pulse recurrence rate: 200 pps (allowing theoretical maximum range of 300 km.)

IFF Receiver Frequency:	155 (mcs) (nominal wavelength 1.94 meters)	
Transmitter peak power:	15 - 20 Kw.	
Split:	When fitted, is on receiver and/or IFF aerials only.	
Beam Widths:	Transmitter 40° zero to zero without split (about 20° eff.), 53° with split.	
Aerial Arrays	(Limber type)	separate arrays for Transmitter and receiver - more recently 3rd. small array for IFF.
	(Pole type)	lowest and middle banks for Transmitter and receiver respectively. Top bank for IFF (occasionally omitted)

The Pole type Freya is a newer design than the original Limber type Freya. Its functions, radio characteristics, and performance are much the same, but its form and mechanical design are entirely new. It is assembled from a larger number of smaller components, which renders it more suitable for air transport; it is not fitted with limbers for road transport.

ITEM: LORENZ FuMo 61 (HOHENTWEIL) FOR U-BOATS

INTELLIGENCE: Drawings for this set are reliably reported to have been received in Japan in February and August 1944. (A-2)

IDENTIFICATION: This is an electro-magnetic, location-finding equipment operating on reflected-beam principle, for use against sea surface targets with range determination. It consists of transmitter with modulator stage, receiver with artificial target device, viewing device with brilliancy-control equipment, reflector, convertor and power supply and switch box for antenna switch. The array is rotatable mattress 4 ft. sq.

Wave length	54 cm with "stray waves"
Pulse Recurrence Frequency	50 cps
Range	15 and 150 km. depending on position of range switch.
Power (peak)	30 to 40 kw.
Voltage Pulse	10,000 volts
Antenna	Consists of rotary reflector (which can be rotated 190° either side of zero.) 2 dipole groups of 6 each, 2 FuMB wide band dipoles.
Accuracy of D/F	1 to 2°

ITEM: FuG7a (TRANSMITTER-RECEIVER)

INTELLIGENCE: Components were found at Bordeaux awaiting shipment to

1. RADIO and RADAR

Japan, October 1944.

IDENTIFICATION: This was standard equipment in single seater aircraft Me109, Me109F, FW190, until 1943 when it was replaced by the FuG 16Z. Since 1943 it has been used in twin seater aircraft. (JU87 and Hs129). For communication with ground stations and other aircraft. Type of signal: Transmitted, CW and voice; received tone and voice.

Range (miles) 15 or less
Frequency range (mc) - 2.5 - 3.75 for trans. & receiver
Preset frequencies - Preset on one frequency on ground in fighter a/c; in dive bombers set accessible during flight.
Tuning - (MO or crystal) - MO
Tubes: - Transmitter, 2 Ren 904 and 2 Rens 1664;
Receiver, 5 Rens 1264.
Principal Components:
Transmitter (S-6b) 8" high, 14" wide, 9" deep, wt. 20 lbs.
Receiver (E-5a) 8" high, 14" wide, 9" deep, wt. 25 lbs.
Junctionbox (VK-5a) 8" high, 8" wide, 9" deep, wt. 5 lbs.
Dynamotor (u-1b/24) 8½" high, 9½" wide, 5" deep

CONCLUSIONS: Inasmuch as spare parts were crated for shipment in October 1944, it is assumed that the basic FuG7a had been sent to Japan before that date.

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ITEM: FuG10 (TRANSMITTER - RECEIVER)

INTELLIGENCE: Components found at Bordeaux awaiting shipment to Japan, October 1944.

IDENTIFICATION: This is a widely used transmitting and receiving set installed in multiple engined aircraft by the Germans. Not crystal controlled, relying on capacitance compensation for frequency stability. Can be turned in flight. Each transmitter-receiver unit is constructed so that 4 channels may be quickly selected.

Range (miles) - 350 to 500
Frequency range - (mc) Transmitters: long wave (S-10L) 0.3-0.6, short wave (S-10K) 3.0-6.0;
Receivers: long wave (E-10L) 0.3-0.6, short wave (E-10K) 3.0-6.0.
Preset frequencies - four click stops on tuning dials.
Tuning - (MO or crystal) MO. Manual with 4 click stops on each transmitter and receiver. Antenna matching units tuned remotely by selsyn system.

Tubes - 31 - 6 RL 12 P 35 and 25 RV 12 P 2000. These tubes perform well over a frequency range of 200 kc to 400000 kc. The receiver tubes function as R-F amplifier, detector and audio amplifier for both pentode and triode operation.

Use - Current equipment for all first line multiple-engine aircraft. It has been found in all bombers, twin engine fighters and certain flying boats.

Type of signal - transmitter, CW on both long and short wave; Received CW, on both long and short wave; tone and voice also received on short wave.

To communicate with: Aircraft and ground stations.

Principal components: Transmitters S10K and S10L, each 9" high, 8-3/4" wide, 8" deep, wt. 16 lbs.
Receivers E10K and E10L, each 7-½" high 8-3/4" 8" deep, wt. 16½ lbs.
Dynamotor U10/S, 9" high, 13¼" wide, 6½" deep, 28½ lbs. wt.
Dynamotor U10/E 6½" high, 10¼" wide, 4½" deep

CONCLUSIONS: Basic model would have been received in Japan before date of shipment of spare parts.

ITEM: FuG 15 (TRANSMITTER - RECEIVER)

INTELLIGENCE: The Joint Communications Board, Counter-measures Committee, reports definite knowledge of this transfer, December 1943. Eval. A-1.

IDENTIFICATION: This apparatus replaced the FuG 16 on bomber aircraft, being designed for H. F. air-to-air and air-to-ground telephony. It differs considerably from the FuG 16 and FuG 17, and is considered an ingenious electrical design. The main points are as follows:

(a) Use of frequency modulation.
(b) Wider frequency band covering 37,8 to 47,7 Mc/s.
(c) Remote control.
(d) Many of the circuits are shared between the transmitter and receiver. For instance, the master oscillator of the transmitter is also the beat frequency oscillator of the receiver, the I. F. stages of the receiver are also the modulator stages of the transmitter.

It is stated that the FuG 15 had been evolved as far as the prototype stage, and that series production was just beginning at the time of the visit to Berlin in the Winter of 1942. The following characteristics have been given:

Transmitter

Frequency range 37,8 to 47,7 Mc/S (can therefore be operated with existing FuG16 and FuG17 ground equipment.

1. RADIO and RADAR

Aerial power	10 watts
Tuning	Single control with variable condensers.
Aerial tuning	Semi fixed aerial tuned "con regolazione a scatti" (by regulation of springs?)
Deviation of frequency	/ 10 Kc/s. Presumably refers to fine control similar to that on FuG16 and FuG17.
Receiver	
Circuit	Two stages of R. F. amplification followed by mixer, I. F. amplifier second mixer, second I. F. amplifier, 2nd detector and L. F. band width, / 40 Kc/s. (?).
Tuning Control	Single control as in transmitter.
Type of valves	LS 4 and RV 12 P 2000
Control	Electrical remote control.

It is stated that tuning can either be carried out continuously or "a scatti". The latter presumably refers to a pro-setting device operated by means of springs. In the case of the prototype, there were 100 frequency channels corresponding to 100 equally-spaced positions of the control knob. The distance between adjacent canals is 100 Kc/s, in every case, but since the tuning scale is not linear as far as the frequency is concerned, there is a compensating condenser set automatically for each channel. According to the data given by Lorenz, the performance is as follows:

Ground to Air (with ground transmitter of 100 watts)

Quota (m) (= altitude ?)	Range (Km)
1000	80 - 100
100	30
Air to Air	
1000	130

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ITEM: FuG 16 (TRANSMITTER)

INTELLIGENCE: The Joint Communications Board, Counter-measures Committee reports definite knowledge of this transfer December 1943. Evaluation A-1.

IDENTIFICATION: The FuG 16 is a voice transmitter for aircraft operating on 38.5 to 42.3 megacycles. This apparatus was used in all bombers for air-to-air and air-to-ground.

Range (miles)	20 at ground level 100 at 10,000

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Preset Frequencies	4 click stops on tuning dials
Tuning	(mo or crystal) manual
Sensitivity	9-10 microvolts across input feeder for 1 milliwatt output, 30% modulated signal
Tubes	2 RL 12 P 35 11 RL 12 P 2000
Principal Components	Transmitter (S16), Receiver (E16), modulater and meter unit (BG16) in 1 case - weight 44 lbs. Dynamotor Antenna

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ITEM: FuG 17 (TRANSEIVER - RECEIVER)

INTELLIGENCE: Reliable evidence of transfer; date unknown. (A-2)

IDENTIFICATION:

DESIGNATION:	Army cooperation transceiver and receiver. Voice and tone in twin seater close support aircraft. Provides intercom. Voice and tone air to air and air-to-ground. Communication to submarines on long range aircraft.
RANGE:	30 mi. at ground level. 185 mi. at 26000 ft. with 20W ground station.
FREQUENCY RANGE:	Calibrated: 42.1-47.9. Can be tuned beyond.
PRINCIPAL COMPONENTS:	Trans. Receiver and modulator consisting of, in one case, (FuG 17); Transmitter (S-17); Receiver (E-17): Modulator and meter unit (BG-17); Dynamotor (U-17): Rod aerial and match unit (AAG-17).

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ITEM: FuG25 AND FuG25A (IFF)

INTELLIGENCE: Reliable source indicates transfer of details around August 1944. Two sets were contracted for in November 1944. FuG25A was made available in January 1945. (Eval. A-2)

IDENTIFICATION: FuG 25 notifies short range ground radar stations (Wurzburgs), by coded pulses, that plane is friendly. Designed originally for bombers, but found in 2-engined fighters. There are 2 units: a

transmitter-receiver unit (SE25) and a tone generator. FuG25A is a duplicate system which works with the Freya.

Range	40 miles
Frequency range (mc)	Interrogates 550 to 580 Responds 150 to 160
Pulse Recurrence Frequency (cps)	5000
Pulse Length (microseconds)	2
Antenna	14" vertical
Type modulation	CW Transmission is modulated by tone generator and coded in Morse.
Tubes	1 LG-1a Diode 6 RV 12 P 2000 Pentode 1 STV 150/15 Stabilvolt

CONCLUSIONS: Japanese use of IFF has been reported but not confirmed. Section 22, GHQ, SWPA reports recovery of a Japanese document 11 March 1945 which suggests development of experimental Japanese IFF system from German transponder.

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ITEM: FuG102 (ALTIMETER)

INTELLIGENCE: Reliable sources indicate transfer of at least 3 sets. (Eval. A-2) Apparatus fitted in Ar 234 around January 1945.

IDENTIFICATION: This is an altimeter utilizing pulsed transmission and cathode ray tube presentation, and having electro static deflection. The only other German altimeters encountered were the FuG101 and 101A which used frequency modulation and were of extremely limited range. The presentation in this case is by microammeter. The FuG102 is actually a miniature radar set complete in all details. It consists of 3 units:

1. Transmitter
2. Power unit
3. Receiver indicator

Altitude & range (feet) - 16,000
Input volts (DC) - 22-29
Frequency (mcs) - 180
Pulse width (microseconds) - 1.5
Transmitting antenna - single dipole - 29-1/4"
Receiving antenna - induction or above - 29-1/4"
Receiver & induction unit - 8" x 6" x 6"
Tubes - super heterodyne - 12 RV 12 P 2000
Transmitter unit - 7-$\frac{1}{4}$" x 5-$\frac{1}{2}$" x 4-$\frac{1}{2}$"

1. RADIO and RADAR

ITEM: FuG 103

INTELLIGENCE: Equipment was in Japanese possession in April 1944. (A-2)

IDENTIFICATION: The FuG 103 is an electric altimeter similar to, and operating on the same principle as FuG 101. It does not interfere with other wireless apparatus in the aircraft. Employs 2 range scales.

Range - 0 - 150 meters
150 - 750 meters
Frequency - 370 mcs
Type of Signal - FMCW

Readings from 0-150 read directly from meter on instrument panel.
Readings above 150 meters - knob is turned and height is read from coarser scale, adjacent to first one.

ITEM: FuG 202 (LICHTENSTEIN) AIR INTERCEPT

INTELLIGENCE: Transfer of this equipment known to be fact.

IDENTIFICATION: FuG 202 (Lichtenstein) airborne AI Radar is standard forward-looking air intercept equipment, and was mounted in twin engine night fighters: Ju 88, Me 110, and Do 217. Transmitter is triggered by the modulation; receiver approx. 160 under average operating conditions. Receiver can be tuned in flight. Range is circular (with radial deflection) derived from phase-split sine wave. The very narrow beam of the Lichtenstein is to a great extent offset by high sensitivity to small changes in bearing of the target aircraft. It has excellent D/F accuracy.

Range	Limited by low power output to a theoretical range of 5 miles and a practical range of 2 miles.
Frequency Range (Mc)	Transmitter 410 - 540 Receiver 479 - 499 Spot 490
Pulse Recurrence Frequency (cps)	2700
Pulse Length	1 microsecond
Antenna	Yagi; common T & R in 4 sections of 4 half wave dipoles with parasitic reflectors. Vertical polarization.
Type modulation	Pulse with triggering
Total Weight (including cables and antennas)	110 lbs.

ITEM: FuG212 (AIR INTERCEPT)

INTELLIGENCE: Reliable information establishes the transfer of two FuG212s to Japan around July 1943.

IDENTIFICATION: The Lichtenstein "C" is a cleaned up version of FuG202. Because of allied jamming the fitting of the equipment was not continued. It was subsequently superseded by FuG220 (SN 2).

Frequency coverage (mcs) - Transmitter: 410 - 540
Receiver: 479 - 497
Impulse effect - 1-2 kws.
Impulse frequency - 2680 period per second (which corresponds to distance of 56 km.)
Range (km) 1 - 16
Antenna system - Common transmitter and receiver. A single R. F. cable comes from S. E.: unit and transmitter and receiver matching is performed within the base of the unit.
Main units of FuG212:
1. Sende-Empfangs - containing the pulse, black out, time base and modulator circuits.
2. Sichtgerat - consisting of the three tubes but no auxiliary valve circuits.
3. The high voltage unit for the C. R. T. supply.
4. The Kabel-abgleich Kasten
5. Drehverteiler - scanning and signal switching unit.

Measurements:
Sending-Receiver*Set - 11¼" x 9" x 9"
Indicator (3 tubes) - 14½" x 13" x 6"
(New type - 2 tubes) - 6" x 8" x 8"
Transmitter (2 valves arranged in push pull) - Type LD 15
Total wt. (less cable and aerial) - 130 lbs. (ca.)

*The receiver circuit is practically identical with that of FuG202. The R. F. section is a super regenerative receiver.

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ITEM: FuG 213 (LICHTENSTEIN "S") (ASV)

INTELLIGENCE: Reliable source states that two sets were shipped to Japan in July 1944. (A-2)

IDENTIFICATION: This is an airborne radar equipment, which has transmitter, receiver and presentation unit. It is used for detection of shipping, also found with FuG 203e in control operation on guided missiles Do217K.

Frequency - 75-80 Mc/s

Antenna - Receiver has colinear dipoles phased to give lobe deflection.
Polarization - Horizontal
Method of Scanning - One receiver array on each wing port phased to port, starboard to starboard.
Fitted in - Do217K, Ju88
Provides range in bearing on separate cathode ray tubes.

ITEM: FuG 217

INTELLIGENCE: Reliable information indicates that FuG 217 was in possession of the Japanese in January 1945.

IDENTIFICATION: The FuG 217 is the latest of the tail waring devices. It replaces the FuG 216, to which it is almost identical externally. It is fitted on the Arado 234 B2.

Receiver unit: Double super-hetordyne, case (cms) 27 x 26.5 x 13
Operating frequency - 166 mcs
RF Stages (4)
Valves - RV 12 P 2000
RV 12 P 2000 (mixer type)
LD.1 (oscillator type)
IF Stages (2)
Valves - LV 1
Detector: double diode type LG 1 giving symmetrical detection. A single video stage, type LV 1.
Remote tuning system.

Transmitter: case - (cms) 27 x 18 x 21.
2 valves - LD 15 (V.H.F.)
Modulation valves - 2 LV13 (40 watt triode)
1 LG 200 (gas filled relay with maximum anode voltage of 1000 volts and control ratio of 35 volts.)
2 double diodes with enequal anodes
5k Potentiometer

Indicator: similar to FuG 216 (but has vertical time base).

Aerial Arrays: Consists of half-wave horizontal Yagi array mounted on a vertical pillar on top of wing.
Reflector - 108.5 cms.
Radiation - 95 cms.
Direction - 77.5 cms.

ITEM: FuG 218

INTELLIGENCE: Device reliably reported in Japanese hands (A-2)

IDENTIFICATION: When used in Oberon system (with R100 BS fin stabilized rocket carried on Me 262) continuously determines range between the fighter and its target, and feeds this value into the "Elfe" computer.

1. RADIO and RADAR

ITEM: BERLIN GERAET (FuG 224)

INTELLIGENCE: Inspected by the Japanese in May 1944. Details made available. (A-2)

IDENTIFICATION: Berlin Geraet used with PPI presentation provided identifiable panorama of ground objects to airborne operator. Unquestionably developed from British airborne H2S equipment, but used totally different aerial system. Known as "Berlin". Possibly also used as aircraft warning device in U-Boats. Antenna array formed of 4 parallel plastic rods. Plastic dome covers array. Rods lie parallel to plane of a circular metal plate. Energy to be radiated is led to aerial rods by coaxial cable which forks into 2 branches where it enters the metal plate and again forks, making 4 branches to feed the 4 aerials. Aerial system makes use of "end-fire" principle. Beam of radiation is produced, the long axis of which passes thru the length of the rod. The 4 rods in parallel combine to form a beam narrow in the plane of the rods, relatively wide at right angles to this plane. The metal plate backing acts as suppressor to radiation in area behind the plane of the metal plate.

Width of beam: narrow - 10° to half-power
wide - 35° to 37°

Wavelength: 9.1 cm.

Antenna array: 4 parallel rods of Trollitul plastic, 3" - 4" in diameter at bases tapering somewhat to rounded ends, and about 14' long; fixed at bases to lie about 6" above surface of circular metal plate about 40" in diameter. Entire unit rotatable.

Presentation: Believed that scope showed area of about 37 miles diameter (altitude unknown).

Receiver tube: Weak point in FuG224 was magnetron receiver tube, which was subject to frequent breakdowns. It included glass envelope, set into metal cover, and was 3.5" to 4" long.

Transmission lobe: Half-value lobe of 10° width lay in plane of the four rods and was about 35° wide at right angles to the plane. Moisture detrimental; when dome was wet nothing could be detected even at range of 20 m. along axis of rods.

NOTE: This set was the LB-9-N cathode ray tube.

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ITEM: FuG 302 - Radio Beacon Bomb

INTELLIGENCE: Two sets were acquired by the Japanese in July 1944 (A-2)

1. RADIO and RADAR

IDENTIFICATION: Consists of transmitter housed in bomb casing. Any time after being dropped, up to 30 hrs., may begin sending signal on which aircraft can home - thus providing method of taget marking. Upon impact, switch turns set on, whereupon it transmits 900 cycle audio tone. After adjustable delay period. Radio equipment, timing clock (4 day type) and batteries are housed in tail and center sections.

Frequency - 40 cm/s
Case - steel tube
Lgth. (without nose cap and tail fins) - 3'
Dia. - 13"
Overall length - 6'
Transmitter - low-powered, crystal-controlled VHF set. Operates for short period at reduced power, just after being dropped, so parent aircraft can test its service-ability.
Power supply - 12 volt battery

- -

ITEM: FuG 350 (Naxos II)

INTELLIGENCE: Reliable information indicates that one set and complete details were in Japan in February 1944 (A-3)

IDENTIFICATION: This is an airborne centimeter search receiver for use against allied centimeter transmissions. It is quite similar in detail to German Naval Naxos equipment. A small compact antenna - consisting of 2 upright cylinders backed up by semi-circular metal reflector - is mounted in plexiglass dome. Antenna is rotated by motor generator, about its vertical axis at 1000 rpm. Incoming radar signals in 10 cm range are presented on a circular trace in a cathode ray tube. Signals appear as radial deflections on the circular trace at a position around its perimeter depending upon the azimuth of the particular H2S equipment intercepted.

The usual sensitivity and intensity controls are provided, and additional "Far-Near" switch which allows approx. estimate of range to be made by reducing the gain a given amount.

Aerial - Dia. at base - 5 cm.
Dia. at hemis. end - 4 cm.
Lgth. of dielectric - 19 cm.

Could be used as a defensive as well as attack instrument since will give indications of centimeter A. Il equipped aircraft operating on bomber-support or intruder operations.

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ITEM: MAMMUT (HOARDING)

INTELLIGENCE: Transfer to the Japanese is reliably reported. (A-2)

IDENTIFICATION: Long range aircraft reporting equipment. Has arrays on both faces, and measures range and bearing of targets over forward and rearward sector of approximately 120° with gaps of 60° to either side. Searching is done by electric swinging of the beam. Frame cannot be turned. It consists of frame, carried on 4 main vertical supports, and has chicken wire reflector with dipoles in front. Equipment employed is identical with that used in Freya radar. For detaching range there are 2 Cathode Ray tubes.

Range	- 200, possible 300 km.
Frame	- 30 meters long - 11 meters high
Frequency	- 120 - 130 (mcs)
Pulse recurrence rate	- 500 pulses per sec.
Beam width	- 10° zero to zero

- -

ITEM: FuMB 4 (SAMOS)

INTELLIGENCE: A contract for three sets was placed by the Japanese in November 1944. (A-2). It is not known if delivery was made.

IDENTIFICATION: Wave length - 64 cm to 333 cm (470 to 90 Mc) covered in four bands.

Tuned Circuits -
a. One variable input circuit
b. One oscillator circuit
c. Eight fixed intermediate-frequency band-filter circuits, two of which are active only when the receiver is adjusted to "frequency modulation."

Volume Control - Volume control is automatically regulated by a control voltage taken from the detector stage. Volume level can also be controlled in the audio range by a potentiometer placed in the detector output. The automatic volume control hampers the recognition of the minimum or the maximum during direction finding.

Power Supply - The receiver is built for 220V AC operation. The built-in power supply furnished 180V as plate voltage and 100 V as screen grid voltage. The screen grid voltage is stabilized.

Power Consumption - 30 watts.

A built-in transmitter makes it possible to t[illegible] receiver.

1. RADIO and RADAR

ITEM: NAXOS (FuMB 7)

INTELLIGENCE: 1) Reliable PW states that the first sets were shipped to Japan in April 1943. 2) All blockade runners carried numerous cases of radar and GSR parts. 3) A letter from the Japanese Naval Attache in Germany to Japan confirms their acquistion of Naxos. 4) In light of the above it is significant that the first information of the use of search receivers by the Japanese dates from September 1943. 5) Other information states that full plans were received in Japan in February 1944. (A-2)

IDENTIFICATION: The Naxos was used for reception of waves in range 8-12 cm; was installed on subs and aircraft. Designed primarily for S band frequencies. Naxos is quite sensitive to interference, both radiated and power line, and the range is limited by the interference that may be present. The equipment is generally reliable and well built, although some trouble was experienced with the crystal contact on the central conductor of the converter antenna unit.

Types of Reception:	Non-directional or directional, depending on antenna used.
Frequency range:	8-12 cm.
Range:	Maximum; 10 miles for antenna ht. 15 ft. ASG radar eqpt. at altitude of 1000 ft. may be detected at 40 miles.
Presentation:	Head phones or oscillograph
Tubes:	6 RV12P2000 (Tubes #02, 03, 04, 06, 07, 08) 1 Stabilizer tube, Stabilovolt STV 150/15 (Tube #05) 1 Rectifier RG 12060 (Tube #01) for power supply. 1 500 ma. fuse for power supply Weckmann 19 120
Polarization:	Horizontal and Vertical

Dimensions:	Ht.	Width.	Depth	Wt.
Case	1½"	13-3/4"	8¼"	2-3/4 lbs.
Receiver	5½"	7-3/4"	5½"	6-½ lbs.
Power supply	5½"	7-3/4"	6"	7-3/4 lbs.
Distributor plug box	1½"	6"	4"	½ lb
Control box	2"	3½"	3"	3/4 lb.

The airborne Naxos (FuG350) was used for detection of H2S (X-band) signals. It was employed for defensive warning and offensive homing against allied aircraft fitted with 10 cm radar. A dielectric antenna, made of Plexiglass, was used with this; the antenna was rotated about by motor. This installation is neat solution to problem of high speed scanning in a horizontal plane without adding large excresences to medium sized aircraft.
Range: 50 kms. at 1000 meters below H2S aircraft; 100 kms. at 2000 meters below and 200 kms. at 3000 meters below.

1. RADIO and RADAR

ITEM: RUNDIPOL - FuMB ANT. 3

INTELLIGENCE: Reliable source states that this equipment was in Japan in September 1944. Photographic evidence shows installation on Japanese API, 5 February 1945.

IDENTIFICATION: This is an omni-directional, drum type, search receiver aerial. The aerial units are mounted at 45° to receive either horizontally or vertically polarized waves. Rondipol is composed of round frame, inside of which are placed cross-wise, two porcelain tubes with dia. 15mm. In each tube are 14 thin wires. The frame of Rundipol is placed horizontally at a distance of several centimeters from the periscope. On frame are placed two rods 100mm. long. It is connected with Wanze by means of 2 cables placed in steel tube. May be plugged into Borkum as well.

Round frame - 270mm. dia.
Band coverage - 100 - 400 Mc/s
Receiver frequency - 14.5 Mc/s
Band width - 0.1 Mc.
Dia - 10"
Depth of netting - 4"

CONCLUSIONS: There is no doubt as to Japanese intentions of using the Rundipol on surface craft as well on submarine Schnorchels. Data on its application to Schnorchel has also been made available to them.

APPROXIMATE DATE OF PRODUCTION: Underway.

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ITEM: FuMB 9 (WANZ G-2)

INTELLIGENCE: Details of the improved Wanz were made available to the Japanese in February 1944. (A-2)

IDENTIFICATION: This is a motor-driven panoramic receiver. It was used on submarines for radar intercept; it will pick up and identify with certainty a radar signal in its band before the radar echo is strong enough to identify the submarine. Displays the spectrum between 166 and 240 Mc on a built-in cathode ray tube.

Range - 40 nautical miles - SK shipboard radar 50 miles - ASE aircraft radar.

Supply voltage - 220 v a-c 50 cps.
Type of receiver - Superheterodyne, 30 Mc, i-f
Sensitivity - 100-300 microvolts across 150 phms produces 5mm pip. A signal of about half this value is just discernable.
Overall bandwidth - 200 kc at 3 db down, 700 kc at 20 db down.

Dimensions: One unit 15-3/4" high, 9-3/4" wide, 18" deep containing receiver proper and cathode-ray tube indicator.
One unit 7-3/4" high, 9" wide, and 13" deep, containing power supply.

ITEM: FuMB 26 (TUNIS) RADAR SEARCH ANTENNA.

INTELLIGENCE: Reliable information establishes transfer of equipment; (A-2) date unknown.

IDENTIFICATION: This radar intercept and D/F installation, on board ships, especially U-boats, was for reception of enemy radar transmissions in the wave-band around 3 cm. and between about 8 and 15 cm. By estimation and comparison of the signal strengths a bearing indication to an accuracy of 15° can be made. The two principal components of FuMB 26 are FuMB 25 (Mucke) Receiver and FuMB 24 (Fliege) broad-band crystal detectial receiver. These provide warning of the approach of radars.

Waveband - 3 cm and 8-15 cms.
Type of reception - directional reception
Polarization - horizontal and vertical
Receiver installation - 2 wide band detector receivers; in addition: 2 LB amplifiers including main units of the Naxos; 2 x 6 valves RV 12 P 2000; 2 x 1 rectifier RG12D60; 2 x 1 Stabilovolts STV 150/15; 2 x 1 rectifier RG12D60; 2 x 1 fuse 500 ma Wickmann 19120
Receiver head - 522 mm High, 164mm wide, 430mm deep; wt. 9 kg.

Not watertight, therefore, array must be taken down when U-boat submerges.

ITEM: FMG 41T or FuSe 64 (MANNHEIM GERAET)

INTELLIGENCE: Japanese representatives inspected "Mannheim" in October 1944, but it is not known that specifications were supplied them.

IDENTIFICATION: This is a development of Wurzburg 1 and is the latest flak control radar. It is mobile and mounted normally on a special trailer with detachable bogies. The reflector folds down in 2 halves for transit. It is continuously rotatable in azimuth by hand or variable speed motor drive. Fire control data are transmitted automatically to the director by coarse and fine lelsyns. In addition is sometimes computor panel for ground range and target height.

1. RADIO and RADAR

Frequency range: 560 mc.
Transmitter power (peak) - 12 - 20 kw.
Transmitter - a V shaped aluminum tube with an IS 180 transmitter tube in each leg.
Elevation - + 3° to + 87°
Pulse Generator IG64 - 20 valves
Pulse Length - Microsecond
4 Cathode Ray tube display units.

Several of the usual anti-jamming procedures are not applicable with the Nurnburg; the Goldammer is not certain. Wismar would appear difficult; Wurzlaus if questionable. Stendal is fitted as part of normal equipment. Was originally fitted with standard Wurzburg IFF but probably modified to be fitted with new IFF called Kuckuck (Cuckoo) which involves addition of a suitable interrogation (Kuh) for FuGe25A on 125 mc/s.

CONCLUSIONS: Japanese efforts to reproduce Wurzburg will undoubtedly take "Mannheim" modifications into consideration.

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ITEM: FuMG 42

INTELLIGENCE: Reliable PW states these were being manufactured in Japan in 1943. Part of the manufacturing equipment for this set, as well as other types of radar, were supplied during 1942 and 1943.

ComNavEu reports that this set was taken from Germany to Japan in a Japanese submarine in August 1942. Further report states that the Japanese sub which visited Lorient in 1943 received another model of this set. Eval. A-2.

IDENTIFICATION: FuMG42 made by Gema was widely used as submarine search gear but later replaced by FuMO61 or FuG200U ("Hohentweil" ASV set, slightly modified) made by Lorenz. The antenna is the wire mattress type, 1 meter tower. 4 - 6" dipoles are in the center. There are separate aerial arrays for transmitting and receiving; it contains a built-in signal generator (the "X" part) which is provided for tuning the receiver; and a calibrator (the "Z" part) for calibrating the range time base. The indicator unit uses an "A" type presentation and provides D.F. The receiver is a double superheterodyne. The range calibration can be effected by a velocity control and a time base shift control.

Range (miles)	5 - 10
Frequency Coverage (mc)	355 - 395
Normal Frequency (mc)	375 (80 cm)
Pulse Recurrence Frequency (cps)	500
Range Accuracy (yds)	100 - 200 (Probable)
Bearing Accuracy	5 - 10° (Probable)

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1. RADIO and RADAR

ITEM: JAGDSCHLOSS (FuMG 404)

INTELLIGENCE: Particulars of JAGDSCHLOSS were made available to the Japanese early in 1945. (A-2)

IDENTIFICATION: This German ground radar of P.P.I. type incorporating IFF principle, was developed satisfactorily by Siemens. Short wave pulses are sent out of radar transmitter at definite pulse recurrence frequency over a horizontally rotating directive antenna. The reflector impulse is received by the directional antenna and transmitter thru the radar receiver to the display units O-Geraet (Monitor Unit) and Sternschreiber (PPI Display). Recognition impulses are received on a FuG25A in aircraft and its transmitter is tuned to IFF frequencies of the ground stations. An oscillator located in Z-Geraet generates impulse frequency which serves to synchronize entire high frequency system. The air situations around the Jagdschloss is reproduced on the Cathode Ray tube of the Sternschreiber which shows all radar targets. There is apparently no height finding facility in Jagdschloss, hence the appearance in some cases of "Chimneys".

Maximum range:	75 miles
Minimum range:	3 miles
Frequency:	120 - 180 mcs. with working frequency at 160 mcs.
Output: (average)	64 kw.
Hut on which mounted:	23' cube
Aerial:	2 rows of wide band dipoles (8 groups of 2) - 80 x 10'
	Dipoles - 140 cm. length, 8 cm diameter.
	Spaces - 1 meter
	Wavelength - 2 meters (150 mcs per sec.)
	Beam width (est.) - 10° from zero to zero and 5° effective.
	Stand off of dipoles from reflector 1 m. or 1/2 wavelength. (This technically inefficient, probably 5/8)
Main array horizontally polarized:	
	Rates clockwise - 11 revs. per min.
IFF Aerial on top of main aerial array, vertically polarized:	
	2 sections of 4 aerials
	Transmission - 125-128 mcs.
	Receiver - 150-160 mcs.

ITEM: X-GERAT (RUFFIAN)

INTELLIGENCE: Reliable information states that this equipment was in Japanese hands in March 1945. (A-2)

IDENTIFICATION: Used for navigational aid and blind bombing. Also used with FuG200 and FuG 103, and He 111H.

Range - 250 miles
Frequency - 66.5 - 75.0 mcs (2 receivers)
Modes Rec. & Transmit - AM 2000 c/s
Operation - Beam over target and 2 at right angles to target beam. Right angle beams set X-Gerat clock which releases bombs.
Polarization - Vertical
Power output (peak) - 400 kw.
Antenna - 2 vertical 1/4 wave rods in streamlined housings.
Tubes - 20 RV 12 P 4000

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ITEM: FuMO (FLUM)

INTELLIGENCE: Drawings were received in Japan early in 1943. (A-2). High ranking German naval officers state that actual sets were delivered in Japan.

IDENTIFICATION: Direction finding equipment of the aircraft warning and fighter direction service. Long range. It measures the ranges of aircraft, determines the bearing, and can be fitted with accessory apparatus for obtaining elevation.

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ITEM: BORKUM

INTELLIGENCE: Details are known to be in Japanese hands; date unknown.

IDENTIFICATION: The Borkum set is a single oscillator circuit with rectifier. It is used with Wanz or Naxos aerial, and when with the latter, it has a connection to the amplifier section and is connected to the Radione. Borkum could theoretically receive on the 10 cm wave band at greatly reduced sensistivity, but the aerial and cabling used are unsuitable for such very short wavelength and heavy alteruation would occur resulting in very low sensistivity.

Frequency - 30 - 300 cms (P/W)

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ITEM: CHIMNEY (WASSERMANN)

INTELLIGENCE: Two installations and full details are reliably reported to be in Japan. (A-2)

IDENTIFICATION: The Chimney or Wassermann apparatus, of which two types exist (the cylinder type and the girder type), is a fixed radar installation determining the range and bearing of target aircraft. The cylinder type can measure heights also. When searching for targets, the massive apparatus can be rotated in azimuth mechanically; for height finding the beam is swung electrically in the vertical plane. The principal use

is long range aircraft reporting, and occasionally long range G. C. I.

Cylinder Type - Base is large partly buried concrete casemate, at one end of which is set up rotatable hollow steel cylinder, surmounted by crane arm with block and tackle for hoisting aerial frames into position. A huge aerial wire-netted reflector curtain is secured to the cylinder.

Frequency - 120 - 125 mcs
Range - 160 miles
Antenna System - Broadside array 30 x 19 or 30 x 13.5 meters
Polarization - Vertical
Pulse Recurrence Frequency - 485 - 510 c/s
Transmitter Peak Power - 20 Kw.

Girder Type - Main structure is triangular section girder work mast of light alloy rising out of short steel column, the lower end of which rests in a socket on the ground; The elaborate aerial system consists of a girderwork frame 6 meters wide and 30 meters high secured to one side of the triangular mast and covered with wire netting.

Frequency - 120 - 125 mcs
Range - 160 miles
Antenna System - Broadside array 30 x 6 meters in 2 stacks of 4 sections each with 3 rows of 3 full wave dipoles.
Polarization - Vertical
Pulse Recurrence Frequency - 485 - 510 c/s
Transmitter Peak Power - 20 Kw.
Beam Width - 40°

ITEM: BENITO

INTELLIGENCE: Reliable evidence of transfer to the Japanese (A-2)

IDENTIFICATION: A blind bombing device of considerable accuracy. The Benito system consists of beam giving line and means for determining range. Ground Benito station emits ranging tone which is retransmitted by the aircraft on the Y Fuhrungsvelle frequency. Ground station is able to plot the position of aircraft by (a) measuring difference in phase between transmitted and re-radiated Benito frequency to determine range; and (b) DF-ing on the signal to determine the azimuth of the aircraft.

Carrier frequencies (mcs) - 42 - 28
Consists of: FuGe 10; FuGe 162Y, the Gratz Display Unit; and simple type of D/F apparatus which is connected with Type E.16P receiver.

Y-Geraet operated with Benito ground station, and is used with FuG17E and FuG 22a. Characteristics of Y-Geraet are as follows:

Frequency (mcs) - 42.1 - 47.9
Power output (watts) - 10
Type of signal - MCW phone
Circuit - Trans: MOPA
Receiver: 9 tube superheterodyne

ITEM: SEETAKT, COASTWATCHER (GEMA)

INTELLIGENCE: Conclusive evidence of transfer. (Eval. A-1)

IDENTIFICATION: This set was used for detection of ships approaching coastline and for coastal gun ranging; it measures the range and bearing of the target. The whole arparatus can be rotated in azimuth in searching for targets. Frequently set up on octagonal towers.

Frequency - 370-390 Mc/s (nominal wavelength 80 cms)
Polarization - Vertical
Pulse recurrence - 500 c/s (1000 in some older models)
Pulse length - 3 microseconds.
Transmitter peak power - 5-10 Kw (est.)
Aerial system - one Freya frame supporting both transmitter and receiver arrays. Each array consists of a horizontal bank of 16 full wave vertical dipoles.
Beam Width - 1° zero to zero.
Presentation - General observation tube and high speed trace tube for precision ranging.
Precision range measurement - By calibrated phase shifter working on the sinusoidal deflector voltage of the high speed trace.
Accuracy: - Range: better than 1 km, probably 100 m.
Maximum range - Dependent on site.
Minimum range - Probably 1 km.
Mounting - Identical with old type Freya
Weight - 6200 kg.
Manufacturer - GEMA

ITEM: WANZ G.S.R.

INTELLIGENCE: Reported loaded on 2000 ton Japanese submarine in France on 9 August 1943.

Photographic confirmation of Japanese (APD) use of the German Rundipol circular-dipole antenna points to use in conjanction with the Wanz amplifier. Eval. A-1.

IDENTIFICATION: In reception of waves transmitted at short intervals from rotating antennas, the Japanese use h[illegible] and cathode

tube type of indicaton together. Headphones are used with the Naxos amplifier; Wanz amplifier is fitted with a cathode ray tube.

This receiver has visual indication of a received transmitter on a Cathode Ray Tube, with simultaneous audible reception. Used for detection and observation of radar carriers.

Frequency range - 146 - 254 (mc) (205 - 118 cm)
Frequency accuracy - ± 1%
Reception band width - 300 Kc
Frequency band width - 700 Kc (Cathode Ray tube)
20 Kc (high in head phones)
20 cps (low in head phones)
Sensitivity - 100 - 300 microvolts across 150 ohms produces a 5 mm pip (A signal of about half this value is just discernable.)
Tuning - Variable control between 600 and 2600 rpm.

Dimensions & Wts.	hght.	wdth.	depth	wt.
Indicator Unit	15-3/4"	11½"	20½"	55 lbs.
Power Rectifier	14½"	9½"	7-3/4"	26½ lbs.

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ITEM: METOX (GSR)

INTELLIGENCE: Old Metox with Southern Cross aerial was turned over to the Japanese early in 1942. (A-2)

SoKenPac reports vague description by P/W which suggests adaptation of Metox with cathode ray visual presentation and directional (10°) dual cone antenna.

IDENTIFICATION: This G. S. R. has been improved by addition of a tube, Cathode Ray, which extends range of Receiver to cover frequencies above limit of hearing. Visual indication is obtained when such signals are received. Another addition is an external oscillograph by means of which all alternating signals of Sinusoidal form can be followed.

The aerial functions best when broadside onto a transmission and has a blind spot when head on. The only advantage of Southern Cross Type Aerial Array was that a rough bearing of the searching aircraft or surface vessel had been obtainable.

Wavelengths: 60 cm to 265 cm (500 - 113 (mcs)
Power supply: 220 volts AC 50 cps.
Power consumption: Approx. 100 watts
Volume control: Volume control can be adjusted on the high frequency side by variation of the grid bias of the second intermediate frequency amplifier tube, on the low frequency side by variation of the alternating voltage at the grid of the output tube.

1. RADIO and RADAR.

Tuned circuits: 1 antenna circuit
1 oscillator circuit
3 circuits fixed to the intermediate frequency.

Main components: 1. Power supply unit with transformer and full wavelength rectifier.
2. Voltage stabilizer
3. High frequency unit with aerial turning system.
4. Mixing stage
5. Amplifier and output circuit

- -

ITEM: THETIS (R.D.S.)

INTELLIGENCE: Several instances of reflectors for deception have been reported. It is not definitely known whether these were R-D-S or R-D-B, but reliable information reveals that Thetis was turned over to the Japanese.

IDENTIFICATION: Thetis is a radar decoy spar buoy consisting of a cork plug and two hollow rods approximately 2 meters in length. Assembly takes place on deck. Each of the hollow rods contain 1 radar decoy mast which is removed. The two rods are then fastened together end to end with a cotter pin and fastened in like manner to the cork plug. The two radar decoys are similarly fastened together and mounted on the cork float. The rods are opened at the bottom so that they fill with sea water.

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ITEM: PeG4 (DIRECTION FINDER)

INTELLIGENCE: Transfer of a receiver, EZ4, for this airborne direction finder is the only positive evidence which exists that the Germans transferred a PeG4 to the Japanese. Eval. A-2.

IDENTIFICATION: .250 to .400 megs. The Peilgerat 4 was used for D/F homing; originally in light bombers, last in single-seated fighters; in JU 87, in a few ME 109 (F) and ME109(G) prior to the use of FuG 16Z. It has the appearance of being hurriedly made and does not compare favorably with other German receivers. The type signal is C. W., tone and voice.

Range (miles)	ca. 150 with mobile D/F beacon
Frequency Range (mc)	.25 - .4
Tubes	8 RV 12 P 2000
Receiver EZ4 (Superheterodyne)	Ht. - 11 Width - Depth 6 Wt. 22½ lbs.

1. RADIO and RADAR

ITEM: PeG 5 (AIRBORNE D/F FINDER)

INTELLIGENCE: Components were found at Bordeaux awaiting shipment to Japan, October 1944.

IDENTIFICATION: The Peilgerat 5 is an airborne D/F radio used by navigator for homing and D/F bearings.

Range (miles) - up to 250
Frequency range - (mc) 0.165-0.4; 0.4-1.0
Tuning - (MO or crystal) 4 gang condenser.
Tubes - 6 NF 2
Type of signal - CW and voice.
To communicate with: Airdrome beacons.
Principal components:
Receiver Type EZ-2 10" high, 24" wide, 8" deep, 24 lbs. wt.
Loop PRE 6 13" high, 6-½" wide, 2-½" deep, 10 lbs. wt.
Antenna Matching Unit wt. 2 lbs.
Dynamotor U-8 wt. 5 lbs.

CONCLUSIONS: As in the case of other equipments recovered in warehouses, factories and submarines en route to Japan, it cannot be definitely stated that previous shipments of such devices were actually received there. Where Japanese adaptations are known to exist, there is, of course, no doubt of earlier transfer; also when material recovered consist of components, spares or replacements, it is a fair assumption that the basic model was already in Japanese hands prior to shipment of such spares

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ITEM: PeG6 (DIRECTION FINDER)

INTELLIGENCE: Transfer of receiver, EZ6 for this airborne direction finder is the only positive evidence of transfer of the basic set.

IDENTIFICATION: The Peilgerat 6 was installed either as a separate D/F receiver in addition to FuG10 for use by the navigator or else it takes the place of the long wave receiver E10L in FuG10 and performs the dual function of D/F and communication. It is a modern replacement for Peil G5 and is similar to Peil G4 without evidence of haste. The type signal is C.W., tone and voice.

Frequency Range (mc)	.15 - 1.2 in 3 bands
No. of Crystals	2 - for stabilizing the intermediate frequency of 130 KC/s and the BFO at 129 KC/s. This produces a 1000 cycle audio frequency for D/F work.
Tubes	7 RV 12 P 2000
Receiver EZ6 (Superheterodyne)	Ht. - 7" Width. 7½" Depth - 9½" Wt., 20 lbs.

ITEM: P53N (HOMING AND D/F)

INTELLIGENCE: Japanese planes examined in September 1944 were found to contain German designed direction finders. This equipment was almost an exact duplicate of the Telefunken P53N rader beacon, except for a slightly modified loop.

IDENTIFICATION: Type P53N comprises a 2 turn rotating loop and receiver and amplifier, both of which are remotely controlled from the pilot's cockpit. It is used for non-directional reception, homing with aural or visual indication and D. F. It has been mounted in Ju52.

Aerial - (Auxiliary non-directional) 15 - 20 ft. long
Loop aerial - Remotely controlled two turn tubular steel loop. The turns have a diameter of 16½" and are strong enough to withstand air speeds of 280 mph, at which speed the drag, with the loop set athwartships, is less than 10 lb. The loop is rotatable through 360°.

Wave range: 1000-167 Kc (using 2 bands)
Power: Low tension supply for filament from main battery of a/c and a 150 volt anode battery.
Wt. 62 lbs.
D. F. using Cosine Diagram: Very high step up transformer with voltage ratio of the order of 1:1000 is used for compiling to the first valve.
Three R. F. screened grid stages with gain control on the screen voltage.
A grid detector stage with separate oscillator for C. W. reception.
2 L. F. Amplifiers.
In use of receiver when homing auto-gain is incorporated but this is out of action when using D. F.
Auxiliary aerial is used thru a differential condenser for zero sharpening, but not for sense determinations.

? FuBiL

ITEM: FuBiL (HOMING APPARATUS)

INTELLIGENCE: Components found at Bordeaux awaiting shipment to Japan, October 1944.

IDENTIFICATION: The Lorenz system of blind flying works on 30, 31.5, or 33.3 mcs, which are the usual Knickenbein frequencies. The same receiver in aircraft is used both for flying on Knickebein beams and for blind landing. For daylight landings the visibility must be at least 800 yds. and lower cloud level at 250 feet. By night the

minimum requirements are flare visibility 2000 yds. and cloud level 360 feet. The range of the beam is 30 km; the two marker beacons are placed 3000 and 300 meters from the aerodrome and both work on 7.9 meters wavelength. The first transmits 200 meters up to a height of 600 meters; the main marker beacon transmits high pitched dots over an area of 150 meters up to a height of 500 meters. On the correct landing cruise a vertical ground beam is picked up as a deep tone, by plane, about 300 m. from landing strip, while one 50 m away is as a high tone. Development of this same principle is for the former a green light, for the latter a red light.

	*FuLandgereat 1 Nav. Rec. EBl. Main Beacon Rec'r.	FuLandgereat 1 Nav. Rec. EBl. 2 Marker Beacon Rec'r.
Function	Blind landing	Blind landing
Frequency (mc)	28.5 - 35.0	38.0
Type of signal	Aural, visual and phone	
Receiver	TRF	TRF
	*FuLandgereat 1 Nav. Rec. EBl. Main Beacon Rec'r.	FuLandgereat 1 Nav. Rec. EBl. 2. Marker Beacon Rec'r.
Tubes used	2 NF 2	5 NF 2
Range (miles)	250	
Preset frequencies	Two	Fixed on 38 mc
Installed in	Ju52, Ju88, Me110, Fw58, FW200, He111, Do17, Do24	

* Carried loose in aircraft with FuG 10 and Peilgereat 6.

CONCLUSIONS: Complete equipment undoubtedly in Japan prior to October 1944.

- -

ITEM: TAKI MOD. 1 AIRBORNE RADAR

INTELLIGENCE: Transformer and tube socket are contained in one unit. This technique suggests German origin.

IDENTIFICATION: TaKi, Mark I, "Electric wave warning device for aircraft use, Model I". ASV radar; possibility that the receiver could be used for homing on Allied radars. The transformer IF circuit built directly into the tube socket may indicate German influence as this feature is used consistently in German radar. TaKi, Mark I characteristics are as follows:

Frequency 190-210 mc

PRF	1000 cps / 100
Trans. Peak Power	10 kw
Pulse width	probably 5 ms
Theoretical range	45 miles
Receiver IF	30 mc (approx.)
Rec. IF band width	3 mc (approx.)
Rec. Video band width	1 mc (approx.)
Rec. sensitivity	Better than 10 mv
Presentation	"A" scan with electronic range marks
Antennas	3 Yagis, 1 in each wing pointed outward at 20° angle to longitudinal axis of A.C. One in the nose. A gas tube T/R switch is employed.
Lobe Switching	Motor driven switch connects the radar to the antennas
Lobing rate	Very slow. On test about 40 sec. required for 1 complete cycle. Provision is made for switching off the lobing motor and rotating the switch gear by hand. 3 pilot bulbs in the indicator show which antenna is in use.
Installation	Sally - Helen
Power Supply	Motor generator 100v AC and 24v DC. Metallic rectifier used throughout.
Range (from a captured document)	Aircraft 12 miles 3000 ton ship 36 " 1000 ton ship 18-21 " 500 ton ship 9-12 " Surfaced sub 7-9 " Large island (Formosa) 141 " Med. " (Nansei-Shote) 72 " "Altitude affects these figures but they will apply in general between 500-3000 meters."

ITEM: MK 1 RADIO HOMING D/F (JAPANESE DESIGNATION)

INTELLIGENCE: Laboratory tests reveal similarity to German Telefunken equipment EZ-2.

IDENTIFICATION: Frequency range (mcs) - 0.16 [illegible]
Antenna - Single Loop
Receiver Tuning - 3 remote controls
Tubes used - (5) UY76, (4) UZ6D6 (1) UZ6L7G
Trans. and Rec. Size (ins.) - 17-3/4 x 7 x 9-3/4
Overall Wt. (lbs) - 24
Power Source - 2 Dynamotors

1. RADIO and RADAR

ITEM: APHRODITE - RADAR DECOY BALLOONS

INTELLIGENCE: Reliable evidence (A-2) indicates transfer of data to the Japanese. Date unknown.

IDENTIFICATION: The balloon is inflated with hydrogen and moored to floating plate anchor by a metallic cable, to which is attached 3 strips of aluminum, placed 2 meters apart. Impulses cast by enemy radar are reflected by the aluminum strips which produce resoundings similar to those of a submarine.

Diameter - 2'6"
Cable - 20 meters
Aluminum strips - 21 meters
Functioning time - 2-8 hrs. (according to atmospheric conditions)
Max. Range at right angle to wind - 12,000 yds.
Drift velocity when wind force - 4-5 knots
and sea force - 3-4 knots - 4-8 knots
Limits of use - wind force - 4-6 knots
sea force - 4-5 knots
Saturation echo - 3000 yds.

- -

ITEM: WISMAR (ANTI-JAMMING)

INTELLIGENCE: Reliable information indicates that the Japanese had complete drawings and literature before the end of 1944. (A-2) Two sets of equipment reported in Japan in March 1944. (A-2)

IDENTIFICATION: In GAF Anti-Jamming practice, WISMAR procedure refers to all efforts which aim, by change of frequency of the radar, at avoiding active interference. A German Manual for flak personnel states that "WISMAR Procedure renders possible complete mitigation of active jamming (such as Carpet)". However, while capable of elimination of interference under some conditions, WISMAR involves no little training on operations which must be carried out very accurately in a few seconds, viz - a change of wave length necessitates first altering the transmitter/local oscillator and on going from one band to another a change on the rotating dipole is likewise necessary, provided this is not a wide band dipole. In addition there are 3 types of transmitter/local oscillators and 3 types of rotating dipoles, not all of which provide for a change of length. Since it is apparently not possible to actually follow a target with radar while searching for an unjammed channel and tuning the transmitter to it, the total effectiveness of WISMAR is questioned.

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ITEM: WURZIAUS (ANTI-JAMMING)

INTELLIGENCE: Reliable information indicates that details were made

available to the Japanese in March 1944. (A-2)

IDENTIFICATION: Operated on the basis of the Doppler effect. It distinguishes between the blip due to targets moving at aircraft speed and that of comparatively slow-moving targets, such as Window or permanent echoes. Depends for its operation on the physical fact that the waves reflected from a moving target experience a change in phase in relation to the phase of the oscillations of a locking oscillator. Consisted of a low-powered transmitter with very accurate frequency control. Coupled to regular transmitter in Wurzburg.

The Weurzlaus is not accurate enough for anti-aircraft units.

- -

ITEM: NUERNBURG (ANTI-JAMMING)

INTELLIGENCE: Reliable information indicates that details were made available to the Japanese in March 1944.

IDENTIFICATION: This is the name given to the provision of aural distinction between responses due to Window and those due to aircraft. Depends for its operation on the variation of the amplitude of the response from an aircraft due to the rotation of its airscrews. Also gives aural indication of the Weurzlaus device, with sets fitted for Weurzlaus procedure.

When Window is dropped, high frequency tone may be heard due to the varying reflections as the tin foil turns and falls. The operator takes bearings on low pitched tones and is thus able to follow aircraft thru window.

Tone frequency - 50 - 150 c/s

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ITEM: GOLDAMMER (ANTI-JAMMING)

INTELLIGENCE: Reliable information indicates that Japanese obtained details in March 1944. Eval. A-2.

IDENTIFICATION: This was the use of polarization perpendicular to that of the jamming signal to get range. Basic principle of operation was to darken screen of the CRT with negative pulse voltage when the strength of the jamming signal was greatest.

Device containing a high frequency amplifier, detector, low frequency amplifier and phase inverter stage.

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ITEM: COUNTER RADAR APPLICATION, MAGNETITE

INTELLIGENCE: While there is no definite evidence that the Japanese

secured formula for this substance, ComNavEu reports that it was considered to be a first priority Japanese Intelligence target.

IDENTIFICATION: During the last few years (dated 18 April 1945) I. G. Farben has successfully produced, by experiment, an improved cover against radar composed of a new sort of Magnetite (FE304) churned up with some rubber or Oppanol. Information available would indicate that Magnetite of this kind was not produced outside of Ludwigshaven.

Japanese anti-radar materials and research: An indication of Japanese RCM and Deceptions efforts is found in an undated translated document, published by the Gateyama Gunnery School and captured on Iwo Jima. It appears that, as of the date of publication, little progress had been made in developing radar-absorbing materials but the Japanese policy is probably correctly outlined in the statement that "research on radar-wave absorbing materials is the most important consideration."

The following passages are quoted as of general interest:

"Wave Absorption: The obvious way of increasing the difficulties of radar detection is through the absorption of radio waves."

"Wave Absorbing Bodies: Dr. MORITA of the TOKYO Engineering University (TN:KOKAI) holds a patent on various methods of making wave absorbing bodies. (Patent No. 144839). There is a definite relationship between the thickness of a titanium oxide layer of the proper conductivity and the thickness of a saline solution of the proper conductivity on the one hand and the wave length on the other. Consequently, wave absorbing bodies can be produced when this relationship is properly ascertained. The back side of these layers is covered with copper, iron or aluminum plates or plates of a similar metal. When the incoming radar wave strikes the layer, the wave is directly reflected from the metal surface after passing through the absorbing layer. Through the interaction of these two waves, the reflection can be cancelled out. It would be necessary, however, to alter somewhat the thickness and quality of the material depending on whether the incoming wave strikes the face of the absorbing body directly or enters at an angle.

Another way of producing an absorbing body which will clearly have the same effect is as follows. Resistance rods slightly less than $\frac{1}{2}$ the wave length are affixed parallel to a metal plate, or resistance pins slightly less than $\frac{1}{4}$ the wave length are affixed perpendicular to the metal plate.

Still another way is to cut the absorbing surface of the conducting body in an irregular saw-tooth fashion. When this is done, the incoming wave while being reflected back and forth between the adjoining teeth will enter the hollow portion. Hence, the quantity of the wave absorbed will be proportionate to the number of times the incoming wave strikes the conducting body. This is the invention of Mr. KUSONONSE (Patent No. 53341). However, it is impossible to know from which direction waves from early warning or fire control radar will come. Therefore, incoming waves do not necessarily enter between the teeth as desired. Actually,

then, it must be concluded that it is almost impossible to have the waves enter the absorbing surface in the direction desired. A difficulty with this type of absorbing body is that it cannot very well be installed on aircraft which require light materials because of its great weight. Nevertheless, the question remains of whether or not there is a material capable of completely absorbing radio waves.

It is virtually impossible to do away with reflection due to the basic difference between air and matter. In practice, then, the problem becomes one of endeavoring to minimize reflection. At any rate the problem to be solved in the future is how to produce an object which will be of a suitable shape and yet be sufficiently light reight."

"The Future of Radar Wave-absorbing Materials: Research is progressing on methods of concealing the location (of targets) through the absorption of radar waves. It is anticipated that a time will come when aircraft and ships will be covered with radar wave-absorbing materials. Painting offers considerable difficulties because the thickness of the paint (layer) must be related to the wave length utilized by (each type of) radar set. The paint must be applied to the exterior in the proper thickness, even though the wave length may be only 10 centimeters. In this respect, if we are prepared to increase the weight of warships and submarines to a certain extent, a certain amount of radar wave-absorbing substances may be applied (to them). Specifically, in cases where submarine periscopes are likely to be picked up by radar, it should be sufficient to apply radar wave-absorbing material to the periscope alone. The fact that German submarine activity has recently reached such a high point might well be due to the perfection of such a periscope. It must be said, however, that rendering aircraft and warships "non-radar reflecting" still lies in the distant future. At present, research on radar-wave absorbing material is the most important consideration; radar, as a detection device, has altered the aspects of warfare in that it has replaced the formerly used optical equipment. Decisive night engagements are no longer idle fancies. How to turn out superior radar equipment on a mass-production basis has become a great problem which is influencing the fortunes of war."

"The Japanese have also attempted to develop equipment similar to Moonshine although their principal tactical use of such equipment appears to differ from Allied use. It appears from the meager information in this article that it was, at the time of publication, being studied but had not been developed."

"Decertion Tactics: In addition to the technique of eliminating the reflected wave by absorption, another technique is being studied whereby either the reflected wave is cancelled by the transmission of an impulse stronger than the reflected wave. (Patent No. 15197). The invention of Dr. HAYASHI of the Imperial University at OSAKA is related to this technique. When the radar wave transmitted by the search radar strikes the plane, it is picked up by receiving antenna. Since the phases of the reflected and transmitted waves are directly opposite, both waves tend to weaken each other. If those waves are of equal amplitude they

cancel out perfectly and the reflected wave is eliminated. Moreover, if, simultaneously with the cancelling of the reflected wave, a wave is transmitted whose phase is slightly behind that of the reflected wave the plane will appear to be at a greater range than it actually is. Conversely, if a wave is transmitted with its phase slightly ahead of the reflected wave the plane will appear nearer than it actually is. Such methods as these cause the plane's position to be miscalculated and so are useful in avoiding attacks."

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ITEM: IGELIT

INTELLIGENCE: Process reliably reported to have been given the Japanese. (A-2)

IDENTIFICATION: Igelit is a Schnorkel anti-radar covering consisting of seven to ten coatings of paper or plastic film containing carbon black, the conductivity of which is widely varied. These coatings are spaced by layers of Polyvinylchloride foam plastic. Due to the finished product's thickness of three inches, it can be used only on flat or cylindrical surfaces. It is believed to absorb over 90% of the radar energy striking its surface. In the S and X bands reflection in amplitube is less than 10%.

- -

ITEM: WINDOW 10 cm. (DISC TYPE)

INTELLIGENCE: Japanese acquired disc window for 10 cm radar from the Germans early in 1945. (A-2)

IDENTIFICATION: This Window consists of circular pieces of cardboard with tinfoil covering, approximately 2.9 cm. diameter.

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ITEM: RADAR COMPONENTS, WIRE-WOUND RESISTERS

INTELLIGENCE: GHQ, SWPA, Section 22, laboratory examination.

IDENTIFICATION: A series of wire-wound resisters with the trade name "Rikenohm" appears to be similar to German resisters.

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ITEM: VACUUM TUBES (GENERAL)

INTELLIGENCE: Three of the five types of vacuum tubes known to be made by Nippon Musen K.K. are copies of Telefunken tubes. One 1-65 tube which was recovered bears the Nippon Musen trademark and the legend, "Made in Germany." In addition, many RF-2 tubes made by Telefunken in Germany have been recovered with Japanese equipment and in supply depots, indicating that Telefunken supplied more than just a few samples of these important tubes to the Japanese. It is probable that of the aid Germany has given to Japan in the design and manufacture of electronic equipment, particularly of radar, a substantial part has been granted through Nippon Musen K.K. and that this firm may eventually produce German-type radar.

Reliable information indicates delivery in Japan of Telefunken tubes for decimeter waves (A-2).

Two Pilger-Stiefel units for manufacture of vacuum tubes were received in Japan in October 1943. (A-2)

Reliable I/W states that Panorama type cathode ray tube was shipped to Japan in 1943. (Evaluation F-D). A condensed summary of German cathode ray tubes follows:

IDENTIFICATION:

LB 1 -- This is a high vacuum cathode ray tube with double-electrostatic deflection.

LB 2 -- This is a high vacuum cathode ray for electro magnetic-electro static polars coordinate recording graduation 80.

LB7/15(2) -- This is a high vacuum cathode ray tube with double electro static deflection.

LB 10 -- This is a cathode ray tube with a design similar to the tuning indicator tube (magic eye). 2 electrically separated units with zero marking and scale. Built-in triode for 1-f or indicator amplification.

LB13/40 -- This is a high vacuum cathode ray tube for electro-static-electromagnetic polar-coordinate recording graduation 420.

LB 40/43 -- Documents and I/W sources indicate that 2 makes of CRT are used in the Jadgschloss, but both are known by the same type designation. One is a constant current, indirectly heated type with varying filament voltage; the other is a constant filament voltage type and varying current.

	LB 1	LB 2	LB7/15(2)
Use	Hds	Hmsp	Hds
Screen dia. (cm)	7	7	7
Heating: volts	12.6	12.6	4
amps.	0.27	0.27	1
Cathode	ind.	ind.	ind.

	LB 1	LB 2	LB7/15(2)
Max. plate voltage (volts)	2000	2000	2000
Max. screen voltage (volts)			400
Focussing voltage	150...300	225...325	450...550
Grid cut-off voltage (volts)	-35...-65	-30...-55	-60...-110
Mean cathode current ua	50	35	25
Deflection sensitivity of:			
range plates	0.077		0.07
time plates	0.05	condensor rings: 0.08	0.05
Socket: Ln number	30125 20126	30127	30128
RLM standard	--	--	--
Manufacturer	Telefunken	Telefunken	Opta/Telef.

	LB 13/40	LB10	LB 40/M3	LB 40/M3
Use	Hmsp	Abst.		
Screen dia. (cm)	13	--	40	40
Heating: volts	4	12.6	.8-1.0	4
amps.	1	0.15	1.7	.4-.6
Cathode	ind.	ind.		
Max. plate voltage (volts)	4000	275		
Focussing voltage	1050..1350			
Grid cut-off voltage (volts)	-75...-150			
Mean cathode current ua	35			
Deflection sensitivity of: time plates	condensor rings: 0.12			
Socket: Ln number	30129			
RLM standard	--	--	--	--
Manufacturer	Telefunken	Philips-Valvo	Fernsch	Opta

ITEM: LDI (German Designation)

INTELLIGENCE: Captured Japanese document, Tama Technical Research Laboratory dated 30 November 1943, describes detailed tests on 20 Telefunken LDI described below.

IDENTIFICATION: (Japanese comments) Ultrashort-wave transmitting triode; characteristics of tubes (TN 20 tubes.) closely uniform. Short critical wavelength. Superior to our UN 955. Socket in opposite position compared to ordinary tubes. It is sturdy, and handling is facilitated by means of the attached handle.

The electrodes supporting and lead wires are thick and short. Two wires lead outside from the plate and grid, providing a strong construction and low inductance. Interval lead-in wires presumed to be molibdenum. Extremely high electron emission cathode material. Outer body of tube of hard glass.

Ratings

Cathode, type - Indirectly heated. Oxide coating
Cathode heater voltage - 12.6 V
Cathode heater current - 0.1 A
Maximum plate voltage - 300 V
Mutual conductance - 3 mA/v
Amplification factor - 11
Interelectrode capacity - Grid to plate (maximum) - 1.35pF
Maximum plate dissipation - 5 W

CONCLUSIONS: See last page, Chapter 1.

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ITEM: LD2 (German Designation)

INTELLIGENCE: Captured Japanese document, Tama Technical Research Laboratory dated 30 November 1943, describes detailed tests on 20 Telefunken LD2 described below.

IDENTIFICATION: (Japanese comments) Ultrashort-wave transmitting triode; slightly larger than LD1 but similar in appearance. The plate is especially rigid with cooling vanes attached. Its surface is carbonized to prevent local temperature increases. The leads to electrode terminals differ from LD1; one for each electrode.

Glass body and internal lead-in wires same type as LD1. Electrode material not investigated. Cathode appears to be same type as LD1.

Ratings

Cathode, type - Indirectly heated. Oxide coated
Cathode heater voltage - 126 V (TN Presumably 12.6V.)
Cathode heater current - 0.175 A
Maximum plate voltage - 800 V
Mutual conductance - 9
Amplification factor - 25
Interelectrode capacity - Grid to plate maximum - 3.5pF
Maximum plate dissipation - 12 W

CONCLUSIONS: See last page, Chapter 1.

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ITEM: LG1 (German Designation)

INTELLIGENCE: Captured Japanese document, Tama Technical Research

Laboratory dated 30 November 1943, describes detailed tests on 20 Telefunken LG1 described below.

IDENTIFICATION: (Japanese comments) Ultra-short-wave duo-diode with excellent electrical characteristics. Used as detector in ultrashort-wave band. Outward appearance similar to LD1 and LD2. Glass and internal electrode lead structure as well as property of cathode similar to those of LD1.

Ratings

Cathode, type - Indirectly heated. Oxide coated
Cathode heater voltage - 12.6 V
Cathode heater current - 0.075 A
Maximum plate voltage - 100 V
Plate current - 2 mA each

CONCLUSIONS: See last page, Chapter 1.

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ITEM: LS3 (German Designation)

INTELLIGENCE: Captured Japanese document, Tama Technical Research Laboratory dated 30 November 1943, describes detailed tests on 3 Telefunken LS3 described below.

IDENTIFICATION: (Japanese comments) Noteworthy ultrashort-wave diode-triode. Performs both detection and amplification. All-glass type; no base electrodes connected directly to prongs. Weak glass; platinum substitute internal leads; weak, thin wires to prongs. General impression [illegible]gile construction as compared to LD1 type.

Ratings

Cathode type - Directly heated. Oxide coated
Cathode heater voltage - 1.9 V
Cathode heater current - 0.1 A
Maximum plate voltage - 200 V
Mutual conductance - 0.8 mA/V
Amplification factor - 25
Interelectrode capacity: Grid to plate (Maximum) - 1.5 pF
Maximum plate dissipation - 1w

CONCLUSIONS: See last page, Chapter 1.

- -

ITEM: SA 100 (German designation)

INTELLIGENCE: Captured Japanese document, Tama Technical Research Laboratory dated 30 November 1943, describes detailed tests on 5 Telefunken SA 100 described below.

IDENTIFICATION: (Japanese comments) Short wave diode. According to TELEFUNKEN catalogue it can be used to rectify waves up to approximately 10cm. At centimeter wave lengths its detection was not especially good. However, it proved more stable than a crystal.

Extremely small tube; diameter of glass tube less than 2 cm; height little over 1 cm. Delicate construction. Fits into a special light metal holder Elaborate electrode construction. The cylindrical type plate and the cathode, which resembles a BRAUN Tube type cathode, are interpositioned so that in operation the space between them diminishes as the cathode is heated. This shortens the time of electron travel and decreases inter-electrode capacity.

Ratings

Cathode, type - Indirectly heated. Oxide coated
Cathode heater voltage - 1.9 V
Cathode heater current - 0.32 A
Maximum plate voltage - 100 V
Plate current - 0.1m A

CONCLUSIONS: See last page, Chapter 1.

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ITEM: SA102 (German designation)

INTELLIGENCE: Captured Japanese document, Tama Technical Research Laboratory dated 30 November 1943, describes detailed tests on 3 Telefunken SA 102 described below.

IDENTIFICATION: (Japanese comments) Ultrashort-wave diode. Save for the fact that the gap between plate and cathode is smaller, its shape and construction exactly resemble the SA100. The smaller interelectrode gap makes a considerable difference in its characteristics.

Ratings

Cathode, type - Indirectly heated. Oxide coated
Cathode heater voltage - 1.9 V
Cathode heater current - 0.35 A
Plate peak voltage - 100 V
Plate current - 0.1mA

CONCLUSIONS: See last page, Chapter 1.

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ITEM: RV12H300 (German designation)

INTELLIGENCE: Captured Japanese document, Tama Technical Research Laboratory dated 30 November 1943, describes detailed tests on 6 Telefunken RV12H300 described below.

IDENTIFICATION: (Japanese comments) HF hexode, possessing variable -

mu characteristics. Can be used as a mixer or RF amplifier. So-called "inverted type" tube with handle attached. This enables insertion of tube in a special socket in the opposite direction from an ordinary tube. Upper stud connection is also completed upon tube insertion. A part of the tube is provided with an outer shielding which is grounded by the special socket. Handling is very simple. The small size of its elaborately constructed electrodes is gained by precise workmenship and the use of "button stem" (TN Presumably small supports). In view of its general rigid constructional qualities it is our opinion that this tube represents the acme in tube technique.

Ratings

Cathode, type - Directly heated. Oxide coated.
Cathode heater voltage - 12.6 V
Cathode heater current - 0.07 A
Maximum plate voltage - 200 V
Maximum screen grid voltage - 100 V
Mutual conductance - 300 mA/V
Plate resistance - 0.8 m
Interelectrode capacity: Grid to plate (maximum) - 0.003 pF
Maximum plate dissipation - 1 w

CONCLUSIONS: See last page, Chapter 1.

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ITEM: RL2.4F3 (German designation)

INTELLIGENCE: Captured Japanese document, Tama Technical Research Laboratory dated 30 November 1943, describes detailed tests on 6 Telefunken RL2.4F3 described below.

IDENTIFICATION: (Japanese comments) Pentode, output tube; used in final amplifier stage. The static characteristics of several tubes were tested. Results showed almost perfect uniformity.

Ratings

Cathode, type - Directly heated. Oxide coated
Cathode heater voltage - 2.4 V
Cathode heater current - 0.13 A
Maximum plate voltage - 200 V
Maximum screen grid voltage - 130 V
Mutual conductance - 14 mA/V
Interelectrode capacity: Grid to plate - 0.03 (TN Unit not stated.)
Maximum plate dissipation - 2 W

CONCLUSIONS: See last page, Chapter 1.

ITEM: RV2.4T3 (German designation)

INTELLIGENCE: Captured Japanese document, Tama Technical Research Laboratory dated 30 November 1943, describes detailed tests on 3 Telefunken RV2.4T3 described below.

IDENTIFICATION: (Japanese comments) Space charge grid triode. Used as low frequency amplifier. Same type socket as RV12H300 and RL2.4T3.

Ratings

Cathode, type - Directly heated. Oxide coated
Cathode heater voltage - 2.4 V
Cathode heater current - 0.06 A
Maximum plate voltage - 100 V
Space-charge grid voltage - 20 V
Mutual conductance - 0.7 mA/V
Amplification factor - 4.5 (TN Indistinct could be 5 or 6)
Plate resistance - 6000 Ω
Interelectrode capacity: Grid to plate (maximum) - 3 pF
Maximum plate dissipation - 0.5 W

CONCLUSIONS: See last page, Chapter 1.

ITEM: RV2.4 P1400 (German designation)

INTELLIGENCE: Captured Japanese document, Tama Technical Research Laboratory dated 30 November 1943, describes detailed tests on 6 Telefunken RV2.4 P1400 described below.

IDENTIFICATION: (Japanese comments) HF pentode. Although complete tests have not yet been made, there seems to be some irregularity in its characteristics. Tube is completely enclosed in metal shielding. Inverted type, easy to handle like the RV2.4T3 and similar in shape.

Ratings

Cathode, type - Directly heated
Cathode heater voltage - 2.4 V
Cathode heater current - 0.35 A
Maximum plate voltage - 200 V
Maximum screen grid voltage - 200 V
Mutual conductance - 3.3 mA/V
Amplification factor - 4.5
Plate resistance - 0.2 Ω
Interelectrode capacity: Grid to plate (maximum) - 0.003 pF
Maximum plate dissipation - 2 W

CONCLUSIONS: See last page, Chapter 1.

ITEM: RL2.4T4 (German designation)

INTELLIGENCE: Captured Japanese document, Tama Technical Research Laboratory dated 30 November 1943, describes detailed tests on 3 Telefunken RL2.4T4 described below.

IDENTIFICATION: (Japanese comments) Twin triode. Characteristics of both sets of elements are nearly uniform. Inverted type, form same as RV2.4P1400; also fits into same socket.

Ratings

Cathode, type - Directly heated. Oxide coated
Cathode heater voltage - 2.4 V
Cathode heater current - 0.2 A
Maximum plate voltage - 220 V
Mutual conductance - 2mA/V
Amplification factor - 17
Maximum plate dissipation - 2 x 2 W

CONCLUSIONS: See last page, Chapter 1.

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ITEM: RL4.8 P15 (German designation)

INTELLIGENCE: Captured Japanese document, Tama Technical Research Laboratory dated 30 November 1943, describes detailed tests on 3 Telefunken RL4.8 P15 described below.

IDENTIFICATION: (Japanese comments) Transmitting diode-pentode. Output of pentode part corresponds to our UY503 type. Compared with its output the size of the tube is small, and its construction simple. Electrical tests are not yet completed.

Ratings

Cathode, type - Directly heated. Oxide coated
Cathode heater voltage - 4.8 V
Cathode heater current - 0.675 A
Maximum plate voltage - 400 V
Maximum screen grid voltage - 200 V
Mutual conductance - 4 mA/V
Interelectrode capacity: Grid to plate (maximum) 0.15 pF
Maximum plate dissipation - 15 W

CONCLUSIONS: See last page, Chapter 1.

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ITEM: LS30 (German designation)

INTELLIGENCE: Captured Japanese document, Tama Technical Research

Laboratory dated 30 November 1943, describes detailed tests on 6 Telefunken LS30 described below.

IDENTIFICATION: (Japanese comments) Ultrashort-wave transmitting triode. No detailed report yet on electrical tests. Use unknown. Tubes lack uniformity in their characteristics. Electrode construction and material resembles RS 393. The electrode leads run directly to the terminal prongs. There is a light metal base on the opposite end from the prongs with a grip attached. Tube fits into special socket. Very strong construction.

Ratings

Cathode, type - Indirectly heated. Oxide coated
Cathode heater voltage - 12.6 V
Cathode heater current - 0.3 A
Maximum plate voltage - 700 V
Mutual conductance - 6 mA/V
Amplification factor - 20
Interelectrode capacity: Grid to plate (maximum) - 2.6 pF
Maximum plate dissipation - 30 W

CONCLUSIONS: See last page, Chapter 1.

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ITEM: RS393 (German designation)

INTELLIGENCE: Captured Japanese document, Tama Technical Research Laboratory dated 30 November 1943, describes detailed tests on 3 Telefunken RS 393 described below.

IDENTIFICATION: (Japanese comments) Ultrashort-wave triode. Can be used as impulse oscillator. Utilizes oxide-coated filament with great electron emission. Large output obtainable with comparatively low voltage. The plate is constructed of thick pure molybdenum and assembled with iron-chrome alloy metal solder. The exterior of plate is coated with zirconium. This comparatively heavy and large plate is mounted semi-indirectly so that it does not exert a strain on the stems.

Heater type cathode. Heater element is surrounded by an insulated sleeve, rate of heating is good.

Ratings

(No ratings published by Telefunken Co. The following are the values obtained in the testing laboratory:)

Cathode, type - Indirectly heated. Oxide coated
Cathode heater voltage - 12.5 V
Cathode heater current - 06 A (TN Presumably 0.6A)
(temperat[illegible])

Ratings (Continued)

Maximum plate voltage - 2000 V (?)
Mutual conductance - 13 mA/V
Amplification factor - 16

CONCLUSIONS: See last page, Chapter 1.

- -

ITEM: RL12P50 (German designation)

INTELLIGENCE: Captured Japanese document, Tama Technical Research Laboratory dated 30 November 1943, describes detailed tests on 3 Telefunken RL12P50 described below.

IDENTIFICATION: (Japanese comments) Transmitting pentode. From the standpoint of output it corresponds to our UY530 and UY540. Compared to its output, its size is small and its construction simple. Electrical tests not yet complete.

Three studs are located at the top. One is connected to the plate; one is connected to the upper screen; the third is idle.

Ratings

Cathode, type - Indirectly heated. Oxide coated
Cathode heater voltage - 12.6 V
Cathode heater current - 0.66 A
Maximum plate voltage - 1000 V
Maximum screen grid voltage - 300 V
Mutual conductance - 4 mA/V
Interelectrode capacity: Grid to plate (maximum) - 0.07pF
Maximum plate dissipation - 40 W

CONCLUSIONS: See last page, Chapter 1.

- -

ITEM: LS180 (German designation)

INTELLIGENCE: Captured Japanese document, Tama Technical Research Laboratory dated 30 November 1943, describes detailed tests on 5 Telefunken LS180 described below.

IDENTIFICATION: (Japanese comments) Ultrashort-wave triode used as an impulse oscillator. Good design and manufacture; large output available from relatively small tube and electrodes. Cathode lead-in is especially long and the electrodes are assembled at one end. The plate and grid supports and the cathode supports are completely independent. Plate material and method of mounting presumed to be same as RS393. Thoriated tungsten filament formed into spiral shape. A heater shield is attached to both ends.

Ratings

(No ratings published by Telefunken Co. The following are the data obtained in the testing laboratories:)

Cathode, type - Thoriated tungsten filament
Cathode heater voltage - 5.8 V
Cathode heater current - 15 A
Mutual conductance - 5 mA/V
Amplification factor - 15.6

CONCLUSIONS: See last page, Chapter 1.

ITEM: RS383 (German designation)

INTELLIGENCE: Captured Japanese document, Tama Technical Research Laboratory dated 30 November 1943, describes detailed tests on 3 Telefunken RS383 described below.

IDENTIFICATION: (Japanese comments) Transmitting pentode. Tubes were damaged, and thus electrical test impossible. The large, heavy plate is supported only by a magnetic rod, and it does not seem strong or shock-proof. Two studs are atop of the tube. One is connected to the plate, the other to a net-type screen.

Ratings

Cathode type, - Indirectly heated. Oxide coated.
Cathode heater voltage - 12.6 V
Cathode heater current - 2.7 A
Maximum plate voltage - 1500 V
Maximum screen grid voltage - 450 V
Amplification factor - 330
Mutual conductance - 6 mA/V
Maximum plate dissipation - 160 W
Maximum screen grid dissipation - 30 W
Output - Approximately 250 W

CONCLUSIONS: See last page, Chapter 1.

ITEM: RG62 (German designation)

INTELLIGENCE: Captured Japanese document, Tama Technical Research Laboratory dated 30 November 1943, describes detailed tests on 3 Telefunken RG62 described below.

IDENTIFICATION: (Japanese comments) Diode rectifier. Electrical tests are not completed. Not of "button" stem type so unworthy of special mention.

Ratings

Cathode, type - Directly heated. Oxide-coated
Cathode heater voltage - 2.5 V
Cathode heater current - 4.5 A
Maximum inverse voltage - 5500 V
Emission current - Approximately 0.6 A
Plate resistance - 185 Ω
Maximum plate dissipation - 5 W

CONCLUSIONS: See last page, Chapter 1.

- -

ITEM: MS50/14R (German designation)

INTELLIGENCE: Captured Japanese document, Tama Technical Research Laboratory dated 30 November 1943, describes detailed tests on 1 Telefunken LS50/14R described below.

IDENTIFICATION: (Japanese comments) Four segment magnetron. No remarkable features were noticed in its electrical characteristics as compared to present day magnetrons.

In the plate, rivet connections are abolished; everything is welded. This raises electrical and heat conductance. The plate section utilizes tantalum plate for reinforcement. Mica plates are used in comparative abundance in this HF tube. They are installed above and below the electrodes to achieve shock-proof construction. A great deal of light alloy is used in the base. Handle is attached to rear part. Very rigid construction. Suitable for mass production.

Ratings

Oscillating wavelength limits - 40 - 60 cm
Output - 14.5 W
Cathode type - Directly heated
Cathode heater voltage - 3.9 V
Cathode heater current - 4.2 A
Maximum plate voltage - 2000 V
Maximum permissible plate dissipation - 35 W
Magnetic field - 530 G

CONCLUSIONS: See last page, Chapter 1.

- -

ITEM: RD4Ma (German designation)

INTELLIGENCE: Captured Japanese document, Tama Technical Research Laboratory dated 30 November 1943, describes detailed tests on 1 Telefunken RD4Ma described below.

IDENTIFICATION: (Japanese comments) Four segment magnetron. When compared to present magnetrons, no remarkable features were noticed in its electrical characteristics. Construction practically identical with MS 50/14R.

Electrode and general tube form are smaller. Suitable for mass production.

Ratings

Oscillator wave length limits - 18-26 cm
Output - 14 W
Cathode, type - Directly heated
Cathode heater voltage - 3.3 V
Cathode heater current - 4.2 A
Maximum plate voltage - 2000 V
Maximum permissible plate dissipation - 35 W
Magnetic field - 1330 G

CONCLUSIONS: See last page, Chapter 1.

ITEM: BG-75A (Japanese designation)

INTELLIGENCE: MIS (Evaluation - A-1)

IDENTIFICATION: Cathode Ray tube (American equivalent 3-BP-1), used in Mark 1, Model 2; Mark 2, Model 1; Mark 4, Model 3 radar sets.

This tube is also manufactured by Sumitomo Tsushin Kogyo K.K. It is identical electrically with their SSE-75-G, but has a different kind of socket, adopted from the Germans.

CONCLUSIONS: See last page, Chapter 1.

APPROXIMATE DATE OF PRODUCTION: In present production.

ITEM: RE-3 (Japanese designation)

INTELLIGENCE: MIS (Evaluation A-1)

IDENTIFICATION: Receiving Pentode Amplifier (American equivalent 1853 (1852)), used in Mark 1, Model 1, Revision 1; Mark 1, Model 2; Mark 2, Model 1, Taki MK 1 sets. This is a Telefunken-type tube which the Japanese have had difficulty manufacturing and have apparently not included in their more recent sets.

CONCLUSIONS: See last page, Chapter 1.

APPROXIMATE DATE OF PRODUCTION: In production.

1. RADIO and RAD

ITEM: BU-120-A (Japanese designation)

INTELLIGENCE: MIS (Evaluation A-1)

IDENTIFICATION: Cathode Ray tube (American equivalent 5-BP-1), used in Mark 2, Model 3; B, Mark 231, Model 1, radar sets.

The BU-120-A is identical electrically with the SSE-120-G but has a different kind of socket, copied from the Germans.

CONCLUSIONS: See last page, Chapter 1.

APPROXIMATE DATE OF PRODUCTION: In present production.

ITEM: SSE-120-G (Japanese designation)

INTELLIGENCE: MIS (Evaluation A-1)

IDENTIFICATION: Cathode Ray tube (American equivalent 5-BP-1), used in Mark 1, Model 1; Mark 1, Model 1, Revision 1; Mark 1, Model 2; Mark 1, Model 3; Mark 2, Model 1; Mark 2, Model 2; Mark 2, Model 2, Revision 2; Mark 4, Model 1; Mark 4, Model 3; Mark 6, Model 4; Mark 6, Model 4, Revision 1; B; B, Mark 229, Model 4; B, Mark 229, Model 50-2; B, Mark 230, Model 1; B, Mark 231, Model 1, radar sets.

This tube is also manufactured by Sumitomo Tsushin K.K. The SSE-120-G and BU-120A are identical electrically, but the BU-120A has a different kind of socket, copied from the Germans.

CONCLUSIONS: See last page, Chapter 1.

APPROXIMATE DATE OF PRODUCTION: In present production.

ITEM: FM-2A05A or NF-2 (Japanese designation)

INTELLIGENCE: Laboratory report.

IDENTIFICATION: Tube manufactured by Nippon Musen K.K. is a copy of a Telefunken tube. It is used in large quantities in Navy Airborne radio sets designed and produced in quantity since 1941. This tube is an impulse moderator used in the following equipment:

Radar	No.	Type Set
	2	Mark II Model II
	2	Mark II Model II Rev. II
	8	Mark VI Model 4
	13	Mark VI Model 4 Rev. 1
	13	FD2 (Exper. Guide Radar)

1. -RADIO and RADAR

Radio	No.	Type Set
	6	Type 96 Aero Mark 2 Rev. 1
	5	Type 1 Aero Mark 3 Rev. 1
	10	Type 2 Aero Mark 3 Rev. 1
	10	Type 3 Aero Mark 1
	10	Type 3 Aero Mark 5
	7	DF, Radio Homing, Type TE Aero Mark 4 Model 3
	7	DF Type 0 Aero Mark 4

APPROXIMATE DATE OF PRODUCTION: In present production.

ITEM: "Ultra Short Wave Tube"

INTELLIGENCE: An item under "Patent News" in the March 1942 issue of a radio magazine entitled "Japan Radio" contains sketch and brief summary of a Telefunken tube.

IDENTIFICATION: Special feature of this invention is the insertion of a choke in both the heating conductors forming a part of the resonance system which connects with the discharge system and the cathode.

CONCLUSIONS: The fact of traffic with Telefunken is established in the following descriptions of laboratory test data or some twenty types of vacuum tubes, and laboratory tests.

ITEM: RD-2-LH (German designation)

INTELLIGENCE: Reliable source indicates negotiations for rights for manufacture in Japan; March 1945 (A-2).

IDENTIFICATION: Receiver use.

ITEM: LLS-100 (German designation)

INTELLIGENCE: Reliable source indicates negotiations for rights for manufacture in Japan; March 1945 (A-2).

IDENTIFICATION: Transmitter use.

ITEM: VH-3 (German designation)

INTELLIGENCE: Reliable source indicates that rights for the manufacturing of this Gema tube were acquired by the Japanese in September 1944.

1. RADIO and RA

ITEM: SD-6 (German designation)

INTELLIGENCE: Reliable source indicates that rights for the manufacturing of this Gema tube were acquired by the Japanese in September 1944.

- -

ITEM: TS 6 (German designation)

INTELLIGENCE: Reliable source indicates that rights for the manufacturing of this Gema tube were acquired by the Japanese in September 1944.

- -

ITEM: RD 12 TF (German designation)

INTELLIGENCE: Reliable source dates transfer of tube to the Japanese as March 1944 (A-2).

IDENTIFICATION: This transmitter tube is used in Hohentweil (Lorenz) radar.

- -

ITEM: Z S - 6 (German designation)

INTELLIGENCE: Reliable source indicates that twenty units of this Gema tube were purchased by the Japs in November 1944. It is not known whether delivery to Japan was effected (A-2).

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1. RADIO and RADAR

ITEM: TUBE MANUFACTURE: GENERAL CONCLUSIONS

INTELLIGENCE: The manufacture of vacuum tubes of good quality requires specialized machinery and highly skilled labor. In Japan, as did Germany production of tubes for non-military purposes has been either severely curtailed or altogether eliminated. All of the known facilities which can make tubes for the armed services are already doing so, and the tubes for necessary civilian use probably are being made by a few small firms incapable of producing tubes of military value.

The facilities for producing high quality vacuum tubes in Japan are far less adequate to meet war needs than those in the United States. The expansion of the Japanese radio industry has been hampered by government policy. Strict government regulations against amateur operators prevented the creation of a civilian market for special purpose and advanced types of tubes. The manufacture of short-wave radios for civilian use was prohibited. In 1941 eighty percent of the radio sets in use in Japan were cheap three-tube affairs, with a radius of only a few miles, and most Japanese broadcating equipment was designed to serve such sets. As a result, Japanese civilian industry has been inadequate to meet the demands of the expanded radar program.

The rate of attrition for radar tubes in combat is extremely high, not only because of losses through capture and destruction, but also because of the shocks suffered by delicate equipment under field conditions. Accurate information is not yet available on the length of time for which different types of Japanese radar tubes can operate. On the basis of captured documents indicating the life expectancy of radio tubes and technical studies of captured radar equipment, however, it is estimated that very few types of Japanese radar tubes could withstand more than two weeks or a month of continuous service. Japanese radar tubes are now almost as specialized as American tubes; and it is believed that, because replacement requirements are so high and the regular demand so great, no substantial reserves could be accumulated for any types of tubes.

2. ARTILLERY and WEAPONS

ITEM: AA BATTERIES ("GROSS-BATTERIE")

INTELLIGENCE: (1) A/A defenses at Nagoya include use of "Gross-Batterie" System ("Multiple Battery Sites.") (Reported).
(2) U-234 enroute to Japan at time of German surrender was carrying "Gross-Batterie" Computers.
(3) Photo interpretation of Nagoya, Yokohama-Kawasaki, Tokyo areas confirms use of this type of battery.

IDENTIFICATION: In this German-designed system, several batteries are situated close together with the fire-control equipment pooled into a central command post. Usually, there are five 2-gun batteries and one three gun battery in the German version; Japanese "Gross-Batteries" are somewhat differently arranged: each battery consists of from 3 to 5 groups of 6-gun positions. This may indicate predominance of single barrel 120 mm guns rather than twin barrel 127s or 88s.

CONCLUSIONS: While German successes with "Gross-Batterie" flak were considerable, their effect was in large measure the result of an excellent gun - the 88 mm - 41. As the Japanese develop numbers of this gun, models of which were reported in use in January 1945 and the 127 mm/56 cal. reported (May 1945) under development, it is to be expected that range and possibly accuracy will exceed maximums of their standard 120 mm/45 and 127 mm/40 batteries.

APPROXIMATE DATE OF PRODUCTION: Now in operational use.

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ITEM: 88 mm ANTI-AIRCRAFT GUN

INTELLIGENCE: German manufacture of 88 mm AA guns for the Japanese Army is revealed in a letter recently captured in Europe. The letter dated 27 July 1943, was written from the German branch, Mitsubishi Commercial Company, to the War Material Section, Machinery Department, of the company in Japan. Previous data on the Japanese 88 mm AA gun has been fragmentary, but from prisoner of war interrogations, captured documents and recovered ammunition, it is now known that the new Jap 88 is an adaptation of the German gun. None of these weapons have been captured. The Rangoon Battery, while not of the conventional German design, was equipped with fire control radar.

IDENTIFICATION: The Jap experimental Type 99 (1939) 88 mm AA gun is an adaptation of the German Flak 36, and elements of the Flak 41. The Jap may have been able to improve the older German weapons through enlarging the powder chamber or increasing the length to 50 calibers. The following tables give comparison data on each of the guns:

	Jap	German Flak 36	German Flak 41
Muzzle Velocity	3280	2600	3280 (1980)
Max. Range (yds)	16,400 - 19,000	16,	2
Max.Eff.Range (ft)	32,000 - 37,000	34,	4

	Jap	German Flak 36	German Flak 41
Max.Eff.Vert.Range(ft)	29,500 - 30,000	26,250	35,000
Rate of Fire	25 - 26	15 - 20	20
Ammunition	Model 100 AA Pointed HE Projectile	HE, AP40, APCBC, HC	HE, APC, AP40, HC, APCBC
Remarks	Jap POW states adapted for Radar Fire Control	Sight: KOMMANDO Geraet 36 or 40	Sight: KOMMANDO Geraet 40

CONCLUSIONS: An official Army order listed the gun as being among new ordnance equipment available to the Japanese Army in 1943.

The adaptability of the German 88 mm Flak to anti-tank use is significant in that the Jap Model 99 may be a factor in future ground operations against the Japanese.

APPROXIMATE DATE OF PRODUCTION: In production at present time.

ITEM: SPECIAL AMMUNITION FOR 8.8 CM FLAK

INTELLIGENCE: Reliable source - evaluation A-2. Early 1945 is given as date of transfer.

IDENTIFICATION: Ammo consists of an incendiary explosive shell in the rear center of which are many incendiary fragments surrounding the bursting charge. Iron particles in 8 sectors constitute the incendiary fragments. A 1.5 cm hole drilled through each fragment is filled with incendiary material.

CONCLUSIONS: There can be no doubt that Japanese efforts to develop effective ammo for the 8.8 Flak acquired from Germany are being given high priority. Increasingly effective projectiles have already begun to manifest themselves in the war over Japan.

ITEM: FLAK TOWERS

INTELLIGENCE: Reliable evidence of transfer of details. Date unknown. (A-2)

IDENTIFICATION: Towers having light flak guns on searchlights were erected at GAF bases, ports and defended areas. One type mounted single-barrelled 20 mm Flak gun; a larger type mounted the 4-barrelled 20 mm, 37 mm, 50 mm gun, or 150 mm searchlight. This latter type could be easily disassembled and quickly erected. It was of steel, fastened with nuts and bolts and rose 26' or 33' in height according to requirements. Some [illegible] following data pertains to those erected in Berlin:

Stories:	Five
Material:	Steel and concrete
Base (sq. ft.):	250
Height (ft.):	100
Thickness of walls (ft.):	3
Armament:	
Main tower (reported):	4 twin-barrelled 88 mm guns or 105 or 128 (?).
	4 4-barrelled 20 mm or 37 mm. Contains central anti-aircraft control room for the entire Berlin area (reported).
2nd tower:	(Somewhat smaller and more rectangular than main tower) 4 20 mm Flakvierlings; Giant Wurzburg.

CONCLUSIONS: Frantic Japanese effort to develop A/A protection in their home islands is following a definite German pattern. Flak Towers should be expected in the immediate future. One such tower has already been spotted through photographic interpretation in Formosa.

APPROXIMATE DATE OF PRODUCTION: Underway.

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ITEM: 7.92 mm MG, AIR (JAPANESE TYPE 98) (GERMAN MG15)

INTELLIGENCE: Captured equipment.

IDENTIFICATION: The Type 98, flexible aircraft machine gun is an exact duplicate of the German MG15. It uses the German caliber 7.92 mm ammunition. It is an exceptionally light, compact weapon with high rate of fire, operates on short recoil principle and is fed by saddle drum type magazine. Maximum range 3,000 yds., effective range 300 yds., rate of fire - cyclic 900 rpm, practical 250 rpm, M.V. 2450 feet per second.

APPROXIMATE DATE OF PRODUCTION: In use.

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ITEM: 8 mm SUBMACHINE GUN, MODEL 100 (1940)

INTELLIGENCE: Captured Equipment (Aberdeen Proving Grounds)

IDENTIFICATION: This Japanese paratrooper's weapon is blowback operated, magazine fed, and fires from an open bolt. Although in basic design the Model 100 resembles German Submachine guns, it is not a direct copy of any other weapon. It weighs 9 lbs., 2 ozs., and is 36 inches long.

The cyclic rate appears to be excessively high (estimated 800-1000 rounds per minute). The muzzle velocity is approximately 1050 feet per second.

An interesting feature is the replaceable firing pin which screws into the face of the bolt.

When test fired with the standard Japanese pistol ammunition 8 mm, cupronickel ball projectile, the weapon failed to extract 75% of the rounds fired.

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ITEM: 13 mm FLEXIBLE AIRCRAFT MACHINE GUN

INTELLIGENCE: Captured equipment.

IDENTIFICATION: Tactical counterpart of U. S. Browning, cal. 50, M2. Action is Solothurn type; locking cam on a rotating bolt head engages a cylindrical locking collar to lock the action for firing. It is fed by a metallic disintegrating link belt. It is used singly and in twin-mounted versions in hand-operated mounts and power-operated turrets in many German bombers. The recoil operation is assisted by a muzzle recoil booster. It is unusual in that the cartridges are ignited electrically instead of by a mechanically operated firing pin. Recoil-operated, gas-assisted, belt-fed, air-cooled, automatic weapon in extensive use in GAF. It is found as remotely controlled top-turret guns in HE 177. Characteristics of the MG131 and the Jap Type 2 13 mm Flexible, Model 1, are as follows:

	German MG 131	Jap Type 2
Caliber	13 mm	13 mm
Weight 40	40 lbs.	37.6 lbs.
Length	46"	46"
Rate of fire	900 rds/min. cyclic	936 rds/min
Muzzle velocity	2370 ft/sec.	2460 ft/sec.
Sights	Refractor type on mount	?
Ammunition	13 mm Solothurn types AP-T, HE, T	Ball/Inc, HE, AP/T, T, NET
		Belt-fed, hand-fired, barrel recoil.

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ITEM: 20 mm (GERMAN MG 151/20) AIRCRAFT CANNON (ARMY)

INTELLIGENCE: This 20 mm aircraft cannon is mounted in Army planes. It is the German MG 151/20, of German manufacture, and found only with German manufactured ammunition. Captured equipment.

IDENTIFICATION:

Calibre	.79 ins. (20 mm)
Overall length	69.5 ins.
Weight of gun	92 lbs.
Rate of Fire (est.)	800 rounds per min.
Muzzle Velocity (est.)	2500 ft/sec.
Eff. Range (est.)	800 - 1000 yds.
Charging system	Electrical or hand

Firing System		Electrical
Ammunition		5.75 ins. rimless
Type: AP	Wt. 115 gms,	
HE	86.4 gms	
HE/I	113 gms	
HE/AP	116 gms	
AP/I	116 gms	

- -

ITEM: 20 mm AAMG - SINGLE

INTELLIGENCE: (2) 20 mm Singles mounted on U-511 at time of its transfer, September 1943.

Reliable PW states that early in 1943, 500 pieces were shipped to Japan. Throughout 1942 and 1943 huge quantities of fuses and ammunition for this gun were shipped.

IDENTIFICATION: The 2 cm Flak 38 was introduced to replace the 2 cm Flak 30. It is operated by short-barrel recoil, and the residual pressure of gas in the barrel. Except for a higher cyclic rate of fire, it does not differ in performance from the Flak 30. This gun is mounted on a 760 lb. carriage, which may be disassembled easily into 27 loads for mountain warfare. This combination is designated 2 cm Geb. Flak 38.

Caliber	20 mm (0.79 in.)
Length of tube	56.6 ins.
Weight in action	896 lbs.
Effective ceiling	3500 ft.
Max. Horiz. range	5230 yds.
Rate of fire	Practical - 180 to 220 rpm
Muzzle velocity:	HE - 2950 f/s
	AP - 2625 f/s
	AP40 - 3250 f/s
Traverse	360°
Elevation	-20° to 90°
Traction	motor drawn, RR, SP
Anti-Aircraft sights	Flakvisier 38, Linealvisier 21, Schwebekreisvisier 30/38

- -

ITEM: 20 mm A/AMG - Twin

INTELLIGENCE: Samples of the twin mm gun were sent to Japan during the summer of 1943. This gun was also believed mounted on U-1224 at time of its transfer in 1944.

IDENTIFICATION: The 20 mm twin compares closely with the quadruple mount.

Muzzle Velocity	2950 HE; 2625 AP (delayed)
Maximum Range (yds.)	5200

Max. Vert. Range	12,090 (ft.)
Max. Eff. Vert. Range	6000 - 10,500 ft.
Rate of fire	180 - 480
Ammunition	HE Inc. AP (in any combination with or without tracer) Ball. Fuze percussion self-destroying at 6800 ft.
Remarks	Sight: 2 ring sight; tracer. Shell required 2 sec. to reach 1000 ft.

CONCLUSION: The Japanese have not adapted a 20 mm twin for Naval use and it is not believed they contemplate doing so. Their 25 mm twin has been an effective weapon and has, since 1942, been in large scale production.

APPROXIMATE DATE OF PRODUCTION: Production unlikely.

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ITEM: 20 mm MACHINE GUN, QUADRUPLE

INTELLIGENCE: Specifications and manufacturing equipment were shipped on the Rio Grande in 1942. (A-2)

IDENTIFICATION: Consists of four 2 cm Flak 38's on a triangular-base mount with three leveling jacks. Muzzle preponderance is counteracted by an equilibrator bolted to the mount.

Caliber	20 mm (0.79 inch)
Length of tube	56.6 inches
Weight in action	1.68 tons
Effective ceiling	3,500 feet
Max. horiz. range	5,230 yds.
Rate of fire: Practical	700 to 800 rpm
Muzzle velocity (HE)	2,950 ft/sec.
(AP)	2,625
(AP40)	3,250
Traverse	360°
Elevation	-10° to + 100°
Traction	Motor drawn, SP or static
Anti-aircraft sights	Flakvisier 40, Lincalvisier 21, Schwebekreisivisier 30/38
Ammunition	Weights of projectiles fired are: HE 4.2 oz., AP 5.2 oz., AP 40 3.6 oz.

CONCLUSIONS: Japanese production of a multiple barrel Anti-Aircraft Automatic has been limited to the triple 25 mm piece. This gun is understood to be in large scale production at the present time.

APPROXIMATE DATE OF PRODUCTION: Not believed to be scheduled for production.

ITEM: 50 mm BK 5, A/C CANNON

INTELLIGENCE: Reliable P/W statement indicates that this gun was investigated by the Japanese at Posen Airfield.

IDENTIFICATION: Mounted in ME 410, it is entirely self-contained and is fed by a non-disintegrating belt of 21 links.

Loading is performed electro-pneumatically, whilst the ammunition is fired by an electric primer. Recoil is taken by two hydro-pneumatic cylinders mounted above the gun cradle.

Overall length	14 ft. 3 ins.
Depth of gun over belt housing	28 ins.
Muzzle brake length	19 ins.
Length of barrel from below recuperator housing	6 ft. 6 ins.
Magazine width	25-5/16 ins.
Length of belt link	8-3/16 ins.

No ammunition has yet been recovered for this gun, but according to a captured handbook 5 cm high-explosive known to the Germans as 38 KwK projectiles are used.

Overall length of round	18.9 ins.
Weight of round	7 lb. 1 oz.
Weight of projectile	3 lb. 15 oz.
Fuze	AZ 39 (impact)

When this gun is installed on the ME 410, complementary forward-firing armament consists of 2 x MG 151/20. The three guns are set so that they harmonize at 400 metres, but the BK 5 is sighted up to 1,000 metres. It is estimated that with the 38 KwK ammunition a useful range of 2,000 yds. would be attained.

ITEM: 30 mm CANNON, AIRBORNE

INTELLIGENCE: An Italian document captured in Rome states that Japanese production of the German 30 mm airborne cannon was expected to get underway in the near future. The letter was dated June 1943. Other information verifying transfer evaluated A-2.

IDENTIFICATION: The Mk. 108 A-3 is an automatic, air-cooled, belt-fed weapon operated by blowback and firing electrically from an open bolt. Initial cocking and initial depression of the sear to release the bolt are accomplished by compressed air. The gun is mounted on its side, and fires through the propeller hub in Me 109 G fighters. This gun is unusual in being a blowback operated, low muzzle velocity weapon.

Sixty rounds of ammunition are fed by means of a disintegrating belt from an ammunition can mounted above the gun. A feature of the gun is the fact that the barrel and receiver do not move in recoil, the entire force of which is taken up by the rearward motion of the bolt against driving springs which act as buffers on recoil. There is no locking action between the barrel and bolt at any time.

All ammunition found to date has been high explosive, high explosive tracer, incendiary and incendiary tracer. It is doubtful if the muzzle velocity is high enough for the effective use of armor piercing ammunition.

Caliber	29.6 mm (1.117 in.)
Weight (total)	265 lbs.
Weight of mount	28 lbs.
Length of gun with blast tube	7 ft. 6-3/4 ins.
Length of barrel	21-1/2 ins.
Rate of fire	500 rds/min.
Muzzle velocity	HE 1650 f/s (not verified)

- -

ITEM: 37 mm A/A GUN (NAVAL TYPE)

INTELLIGENCE: 37 mm gun mounted on U-511 at time of her transfer, September 1943. Also on U-1224 - August (?) 1944. Other information on transfer evaluated A-2.

IDENTIFICATION:

Length of barrel	3-1/4 yds.
Weight	155 lbs.
Muzzle Velocity	2493 f/s
Effective Range	4400 yds.
Ceiling	4200 yds.
Rate of Fire	Theoretical: 100 - 120 rpm Practical: 50 - 60 rpm
[illegible]	Fixed H.E. with tracer to 2500 yds.

Weight of round	4-1/2 lbs.
Elevation	90°
Depression	10°
Traverse	360°
Sights	Ring and head - demountable. Telescope sight can be substituted.
Breech Block	Vertical sliding wedge type
Firing Mechanism	Operated by foot pedal on pointers side of gun
Gun Crew	Five men
Detonation	Impact, self-destroying at 4400 yds. Explodes on impact with water or lighter materials such as wood.

CONCLUSIONS: The Japs have not adopted this design to date.

ITEM: 105 mm D. P. GUN

INTELLIGENCE: 105 mm Deck Gun - mounted on U-511 at time of U-Boats transfer - September 1943. Other information indicates delivery of one gun in February 1943. (A-1)

IDENTIFICATION: This was the heaviest German submarine gun, widely used. Due to threat of aircraft they were subsequently removed and superseded by a close defense AA gun.

Length of gun in calibers	45
Shell weight	38.4 lbs.
Muzzle velocity (f/s)	2132
Rate of fire	6/min.
Max. elevation of mounting	35° to 80° as permitted by shield
Range (est.)	12,000 yds.

CONCLUSIONS: The Japanese have not developed a 105 mm naval gun to date and there appears to be no purpose in their doing so. Their 100 mm dual-purpose gun is a recent development in this class and is rated an efficient piece.

APPROXIMATE DATE OF PRODUCTION: Not likely to be produced.

ITEM: 128 mm FLAK 40 - A/A GUN

INTELLIGENCE: Official records show purchase by the Japanese, but date of delivery is not indicated.

IDENTIFICATION: This gun looks like the 10.5 cm Flak. The breech-block

slides horizontally to the right, and incorporates an electric firing mechanism.. The recoil system is conventional, with hydropneumatic recuperator above the tube, and buffer below. Hydropneumatic equilibrators are used. Elevation and traverse are either manual or powered. Fuze setting is by director control, and loading is facilitated by a power rammer incorporating two horizontal rubber rollers at the entrance to the bore. The gun may be statically emplaced, transported on a mobile mount, or mounted on a railway car. A twin barrelled version of this gun also exists, but is produced only for a static role.

Caliber	128 mm
Length of tube	25'8"
Weight in action	Mobile - 18.75 tons Static - 14.34 tons
Max. ceiling	48,555 ft.
Max. horiz. range	22,910 yds.
Rate of fire	12 rounds per min.
Muzzle velocity (HE)	2,886 ft. per sec.
Traverse	360°
Elevation	-3° - + 88°
Ammunition	HE - 57 lbs. APC - 58.13 lbs. AP - 62.5 lbs.

CONCLUSIONS: Japanese 5" construction is being given high priority at the present time. A new Japanese 5" Flak gun has been reported in operation, but has not as yet been identified as the Flak 40.

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ITEM: NAVAL 20.3 cm GUN

INTELLIGENCE: A completely reliable source (evaluation A-2) states that complete data on powder charges of this gun was procured by the Japanese.

IDENTIFICATION: The powder charge is tubite, composed mainly of gun cotton and possibly nitroglycol. One main powder charge is placed in the center and several auxiliary charges around it.

Main powder charge on steel case, primer at rear - weight 31 kgm. The auxiliary bag charge weighs 21 kgm. For loading, a brass covering is attached to the end of both charges.

CONCLUSIONS: Japanese research in development of "special" projectiles for the main batteries of their CAs is suggested. Action Reports from the Pacific Fleet have indicated unusual effects in color and dispersion of Japanese 8" fire.

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ITEM: 600 mm FORTRESS MORTAR

INTELLIGENCE: PW had heard that this mortar was a copy of a German model

and was being manufactured in Tokyo for coastal defense. Date of interrogation - 3 March 1945.

IDENTIFICATION: No information available on a German weapon of this caliber.

ITEM: FIRE CONTROL, 7.5 cm GUN

INTELLIGENCE: Drawing and report on this device was forwarded through channels of Japanese Military Attache, Berlin, by Office of Army Administration in Germany, unsigned, to Army Ordnance Administration in Tokyo. Document was dated January 1943.

ITEM: TYPE 2 FIRE DIRECTOR

INTELLIGENCE: Inspection of director indicates that Japanese Type 2 Director is based on German design.

IDENTIFICATION: Navy Type 2 Director was originally designed to be used with Naval 4.7"/45 cal. and 3"/40 cal. dual-purpose guns. It has lately been used with Naval 127 mm/40 cal. dual-purpose gun. For use with Army Mod. 88 .75 AA gun, it may have been modified and fitted with specially designed drums and dials.

This director is equipped to receive (electrically) data from tracking radar, though to this date (December 1944) few such radars have been reported in use. It is believed that the Japs are doing their best to develop this equipment, however, and its more general use will markedly increase the effectiveness of the director, particularly for night and poor visibility firing. The capabilities of the Type 2 Director compare favorably with the U. S. Mk. 7.

Limitations of Type 2 Director

Slant Range Calibrated to	43,750 ft.
Horizontal Range	13,650 yds.
Altitude	29,529 ft.
Quadrant Elevation	-10° to + 90°
Time of Flight Limit	35 seconds
Wind Velocity	43 knots (approximately)

ITEM: COMMANDGERÄT 40

INTELLIGENCE: Luftwaffe records show delivery in Jan. 43

IDENTIFICATION: This is a director for major caliber weapons, such as 8.8 cm and 10.5 cm anti-aircraft guns. It computes continuously Case III data by a plane prediction method and can handle diving and curving target

courses. By installing proper ballistic cams, it may be used with any type gun.

Slant range finder used with this is 4 meter Stereo 40 (Em 4m R40), which is mounted on the director, and gun data is transmitted electrically to the guns. Also linear speed method of data computation is used. Can be operated by five men.

Azimuth	no limit
Elevation	-1.5° to + 90.5°
Slant Range	1200 to 18,000 m
Present Horizontal Range	570 to 14,500 m
Future Horizontal Range	570 to 14,500 m
Altitude Prediction	+ 3000 m
Muzzle Velocity	24 numbers

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ITEM: NAVAL A/A DIRECTOR

INTELLIGENCE: ATIS interrogation of 3 February 1945 quotes P/W as saying that simultaneous fire of three guns installed on DD KUWA and DD KIRI was directed by German equipment. Installation was fitted along with these guns in November 1944. Crew continually referred to a manual for information on its operation. Evaluation F-0.

IDENTIFICATION: Although he could not explain how, P/W said that the director, independent of the gun crew, set the fuze. The other calculations were transmitted electrically to a pair of dials at the gun, that indicated angle of elevation, depression or angle of traverse. Crew pointed gun manually to indicated position. His general impression was that the director was none too effective.

CONCLUSIONS: Names of these DD's represent new construction thought to mount 4.7"/45 cal. dual-purpose guns.

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ITEM: 4m RANGE FINDER, MODEL Em 4m R40

INTELLIGENCE: Details are reliably reported to be in Japan since February 1945. (A-2)

IDENTIFICATION: The German 4 meter base range finder is a stereoscopic instrument. Ortho-stereoscopic and psuedo-stereoscopic fields can be selected at either 20 or 32 power.

The range finder proper, the outside of which is a one-piece aluminum alloy casting except for end boxes, bearings and auxiliary plates, rests on a cradle containing elevation and azimuth hand wheels and mechanisms. This in turn rests upon a tripod, which is leveled by two horizontal screws, 90° apart.

The instrument has no inner tube, and has an optical bar only for reticle collimation; fixtures for optical elements and internal mechanisms are positioned on the inside of the casting by the process of machining a surface where attachment is desired and then hand lapping the fixture into place.

Because the elevation scale goes from 0° -90°, it is believed that the instrument is an anti-aircraft range finder, although the only range-to-height device is a conversion table on the right end box. It is thought that the range finder proper can also be placed on an anti-aircraft director into which it would then feed slant range, by means of a clutch device which is connected directly to the range knob mechanism.

Like the height finder M2, the controls from knobs to mechanisms inside the range finder are of the ball and socket universal type, with rods of whatever lengths as needed. In some cases these are connected to gears, in other cases to threaded nuts, depending upon how fine a setting is desired to position the optical elements.

Manufacturer's name, Zeiss, is found only upon the electrically illuminated measuring lath.

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ITEM: FUZE El. A.Z. (28)A

INTELLIGENCE: Interrogation of high ranking German naval officers reveals transfer of this fuze to the Japanese. Date unknown. Evaluation B-2.

IDENTIFICATION: An electrical impact fuze, used in H. E. bombs; S.C. 250, 500 and 1000 kg., 2500 kg. It is dark gray aluminum, Construction Type II, with yellow paint on shoulder.

Overall length	4.125"
Overall width	2.25"
Elec. features	3 firing circuits Safety switching: Each plunger, on depression, switches off the opposite arming circuit.
Possible Actions	Instantaneous 0.15 sec. delay 14 sec. delay

Arming Times:

	Level Flight (150v.)	Diving Flight (240v.)
Instantaneous	÷ 1.6 - 2.8 sec.	÷ 1.0 - 1.5 sec.
0.15 sec. delay	÷ 2.1 - 3.3 sec.	÷ 1.4 - 2.2 sec.
14 sec. delay	÷ 0.7 - 1.3 sec.	÷ 0.3 - 0.7 sec.

ITEM: FUZE St. Z.S/30^2

INTELLIGENCE: High ranking German naval officers reveal acquisition of this fuze by the Japanese. Date unknown. Evaluation B-2.

IDENTIFICATION: This clockwork time fuze is an improved version of Zt.Z. S/30, having improved time mechanism. It is used in 8.8 cm, 10.5 cm and 12.8 cm Flak equipments; 12.8 cm K40 (Pz.Sfl.) Projectile; 21 cm Mgr. 42. Mechanism is similar to the British No. 207; armed by set back. Mechanism is operated by centrifugally operated weights. There is no magazine.

Overall length	4.45"
Weight	19 oz.
Max. time of running	30 sec.
Material	Steel

Fuze St.Z.S/30 is made of brass and is slightly lighter than St.Z.S/30^2 (exact weight not given). Other dimensions are identical to St.Z.S/30^2.

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ITEM: FUZE, ANTI-AIRCRAFT SHELL

INTELLIGENCE: A case in Bordeaux warehouse recovered fuze intended for shipment to Japan. It is not known whether this was to have been an initial shipment or whether others preceded them.

IDENTIFICATION: Type 1 described as an electrical bomb nose fuze with spinner; Type 2, Abfeuer Schutz AS III List.

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ITEM: BT (BOMBEN TORPEDOES)

INTELLIGENCE: Completely reliable information (A-2) reveals transfer of information on four types of BTs to Japan in 1944.

IDENTIFICATION: Designed in 200, 400, 700 and 1400 kg. sizes, the Bomben Torpedo was intended for use against landing craft, submarines (and large type vessels in the case of the 1400 kg. size). They have a truncated conical tail and head and cylindrical body. As bomb is released plane pulls out of its dive at altitude of about 800 meters and about 1,500 m from target. Point of entry into the water varies from 20 - 30 m on near side of target. Due to interval of delayed action, the bomb is designed to explode beneath target. The straight line TSA 2 Type dive bomber sight is used.

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ITEM: RUSSIAN BOMBS - RS 82, RS 132

INTELLIGENCE: Among information on Russian materiel passed along to the

Japanese by the Germans, data on RS 82 and RS 132 was made available in July 1944 (A-2). It is not known that the modified RS 132 (Elongated) was included in these.

IDENTIFICATION: RS 82 (Russian Bomb). This type rocket bomb is launched horizontally by means of a propulsive charge and consequently could be used on aircraft because a limited initial speed is required. The front part is the body of the bomb; the central part, the propulsive charge made up of TNT powder; the back end, the thrust nozzle with the tail piece. The ignition of the propulsive charge takes place in the above mentioned types as follows: through the electric pyrotechnical system and controlled by the pilot.

In use for attack on battleships or cement fortifications, the fuze used is set for a delayed explosion. It is also used from the ground as an anti-aircraft weapon. The numbers representing the diameter are in millimeters of the sheathe.

Diameter	82 mm
Length	560 mm
Total weight	6.85 kg.
Weight of charge	.585 kg.
Weight of propulsive charge	1.01 kg.
Initial speed	50 m/sec.
Max. speed	350 m/sec.
Speed given by the propulsive charge	250 m/sec.
Length of time of function of the propulsive system	.4 sec.
Radius of splinter action	160 - 170 m
Distance of safety	600 m
Range	1600 - 1700 m
Max. range	6200 m

RS 132 (Russian Bomb). This is the fall type rocket bomb in which the propulsion charge provides an increase in the impact speed and hence increases the penetration quotient of the bomb. The front part is the body of the bomb; the central part, the propulsive charge made up of TNT powder; the back end, the thrust nozzle with the tail piece. The ignition of the propulsive charge takes place in the above type as follows: by means of a time fuze with a set time corresponding to the ratio of the ignition desired.

In use for attack on battleships or cement fortifications, the fuze used is set for a delayed explosion. It is also used from the ground as an anti-aircraft weapon. The numbers representing the diameter are in millimeters of the sheathe.

Diameter	132
Length	864
Total weight	23
Weight of charge	2.25 kg.

Weight of propulsive charge	3.75 kg.
Initial speed	40 m/sec.
Max. speed	350 m/sec.
Speed given by the propulsive charge	250 m/sec.
Length of time of function of the propulsive system	.9 sec.
Radius of splinter action	180 - 200 m
Distance of safety	800 m
Range	1800 - 2000 m
Max. range	7100 m

Elongated RS 132 (Russian Bomb). This is a variation on the RS 132. It has a fragmentation effect and is of the rocket type. The weight of the bomb was increased and the bomb itself was elongated. It has not yet (January 1945) been discovered in use by aircraft.

Diameter	132 mm
Length	1400 mm
Total weight	42 kg.
Weight of propulsive charge	7.06 kg.

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ITEM: BV-246, GLIDER BOMB

INTELLIGENCE: Details available to the Japanese before April 1944.

IDENTIFICATION: Designed for high altitude long range area bombing. Total weight of bomb is 730 kg including the 530 kg - Amator explosive charge. The type 50-111 plane carries 3 bombs and the JU-188 carries two. For a bombsight, the planes use a type FuG 103 radar. By attaching a timing mechanism to the bomb, the gliding can be stopped after a fixed interval and the control of the bomb released. BV-246 is experimental.

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ITEM: HOLLOW CHARGE AMMUNITION

INTELLIGENCE: A Netherlands Forces Intelligence Bulletin dated 1 January 1945 states as follows: "It is significant to note that in ATIS Bulletin 1581, Item 3, CD15893, para. IV (D), the reference is made to a Japanese type 10th Year segmented projectile for type 11th Year 75 mm Field Gun. As the Germans have also referred to this type of ammunition as a segmented shell, it appears that there is a tie-up between these two countries in the production of a more lethal type of shell." Japanese anti-tank ammunition is in fact a strict copy of that used in PAK 40.

IDENTIFICATION: The PAK 40, an anti-tank and anti-personnel weapon, has a barrel of monobloc construction to which is screwed a two-baffled muzzle brake. The horizontal sliding type breechblock operates

semi-automatically. Recoil and counter-recoil are effected by means of a hydraulic buffer and a hydropneumatic recuperator.

Although no sighting equipment was captured with the gun, it is assumed that there was a telescopic sight for direct fire, a sight for indirect fire, and an auxiliary open sight. Mounts for these sights are attached to the breechring and the left trunnion.

Caliber	75 mm (2.95 ins.)
Length of tube	126.1 ins.
Weight (traveling position)	3,350 lbs.
Length (traveling position)	19 ft.
Muzzle velocity (APC shell)	2525 f/s
Max. range (horizontal) effective	3200 yds.
Traverse	65°
Elevation	+ 22°
Depression	-5°
Ammunition	AP - HE - HE Hollow charge
Weight of projective (APC)	15 lbs.

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ITEM: PANZERFAUST

INTELLIGENCE: Information has been received that Germany may have presented manufacturing rights and full working drawings of the Panzerfaust to Japan last November. The results which can be achieved by determined tank hunting parties have always been stressed in Japanese infantry; and close country favors this form of attack.

IDENTIFICATION: Panzerfaust 30: Faustpatrone 2, designed for use against armor at ranges of about 30 yds. Consists of steel launching tube, containing a percussion fired propellant charge. A hollow-charge anti-tank grenade is fired from the tube. Aim is taken over the vertical sight and forward end of the bomb. Grenade is provided with spring steel fins which are wrapped around the tail for loading and which are released as the projectile leaves the tube and stabilize the bomb during flight.

Faustpatrone 1: (Panzerfaust Klein 30); a smaller version of the Panzerfaust 30, and has a differently shaped projectile head.

Panzerfaust 60: This is similar to the Panzerfaust 30, with redesigned firing mechanism. The tube is thicker (3 mm approximately instead of 1.5 mm); new sight fitted, which has apertures for 30, 60 and 80 meters.

Panzerfaust 100: This is similar to the Panzerfaust 60, but slightly increased in size and performance. Sighted up to 164 yds. Not necessary to insert primer and detonator as weapon is issued fitted with them.

Characteristics:

	30	60	100
Diameter of tube	1-3/4"		
Overall length	41"		

	30	60	100
Weight	11 lbs.	13-1/2 lbs.	
Weight of bomb	7 lbs.	6 lbs.10 oz.	
Diameter of bomb	6"		
Propellant charge (gunpower ?)	95 gms.	134 gms.	
Range	30 yds.	65 yds.	
Penetration	200 + mm	200 + mm	200 + mm

CONCLUSIONS: Bearing in mind tendencies already evinced, and her probable inability to produce anti-tank guns in large numbers, it is considered probable that Japan will concentrate on the production of the Panzerfaust or a similar infantry type anti-tank weapon.

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ITEM: JAPANESE STICK GRENADE

INTELLIGENCE: Captured equipment.

IDENTIFICATION:

Overall length	7-3/4"
Body length	2-3/4"
Body diameter	1-5/16"
Color	Black
Weight of body	14 oz.
Weight of explosive	3 oz.
Weight of handle and cap	1 oz.
Total weight	1 lb. 3 oz.

The body containing the main charge is cylindrical in shape and made of cast steel. The handle is turned from soft wood.

CONCLUSIONS: It has not been definitely ascertained that this grenade is based on the German "Potato Masher", but they are similar in appearance and operation. The basic difference lies in the larger size of the German grenade and the higher blast effect caused by it.

APPROXIMATE DATE OF PRODUCTION: In production.

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ITEM: GYRO GUN SIGHT - EZ 42 A-1

INTELLIGENCE: Reliable information places transfer on or before February 1945. (A-2)

IDENTIFICATION: This sight, gyroscopically-controlled, has its computing mechanism inserted remotely in the tail of the aircraft. It is similar to British G.G.S. and our Mk. 21 and 23.

Sighting head	Conventional reflector, conventional lens mirror - may be moved in elevation and azimuth by small electrically driven motors; lens, ground glass, variable aperture, electric light bulb.
Pilots gun sight controls	To make settings to compensate for all range setting mechanism.
Computing mechanism	Located aft.
2 Gyroscopes	1 mounted in its spin axis parallel to the line of flight. 1 mounted parallel to vertical axis of aircraft.
2 motor generator units	Power source for gyroscopes or mirror drive motors.
Range	Range problem solved electrically and mirror drive motors elevate or depress the mirror accordingly.
Air speed and altitude corrections	Made by introduction of a resistance into mirror drive motor circuit. Resistance is preset thru use of two rheostats.

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ITEM: COASTAL DEFENSE CASEMATES

INTELLIGENCE: Photographic comparison reveals striking similarity of construction between German and Japanese structures for various caliber guns.

CONCLUSIONS: From a study of Japanese concrete reinforcement practice, it has been concluded that the state of this art is highly developed in Japan, and recent installations examined confirm high compressive strength of strategic installations.

APPROXIMATE DATE OF PRODUCTION: Now in use.

3

ITEM: PROXIMITY FUZES

INTELLIGENCE: Hq. Com. Zone ETO U. S. Army dispatch to War Department 27 May 1945 states in re above, "no specific evidence of interchange../ with Japanese, but consider it highly probable in light of statements of German scientific leaders".

There is some evidence that the Japanese are employing a special type of fuze to obtain air-burst of large bombs. Observers reported that during a Japanese night air raid on Saipan, in March 1945, each of three bombs seen to fall from enemy planes could be traced in flight from the plane to the ground because of a small light on the bomb. No craters were found, although detonations occurred. One bomb had exploded over a cane field permitting its center of impact to be determined, and there was evidence of fragment damage up to 15000 feet away. The bombs were identified as the Type 3, Mark 31 Land Bomb, weighing 800 kilograms (760 pounds).

It is remotely possible that the lights observed on these bombs were part of a photo-electric application for fusing the bombs, but the evidence is inconclusive on this point. It can only be stated that airburst of bombs was accomplished, possibly by means of a proximity fuze, the nature and operation of which are unknown.

In view of the above, a brief review of German proximity fuze development is given.

IDENTIFICATION: "Kugelblitz" - employs the Doppler principle. Not jam proof. Similar to "Fox" but more complicated (1 transmitting tube, 2 amplifiers). Range of sensitivity is between 30 and 50 meters. The important development in this fuze was an excellent power-supply for constant voltage "Stalilavolt". However, the low frequency part of the fuze was not wholly satisfactory. Work carried on at PVG (Patent Vertungs Gesellschaft), Salzburg.

"Marabu" - Mfr. Siemens-Halske; 50 cm operation. Compact construction but complicated antenna structure. Considered jam proof. Like FuG 101 in principle - frequency modulated altimeter.

"Kakadu" - Mfr. Donag; operated on MF and Doppler principle, wave length 80 cm. Radio transmitter fuze. 20,000 units were in production early 1945; each weighed 7 kilograms and contained 4 tubes. Purpose was to cause bombs and rockets to explode approximately 20 meters from the ground or from enemy aircraft. Specifically, they were to be included in air-to-air bombing, air-to-air rockets of the radio controlled variety and ground-to-air A/A rockets which were radio controlled.

"Fox" - Mfr. AEG - 2 meter operation - simplified Kakadu; not jam proof. This is a very simple transmitting device containing only two tubes - one transmitter and one amplifier. There is no receiving antenna or circuit; the approach of the fuze to a neighboring body is measured by the variation of the lead on the antenna. The range of sensitivity is between 6 and 9 meters. Developed by A.E.G. under contract to Henschel; tested extensively but never used in operations.

3. DIRECTED OR CONTROLLED MISSILES

Infra Red Proximity Fuze - (See Physical and Optical Devices - "LINSE"

"Paplitz" - It is understood the fuze was primarily designed for use in initiating war heads of rocket type missiles. A lead sulphide cell and amplifier are fitted to the nose section. Forward of the cell is a circumferential glass "window". The missile is fired so as to intercept the line of flight of the aircraft. As the missile approaches the target, the infra red radiation from the target striking the cell continue to increase in intensity. It suddenly decreases owing to the geometry of the glass window and the cell aperature. The corresponding drop in amplifier output is used to function the war head.

For a relative small charge of approximately ten (10) meters effective range no cooling of the cell is necessary. For heavier charges on the order of fifty (50) meters renge the cell requires cooling. Dry ice within a double wall vacum cup like container is resorted to by the method used for cooling the cell.

The device hes heem fired experimentally with success and was reported as being actively developed for operational use.

The homing device was described by Dr. Kutzscher of ELAC as the "Hamburg". An electric cell is placed at the focus of a minor and the beam is interrupted by a rotating semi-circular shutter.

By measuring the phase of the rotation at which the signal arrives, the direction of its source (target) is established. This is transferred to the flight control of the missile. It is said the mechanism reacts if the target is 1/40 off the axis of the missile.

The device is reported to have been tested experimentally and with success.

"Emden" - The AEG have developed a similar device called "EMDEN" which uses a lense instead of a morror.

Only German proximity fuze for shell is called an influence fuze and operated by interaction of electrostatic fields of shell and target. From tests in 88 milimeter guns at ranges up to 700 meters against screen targets they claim action at 1½ meters and scores of 90% from trials of about 1000 rounds. Score goes down markedly in bad weather and opinion that distance from screen corresponds to about 5 meters from aircraft is quite uncertain. Would have been in mass production by end of this year.

Nose of shell is split and capacity currents between parts supply triggering action. Shell becomes charged by explosion gases of firing. Nose split axially gives correct pattern against ground. Employs no batteries. Electrical parts include one glow tube, three resistors, three condensors, and insulating bushings. The three element glow tube is used with three volt control for distance from screen stated in Paragraph 1. Greater sensitivity is claimed for a four element tube but no trials have been made. Ruggedness of glow tube thoroughly proved by thousands of rounds in electric time fuze. Energy for squib comes from precharged condensor.

German safety includes acceleration switch giving additional safety in bore over ordinary setback, spring operated plug under squib and RC arming. Present RC arming of .02 second can be varied. Squib is of bridge wire type with resistance of 5 to 10 ohms.

Samples of fuze and detailed report follow. This influence fuze is to be regarded as most dangerous of German proximity fuzes.

CONCLUSIONS: As fewer than fifty "Kugelblitz" had been produced and only twelve turned over to the military, it is unlikely that the Japanese are in a position to exploit this set; the "Kakadu" however, of which considerable numbers are alleged to be in Russian held territory, was produced late in 1944, in sufficient quantity to permit the Japanese an opportunity to cut in.

APPROXIMATE DATE OF PRODUCTION: An authoritative source states that "there is no cause for panic" as he is confident that German developments were not so far advanced as to be a danger to us in the Pacific in the near future.

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ITEM: FX-1400 (RADIO CONTROLLED MISSILES)

INTELLIGENCE: Information on hand indicates Japanese familiarity with construction of the FX-1400. Full details were made available to them in Sept. 1944; initial description in March 1944. (A-2)

IDENTIFICATION: This missile is an armor-piercing 1400 kg. bomb, in which aiming corrections both in range and azimuth are made by radio, and employs for this purpose the E-230 receiver as used in the glide bomb HS-293.

Radio correction of the aim of the weapon, both in range and azimuth may be made by the bomb-aimer after its release, and this is achieved by a series of four "spoilers" arranged to disturb the airflow over tail fin surfaces. Roll, about the vertical axis, is countered by another pair of spoilers which are under the control of the gyroscope only. The unit consists of two gyroscopes in tander, one measuring the roll angular displacement, while the other measures the rate of roll, and introduces damping into the system. There is no interconnection with the radio system. Both motors are identical, and are standrad instruments in German auto-pilot and gyroscope equipments. When supplied with a three phase alternating current at 36 volts, 500 c/s, they spin at a rate of about 29,000 rpm.

There are two types of spoiler, which differ only as regards the solenoid winding. The four inner spoilers which are radio controlled and operate from the H.T. supply, have two coils, each of 900 ohms resistance, while the two outer spoilers, which are gyroscope controlled and operate from the L.T. supply, have coils of 100 ohms resistance.

The aerial consists of one section of the tail structure, and this is insulated from the framework by constructing the side members, which

hold it to the structure of fibre. Two of the eight clamping plates of the tail framework are not metallic, and the tubular section held between these plates is connected by a brass strip into the fin nearest to it. It is apparent that the aerial does not approach a quarter wave-length at the frequencies involved (48-50 mc/s) and must be highly capacitatives. Hence the inductive matching unit.

Weights & Dimensions

Unit	Overall dimensions inches Length	Height	Width	Diam.	Weight lbs.	ozs.
Receiver	10-3/4	6-1/2	7-1/2	-	17	6
Power Unit	10-3/4	6-1/2	8-3/4	-	-	-
Alternator	7-1/2	-	-	3-1/4	5	0
Gyroscope	10-1/2	-	-	7	6	0
Fins and Spoilers;						
Large	8	17	16-1/2	-	22	0
Small	8	17	7-1/2	-	12	0
Tail Casting	51-1/2	-	-	18	84	8
Flare Unit	15	-	-	15-3/4	68	8
Fin Frame-work	48	15-3/4	30-3/4	-	54	0

The FX-1400 weapon appears to be a simple but effectively-controlled missile, provided that it is not subjected to deliberate radio interference. The heart of the weapon, the E-230 receiver, is of neat design and extremely efficient, but its final relays must always be the ultimate criterion of its effectiveness. Since the whole operation depends upon the regular "ticking" of their movable contacts, the system may be easily upset by any signal which prevents this taking place. To jam the control system, therefore, it is necessary only to put up a carrier on the correct frequency in the 48-50 mc/s band having amplitude modulation at either 100 c/s, 1500 c/s, 8000 c/s or 12000 c/s. While the setting of the carrier frequency must be accurately placed on the control signal carrier it is sufficient if the modulation is accurate in frequency to ± 5%.

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ITEM: GUIDED MISSILES, HS293

INTELLIGENCE: Interrogation of Professor Herbert WAGNER, head of Henschel's Research Organization, reveals that a Japanese delegation was shown test flights of HS293 at Military Testing Field, Gartz early in 1943. The missile demonstrated was the old A-1 series and not the new A-2 in which the considerably improved steering device is incorporated. Professor WAGNER does not believe that the wire control feature was revealed at that time, nor the telescope device which had not been completed by the Germans until later in the year. Professor WAGNER's information is considered entirely reliable. Other source material confirms WAGNER's statements. (A-2)

3. DIRECTED OR CONTROLLED MISSILES

IDENTIFICATION: This radio controlled glider bomb is equipped with wings and tail unit so that it glides to ground with extended trajectory. HS293 were carried, one under each wing, of aircraft FW200, Ju290, Do217, He177. Guided to definite target by transmitter in a/c and FuGe203 receiver in HS293. Jet propulsion unit, suspended from base, operates during first 10-12 sec. of flight giving additional acceleration and range. Flare unit and electric lamp attached to tail for sighting. Aimed by eye alone. Radio control depends on a tone modulated radio frequency of about 48 mc.

Overall length - 13 ft.
Wing span - 10 ft.
Wing area - 26½ sq. ft.
Total wt. - 2000 lbs.
Wt. of bomb - 1322 lbs.
Average speed - 325 knots
Tail span - 3'8"
Dia. of bomb - 18½"
Color - Sky blue
Expl. filling - Trialon on poured Amatol 60/40

Main parts:
1. Bomb (forms forward part of fuselage)
2. Control unit housing
3. Jet propelling unit
4. Main planes
5. Tail plane
6. Tail tracer unit

CONCLUSIONS: In view of the appearance of suicide aircraft and the "Baka", which in a sense are guided missiles, it seems possible that the Japanese have decided that this method of attack presents less technical difficulties than the development of HS293. Tooling necessary for production of controlled missiles demands a high degree of precision. The "Baka" design is not dissimilar from HS293 and for the exception of the radio control feature and solid propellant, may actually have been inspired by it and represent the extreme limit of Japan's intentions along these lines. The latter seems particularly true in view of recent formalizing of the Suicide Corps in Japanese naval hierarchy.

APPROXIMATE DATE OF PRODUCTION: According to Professor WAGNER, at least 12 months of preliminary work and experimentation are required before production can be expected. Another 6 months for tests and adjustments are then considered the minimum. This, if the Japanese do intend developing this intricate equipment, would make possible the advent of HS293 in the early Fall, 1945.

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ITEM: GUIDED MISSILES, HS294

INTELLIGENCE: Interrogation of Professor Herbert WAGNER, head of Henschel's Research Organization, reveals that discussions carried on between the German Air Ministry and Japanese naval representatives in December 1944 were on the subject of the HS294.

3. DIRECTED OR CONTROLLED MISSILES

IDENTIFICATION: Enlarged version of HS293, also used for shipping attack. Elongated nose, semi-armor piercing steel. Further differences from HS293 are two propulsion units, one under each wing which drop away when bomb enters water.

Explosive charge 656 kg.
Wing Span 402 cm
Total Length 607 cm.

Fired into water in straight line with target at level distance of from 4 km. (alt. 900-1000 m) to 14 km (alt. 2900-5500 m). Fired into water at angle of from 13° to 27°; the bomb's total speed at entrance is approximately 150 meters/sec.

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ITEM: GUIDED MISSILES, X-4

INTELLIGENCE: It is believed that the Japanese are familiar with the design of X-4. (F-0)

IDENTIFICATION: Two specimens of the X-4, German air launched anti-aircraft rocket, have been recovered from the Ruhrstahl AG Presswerke at Breckwede, and the Brinkman plant at Hovelhof in the Bielefeld region. Both firms had taken care to remove all documents concerning the rocket before Allied forces took over.

The X-4s recovered are believed to be partly assembled production models. The warhead, fuse, and some control items are missing on all of them. Control parts have since been obtained from another source, although only one wire control device was found. Electrical wiring of both missiles was reported to be rudimentary. Practice warheads similar in shape to the operational model have also been found.

Performance: The X-4 is a wire-controlled, rocket-propelled, fin-stabilized missile with a proximity-fused warhead. It was intended for launching from fighter aircraft against heavy bomber formations. From information obtained from documents found at the Schmidding plant in Cologne it was not clear what type of control the X-4 employed. It is now known that the crew of the launching aircraft was to control the flight of the projectile through visual observation aided by signalled correction from a control unit in the aircraft connected to the rocket's controls by two insulated wires.

The X-4 is propelled by a bi-fuel rocket motor manufactured by BMW (designated "109-548"), utilizing the reaction between fuels designated "Tonka" and "Salbei". Four large fins are fitted symmetrically to the body of the rocket as shown in the drawing, and four smaller fins on the tail are intended to stabilize the flight of the missile. The smaller fins incorporate solenoid-operated control surfaces through which two-dimensional control of direction is made possible. A small aluminum tri-tab is fitted on the trailing edge of each of the four large fins, causing the missile to spin on its horizontal axis during flight.

3. DIRECTED OR CONTROLLED MISSILES

Although the warhead of the X-4 has not yet been obtained, it is believed to consist of an uncased, molded, streamlined, dinitro-glycol-based explosive fitted with a combination acoustic proximity-impact nose fuse, which is also self-destroying. A conventional bomb carrier which has been modified to hold the X-4 is designated ETC.7041.

Additional details of the X-4 were secured from its designer, who said that the missile in the form described above was considered a success after development trials. However, due to dangers inherent in its fuel system, the X-4 was not considered practical for operational use. Attempts were made to remedy the situation with a solid fuel propulsion system, and trials with the rocket used as a glider were also carried out. The measurements and capacity of the rocket in the original form were given as:

Overall Length	6 feet 6-3/4 inches
Length of warhead	1 foot, 5-3/4 inches
Diameter of warhead (at base)	8.675 inches
All-up weight of missile before launching	132.3 pounds
Weight of warhead	44.1 pounds
Estimated fuel tank capacity	
Salbei:	4 to 5 liters (approximately)
Tonka:	2 liters (approximately)

Warhead: Although accuracy of details on the X-4 warhead cannot be verified, it is believed to be of unique construction. The missile was developed on the theory held by some German experts that a weapon of high blast efficiency and little or no fragmentation could do great damage when detonated in the middle of heavy bomber formations. The explosive is drilled to take an offset fuse gaine and a five-core cable to the nose fuse of the warhead. The warhead is attached to the afterbody by wood screws and has an adaptor for the nose fuse attached in the same way.

Operation: The designer said that on release of the projectile from the launching aircraft, a pyrotechnic train in the fuse starts electrically, and seven seconds later it arms the proximity and impact elements. Should the missile fail to find the target, 28 seconds later the train initiates the self-destruction element. The armed acoustic element consists basically of a vibratory reed with a diaphragm tone filter sensitive to sound at 150 to 400 cycles per second. It operates a lever amplifier completing the circuit to the detonator when actuated at a range of around 59 feet by aircraft propeller noises. A delay of 1/50 second is incorporated in the detonator to enable the missile to close up to the target before detonation takes place. If the projectile hits the target the armed impact element then detonates the warhead.

The afterbody of the missile consists of forward and tail portions. The forward outshell of cast machined aluminum houses the helical aluminum tube fuel tanks and combined two-compartment steel air bottle. Electric wiring passes through this portion to the fuse and air bottle opening valves. Four sharply swept-back plywood main stabilizing fins are fitted to the external case by angle aluminum brackets. A steel suspension lug for hook-type suspension is riveted to the body midway between two of the fins.

Two diametrically opposed fins carry torpedo-shaped containers, each housing a spool wound with nearly four miles of two-tenths millimeter insulated steel wire, to the end of which a plug is fitted to enable the wire to be connected into the aircraft control apparatus. Tabs which give spin to the X-4 are fitted on the trailing edge of each fin. The other two fins are each fitted with a tracer candle at the top and have similar and probably smaller spin-imparting tabs. Leads from the candles and the wire spool containers are led to the wiring inside the rear part of the rocket.

Tail: This portion of the X-4 is a thin pressed aluminum envelope made in four sections, spot welded together. On the upper surface at the forward end is a seven-pin plug through which connection is made to the launching aircraft. At the rear end, the four tail stabilizing fins of aerofoil section are set at 45° in relation to the main stabilizing fins. Each tail fin is fitted with a double-acting solenoid-operated control spoiler, the surfaces of which are in the form of minute rakes. The tail portion houses the gyro control unit, nine-volt battery and box, and fuel leads from the tanks to the fuel combustion chamber located at the extreme rear of the tail section. The combustion chamber is held rigid by three adjustable steel tubes spaced equidistantly, connecting it to the forward portion of the afterbody. The venturi protrudes from the tail portion and is adjusted to take a pressed steel locking ring which holds the tail portion in position.

Motor: The BMW 109-548 rocket motor which propels the X-4 utilizes a self-igniting mixture of Salbei (98-100 percent nitric acid) and Tonka 250 (57 percent crude m-xylidine with 43 percent triethylamine). The motor is reported to be capable of delivering an initial thrust of 270 to 315 pounds, which falls progressively to 45 to 68 pounds after 30 seconds.

The motor consists essentially of a double compartment air bottle, which pressurizes two aluminum fuel tanks delivering fuel to a combustion chamber and venturi. The double compartment steel air bottle is located centrally within the helical fuel tanks. The after compartment is fitted with a charging valve, the connection to which passes through the forward compartment. A delivery valve is connected in the same way. The forward compartment is fitted directly with a charging valve and a delivery valve. The delivery valve of the forward and larger capacity compartment is connected by a short length of small bore steel tubing to the outer and larger fuel tank. The second delivery valve is connected in the same manner to the inner fuel tank.

The fuel tanks are close-fitting helically wound aluminum tubes of internal diameters of 2.8 and 2.2 centimeters respectively. In the forward end of each spiral a flexible aluminum fuel ejection piston is fitted, insuring that all of the fuel will be driven from the tanks into the combustion chamber when pressurization is effected. The outer tank, fuelled with Salbei, is connected by a length of small-bore aluminum tube to the outermost fuel inlet of the combustion chamber. The inner tank, using Tonka, is connected in the same way to the inner fuel inlet, from which entrance is made directly to the combustion chamber through a simple aluminum grid filter and three equidistantly spaced holes in the base of the combustion chamber. The latter is a steel cylinder ending in the venturi orifice. The chamber is double-walled with a spiral tube inserted between the walls.

Salbei circulates by entering the outer inlet through the double wall, and acts as a coolant before it goes into the combustion chamber proper. This last is effected by six equidistantly spaced holes almost concentric with the three holes in the inner tank holding Tonka. The holes meter the delivery rate of fuel to the combustion area, where spontaneous combustion takes place.

Control: The control system for the X-4 shows great similarity to the FX radio-corrected armor-piercing bomb, which was the work of the same designer. The rake-spoilers in the tail fins vibrate five times per second, moving as possible to each side with each vibration. Control of flight is effected by the variation of duration of stay at each limit of travel. When no control is applied the spoilers vibrate for equal time-durations to each side. When a turn is desired the spoilers are made to remain longer at one limit of travel with corresponding reduction of time of stay at the opposite limit. The control unit in the aircraft is a small instrument (10 centimeters square) carrying a single control stick which moves forward and back for elevation and from side to side for azimuth correction.

Inside the unit are two drums which revolve at a rate of five times per second. One drum controls elevation and the other controls azimuth. The control stick governs the position of a spring contact along each drum. Each drum is built up of two surfaces so that when the contact is at the mid-point it rests for equal time-durations on each surface, but when moved towards either end there is an increase in contact time on one surface with an equal decrease of contact time on the other surface.

The azimuth drum provides polarity change to a sensitive relay in the X-4 and the elevation drum current change to a second relay. Since current and polarity changes are passed simultaneously down the length of connecting wire, the elevation relay is fed through a rectifier and resistance bridge circuit so that it is unaffected by the polarity changes present in the signal, and reacts only to current change. To allow for voltage drop in the wires connecting aircraft to rocket, 190 volts DC are provided by a small power pack using the 36 volt 500 cycle supply which runs up the gyro prior to launching. The relays connect the small 1-1/2 watt solenoids in each tail fin to the nine-volt battery carried in the rocket. Time duration to each solenoid depends on the control being applied.

The rocket rotates about its axis at the rate of one rotation per second. This rotation causes symetrical cancellation of errors in manufacture and consequent simplification of the stabilizing mechanism. If a missile of this kind did not rotate it would require gyro-stabilization both in azimuth and elevation. In this way the X-4 is stabilized in line of flight by a single gyro.

Fixed to the girbal mount is a segmented commutator. As the rocket rotates, the elevation and aziruth signals are applied to the appropriate fins in cyclic succession. The main segments are 60° with subsidiary segments of 15° spaced by 15° to each side. The application of 15° of counter control inserted in the tiring cycle greatly increases the overall stability of the missile.

3. DIRECTED OR CONTROLLED MISSILES

Launching of the X-4 was intended to be from FW-190 and Me-262 fighters. The one modified X-4 bomb carrier found was of a single-hook electrically-fired type, fitted with a mechanical jettison linkage. The usual fuse-charging arm had a seven-pin socket (fitted in place of a fuse-charging head) to connect with the seven-pin plug on the rocket body. Through this connection current is supplied from the aircraft to spin and decage the gyro, fire the piercing detonators, arm the fuse and function the fin tip tracer candles. The gyro is spun up some minutes before the rocket is launched by separate control, while remaining operations take place at the instant the pilot of the parent aircraft presses the bomb release switch to launch the missile.

The carrier is also fitted with two arms, one on either side of the rear of the carrier frame to which the pull-off connections from the wire spools are attached. The plug-in connections of the spools are attached near the carrier to the underside of the aircraft mainplane. It is expected that the carriers would be fitted outboard of the propeller arc on the FW-190, and on the fuselage or outboard of the jet units of the jet units of the Me-262.

4. PHYSICAL AND OPTICAL DEVICES

ITEM: INFRA-RED DEVICES

INTELLIGENCE: 1. Correspondence files of the Berlin office of Mitsubishi seized at Bordeaux contain details of the shipment of Photocell Colorimeters to Japan by the firm of Bruno Lange. (Dr. Lange has been in Japan since the summer of 1943 and is an expert in infra-red research.)

2. Reliable P/W states that Falter was shipped to Japan during 1943.

3. Reliable information indicates that details of Igel were available to the Japanese in October 1943 (A-2).

4. Reliable information (A-2) indicates that full details on the following were in Japanese hands by October 1943: Spanner, Seehund. Equally reliable information states that specimens of WPG, NMG, and Flamingo were in Japan by July 1944.

5. Reliable P/W states that Adler was shipped to the Japs during 1943 (B-3).

6. A report of undetermined reliability indicates that Kiel was made available to the Japanese in February 1945.

7. Rights for manufacture in Japan of Telefunkens Braun tubes are reported to have been purchased.

8. I.G. Farben correspondence of 7 December 1944, indicates that infra-red camouflage patents were about to be turned over to the Japanese.

9. A reliable P/W states that blockade runners carried important quantities of such paint to Japan. Date of availability area October 1944. Other confirmatory source material on this evaluated (A-2).

10. A large quantity of thallium metal found aboard the U-234 is rather conclusive proof of the fact that Japan is frantically pushing an intensive I.R. program.

In view of the foregoing, it is important to review the following digest of German infra-red development:

ITEM: ANTI INFRA-RED PAINT

IDENTIFICATION: A substance having an index of refraction the same as that of powdered glass, which has exceptional index of refraction. Its appearance is different from glass material. Contains uniform glass particles, 10-20 microns. Ratio for deflection is 33-40% on average of visible light, 4-5% for I.R.

Gartenzaun and Lattenzaun - I.G. Farben [illegible]

for I.R. absorbent as undercoat. Final coat of clear paint used to reflect white rays and which either permits passage of I.R. rays or absorbs them. Present ratio of I.R. rays is 4% and ratio of reflection of visible rays is 20% (400, 500, 600 millimicron average).

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ITEM: INFRA-RED

Seehund

Application: aircraft detection from ships, I.R. signalling. Objective diameter: 6.5 cm. Objective focus: 10.5 cm. Cathode diameter: 5 cm. Field of view: 16°. Target: A/C. Range: 2-3 km.

Single eye-piece infra-red detector. Uses caesium tube.

Seehund Drei (III), Falter (?)

I.R. signalling. Smaller than Seehund. "Falter" also known as Small Seehund; can be used to detect A/C at ranges of 2 or 3 km. "Igel" and smaller Seehund called Seehund III.

Spanner, Large

Application: air to air detection. Objective diameter: 20 cm. Objective focus: 15 cm. Cathode diameter: 11 cm. Field of view: 30°. Target: A/C. Range: 6-8 km; 8-10 in good weather. Spanners used in night fighting; are employed in two ways. Can first pick up hot parts of target bomber. As range is closed, Spanners are used as I.R. gunsights in conjunction with screened searchlights carried on aircraft. There are two sizes of S/L, each about 30 cm in diameter, one carrying 500w lamp, the other a 1,000w lamp. Former 300-meter range, latter 400-meter. Range then estimated by size of image in Spanner on which reference disc is marked corresponding to size of an A/C at 150m. When image fills disc pilot opens fire.

Spanner, Small

Application: air to air detection. Objective diameter: 15 cm. Objective focus: 20 cm. Cathode diameter: 5 cm. Field of view: 10-12°. Target: A/C 4 eng. Range: 4-6 km.

Bildwandler Tube

Application: searchlight control. Target: A/C; 15-20 km against A/C. Mounted on special trailer. Also called "BW." I.R. picture transformer or P.T. tube (not far beyond threshold of human vision.) Only useful for detecting sources at fairly high temperature, or objects illuminated by such source. Tube for lower temperatures is under development. BW for S/L control mounted in Flak equipment trailer. Probably identical with Adler; range, 20 km.

4. PHYSICAL AND OPTICAL DEVICES

Adler

Application: searchlight control. Target: A/C. GAF has Adler which is large instrument for ground use and perhaps identical with Spanner. Range: 10 miles. Focal length: 40 cm.

Igel

Application: naval fire control. Improved Seehund with electronic focusing. Uses P.T. tube.

Katze (Handspanner), (Nachtsuchgerat), (NSG)

Produced in 1942. Application: detection of approach of night fighters. Range claimed was 800 m. Equipment described as 18 cm long by 8 cm in diameter. Specimens of equipment have been recovered bearing names of "Kater" and NSG apparently intended for use in detecting screened searchlights on ships or Army vehicles; size slightly larger than Katze (19.3 cm by 9.3 cm), and it is possible that Kater is a second mark of Katze or earlier informant may have misheard name. Kater is sensitized by exposure to daylight by not direct sunlight. This type of detector for near infra-red is made by using the effect produced by the radiation on certain phosphors which are triggered to produce their latent radiation in a relatively short flash.

Flamingo

Application: aircraft warning on submarine. Range: 7 km against bomber. Equipment mounted outside boat in hemispherical glass dome. Inclined reflectives which can be rotated 25 times a second by an electric motor scans the sky above horizon through 360° and throws radiation on a Thallium Sulphide cell. The motor also generates voltages to produce a rotating time base on an indicating cathode ray tube inside the boat, and any sources of heat radiation at temperatures above 500° C are shown as radial deflections from which bearing can be estimated to about 5°. "Flamingo" also fitted to surface ships and can be used as an all around viewing detector for an I.R. signalling system.

Obi Gerat (Optisches Bildgerat)

I.R. air interception apparatus. Range: 400 metres; visual presentation on 10 cm screen. Searchlight diameter of 20 cm using a Zeiss R.G.7 or R.G.8 filter. The receiver designed to pick up reflections coming within a 2° by 20° cone.

Gross-Biber

A development of the Obi Gerat in which photocell moves and scans image of I.R. picture. The Nipkow disc of the Obi Gerat is eliminated in the Gross-Biber.

4. PHYSICAL AND OPTICAL

Warmpeilgerat 15 (WPG15)

Application: D/F; said by Germans to be most promising equipment. Apparatus does not transmit and therefore cannot be picked up or jammed. This apparatus (German Navy) and the NMG42 made by ELAC a lead sulphite cell cooled by solid CO_2. Range against bombers approximately 5 km; against ships and factories 10 miles. A-3 information indicates recent transfer.

Nachtmessgerat 42, NMG42, "B" Gerat (Beobachtung)

German Air Force night locating equipment. See above. In lead sulphite cells, photoelectric and photoconductive effects constitute trigger effects which can be made to actuate electronic equipment.

Donau Gerat, Bolometer

Used for location of ships by coast defense troops. Two thermo couples are mounted at the focus of the mirror in such a way that the image of the ship can be focused on one or both of them. Differences in temperature in the ship and its background give rise to a signal from the thermo couples; the electric impulse is amplified and recorded on a visual receiver. Theoretically such a device is capable of detecting all bodies at temperatures different from their background, but this apparent merit is a weakness in that any body, both wanted and unwanted, will cause deflection. Furthermore, the response time at best can only be between 1/100 to 1/10 second. More hope was therefore placed by the Germans in detectors of the lead sulphide type.

Linse

This I.R. proximity fuse was to have been applied in a flak rocket projectile to be steered and controlled by a radar beam. A photo cell having maximum sensitivity to wave lengths of about one was used. In front in nose was small propeller which in revolving intermittently cut out I.R. light impinging on cell. By this means an alternate current was set up and when the alternations reached a certain amplitude, the fuse came into operation and exploded the shell. Designed to operate on A/C exhausts.

Uhu Gerat

This is an I.R. night aiming device installed in tanks. The instrument attached above the cradle of the gun with a blue disc attached to the gun sight. In looking through the gun sight this device made targets visible at night to a range of 4600 m, and at that range the cone of light was 40 m in diameter. This would indicate an electronic telescope and a small I.R. searchlight.

Other reported developments include I.R. detection against swimmers at range of 200 to 300 yards and countermeasures against I.R. by application of special submarine paint, use of floating stoves burning benzine or similar incendiary material as decoys.

Japanese I.R. development has thus far given no evidence of any unusual degree of progress. It is known that they have I.R. signalling equipment for transmitting code at range of 10 miles. Night vision and detection research has not been very successful. In the former, a 1 km, 30 cm searchlight is fitted with I.R. filter and can detect a plane at 5 miles. In the latter, a ship's range and bearing can be detected by means of a thermopile and an output amplifier at range of 320 to 420 yards.

Zielgeralt Gewehr (Rifle Aiming Device)

This equipment is normally designated the ZG 1229. It comprises a small infra-red telescope and infra-red searchlight which can be mounted on the standard German infantry rifle, and a 6-volt battery operated vibrator power supply which is carried on one's back in a gas-mask canister. The telescope has a field of view of approximately 15-20°; its objective of focal length 9 cm; its eye-piece a magnification of 10. A voltage of 9000 volts is used on the tube. The equipment is alleged to have a range of 100 meters on a man under favorable conditions, and can operate for a period of approximately two hours without a change of batteries. (Signal Corps, EEIS)

Muecka

This is a very small infra-red telescope for airborne use. Its official nomenclature is not known. It employs the same image tube as the rifle-aiming device but has a much smaller optical system. One such telescope with power supply has been found by 9th Army EEIS Team. It is alleged to be for use in aircraft to enable pilots to stay in formation at night by observing small I.R. sources on the wing tips of other aircraft. It may be a search receiver to allow pilots to determine whether Allied aircraft are using I.R. searchlights. It is believed to be an experimental equipment produced by Leitz-Wetzlar. (Signal Corps, EEIS)

Wuerzburg "B"

The Wuerzburg "B", about which information has been singularly lacking, is said by P/W to be a modification of a standard 150-cm searchlight. The mirror and lens of the searchlight were kept intact but the carbon rods were replaced by a heavy coil installed in the focal center and supported by a hollow horizontal arm. A carbon arc or incandescent lamp (informant was uncertain on this point) placed in the center of the coil, fed from a 110-volt source, and screened by a glass I.R. filter, furnished I.R. energy which when reflected from an airborne target produced an image in a photo-electric camera mounted on the side of the searchlight. The light, however, was found to be unsuitable and the filter inadequate. Accordingly, a larger searchlight, a Zeiss filter and a Zeiss Ikon I.R. telescope were installed. This was not powerful enough to permit ranging on a target so two similar installations sited 2½ miles apart were tried. Although ranges of 40 to 50 miles were possible under suitable atmospheric conditions, the use of two installations was considered unsatisfactory. (Unverified P/W statement, 19 May 1945.)

Pulses Infra-Red

The last six months prior to P/W's induction into the Army were spent in experimental work on two I.R. sets which, lacking nomenclature, he designated as "B1" and "B2". The former made use of a telescope of greater diameter and shorter length than that used in the Wuerzburg "B", an improved filter, and carbon rods energized by a DC voltage of 110-120. Proper adjustment of voltage, current, and spacing produced a pulsed discharge between the carbon rods. An energy pulse received from the target was amplified and fed to the presentation system of a standard Wuerzburg set placed beside the searchlight. Lobe switching was also provided. Continuous operation for five hours was possible with "B1" without changing the carbon rods. During trials with this set, a Mannheim or a Wuerzburg was used to pick up a target which the I.R. set could follow easily. "B2" was almost identical with "B1" except that two searchlights mounted on the same stand were used. No "split" was provided. This, in the opinion of the informant, is not a disadvantage provided good operators are employed. P/W thought that six of the "B2's" and three of the "B1's" were in existence when he was called into the Army. (Unverified P/W statement, 19 May 1945.)

Infra-Red Control of Pilotless Aircraft

"Weihe", under way during the summer of 1944, was a method of controlling the flight of aircraft equipped with an automatic pilot. An infra-red detector 25 cm in diameter and containing 13 cells was mounted under the fuselage of a bimotored trainer. Each cell was connected with a different control of the automatic pilot. Direction from the ground was accomplished by a pulsed infra-red set through the medium of a variable pulse repetition frequency. (Unverified P/W statement, 19 May 1945.)

Ziel Gerat (Aiming Device) Beobachtungsgerat IR-1B

This equipment is normally designated the ZG 1221. It comprises an electron telescope and a 60-cm infra-red searchlight. The telescopes are marked BG 1221 (Bild Gerat) and the searchlight SW 1221 (Scheinwerfer). It is alleged to be intended for use by Waffen SS anti-tank units for locating and firing upon enemy tanks. The details of the searchlight are not known. The telescopes, however, have a field of view of about 12°; its objective, a focal length of 12.5 cm; an aperture 1.25 f; its eye-piece a magnification of 10. Its power supply provides a voltage of 17 kv for the image tube. The equipment is alleged to have a rnage of 300 to 400 meters on tanks on dark nights. Uses older BW tube made by AEG. Partially completed drawings recovered show modifications dated 5 March 1945. Notes indicate magnification W/10S eye-piece - 5.55X; W/5X eye-piece - 2.77X. Weight, 10.2 kg. Aiming device is adjectable, with markings indicating settings for different types of ammunition.

Fahrgerat (Driving Device)

This equipment is normally designated the FG 1250. The telescopes

are marked "27-1250". The equipment was supposed to be used in vehicles for night driving, searching, and shooting. The telescope has a field of view of about 30°; its objective, a focal length of about 9 cm; an aperture of 1 ft; its eye-piece, a magnification of 2 or 10; its power supply provides a voltage of 17 kv for the image tube. The equipment is alleged to have approximately the same capabilities as the Ziel Gerat. It appears to exist in two types--one has a small optical system which projects a chevron on the objective lens (the location of this chevron can be changed by turning a knob on the outside of the telescope) to provide a reference when the device is being used as an aiming instrument; the other does not have this provision. Uses newer BW tube.

Kiel III

The FuG 280 (Kiel III) is essentially an airborne infra-red aircraft intercept equipment for installation in German fighters for use against Allied bombers. Infra-red radiations given off by bomber aircraft are picked up by the equipment's scanning mechanism, which scans a conical pattern similar to that of certain American types of A.I. radar. The energy picked up is concentrated on a sensitive lead sulphide cell, and through the use of conventional amplifier and timing circuits, PPI presentation is obtained. Prisoner-of-war information indicates that this equipment was about to be introduced into operations, and that 30 installations were being made when the installation site was overrun. USSTAF representatives are despatching investigators to this site in an effort to obtain sample equipment.

Diameter of I.R. scanning element	...	1.2°
Maximum diameter of cone of scan	...	20°
Estimated range from which reflections are obtained (interpolated from diagram)	...	Greater than 5.7 kms.

Conclusions:

The foregoing suggests an intensive effort to convert infra-red to a wide range of applications. A fair amount of success was achieved in Germany. How far Japan will go in continuing I.R. research remains to be seen. It is important, however, to accept Japanese intentions as being extremely serious in this direction, and to consider such countermeasures as may become necessary in the Pacific.

ITEM: INGOLINE TORPEDOES

INTELLIGENCE: Reliable information indicates that the Japanese were given details of the Ingolin Torpedo in October 1944, at which time it was stated to them that they were 6 times more effective than German air-driven types and twice as effective as Japanese oxygen types. (A-2)

High ranking German naval officers state that details of torpedoes as well as fuel and turbines were transmitted.

IDENTIFICATION: General Description of Torpedo Propulsion Units: The fundamental principles of the Walter torpedo propulsion units are similar to those of the U-boat, except that no decomposition chamber is fitted, all the decomposition of the hydrogen peroxide taking place in the combustion chamber. Decomposition is started by a liquid catalyst instead of a solid catalyst as in the U-boat; no condenser or CO_2 compresser is fitted in the case of the torpedo which causes the back pressure on the turbine to vary directly with the torpedo immersion.

A. Combustion Chambers: The combustion chamber design has been stabilized for about two years, one of the first giving best results and efficiency of about 98%. The Ingolene (H_2O_2) and fuel containing catalyst enters the top or forward end of the combustion chamber via two concentric spray nozzles of 95 to 105 degrees cone angle. The mixing takes place in a swirling chamber in the first part of the combustion chamber which is approximately 2½ inches long. The complete combustion chamber itself is approximately 16 inches long and 7 inches in diameter. The chamber is surrounded by a water jacket with water entering at the top or forward end, and is guided by a spiral fin or tube, being constrained to follow around the chamber cooling all parts. This insures intimate contact with the water and uniform pre-heating, after which the water enters the bottom or after end of the chamber in the form of a spray, is evaporated into steam, and flows with the remainder of the gases into the nozzle chest of the turbine. The combustion chamber is bolted directly into this chest, eliminating piping connections. With this arrangement all metals of the combustion chamber are mild steel, no special alloys being necessary.

B. Combustion Control: The regulating mechanism is fitted which controls the proportion of the flow of the various liquids into the combustion chamber. The pressure in the combustion chamber is approximately 35 atmospheres. The torpedo mechanism is started when the torpedo is approximately 2/3 out of the tube by a starting lug which up to that time has been restrained by the wall of the tube. For a period of 3 seconds H_2O_2 and the fuel carrying catalyst (Helmann) is injected. At the end of this period the supply of Helmann is stopped and the ordinary fuel is injected, the H_2O_2 continuing to decompose from the heat of reaction.

C. Turbines: The design of the turbines is standardized for all of the torpedoes, except as mentioned below, and delivers 500 HP with an estimated overload margin of 10%. The rotor is 30 cm in a diameter, running at 30,000 RPM. It is a single overhung rat[illegible]wi[illegible]

milled in the periphery of the disc without shrouding. The casing covers the tips of the blades with a small running clearance. The nozzles consist of 3 groups of 4 each of the DeLaval type. The exhaust of the turbine passes through 4 spring-loaded check valves, to prevent entry of sea water before the turbine is in operation and after the run is completed on exercise shots. The turbine is identified by the code name BO-6 or Gerat 30. All auxiliary pumps are driven by the turbine through gearing. The turbine rotor is geared to a fly wheel and then by a planetary gear train to a propeller shaft which rotates at approximately 1,650 RPM. The differential gearing for driving the two propellers in opposite directions is located in the extreme after portion of the tail, both propellers rotating at the same speed. The turbine efficiency is reported to be 50-55%.

D. Pressure Vessels: Pressure vessels are mounted in various combinations to control the buoyancy and trim of the torpedo for its designed use. In the fresh water torpedoes the largest container is the one containing water; the next largest contains Ingolene (H_2O_2). A compression air bottle supplies pressure at 40 Kg per square cm (560 lbs per square inch) through a reducing valve to all the pressure vessels. The fuel and Helmann liquid (fuel and catalyst) are considerably smaller as shown in the photo. All of these except the air bottle are made of aluminum magnesium alloy called Pantalo in Germany.

* * * * * * *

Torpedo Types: The following German code names for the various types of Walter torpedoes classified them by propulsion mechanism only and have no reference to the control mechanism employed for seeking the target or explosion of the warhead. It was believed by the Walter concern that all of the Walter torpedoes were intended for straight run depending on their high speed and trackless operation. For certainty of hitting before evasive tactics could be made effective, the torpedoes are trackless because the exhaust from the turbines is 85% steam, which condenses immediately to water in the sea, and 15% oxygen which when finally divided as discharged is absorbed by the sea water before any bubbles reach the surface.

Walter Code Names of Torpedoes

a. KABUTT - A 7-meter long torpedo of neutral buoyancy for the midget U-boats. These had separate Ingolene and water bottles. Fifty had been shipped to Norway but not yet used operationally.

b. GOLDBUTT - Same as above but five meters long; short runs for practice.

c. STEINBUTT - Same as (a) but long range with larger tanks and with negative buoyancy for U-boats.

[illegible] - Same as (b) but Ingolene tank inside of water tank for [illegible], especially from splinters.

e. STEINBARCH - Same as (d) but as long as (c) for U-boats. Manufacture of series production torpedoes started and supposed to be operational by May 1945. Those completed were sent to T.V.A. Ecken Furde.

f. WAL - Generally similar to (c) and (e) but runs on salt water after starting on fresh water. Still only experimental but ran for 10 km at T.V.A. Differences from the fresh-water types include a strainer basket filled with Raschig rings (short lengths of boiler tubes) inserted between combustion chamber and turbine. It is claimed this removes all the calcium sulphate. The turbine inlet temperature is kept below 250° (500 with fresh water) in order to permit the ether salts to pass through the turbine without depositing. This reduces turbine power to 380 HP with a reduction in speed to 45 knots. Atlantic sea water was more difficult than North Sea or Baltic. The consequent decrease in efficiency was compensated for by increased ability to carry Ingolene and fuel. Speed was reduced to 45 knots, as compared to 50 for fresh water. WAL has three ingenious five-plunger swash plate pumps in one casing for fuel, Ingolene, and sea water; hence, has a very small air bottle and small fresh water tank.

g. SCHILDBUTT - Same as (f) but has a pump for salt water only and therefore a larger air bottle for forcing fuel and Ingolene into the combustion chamber.

ITEM: T-1 (G7a) TORPEDO

INTELLIGENCE: Interrogation of high ranking German naval officers by British Admiralty 30th Assault Unit at Glucksburg reveals that ten T-1's and all specifications, including pistols, were made available to the Japanese in 1941-42. Other information confirms this statement.

IDENTIFICATION:

Use:	CA, DD, E-Boats, U-Boats (long cruise)
Type:	Air torpedo
Diameter:	21"
Length o.a.:	23'7"
Warhead length:	46"
Explosive:	TNT/HND/AL
Chg. Weight:	660 lbs.
Pistol Type:	Impact magnetic "PiB", essentially Italian S.I.C. Degaussing has no appreciable effect against it.
Speed/Range:	44/6500 yds. 40/8700 yds. 30/15,300 yds.

Depth Setting:	0-40'
Gyro Angling:	Yes
Increments Gyro Set:	1° steps from 90° left to 90° right
Wake:	Visible but not pronounced
Propeller:	6 blades

ITEM: T-3 (G7e) TORPEDO

INTELLIGENCE: Two ComNavNaw reports, dated 23 March 1944, and 12 April 1944, quote reliable information to the effect that Japanese submarines were equipped with G-7e's having range of 5,000 yds. at 30 knots.

Earlier intelligence on the subject states that 50 electric torpedoes and 75 additional warheads were carried to Japan by the blockade runner Alsterufer, which left Bordeaux in February 1943.

German naval officers interrogated in Glucksburg states that ten T-3 torpedoes and pistols were shipped to Japan in 1943.

IDENTIFICATION: This standard torpedo exists in several varieties. The original electric torpedo "T.2" was still being used with the impact pistol "G.7H" (P:1) but was generally replaced. A later model of the same torpedo was "T.3" which differs in having electric connection from main battery to pistol pocket, enabling it to employ the German magnetic pistol "Pi2". Latest electric torpedoes were fitted with "Curly" gear "Fat 2".

G7e was driven by lead-acid secondary battery and electric motor; has an R.G.F. pattern tail with two-bladed propellers; gyro and depth gear are operated by air from bottles with exhaust into battery chamber. It is almost trackless.

Speed (one setting only): To obtain this performance the battery must be pre-heated electrically. Otherwise:	30 knots to 5,400 yds. 28 knots to 3,300 yds.
Warhead:	600 lbs. of TNT/HND/AL
Gyro Angling:	Up to 90° right or left in 1° steps
Depth setting:	0-40 feet

In addition to submarine use for which G7e is primarily designed, it has been fired from MTB's at speeds up to 40 knots and from heights of 8 feet.

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5. UNDERWATER ORDNANCE

ITEM: T-3a TORPEDO

INTELLIGENCE: Interrogation of high ranking German naval officers by British Admiralty 30th Assault Unit at Gluecksburg reveals that batteries for the T-3a were supplied to the Japanese. Reliability - F-0. Date unspecified.

IDENTIFICATION: Similar to the T-3 but considerably heavier, and has larger battery capacity. Estimated performance is 8,000 yds. at 30 knots with considerable over-run at a tailing off speed. Has been in use in U-boats since early 1944. "Lutl", curly gear superseding FAT, is in common use with T-3a torpedoes. Uses Pi-2 impact magnetic pistol, introduced in 1942. Pi-2's sensitivity is sufficient to fire 10' below the keel of a heavy ship but is not entirely proof against prematures, especially at end of run.

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ITEM: T-5, ACOUSTIC (GNAT) TORPEDO

INTELLIGENCE: Those used in German subs in the Indian Ocean were adjusted for them by the Japanese torpedo testing establishment at Penang.

Interrogation (15 May 1945) by Japanese Section, SHAEF, of ELAC directors reveals that "Zaunkonigs" (cover name for T-5) were shipped to Japan during 1944.

Other information indicates delivery of working plans in July, September, and October 1944 (A-2). Testing gear received in December 1944.

IDENTIFICATION: Directed by device in torpedo heat. Range when proceeding on opposite courses, 2000 m; bearing, 5° and 60°; when proceeding on parallel course, 800 m, bearing 160°. Target speed, 12-16 knots. In general if torpedo misses target, it will turn around and follow the sound propellers. Sound picked up through 45-50° angle, left and right, ahead and behind.* In operation since October 1943; approximately 45% accuracy in combat; 21" diameter.

* Homing radius, 300 yds., from vessel doing revolutions for 15 knots.

CONCLUSIONS: The logistics problems involved with manufacture and testing of T-5 in Japan are not considered beyond their capabilities. Evidence definitely points to intentions of equipping their submarines with an acoustic torpedo, and its advent in the Pacific War should be expected. Approximate date of production - August-September 1945.

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5. UNDERWATER ORDNANCE

ITEM: TORPEDO ANGLING GEAR

INTELLIGENCE: FAT gear described by P/W who boarded the DD TANIKAZE at Guam. DD captain stated that his torpedoes were of the latest design and capable of being set for various angles.

Transfer of LUT torpedo is reported by ComNav for France, 8 February 1945; date sent to Japan and other details lacking. Evaluation - A-2.

High ranking German naval officers state that transfer of FAT 1 and 2 gear and drawings was made to the Japanese in September 1943; LUT 1 and 2, gear only, in the summer of 1944.

IDENTIFICATION: FAT-1 - Form of "Curly" gear (mechanism causing torpedoes to describe circling course to obtain greater chance of hit), fitted in 21" air torpedoes. Used chiefly at night and with long-range 30-knot setting. Can be fired with normal gyro angling, and will run straight to any set target, then will begin to execute either long or short legs either to right or left, as may have been pre-set. Best suited for shots from the beam of a convoy.

Straight Run - Any multiple of 110 yards up to the full range of torpedo.

Turns - Diameter of all 180-degree turns; therefore distance apart of legs is 370 yds.

Long Legs - Straight run on each leg when set to long is 1640 yds.

Short Legs - Length of each leg when set to short is 900 yds.

No. of Legs - On long setting torpedo will, if range allows, describe 4 complete "there-and-backs" and on short setting, 6.

Speed - On long setting, 5 knots; on short setting, 7 knots.

FAT-2 - Very similar to FAT-1; fitted in 21" electric torpedoes.

Straight Run - Can only be set in multiples of 550 yds.

Long Legs only can be set either to right or left. Alternately it can be set to describe circles of 370 yds. diameter.

LUT - This is a fully developed form of "FAT", having more general application. Fitted in longer range electric torpedoes. Valuable for browning a convoy from any direction. Fired against single ships right ahead or astern, and with curly advance set just in excess of target's speed chance of hit is great, unless target zig-zags.

Improvements:

1. Line of advance when curlying can be pre-set to any angle from its straight run.

2. Mean speed of advance along its curlying direction can be pre-set at will from 5 to 19 knots.

CONCLUSIONS: Action reports do not conclusively prove Japanese employment of LUT or FAT. It would be well, however, to consider their advent in the Pacific inevitable.

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ITEM: T-10 "SPINNE" TORPEDO

INTELLIGENCE: Interrogation of high ranking German naval officers by British Admiralty 30th Assault Unit, 9 May 1945, reveals that Japanese representatives at least observed firing tests.

IDENTIFICATION: T-10 is a 21" electric, coast defense torpedo, controlled electrically from shore pillboxes by means of a fine insulated wire paid out by the torpedo. Launched from a cradle below waterline. Operator can steer torpedo to left or right and can cause it to break surface by day or flash a light by night to disclose its position. Starts its run as an aimed shot under normal gyro control but once operator has assumed steering control cannot revert to gyro. Three T-10 torpedoes can be controlled simultaneously by one operator. Installed in 1944 in some French ports. Difficulty in fixing torpedo's position, with respect to target, and of steering to achieve a hit would seem to make this weapon of doubtful value. Range at 30 knots is 5,400 yds.

CONCLUSIONS: P/W description of shore-based torpedo installations is evidence that the Japanese have given thought to the idea. Additional evidence of two shore-based torpedo installations under construction was found on Iwo Jima.

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ITEM: SIC MAGNETIC PISTOL

INTELLIGENCE: Italians sold this pistol to Germany for use in G7a and G7e, but refused to make it available to Japan. In August 1943, the Germans requested permission to turn SIC over to the Japs. The Italians made no answer by September 1943. It is assumed that the Germans did turn it over subsequent to the Italian Armistice. Other information indiaates Japanese acquisition. (A-2)

CONCLUSIONS: Assuming the transfer to have been made by submarine, the Japanese could not have had possession before late 1943 or early 1944. Tests and experiments there would have required six months owing to known instability of Japanese torpedoes. Added to this, another six months would be needed to get the pistol into production.

ITEM: TORPEDO REFINEMENTS

INTELLIGENCE: Reliable source dates Japanese acquisition of data as March 1945 (A-2).

IDENTIFICATION:

1. Reported that Askania type of vertical rudder gear for torpedoes has a low power amplification. Said to be replaced by a slide valve type of vertical rudder gear in all except acoustic torpedoes.

2. Experiments are reported of torpedo stabilizer which consists of a small gyro in the after buoyancy chamber.

ITEM: MINES, OYSTER

INTELLIGENCE: High ranking German naval officers state that Japanese are familiar with pressure principles of "Oyster," but working drawings were not made available to them. Other information tends to confirm this statement (A-2).

IDENTIFICATION:

Oyster Mines

The Oyster is the unit operated by the suction effect which is caused by ships on sea-bed. It is used in combination with the magnetic unit in C mines and the acoustic unit in G mines.

G (Bomb Mine (1000 kg))

This influence ground mine is used to block waters under enemy control up to effective depth of 20 fathoms. Originally laid from aircraft without parachute; lately has been fitted with 5' parachute. Fitted with tail piece similar to that on German high-explosive bombs, so that can be laid accurately by bomb-sight, since it is not subject to drifting with wind unless parachute attached.

It is designed to:
1. Detonate instantly on impact with hard surface.
2. Detonate with delay of 40-90 secs. on impact with soft surface.
3. Become active as magnetic mine after reaching depth of 24'.
4. Detonate with slight delay by operation of its PSE by action of light.

Fitted with magnetic, acoustic, or magnetic-acoustic units.

Length:	6'4"
Diameter:	26"
Weight:	2050 lbs.
Color:	Light blue
Charge:	1600 lbs. hexanite
Case:	Manganese steel; false nose smashed on impact.
Fuse:	Reinmetall 157/3
Activation:	Hydrostatic switch and bomb fuse
Sensitivity:	Magnetic acoustic unit: Arms at 15 mg Fires at 20-40 cps Fires at 30-40 dynes per cm^2 Acoustic unit: Fires at 250 cps
Firing time:	Magnetic - 2-7 secs.; acoustic - ½-1 sec.

C Mine (C1 and C2)

C1: Influence ground mine laid by aircraft with parachute, for use against surface craft. When dropped two lanyards are pulled; one releases parachute cap latch, then serves as pilot chute; other removes bomb fuse safety pin and booster release mechanism safety fork, allowing bomb fuse to arm after short delay controlled by hydrostatic clockwork. Upon impact with any surface bomb fuse clock work starts again, and bomb fuse flies mine after 17-second delay unless mine has reached depth of 15' or more, in which case mine fuse again becomes passive and may or may not become active again if raised, depending on fuse fitter. Fitted with magnetic, acoustic, magnetic-acoustic units. No self-disarming devices are fitted.

C2: Differs from C1 as follows: Surface craft laid without parachute; after end is rounded. Operates in same manner except no parachute is fitted, and the bomb fuse if fitted will probably have safety pin still in place.

Characteristics:		C1	C2
Length:	o.a.:	9'9½"	7'4"
	Tail door:	19"	7½"
	Case:	5'8½"	5'8½"
Total wt. in air:		2175 lbs.	2076 lbs.
Diameter:		26"	26"
Charge (hexanite):		1535 lbs.	1535 lbs.
Shape:		Cylindrical with hemis. nose and tapered tail	Cylindrical with hemis. nose and rounded tail
Color and Material:		Dark green or black aluminum	Same as C1
Fuses:		34A-34B (some cases fitted with additional clock-work bomb fuse).	May or may not be fitted with bomb fuse.

Activation:	Hydrostatic clock	Hydrostatic clock
Sensitivity:	Magnetic unit arms at 20-40 mg.	Same as C1
	Acoustic unit fires at 250-75 cps.	Same as C1
	Acoustic unit fires at 15 dynes per cm^2 at 250 cps.	Same as C1
Firing Time:	Magnetic - 2½-3 secs. or less than 1 sec.	Same as C1
	Magnetic-Acoustic - 3-4 secs.	Same as C1
	Acoustic - 1½-3 secs.	Same as C1

CONCLUSIONS: In January 1945 an urgent order was placed with AEG for an undetermined type of mine fuse. The significance of this order is not known, but Japanese adaptation of "Oyster" should be expected.

ITEM: CB, GROUND INFLUENCE MINE

INTELLIGENCE: High ranking German naval officers reveal acquisition of this mine by the Japanese. Date unknown.

IDENTIFICATION:

Laying:	Aerial by parachute; surface craft.
Case Depth:	Minimum - 15'; maximum - 180'.
Description:	Aluminum, cylindrical, 26" diameter, 8'8" length, 6 anti-rolling horns on nose.
Main Weight:	1536 lbs.
Weight in Air:	2175 lbs.
Fuse:	24A; 34A.

ITEM: GC, GROUND INFLUENCE MINE

INTELLIGENCE: According to reliable information, the Japanese had a specimen mine by August 1943. (A-2) High ranking German naval officers confirm transfer.

IDENTIFICATION:

U. S. Designation:	Type C (CM, CA, CAM)
German Designation:	LMB (Luft Minen B)
	Aerial by parachute in up to 20 fathoms. (15-120'; usually not over 100')

Type and Use:	Used offensively to block shipping channels and dock areas; also occasionally as land bomb and possibly as depth bomb against small craft. Same as GD except for weight, length, and charge (q.v.).
Case:	8'8" long, 26" diameter; aluminum, black or dark green; cylindrical with parachute; weight, 2175 lbs.
Charge:	1535 lbs. hexanite.
Arming and detonation	On release from A/C bomb fuse and bosster operates on impact with land or water but becomes dormant at a depth of over 15' water. It may fire if lifted. Over 15' water starts the hydrostatic clock which arms the influence firing units. May contain any type of influence firing unit. For additional details see GD write-up.
R.M.S.	No disarming features and dangerous to handle.
Safety features:	Only ones are the arming devices (see above).
Remarks:	For German color markings of GD and GC type mines, see MDB 19 of 1 July 1943, Conf.

ITEM: GD, GROUND INFLUENCE MINE

INTELLIGENCE: According to reliable information, the Japanese had specimen mine by August 1943.

IDENTIFICATION:

U. S. Designation:	Type D (DM, DA, DAM)
German Designation:	LMA (Luft Minen A)
Laying:	Aerial by parachute in 15-120'; usually not over 100'.
Type and Use:	Influence ground mine as Type "C", offensively against channels and dock areas; also occasionally as land bomb and possibly as depth bomb against small craft.
Case:	5'8" long, 26" diameter; black or dark green aluminum alloy; cylindrical with parachute; 875 lbs.
Charge:	660-674 lbs. hexanite.
Arming and Detonation:	In general, same as Type "C" mine. Source gives unit as magnetic Mk IVa, M Mk II (rev.). Period of delay interval 40-120 secs.; activating hydrostatic clock period 1/2 hour 6 days; 20-40 mg sensitivity of unit (setting as high as 5 mg used against Russians); firing time 2½-3 secs. or less than 1 sec.; bomb fuze is 3A; operates on [illegible] or more.

R.M.S.	No disarming features and dangerous to handle See source for procedure. For anti-recovery devices see GC.
Safety Features:	Same as Type C.

ITEM: GG, GROUND INFLUENCE MINE

INTELLIGENCE: According to reliable information, the Japanese had specimen mine and details in November 1942.

IDENTIFICATION:

U.S. Designation:	Type G (German George)
German Designation:	BM 1000 (Bombe Minen 1000 kg.)
Laying:	Aerial free falling with bomb-sight in depths up to 20 fathoms.
Type and Use:	Magnetic (or other influence) ground mine for accurate laying offensively in dock and other restricted areas, or as a land mine.
Case:	6'4" long, 26" diameter; light blue; manganese steel case; non-magnetic false nose weight, 2020 lbs.
Charge:	1600 lbs. hexanite.
Arming and Detonation:	Fitted with Rheinmetall 157.3 bomb fuse. Instantaneous detonation on impact with a very hard surface. Detonation delayed 40-90 secs. on impact with soft ground or water less than 24 feet; magnetic mine after depth of over 25 feet is reached. May also be fitted with acoustic and pressure actuation. Both red and blue direction of firing. Has electric-magnetic auto. lat. adjustment. Ten place max. period delay mechanism. Sensitivity is 15-35 milligause; arms at 15 mg, fires at 20-40 cps, fires at 30-40 dynes per cm^2; acoustic fires at 250 cps. Firing time for M, 2-7 secs., for A, ½-1 sec.
R.M.S.:	May be booby-trapped and dangerous to handle, especially if still under water.
Safety Features:	Delayed arming period in bomb fuse and delay before magnetic unit becomes ripe.

ITEM: GN, INFLUENCE MINE

INTELLIGENCE: NavTecMisEu reports specimen mine turned over to the Japanese.

IDENTIFICATION:

U.S. Designation:	GN (NM, NA, or NAM)
German Designation:	TMC
Laying:	SS, TT, or S/C
Type and Use:	Same as S except larger case and charge.
Case:	21" diameter, 11'1½" long, 2300 lbs.; torpedo shaped.
Charge:	1,850 lbs. cast hexanite.
Arming and Detonation:	See "S" mine. Magnetic, acoustic, or combination firing.
Remarks:	In general, full information entered under S mine. Several fields of "S" and "N" laid off U.S. East Coast. Three Y.S. or 2 GN's will fit a single German torpedo tube or rack.

ITEM: GO, MOORED INFLUENCE MINE

INTELLIGENCE: NavTecMisEu reports specimen turned over to the Japanese.

IDENTIFICATION:

Laying:	Type I via vertical shaft in submarine; Type II, III by S/C in up to 300 fathoms. Type II usually laid 8-35 fathoms; Type I, 10" mooring cable max. length, 1320'.
Type and Use:	Moored, against shipping lanes.
Case:	46" diameter; black or dark green; weight, 1250 lbs.; length, 53"; spherical with center band; aluminum.
Charge:	772 lbs. hexanite.
Anchor:	3000-lb. cylindrical, loose bight.
Arming and Detonation:	When mine takes its depth, tension on the mooring spindle and hydrostatic pressure start Mk. III 6-day arming clock (set from 30 min. to 6 days). Maximum period delay is 15 actuations (M Mk IV a unit). Active period is 80 days. Has scuttling charge.

ITEM: GS, GROUND INFLUENCE MINE

INTELLIGENCE: NavTecMisEu reports transfer of specimen to Japan.

IDENTIFICATION:

U. S. Designation:	Type S (SA, SAM, SM)
German Designation:	TMB (Torpedo tube mine Type B)
Laying:	SS torpedo tube (or S/C) offensively in 15-120'; usual depth not over 100'.
Type and Use:	Magnetic (and probably other influence types) ground mine to block coastal waters under enemy control.
Mine Case:	Cylindrical with hemispherical nose; 7'7" long; 21" diameter; black aluminum; 1540 lbs.
Charge:	1220 lbs. cast hexanite.
Anchor:	None.
Arming and Detonation:	M. Mk II rev. or A Mk II units. Hydrostatic clock is actuated by 15' or more of water after laying, and firing unit armed after 6-day hydrostatic clock has run off. Only magnetic firing unit has been positively identified, but other influence types could be and probably have been fitted. P.D.I. is 40-45 secs.
R.M.S.:	Probably not booby trapped and moving is dangerous.
Safety Features:	Pre-laying safety devices include a safety bar, hydrostatic clock, booster release mechanism, and toggle pins and caps for the clock and booster release.

ITEM: MK IIIa - HYDROSTATIC ARMING CLOCKS

INTELLIGENCE: NavTecMisEu reports specimen in Japanese hands.

IDENTIFICATION:

Operating Depth:	15'
Time Limits:	½-6 days
Switches:	a-g) b-c) end of set period e-f - 18 mins. after a-g b-c
Delay Starting:	None
Plates Used:	Types 1, 3, O.

Once started, runs to end of set period.

Source states that Mk. Ia, Mk. IIa, Mk. VI of this series were also given to the Japanese.

ITEM: M MK I - GERMAN MAGNETIC FIRING UNIT

INTELLIGENCE: High-ranking German naval officers reveal acquisition of this firing unit by the Japanese. Date unknown. Other information states that specimen was delivered to the Japanese.

IDENTIFICATION: Used in mines Types GA and GB.

Firing Mechanism:	Needle
Direction of Firing:	One way Red or Blue
A.L.A.:	None
A/C Feature:	Pendulum
P.D.M.:	None
R.A.M.:	None
Sensitivity (mg.):	50-80
Time to Fire:	1½-3
Hand-set latitude adjustment	

ITEM: M MK II - MAGNETIC FIRING UNIT

INTELLIGENCE: NavTecMisEu reports specimen in Japanese hands.

IDENTIFICATION: Used in mines Types GB, GC, and GD.

Firing Mechanism:	Needle
Direction of Firing:	One way Red or Blue
A.L.A.:	Mechanical
A/C Feature:	Pendulum
P.D.M.:	None
R.A.M.:	None
Sensitivity (mg.):	20-30
Time to Fire:	2½-3

ITEM: M MK III - GERMAN MAGNETIC FIRING UNIT

INTELLIGENCE: High-ranking German naval officers reveal acquisition of this firing unit by the Japanese. Date unknown.

IDENTIFICATION: Used in mine Types GS and GN.

Firing Mechanism:	Needle
Direction of Firing:	One way Red or Blue
A.L.A.:	Mechanical
A/C Feature:	Pendulum
P.D.M.:	6-plate
R.A.M.:	None
Sensitivity (mg.):	20-30
Time to Fire:	2½-3

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5. UNDERWATER ORDNANCE

ITEM: A MK III - GERMAN ACOUSTIC FIRING UNIT

INTELLIGENCE: High-ranking German naval officers reveal acquisition of this firing unit by the Japanese. Date unknown.

IDENTIFICATION: Used in mine Types GC1, GC2, GS, and GN.

Type Microphone Used:	Cantilever
A/C Period:	80 secs.
P.D.M.:	12-plate
R.A.M.:	6-day
Firing Frequencies:	175-325 cps
Firing Sensitivities: (dynes per sq. cm.)	175-325 15 @ 250 cps
Time to Fire:	1½-3

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ITEM: AM MK I - MAGNETIC-ACOUSTIC FIRING UNIT

INTELLIGENCE: NavTecMisEu reports that specimen is in Japanese hands.

IDENTIFICATION: Used in mines Types GC 1 and 2, GS, and GN.

Arming Mechanism:	M Mk II Revised
Direction Arming:	One way Red or Blue
P.D.M.:	12-place
R.A.M.:	6-day
Sensitivity (mg.)	3-9
Microphone	Cantilever
Firing Frequencies	175-325 cps
Firing Sensitivities: (dynes per sq. cm.)	30-50 150 @ 250 cps
Time to Fire:	½-1 sec.
Time Active	45 secs.

Source states that verbal description of MP Mk I was given to Japanese.

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6. ROCKETS

ITEM: V-1

INTELLIGENCE: A Jicana report, 4/29/44, states that designs for offensive craft with propulsion and steering syster analogous to those designed for V-1 were turned over to the Japanese in Oct 1943. Other reliable information dates Japanese acquisition as Nov. 1944. (A-2)

IDENTIFICATION: Structure made entirely of steel, other parts of light metal alloy. Fuselage composed of 6 sections, including nose-cap, warhead, fuel tank, compartment containing control equipment. Reaction propulsion unit mounted above rear of fuselage.

Ignition caused by hot or flaming residue of gas remaining in duct. Controlled by auto-pilot monitored by a magnetic compass. Carried, in addition to normal explosive warhead, incendiary bombs or propaganda leaflets.

Range (miles)	160
Speed (mph)	360
Fuel Cap. (gals)	150
Consumption	320 (gals per hr.)
Duration (mins.)	25
Length	25 ft. 4½"
Dia.	2 ft. 8"
Wing span	17 ft. 6"
Wt.	4700 lbs.
Wt. of Warhead	1983 lbs.

WARHEAD

Length	47"
Dia: Rear end	33"
Forward end	28"
Wt. of casing & exploder system	113 lbs.
Wt. of explosive	1870 lbs.

Three fuzes in warhead:
1. 106 ELAZ El. impact
2. 80A mechanical all-ways impact
3. either 80A or mechanical clockwork delay of 17B type

CONCLUSIONS: It appears that Japanese intentions along lines of V-1 are serious. Further activity in this direction involves plans for aircraft launching of the V-1. Detail of German launching from HE111 were obtained in Nov. 1944.

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ITEM: V-2

INTELLIGENCE: An OSS report dated Sept 1944 states that the Japanese purchased plans for the V-2. Another OSS report from a usually reliable source states that plans for this weapon were brought to Japan in February of 1945 by Doctor Yamada who is supposed to belong to the J[illegible]

Chemical Research Institute. At the present time, it was stated, construction is being undertaken by the Japanese at the arsenal in Mukden. They plan to use it after accumulating a sufficient stockpile and probable target areas will be the Philippines and portions of the interior of China.

IDENTIFICATION: Outer surface of thin sheet metal with four fins (13.3 ft. length) attached to rear section. Consists of warhead at front, followed by: control section, fuel tank, tank for liquid oxygen, section containing turbo-pumps, hydrogen peroxide tank, calcium permanganate tank, and at rear, main burner system and venturi with heavy carbon steering vanes.

Warhead detonated on impact by electrical fuzing system incorporating nose fuze with 2 trembler fuzes at right angles to one another, and point switch of simple crush type glass enclosed. Base fuze also has 2 trembler fuzes at right angles. Three wires lead from fuze to control box in warhead.

During flight held on course by azimuth gyro. Range controlled by shutting off of fuel by integrating accelerometer, which also renders radio interference impossible.

Range (miles)	190
Speed (ft/sec)	5000
Length	46.7 ft.
Dia.	5.4 ft.
Total wt.	13.5 tons
Wt. of warhead	1900 - 2000 lbs.
Wt. of fuel	9.6 tons

WARHEAD

Length, incl. fuze	7.4 ft.
Dia.	3 ft.
Wt. of casing	350 lbs.
Volume	15.5 cu. ft.

FUEL TANK

Length	34."
Dia.	20"
Contents	Hydrogen Peroxide

CONCLUSIONS: There is as yet no information to bear out these OSS reports and it seem unlikely that this weapon would have nearly as much strategic appeal to the Japanese as it did in Europe where concentrated targets eliminated the problem of accuracy.

APPROXIMATE DATE OF PRODUCTION: Production unlikely.

6. ROCKETS

ITEM: NEBELWERFER 15 cm

INTELLIGENCE: Reliable PW states that this rocket launcher and ammunition were shipped to Japan. Date unknown. Photographic interpretation reveals two unusual devices on deck of CV Hayataka which appear to conform to shape of the "Nebelwerfer." A PW from this ship interrogated in mid 1944 states that "tiers of rockets were mounted." Another PW suggests an adaptation of this weapon on CV ZUIHAKU. Other information A-2.

IDENTIFICATION: This 15cm Nebelwerfer, is a six-barreled, breech-loading weapon firing gas, smoke and high-explosive projectiles. The four foot barrels are not rifled, but have within them three straight guide rails above 1/3 inch deep. The projectile rotates in flight, however, due to the set of the gas jets. There is no breech mechanism, but each barrel has a kind of spring operated latch to retain the ammunition in position after loading.

The rocket type projectiles are fired electrically by remote control at the rate of one ripple of six rounds in 90 seconds. They are always discharged from the projector in the following order: 1, 4, 6, 2, 3, 5. This is a fixed firing order calculated to prevent the projector from being overturned by blast.

The carriage is two wheeled and has a split trail. Due to extremely great dispersion, targets of limited area are not engaged.

Caliber - 150 mm (5.9 ins.)
Lhgt. of barrels - 51 ins.
Rate of fire - 6 rds. per 90 secs,
Range: 45° - 7723 yds.
30° - 7018 yds.
6½° - 2710 yds.
Ammunition - HE Shell, Smoke shell, C. W. Shell
Weight - 1195 lbs.
Traverse - 30°
Elevation - 44°
Velocity - 1120 f/s

CONCLUSIONS: Japanese use of rockets has been observed on a rapidly expanding scale. Ease of manufacture, effectiveness and minimal amount of metal employed are obvious factors.

APPROXIMATE DATE OF PRODUCTION: Use of the Nebelwerfer as such has not been conclusively ascertained but its imminent appearance is expected

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ITEM: NEBELWERFER 21 Cm

INTELLIGENCE: Reliable source; Evaluation A-2 - full details made available.

6. ROCKETS

IDENTIFICATION: Length of launching tube - 130 cm
No. of launching tubes - 5 (arranged circularly)
Wt. in kgs. - 1100 fully loaded
Range: Minimum - 500 km
Maximum - 7850 km
Rate of Fire: 5 rounds in 5 sec.
2 volleys in 5 minutes
Truck or tractor drawn

CONCLUSIONS: See 15 cm Nebelwerfer

- -

ITEM: NEBELWERFER 28 cm

INTELLIGENCE: Reliable source; Evaluation A-2 - full details made available.

IDENTIFICATION: Actual caliber 32 cm which can be reduced to 28 cm by inserting tube liner.
6 tubes in banks of three
Wt. - 1600 kgs.
Range: Minimum - 750 km
Maximum - 1925-2200 km
Rate of Fire: 6 rounds in 10 sec.
2 volleys in 5 min.

CONCLUSIONS: See 15 cm Nebelwerfer

- -

ITEM: NEBELWERFER 30 cm

INTELLIGENCE: Reliable source; Evaluation A-2 - full details made available.

IDENTIFICATION: Cal. 30.6 cm
6 tubes in banks of three
Wt. - 1860 kgs.
Minimum Range - 700 km
Maximum Range - 4550 km
Rate of Fire - 6 rounds in 10 sec.
2 volleys in 5 min.

CONCLUSIONS: See 15 cm Nebelwerfer

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ITEM: 8" ROCKET

INTELLIGENCE: This spin-stabilized rocket is apparently copied from the German 21 cm rocket and closely resembles German practice with exception of explosive head.

A letter dated 27 July 1943 from the German Branch of Mitsubishi, to the [illegible] Department mentions delivery of a 21 cm gun.

6. ROCKETS

IDENTIFICATION: Resembles certain German rockets with exception of explosive head which appears to be an 8" projectile cut off just forward of the rotating band and threaded internally to take a base plate. A motor body is located on after end. Maroon paint indicates that it is a Naval weapon. The presence of bourrelets fore and aft on the motor body indicates that the projectile is launched from some type of tube rather than open trough. Propelled by gas escaping from 6 orifices in the base plate of motor. These orifices, drilled at an angle of 65° to longitudinal axis of rocket, causing projectile to rotate in flight and adding somewhat to range and accuracy. Nose is (r/h) threaded for standard Navy fuses.

Lght. Overall - 43"
Dia. - 8"
Wall thickness projectile - 7/16"
Wall thickness rocket motor - 7/16"
dia. igniter opening - 1"
dia. gas orifice - 19/32"
wt. rocket less propellant - 195 lbs.
Propellant(Nitroglycerine - 32.1%
(Nitrocellulose - 65.4%
(Stabilizer - 2.5%
wt. projectile with base plate - 120 lbs.
wt. motor less propellant - 75 lbs.
wt. HE charge - 40 lbs.
Explosive filler - Trinitroanisole (melting point 69°C)
Lgth. of motor - 18½ ins.
Fuse - Special super quick point detonating

CONCLUSIONS: Production of rail launched rockets poses few of the technical and supply problems involved in the manufacture of heavy ordnance.

APPROXIMATE DATE OF PRODUCTION: Now in operation.

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ITEM: PANZERBLITZ

INTELLIGENCE: Actual specimens were received in Japan prior to March 1945. (A-2)

IDENTIFICATION: Consists of 6 rockets, held in framework of six metal rails, which is familiarly called the "Gartenzaun" (garden fence). Framework is held by four belts secured to the structure of the wing, and cannot be jettisoned. R. P. are loaded into the frame by inserting them into the rail channals from the front. Projectiles are hollow charge type, of a diameter slightly less than 8 cm., and can be fired in salvoes of three, six, nine, or 12. Each projectile has two wires let into the rear of the projectile through a wax plug. After the rocket is inserted into its rail, the free ends of the wires are connected to two terminals on the Gartenzaun itself, from which electrical connections run to the ordinary bomb release in the aircraft. Shortly before firing the rockets, the pilot switches on main switch on control panel in the cockpit. 4 dash lamps then light up, under each of which is a button representing a salvo of three rockets. When one of these buttons is [illegible] three R.P.'s are

pre-selected and the appropriate lamp goes out. They are fired by pressing the bomb-release in the usual way, then ignition takes place and the rocket discharges along the rail of the Gartenzaun.

Aiming is done in the normal way by means of the revi sight, but the latter is pre-set to compensate for the 2° inclination of the Gartenzaun.

Range - 6 km. (theoretical) not more than 500 meters to obtain any accuracy at all (P/W).

Charge - 6 sticks of cordite fitted with impact fuze in the nose, which is primed by withdrawing a pin after rocket has been loaded into frame. Once the pin is out, an impact equal to 5 kg. is necessary to explode the rocket.

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ITEM: 88 mm. PANZERBUSCHE (R.Pz.B), "PANZERSCHRECK", or "OFENROHR"

INTELLIGENCE: Reliably reported to have been delivered to the Japanese in July 1944 (A-2)

IDENTIFICATION: Recoilless rocket launcher similar to U.S. "Bazooka" but larger. Consists of steel tube with fore and back sights. Used against all, even heaviest, armor. Not considered effective against unarmored vehicles. Model R.Pz.B.43 improved in in models R.Pz.B.54 and R.Pz.B54/1, which are equipped with shields to protect firer against flying powder parts. Fired by electrical induction.

Characteristics of PANZERBUSCHE 43 (R.Pz.B43)

Caliber:	88 mm (3.5")
Weight of tube:	20-1/2 lbs.
Overall length of tube:	5'3"
Overall length of weapon:	5'4-1/2"
Inside diameter:	3.58"
M.V.:	345 f.s.
Range:	164 yds. (approx.)
Penetration (claimed in captured documents):	6.3"
Projectile:	Called R.Pz.B.Gr.4322
	Hollow charge - cyclonite/TNT (60/40)
	Fin stabilized
	Fuze A.Z. 5095
	Gaine Kl. Zdlg. 34. Np.
	Electric fuze and igniter
	Overall length - 25-1/2"
	Weight - 7 lb. 4 oz.
	Max. diameter - 3.5"
	Painted deep olive green

Characteristics of PANZERBUSCHE 54 (R.Pz.B54)

Caliber:	88 mm. (3.5")
Overa	-1/2"

6. ROCKETS

External diameter:	3.7"
Weight:	20-1/2 lbs.
Maximum range:	160 yds. (approx.)
Projectile:	(reported same as for R.Pz.B.43)

Characteristics of PANZERBUSHCE 54/1 (R.Pz.B 54/1)

Caliber:	88 mm (3.5")
Length:	4'6-1/2"
Weight:	18 lbs. (approx.)
Range:	200 m.
	Good performance claimed:
	200 m. (220 yds) at + 25°c
	150 m. (165 yds) at 0°c.
	100 m. (110 yds) at -25°c
Projectile:	New model called R.Pz.B.Gr.4999; could be fired from both old and new style launcher: for firing at temperatures - 25° to plus 25°c, liable to explode in launcher if fired at temperature above 25°c. Not to be left in sunlight.

New sights introduced about December 1944; to be fixed to old pattern launcher for newer ammo. New pieces - foresight slide, backsight with slots for aiming off.

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ITEM: PANZERSCHRECK

INTELLIGENCE: Actual specimens were received in Japan prior to March 1945 (A-2)

IDENTIFICATION: An important application of rocket projectiles adapted to aircraft use; designed for operation against armor with equal ability to penetrate 12 cm of panzer steel.

Panzerschreck consists of three 8.8 cm R.P.'s of the German "Ofenrohr" variety held in framework of three semi-cylindrical containers, the whole apparatus fitting into the ordinary E.T.C. bomb rack under each wing of a FW-190.

7

7. SUBMARINES

ITEM: MIDGET SUBMARINES

INTELLIGENCE: Reliable information reveals extensive Japanese knowledge of German midget submarine types. (Evaluation A-2). It is known that details of Marder were in their hands as early as 1941; further details were made available to them in July 1944, and it is reported that they visited the manufacturer's plant in October 1944; Molch by February 1945, Seehund by December 1944. Japanese construction now shaping in this direction suggests the advisability of a review of these German types.

IDENTIFICATION: MARDER (Marten) (Human Torpedo)

Used for attacking ship concentrations; fired at 300-500 meters. Made from 2 - 21" torpedoes clamped one over the other. The upper or control torpedo is built in 3 sections; a practice warhead, battery compartment, and buoyancy chamber (10 min. fuze delay in buoyancy chamber). The lower line torpedo is normal T-3.

These are usually launched from 2 wheel trailer carriage directly into surf, however, they have been lowered from a mothership.

A vertical rod fixed to bow is used for torpedo sighting.

Lgth - 25' - 2" oa.
Dia. - 21" each
Disp. - 5 tons

* A committee of Japanese visited the Deutsches Werke near Kiel in October 1944 to obtain information on "Marder".

Water line .....about 1 inch below bottom of dome.
Designed collapse depth.....55 meters
Maximum operational depth.....30 meters
Speed on surface, with torpedo.3 - 3½ knots.
Speed on surface, without " 5 knots
Speed submerged.....approximately 2 knots
Estimated endurance at 3 knots.20-24 hours

Note: The earlier models of "MARDER" were not able to dive. They could only porpose by forcing the device down with the stern planes for a very short time.

To convert a G7E into a "MARDER", the explosive charge and all the torpedo control equipment is removed. The batteries are connected in parallel to give 8 volts. By removing every second brush holder and operating it on 8 volts, the standard G7E motor (rated at 72Kw. at 110 volts and 1700 rpm) is reduced to about 2 Kw. at 600 to 900 rpm.

A 100 Liter diving tank is fitted into the bow forward of the cockpit, the flood valve for which is located on the bottom center line. Two flasks are inserted aft of the batteries, one containing compressed air for blowing and the other containing a mixture of 2/3 oxygen and 1/3 air. A relief valve is built into the hull on the starboard side just aft of the cockpit. It relieves outboard whenever the [illegible] external by more than 0.1 atmospheres.

A cockpit, containing controls and instruments is fitted just forward of the batteries. It is covered with a pressure tight transparant dome. In addition to the firing lever, the joy stick control lever and the main propulsion power switch lever, the cockpit equipment includes the following:

A depth gage graduated in meters.
An inside pressure gage graduated in tenths of atmospheres.
A needle valve for blowing the diving tank.
A reducing valve for the oxygen-air mixture.
A vent valve for venting the diving tank.
An injector nozzle for the oxygen-air mixture which sucks the free air from the compartment and forces it through the lime cartridge to remove the carbon dioxide.
A valve to blow water out of the pressure hull (in case leakage occurs). There is a branch from this blow line which automatically equalizes any pressure built up in the cockpit through a plug in the bottom of the hull..
A pressure gage for the oxygen-air flask.
A gage to indicate the quantity of oxygen-air mixture being bled into the cockpit. Seven-tenths of a Liter per minute was considered adequate for the one-man crew.
A gage for registering the pressure in the air flask.

Release of the torpedo is accomplished by throwing the firing lever which pulls the stop bolt in the after guide slot and simultaneously permits a spring to actuate the torpedo starting lever.

Each individual assembly, including the pilot is ballasted in a test tank. Cast iron ballast is fitted as necessary to the tail and in a compartment at the extreme bow. It has been necessary to remove part of the battery of the torpedo itself to reduce the weight, which reduces the torpedo running speed somewhat.

Before leaving the factory, the current pulled by the motor of the "LARDER", when running in air, is adjusted to 100 amperes by adjusting the brushes. Individual settings are required because of differences in tail shaft stuffing box drag. (The packing in the stuffing box is a coal tar derivative and was stated to be very successful).

Two projected modifications of the "LARDER" were uncovered. The first, called the "HAI", consisted of lengthening the body to permit additional batteries and presumable higher speed or greater endurance. In this case it was necessary to fit bow planes to control the "HAI" submerged. The second project involved modifying the "LARDER" to carry a "schwimmer" with limpet mines near his destination. The "schwimmer" was then to leave the cockpit, swim to the ship being attacked, and return to the "LARDER", the position of the latter being marked in the meantime by a buoy.

BIBER (Beaver)

[illegible] submarine, built with 3 hull compartments and conning tower. [illegible] area by R-boats, trailers or tugs. 2 elec.

torpedoes are hung in hull slots. (2 MAD mines may be carried in place of torpedoes.)

Lgth: 29'6"
Beam: 4'9"
Disp: 6.7 tons
Range: 5000 yds.
Speed: Surface - 6-8 knots (max)
4-5½ (cruising)
Submerged - 2-3 knots (Max. load)
506 (light load)
Diving: 60' depth (operational)
80' depth (max.)
Endurance: Surface 60-70
Submerged 4½-5½ miles
Propulsion: Gasoline engine, 6 cyl., 55 hp
Fuel: 26 gals gasoline
Sight: Ring and cross wire and nose head for torpedo aiming.
Oxygen: 30-36 hr. supply

MOLCH (Salamander)

Short-range, 1-man, used for sneak attacks. Considered suicide craft by crews, due to limited range and difficult handling.

This is an improved Biber, but heavier and larger. The two torpedoes are slung externally, but not fitted in troughs. It is fitted with periscope.

Lgth: 35'
Beam: 7'6"
Dia: 3'8"
Disp: 10-12 tons
Speed: 6-7 knots (max.) 3-4 knots (half) submerged and surfaced.
Diving: 80' depth
Endurance: 36 hrs.
Propulsion: 1 elec. motor.
Scuttling: 6-15 min. fuze delayed charge
Torpedo: 2 elec.
Firing range: 500-600. No angling gear.
Oxygen: 8-10 hr. supply.

HECHT (Pike)

Short-range, 2-man, used for sneak attacks. Fitted with gyro compass; single 30" propeller; non-retractable periscope.

Speed: 45 knots surfaced
Endurance: 25-30 miles
submerged ½-1 hr. @ 5 kn
24 hrs. @ 3.7 knots

7. SUBMARINES

Propulsion: Elec. motors
Torpedoes: 1 21" elec. slung under keel

SEEHUND (Seal) Type 127

Short-range, 2-man used for convoy attack. This is not considered expendable. It is launched into surf from specially built trailer, and is unmanageable over 6 knots. Fitted with periscope; hydrophones; inter. comm. microphones for crew; also gyro steering device.

Lgth: 39'
Dia: 5'3"
Height: 7'10"
Disp: 16 tons
Speed: Surface: 10 knots (max.)
6-8 knots (cruising)
Submerged: 4-5 knots
Diving: 100' (normal cruising depth)
Endurance: Surfaced 30-35 hrs. - 300 miles
Submerged 50 miles, 20-25 hrs.
Propulsion: 1 Diesel engine, 6 cyl., 4 stroke,
60 hp, 1200 rpm.
Fuel: 110 gals.
Fuel consumption: 15 liters per hr.
Oxygen: 30-70 hr. supply
Torpedoes: 2, 21" elec. G7E or 2 LAD mines.
Firing Range: 500 meters.

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ITEM: Ingolene U-Boats

INTELLIGENCE: Principles of the Ingolene closed cycle engine and details of at least the Type XXVI Ingolene U-Boat are reliably reported to have been in Japanese hands in February 1945 (A-2). Correspondence covering negotiations with representative of the Japanese Navy in Berlin recovered in Augsburg, Germany (Chemische Fabrik Gersthofen V. Transehe) involve general subject of jet fuels. These documents dated 1944/1945, are arranged in the following groups:

1. Corrosion problems connected with use of "T" and "C" stuff.
2. Ten pages of production data on "B" and "C" stuff.
3. HZ-3 License agreements and correspondence on "B" and "T" stuff.
4. Properties and production of "B" and "C" stuff.

Dr. Raschig, head of Chemischefabrik, Ludwigshafen, states that quantities of Hydrogine Hydrate, $N_2H_4 \cdot H_2O$ were shipped to Japan.

Other information of unknown reliability indicates that planes for an Ingolene submarine were in Japan before October 1944.

IDENTIFICATION: In view of intense Japanese interest in this entire field, it is desirable to review the German state of the art as of V-E day.

Types of Ingolene U-boats - The first experimental U-boat, the V-80, was of about 80-tons. Apparently, the tests were promising as other U-boats followed. The V-80 came to an unexpected end when she sank due to careless seamanship of the crew. The loss was not due to any fault of the Walter propulsion unit.

There were four WA-WK-series U-boats built which were for experimentation and schooling. They were of about 360 tons.

The V-300 was designed but never built. It was to have been of 400 tons with two 300 h.p. diesels and two 2,000 h.p. turbines. This was abandoned at Dr. Walter's suggestion in favor of other types as one of its disadvantages was a very short range.

Type XVII was designed as a small U-boat for use in coastal waters and was expected to be an improvement over the WA-WK type. Four boats of Type XVII are supposed to have become operational on 5 May 1945.

Type XVIII was designed with Walter propulsion in a large U-boat of 1600-1800 tons. Never built as the shortage of Ingolene forced the German Navy to replace this type with Type XXI.

Type XXVI. This was the latest Walter design and it was a boat of 830 tons. It was intended for Atlantic use. Construction had commenced but none were completed.

Performance. All these Walter boats gave good performance in tests. All could do better than 20 knots submerged even with only one turbine. Surfaced speed was less, about 9-12 knots. The shape of the U-boat is a radical departure from old designs, and is most successful. The boat is a development of the conception that Dr. Walter had from the beginning, that a U-boat should be designed for continuous submergence. During the early part of the war (1942) it looked to the German Navy as if the surfaced U-boat could hold its own. This mistake was fortunate for the Allies as Dr. Walter's boats would have been further along otherwise. (Dr. Walter claims that it was through his persuasion that the Schnorchel was adopted.)

The Walter-boat gives a track for a few hundred meters when it submerges but this is not considered serious.

Substances Involved in Combustion - (a) Ingolene and its Stabilizers - It was thought desirable to eliminate the stabilizer in the Ingolene (See Chemical Processes) in the U-boat unit as it affected the catalyst as was the case in the torpedo. In U-boats a solid catalyst is used but the stabilizer affects the surface of the stone (cement or porcelain) in which the catalyst is embedded.

(b) The Catalyst - Essentially the catalyst is the same in both U-boats and torpedoes, namely Hellmann which is hydrazine hydrate. In the torpedo the catalyst is used as a liquid while in the U-boat it is in a solid form. It may be embedded in I.G. stone (cement or porcelain) or it may be in pill form. The pills are in the shape of cylinders about 1 cm. high and they may be either hollow or solid. Dr. Walter preferred the hollow pills though they are broken up sometimes.

The stone catalyst unit weighs about 30 - 40 kilograms and was said to be adequate for two patrols. Something like 15- 30 tons of Ingolene could be passed through a decomposition chamber in an hour if that were necessary.

(c) The Fuel - Decalene - Used the synthetic fuel generally available which had to be wax free and sulphur free to prevent deposition in the tubes. Gas oil was found to be particularly good as it lights easily, while petrol was considered to be the worst. It is desirable that the fuel be able to ignite without a spark, though actually electrical ignition is used for 10 - 20 seconds and then turned off. After 3- 5 minutes of warming up the combustion would start without a spark and this method would have been adopted were it not for the rather long time involved.

(d) Water - The U-boat system employs sea water presumably in approximately the same ration to Ingolene and decalene as with the sea-water torpedo.

Containers and Working Parts, Capacities and Materials Used in Fabrication - The turbine in the U-boat has the advantage of less stringent space requirements. As a result a decomposition chamber is used. The decomposition of the Ingolene prior to its introduction in the combustion pot gives greater safety. (In the torpedo the introduction of Ingolene directly into the combustion pot is a calculated risk based upon lack of space). The products from the decomposition chamber are introduced into the combustion pot where they are ignited.

(a) Decomposition Chamber - The decomposition chamber is about 500 mm. wide by about 350-400 mm. high. The stone or pill-form catalyst is at the bottom of the decomposition chamber. This chamber is large enough for the 8,000 h.p. turbine. Six or seven sprayers introduce the Ingolene into the decomposition chamber. The Ingolene droplets should be as small as possible.

(b) Combustion Chamber. There are six burners in the combustion chambers of turbines of all horse powers. The chamber can stand 100 atmospheres pressure and the inlet pressure is from 20-25 atmospheres. The temperature at the inlet is about 550°C; once in some experiments it was allowed to rise to 700°C by mistake.

(c) Ingolene Storage. - In the U-boat the Ingolene is stored in polyvinyl-chloride bags. There are 12 to 18 of the bags which are outside the pressure hull and generally self-compensating because of the flexibility of this synthetic rubber-like material. Ingolene kept in these bags is expected to be good for at least 3 months. Fumes in the container escape through a low-pressure, non-return valve. The containers are divided into groups of 3 or 4 bags and salinity is measured continuously so if the salt content increases due to a leak the appropriate group of containers is shut off. During a change in pressure due to normal diving there does not seem to be any great emission of bubbles through the exhaust valve of the container.

General Combustion Cycle - The principles are the same for the U-boat turbine as for the torpedo. The same fuels are used and apparently about the same efficiencies are obtained. The overall efficiency of a full cycle is about 14-15% and with a compressor 18%. The efficiency of combustion may be as high as 97%. When compression is used a half atmosphere of back pressure is developed and can be maintained down to 20 meters. This is a 4 to 1 compression and is not always used. Without compression the outlet pressure is the same as the sea water pressure.

Professor Roeder designed the reaction turbine which was not necessarily better than the action (impulse) turbine. Which sort of turbine was installed depended on which ship-yard built the U-boat. The other turbine was designed by Professor Kramer.

Performance of the U-Boats During Trials - After it became clear that the Ingolene turbine for U-boats would be practical the experiments as to a better shape for the U-boat commenced. Models were made and their Reynold's numbers obtained in a wind tunnel. After the shapes had been established by the results of the tests in the large Brunswick wind tunnel they were checked in the water tank at Hamburg. A Mr. Foschen was responsible for the tests. Lately all experiments had to be done in the Hamburg tank as the Brunswick wind tunnel was too busy... Dr. Walter claims that the designs were done by his establishment though he did discuss them with Kaempf and Loeber. Presumably these included designs for the Type XXI and Type XXIII which were originally supposed to have Ingolene propulsion but were outfitted with extra batteries instead because other services had a higher priority on the available Ingolene.

(a) Noise of the Ingolene U-Boat - It was obvious that any U-boat traveling faster than 10 knots submerged would make considerable noise. It was decided that the U-boat must be designed to go very fast and accept the disadvantage of the noise. Actually the noise turned out to be greater than that with creeping motors but it was considerably less than expected.

The main source of noise was the propellers. Perhaps Blohm and Voss and certainly Germania design and make their own propellers and these are used on the "Walter-boats."

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ITEM: SUBMARINES - RO-500

INTELLIGENCE: Transfer verified in official Japanese Navy announcement 16 September 1944 taken on Saipan.

Correspondence between the "Deschimag" (Deutsche Schiff and Maschinenbau, A.G.) and the Japanese dated 1944 (recovered in Bremen) indicates that a license agreement for the construction of U-Boat, Type IXC in Japan was made. Director Hermann, recently brought from Berlin to speed up production at Deschimag, Bremen and Director Vogel who dealt specifically with underwater craft state that "Deschimag" had delivered two U-Boats to Japan in July and August 1943. One of these was Type IXB: the other was Type IXC. The drawings for this latter type submarine were made available to

the Japanese at the same time. Each of these submarines was manned by mixed German and Japanese crews, but had German commanders.

IDENTIFICATION:

Dimensions:
Disp. 900 tons (stand)(est)
740 tons (announced)
Length: 244'0" (oa)
Beam: 21'0" (oa)
Draft: 1383" (mean)
Depth: 875'0" (tested)

Armament:

No.	Cal.	Mark	Elev.
1	105mm		300
1	20mm (single mounts)		850
1	37mm		
4	21"T.T. (H) (bow); 2-21" (stern) 15-23 - 21" torpedoes carried in hull and deck containers.		

Propulsion:	Speed	H.P.	R.P.M.	
Des.	20	4400	480	
Full	19		460	Crash Dive: 35.41 Sec.
Max.Sust.	17.5		415	Drive: Diesel/Elec.
Full Submer.	8	1500	210	Screws: 2
				Fuel: 240-300 tons oil

Batteries of this Class: 33 HAL 800 - AFA

Diesel engines - MAN/Angsburg
Elec. motor - AEG/Berlin
Elec. Switchboard - Siemens - Schuckert/Berlin

CONCLUSIONS: No production along lines of the four transferred units of this class was ever undertaken. Present Japanese construction policy appears to favor either small submarines or large ones. The distinctly "middle class" 750-ton group is not building.

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ITEM: SUBMARINES -- RO-501

INTELLIGENCE: U501 transferred September 1943. Built by Deutsche Werft, Hamburg. Captured Jap documents indicate that vessel was renamed RO-501.

IDENTIFICATION: 750 ton IX-C

Dimensions:
Disp. 900 tons (stand) (est)*
740 tons (announced)
Length: 244'0" (oa)
Beam: 21'0" (oa)
Draft: 13'3" (mean)
Depth: 875'0" (tested)

* Interrogation of Deutsche Werke director reveals standard tonnage to be closed to 1200 tons than 900.

Armament:

No.	Cal.	Mark	Elev.
1	105mm		300
1	20mm (single mounts)		850
1	37mm		
4	21" T.T. (H) (bow); 2-21" (stern) 15-23 - 21" torpedoes carried in hull and deck containers.		

7. SUBMARINES

Propulsion:	Speed	H.P.	R.P.M.	
Des.	20	4400	480	
Full	19		460	Crash Dive: 35.41 Sec.
Max.Sust.	17.5		415	Drive: Diesel/Elec.
Full Submer.	8	1500	210	Screws: 2
				Fuel: 240-300 tons oil

CONCLUSION: No production along lines of the four transferred units of this class was ever undertaken. This unit now sunk.

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ITEM: SUBMARINES -- RO-502

INTELLIGENCE: Believed to be sister of U-511 (RO-501). Transfer unverified.

IDENTIFICATION:

Dimensions:
Disp. 900 tons (stand)(est)
740 tons (announced)
Length: 244'0" (oa)
Beam: 21'0" (oa)
Draft: 13'3" (mean)
Depth: 875'0" (tested)

Armament:

No.	Cal.	Mark	Elev.
1	105mm		300
1	20mm		850
	(single mounts)		
1	37mm		
4	21" T.T. (H) (bow); 2-21" (stern) 15-23 - 21" torpedoes carried in hull and deck containers.		

Propulsion:	Speed	H.P.	R.P.M.	
Des.	20	4400	480	Crash Dive: 35.41 Sec.
Full	19		460	Drive: Diesel/Elec.
Max.Sust.	17.5		415	Screws: 2
Full Submer.	8	1500	210	Fuel: 240-300 tons oil

CONCLUSIONS: No production along lines of the four transferred units of this class was ever undertaken.

- -

ITEM: SUBMARINES -- RO-503

INTELLIGENCE: U-1224, 750 ton IX-C, built at Deutsche Werft, Hamburg. (A-2) Believed to have reached Japan during summer of 1944. (B-2) Designated RO-503.

IDENTIFICATION:

Dimensions:
Disp. 900 tons (stand)(est)
740 tons (announced)
Length: 244'0" (oa)
Beam: 21'0" (oa)

Armament:

No.	Cal.	Mark	Elev.
1	105mm		300
1	20mm		850
	(si[illegible]		

Dimensions:
Draft: 13'3" (mean)
Depth: 875'0" (tested)

Armament:

No.	Cal.	Mark	Elev.
1	37mm		
4	21" T.T. (H) (bow); 2-21" (stern) 15-23 - 21" torpedoes carried in hull and deck containers.		

Propulsion:

	Speed	H.P.	R.P.M.
Des.	20	4400	480
Full	19		460
Max.Sust.	17.5		415
Full. Submer.	8		210

Crash Dive: 35.41 Sec.
Drive: Diesel/Elec.
Screws: 2
Fuel: 240-300 tons oil

CONCLUSIONS: No production along lines of the four transferred units of this class was ever undertaken.

- -

ITEM: SUBMARINES -- 1200 TON U-BOAT

INTELLIGENCE: Four of this type * have recently been operating in the Indian Ocean, probably out of Penang. There is yet no reason to believe that these have not raised Japanese flags since the German surrender. (A-2).

U-193, U-181, U-847, U-183* (Sunk).

Warrant Officer survivor from U-183 states in 24 May dispatch that 2 U-boats were at Singapore, 1 at Batavia in April. Reliability rated "fair."

IDENTIFICATION: The Type IX D2, operational submarine was used for distant operations, especially in the South Atlantic and Cape of Good Hope areas, and in the Indian Ocean. Known as "U-Kreuzer" (U-Boat Cruisers).

Dimensions:
Disp: 1200 tons
Lgth: 290 ft.
Beam: 20 ft.
Draft: 16 ft.

Armament:

No.	Cal.	Mark	Elev.
1	105mm		
1	37mm		
1	20mm		
*1	105mm		
*1	20mm (Quad)		
*2	20mm		

*Anti-aircraft modification
Torpedoes: 27
Fuel: 550 m3 (475 tons)
Torpedo tubes: 4 bow, 2 stern

H.P.
Endurance: 25000 mls. at 10 knots
Complement: 55-60

[illegible] under Japanese colors.

ITEM: SUBMARINES -- TYPE XXI

INTELLIGENCE: Reliable information indicates transfer of a Type XXI from Hamburg in early 1944 (A-2).

IDENTIFICATION: This is a prefabricated ocean going U-boat, with high submerged speed. A modification of Type IX-C. Improvements are increased diving speed, added protection from surface and air attack. Two periscopes.

Dimensions:
Disp: 1600 tons
Lgth: 250 ft.
Beam: 20 ft.
Beam deck: 13 ft.
Draught Light: 5 m forward and 8m aft
Depth: 450m (theoretical)

Armament:
Twin 30mm forward, and
Twin 30mm aft.
Torpedoes: 30

Propulsion:
2 six cylinder G.W. Diesels
2 auxiliary Diesels for charging
2 motors, each of 2500 hp.
2 VII C Type (i.e., 450hp) motors for maneuvering in harbor.

Speed:
Surfaced, in the region of 20 knots, Submerged, in the region of 15/16 knots. Diesels surfaced; electric motors submerged.

CONCLUSIONS: Prefabrication at remote points of manufacture will inevitably become Japan's only method of putting new submarine constructions into the water. With the destruction of her regular shipbuilding facilities, Japan as Germany, will probably attempt no more than an assembling of prefabricated submarine parts in her yards and bases.

APPROXIMATE DATE OF PRODUCTION: It is possible that production has already begun. Three submarines, I-351, I-352, I-353, recently launched, have characteristics which strongly suggest the Type XXI.

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ITEM: SUBMARINES - TYPE XXIII

INTELLIGENCE: Reliable information places acquisition of drawings by the Japanese circa January 1945. (Eval. A-2.)

IDENTIFICATION: This is a prefabricated coastal type, based on early 250 ton (Type II). It is fitted with quick-diving, heavy armor features of the larger type XXI. Fitted with hydrophones; single periscope; GSR on top of Schnorkel; also W/T transmitter.

The following description, although taken from a P/W account, is considered reliable, and is quoted by virtue of operational data contained.

Fuel Capacity: Rather over 20 cu.m. 1.9 cu.m. only were used on U-2326's first patrol which lasted 8-9 days.

7. SUBMARINES

Range:	5,800 miles surfaced on diesel at about 5 knots. I s/m claimed that travelling at about 3 knots on silent-running motor and schnorkeling only sufficiently to top-up battery, at least 10,000 miles is possible.
Silent Running Motor:	50 H.P. resiliently-mounted motor with rubber belt-drive allows silent running up to 4.8 knots.
Main Motor:	Gives speed up to 13 knots; 1300 amps.
Diving:	Test diving depth is 100 m., but said to allow safety margin of 250%. Best diving times: (i) From surface to 20 m.; 12-13 seconds. (ii) From surface to 60 m.; 42 seconds.
Bottoming:	Boat bottoms easily. When bottomed it is usual to flood two tons extra; to come off the bottom this is pumped out with main control room bilge pump. Time taken to rise from the bottom to periscope depth in 60 m. water is 6-7 minutes.
Hydroplanes:	Hand-controlled only.
Schnorkeling:	The schnorkel head can dip for 2 minutes with diesel at half load; pressure drops to about 300 millibars in the boat. Best schnorkel depth giving suitable camouflage is usually 10.3 m. Maximum charging rate while schnorkeling with the boat proceeding on silent-running motor is 290 volts; 1240 amperes.
Batteries:	Two 62-cell batteries; full capacity 5,800 amp/hrs.
Torpedo firing:	No torpedo computer. The C.O.'s method was to use twice enemy speed for deflection at inclination 90°, twice enemy speed minus 2 knots for deflection at inclination 70°. Periscope range estimation is very crude. The C.O. did not approve submerged hydrophone-aimed shots, owing to range estimation difficulties. Torpedoes are T3A Eat with 30 knot setting. Gyro angle, depth setting and pre-set run are applied at tubes. Normal Type VII C steel torpedo tubes. Torpedo can be withdrawn about one third of its length into the boat for maintenance. Loading from forward essential. Not fitted for Lut T5, or for Falter torpedoes, which were not yet available.
Radar:	None fitted.
G.S.R.	Fliege-Mücke-Tunis combination for surfaced reception. Only the drum-shaped aerial for submerged work.

Hydrophones: Balkon hydrophones with 22 microphones. Range from 1,000-20,000 yards, according to water conditions. Reception entirely satisfactory when bottomed.

S.B.T. Fitted, but not used in U 2326.

Fresh Water: No distiller fitted, but fresh water tank holds 460 litres.

Ship's Company: 15:-
Commanding Officer
1st Lieutenant
Engineer Officer
C.P.O. (Nav).
C.E.R.A.
E.R.A. (E)
E.R.A. (Diesel and Control room combined)
Leading Seaman
Leading Telegraphist
1 W/T Operator
1 Torpedoman (Mechaniker VII T)
1 Stoker (Control room)
1 Stoker (Diesels)
1 Stoker (E)
1 Able Seaman
(Note: A cook is included in the above, and many duplicate duties - e.g., the Leading Telegraphist stands engine-room watch.)

Numbers which have operated off the East Coast: The C.O. of U 2326 believed that only four type XXIII U-boats have operated off the East Coast of England.

ITEM: TYPE XXVI U-BOAT

INTELLIGENCE: Complete details are reliably reported to have been in Japanese possession by February 1945 (A-2).

IDENTIFICATION: Equipped with Walter closed cycle turbine: four units completed.

Length (o.a.)	56.2 m
Beam -	5.44 m
Draft -	5.95 m
Inner Hall-length -	39 m
Inner Hall-dram -	5.4 m
Disp,	852 tons
Hull capacity	1162 cu.m.

Speed and cruising range using Walter turbine -
22 knots cruising speed - 7 hrs.
19 knots cruising speed -10 hrs.
26 knots full submerged - hrs.
Low speed with these turbines -
12-15 knots.

Amount of fuel carried:

For diesel - 70 tons
For turbine
H_2O_2 - 97 tons
(Stored in 16 tanks installed outboard of hull)
Light oil - 10.5 tons
Lube oil - 3.25 tons
Complement - 33
Cruising Period - 60 days
Safe underwater depth - 135 meters

ITEM: SUBMARINES -- 1600 TON U-BOAT

INTELLIGENCE: The U-488, a 1600 Ton U-Boat was recently reported operating in the Indian Ocean, probably out of Penang. This vessel may have made for Japanese port after German surrender.

IDENTIFICATION: Functions of the Type XIV U-Boat were to supply operational U-Boats at sea with fuel, provisions, spare parts and occasionally torpedoes. She also carried a surgeon, delivered mail, and sometimes carried ratings for transfer to other U-Boats at sea. Her armament is purely defensive.

Dimensions:
Disp: 1600 tons
Lgth: 220 ft.
Beam: 26 ft.
Draft: 21'3"

Armament:

No.	Cal.	Mark	Elev.
2	37mm		
1	20mm		
*1	37mm		
*1	20mm		
*1	20mm	(Quad)	
*3	20mm		
*1	20mm	(Quad)	

*with A/A modification
Torpedoes: 4 carried in upper deck container.

Propulsion:
Speed: Max. surfaced, 13-14 knots
Max. submer. 6 k
H.P. - 2800
Endurance: 10,000 at 10 knots

Fuel: 727.5 m^3 (618 tons), of which 130 m^3 (110 tons) is for own use.

Complement: 60-65

ITEM: SUBMARINES -- 2500 TON

INTELLIGENCE: ComSoutheastArea [illegible] states that the Japanese placed an order [illegible]. (Eval. C-2.) (Date unknown)

IDENTIFICATION: [illegible] of Supply or Transport Submarines was begun in Japan in 1943.

7. SUBMARINES

Disp - 2800 tons - standard
Length - 360' - (o.a.)
Beam - 29'10"
Draft - 14'5" - surfaced
295' - Depth
Designed speed - 16 knots - Endurance - 8000 m. - H.P. 6000
Full speed - 19 knots
Full submerged - 7.5 knots - Endurance - 2000 m.

Cargo cap - 250 tons
560 tons - avgas
200 aerial torpedoes
Provisions for 200 men for 1 month..

Complement - 90 - 100

CONCLUSIONS: It is not known that the Japanese submarine described above, the new I-52 Class, is actually a German design. The materialization of I52 and I52 with no photographic evidence of their construction, in Japan suggests that these may have been built in Germany.

ITEM: SUBMARINES - TYPE VII-C U-BOATS (RO-100 - JAP DESIGNATION ?)

INTELLIGENCE: 1. CIOS reports detailed plans of the Type VII-C U-Boat were given to the Japanese (Eval. A-2).

2. Detailed plans for the VII-C, 500 ton U-Boat, were given to Japan in 1942. (Eval. F-0).

IDENTIFICATION: The new Japanese RO-100 Class coincides closely with characteristics of the German Type VII-C.

The RO-100 was built between 1942 and 1944. It may be single hulled. There is no data as to its complement. Asdic is installed with a frequency of 17.5 kilocycles, and its transmission has been reported to have been obtained by U-Boats at a range of 10 miles. The apparatus is made by the German Elac. Co. or Kure Naval Arsenal. It has either 2 or 3 electromagnetic oscillators (magneto striction) for transmission and reception.

Armament: 1 25 mm - Range 5.45 - reported to be twin mount.
4 21" T T (H) bow
8 21" torpedoes
4 reloads
Reported that some in class are equipped to lay mines, either through deck torpedo tubes or mine shafts.

Hull: Displacement - 500 tons.
Length - 180 ft.
Beam - 20 ft.
Depth - 246 ft. (safe maximum)

7. SUBMARINES

Propulsion:	Speed (knots)	Endurance
Designed -	14.2	
Max. Cust -	12	2,500 miles
Full Submg -	8	
Subm. at -	3.5	60 hours
Crash dive -	100 sec.	

CONCLUSIONS: If, as suspected, the RO-100 is the Japanese adaptation of VII-C, the class is now operational in Japanese coastal waters.

- -

ITEM: SCHNORCHEL

INTELLIGENCE: Reliable information establishes date of Japanese acquisition of full description as March 1944. (A-2) In September 1944, Rundipol (circular dipole antenna) for use on Schnorchel, was delivered to the Japanese.

IDENTIFICATION: Extensible air mast or ventilation trunk fitted on submarines. Has one inlet and one exhaust. Air is brought into the sub and engine exhaust is released through Schnorchel at below-surface depth (1.0-1.5 m).

Top of air inlet tube can be automatically closed in rough weather and air in engine room enables the engines to continue running.

Radar gear may be fitted at top of mast.

CONCLUSIONS: Significant German success with Schnorchel makes Japanese adaptation a logical conclusion.

APPROXIMATE DATE OF PRODUCTION: Imminent, if not already in use.

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ITEM: BUBBLELESS TORPEDO FIRING

INTELLIGENCE: Reliable source - evaluation A-2.

IDENTIFICATION: Data on plungerless, no bubble torpedo tubes installed in Types XXI and XXIII U-Boats was made available to the Japs.

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ITEM: FUELING BY SUBMERGED SUBMARINES

INTELLIGENCE: Details of this method were described to the Japanese (A-2). Date unknown.

8. SURFACE CRAFT

ITEM: DESTROYER, TYPE Z-51

INTELLIGENCE: Data on transfer of construction details of Type Z-51 transfer is completely reliable. A-2

IDENTIFICATION: L-108 meters
Beam - 11 meters
Height - 6.5 meters
Draft 3.98 meters
Displacement - Operational - 2314
Displacement - Fully Loaded - 2875
SHP - 37,100
Speed - 36 - 38.5 kts.
Fuel - 562 tons
Crew - 235
Oper. Capacity - 2 - 3 weeks
Armament - 4 - 12.7 cm AA
4 - multiple mount 3.7 cm.
3 - quad. mount 12 mm.
2 - triple mount torpedo tubes

The vessels have 6 V type V-12-Z M.A.N. Diesels with SHP of 10,000.

- -

ITEM: MTB

INTELLIGENCE: April 1941 - German technicians reported to be in Sasebo supervising the construction of 70 MTBs built from German S-Boat designs. Evaluation F-C. Other information from reliable P/W (B-2), states that plans and parts were shipped to Japan.

IDENTIFICATION: These motor torpedo boats are used for torpedo and mine laying operations, and are designed for offensive actions exclusively. Can operate in seas of up to Force 5 or 6. Each carries 4-6 large or 8-10 small mines.

Dimensions of the three main types, known as A, B, & C.

	A	B	C
Disp.	63 tons	86 tons	95 tons
Lgth.	92 ft.	106 ft.	106 ft.
Beam	13'6"	16 ft.	16 ft. 6"
Draft	5 ft.1"	7 ft.6"	5 ft. 6"
Engines	3 Diesels	3 Diesels	3 Diesels (auxiliary engines: (2 Diesels, 15 hp, (800-850 rpm, 4-stroke
Horsepower	2700	3600	6000
Speed: (Max.	33 Knots	34.5 Knots	38 Knots
(Cruising	30.5 Knots	30.5 Knots	[illegible]
Fuel capacity			[illegible] tons

8. SURFACE CRAFT

	A	B	C
Guns	1 20mm AA 1 13mm AA	1 37mm AA 1 20mm AA	2 20mm; twin and single MGs
Torpedos	4 21mm	4 21mm	4 21mm

- -

ITEM: MB 501 - ENGINE FOR MTB

INTELLIGENCE: High-ranking German naval officers reveal acquisition of this fuse by the Japanese. Other information fixes date of transfer of this Daimler-Benz engine as June 1943. (A-2)

IDENTIFICATION: This is a 4-stroke, 20 cylinder diesel engine. Cylinders are arranged in 2 rows of 10, set at a 36° angle. Engine is started by compressed air from two horizontally stowed bottles at 1350 lbs. per sq. in., reduced to 600 lbs. per sq. in. for starting the engine.

Weight	9480 lbs.
HP	2000 @ 1030 rpm 1800 @ 1570 rpm 1500 @ 1480 rpm
Speed	38 knots max.
Fuel Capacity	17.1 long tons
Fuel consumption	363 litres per hr @ 1480 rpm
Cylinder Bore	185 mm (7.28")
Stroke	250 mm (9.84")
Gearing	1.6:1 (?)
Superchargers	None

- -

ITEM: EXPLOSIVE BOATS

INTELLIGENCE: Japanese model is described as a development of the German prototype. Evaluation B-3.

IDENTIFICATION: This explosive motor boat resembles ordinary decked over motor boat; constructed entirely of plywood; fitted with guide lights fore and aft for night operations. Manned by 1 man who leaves the boat at convenient distance from target, after fuzing charge; control boat then takes over control of expl. boat.

On impact explosive boat fires small charge which sinks boat and starts time fuze which detonates main charge after delay of 2-4 sec. Expl. boat may be detonated by remote control if the pilot is killed before fuzing charge. If target is missed, the boat is blown up by chemical self-destructor after about 1½ hrs.

Cannot operate in sea greater than Force 4.

Length: 15 - 18'
Beam: 6'
Draft: 1'

Height: 3'
Propulsion: Ford V-8 engine and 1 propeller
Speed: Max. 27 - 30 Knots
Cruising 6-10 Knots
Range: 60 miles
Expl. chg.: 660 lbs.

CONCLUSIONS: The German "Linse" is described, although its design is not necessarily standard in present Japanese practice which has apparently deteriorated to the point of using any available craft for this purpose.

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ITEM: CATAPULT

INTELLIGENCE: Reliable source states that a German catapult was obtained by the Japanese. Evaluation A-2. Date unknown.

IDENTIFICATION: Wt. about one ton; operated by 60 cu. ft. of air compressed to 60 atmospheres and is capable of catapulting a maximum weight of 5 tons with a maximum acceleration of 4.3 kilograms; duration of acceleration is 1.2 seconds.

A 5 ton plane, Type J-87, at the end of catapulting attains a speed of about 83 mph while another type (5 tons), the ME109, Mark 2, attains speed of 87 mph.

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ITEM: PROPELLOR SHAFT COUPLING

INTELLIGENCE: Correspondence recovered at "Deschimag" reveals license agreement for construction of this naval gear in Japan. These are said to be the removable coupling built into the cruiser Seydlitz.

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ITEM: HIGH PRESSURE TURBINE

INTELLIGENCE: Evidence of license agreement for manufacture of high pressure turbine as used on German destroyer type Z30, to be manufactured in Japan, obtained at "Deschimag", Bremen. Correspondence dated 1944.

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ITEM: WARSHIP PROPELLOR DESIGN

INTELLIGENCE: Data supplied to the Japanese prior to October 1944. (A-2)

IDENTIFICATION: Data: 1. Propellor velocity for DDs = 80 m/sec; for BBs = 72 m/sec. Allowed thrust for projected area = 1.35 km/sq.cm; for the developed area = 1.11 km/sq.cm. The ratio of developed area to the projected area ordinarily up to 80%. No overlay caused in projected surface of each blade.

2. Corrosion at base of blade which made the roundness 150 mm R, has been greatly decreased. As a countermeasure to the bending of the blade edge, they planed the surface all along edge of blade, angle being made rather large.

3. Interval between propellor and hull although not fixed according to HP should be considerable. In case of DD with propellor diameter of 3200, the interval is 750; in case of cruiser it is 1000.

4. The inclination from about 5-6° is determined by relationship of the position of the propeller and the disposition of the engine.

5. Lignum vitae is used as material for the bracket; no better substitute available. The standard bearing interval, depending on the diameter of the shaft, varies from 0.8 to 1.2 mm. If it is four mm, the bearing is dry.

- -

ITEM: WARSHIP COMPONENTS

INTELLIGENCE: A reliable P/W (Evaluation B-2) states that the following were made available to the Japanese:

1. High pressure-hot steam turbine installations. DD36 Deschimag/Berlin.

2. Turbine-auxiliary engines for high pressure-hot steam engine installations. Brueckner, Kanis & Company/ Dresden.

3. Synchron-Shaft couplings--Deschimag/ Berlin.

4. Diesels MZ and VZ MAN/Augsburg

5. Light metal pistons for diesels. Karl Schmidt/heckarsulm

6. Details of resilient mountings; use of rubber and metal.

7. Hansa rotary converter.

9. SOUND GEAR

ITEM: ELAC UNDERWATER SONIC GEAR

INTELLIGENCE: High-ranking German Naval Officers reveal acquisition of this gear by the Japanese. Date unknown.

IDENTIFICATION:

	Phonoscope	K.D.B.(Crystal Rotating Base)	Ultraphone	Ultrameter	"S" Geraet (Mob) Schallwell-enanlage Acoustic Wave gear.
Mfr.; Yr.	ELAC 1937		Elektro-A. 1938	Elektro-A	Gema. for ELAC 1941
Type of Unit	Moving coil with permanent magnets (16 to 20 units in subs 24 in surface vessels)	Rochelle Salt (6 units)	Magneto-striction 35 kc/s	Magneto-striction (4 units)	Magneto-striction (2 or 4 units)
Use	Subs, surface vessels	Subs, surface vessels	Small craft	Sm.surface craft	subs,surface vessels
Method of reception:	Maximum	Maximum	Maximum	-	-
Frequency kc/ SECONDS:	-	-	-	35	15
Location of Units:	Near fore-planes	-	-	-	-
Directing Gear Type:	-	Thru keel hand training and raising	Thru keel hand/train-ing and raising	thru keel	Hand train-ing. Remote control in subs, no dome.
Remarks	Elec.Compen-sator	Directional only when using high pass filters in amplifier. Interference from own pro-pellers when under way.	Claimed better than the multi-unit type for small craft.	Echo rang-ing, tele-graphy and telephony. Rotating light range indi-cator.	Bearings and ran-ges by split beam methdd using Cathode ray tube. No listen-ing or recorder.

SECRET

CONCLUSIONS: The above gear, representing a cross-section of ELAC's sonic

gear types indicates the nature of Japanese acquisitions from this source. The apparatus involves no significant features.

APPROXIMATE DATE OF PRODUCTION: In use.

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ITEM: HYDROPHONES - ATLAS

INTELLIGENCE: It is believed the Germans turned over full details of their submarine underwater sound equipment, possibly as early as 1942, (C-3). High ranking German Naval Officers also cite transfer - date unknown.

IDENTIFICATION: It is believed the Germans turned over full details of their submarine underwater sound equipment, possibly as early as 1942, (C-3). High ranking German Naval Officers also cite transfer - date unknown.

IDENTIFICATION: This multi-unit hydrophone set manufactured by Atlas was very similar to that manufactured by Elektro-Akustic, but not structurally identical, so the component parts were not interchangeable. The principle by which they functioned was identical.

Installations:	Circular base
No. of hydorphones:	12 (6 on each side of ship)
Type of unit (Receivers):	Electroc-hydraulic pressure variety Moving coil with permanent magnets
Method of reception:	Maximum or binaural
Filter 1:	only sounds over 800 cycles
Filter 2:	only sounds over 1500 cycles

Bearings obtained by handwheel rotated over 360°.

The remaining characteristics are the same as those of the GHG

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ITEM: HYDROPHONES, GHG

INTELLIGENCE: Interrogation (15 May 1945) of Directors of Electro-acustic by the Japanese Section, SHAEF confirmed previous intelligence on transfer of GHG for submarines and surface craft in the early days of the European War. Evaluation A-1.

IDENTIFICATION: The GHG was fitted to all German U-Boats. A captured German document describes its appearance on destroyers. It was used to pick up the sound and determine the direction of enemy ships. To obtain bearings a hand wheel was rotated over 360°. Elektro-Akustic & Atlas manufacture the GHG, but the following information pertains to that made by the former.

Installation: Circular bar

(See overleaf first)

9. SOUND GEAR

No. of hydrophones: 24 - 48 according to vessel (Type 7C and 9C U-boats have 24)
Type of Unit (Receivers): electro-hydraulic pressure variety; Rochelle salt crystal.
Sensitivity frequency curve: Very gradual.
Sensitivity of receivers (kept secret): assumed to be 200/Mv/Dive Cm-2
Filter amplifier working up to 10,000 cycles/sec.
Main "Love" - quite acute, therefore determination of sound direction accurate
Method of reception: maximum
Location of units: near foreplane
Ranges: convoys - 20 miles
small ships - 10 miles
(under poor conditions drops to half)

Component parts of set used for destroyers:

Hydrophone set	Order Transmission System
Crystal receivers	Transmitter
Preamplifier	"Trafo" Box (which enables the indicator lamps to work on varying voltages, so that they burn at varying degrees of brightness.)
Main Unit	
Main Switch, with 3 indicator lamps	Receiver
Direction Switch Box	Filter Box
Supplementary Box	Resistance Box

Order Transmission System is to report the type and direction of noises picked up by Multi-unit Hydrophone set. Has series of indicator lamps and a buzzer to indicate the type, etc. of the noise.

NOTE: Elektro-akustic constructed hydrophone receivers of magnetic-pressure type. These were not used by the German Navy, but were given to the Italian Navy with unsatisfactory results.

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ITEM:- LISTENING DEVICE, KDB

INTELLIGENCE: Interrogation (15 May 1945) of Directors of Electro-acustic by Japanese Section, SHAEF reveals transfers 1943/1944 of Horchgerate KDB for use on small surface vessels. Evaluation - A-1.

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10. AIRCRAFT

ITEM: AIRCRAFT (GENERAL)

The Japanese have received information on many of the Luftwaffe's new planes. Since few, if any, of the more recent German airplane types have been developed in Japan, it is probable that Japanese interest has been largely a matter of curiosity and preliminary exploration. It is not intended by the following evidence to convey the impression that the Japs are planning to revamp their aircraft industries beyond the development of a few jet types.

Among the planes which Japan received in days when physical transport was easier were early models of the standard Luftwaffe types: JU 88, ME 109, ME 210, FW 190, AR 196, BU 131, DO 217, and miscellaneous Junkers and Heinkel transports. While only the BU 131 has been put into manufacture (it has become a JAAF and JNAF trainer), the others have contributed substantially to the development of the techniques and engineering principles embodied in Japanese aircraft. An ME 109 type plane was known to have reached an advanced stage toward production before Pearl Harbor, and the Tony is clearly an adaptation of the German model.

Because of the obvious potential use of jet-propelled planes as defensive fighters against Allied high-altitude bombing attacks, it may be assumed that Japanese development of the Luftwaffe's closed-jet ME 163 and the turbo-jet ME 262 will undoubtedly materialize as Jap jet-fighters.

Although there is no short cut for operational and testing experience, it is believed that the information and assistance obtained will permit the Japanese to begin production with the benefit of several years of German experimentation.

ITEM: AIR STRATEGY

INTELLIGENCE: A document issued by the Japanese Imperial General Headquarters on 18 April 1944, makes it clear that whatever lessons were learned from the air war in Europe have been duly appropriated and possibly utilized by the Japanese Air Force in the defense of the homeland. Included in the text are: Methods of Penetration, Fighter Escort, Diversionary Attacks, Methods of Bombing and Bomb Patterns, Feints and Stratagems, Making Use of Bad Weather, Tactics of Mobility, and Interception Combat.

CONCLUSIONS: The study demonstrates full comprehension of Germany's air problems, and the methods used to cope with them. It also reveals considerable understanding of the capabilities of radar in navigation blind bombing and control of fighter defenses. It is reasonable to conclude that within the limits of their ability to build and man planes and ground defenses, the Japanese home islands will become somewhat costlier targets in the immediate future.

ITEM: BP 20 B "NATTER" (VIPER)

INTELLIGENCE: Reliable source states that details of the "Natter" were given to the Japanese. (A-2) Date unknown.

IDENTIFICATION: This is a single-seat, mid-wing, rocket-propelled monoplane with a cruciform tail. In its method of operation it is midway between a directed missile and an interceptor fighter. Originally it was intended to be completely expendable and to have a pilot-ejecting device, but the R.L.M. subsequently decided to salvage the rear half of the fuselage, together with the expensive Walter rocket unit, and a parachute was built in the fuselage for returning the rear section to earth.

A plexiglass dome forms the nose fairing behind which are the forward firing rocket projectiles. The wooden wing is not detachable; no ailerons are fitted; 2 fins and rudders are fitted, one above and one below the fuselage. An HWK 109-509 hi-fuel rocket unit is fitted.

The alternative armament of the Natter is 33 (approx.) R4M rockets, 2 x Mk 108 guns (30 mm) or "Fohn". The nature of "Fohn" is not known, but the word suggests a variety of flame-thrower, although the use of such a weapon at very high forward speeds would be difficult.

Four solid-fuel rockets are fitted on the fuselage, two on each side below the tailplane for take-off. These may be either 500 kg. each, burning for six seconds or 1000 kg. each burning for 12 seconds. The aircraft takes off from a ramp inclined at a small angle to the vertical. The maximum acceleration at take-off is 2.2 g.

Span:	13.1'
Length o.a.:	20.6'
Wing Area:	51.6 sq. ft.
Take-Off Wt. (including A.T.O. units):	4925 lbs.
Wt., dry:	1940 lbs.
Wt. of A.T.O. units:	1000 lbs.
Wing Loading:	Take-off - 95.5 lbs./sq. ft. At end of flight - 37.6 lbs./sq. ft.
Load Factor:	6
Max. Speed:	620 mph at 16,400 ft.
Rate of Climb at Sea Level:	37,400 ft./min.
Max. Range After Climb:	36 miles at 500 mph, at 9800 ft.
Max. Endurance:	4.36 mins. at 500 mph at 9800 ft.

ITEM: ME 163 A B C

INTELLIGENCE:

1. Plane stated in construction in Japan; also that in January 1945, 25 A/C engineers, 2 completed jet planes and 12 turbine engines left for Japan by submarine. (SHAEF, Frankfurt) (B-2)

2. According to Dr. Walther (Walther Werke A.G.), a complete ME 163 power unit of the type known as 509 A1 was supplied to the Japanese Navy in December 1944. Also, all the air frame plans of the ME 163 A and the applicable fuel propellant formulas. Only the Japanese Navy was involved; the Army took no part in negotiations.

3. The U-234 enroute to Japan was found to contain complete drawings of the ME 163 at the time of its surrender.

4. Japanese had full technical descriptions of ME 163B and C in September 1944. (A-2)

IDENTIFICATION:	ME 163B	ME 163C
Power Plant Type:	I x RII HW.K. bi-fuel rocket	H.W.K. 509 C bi-fuel rocket
H.P. or Thrust:	3,520 lbs. max. thrust at S.L.	3,740 lbs. max. thrust at S.L.
Max. Speed (mph):	515 at S.L.; 558-13,000-39,500'	590 at 13,000-39,500'.
Service Ceiling:	Max. operating height - 39,500'	Max. operating height - 52,500'
All-Up Weight:	9,100 lbs.	11,300 lbs.
Fuel Capacity:	4,470 lbs.	5,570 lbs.
State of Production:	Small series	Small series
Remarks:	Time of climb to 39,500' is 3.35 min. Endurance - 8 min.	Time of climb to 39,500' is 3.02 min. Endurance - 12 min.

Fuels: The original training version of the ME 163 (sub-type A) used a form of rocket unit somewhat similar to that installed in the HS 293 glider bomb, the fuels employed being "T Stoff" (80% hydrogen peroxide) and "Z Stoff" (permanganate). The ME 163B, the present operational sub-type, has the more efficient H.W.K. 509 unit. Developed by Dr. Schmidt and Prof. Walter of Kiel, this unit follows the layout adopted in the

A-4 long-range rocket. Points of similarity are: (a) the use of two turbine-driven pumps to supply the fuels to the burner unit, and (b) the employment of one of the fuels as a coolant for the venturi wall.

A new combination of fuels is used in the H.W.K. 509, namely "T Stoff" (80% hydrogen peroxide) and "C Stoff." The exact composition of "C Stoff" has not yet been determined, but the following facts are significant:

(a) Two types of liquid rocket have been developed for the ME 163, known as "hot" and "cold" units respectively.

(b) "C Stoff" is used as a coolant for the jet.

(c) The operating temperature of the H.W.K. 509 unit considerably exceeds that of the older type.

From the above it may be deduced that the fuel most likely to provide the necessary thrust would be an alcohol, perhaps combined with another constituent to give a greater reaction when brought into contact with hydrogen peroxide.

The following description of the H.W.K. 509 unit and its operation is, therefore, based on the assumption that "C Stoff" is an alcohol.

The Rocket Unit - General Description: The unit, which has an overall length of about 7'2" and a height and breadth of approximately 2'6", is supplied ready for mounting into the ME 163B air frame, and weighs about 220 lbs. complete. The layout is shown in the drawing. There are two main assemblies. The forward consists of a housing for the turbine; two worm-type pumps (for delivery of the fuel) mounted on the turbine shaft; a control unit; a pressure-reducing valve; and an electric starter motor. Attached to the forward housing is a small cylindrical unit which is, in effect, a steam producer. Here steam to drive the turbine is produced by the action of a solid catalyst on hydrogren peroxide.

The second assembly consists of the combustion chamber unit which is connected to the forward assembly by a cylindrical alloy casing through which pipes carry fuel to the jets.

Combustion Chamber: The combustion chamber is a double-walled cylindrical unit, the inner wall terminating in a venturi. Cooling is provided by circulating "C Stoff" through the space between the inner and outer walls. The forward end is closed by a plate through which project 17 jets. In the center of the plate there is an orifice whence combustion chamber pressure is applied to operate the automatic cut-out.

Controls: The unit is controlled by means of a single lever having five positions as follows:

1. Off
2. Cooling
3. First stage
4. Second stage
5. Third stage

Operation of the control lever brings into action the appropriate number of jets to give the required thrust.

Operation: To start the unit the following procedure is adopted:

(a) The control lever is set to idling position. This opens the fuel cocks and engages the electric starter motor. The motor then rotates the turbine shafts and pumps, thus priming the system. Under these conditions, the pressure generated is insufficient to force "T Stoff" through the pressure-reducing valve to the steam producer. A feedback is, therefore, provided to carry "T Stoff" to the catalyst in the steam generator.

A sufficient head of steam is thus produced to drive the turbine at a high enough speed to force "T Stoff" through the pressure-reducing valve to the generator. The unit is then operating normally and can be opened up as required.

(b) When the control lever is moved to the "off" position, a scavenge system drains the fuel circuits through a fuel drain pipe under the jet unit.

It is believed that on the latest version an automatic pressure-operated cut-out is embodied to shut off the fuel if the combustion chamber pressure rises above a pre-determined value.

Air-frame: The ME 163B is a small monoplane of mixed wood and metal construction. Dimensions are: span - 31'; length - 20'; wing area (approx.) - 188 sq. ft. The total flying weight is about 9,500 lbs.

Fuselage: Of semi-monocoque construction, the fuselage, according to a P/W has a skin of one mm. dural sheets. Drawn dural stringers of U-section extend for the full length of the fuselage.

Each dural sheet is large enough to go half round the fuselage, six sets of sheets being required to cover the length of the aircraft. After the sheets have been formed, those on the right-hand (viewed from the front of the aircraft) are first riveted to the top and bottom stringers and to each other, thus forming one-half of the complete fuselage.

The sheets forming the other side are then riveted in place and two additional stringers added (one on each side) together with a number of light reinforcing members in each quadrant.

Wing: Of constant taper, the wing has square-cut tips and pronounced sweep-back. Rectangular ailerons are fitted and fixed slots extend along approximately half the leading-edge. It is believed that the wing is of wooden construction with the exception of the tips and ailerons, which are of dural.

Tail Unit: Single fin and rudder. There are no horizontal tail surfaces; the rudder is aerodynamically balanced and has a fixed plate tab.

Tankage: The main tank is believed to be amidships in the fuselage, but it is almost certain that additional tankage is provided in the forward part of the fuselage and in the wing-roots. The total fuel capacity is of the order of 400 gallons.

Undercarriage: A jeetisonable twin-wheel undercarriage is provided for take-off, landing being effected on a retractable skid which is believed to incorporate a method of braking. An auxiliary skid, likewise retractable, is fitted under the tail.

Armament: Believed to be two M.G. 151/20 guns (20 mm) in the wing-roots. It is possible that in later versions MK 103, 30 mm guns will replace the M.G. 151/20, and that additional armament (possibly MK 108's) will be carried.

Endurance: The endurance of the rocket unit at full power is probably only about five minutes, but the total time in the air can be increased by operating the rocket at part thrust.

Take-off: Normally effected under the aircraft's own power, but rocket assistance might be used.

Climb: The rate of climb is exceptionally high and is estimated to average about 10,000 feet a minute to 30,000 feet.

Landing: A prepared airfield is unnecessary; the landing speed is low, probably about 55/60 mph.

Maneuverability: Probably poor under power, but good when gliding after the fuel is exhausted.

Auxiliary Jet: Reliable P/W reports refer to a modification of the ME 163B (possibly the ME 163C) in which an auxiliary or "economy" cruising jet is provided. This is said to increase the powered endurance to 12/16 minutes.

In view of the obvious advantage of such a modification, the development must be considered likely.

CONCLUSION: The probable existence of a second Japanese rocket-propelled plane has been disclosed in prisoner-of-war interrogation. The first was BAKA. The new plane is described as designed for interceptor duties, in particular to combat B-29's. It has an extraordinarily high rate of climb, and is reputed to be capable of reaching 30,000 feet in approximately three minutes. This figure is matched only by the German ME 163 rocket-propelled interceptor. In general appearance, the new plane is said to resemble BAKA, being approximately 20 feet long and 20 feet in wing span. Its weight is approximately 3,000 lbs. According to the P/W two 20 mm cannon are fixed in the nose and propulsion is achieved by means of solid rockets, with the possibility that jet control is available to increase maneuverability. The plane is launched from the ground and is said to be airborne in about 100 feet. No landing [illegible] are fitted. Maximum flight time is limited to seven

minutes, compared to 10-12 minutes for the ME 163 at full power.

No mention is made of a warhead, and since fixed nose cannon are specifically reported, it is possible that none exists. The P/W's insist that it is an "interceptor-bomb," so its exact purpose is obscure. If a warhead is installed, the plane's primary function is probably ramming, and it can then be termed a suicide weapon. If, on the other hand, no warhead is installed, its function is probably high-speed interception similar to the ME 163. Support to this view is added by the fact that P/W's have reportedly heard of pilots parachuting from the planes. (Source: CincPac, 7 May 1945)

The fragmentary information received on the new rocket plane does not permit assessment of its capabilities. Its similarity in several particulars to the ME 163 is noteworthy, however.

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ITEM: ME 209

INTELLIGENCE: Full details are reliably reported to have been in Japanese hands by March 1944. (A-2) (Spare parts are also said to be in Japan.) (A-2) 8 July '44 Tokyo would like to acquire working plane & special parts

IDENTIFICATION: The ME 209 fighter was developed from the ME 109 which it resembles in layout. The engine is a DB 603, and the undercarriage, which has a wide track, retracts inwards similar to that of a FW 190. The armament consists of a 30-mm cannon firing through propeller hub and probably 20-mm cannons in the wing.

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ITEM: ME 210

INTELLIGENCE: Official German records show delivery of these planes to Japan, January 1943.

IDENTIFICATION: Obsolete bomber that was superseded by the improved ME 410. It is a twin-engine, low-wing monoplane. Dive brakes of extruded alloy strips are fixed on upper and lower wing surfaces outboard of engine nacelles.

Maximum Emergency Speeds:	315 mph @ S.L.; 370 mph @ 21,000 ft.; 350 mph @ 27,000 ft.
Cruising Speeds:	Normal, 315 mph; economical, 240 mph; each at 19,000 ft.
Climb to:	19,000 ft. in 11.8 mins.
Fuel:	U.S. gals: 610 (normal)
Ranges:	With normal fuel bomb load, 610 U.S. gals. and 1100 lb. bombs @ 240 mph, 1350 miles; @ 315 mph, 1180 miles

Ranges (cont.):	With max. bomb load and 610 U.S. gals. @ 245 mph, 1240 miles; @ 300 mph, 1120 miles. With max. fuel load @ 245 mph, 2350 miles; @ 300 mph, 2120 miles.
Power Plant:	2 engines, rates 1520, 1330 HP, DB 605 B/0, 12 cyl., liquid cooled, inverted "V".
Armament:	Forward fuselage: 2 x 20 mm, 500 rpg - 2 x 7.9 mm, 1000 rpg Lateral: 2 x 13 mm, 500 rpg
Bomb Freight Load:	Normal load - 500 kg., 1100 lbs. Max. load - 1300 kg., 2850 lbs.
Specifications:	Materials, metal, stressed skin; span - 53'7"; length - 40'3"; height - 14'; gross wing area - 400 sq. ft.

Rear 13 mm guns in "blister" barbettes on the sides of fuselage slightly aft of trailing edge of wing. They are remotely-controlled electrically from dorsal position. A 50 mm has been found on one occasion slung underneath the fuselage. Two 550 or one 1100-lb. bombs carried internally beneath pilot; a central carrier can be fitted between to take an alternative load of one 2,200-lb. bomb. External carriers fitted under inboard section of each wing for four 110 or 154-lb. bombs. "A" and "B" sub-types have DB 601 F/1 engines.

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ITEM: ME 262

INTELLIGENCE: P/W technical expert on jet and rocket planes stated that ME 262 (jet) is in construction in Japan. (Source: SHAEF, Frankfurt) Also see ME 163.

Full drawings of the ME 262 were found on the U-234 at the time of its surrender.

A completely reliable source indicates that details of ME 262 were available to the Japanese in November 1944. Evaluation - A-2.

IDENTIFICATION:

Manufacturer:	Messerschmitt
Crew:	1
Duty:	Fighting, possible ground attack, reconnaissance.

Turbine type jet-propelled aircraft. Single seat, all metal, twin-unit, low-wing monoplane. Wings tapered; tips square; nose long and pointed; propulsion units slung underneath wings. Tricycle landing gear is retractable.

Speed:	500 mph (est.)
Engines:	2 turbine type jet propulsion units

Armament:	30 mm (quantity unknown)
Span:	41' (est.)
Length:	35'5" (est.)
Gross Wing Area:	226 sq. ft. (est.)

CONCLUSIONS: Development of jet fighters will undoubtedly eclipse all other aircraft production in Japan as it did in Germany.

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ITEM: ME 323

INTELLIGENCE: According to reliable information, Japanese are reported to have received plans and parts. (A-2)

IDENTIFICATION:

Manufacturer:	Messerschmitt
Crew:	Probably eight to ten
Duty:	Transport

Powered version of the ME 321 "Gigant" glider. Six-engine, high-wing monoplane. Strut-braced wing has moderate taper to blunt tips. Flaps are hydraulically operated. Fuselage is of rectangular section. Nose of fuselage splits vertically to form two doors which swing open sideways, making an aperture 10'10" high x 9'3" wide. Pilot's cockpit is on top of fuselage, forward of leading edge. There is a single fin and rudder and strut-braced stabilizer. The whole tail unit moves when stabilizer incidence is changed. Landing gear has five wheels on each side of the fuselage inclosed in long fairings. Provision for four rockets for assisted take-off placed under each wing. Main loading space of about 2,000 cu.ft. capacity capable of holding a 3-ton truck or light tank. A secondary loading space of about 1,410 cu.ft. capacity can be obtained by suspending a floor from the main top longitudinal members.

Max. Emergency Speeds:	163 mph @ S.L.; 194 mph @ 13,000 ft. alt.; 183 mph @ 20,000 ft. alt.
Cruising Speeds:	Normal - 163 mph; economical - 129 mph.
Climb:	To 13,000 ft. alt. in 18 min.
Service Ceilings:	Normal load, 23,000 ft.; max. bomb/fuel load, 20,300 ft.; min. fuel/no bombs, 25,000 ft.
Ranges:	With normal fuel/bomb load/U.S. gals. and 26,900 lb. fgt. @ 129 mph, 720 miles; 163 mph, 640 miles; with max. fgt. load and 478 U.S. gals. @ 139 mph, 140 mph.
Engines:	6, rated 965 HP each at 13,100 ft. alt. Gnome-Rhone 14N 48/49, 14 cyl. twin row, air-cooled radial.

Armament: (All free)	For'd fuselage:	2 x 7.9 mm - upper 2 x 7.9 mm - lower 4 x 7.9 mm - fwd 2 x 7.9 mm - rear
	Lateral:	6 x 7.9 mm
	Ventral:	2 x 7.9 mm aft
	Guns of 13 mm caliber may replace the 7.9 mm guns.	
Bomb/Freight Load:	Troops, 60-100 men.	
Span:	181'	
Length:	93'4"	
Height:	27'6"	

ITEM: ME 410

INTELLIGENCE: Specifications are known to have been made available to the Japanese in November 1942. (A-2) 20 Dec 43 Jap M/R MR ME 410 1st mention

IDENTIFICATION:

Manufacturer:	Messerschmitt
Crew:	2
Duty:	Bombing, fighting, ground attack, reconnaissance.

Re-engined ME 210, as the air-frames of each are similar. Twin-engine, low-wing monoplane. Wings have pronounced taper to rounded tips. Leading edge slots, slotted ailerons, and plain flaps are fitted. The nose is blunt. Fuselage is slim with pointed cockpit inclosure at forward end, finishing approximately over the trailing edge. Behind this the fuselage is of small cross-section. The single fin and rudder is large. Landing gear retracts rearward into nacelles; tailwheel is retractable. Divebrakes of extruded alloy strips are fixed on upper and lower wing surfaces outboard of engine nacelles.

Max. Emergency Speeds:	330 mph @ S.L.; 395 mph @ 22,000 ft. alt.; 370 mph @ 25,000 ft. alt.
Cruising Speeds:	Normal, 300 mph; economical, 255 mph; each at 19,00 ft. alt.
Climb:	To 19,000 ft. alt. in 11.5 min.
Service Ceilings:	Normal load, 30,000 ft.; max. bomb/fuel load, 28,000 ft.; min. fuel/no bombs, 39,000 ft.
Fuel:	U.S. gals. - normal, 610; max. (est.), 1192.
Ranges:	With normal fuel/bomb load, 610 U.S. gals. and 1100 lbs. bombs - 225 mph, 1190 miles; 330 mph, 1040 miles.
	With max. bomb load and 610 U.S. gals., 250 mph, 1110 miles; 320 mph, 990 miles;

Engines:	2, rated 1680 HP, each at 18,000 ft. alt. with 2700 rpm and 41.94 in Hg. DB 603 A-2, 12-cyl., liquid-cooled, inverted "V".
Armament:	For'd fuselage - 2/4 x 20 mm*, or 2 x 30 - 2 x 47 mm, or 1 x 37/50 mm - 2 x 7.9 mm Dorsal: 2 x 13 mm; remote-controlled; operated by radio opr.
Bomb/Freight Load:	Normal load, 1100 lbs.; max. load (est.), 2850 lbs.; typical stowage, 2 x 550 lbs.
Span:	53'7"
Length:	40'11"
Height:	14'

* On certain sub types forward firing guns now comprise 1 - 50 mm and 2 machine guns 151/20. The 50 mm is the 5 cm KWK 39 (as fitted on Pz Kpfw. III), suitably modified for aircraft installation.

ITEM: AR 196

INTELLIGENCE: Official German records show delivery of two planes to the Japanese in December 1943. — no info. on the a/c ?

IDENTIFICATION: Standard fighter reconnaissance aircraft of the G.A.F., designed for catapult operation from warships and from shore bases. Also was used for attacks on long-range reconnaissance aircraft. It is a single-engine, low-wing monoplane with either a single float and stabilizing wing floats or twin floats. Fuel is carried in floats of the single-step type attached to fuselage by tubular struts.

Max. Emergency Speed:	195 mph @ S.L.
Cruising Speeds:	Normal, 175 mph; economical, 120 mph; each at 6000 ft.
Climb:	To 6000 ft. in 4.5 min.
Fuel:	U.S. gals, normal - 159.
Range:	With max. bomb load and 137 U.S. gals., 120 mph, 540 miles; 175 mph, 460 miles.
Power Plant:	Engines, 1; rated 920 HP, BMW 132K, 9 cyl., air-cooled radial.
Armament:	For'd fuselage - 1 x 7.9mm For'd wings - 2 x 20 mm Dorsal Twin 7.9 mm
Specifications:	Materials - metal, stressed skin, fabric. Span - 41'; Length - 36'1"; Height - 13'; Gross wing area - 307 sq. ft.

Oil cooler in leading edge or port wing. Bomb carriers under wing. Stressed for catapult launching. Although twin float version is standard, single float model with wing lateral stabilizing floats exists. Max. speed of pull-out dive is 316 mph.

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10. AIRCRAFT

ITEM: ARADO 234

INTELLIGENCE:

German-Japanese intercept, dated 3/44, confirms fact that data on this plane was in Japan early in 1944. This may have been an experimental model.

IDENTIFICATION: This is a single-seat, twin jet monoplane bomber, used for high-speed, low-level attack. Has high wings, single fin and rudder, underslung jet units, transparent nose. Equipped with automatic pilot and one bomb carrier under fuselage.

Width:	14.4 m
Length:	12.68 m
Height:	4.28 m
Regulation wt.:	8650 kgs
Heavy load wt.:	9400 kgs
Speed at 0 km:	700 k/h
Speed at 8 km:	750 k/h
Speed at 10 km:	700 k/h
Speed at 11 km:	655 k/h
Propulsion:	2 Jumo 004 axial flow turbo-jet units mounted beneath wings.

Bomb Weight	No. of Bombs	Reduction of Speed When Carrying
500 kgm	1	15-20 k/h
500 "	2	60-70 "
500 "	3	75-90 "
350 "	2	45-50 "

Cruising Range	Alt.
630 km	0 km
1200 km	6 km
1550 km	10 km

Landing speed at landing wt. of 5650 is 147 k/h

Fuel Capacity: 2 tanks (1 - 475-gal.), (1 - 530-gal.)

CONCLUSIONS: Apparently plans for production of the latest version of AR 234 are indicated by a reliable report which states that a set of FuG 136 designed for use on this plane was received by the Japanese in January 1945.

10. AIRCRAFT

ITEM: HE 113 9

INTELLIGENCE: The Japanese received details of German development of HE 113 in July 1943. Evaluation - A-2. no cards on file o/c

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ITEM: HE 162

INTELLIGENCE: Japan is alleged to have paid 20 million reichsmarks to the German government for plans, but it is not believed that working specifications ever reached Japan.

IDENTIFICATION: The HE 162 is a shoulder-wing monoplane, jet-fighter of mixed construction, employing as few as possible of the materials that are short in Germany. Unusual features of the design are the low span-length ratio, the mounting of the jet unit above the fuselage, the tricycle undercarriage which can be retracted into the fuselage, and the sharp dihedral of the tailplane.

Dimensions and weights of the HE 162 are listed by Heinkel as follows:

Wing Span:	23'7-3/4"
Root Chord:	6'8-1/2"
Wing area (gross):	120 sq. ft.
Aspect Ratio:	4.65
Overall Length:	29'8-1/2"
Tailplane span:	7'5-1/2"
Tailplane chord:	2'8-1/2"
Undercarriage Track:	4'11"
Normal All-Up Weight:	5,480 lbs.
All-Up Weight with Maximum Fuel:	5,940 lbs.
Landing Weight with 20% fuel:	4,820 lbs.
Wing Loading at Landing:	40 lbs. per sq. ft.

Performance figures were taken from the makers' specifications and are presumably subject to the usual three percent tolerance:

Maximum speed at sea level:	490 mph
Maximum speed at 19,700 feet:	522 mph
Maximum speed at 36,000 feet:	485 mph
Rate of climb at sea level:	4,230 feet per minute
Rate of climb at 19,700 feet:	2,460 feet per minute
Rate of climb at 36,000 feet:	690 feet per minute
Time to climb to 19,700 feet:	6.6 minutes
Time to climb to 36,000 feet:	20 minutes
Ceiling at mean weight:	39,400 feet
Range with normal fuel at sea level:	136 mile

Range with normal fuel at 19,700 ft.:	2 7 miles
Range with normal fuel at 36,000 ft.:	410 miles
Range with normal fuel at 38,400 ft.:	434 miles
Full throttle endurance at sea level:	20 minutes
Full throttle endurance at 19,700 ft.:	33 minutes
Full throttle endurance at 36,000 ft.:	67 minutes
Take-off run (normal fuel):	710 yds.
Take-off run with assisted take-off (2,200-pound thrust):	350 yds.
Take-off run (maximum fuel), without assisted take-off:	875 yds.
Take-off run with assisted take-off (2,200-pound thrust):	415 yds.
Landing speed:	102 mph

Wing: The materials used in constructing the cantilever wing of the HE 162 are "TBu20" for the spar boom, a substance presumed to be wood; and beech plywood for the webs and skin of the wing. The ribs are of pine with plywood webs. Fittings and connecting bolts are steel and the end caps are aluminum alloy. The wing has a straight leading edge, blunt tips, and a pronounced forward sweep on the trailing edge. The dihedral is about three degrees.

The main and auxiliary spars are of T-section. The skin is made up of 4-mm plywood which is thickened locally on the upper surfaces between the main and auxiliary spars to 5 mm. The skin is also stiffened by longitudinal stringers. A space between the main and auxiliary spar in each mainplane is used as a fuel tank. The document said that servicing was "by means of special equipment and a mirror after the removal of the end caps."

The wing is connected to the fuselage by four vertical bolts; three additional connections are located on the upper surface for the power unit. The auxiliary spar carries two fittings for each aileron and for the landing flaps.

Ailerons and Flaps: Wood is used for the ailerons, which are dynamically and statically balanced, and have a range of movement of 18° upwards and downwards. The two landing flaps are connected by a shaft and are lowered hydraulically. Structurally they are similar to the ailerons. A mechanical stop prevents their being lowered more than 45°.

Fuselage: The report states that duralumin formers and skin are used in the construction of the fuselage. The fittings are partly of steel and the inspection covers are of dural or wood. In section the fuselage is pear-shaped and constructed in assemblies of nose cap, forward fuselage, port and starboard sections, fuselage, bottom, central and rear sections, and the cockpit enclosure.

Tail Unit: The cantilever tailplane and the elevator have a dihedral of 14° and are of duralumin construction with steel fittings. A range of tailplane adjustment of +3° to --2° is possible. The wooden fins are rectangular and attached to the ends of the tailplane by three

bolts. Each rudder is carried on three bearings, the center one being fixed and the two outer ones adjustable. The rudders are fully mass-balanced and their movement is limited by fixed stops to 25° on either side.

Undercarriage: The tricycle undercarriage retracts rearwards hydraulically into the fuselage and is lowered by means of a spring which is compressed during retraction. It is locked in the "up" position by a bolt which is released by a cable, and in the "down" position by a toggle which passes over dead center. A mechanical indicator in the cockpit shows the undercarriage position and the retracted nose wheel may be seen through a special window. The oleo legs are of ME 109 type and the wheel dimensions are 660 x 190 mm. The brakes are foot-operated from the rudder pedals. When stowed in the fuselage the undercarriage is covered by doors which open and shut automatically. The size of the nose wheel is given as 360 x 150 mm, but it was stated that there is space for a larger wheel if necessary.

The Power Plant described in the Heinkel publication is fitted with a BMW 003E-1 or E-2. Another document mentions a BMW 003A-1. These units run on J-2 fuel and have a sea-level static thrust of 1,760 lbs. at 9,500 rpm. At 36,000 feet and a speed of 500 mph, the thrust is 585 lbs. The specific fuel consumption is high; 1.61 lbs. per hour per pound thrust. The weight of the unit complete is probably about 1,480 lbs. The dimensions as scaled from a drawing are 11'10" in length; 2'10" in height, with width of 2'4". Two spark plugs are used for ignition.

The jet unit is fitted above the fuselage on the upper surface of the wing. At the forward end it is attached by two vertical bolts, and at the rear by one horizontal bolt. The front and rear cowlings are fixed to the power unit and delivered with it; the center cowling consists of two large flaps which may be opened sideways and are normally held shut by a quick-release fastening. If necessary, these flaps may be removed entirely. There is a detachable fillet between the jet unit and the wing.

Starting and Ignition: The jet unit is started by a Riedel two-cycle starter engine which, in turn, is started electrically by a switch on the starboard side of the cockpit. The ignition is switched on when a button on the throttle lever is pressed.

The Normal Fuel Supply is from a single flexible fuselage tank mounted well forward. This tank has a capacity of 150 gals. for normal flight, with an additional 33.6 gals. for warming up, take-off, and initial acceleration. In order to fuel to the maximum, the capacity of the fuselage tank is increased to 194.4 gals. (including the 33-gallon allowance), and an additional 48 gallons can be carried in the fuel-tight wing compartment.

Both the main tank and the specially prepared wing compartment are filled from a single point on the upper surface of the wing. [illegible] delivered to the jet unit from the fuselage tank, into which the wing tank feeds, by an electric immersion pump via a fuel cock and filter.

Cockpit: Entry and exit are through the roof, which opens rearwards and can be jettisoned. The pilot's seat can be catapulted out of the cockpit in an emergency by means of an explosive cartridge. A parachute is attached to the seat, which is adjustable on the ground for the pilot's height. The controls for the power unit are on the port side of the cockpit, and on the starboard side are switches for the electrical installation and radio. The R.P.M. counter, fuel pressure gauge, oil pressure gauge, exhaust temperature indicator, thrust indicator, and fuel contents gauge are fitted. The flight instruments comprise a fine-coarse altimeter, airspeed indicator, and pitot-head heating indicator. An FK38 magnetic compass is fitted and a signal pistol with shortened barrel fires through an opening in the fuselage.

Armament: The HE 162 is designed to use an alternative armament scheme: either two MK 108's or two MG 151's. The guns are mounted low in the forward part of the fuselage, one on each side of the cockpit, and the mountings are sufficiently far back to accommodate the barrels of the MG 151 in the fuselage. If MK 108's are fitted, special blast tubes are attached to the muzzles. An ammunition box above the guns holds two 120 rounds for the MG 151 or two 50 rounds for the MK 108's.

Radio Equipment: A FuG 24 radio and homing set, and the FuG 25A compose the radio equipment of the HE 162.

The FuG 24 is entirely new equipment about which little is yet known. It is interesting to note that several elements of the FuG 15 are used in the equipment. Unlike the previously encountered VHF radio sets, the receiver and transmitter are entirely separate. The receiver is mounted on the right of the cabin and the transmitter in the rear part of the fuselage. Two separate aerial matching units are provided for transmitter and receiver, these being mounted in the port and starboard fins. The homing loop is fitted on the cowling of the power unit.

CONCLUSIONS: This plane has an excellent jet unit, but was never completed for operational use.

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ITEM: HE 219

INTELLIGENCE: Reliable information indicates that the Japanese had full description in July 1944. (A-2) also Nov. 44 request for [illegible] on capacity & performance

IDENTIFICATION: The HE 219, one of the newer types of German long-range fighters, was used principally at night. It is a twin-engine, midwing monoplane. A turbo-jet unit is fitted optionally under the ventral bola, giving the aircraft an estimated top speed of 450 mph when in operation. It is reported that 2 x 20 mm MG are placed in a mid-dorsal position to fire both forward and at angles approaching the vertical. It is said a rocket projector tube can be mounted under each wing outboard of the nacelles. GM-1 power boosting equipment may be fitted. Comprehensive

radar installation probably is employed. A spotlight may be placed in the nose to be used when the guns are to be fired at night. DB 613 engine.

Max. Emergency Speeds:	325 mph @ S.L. (est.) 400 mph @ 22,000 ft. (est.) 378 mph @ 14,000 ft. (est.)
Service Ceilings:	Normal load, 32,800 ft.; max. bomb/ fuel load, 1,326 ft.
Fuel:	U.S. gals., normal - 1,087; max., 1,100
Armament:	Forward wings - 2 x 20 mm Dorsal - 2 x 20 mm Ventral - 4 x 24/30 mm (This new 24 mm gun is reportedly a Mauser with very High-muzzle velocity)
Specifications:	Span - 60'6"; Length - 48'8"; Height - 12' (est.); Cross wing area - 480/500 sq. ft.; Weight - 26,100 lbs.
Range:	With maximum fuel load and bombs - 1,545 miles

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ITEM: HE 177

earliest report - Description from Jap M/A Berlin 1 Jan '43

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INTELLIGENCE: A ComSthFlt serial of 12 February 1945, states as follows: "It is learned from a highly reliable source that, after Japanese entry into the war, the Japanese Embassy in Berlin asked the German Air Ministry for technical information and designs of the 4-Engine Heinkel 177, with a view to reproduction of this plane in Japan. The Germans immediately authorized delivery of the material requested."

He-177 licensed to Japan 15 Nov '41

A document captured in the Italian Air Ministry in Rome, dated 19 February 1942, states that designs for the Heinkel 177 were turned over to the Japanese by that time.

DESCRIPTION: Twin-engine, mid-wing monoplane. Center section of wing is straight, mounting the engines. Although the aircraft is technically 4-engined, it appears as twin-engined, "Doubled" engines composed of two single engines. Clutch enables one engine to be disengaged. Outer panels are tapered, tips elliptical. A highly-developed Fowler flap arrangement is used. These Fowler extensions are believed to cover the greater part of the trailing edge, including aileron sections. Slotted-type dive brakes are fitted on wings outboard of engines. The fuselage is of rectangular section with corners rounded; about one-third of its length is forward of the leading edge. The single fin and rudder is angular-shaped; bottom section of rudder is cut-out. The stabilizer is tapered, tips blunt; elevators are straight. Landing gear consists of double wheels that diverge spanwise during retraction. Tailwheel is retractable. Forward dorsal turret remotely-controlled from astro-do[illegible]. With 2 HS 293 bombs, maximum speed is about 275 mph @ 17,000 ft.; [illegible] 240 mph normal range would be about 2,150 miles, maximum ra[illegible]

10. AIRCRAFT

Manufacturer:	Heinkel
Crew:	7
Duty:	Bombing, torpedo-dropping, reconnaissance
Max. Emergency Speeds:	250 mph @ S.L.; 300 mph @ 20,000 ft. alt.; 270 mph @ 5,000 ft. alt.
Cruising Speeds:	Normal - 260 mph; economical - 210 mph; each at 17,000 ft. alt.
Climb:	To 17,000 ft. alt. in 29 min.
Service Ceilings:	Normal load, 21,000 ft.; min. fuel/no bombs, 32,000 ft.
Fuel:	U.S. Gals., normal - 2,328; max. - 3,350
Ranges:	Economical cruising speed with normal fuel bomb load, 2,328 U.S. gals. and 12,320 lbs. bombs, 210 mph, 1,150 miles
Engines:	2, rated 2,800 HP each at 17,000 ft. alt.; DB 610 (DB 605 doubled), 24 cyl., liquid cooled, inverted twin "V"
Armament:	(All free) For'd fuselage - 1 x 7.9 mm, 2000 rds. Dorsal (fwd.) - 1/2 x 13 mm, remote controlled Ventral (fwd.) - 1 x 20 mm; 1 x 13 mm (rear) Tail - 1 x 20 mm, 150/200 rds.
Bomb/Freight Load:	Max. load, 9,980 kb., 2,000 lbs.
Span:	103'6"
Length:	67'4"
Height:	21'11"

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ITEM: HE 277

INTELLIGENCE: A reliable source indicates that full details of HE 277 were learned by the Japanese in March 1944. (A-2)

IDENTIFICATION: Modification of the HE 177.

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ITEM: HS 129

INTELLIGENCE: Two planes were awaiting shipment to Japan early in 1944, according to an official record.

IDENTIFICATION: Specialized ground attack bomber of the G.A.F., developed for close cooperation with the Army. It is noted for its heavy armor and armament.

Max. Emergency Speeds:	240 mph @ S.L.; 275 mph @ 9000 ft.; 255 mph @ 20,000 ft.

Cruising Speeds:	Normal, 216 mph; economical, 150 mph; each at 6,600 ft.
Climbs:	To 10,000 ft. in 7 min.
Fuel:	162 U.S. gals. (normal)
Range:	With max. bomb load and 162 U.S. gals. @ 150 mph, 440 miles; @ 216 mph, 350 miles. With max. fuel load and 220 lb. bombs @ 150 mph, 690 miles; @ 216 mph, 550 miles.
Power Plant:	2 engines, rated 800 HP, Gnome-Rhone 14M 04/05, 14 cyl., twin-row, air-cooled.
Armament:	For'd fuselage - 2 x 7.99 mm, 1000 rpg.; 2 x 15/20 mm, 250 rpg (with small bomb load) 1 x 30 mm, 30 rds. or 6 x 7.9 mm Dorsal: Possible twin 20 mm
Bomb/Freight Load:	Normal - 100 kg, 220 lbs. Max. - 350 kg, 770 lbs.
Specifications:	Materials - metal, stressed skin, flush-riveting; span - 44'6"; Length - 33'3"; gross wing area - 305 sq. ft.

Air intake through air cleaner or direct from air intakes in front of engines. As an alternate to bomb load a 30 mm cannon can be carried with 30 rds. in which case the bomb load is limited to 2 x 110 lbs. or 48 x 4.4 lbs. anti-personnel; another alternative is 6 x 7.9 mm machine guns. Bomb carriers installed outboard of nacelles and beneath fuselage. Argus engines of about 800 HP each may replace the Gnome-Rhone's. Armament combination report of 4 x 30 - 2 x 20 mm fixed firing forward - twin 20 mm in dorsal position, latter capable of firing forward and at angles up to nearly 90°.

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ITEM: HS 130

INTELLIGENCE: A reliable source states that complete details were obtained by the Japanese in July 1944.

IDENTIFICATION: High-altitude plane; pressure cabin.

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ITEM: DO 217

INTELLIGENCE: The Japanese purhcased manufacturing rights in July 1943. Two planes were delivered to Japan in January 1943. (A-1)

IDENTIFICATION: The Dornier 217 is a bomber being the first to incorporate a turret. Auxiliary fuel tanks can be added for long-range general or anti-shipping reconnaissance. It can be fitted for minelaying and torpedoes. A night fighter version with [illegible] and a crew of 3 was also introduced.

It is a high-wing monoplane, similar to enlarged DO 17; twin engines, large transparent bulbous nose, bomb doors form long bulge running almost whole length of fuselage giving profile deep appearance; twin tail fin and rudders used for level bombing.

Crew:	4
Armament:	6 machine guns and 2 cannons
Bomb Load:	4,000 lbs.
Armor:	Extensive and complete
Motors:	2 - 1600 HP Junkers Jumo 801
Max. Speed:	340 mph
Max. Range:	1,800 miles with 4,000 lbs.
Wing Span:	65 to 70 ft.

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ITEM: DO 335

INTELLIGENCE: Description, but no working drawings, are believed to have been made available to the Japanese in March 1945. (A-2)

IDENTIFICATION: Three versions of the DO 335 (fighter bomber, recco) apparently exist. The first operational type is a single-seater, which may be constructed in both medium and high-altitude models. The latter is said to have an increased wing area of 65 sq. ft., or a total of 495 sq. ft. . There probably is a two-seat trainer version with the second member of the crew sitting behind and slightly above the pilot. A third night-fighter version is probable, and it is likely to be a two-seater accommodating an observer.

Specifications:

Wing Span	- 45'3"
Length	- 45'5"
Gross Wing Area	- 430 sq. ft.
Max. Gross Wt.	- 22,450 lbs.
Normal Wt.	- 17,600 lbs.

Armament:

1 x Mk 108/ 30 mm
2 x Mk 108/30 mm
2 x MG 151/20 mm
(The design of the bomber and reconnaissance versions does not allow for the fitting of any armament.)

Speeds:

Max. @ S.L. - 378 mph
Max. @ 25,000 ft. - 475 mph
Max. (1 engine) @ 19,000 ft. - 336 mph
Rate of climb: 1920 ft. per min.

Bomb Load:

Either 1 x 1000 kg. (2200 lb.) bomb, 2 x 500 kg. (1100) bombs, or 10 x 50 kg. (110 lb.) bombs in the bomb bay, and 1 x 250 kg. (550 lb.) bomb under each wing.
Total load of 3300 lbs.

Fuel Capacity:	600 U.S. Gals.
Power Plant:	Comb. of 2 inline engines and 1 radial. A special high altitude pressure cabin version, powered by DB 603 L or Jumo 213 engines and having wing area of over 360 sq. ft., was reported to have been projected.

A possible development of the DO 335, designated DO 435, was to be a side-by-side two-seater with the wing area of the high-altitude DO 335 (over 360 sq. ft.) and equipped with the Jumo 222, 24-cylinder engines said to develop 2,250 HP each.

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ITEM: FW 190A

INTELLIGENCE: According to files of the Mitsubishi Berlin Office, five FW 190A's, including two complete sets of drawings and spare parts of the above, were shipped to Japan.

IDENTIFICATION: Manufacturer - Focke-Wulf; crew - 1; duty - bombing, ground attack. The FW 190A has been used extensively as a fighter bomber. It is a single-engine, low-wing, cantilever monoplane. Wing tapers moderately in plan and thickness; tips are blunt, corners rounded. Split flaps are fitted; there is a single fin and rudder. Two jettisonable fuel tanks are carried under wings. Bomb carried below fuselage only.

Max. Emergency Speeds:	320 mph @ S.L.; 370 mph @ 19,000 ft. alt.
Cruising Speeds:	Normal - 310 mph; economical - 220 mph; each at 17,500 ft. alt.
Climb:	To 18,000 ft. alt. in 8.5 min.
Service Ceilings:	Normal load, 31,500 ft.; max. bomb/fuel load, 28,500 ft.; min. fuel/no bombs, 38,000 ft.
Fuel:	U.S. gals. - normal, 139; max., 295 take-off in calm air.
Engines:	1, rated 1530 HP; BMW 801 D, 14 cy., twin row, air cooled (fan assisted) radial.
Armament:	For'd fuselage - 2 x 7.9/13 mm, 1000 rpg For'd wings - 2/4 x 20 mm, 200-230 rpg
Bomb/Freight Load:	Normal Load - 250 kg., 550 lbs. Maximum Load - 500 kg., 1100 lbs. Typical stowage - 1 x 500 lbs. Alternate stowage - 1 x 1100 lbs. 96 x 4 or 4 x 100 lbs. Unconfirmed, 1 x 2200 lbs.
Span:	34'6"
Length:	298'5"
Height:	11'6"

Ranges:	With max. bomb load and 139 U.S. gals. - 220 mph, 485 miles; 310 mph, 410 miles. With max. fuel load and 550 lb. bombs - 220 mph, 960 miles; 270 mph, 870 miles.

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ITEM: FI 156

INTELLIGENCE: According to file of Mitsubishi Berlin Office, FI 156 was shipped to Japan. (A-1)

IDENTIFICATION:

Manufacturer:	Fieseler
Crew:	2 to 3
Duty:	Army cooperation, reconnaissance, staff transport.

Single-engine, high-wing monoplane. Fuselage is rectangular; cabin provides excellent visibility. There is a braced tail, single fin and rudder. Landing gear is fixed and especially strong to permit heavy landings. Bomb racks may be fitted below wings for light bombing.

Speed:	145 mph at 3,000 ft.; 100 mph cruising; 25 mph land speed.
Climb:	To 6500 ft. alt. in 9 min.
Service Ceilings:	Normal load, 15,000 ft.; min. fuel/no bombs, 17,500 ft.
Fuel:	U.S. gals., normal - 39; max. - 93.
Economical cruising speed with normal fuel/bomb load:	@ 60 mph, 240 miles; @ 82 mph, 230 miles; with max. fuel load @ 60 mph, 630 miles; @ 82 mph, 600 miles.
Engines:	1 rated 240 HP
Armament:	1 - 7.9 mm
Landing Run:	100 ft.
Overall Span:	46'8"
Overall Length:	31'10"
Overall Weight:	2800 lbs.
Height:	8'6"
Gross Wing Area:	280 sq. ft.

CONCLUSIONS: A small strut-braced, high-wing monoplane with a single radial engine has been found on Clark Field. It is almost a small replica of the German Fieseler Storch, and is probably used for surface reconnaissance and headquarters liaison work, or possibly for low-level photographic work against undefended areas.

No armament is carried. A HA 42 engine of 282 HP is installed, using a two-blade propeller.

Large Fowler type flaps, with long guide rails, are used in addition to slots along the entire leading edge of the wings. These features would assist in quick take-off and [illegible] landings.

Undercarriage is the non-retractable type, having a "bow-legged" appearance. It is attached from the wing roots and strut-braced on to the base of the fuselage.

APPROXIMATE DATE OF PRODUCTION: This plane has been identified as "Stella" in operation at present.

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ITEM: BLOHM AND VOSS DESIGN

INTELLIGENCE: Observation.

IDENTIFICATION: Over Tachikawa 4 May 1945, an unidentified twin-engine Japanese fighter unsuccessfully attacked a XXI Bomber Command B-29 at approximately 34,000 feet. The B-29 crew was impressed with the attacker's high speed and great maneuverability, describing it as "more maneuverable than any Japanese plane previously encountered above 30,000 feet."

No hand camera was available to photograph this new aircraft and there were apparently several "definite recollections" of general shapes.

The characteristics which seemed quite definite are:

1. Twin radial engines.
2. Inverted gull wing in a low-mid position, with parallel leading and trailing edges to wing and tail plane and almost square tips.
3. Sleek fuselage with canopy fairing smoothly into it.
4. Fin with straight and almost vertical leading edge, rudder with definite rearward slope.
5. Prominent tail cone like DINAH.
6. Navy paint scheme--i.e., dark green top surfaces and light gray under surfaces.

It is considered probable that the aircraft is a Navy fighter. Its high speed and maneuverability, and its attack at high altitude point to the possibility that it may be the new OTSU fighter TENRAI. Assuming that it is powered with HOMARE 21's, an approximate span and length for this power would be about 46-48 feet by 37-39 feet. Reported dimensions of TENRAI are 46-feet span and 37'7" long.

The unusual parallel-edged wing and tail plane with inverted gull are reminiscent of successful Blohm and Voss designs of 1938, and if correct as reported should be a definite characteristic for future sightings.

CONCLUSIONS: Some doubt exists as to whether gull wing is accurately reported.

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10. AIRCRAFT

ITEM: GO 242/244

INTELLIGENCE: Letter picked up at Bad Eilsen in May 1945, from the Deutsche Mitsui Bussan to German authorities, requests blueprints and dimensional data. Letter dated 7 February 1944.

IDENTIFICATION: Manufacturer: Gothaer Waggonfabrik
Crew: 2
Duty: Transport

This is a twin-engine, high-wing, twin-boom aircraft. The strut-braced wing tapers moderately to squared tips. Ailerons and flaps cover entire trailing edge. Lift spoilers are fitted on upper wing surface forward of outer portion of flaps. Nacelle is hinged at top aft of trailing edge for loading purposes. Forward upper part of nacelle is fitted with large windows. Tricycle landing gear is employed. Armament fitted on manually-operated mountings. Cruising at 126 mph @ 10,000' range is 330 miles, and at 116 mph, 340 miles.

Max. Emergency Speeds:	146 mph @ S.L.; 169 mph @ 10,000 ft.
Cruising Speeds:	Normal - 109 mph @ S.L.; economical, 100 mph; each at sea level
Climb:	To 10,000 ft. alt. in 20.2 min.
Fuel:	217 U.S. gals. (normal, est.)
Ranges:	Economical cruising speed @ 100 mph, with normal fuel/bomb load, 217 U.S. gals. and 4400 lb. bombs, 385 miles; 109 mph, 360 miles.
Power Plant:	2 engines, rated 800 HP, each at 8,000 ft. alt.
Armament:	For'd fuselage - ½ x 7.99 mm; Dorsal - 1 x 7.9 mm; Lateral - 4 x 7.9 mm; tail - 1 x 7.99 mm
Bomb/Freight Load:	Freight 4400 lbs; troops 23 men.
Materials:	Wood and metal
Span:	79'
Length:	52'7"
Gross Wing Area:	700 sq. ft.
Weights:	Landing, 15,900 lbs.; normal load, 17,500 lbs.

CONCLUSIONS: Japanese interest in gliders is well known, but this is first documentary evidence of their efforts to obtain details. It is remotely possible that the newly-discovered Ku7 Japanese glider may stem from this plane.

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ITEM: JU 88K

INTELLIGENCE: According to the files of the Mitsubishi Berlin Office, a number of JU 88K5 and spare parts were shipped to Japan.

IDENTIFICATION: Little information is presently available other than that the 88K is supposedly similar to the JU 88, and may be fitted with BMW 801 engines which are equipped with turbo-superchargers.

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ITEM: JU 290

INTELLIGENCE: Full details are reliably reported to have been in Japanese hands by October 1943. (A-2)

IDENTIFICATION: The JU 290 was developed from JU 90. It is a four-engined low-wing monoplane, and was used for transport, possibly glider-towing, or bombing, and can carry 90 men. A retractable loading ramp, 16'2" long by 7'8" wide, is built into the bottom of the rear fuselage. It is mechanically operated and acts as a jack which lifts tail of the aircraft clear of the ground to facilitate loading. One dorsal turret is hydraulically operated. Ventral gunner's position is under port side of fuselage forward of wing. The tail gun mounting appears to be manually operated. It may be converted into a heavy bomber with 2 x 20 mm in dorsal turrets, 2 x 13 mm in lateral positions, and twin 7.9 mm in tail.

Crew:	Probably 4 to 7
Manufacturers:	Junkers
Max. Emergency Speeds:	209 mph @ S.L.; 243 mph @ 18,000 ft.; 212 mph @ 8,000 ft.
Cruising Speeds:	Normal, 203 mph; economical, 191 mph; each at 18,000 ft.
Climb:	To 18,000 ft. alt. in 43.5 min.
Service Ceilings:	Normal load, 19,000 ft.; min. fuel/no bombs, 23,000 ft.
Fuel:	U.S. gals., Normal - 1909; max. - 3319 (est.)
Ranges:	With normal fuel/bomb load, 1909 U.S. gals. and 19,000 lbs. @ 191 mph - 1030 miles; @ 230 mph - 990 miles. With max. fuel load and 10,000 lbs. bombs @ 186 mph - 2010 miles; @ 208 mph - 1880 miles.
Armament:	Forward fuselage poss. - 1 x 20 mm Dorsal - 1 x 15/20 mm fore and aft Lateral - 4/6 x 7.9 or 2 x 13 mm Ventral (rear) - 1 x 13 mm (fwd.) - 1 x 20 mm Tail - 1 x 20 mm
Specifications:	Span - 138'; Length - 92'10"; Height - 18'; Gross wing area - 2210 sq. ft.; Weight - 90,000 lbs.

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10. AIRCRAFT

ITEM: JU 390

INTELLIGENCE: Reliable information fixes acquisition of details by the Japanese as October 1943. (A-2)

IDENTIFICATION: The Ju 390 was expected to serve as a reconnaissance and also a long range transport plane. It is similar to the Ju-290 with an enlarged central wing section allowing for an additional wing on each side, making a total of six engines.
Engines (BMW-801-E, 2000 H.P.) - 6

Wing Span	164 sq. ft.	
Wing Surface	2,733 sq. ft.	
Weight	39.6 tons	
Flying wt.	75 tons	
Crew	7	
Max. speed at normal alt. of 19,680'	310 MPH	
Cruising speed at 6500' alt.	186 MPH	
Cruising range	3,960 miles	
Rate of climb at take-off	10.5'/sec	
Ceiling	26,200'	
Take-off run	4,920'	
Bomb Load	10 tons	Heavily armed

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ITEM: AIRCRAFT ENGINE - BMW 801

INTELLIGENCE: Official German records show delivery of one unit in February 1943.

IDENTIFICATION: This 14 cylinder, twin row, air cooled, radial engine has a single stage, two speed supercharger and direct fuel injection. A novel feature is the engine driven cooling fan mounted immediately behind the propeller. This fan is used primarily to cool the engine during taxiing and take off.

Power output	1600 hp
Bore	6.14"
Stroke	6.14"
Displ.	2.550 cu.in.
Comp. ratio	6:5
Dry weight	2960 lbs.
Red. gear	.541
Eng. diameter	52"
Eng. length	58"

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ITEM: A/C ENGINE, JUMO "C" TYPE 207

INTELLIGENCE: Reliable information places date of acquisition around May 1944.

IDENTIFICATION: In-line opposed; 6 cylinder (12 pistons), two crankshaft, two cycle diesel aircraft engine; said to exceed altitude of 3 miles; develops 1000 hp at take off.

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ITEM: A/C ENGINE, JUMO "D" TYPE 207

INTELLIGENCE: Reliable information places date of transfer around May 1944.

IDENTIFICATION: In-line opposed; 6 cylinder (12 pistons); two crankshaft; two cycles diesel A/C engine. Said to develop 1200 hp and 3000 RPM at take off.

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ITEM: AIRCRAFT ENGINE, JUMO 213 A/1
211J

INTELLIGENCE: Official German records show delivery of two units in December 1943 of the 213; no date of delivery given for the 211.

IDENTIFICATION: This is a 12 cylinder, liquid cooled, inverted "V" type engine.

Power output	1700 hp
Bore	5.91"
Stroke	6.5"
Displ.	2.133 cu.in.
Red. Gear	.471

ITEM: A/C ENGINE, JUMO TYPE 222

INTELLIGENCE: Transfer reliably reported (A-2).

IDENTIFICATION: Junkers, 24 cylinder; 4270 cu. in. displacement, conventional A/C engine. Develops 2500 hp and 4000 RPM at take off.

ITEM: AIRCRAFT ENGINE, DB 601 F

INTELLIGENCE: Official German records show deliveries beginning January 1943.

IDENTIFICATION: This Daimler-Benz 12 cylinder, inverted V, liquid cooled type has direct fuel injection. It is fitted with an automatically controlled hydraulic-coupled supercharger. Also has an improved reduction gear ratio.

Power output	1400 hp
Bore	5.91"
Stroke	6.30"
Displ.	2070 cu.in.
Comp. ratio	7:1
Dry weight	1500 lbs.
Red. gear	.595
Eng. diameter	29"
Eng. length	68"

CONCLUSIONS: High ranking German naval officers state that this engine is being reproduced in Japan; other information indicates that production is for use in a fighter-bomber (Aichi-Koku) which was scheduled to become operational early in 1945.

ITEM: AIRCRAFT ENGINE, DB 603

INTELLIGENCE: Official German records show at least four deliveries of twelve units on order, January 1943.

IDENTIFICATION: This is a 12 cylinder, liquid cooled, inverted "V" type engine used in FW 190.

Power output	1680 hp
Bore	6.38"
Stroke	7.09"
Displ.	2720 cu.in.
Comp. ratio	7:1
Dry weight	2120 lbs.
Red.gear	.5175; .475
Eng. diameter	30"
Eng. length	101"

ITEM: A/C ENGINE DB 613

INTELLIGENCE: The Japanese learned details of engine (DB 613) in July 1943; obtained full description in July 1944. Evaluation A-2.

ITEM: TYPE 2, A/C ENGINE (MFR. KAWASAKI)

INTELLIGENCE: Captured equipment.

IDENTIFICATION: Ha 60 Model 22, an 1100 h.p. army engine, is a copy of the German DB 601A. A few Japanese features have been incorporated, notably the injection pump.

Type:	
Cylinder arrangement	Inverted V
Coolant	Liquid
Number of cylinders	12
Fuel:	
Cruise and normal	92
T./O./Mil/W.E.P.	92
Characteristics:	
Fuel metering system	Direct injection pump
Compression ratio	6.7
Propeller ratio	.643
Supercharger:	Variable speed
Ratio (s)	10,39 (-3% slip)
Imp. dia - mm/in.	260/10.25"
Diameter - mm/in.	
Length	1720/67.7"
Width	712/28,0"
Height	1000/39.4"
Bore/Stroke - mm/in.	150/160/5.91"/6.3"
Displace. - ltr/cu.in.	33.9/2070
Dry weight - kg/lbs.	685/1500
Installed in:	TONY I

ITEM: ATSUTA A/C ENGINE MODEL 21 (MFR: AICHI)

INTELLIGENCE: Captured equipment.

IDENTIFICATION: The Atsuta 21 Navy engine (Ha 60 Model 2) is a design copy of the German DB601A with slight modifications.

Type:	
Cylinder arrangement	Inverted V
Coolant	Liquid
No. of cylinders	12
Fuel:	
Cruise and normal	91
T.O./Mil/W.E.P.	91
Characteristics:	
Fuel metering system	Direct injection pump
Compression ratio	6:9
Propeller ratio	.643
Supercharger:	Variable speed
Ratio (s)	10.04 without slip (Actual range 7.03-9.7)
Imp. diam. - mm/in.	260/10.25"
Diameter - mm/in.	
Length	1722/68"
Width	712/28.0"
Height	1072/42.2"
Bore/Stroke - mm/in.	150/160/5.91"/6.3"
Displace. - ltr./cu.in.	33.9/2070
Dry weight - kg/lbs.	625/1380
Installed in:	JUDY 11 (Code name)
	JUDY 21

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ITEM: ATSUTA A/C ENGINE MODEL 31 (MFR.: AICHI)

INTELLIGENCE: Captured equipment.

IDENTIFICATION: Ha 60 Model 31 is very similar to Atsuta Model 21, and Type 2, 1100 hp., therefore, also copied from German DB601A. All structural differences between the Model 31 and 21 are unknown at present. Impeller diameter has been increased slightly and the propeller shaft resembles that of the Type 2, 1100 hp. rather than the serrated flange type of the Model 21. The 31 is designed to operate (Military rating) at 2600 rpm and 39.8" boost in contrast to 2400 rpm and 35.8" for the 21.

Type:	
Cylinder arrangement	Inverted V
Coolant	Liquid
No. of cylinders	12

Fuel:	
Cruise and normal	92
T.P./Mil/W.E.P.	92
Characteristics:	
Fuel metering system	Direct injection pump
Compression ratio	7:2
Propeller ratio .	.593
Supercharger:	Variable speed
Ratio (s)	10.04 without slip (Actual range 7.10-9.7)
Imp. dia - mm/in.	265/10,42"
Diameter - mm/in.	
Length	2150/85"
Width	712/28,0"
Height	1060/41.7"
Bore/Stroke - mm/in.	150/160/5.91"/6.3"
Displace - ltr/cu.in.	33.9/2070
Dry weight - kg/lbs.	715/1576
Installed in:	JUDY 12
	JUDY 22

- -

ENGINES AND SUPERCHARGERS

(General Conclusions)

Japanese interest in German aircraft engines probably has been primarily directed at learning techniques, principles and designs for adaptation to Japanese products. Copies of German power units have not been mass produced in Japan, except for the Daimler-Benz 12-cylinder in-line engine, which is installed in the Tony and possibly in certain new twin-engine in-line planes.

Recent indications are that emphasis has been placed on obtaining high-performance carburetors, fuel-injection equipment, high-altitude ignition systems and other equipment to improve high-altitude aircraft performance. Much of this material had been assembled in French ports for shipment and was destroyed there at the time of the Allied landings.

The Japanese apparently sought information on superchargers, but in this case also certain models, probably from the DB 627 and 628, were destroyed at Lorient, where they were awaiting shipment. Nevertheless, considerable information, parts and technicians have been sent to Japan. There is evidence that the Japanese have considered the installation of two-stage superchargers in several of their new aircraft.

ITEM: Bomb Sights, Lofte

INTELLIGENCE: Models of the latest German bomb sights for aircraft were shipped to Japan in the summer of 1943, again in March 1945. Evaluation A-2.

IDENTIFICATION: Type 7A Fully Automatic. Rather ponderous design - Height must be set twice.

Type 7B An improved version of the Lofte 7A. Height has to be set only once. The vertical is stabilized by a gyroscope. Fully automatic. The settings made enable the sight to measure the bombing angle, when the line of sight is turned to this angle the bombs are released automatically. The sight is telescopic and is focused by tuning the eyepiece. In the field of vision a cross-wire appears, reflected by a light on a mirror. The strength of the light is adjustable and the movement stabilized by a pendulum system. Also reflected into the telescope is a rotating disc which indicates against a fixed mark, the position of the line of sight measured in degrees. The vertical is 0°. Also moving with disc is a pointer, which indicates the moment of bomb release when it is at the fixed mark. The position of the pointer on the disc depends on the settings of the height, ground speed, trails and size of stockknobs.

Type 7C Operates same as 7B, except stabilization of cross wires is done by gyroscope instead of pendulum, which is switched on while aircraft is on approach to target, and takes 10 sec. to run up.

Type 7C-2 Almost identical with 7C except heater is controlled by thermostat in the nose of the bombsight, scale is calibrated in intervals of 5°, also different manufacturer.

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ITEM: Take-Off Gear

INTELLIGENCE: Reliable source gives dates of transfer as shown below. (A-2)

IDENTIFICATION: 1. Accelerated take-off gear for launching carrier aircraft as used aboard the Schornhorst. Date - July 1943.

2. Take-off gear of Zeppelin "Drum" type, Mk12. Rights acquired September 1944.

3. Take-off gear intended for use with JU 87 and ME 109.

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ITEM: Aircraft, Propellers

INTELLIGENCE: Reliable PW states that large numbers of special propellers, particularly variable pitch propellers were shipped to Japan in 1942 and 1943.

ITEM: Automatic Pilots, Aircraft

INTELLIGENCE: In July 1943, Japanese obtained details of Patin type PDS, 3-dimensional; Siemens Model K 12 (to be used in place of Siemens KAU). In September 1944 the Japanese may have obtained a SAM Co. model pilot.

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ITEM: German Power-Boosting Systems.

INTELLIGENCE: In view of the fact that these power-boosting systems were designed for several types of aircraft known to be in possession of the Japanese, it appears likely that methods of boosting are also known to them, although no confirmatory evidence is at hand.

IDENTIFICATION: Five power-boosting systems are used by the Germans to improve performance of airplane engines. They are:

1. GM 1.
2. Methanol Injection.
3. Ethanol Injection.
4. Pure Water Injection.
5. Fuel Injection into Air Intake

GM 1: This system is used to improve performance above the rated altitude of an engine. Nitrous Oxide in liquid form is carried in a container being supplied to the supercharger inlet by air pressure. The nitrous oxide provides additional oxygen to the engine and also acts as an anti-detonant. Part of the increased power obtained is due to its charge-cooling qualities.

In twin-engined aircraft, e.g., JU-88 S, three interconnected nitrous oxide containers, each with a capacity of 25 gallons, are mounted in the fuselage, together with the compressed air cylinders. The complete installation (dry) weighs 400 lb. (estimated) the weight of nitrous oxide is 900 lb., assuming full tanks.

In single-engined aircraft, e.g., ME-109 G, the cylindrical containers, of 16 gallons capacity, is mounted vertically behind the pilot and the installation weighs 90 lb. dry. In both cases the tanks are heavily lagged with glass wool and enclosed in a shell of light alloy.

Increase in Performance Provision is made for "emergency" and "normal" rates of injection, corresponding repectively to 13.2 lb. and 7.95 lb. per engine per minute. It has been estimated that a JU-88 S-1 (BMW 801 G2 engines) with a normal maximum speed of 343 m.p.h. at 26,000 ft. attains 360 m.p.h. with the "normal" rate of injection and 370 m.p.h. with "emergency". At 33,000 ft. the normal maximum speed is 301 m.p.h., which is increased to 330 m.p.h. and 345 m.p.h. with the two rates of injection The increase in power of the BMW 801 engine using the GM 1 system is 135 h.p. at "normal" and 224 h.p. at "emergency."

The endurance of the system as installed in the JU-88 S-1 is 45 mins. at "normal" and 27 mins. at "emergency." The use at the "emergency" setting is limited to about 3 mins. at a time. The endurances specified only account for about 712 lb. of nitrous oxide as compared with

900 lb. with the tanks full. There is thus an ample margin for evaporation if the tanks are completely filled.

When installed in the ME-109 G the endurance of the GM 1 system is 24 mins. and 14½ mins. at the two settings. It is estimated that this aircraft attains a speed of 450 m.p.h. at 30,000 ft. with GM 1. The speed of the FW-190 A is increased from about 415 m.p.h. at 22,000 ft. to about 430 m.p.h. at 26,000 ft. when using GM 1.

Methanol Injection: This installation is designated MW-50 or MW-30 according to the proportions of methanol (methyl alcohol) in the mixture. The system is chiefly used to obtain extra power below the rated altitude of the engine. The mixture is normally injected into the eye of the blower and acts as an anti-detonant, providing charge cooling and enabling higher pressures to be used. A 4 percent increase in power can be obtained, even at constant boost pressure.

The MW-50 fluid consists of 49.5 parts (by volume) of tap water, 0.5 parts of anti-corrosion fluid (Schutzöl 39), and 50 parts of methanol. MW-30 fluid consists of 69.5 parts of tap water, 0.5 parts of anti-corrosion fluid and 30 parts of methanol. MW-50 has a lower freezing point than MW-30 and is probably an alternative mixture for use when extreme temperatures are likely to be encountered.

The mixture is carried, on a single-seat fighter, in a tank situated in the fuselage behind the pilot. Boost pressure is utilized to pressurize the tank, forcing the mixture along a pipe to the eye of the supercharger. The flow of mixture is controlled by a solenoid valve operated by an automatic throttle switch and a master switch in the cockpit. A pressure gauge indicates the pressure of fluid in the supply pipe.

Application of ME-109 (DB 605) The increased performance is obtained by opening the throttle fully to give 1.7 boost (9.5 lb./sq/in) at 2,800 r.p.m. The mixture is then automatically injected into the eye of the supercharger. Both the DB 605 A and DB 605 AS (large supercharger) can be adapted for this system, being then designated the DB 605 AM and DB 605 ASM respectively. When fitted to the DB 605 AM the system can be used up to 19,700 ft. and up to 28,000 ft. with the DB 605 ASM.

Adaptation of the engine for the MW-50 system involves changing the boost regulator, re-setting the boost pressure, and fitting special sparking plugs (DW 250 ET 10/1). After conversion to the MW-50 system, but without methanol in the tank, it is not possible to use the take-off and emergency boost rating of 1.42 (5.5 lb./sq/in.). At one time it was stated that C3 (96 octane) fuel must be used with MW-50, but a German document has since indicated that either C3 or B4 (89 octane) fuel can be used.

Another document states that 18.7 gallons or 16.5 gallons of mixture is carried on the ME-109 fighter and reconnaissance versions respectively. This is sufficient for 30 mins. (or 26 mins.), injection being at the rate of approximately 35 gallons per hour. At 1.7 boost and 2,800 r.p.m., the fuel consumption is increased to 141 gallons per hour. At 1.42 boost and 2,800 r.p.m. the consumption is 106 galls./hr. The increased power can be

obtained for a maximum of 10 minutes at a time, and at least 5 minutes must elapse between successive periods of operation. At this increased power the sparking plugs have a life of only 15 to 30 hours. Higher take off power can be obtained at 2,600 r.p.m. and 1.64 ata boost (8.7 lb./sq.in.) in the engine is supplied with MW-50, but the following points are made in a German document:-

1. 1.64 ata can only be obtained at sea-level, and decreases with increasing height of the airfield above sea-level.

2. Maximum time of use is 80 secs. (Do. 24), 180 secs. (Bv 222) and 1 minute for all other aircraft fitted with these engines.

3. 2,600 r.p.m. must not be exceeded when airborne.

4. After using higher power, engine must be throttled down to climbing power (1.25 ata boost and 2,250 r.p.m.).

5. Consumption of MW-50 is at the rate of 0.75 to 1.0 gallon per minute.

An increase in speed of 50 m.p.h. is claimed for the ME-109 G-6. The increased power obtained from the DB 605 A at sea level is between 120 and 150 h.p. The FW-190 D with MW-50 can attain a speed of 440 m.p.h. at 16,500 ft. The MW-50 system is so far known to be fitted in the FW-190 D-9 (Jumo 213), ME-109 G (DB 605A), Do 24 (BMW 323) and BV 222 (BMW 323). The system could, however, be applied to most aircraft without extensive modifications.

Ethanol Injection: An official German document dated November 1944 has mentioned an ethanol-water mixture to be used in the DB 605 and the Jumo 213 A. The mixture consists of 49.5 parts tap water, 0.5 parts anti-corrosion oil and 50 parts of ethanol (ethyl alcohol). It can be used with either B4 or C3 fuel. It is difficult to understand why ethanol has been substituted for methanol in the mixture, as it offers no apparent advantage and probably gives slightly higher cylinder head temperatures.

Pure Water Injection: This syten has been mentioned in connection with the BMW 323 R-2 and T engines. It can be used if methanol is not available, subject to the following conditions:-

1. Ground temperature must not be likely to fall to 0°C.

2. High or long flights must not be undertaken if the temperature is likely to be below 0°C.

3. The engine must be checked after every 50 hours running time for signs of corrosion.

The points noted in connection with the BMW 323 R-2 and T engines with MW-50 injection must also be observed when using pure water.

Fuel Injection into Air Intake: This system is used on the BMW 801 D to increase the emergency performance. It provides for the over-riding of the boost regulator and a simultaneous injection of C3 (96 octane) fuel into the port air intake to prevent detonation and provide internal cylinder cooling.

The pilot has a push-pull control which operates two cocks. The first cock opens an air bleed in the boost pressure regulator chamber, causing the regulator to open the throttle butterfly to provide 1.65 ata (8.8 lb./sq./in.) instead of 1.42 ata (5.5 lb./sq./in.) at sea-level. The second cock opens a pipe-line from the fuel pump to a spray nozzle fitted in the port air intake. The spray nozzle is calibrated to pass 14.3 ± 1.43 gallons per hour at a pressure of 18 to 25 lb./sq./in.

The increased emergency performance (1.65 ata and 2,700 r.p.m.) must only be used in extreme emergency and at high speed, with the throttle fully open and the propeller control in "automatic". The lever should not be operated on the ground, or at low power outputs, because of the danger of fire, and the installation cannot even be tested on the ground. Although no specific time is laid down, the system should only be operated as long as is necessary during extreme danger. The fuel consumption at 1.65 ata and 2,700 r.p.m. is approximately 185 gallons per hour. (146 gallons per hour at 1.42 ata boost and 2,700 r.p.m.)

There is some uncertainty as to the conditions under which special emergency power can be employed. One German document states that the increased boost pressure can be used with both high and low blower ratios. Another document indicates that it must only be used in low blower below 3,200 ft., but this may be a temporary restriction.

The system is used on the FW-190 fighter-bomber fitted with the BMW 801 D engine. It is believed that the designation of the engine is changed to BMW 801 Q when this sytem is fitted.

Increase in Performance: The BMW 801 D at sea-level develops 1,730 h.p. at 1.42 ata boost, but the BMW 801 D (or Q) with extra emergency performance develops 1,870 h.p. at 1.65 ata boost. The FW-190 (with BMW 801 D) has a normal maximum speed at sea-level and 1.42 ata boost of about 344 m.p.h. Assuming that special emergency power can also be used with the high blower ratio, the maximum speed at 19,000 ft. is about 405 m.p.h. (A.I.2(g) Report No. 2322).

Applications: The system is so far known to be installed in the ME 109 G (DB 605), FW 190 A (BMW 801), Ju 88 S and T (BMW 801), Ju 188 A and D (Jumo 213), Ju 188 E and F (BMW 801); ME 110 (DB 605), ME 410 (DB 603) and Ju 86 R (Jumo 207 diesel).

ITEM: HEINKEL HIRTH .001 JET ENGINE (HEINKEL Hs11)

INTELLIGENCE: A letter from Kurt Lammertz to Director Wolff of Heinkel Hirth, dated 21 March 1945 is in regard to supplying the Japanese Navy with complete data on this unit. According to the letter, received by Director Wolff in Stuttgart 3 April 1945, the data was probably to be forwarded to Japan by long range submarine.

IDENTIFICATION: At the inlet end is a fan mounted at the forward end of the quill shaft which drives the auxiliaries. There are 11 blades of aerofoil section, and the blade angles vary from 9 degrees, 30 minutes at the root, to 48 degrees, 30 minutes, at the tip. It is probably intended primarily to impart swirl to the incoming air, but may also provide a degree of initial supercharging for the main compressor.

The first stage of the compressor proper is centrifugal. The rotor is of built-up type with 12 inserted blades, and has a maximum diameter of approximately 2 ft. 1.5 in. The blades have a pronounced variation in pitch from root to tip.

Following the centrifugal compressor stage there are three axial stages. The diameter over the blades of the axial rotors is about 2 ft. 5 in., and the mean blade heights range from 2.5 in. at the first stage to 1.6 in. at the third and final stage. Provision is made in the design for varying the pitch of the stator and rotor blades at the time of assembly.

There is a single annular combustion chamber, and the fuel is injected in a rearward direction by a series of jets (number unknown) carried by a shrouding ring. Behind the jets is an elaborate arrangement of baffles to control the air flow. Auxiliary jets and sparking plugs provide for starting combustion.

At the rear end the combustion chamber is reduced in diameter rather abruptly, and the exhaust gases pass out through an annular opening to the two-stage turbine. The diameters over the blades are approximately 1 ft. 11.5 in., and 2 ft., and the blades heights are about 4.15 and 4.9 in. at the first and second stages respectively.

The tail pipe is of the variable-outlet type. The bullet, which has a maximum travel of about 6.5 in., always projects beyond the end of the pipe. A piston operating in an axial hydraulic cylinder is directly connected to the bullet. A large-diameter hollow shaft connects the turbine to the compressor, and the main rotor assembly is carried in a single-row roller bearing at the rear, and a ball bearing at the forward end. An additional ball bearing supports the front end of the quill shaft which drives the intake fan and the auxiliaries. Bevel gearing and radial shafts transmit the drive to the auxiliaries.

Starter Motor. An electric starter motor is mounted above the unit at the forward end, drive being transmitted to the rotor through one of the radial shafts. The overall length of the unit is 10 ft. 8 in. (or 11 ft. 2 in. with a larger starter). The outside diameter of the [illegible]

chamber casing is 2 ft. 9 in.

CONCLUSIONS: The advent of jet propelled aircraft in the Pacific war has already been hinted. It should be expected that their numbers will increase as quickly as the Japanese A/C industry can turn them out under present conditions.

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ITEM: JUMO 004 TURBO-JET UNIT

INTELLIGENCE: Reliable evidence of transfer date of March 1944. Evaluation A-2.

IDENTIFICATION: JUMO 004 (203) Turbo Jet designed for the AR 234B-2 and ME262 Mfr: Junker. Turbine is of axial flow type; has small horizontally opposed 2 stroke engine, with length of 18/20 cm between cylinder heads attached to its forepart. This engine has crankshaft speed of 8000 rpm and develops 10 BHP. It is used to start and run up the compressor impeller and the turbine. Throttle valve in discharge conduit is used to govern power output. Provision is made for ventilation or cooling of many parts.

Propulsion is developed through the reaction to ejected hot gases which have been created by compressed air igniting with liquid fuel.

Dry weight each unit	1500 lbs.
Overall diameter	32"
Length	11'8"
Static thrust	1800 lbs.
Main components:	8 stage compressor, turbine, adjustable exhaust cone for speed control, and fuel injector.

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ITEM: BMW JET UNITS

INTELLIGENCE: Data furnished to Japan. Evaluation A-2. Date unknown.

IDENTIFICATION: Mfr., Bayerisches Moteren Werke. This turbo jet is used in AR 234-A. It consists of air intake, 6-stage axial compressor, 6 circumferential combustion chambers, single stage turbine, jet orifice. It is similar in principle and construction to Jumo 004 although smaller. An auxiliary electric motor, which is coupled to the fuel control lever in the cockpit, drives the variable area nozzle regulator.

Length	11'
Diameter	3-1/2'
Thrust	[illegible] sea level

12. FUELS, CHEMICALS, METALS

ITEM: INGOLENE OR H_2O_2 PROPULSION UNITS (CHEMICAL PROCESS)

INTELLIGENCE: The Japanese are known to have received details of Walters propulsion units developed for submarines, aircraft, torpedoes and rockets. Transfers to the Japanese are reliably reported as having taken place in September and October 1944, February and March 1945. Details of the manufacture and use of all chemical components used in the propulsion units were involved.

IDENTIFICATION: The H_2O_2 propulsion system may be classified into four main classes:

1. Direct decomposition with a liquid catalyst utilizing resulting steam and oxygen to drive a turbine or push a piston (as in the V-1 catapult). The decomposition temperature is theoretically 480-500 degrees C.

2. Use a catalyst that is also a fuel such as Helmann. The oxygen from the H_2O_2 is used to burn the fuel and gives a combustion temperature of approximately 1900 degrees C.

3. Decompose H_2O_2 to steam and oxygen in a decomposition chamber and lead these gases into a further combustion chamber where fuel is injected which gives a combustion temperature of 2200-2300 degrees C. The first decomposition takes place while passing through a basket of solid catalyst. This method is used in U-Boats.

4. Decompose H_2O_2 with Helmann as in (2) but shut off the Helmann and at the same moment inject fuel which continues the process at a combustion chamber temperature of 2200-2300 degrees C. This method is used in torpedoes.

The four processes vary in safety. The safest is Number 3 where the decomposition of the H_2O_2 is stable and insured by the presence of solid catalyst. This process is used wherever personnel are present as in U-Boats and rocket aircraft. Process Number 1 is next safest. Except that the catalyst being liquid, if a stoppage should occur and the combustion chamber fill with H_2O_2 a sudden un-stoppage would cause an explosion. Process Number 2 is next safest but suffers from the same disadvantage. Here too explosion would be more powerful due to the presence of the fuel. The most dangerous is Process Number 4 which is used in torpedoes. There is considerable danger if the fuel is injected at the same time as the Helmann as an explosion equivalent to high explosives would result. This is an additional reason why the beginning of the process is accomplished using Process Number 2.

Code names used in Hydrogen Peroxide Processes:

Ingolene or "T-Stoff" - composed of 80 - 82% H_2O_2, a small amount of stabilizer and the remainder water. Stabilizers, phosphoric acid or oxyquinoline, are not mandatory. Also known as Aurol.

Catalysts - Usually permanganates or cyanates. The former usually sodium, calcium, sometimes potassium. These in liquid form are known as "Z-Stoff".

Fuel and Catalyst Mixture - Helmann. The catalyst is usually copper cyanate; used only with mixed fuels.

Fuels - "B-Stoff" - for torpedoes, hydrazine hydrate mixed with methyl alcohol in ratio of 1 to 3.
"C-Stoff" - Methyl alcohol/water mixture.
"M-Stoff" - Methanol decalene - ordinary fuel oil.

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ITEM: HYDROGEN PEROXIDE

INTELLIGENCE: Reliable PW believes that considerable amounts of H_2O_2 were shipped to Japan in long flasks under pressure. Reliable information fixes the date as October 1944.

CIOS Evaluation Report 21, 17 May 1945, reveals definite knowledge of contact between Elektrochemisches Werke A.G. and Japan.

IDENTIFICATION: The Elektrochemisches Werke A.G. has engaged in the production of hydrogen peroxide 82% (T-stoff) and of sodium and calcium permanganate (Z-stoff made only from the potassium salt).

In addition, the higher officials of this company, together with their subsidiary company at Gesthofen, and the I.G. have been very closely associated with the whole development of chemical fuels and explosives derived from the reaction of T-stoff with hydrazine hydrate, permanganates, alcohols and easily oxidisable materials. They have also been closely concerned with the development of catalysts for use during manufacture of ingredients and also during the use of the finished products.

CONCLUSIONS: CIOS concludes that the Japanese were not supplied with full details of the latest processes so that while they could make hydrazine hydrate from the information supplied they would encounter numerous difficulties in doing it.

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ITEM: HYDROGENATION PROCESSES

INTELLIGENCE: Several files on proposed Japanese and Manchurian fixed nitrogen and hydrogenation recovered at the TB/N Buro (Construction Office) at Bobenhen. Other files on transfer of fuel processes (still unexploited) recovered at Ammoniakwerk Merseburg GmBH Plant of the I.G. Farben Co. at Leuna, Germany.

12. FUELS, CHEMICALS, METALS

ITEM: HIGH TEMPERATURE RESISTANT STEELS

INTELLIGENCE: Recovered in Essen, Germany, April 1945, was folder containing negotiations and agreements relative to the production in Japan of German high temperature resistant steels, "cromadur" and "tinidur", which the Japanese wished to use for "Turbinenschanteln" in airplane motors. Formulas for the production of these steels are included. Also included were formal agreements which reveal that an official government policy of interchange of Jap-German information was inaugurated on 2 March 1944.

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ITEM: INDUSTRIAL PROCESSES, ALUMINUM

INTELLIGENCE: Reliable PW states that complete equipment for a plant for manufacturing aluminum from bauxite was shipped to Japan in 1943.

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ITEM: ALUMINUM EXTRACTIONS FROM VOLCANIC ASH

INTELLIGENCE: Intelligence evaluated A-2 states that the Japanese have acquired a process of manufacturing aluminum from volcanic ash.

IDENTIFICATION: Preparation of (SiO_3) Alk-powdering of the volcanic ash and magnetic separation.

Al_2 (SO_4) 2 (K2504) $24H_2O$ produced by treatment with sulphuric acid.

Impurities eliminated in form of iron.

Crystallization of material and removal of water.

Material heated and resolved, separated in water into potassium sulphate and alumina. 800 kg. of alumina can be obtained from 5 tons of (SiO_3) Alk.

Consumption of electric power is 25% less than when ordinary methods are employed because alumina so produced has low fusion point.

CONCLUSIONS: Volcanic ash is liberally distributed throughout Japan.

ITEM: TIGER TANK E

INTELLIGENCE: Secret correspondence relative to the shipment of 1 Tiger Tank E and spare parts was on dock at Bordeaux for shipment 17 January 1944 to SHOWA TSUSHO KAISHA, Ltd.

IDENTIFICATION: Hull constructed of large plates entirely welded together for mounting of heavy gun (8.8 cmKwk 36). Designed on familiar German lines, but all dimensions increased.

Wt. in action - 62 tons
Lgth. - 20'8½"
Wdth. - 12'3"
Height - 9'4-3/4"
Speed - Road: 15 mph
Cross-country: 5-10 mph
Engine - Maybach HL 230 P45 - V-12
Fuel - Gasoline
Fuel Capacity - 150 gals.
Armament - 1 8.8 cmKwK 36 (L/56)
2 MG's 34
Suspension - Front driving sprocket and rear idler.
8 load-carrying axles each with 3 large bogie wheels interleaved.

ITEM: PANTHER TANK

INTELLIGENCE: Secret correspondence relative to the shipment of 1 Panther Tank and spare parts was on dock at Bordeaux for shipment 17 January 1944 to Showa Tsusho Kaisha Ltd.

IDENTIFICATION: Principal advantages: high speed, maneuverability, effective armament and good protection.

Wt. in action - 50 tons
Lgth. - 21'11½"
Wdth. - 10'9½"
Height - 9'4"
Speed - Road: 20 mph
Cross-country: 15 mph
Armament - 1 7.5 cm KwK42 (L/70)
2 MG's 34
Engine - Maybach HL230 P30 V-12
Fuel - Gasoline
Fuel capacity - 193 gals.
Suspension - 8 load carrying axles each carrying 2 large disced rubber tired bogie wheels interleaved.

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13. VEHICLES

ITEM: MARK IV TANK

INTELLIGENCE: A letter dated 27 July 1943 from the German branch, Mitsubishi, to Japanese War Department mentions delivery of this tank.

IDENTIFICATION: This is the standard medium tank, weighing to 26 tons. Ten models (A-K) are known to have been produced. All models utilize same suspension arrangement of 8 evenly spaced bogie wheels, 18-1/2" dia., sprung in pairs on each side, with 4 return rollers. All models mount 7.5cm Kw.K, except F2 and G which mount 7.5cm Kw.K.40. Chassis is used as self propelled mount for heavier guns.

Specifications

Wt.	21.5 tons (A-E) to 26 tons
Lgth.	19 ft. 4 ins.
Wdth.	9 ft. 7 ins.
Height	8 ft. 6 ins.
Speed - Road	28 mph.
Cross Country	15 mph.
Armor - Front Plate	50 mm
Sides	30 mm
Armament	75 mm Kw.K40 - 2 MG's 34
Engine	Maybach HL 120 TRM, 320 hp
Crew	5

CONCLUSIONS: The following comparison is based only the general similarity to the MK IV suggested by P/W statements:

Several Japanese prisoners of war have affirmed the existence of a Jap "heavy" tank weighing approximately 30 tons and have furnished some specifications and performance data on this tank. While the statements of these prisoners show some discrepancies as to details, the existence of such a tank, at least in a developmental stage, is though to be fairly well established.

The Japanese are capable of designing and producing modern tanks, and their realization of the inferiority of their armor as compared to the Allied equipment, coupled with the approach of our forces to terrain suitable for large scale employment of tanks, has probably resulted in increased effort to produce more modern equipment.

The available details of the 30-ton tank indicate that it is a considerable improvement over the well-known Jap medium tanks both in armor and armament, though still inferior to the US medium in these respects.

The latest and most complete data concerning a Jap heavy tank of about 30 tons was obtained from a document captured on LEYTE on 28 December 1944, which consisted of an undated hand-written file containing spec[illegible] of which is a micro

vehicles. This document was translated by ATIS, SWPA and published in ATIS Bulletin #1735. The specifications of the heavy tank are given in tabular form along with specifications of five other armored vehicles, including Type 89 and Type 97 tanks. The specifications of the Types 89 and 97 tanks, as given in this table, agree very closely with previous information. This lends credence to the data given on the heavy tank.

Specifications and performance figures for the "Type 95 Heavy Tank" as given in the captured document are given below. These figures have been converted from the metric to the English system.

Type 95 Heavy Tank Specifications:-

Weight	Approx. 28½ tons
Length	Approx. 21 feet
Width	8 feet 10 inches
Height	9 feet 6 inches
Minimum of Ground Clearance	1 foot 8 inches
Width of Track	17 inches
Crew	5
Ehgine	290 horsepower
Armament	1 - 70mm Tank Cannon 1 - 37mm Tank Cannon 2 - machine guns
Armor (vital sections)	35mm (1.4 inches)
Fuel Capacity	100 gallons

Performance

Trench crossing ability	9 feet 10 inches
Gradient	34°
Maximum speed	13½ m.p.h.
Radius of turn	42 feet 6 inches
Cruising	Approx. 10 hours.

14. MISCELLANEOUS

ITEM: ATOM SMASHING

INTELLIGENCE: 1. In November 1944 PW heard from his Platoon Leader, a 1st Lt. Military Academy graduate, that some time during 1944 the Japs exchanged the blueprints of their V-12 diesel tank engine used in the Type 97 Med. Tanks (HAKE) for the formula of the German Atom Bomb. According to the officer, the bombs were match box size and had an effective radius of 1,000 meters. PW did not know if the bombs were being manufactured by the Japs, nor how they would be employed. They were not used in the Philippines.

2. The U-234 had uranium oxide aboard (destination Tokyo) at the time of its surrender. It is not known that this cargo was earmarked for research on the atom bomb, but its presence in quantity is of possible significance.

ITEM: TOWED COIL GEAR - "S.S.G." (SCHLEPP SPUL GERAT)

INTELLIGENCE: Acquisition by the Japanese is reliably reported. (A-2)

IDENTIFICATION: This gear consists of floated coil of energized cable towed astern. It does not require a sea return, therefore, it can be used in fresh water harbors. The main use is in harbors, entrance channels, and protected off-shore channels. It is probable that the form of pulsing of towed coil magnetic sweep may apply only to Sperrbrecher, towed electro-magnets and electrode sweeps. Sweep is towed about 100 meters astern of the sweeper. The length of the cable between the generator and the foremost buoy of the coil is 120 meters, the extra 20 meters consisting of slack wire on the deck of the sweeper. Details are as follows:

Total length of cable - 800 meters
Maximum speed - 9 knots
Useful speed - 6 knots
Power - 25 k.w. (230 amps 110 volts)
Width of coil - 70 meters
Swept path - 100 meters
Flotation - 8 floats serving to spread
Float pendants - 1 m. long coil in diamond shape
Copper conductor - .2 inches 2 section
Resistance - .01250 kw. per 100 yds.
E.M.F. of 37.5 volts) Produces - Current of 600 amperes in sweep
Power of 22.5 k2)
Generator (Shunt) D. C. - 110 volt, 230 amp. (25 kw)
Automatic pulsing cycle - believed 8.5 and 12 sec.
Sweeping speed - 9 k (6k if automatic pulsing fails)

In the large coil, 8 floats are used. Six of these are for buoyancy and two (Type "A" or similar) are used to keep the loop at its proper width. In the small coil the foremost Port and Starboard buoys are not used.

14. MISCELLANEOUS

ITEM: CABLE FOR TOWED COIL GEAR "S.S.G."

INTELLIGENCE: Reliable evidence of transfer (A-2) - date unknown.

IDENTIFICATION: The cable of this sweep is non-buoyant, being supported by floats. It may be employed in either of the following forms:

(a) A 2 turn loop of 70 m maximum width having a married portion extending 100 m from the stern of the sweeper, the peak current during the pulsing cycle being 300 amperes and producing 600 ampere turns and the peak power being 16.5 KW.

(b) A 4 turn loop of 30 m maximum width, developing a maximum of 1200 ampere-turns, but otherwise the same as (a).

CONCLUSIONS: The Japanese are reliably reported to have had difficulty making a suitable cable.

ITEM: SKID TYPE MAGNETIC MINE SWEEP

INTELLIGENCE: Reliable evidence of transfer (A-2).

IDENTIFICATION: The skid type sweep was intended for sweeping magnetic mines by a horizontal magnetic field. It was used in rivers, canals and restricted waters. Craft about 70' in length tow the skids at a distance of some 60'. The cable is non-floatable, so floats were arranged midway.

Skid:	30' long
Steel Tube:	1/2" plate-welded
Center section:	Had copper coil presumably with heavy iron core.
Tiller:	Moves freely not more than 10° from amidship.
Towing eye:	Set low under bow.

CONCLUSIONS: It is believed that an adaptation of the skid type magnetic sweep is now being employed by the Japanese.

ITEM: HOHLSTABGERAT MINESWEEPING GEAR

INTELLIGENCE: Reliable source reports Japanese acquisition of gear in September 1944. (A-2)

IDENTIFICATION: Two types of these towed cylinders.

	Large	Small
Length:	24 m	12 m
Dram:	1.8 m	1 m
Disp:	70 tons	[illegible]
Intensity of magnetic field	0.6 times te[illegible]	[illegible]

Area swept:

(1) When sensitivity of the mine is 5 oersted

Width	200 m	100 m
Depth	70 m	35 m

(2) When sensitivity is 12 oersted

160 m	80 m
60 m	24 m

ITEM: MINE SWEEPING GEAR (VARIOUS)

INTELLIGENCE: Reliable sources indicate that a variety of mine sweeping gear was acquired by the Japanese beginning in July 1943. The ambiguous descriptions given by sources indicate advisability of receiving successful German types.

IDENTIFICATION: H.F.G. This is a towed electro-magnetic sweep. The floats containing the magnet are made in three sizes, 24 meters, 12 meters and 6 meters. They are roughly cylindrical in shape and have diameters of about 1½ - 2 meters, 1m and 80 cms., respectively. They are fitted with a rudder which in the case of the 24 meter type is 1.5 meters in length. The float is divided into several watertight compartments, the actual magnet taking up about a quarter of the total length. It is wound with coils of copper wire 0.9 sq. cms. and protected by a metal tube filled with oil and an outer cover of wood. The copper wire is bound with oiled paper and linen.

The apparatus is usually towed one cable astern of the sweeper. Two of the 12 meter and three of the 6 meter magnets may be towed abreast, with rudders adjusted to make them tow out.

Sweeping width - 24 meter type - 500 ft.)
12 meter type - 180 ft.)---at 10-12 fms.
6 meter type - 80 ft.)

The magnets are probably excited by regular pulsing reversals of current from 0-150 amps. Possibly three negatives and three positives per minute. A small motor controls the pulse period. The current has voltage of 110 and amperage of 150 giving 150,000 ampere turns.

G.E.T. (Gerausch Boje Trage) This is an acoustic sweep and is thought to exist in two sizes. The specimens recovered consist of an iron box about 6 ft. in length and 15 ins. in dia. The fore part is pointed and has a towing eye. The after part is cylindrical and a four bladed variable pitch propeller is mounted right aft and protected by a metal ring. The propeller drives a shaft carrying the striker unit at forward end. The striker is bolted to the shaft. When this shaft rotates [illegible] rings beat upon the four faces of the diaphragm hea[illegible]

clamped to a boom mounted on the stem of the sweeper or towed at short stay therefrom and taken down by a depressor Type "GD" (T.S.G. Drachen).

It is known that a form of noise buoy is towed astern of the sweeper. One report finds the distance as 60 yds. The distance will, however, vary according to the circumstances, and as has been stated in paras. 5-12, when used with K.F.R.G. has been observed in several different positions.

Range - 150-200 meters
Sound output good in the 150-500 cps region

K.F.R.G. (Kabel Fern Raum Gerat) This is an electrode sweep having a sea return and is known to exist in two forms, viz: K.F.R.G. (Tief) for deep sweeping, and K.F.R.G. (Flach) for shallow sweeping.

K.F.R.G.(T) has its tails supported by two floats possibly Type "C". A form of depressor is used to take the sweep down and two kites obtain a spread of about 90 yards. The depressor is probably Type "GD". It is towed approximately 120 meters astern. The length of tail from the kite shackle to the electrode is 245-270 meters, the full length of tail including the married portion thus being about 370 meters. The electrode itself is 20 meters long. Depth can be adjusted to 25, 35 or 50 meters.

K.F.R.G.(Fl) has a different rig. In place of the depressor is a float (possibly Type "C") linked to the cable by a 5 meter float wire. Cable and electrode lengths are the same as K.F.R.G.(T). In place of the Type "C" floats used in K.F.R.G.(T) are two floats with twin planes (possibly Type "A") and each cable has in addition one float of the same type (or Type "B" with shorter planes) about half-way between the electrode and the supporter float 100 meters astern of the sweeper. The starboard after float (and probably the port aft float) may have a twin float Type "E" (Spurboje) linked to it by a 30 meter pendant.

K.K.G. (Knall Korper Gerat) This is an acoustic sweep of an explosive nature. It consists of three lengths of iron tubing 1-7/8 ins. in dia. which are screwed one into the other and make a total length of approximately 28 ft. The device is mounted on the sweeper so that the outboard end is submerged. An electric cable passes down the center of the tube to two contacts situated a few inches from the foot.

A series of charges (up to 20 in number) are loaded into the tube and released by a trigger at the top of the tube. They then drop down the tube, pass the electric contacts which ignite a burning mixture in the center of the charge and so into the water. The end of the tube is fitted with flat side pieces to assist their departure. The charges are 6-3/10 ins. in length and 1/5 of an inch in dia. Each charge produces two detonations.

Reports have given distances for K.K.G. to [illegible] mines from 900 yds. to 3-1/2 miles. There has been no indication [illegible] radius.

G.B.E. (Gerausch Boje Electrical (?)) Details of this nois-maker are lacking, but it is probably similar to G.B.T. but driven electrically. Possibly it is a form of the "Benghazi Tadpole" which was a cigar-shaped body containing a wheel carrying six eccentrically mounted wheels which struck upon hardened steel studs on the inner side of the casing. Motive power was provided by two 24-volt Bosch motors.

MS (Mausi) - Minesweeping Aircraft - The Ju52 (Mausi aircraft) can be fitted with a minesweeping ring similar in appearance to the British D.L.I. The ring is supported from the underside of the fuselage and wings, and consists of 44 turns of 14 millimeter rod, the whole being encased in an eliptical housing 32.5 x 14.3 centimeters. Details of current are not known, but it is possible that it is about 300 amps, the power generated being 36 kilowatts.

Four Ju52s have been reported to fly in quarterline formation with a width of sweep of 150 meters. Flying height is probably dependent on depth of water. Reports indicate that when the aircraft is 150 ft. from the mine a path of 300 ft. would be swept. It is possible that other types of aircraft are used for minesweeping. It is also possible that these aircraft drop small charges for sweeping acoustic mines.

Speed is probably about 180 K.P.M.

V.E.S. (Minesweeping gear of the Sperrbrecher) - Coils passed right round the hull externally from the fore part of the ship into an electro-magnet. Some ships have in addition, a transverse magnet mounted on the bows. It is probably that about 210 turns of copper cable with a 300 square millimeter cross section are used in the external windings.

Two groups of generators producing 120 k.w. each carry current to bus-bars from which three V.E.S. windings are run. Reversals of current take place in V.E.S. winding when sweeping. The period is not known but it is though that the time between each change over is between 6 and 12 secs.

Width of sweep - 1200 - 1600 ft.
Sweeping speed - 9 knots.

ITEM: HAMMERS

INTELLIGENCE: Reliable source indicates that manufacturing rights were acquired by Japan in 1944. Two sets were actually received.

IDENTIFICATION: This is a "double action" hammer.

ITEM:

14. MISCELLANEOUS

INTELLIGENCE: Reliable PW states that in 1942 and 1943 a number of prototypes for degaussing and wiping were shipped to Japan. Orders placed by the Nomura Naval Mission in 1941 were stated to have been filled.

IDENTIFICATION: The following description of a degaussing coil made available to the Japanese is evaluated A-2. Small-type turbine generator used as source of electric power for the degaussing coil, provided there is a reserve of boiler power.

Rubber covered wire, paper-insulation of aluminum wire or any kind of wire may be used to serve purpose. Perbunan, in place of lead (which is not used because of shortage), is used on the outer cover of the former. Construction of degaussing coil is limited to the inside of the ship exdept in case of oiler, where arrangement of tanks necessitates construction of coils on the outside of the vessel. Height of installation is low, usually 1-1½m. above the water line. There are 3 sectional coils and 1 basic coil in this unit. From 10-15% of turns of basic coil given opposite polarity in 50% turns. In laying the wires on the bulkheads, two folds of wire are placed through wooden bold devices fitted to metal seatings which are welded to the beams.

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ITEM: SINTERED STEEL

INTELLIGENCE: Reliable source indicates that process was made known to the Japanese.

IDENTIFICATION: "Sintereisen" and mild steel was used for driving bands of shells. To save copper, a blend of copper and steel was used to save as much as 50% copper. Sintereisen bands used in German 12.7 - 17 cm shells; mild steel in larger shells.

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ITEM: DIESEL ENGINE

INTELLIGENCE: MIS interrogation state that Japanese diesels are patterned after Bosch and Hanomag.

State Department information dated 10 November 1942, states that Japanese ordered 800 diesel engine fuel injection pumps and 7000 nozzles from Bosch; 2000 of the nozzles to be ready January or February 1943. Subsequent information (A-2) establishes delivery of at least a portion of this material.

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ITEM: LUBRICANTS, PHLEGMATISERS

INTELLIGENCE: Interrogation of Dr. Ja[illegible] who was engaged in work on synthetic waxes at I. G. OPPAU

IDENTIFICATION: These have been made from Montan wax extracted from lignite, with benzene and alcohol, at the Montan Werke, Halle Riebeck. This works has an output of approximately 20,000 tons per year. The Montan wax is then bleached with Chromic and sulphuric acids. A little bleaching was carried out at Oppau but most of it was done at Gerstofen bei Augsburg. The bleached wax can be used in a number of ways as follows:

(a) By esterification with glycols, when a wax is obtained which is very similar to Carnauba Wax in properties and in fact is of very similar composition chemically. This was used for polishes etc, and generally as a substitute for carnauba wax.

(b) By ketonishing the bleached wax a new wax is obtained which has found military applications in phlegmatising explosives. The process consists in coating the explosive in finely divided form with the wax to reduce the sensitivity. PENT and RDX had been treated in this way. Oppau produced about 100 tons per month of ketonised wax for this purpose.

(c) By forming the sodium salt of the bleached wax, a grease can be made with mineral oils which is claimed to have advantages as regards stability at high temperatures. Such greases which contain no ordinary soaps are in fact being used in German tanks.

(d) By ketonising the wax as at (b) above followed by hydrogenation long chain paraffin waxes of high melting point are obtained. These normally melt about 100°C and have found application in the electrical industry as insulating waxes, in emulsion form for impregnation of cloth for water-proofing, and for pakaging. For packaging purposes the new wax has been used either alone or in a mixture with ordinary paraffin wax in order to raise the melting point. The production of this type of wax was however limited to 10-20 tons per month. Sodium soap materials for use in greases were produced to the extent of 150 tons per month.

Dr. Jahrstorfer has also worked on the Schollar process for obtaining sugar from wood. The normal process employs dilute sulphuric acid, but he had found HF to be much better. However, this had never been operated owing to the shortage of Flurides in Germany. In this connection, however, he mentioned that he understood that the Japanese were operating a sugar plant by the Scholler process. He also mentioned that the lignin which is a by-product of this process has been employed recently by the Germans in a mixture with ammonium nitrate, as a diluent for RDX., owing to shortages of the latter.

Dr. Jahrstorfer was too junior to have been in touch with any negotiations with the Japanese, but he knew that some Japanese experts had visited Oppau in 1942 or 1943 in connection with the work being carried out on desensitising explosives.

14. MISCELLANEOUS

ITEM: PARACHUTE (SITZBAENDER - FALLSCHIRM)

INTELLIGENCE: Reliable source dates Japanese acquisition as January 1945 (A-2).

IDENTIFICATION: This is a parachute designed for high-speed use.

ITEM: ROTOR KITE

INTELLIGENCE: Skipper of U-188 recommended use of rotor kite for Penang based U-Boats, 10/44. Unsatisfactory performance of A/C on Japanese subs would make this equipment attractive if it was exposed to them. A G-3 report states that kites were later used by the German in that area.

IDENTIFICATION: This is an observation device, carried by 1200 ton U-Boats on deck abaft conning tower in a waterproof hanger. No engine is fitted, wind plus U-Boat's speed serves both to launch and keep kite aloft. Connected to U-Boat by 20 cwt. cable of unspecified length. May be turned 30° to port or starboard. In case of emergency rapid descent, rotor head complete with vanes may be jettisoned by operating a lever. Assembly and raising speed - 10 mins. Fitted with telephone cable in core of bow, also has brake lever which controls speed of rotor head.

Main parts: Body; Mast; Rotor-head; Blades; Tail surface.
Overall lgth. - 13'5½"
lgth. w/o rudder - 10'6"
Dia. - 2½"
Alt. - 400 ft.
Increases range of vision - 20-25 ft.
Kite - aluminum frame 4' long
Rotor head - carried by vertical column behind pilot's seat. Made of 3 cloth-covered blades 3 meters long.

ITEM: SBT (SUBMARINE BUBBLE TARGET)

INTELLIGENCE: A large quantity of SBT charges and prototypes were shipped on the Bergenland in 1942. Submarine Bubble Target is known to have reached Japan on U-511 and U-1224, the former arrived in September 1943.

INTELLIGENCE: Device ejecting chemical pellets which are activated on contact with sea water creating a distrubance which gives echo to Asdic transmission, thus creating false target, and allowing U-boat to escape undetected. The bubble screen starts to operate 2 minutes after ejection,

and persists for about 15 minutes. The ejector consists of a tube 6" in dia., projecting thru the pressure hull and fitted inboard with a breech mechanism. The mechanism can eject 3 main variations of pellet which serve to delude hunting craft in different manners.

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ITEM: PILLBOXES - GERMAN TYPE, REENFORCED CONCRETE

INTELLIGENCE: Encountered on Iwo Jima.

IDENTIFICATION: These are 4' thick, the circular, 40' diam., 4 embrasures; are of the strongest known type of defense structure employed by the Japanese.

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ITEM: KINOTHEODOLITE

INTELLIGENCE: Reliable source evaluated A-2, indicates delivery to the Japanese in 1943 and March 1945; actual specimens.

IDENTIFICATION: The German Kinotheodolite is a complex precision instrument which is used in Anti-Aircraft Artillery to obtain a photographic record of the path of an aerial target. The mathematical evaluation of this record provides a means of checking data from position finding instruments. It is also employed in connection with the calibration and trial shot problems of Anti-Aircraft Artillery, and for accurate analysis of target practices against towed sleeve targets. It is known that this instrument is used in the Mirror Image Method of conducting AA target practices. PW testimony, unconfirmed, has indicated the employment of Kinotheodolite at the launching sites of certain long-range rockets. These instruments are reported used in determining the initial deviations of the rocket from its previously computed theoretical course. Overall characteristics follow:

Dimensions	40" x 39" x 26"
Weight	220 lbs.
<u>Main Telescope</u>	
Frame size	1.14" x 1.46"
Aperture	1:45
Focal length	11.8"
Angle of view	5° 32' x 7°
Focal length	23.6"
Angle of view	2°46' x 3°30'
<u>Tracking Telescopes</u>	
Magnification	10x
Angle of view	6°
Reticle graduation	10'
<u>Scale Graduation</u>	
Azimuth scale	0° - 180°
	0° - 180°
Elevation scale	0° - [illegible]

Scale Image	
Magnification	4x
Reticle graduation	1' resp. 2'
Times of Exposure	
Target image	1/150 sec.
Scale "	1/500 "
Counter "	1/40 "
Electrical Data	
Voltage	12 Volt
Current	8-12 amp.
Magazines	
Capacity	164'

The Kinotheodolite tracks and photographs the target is space, recording on the films the instantaneous angle of elevation and azimuth (measured from a known base line, rather than from North) at which the instrument is directed. Should the instrument not be pointed directly at the target i.e., should the target appear at a point other than the center of the film, corrections are made by means of a Kinotheodolite Film Evaluator.

In general 2 or 3 Kinotheodolites positioned at the ends of previously surveyed base lines are employed. If only 2 are used, one base line will suffice. Length of base line varies from ½ - 2½ miles depending on caliber of battery and general terrain features.

All Kinotheodolites are connected to a central control box. This instrument is also connected to the Time Printer (Zeitdrucker). The Time Printer, operating thru the Control Box, starts and stops operation of the Kinotheodolites. It also receives and records a monitor signal from each Kinotheodolite which indicates that the cameras are in operation.

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ITEM: GIESS HARZ

INTELLIGENCE: Reliable source places date of transfer as April 1945. (A-2)

IDENTIFICATION: Giess Harz is a resin which can be cast. It is said to be suitable for the manufacture of moulds used in treatment of light alloys for air frames.

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ITEM: PENETRABILITY OF OPTICAL GLASS, METHODS OF INCREASING

INTELLIGENCE: Reliable information indicates that the Japanese have details of these processes along with knowing advantages and disadvantages. (A-2)

IDENTIFICATION: Processes:

14. MISCELLANEOUS

(a) Method #1 is the TEISS process. Lens is set in a vacuum container in which a small tungsten container holding an aluminum fluroide (cryolite) is placed. The fluoride adheres to surface of lens when vaporized by electric heating.

(b) Method #2 is the LEITZ process. The lens is made to revolve and a silicate solution is dropped on it. After the surface is covered, it is dryed and again dropped into the solution.

(c) Method #3 is the SCHOTT process. The lens is placed in a metal mould. This is heated to soften the glass. Vaporized silicon oxide and titanium oxide are blown on. These react chemically with the surface of the lens.

Explanation of Coding System Used in Qualifying Intelligence Contained in the Survey

Evaluation of Information as to SOURCE:

A - Completely reliable
B - Usually reliable
C - Fairly reliable
D - Not usually reliable
E - Unreliable
F - Unknown

Evaluation of Information as to TRUTH, CREDIBILITY, or PROBABILITY:

1 - Report confirmed by other sources
2 - Probably true report
3 - Possibly true report
4 - Doubtfully true report
5 - Improbable report
0 - Truth cannot be judged