1946

History of Ordnance Technical Intelligence in World War II, Part 3: Tab 1- History of Ordnance-CIOS [Cooperation]; Tab 2 – Draft of Speech for Ord TI Teams (WWII); Tab 3 – Speech on metallurgy of foreign auto materials; [and] Tab 4 – Article on material for the Franklin Institute

Robert Bolin , depositor
University of Nebraska - Lincoln, rbolin2@unl.edu

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√ Tab 1 - HISTORY OF ORDNANCE CIOS (1944-45)

√ Tab 2 - DRAFT OF SPEECH FOR ORD TI TEAMS (WWII)

√ Tab 3 - SPEECH ON METALLURGY OF FOREIGN AUTO MATERIAL

√ Tab 4 - ARTICLE ON MATERIAL FOR THE FRANKLIN INSTITUTE

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STANDARD FORM No. 64

CHCorey/lf
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Office Mem[illegible]S GOVERNMENT

TO : Chief, Research & Materials Division DATE: 27 February 1946

FROM : Chief, Technical Intelligence Branch

SUBJECT: CIOS History

1. The attached history of Ordnance-CIOS activities in the ETO in 1944-1945 is not as satisfactory as I would ~~have~~ liked to have prepared it. It is the best I could do, however, without access to the files and records which I maintained in our London Office.

2. Those files were requested of the Chief of the Technical Division, Office, Chief Ordnance Officer, three months ago, but will not arrive here until approximately March or April 1946. When they do arrive additional copies of the appendices ~~to this history~~ will be available for the other two copies of this history.

1 Incl
CIOS History

C.H. Corey
Lt Col, Ord Dept

Appendices attached to [illegible] copy of history

1 Combined List of Shipments dated 14 July 1944 - pages 1 thru [illegible]

2 Office Order 3 from APO 413 dated 8 December 44

3 Office Order No 3 - Change No 2 from APO 413 dated 6 April 1945

4 Daily Report of Research & Dev Branch dated 28 June 45

5 Daily Rep[illegible] of Intelligence [illegible] dated 15 Aug 45

ORDNANCE-CIOS HISTORY

Brigadier General T.J. Betts (U.S.A.), Chairman, and Mr. R.P. Linstead, Ministry of Supply (British), Deputy Chairman of CIOS, stated on 15 Sept 45:

> "The effective exploitation of German technical development has proven one of the significant results accruing from the conduct of the European War. The value of the scientific knowledge and 'know-how' thus obtained cannot now be fully measured. That this intelligence contributed to the defeat of Japan is well established. The benefits of this knowledge to British and U.S. industry will be measured in terms of economic progress and well being for many years to come. This record of achievement will prove all the more interesting when it is recalled that prior to the formation of CIOS, no planned and coordinated exploitation of enemy technical intelligence was ever attempted."

The U.S. Army Ordnance Office can feel proud of its valuable contributions toward making CIOS a success. It was the first of the Army Technical Services to establish an organization in the ETO primarily to make CIOS investigations and it had more investigators in Germany in the Spring of 1945 than any other single member agency of CIOS. Because of its wide representation on CIOS Working Parties and as U.S. organizers for many of the Black List and Grey List Items, the Ordnance Department contributed much toward the fundamental operation of CIOS.

Ordnance furnished a total of 119 technical investigators which were, at various times, sent to German targets through the sponsorship of CIOS. Sixty-two of these 119 investigators were officers, the balance, 57 being civilians.

CIOS printed approximately 800 target reports. The Ordnance Department investigators prepared 262 Target Reports, most of which were printed by CIOS, the balance by FIAT. These figures are evidence of the large part which Ordnance contributed toward CIOS investigations of Germany. In addition, Ordnance investigators prepared 113 Progress Reports (See Appendix (A) for a list of the subjects of these Target and Progress Reports).

A Target Report is the report which the technical investigators (Field Team) prepared and contains the results of their investigation of one target. These reports are sometimes referred to as FINAL Reports or CIOS Reports.

A Progress Report is a report prepared by an Ordnance-CIOS investigator and contains the results of investigations into one phase of German technical intelligence; e.g., Small Arms Tracer Bullets, High Explosives or Manufacture of Steel Cartridge Cases. These reports were also referred to as Subject Reports. Many of these reports were printed by CIOS as Final Reports because of their general interest. Most of them, however, were prepared by the Ordnance Staff Organization in London, and sent direct to OCO-Washington to advise of the progress of investigations into a particular subject.

It is probably a fact that never before in recorded history, has a defeated nation been so thoroughly investigated politically, industrially and scientifically or been the source of so much valuable technical intelligence as has Germany. Tons of reports have been, and are still being, written on the results of such investigations. Hundreds of tons of technical German documents have been, and remain to be, translated. All of this information was obtained by the various Services and Government agencies of Britain, Canada and U.S., and is gradually being made available.

The following are a few brief "highlights" of the "finds" which Ordnance investigators obtained or assisted in obtaining through their investigation of German technical intelligence. For convenience, the list is classified to correspond to the various Sections in our London Office organization.

A. Automotive

1. General: Investigation of the German automotive development program revealed that the effort was almost exclusively concentrated upon armored fighting vehicles to the exclusion of regular motor transport. Continuous improvements were made in the engines, power trains, running gear, armor and armament of tanks and gun-motor carriages. In addition, a series of super-heavy tanks, a class of self-propelled weapons known as the "Waffentraeger", and a new series of tanks called the "E" series, were under development, as well as rigid mounting of tank guns, and a gas-turbine application for a tank power plant. An outline of these projects follows:

2. Engines: Considerable pressure was exerted from above on the German engine designers to produce an air-cooled diesel tank power plant. A number of attempts were made to fulfill this requirement, but the only significant engine development was the Maybach HL234 gasoline injection engine which had successfully passed development tests in which 900 horsepower was delivered.

3. Power Trains: German activity along these lines had not met with notable success, although a considerable program was uncovered. Electric drive had been tried and found lacking in reliability. Improvements in mechanical gearboxes and steering mechanisms were aimed mostly at

simplification in construction and operation. Turbo or torque converter drive was actively under development and was considered the most promising for the high horsepower applications.

4. Running Gear: Considerable effort was being made along the lines of improving the ride of German tanks, and producing lighter, simpler and more effective suspensions. The program on suspensions was closely tied in with the study of the problem of gunnery from a moving vehicle with stabilized line of sight.

5. Armor: Investigation of the German armor producers and fabricators disclosed a considerably more advanced state of the art than had been supposed from examination of equipment captured during the war. Specifications on the techniques that were of interest were obtained in most cases, one of these being the welding of the thick sections of armor used in the Tiger and the later super-heavy tanks.

6. Armament: Armament projects of interest included the rigid mounting of the 75 and 88mm guns, the development of a gyroscopically stabilized line of sight, the "Kugelblitz" anti-aircraft armored turret and the 1.6 meter rangefinder installation in the new small turret for the Panther.

7. Super Heavy Tanks: The pilot model of the E-100 tank was located and layout drawings of the important assemblies were obtained. This tank was designed to weigh about 100 metric tons, mount a 150mm gun, and have a sloping front plate about eight inches thick. An even heavier tank had been constructed and tested, known as the "Mouse", and mounting the same turret, but weighing 200 metric gons. Complete engineering data was obtained on the "Mouse", but the pilot model was never found, having been destroyed at Kummersdorf south of Berlin.

8. <u>The "Waffentraeger":</u> Mass production of a gun-motor carriage series known as the "Waffentraeger" was being planned at the end of the war. There were to be two basic chassis, lightly armored, based on the Pz 38T components, mounting normal field artillery. Provisions originally were made for demounting the weapons as an alternative firing position, but this requirement was abandoned. This program was considered to be an artillery development not favored by the armored force, and was mainly an expedient to produce as much fire-power as possible with the existing resources.

9. <u>"E" Series Tanks:</u> The "E" series of tanks was the latest thinking of the Heereswaffenamt, and included the E-10, the E-25, the E-50 and the E-100. The numbers represent the estimated weights of the basic chassis. The first two, upon which very little information has as yet been discovered, were considered to be the most promising, and represent the return of the German tank design trend to lighter and more maneuverable tanks.

10. <u>Gas Turbine Power Plant:</u> Potentially the most important single development that has been discovered is the work that had been done upon the application of the gas-turbine for use as a tank power plant. An increase of 30% in power installed into a given size engine compartment was predicted, with eventually no poorer fuel economy than an automotive-type diesel by utilizing a rotary ceramic heat exchanger.

B. Ammunition

1. In the field of propellants, the use of DEGDN (diethylene glycol dinitrate) was known from the analysis of captured samples. Investigation has revealed that this development, originally based on a search for an "Ersatz" material to meet an anticipated shortage of NG (nitroglycerin), gave rise to powder compositions having both desirable manufacturing characteristics and, in service, causing less gun tube erosion than NG powder. Relative to NG, the higher volatility of DEGDN was undesirable. This led to the further development of TEGDN (triethylene glycol dinitrate) and Metriol for use in powder compositions destined for tropical service.

2. With regard to high explosives, it is probably of most significance that no essentially new compounds were found during the course of the investigations. It was discovered that hexogen development and manufacture was undertaken to provide a substitute for TNT because of the potential raw materials for hexogen manufacture were particularly well suited to the German economy. From investigation it seems reasonably certain that the German hexogen development was quite independent of that in the U.S., Canada and the U.K. However, it is of interest to note that the German work followed a parallel course and reached about the same point of technological application.

C. Artillery

1. The investigations of German artillery developments made to date reveal that although their artillery designs were such as to give most of their weapons superiority in performance over the nearest

c. <u>Consumable Cartridge Cases:</u> The Germans were well along with the development of such a cartridge case, the many advantages of which are readily apparent particularly when used for aircraft armament. Attempt is now being made to obtain complete data on the development of this type of case and will be presented when available.

d. <u>Double Recoil Carriages:</u> Almost all new medium and heavy field field carriages of German development were going to the use of double recoil type carriages. The over-all advantages in performance to be gained by such a carriage are clear cut and indisputable. These advantages have long been touted in the States. The fact that the Germans were about to use this type carriage in most all of their medium and heavy field weapons should provide an additional argument for its use in any further artillery developments conducted in the States.

e. <u>Recoilless Guns:</u> The Germans had a comprehensive development program under way for this type of weapon. They recognized clearly the many disadvantages of such a weapon for field use but considered that for special purposes in the field the development of a complete line of such weapons was justified. There greatest interest in this type weapon, however, lay in its application as aircraft armament, where the mal-effects of back blast can be minimized and where the advantages when compared with orthodox designs of guns and rockets; i.e. light weight and good accuracy, are optimum. It appeared to be their intention to effect an"up-gunning" of their aircraft by employing recoilless guns extensively.

f. Super-Heavy and Super Long-Range Guns: Weapons that all into this classification appear to be, in the main, a waste of time, effort and money. This opinion has been corroborated in almost every instance by each sober German engineer with whom these weapons have been discussed. It is felt that the Ordnance Department should avoid getting itself embroiled in any developments of this type as long as there exist other, more economical means for obtaining similar results at the target.

g. Automatic Cannon: The Germans are considered to be considerably ahead of us in this field by way of details of design and variety of weapons. Probably, this is so only because of the greater effort that they put into this field. The only basically new principle that they had applied that does not appear in our weapons is that of using designs which permit very expensive manufacturing procedure without sacrificing performance. The most notable single practice along this line is their use of stamped and pressed parts for gun mechanism components. This most certainly deserves our attention as the saving in man hours and materials is very great.

2. In addition to the above, useful information has been obtained on the subjects of torsion and other spring suspensions for gun carriages, the high-low pressure gun, erosion, gun life and rotating band design, and ballistic and weapons research. The information obtained on the subjects will also be available shortly in reports to be published.

D. Small Arms

1. Small Arms investigations were conducted with objective of obtaining information of immediate use to the Office, Chief of Ordnance. Actual projects will be listed below according to subject. One phase of the investigation was to determine why the Germans used a relatively lower velocity in their aircraft weapons than was our practice. It appears that they laid greater importance on high cyclic rate, reasoning that for a comparable installation, a high velocity round would be larger and heavier and thus reduce cyclic rate. This information is based on various interviews and discussions and on the fact that their last researches were directed toward super cyclic rates in the neighborhood of 20,000 to 30,000 rounds per minute.

2. Ammunition: The principle German activities in Small Arms Ammunition were directed along two main lines: first the development and production of steel case ammunition and later, the development of improved electric primers. Steel cases were produced and used, although they were not superior to those made in the U.S. In most cases they were coated with wax to improve extraction. Electric primers were used throughout the war. Their production was very difficult, employing a lot of hand assembly operations, and that, together with the desire to use them in larger caliber shell led to an extensive program to develop a more satisfactory one. German experiences were similar to those in the U.S. and U.S. and the program was not completed at the end of the war. Some "freak" projects were discovered, such as rocket projectiles, poison bullets and consumable cases, but no evidence was found that would indicate that these projects were successful or intensively pursued. Consumable case development [illegible] have been carried on with larger calibers.

3. Pistols: Pistol development was largely completed before the war. The Walther P38 was developed and largely adopted because of feeding difficulties with the Luger. Toward the end of the war Mauser developed, but did not produce, the Volkspistole. This is a 9mm weapon made by stamping and appears to be reliable, cheap and easy to produce.

4. Machine Guns: Development of Infantry machine guns was directed toward speeding up and easing of manufacture. This fact is illustrated by such weapons as the MG 42, MP 44 and FG 42, all of which made great use of stamped parts. At the end of the war, Mauser was developing an almost identical copy of the British Sten gun. The most important machine gun developments were the Mauser MG 213 and MG 215. Both have high cyclic rate and comparatively high velocity. The MG 213 is 20mm caliber convertible to 30mm and the MG 215 is 13 or 15mm. Both have light weight and will materially aid in meeting our requirements for a high speed caliber .50 machine gun, a caliber .60 machine gun and a 20mm cannon. In an effort to combat bombers with high speed pursuit aircraft, machine guns with cyclic rates on the order of 20,000 to 30,000 rounds per minute were under development. These guns fire very short bursts, and firing is initiated photo-electrically when the plane is in the proper position. The object of the high rate is to lay down a dense curtain of fire from a very short range. Two different methods were employed to attain the high rate. One was to use a gun with one cartridge case which contains from 7 to 9 projectiles. On ignition, the first projectile is fired and the resultant pressure drop causes the next one to be rotated in line with the bore and then pressure goes up and fires the second one. The propellant burns until all projectiles are fired. The other method was to group together several single shot guns and arrange, usually electrically, to fire them in succession.

5. Rifles: The most notorious German development in the field of rifles was the curved barrel. Two curved barrel attachments were developed and put into limited production. They are for use with the MP 44, which shoots the short 7.92mm cartridge. It will shoot a bullet 30 degrees from normal in the infantry adaptation and 90 degrees from normal in the tank model. It consists merely of a rifled barrel bent to the proper angle and fastened to the gun by a simple clamp. The Volksgewehere is important only in that it shows how cheap a rifle can be made on a large scale and still function. It jolts the average person's conception of the quality required in a rifle. Two important production techniques were found. One is a method for cold forging rifle barrels, complete with rifling, on one machine. The other is a barrel straightening machine with a mechanical optical system which eliminates the human error and speeds up the process.

6. Government agencies and proving ground had much less influence on weapon development than in the U.S. and U.K. Practically all such small arms work was done by the three firms of Rheinmetall-Borsig, Mauserwerke and Deutsche Waffen and Munitionsfabriken. These concerns apparently had an unlimited budget for their experimental departments as they had a wealth of excellent equipment and employed very able engineers and scientists. It is interesting to note that they all greatly felt the lack of alloys and high grade steels in the development of new weapons.

E. Miscellaneous Materials:

1. Fuels and Lubricants: Investigation of Fuels and Lubricants targets in Germany yielded complete and valuable information on the following new and little known processes:

   a. Manufacture of high quality (aviation) lubricants from ethylene.

   b. Manufacture of automotive lubricants from olefins (wax)

   c. Manufacture of aldehydes and sulfonic ester soaps from olefins by the new OXO process.

   d. Manufacture of high Cetane Diesel fuels over iron catalysts by the Fischer-Tropsch synthesis.

   e. Latest technique and equipment used for the successful manufacture of high octane fuels from coal and coal tar by hydrogenation.

   f. Manufacture of high quality, high aromatic content fuel by the new and highly important DHD process.

   g. Latest technique and equipment for the isomerization of butane or butylenes required in the manufacture of high octane fuel.

   h. Two new processes for the manufacture of toluene, i.e. methanol and benzene (Waldenburg) and by cyclization of heptane (Ruhrchemie).

   i. Development and manufacture of a new and extremely stable grease called INVAROI, useful in instruments and fire control equipment.

The specification, formulation and utilization as well as distribution (WIFO) of many German military fuels and lubricants have been obtained. Samples of many of the important products were obtained for full scale tests in service equipment. The following new materials upon which full laboratory and in some cases plant manufacturing and test details have been obtained, are considered outstanding:

a. Product 891, dichlorodiphenyl-phosphorous acid was additive for the lubricating oil used during the break-in period of engines to eliminate rejects and reduce the break in time from 70 to 20 hours.

b. Bohrmittel H additive was extremely useful in cutting and drawing operations.

c. KSE, RSO_2NHCH_2COOR was additive which had wide and useful application in corrosion resisting Torpedo and hydraulic oils.

d. Mesulfol 2 $(R\text{-}O\text{-}C\text{-}S\text{-}CH_2)_2$ was extremely interesting high pressure additive developed for use in machine gun oil.

e. Additive "R" was a tin compound which had remarkable properties when used in aviation engine lubricating oils. The rin sticking time was more than doubled with its use.

f. "Y" Axle oil containing 20% of ester E-502 and 80% "R" oil, allowed rail road cars to be 100% overloaded without bearing failures.

2. Rubber: Investigation of Rubber Targets in Germany has yielded valuable information on the manufacture of Buna Type Synthetic Rubbers and important information on the manufacture and serviceability of various products made by the German Rubber Industry for War Time Consumption. The information secured was of the following nature:

   a. Manufacture and Design Data for Pneumatic Tires for Military and Civilian Vehicles.

   b. Design and manufacture of Buna Inner Tubes

c. Design and manufacture of Buna Bogie Rollers and Track Pads.

d. Design and manufacture of "Luka Reifen" tires for operation without air.

e. Design and manufacture of "Drahtband-Reifen" solid tires which were demountable units made without steel base bands.

f. Design and manufacture of V belts, Conveyor Belts and Transmission Belts for Military use and for use in Essential Industry.

g. Design and manufacture of miscellaneous rubber products such as rubberized fabrics, fuel cells and technical goods.

By investigation of the largest rubber plants in Germany, it was possible to get a balanced picture of the thinking behind the use of Buna S rubber and the opinions as to the serviceability of products made from it. It was also learned that all product manufacturers found Buna S too difficult to work with and that their complaints to I.G. Farben-industrie had stimulated work by the I.G. Research Staff on improvements that would make Buna of greater plasticity available sometime in the future. It was found that the Physical Test Laboratories of the I.G. Farben-industrie in Leverkusen were very advanced in technique and equipment used to evaluate the Hysteresis character of Synthetic Rubbers and that by means of this study this laboratory had found it possible to reduce the margin of difference between natural rubber and synthetic rubber in heat development characteristics.

Significant data on the manufacture and use of Desmodur R, a high grade adhesive for bonding rubber to steel fabric or other material, was obtained. This information should prove of material value to the Rubber Industry of Allied Countries for superior adhesives are the subject of Continental search and if Desmodur R is capable of most of what German scientists claimed for it, it will be in great demand.

Subsequent to the CIOS investigations of the German Rubber Industry, a survey was made of the performance of Synthetic Rubber Products on U.S. Ordnance Vehicles. This was accomplished by visiting Ordnance Tire Repair Depots and Ordnance Heavy Maintenance Depots. Except in the Tire Repair Companies, most of the experienced personnel had been sent home on points but even so much significant information was gathered that should prove of value to Ordnance. This investigation covered the service on Synthetic Pneumatic Tires, Bogie Rollers, Tank Track Blocks, Inner Tubes, Fan Belts and Gaskets.

3. Plastics: The investigation of plastics targets in Germany has yielded fairly complete development and manufacturing information on plastics of all types, especially those which received special military application during the war. The more important phases of the investigations concerned the following items:

a. Moulding of large extra stsength parts from Polyvinyl alcohole type materials.

b. Production and use of polyethane in several grades.

c. The wide use made of phenol type plastics inside tubes and the moulding technique to accomplish this.

d. The use of poly styrenes in fuzes bodies etc.

e. The manufacture and use of high molecular poly ethylene as a plastic in high frequency radio equipment, submarine telegraphy and as a film for tropical packaging.

f. The development and manufacture of "Luvitherm" as a packaging material for use in tropical climates such as were obtained in the Far East war zone

F. <u>Guided Missiles</u>

1. The most important single item concerned with rockets has been the uncovering of a large variety of highly developed guided missiles in Germany. These missiles may be placed in the following categories:

Ground - to - Ground

Air-to-Ground

Air-to-Air

Ground-to-Air (Antiaircraft)

a. <u>Ground-to-Ground Guided Missiles:</u> The most important of these are

(1) A-4 (V-2). This is a liquid fuel, radio controlled long-range rocket.

(2) X-7. Solid fuel, wire-controlled, antitank rocket

b. <u>Air-to-Ground Guided Missiles:</u> The most import rockets in this class are:

Hs-293
Hs-294
Hs-295
Hs-296

The Air-to-Ground missiles are all closely related with slight modifications from one model to the next. All models are launched and radio-controlled from a parent aircraft. They are most generally employed against other aircraft. Propulsion is supplied by means of one or more liquid propulsion units.

c. Air-to-Air Guided Missiles: The most important rocket in this class is:

(1) X-4 ---- This is a solid fuel, guided, missile, Guiding may be of the radio type control or wire control from the launching aircraft.

(2) Hs-298 ---- This missile is somewhat like the Hs-117 (Schmetterling) but smaller. It is radio-controlled but wire control could be used up to 17km. It is propelled by solid type rocket fuel.

d. Ground-to-Air Guided Missiles: The Ground-to-Air missiles are an extremely important development and this fact was apparently realized by the Germans, judging by the time and effort expended on this class of missiles. The more important missiles in this class are:

Wasserfall (C-2)
Schmetterling
Enzean
Rheintochler

All are liquid fuel type rockets and are launch d vertically or at an angle. The missiles are controlled from the ground by a means of joy-stick control which permits the operator to guide the missile to the target. Homing devices and proximity type fuses for these missiles were also in a high state of development. The Germans calculated that, with missiles of this type, they could bag at least one enemy bomber with not more than two (2) missiles, a very reasonable assumption.

The project of guided missiles in Germany was highly developed and had they the time and facilities to continue with this work, the results of air warfare might have been entirely changed.

G. <u>Metallurgy</u>

1. Sintered iron rotating bands
2. Steel cartridge cases
3. Rolled steel cartridge cases
4. Improved cemented carbide cutting tools
5. Ceramic cutting tools
6. Ceramic-powdered metal turbine blades
7. Electric smelting furnace for production of pig iron
8. 50,000 ton forging press
9. Production of steel from low-grade (25-30%) iron ore
10. Vanadium from slag recovery process
11. New flux for welding magnesium
12. Anodized magnesium which has furface hardness equal to that of anodized aluminum.
13. Refinements in continuous casting of light metals.
14. Chemical additions to molten magnesium permitting reduction of $100^{o}C$ in grain refining process.

H. Fire Control and Ballistics

1. Our investigation of the German fire control field revealed that their development in aircraft and seacoast fire control equipment were inferior to those in the United States. They were not as far advanced as the U.S. radar equipment. In the optical field, they were more advanced than U.S. as regards details of manufacture and production. The rangefinders which they were producing at the start of the war were equivalent to those which we planned to produce at the end of the war. However, this was not as important as it might seem, because our applications of radar to rangefinders had diminished the value of non-radar rangefinders. The Germans were using helium in rangefinders as early as 1939.

2. In the field of seeing at night through the use of infra-red, the Germans were farther advanced than either the U.S. or the British. Their equipment on the Panther tank could detect a moving man at 700 yds. Their portable infantry apparatus could detect a moving man at 60 yds, but it had the objection of being too heavy.

EARLY HISTORY

Brigadier General H.B. Sayler, Chief Ordnance Officer, ETO, in a letter dated 29 January 1944 to Major General L.H. Campbell, Jr, Chief of Ordnance, stated that plans were then being made by the Combined Chiefs of Staff to send technical experts into Germany immediately after the surrender and suggested that, if Ordnance were interested, it should consider and so advise. General Campbell replied on 10 February 1944, stating that he indorsed the idea with enthusiasm and that he was working with industry to select a group of highly skilled men to augment certain of our own officers and civilians so as to send a well-rounded team to cover the various fields.

After an interim exchange of correspondence between General Saylor and General Campbell, in which the latter was kept advised of developments being made by the Combined Intelligence Priority Committee on Priority 1 Black List Targets and Working Parties, General Saylor requested on 9 August 1944 that "If the Ordnance Department responsibilities are to be met, it is imperative that picked representatives be ready to come to this theater on very short notice as the majority of Ordnance Department representatives will have to be scientists from the United States. The proper operations of the plan would be highly facilitated by sending a skeleton force of scientists to this theater at once. It is tentatively estimated that fifteen is the total number of Ordnance investigators".

General Campbell approved the mission on 9 August 1944 and a reply was sent to the Commanding General, ETO, on 11 September 1944 stating that Ordnance desired representation on the Combined Intelligence Priorities Committee and requested immediate approval for air travel for 15 picked personnel.

The following officers, civilians and WACs arrived in London the first week of October 1944, as the Ordnance Department skeleton force for work in connection with the activities of CIOS, formerly the C.I.P.C.:

Colonel H.H. Zornig (O-2969), Chief of Group and to cover cannon, armor and ferrous metallurgy.

Colonel H.S. Morton (O-425611), proximity fuzes

Major J.M. Quintance (O-127983) executive officer

Major C.H. Corey (0-920483), non-ferrous metals

Major H.V. Mackey (0-25046), artillery

Major J.M. Crews (0-347699), small arms

Major L.B. Magruder (0-378281) automotive equipment

Capt Lee Nutting (0-280219) bombs, ammunition and air mines

Capt C.C. Chaffee (0-1533413), fuels and lubricants

1st Lt Louise Marks (WAC-L-304875), interpreter

T/3 Jean N. Schaeffer (WAC-A-217838) interpreter

T/4 Henrietta J. Lohner (WAC-A-313298) interpreter

Professor E.J. McShane, Ballistics and ballistic measurements

Mr. W.R. Tomlinson, Jr, explosives and plastics

Mr. E.W. Chaffee, fire control equipment

Colonel F.F. Reed, Assistant Military Attache, U.S. Embassy in London, had arranged office space for the group at 38 Grosvenor Square. Within a week or two thereafter the group moved to more commodious rooms at 27 Grosvenor Square, which was the location in London through the remaining duration of the mission.

The group was originally known as the CIOS Liaison Branch, but that designation was changed two weeks later to Research and Development Branch. It was assigned to the Technical Division of the Office, Chief Ordnance Officer, Paris, France of which Colonel Gorton was then Chief. Since the work of the Branch required close cooperation with the CIOS and with the British Ministries, it was decided to locate the office of the Branch in London. Contact with the Chief of the Technical Division in Paris was maintained by cross-channel telephone and frequent trips to Paris by the Chief of the Branch. Actually, direction of the activities of the Branch were left entirely to the Chief; about the only business required to clear through the Paris office being cablegrams.

As mentioned above, most of the original group of officers and civilians, upon arrival in London, were immediately appointed by CIOS as "U.S. Organizers" and members of "Working Parties". These were positions of considerable authority and responsibility as the following general description of each indicates.

a. Organizers: For each of the then 29 Black List Sections of CIOS intelligence, there were 2 organizers, one British and one U.S. It was their responsibility to organize a field team to investigate each target within the section. They evaluated the expected intelligence at each target and then selected the least number of the best qualified specialists to properly investigate the target. This organized, specially selected group of investigators was known as a Field team.

b. Working Parties: There were approximately 10 Working Parties, or sub sub-committees, to which CIOS referred all technical questions concerning the 30 Black List Sections. Each Working Party was composed of a group of technical experts, whose duty it was to appraise the many targets proposed by CIOS membership agencies, and decide whether or not they were of sufficient importance to warrant investigation. If so, the targets were included in the Black List.

CIOS Organization

In order to understand more clearly how the Ordnance Research and Development Branch functioned in ETO, it is necessary to know, in general, about the organization ~~of~~ and operation of CIOS. Even though CIOS had no authority or responsibility over any of its member agency investigators, it was the medium through which all the activities of the member agency investigators were coordinated with one another and with the Armed Forces, or SHAEF (Supreme Headquarters Allied Expeditionary Forces).

CIOS was established 21 August 1944 by, and was responsible to, the Combined Chiefs of Staff. It was composed of a U.S. military chairman, a British civilian Deputy Chairman, together with 16 members, 8 British and 8 U.S., each member representing a separate Ministry or Agency.

The objective of CIOS was to obtain information in the many fields of German technical intelligence. CIOS had no technical investigators of their own, but all technical specialists who conducted investigations for the member agencies became known as CIOS investigators. It was an instrument whereby the 8 British and 8 U.S. Agencies could pool their target intelligence, investigate targets on a combined basis and report their discoveries to the CIOS Secretariat.

All technical information or intelligence of vital interest to British and U.S. military, industry and science was classified into target categories or items. The original Black List contained 30 such Items but, in the Spring of 1945, when the Black List was merged with the Grey List there were a total of 33. For instance, Item 1 was Radar, Item 2 - Artillery and Weapons, Item 18 - Armored Fighting Vehicles, Item 21 - Metallurgy, Item 24 - Medical, Item 30 - Fuels and Lubricants and Item 33 - Utilities.

A Black List was prepared for each item. It contained as much information as could be procured on the exact location of a target, the physical condition of the target, the type of information expected at the target, together with the names and home addresses of key German personnel. It also contained information to indicate the priority attached to each target by CIOS; i.e. the CIOS Working

Party. In general, Black List information was originally considered as that intelligence which was of high operational priority and which would assist the Allies in defeating Germany and Japan.

Early Problems of the Research and Development Branch

Targets were investigated by teams, composed of British, Canadian and U.S. investigators, as quickly as those targets fell into Allied possession. The highest priority targets were considered so important and valuable that the military leaders were ordered to make these targets their special objectives and to guard them until CIOS teams had completed their investigations. On the other hand, the military leaders had a war to win. They couldn't afford to leave enough troops back to guard a target longer than a few days, and since all available transportation facilities were needed, they couldn't permit extra trips taking investigators to and from targets. We were told that if we didn't have our investigators in London or in Paris, ready to go to the target on 24 hours advance notice, they wouldn't get there.

We had to choose between taking key industrial and scientific personnel from their important jobs here and take the chance of their not getting to the targets until after the targets had been investigated by others. It was less complicated for the British than for us, because their specialists were quickly available at home or at their jobs.

In retrospect it seems simple, but in the Fall and early Winter of 1944, we thought we had some mighty difficult problems trying to anticipate answers to such questions as:

a. Will Germany collapse suddenly or will we take her slowly from town to town?

b. If we advance slowly, what parts of Germany will fall first?

c. How much of Eastern Germany will we have an opportunity to investigate, which, of course, depended upon Russia?

d. Should we prepare to investigate targets in the Berlin area? If so, should we send in commandos and fly in investigators shortly thereafter?

We knew something of the plans and strategy of the Allied High Command, but no one knew those of Hitler, who, of course, could not be disregarded. In early October 1944, it appeared that a sudden German collapse was a good possibility and that the total number of technical investigators available from both Britain and U.S. was sufficient to investigate only a limited number of the highest priority targets. Accordingly, the first Black List contained only those targets where technical intelligence of direct or indirect military value was expected. By late October 1944, it became apparent that an imminent sudden collapse of Germany was highly improbable. The Black List was then revised and expanded, and plans were laid for investigating targets as they fell into Allied hands from street to street and town to town. Also at this time, a Grey List was prepared. From the outset, CIOS recognized that many technical intelligence targets had been excluded from the Black List even though they might contain intelligence of vital interest to British and U.S. industry and research establishments. It therefore established the Grey List which contained targets, not of sufficient military urgency to justify inclusion in the Black List, but which focused on industrial techniques and methods.

When the famous "Battle of the Bulge" came, it appeared at first that we might have to investigate many targets all over again. However, it was quite generally believed that this was Germany's last deep breath and that a rapid Allied break-through on a broad front was again a good probability. The experience gained from investigations of targets in France, Belgium, Holland and Luxembourg showed that, although our Black List intelligence was substantially correct, many targets had moved from their original locations or were not conducting their expected activity. This meant that combat troops were, in many cases, guarding targets of negative intelligence value and that highly trained specialists were sent long distances to targets which they were not qualified to investigate.

Caft Operations

To meet these changed conditions, the existing CIOS plan of operations was drastically revised. The Black and the Grey Lists were merged into one Target List and the plan for Consolidated Advance Field Teams (CAFT) was formulated. CAFT provided that a limited number of qualified specialists would move forward with the advancing army spearheads. As a target was seized, these specialists, called CAFT assessors, quickly appraised it and advised the combat commanders whether or not it was of sufficient importance to merit guarding by troops. Reports covering each target assessment were sent to the Rear to CAFT leaders at each Army Group, and by them through military channels to the CIOS Secretariat in London. Targets which merited further detailed investigation were then exploited by specially qualified investigators.

Investigations in German Occupied Countries

The early investigations of targets in the German occupied countries, such as France, Belgium, Holland and Luxembourg revealed that the Germans had not entrusted their most valuable developments and processes to these people, and that we would not start to receive really valuable technical intelligence until targets on German soil were cpatured. Those early targets did, however, provide many valuable leads in Germany proper.

A total of 3377 targets were assessed by CAFT.

A total of approximately 800 field team reports were prepared by CIOS technical investigators.

BIOS and FIAT

CIOS dissolved on 13 July 1945, but technical investigations had not yet been entirely completed. In order to complete the job similar organizations were formed independently by both the British and the U.S. The British changed the word "Combined" to"British" and called theirs BIOS. The U.S. organization was called FIAT, which means "Field Information Agency, Technical". Even though the combined British - U.S. orgnaization, dissolved, there was a strong desire on the part of both countries to continue the close cooperation which had existed. BIOS investigations were made in the U.S. zone and FIAT in the British zone. Therefore, in addition to CIOS reports, there are FIAT reports which cover technical investigations of Germany subsequent to mid-July 1945.

Ordnance Civilian Investigators

Although CIOS investigations were made under control of the Military authorities and in combat zones, hundreds of British and American scientists who participated came from civil life. Industry and science owe these civilian investigators a debt of gratitude. Many investigations were made under battle conditions. In some cases, the targets under investigation were between the enemy and our small artillery. In other cases, the targets were used as forward observation posts and as billets for front line troops. Throughout all the investigations in Germany there was danger of sniping, mines, and booby traps. Fortunately, of the several hundred investigators involved, only two lost their lives, one a U.S. Captain and the other his jeep driver, a U.S. Sergeant.

In an effort to obtain the best qualified personnel for CIOS investigations, the Ordnance Department tried to obtain the services of civilian employees of private concerns which had been engaged in the production or development of Ordnance Materiel. Nationally recognized associations and organizations assisted the Ordnance Department in selecting these technicians by providing recommendations of individuals who were considered best qualified for the job and who were, at the same time, available for an overseas assignment. Automotive experts were obtained through the SAE War Engineering Board, metallurgists through the American Iron and Steel Institute, explosives experts through the Association of Explosives Manufacturers and Optical Glass Specialists through the National Bureau of Standards.

Grievances of Civilian Technical Investigators

One complaint, common to practically every Ordnance civilian investigator, was the fact that they were exposed to as much danger from mines, booby traps and sniping as were officers, but still they were not permitted equal protection; i.e. of carrying firearms. Minor grievances were what they considered embarrassing, such things as:

a. Not being permitted to get rooms or billets on an equal basis with officers. Many of the investigators were simulated Colonels, but in London, Paris and in Germany, the Army placed them lower than 2nd Lieutenants as regards billets. In other words, the Army took care of the Army first, civilians second.

b. Irregularities or non-uniformity of regulations in Washington, London, Paris and Germany as regards uniforms for civilians, especially shoulder patches and insignia on their hats. Many investigators were told by M.P.s to remove the braid from the edge of their overseas hats, in fact, several were forced to do so before they could get into the Army mess in London. In Paris, they were told to put the braid back on their hats. Some investigators were told they should remove the U.S. gold letters from their overseas hats, others were told the reverse. M.P.s stopped many a civilian investigator for not having any or the proper shoulder patch indicating that he was a technical investigator for the Army.

c. CIOS investigator teams were composed of both British and U.S. investigators. The ranking officer of the group was generally made the team Captain or Leader. As such, he had considerable authority and responsibility over the team. Since the Britch gave their civilian investigators temporary commissions in the various Services, their men were generally made team leaders. Their temporary commissions were generally Lt Colonel or full Colonels, which meant that they ranked 99% of the Ordnance regular army(ACC) investigators and 100% of our quasi-military civilian investigators of assimilated rank. This was a bitter pill to take sometimes, especially by U.S. Army officers, who generally resented being told to do things by a non-military Britisher, especially in U.S. 12th and 21st Army Group Areas, using U.S. billets, mess and transportation facilities.

d. A few Ordnance investigators arrived in London with the mistaken impression that their assimilated rank entitled them to all privileges peculiar to that full army rank. As indicated above, they were entitled to equal privilege as regards billets, mess, transportation, medical and dental attention, officers' clubs, Post Exchange (PX) and quartermaster (QM) stores. They were, however, not entitled to give or receive salutes, to mail letters free of charge, to send gifts home free of duty or to receive the liquor rations on the Continent.

Organization of Research and Development Branch

The assignment of the original personnel in the Research and Development Branch is shown in the attached copy of Office Order #3.

Colonel H.H. Zornig resigned as Chief of the Branch, 14 December 1944, to become Chief, Technical Intelligence Branch, A.C. of S., G-2, ETOUSA. It co-ordinated and supervised the technical intelligence activities of the seven Technical Services of ETOUSA; i.e., Ordnance, Engineers, Quartermaster Corps, Transportation Corps, Signal Corps, Medical Corps and Chemical Warfare, and represented their interests on the CIOS and Grey List Panel.

Lt Col Corey, then Major, carried on as Acting Chief of the Branch from 14 December 1944 to 8 April 1945. The organization as of 6 April 1945 is shown in the attached copy of Office Order No. 3 (Change No. 2). Colonel N.A. Quinn became Chief of the Branch 8 April 1945, with offices in Paris, France. Lt Col Corey became Deputy Chief of the Branch, in charge of the London Office. This set-up remained until 10 September 1945 when the London Office was closed. All investigations had been completed, but a backlog of target and progress reports remained to be edited and typed. The Reports Unit then moved to the Paris Office 10 September 1945 where their work was completed by late October 1945.

All personnel, except the translators, of the Research and Development Branch were on T.D. from the Office, Chief of Ordnance. The T.D. was generally for 90 days, which was renewed in those cases where longer duty was required. Because of this relatively short period of duty in the ETO and because all investigators, after March 1945, were continually traveling between London, Paris and Germany, it is not possible to show an organization chart which applies to more than two days. The attached Organization Chart, dated 28 June 1945, shows the organization when it was at its peak.

The attached Organization Chart, dated 15 August 1945, shows the assignment of personnel of the Research and Intelligence Branch. It combined the personnel of the Research and Development Branch with those of the Technical Intelligence Branch (formerly under Col Toftoy) under Col Quinn, as Chief, with Lt Col John A. Keck and Lt Col C.H. Corey as Deputy Chiefs.

The Research and Intelligence Branch was organized approximately 4 July 45. Colonel Quinn departed the ETO the latter part of August 1945 having become Chief of the Technical Division, ETO, a few days previously. Lt Col Franklin Kemble, Jr. then became Chief of the Research and Intelligence Branch as well of the Technical Division. The whole ETO Ordnance organization disintegrated rapidly thereafter, the technical investigation work had been completed and everyone wanted to get home. Both Germany and Japan had been defeated.

Other Technical Intelligence Gathering Agencies

In April 1945, there were a total of 19 different British-U.S. agencies gathering intelligence on Germany. All 19 had provided the various Armies with the names and locations of targets in Germany which they wanted to investigate. Most of these 19 agencies were seeking operational and counter-intelligence information. Of these 19, four were prominently known in the scientific and industrial intelligence gathering field; i.e., CIOS, ALSOS, USSBS, and BBRM.

a. ALSOS was an entirely American organization, sponsored by G-2, War Department to gather technical intelligence, much the same as that gathered by CIOS. It was a relatively small organization. The letters ALSOS, as far as I can determine, are not the abbreviation for any English words, they are Greek, actually and otherwise.

b. USSBS stands for United States Strategic Bombing Survey. It was established by the President, Secretary of War and Chief of Staff, U.S. Army to study the effects of strategic bombing upon the capacity and will of Germany to make war, as well as the direct and indirect consequences of attacks on specific industries.

c. BBRM stands for British Bombing Research Mission. It was an entirely British organization established for essentially the same reasons as apply to the counterpart U.S. organization, USSBS.

Cooperation with the British

The British Ministries and Departments had compiled a vast amount of information and intelligence on German research, development and industrial personnel, activity and locations. They had worked for years on it and had it readily available in usable form.

When we of the nucleus organization of the Research and Development Branch first arrived in London, we had to start from scratch obtaining as much information as possible on the targets which were then in the Black List. We had taken absolutely no such information with us from the States and, if it had been available here, we never knew it. We knew that the British had it but the job was to ferret out the proper Ministry as well as the proper individuals. Whenever any one of our group learned a new source, it was speedily broadcast to others in the Branch, and before many weeks, all of us became quite familiar with the British Government set-up. Contacts with the British as team organizers, as team members and as Working Party members also afforded valuable contacts and leads.

The following British Ministries andDepartments provided the Branch much valuable intelligence on German targets:

Economic Advisory Branch (EAB)
Ministry of Economic Warfare (MEW)
Lansdowne House, London

M.I.-10 and M.I.-19
The War Office, Whitehall, London

Air Department Intelligence, Sub-Section K (A.D.I.K.)
Ashley Gardens, London

Department of Tank Design (D.T.D.)
Admiralty, Chobham, England

Scientific Research Department (S.R.D.)
Fanum House, Leicester Square, London

Royal Aircraft Establishment (R.A.E.)
Farnborough, England

Ministry of Aircraft Production (M.A.P.)
Thames House, Millbank, London

We learned at first that the British would give us anything we asked for, but they were slow in volunteering information. Later, however, after we became more fully acquainted, they became most cooperative, in fact more cooperative than one U.S. agency to another.

It is the writer's opinion that the combined British-U.S. investigation of Germany resulted in benefits to each country which could not have been obtained separately. They were especially helpful throughout the first few months of our combined relations in providing preliminary intelligence on Germany. They provided a greater number of investigators than we did, which was natural because of their closeness to the targets. Their facilities for immediate examination of materiel was helpful to us as well as to them. They gave us assistance, at various times, by providing translations, photostats, photographs and typing help. They have a huge document establishment at Fort Halstead, and a smaller one at the Department of Tank Design, the benefits of which are being made available to us through receipt of regular accession lists showing the German documents located there. Those documents are available to us upon request, I believe translated. Another point is that the British industrialists continued to investigate Germany long after we stopped, and their reports are being made available to us through BIOS (British Intelligence Objectives Agency) via Colonel Reed, our Assistant Military Attache in London.

The Ordnance Department provided a group of high class technical investigators who, had they been otherwise, might not have been as welcome in London or the recipient of so generous cooperation. The Ordnance Department provided a large percentage of the transportation and trucking facilities for CIOS activities.

It is true that there were a few isolated heated discussions between the British and U.S. investigators over minor issues, but that is expected, even in families. The overall results, however, were exceedingly gratifying to both sides when, for the first time since we established our Independence in 1776, it was demonstrated that a large group of technicians from both countries could work and live together so harmoniously.

Miscellaneous Observations

It was learned that the best way to obtain all the detail information of the projects on which German engineers and scientists were working was to have them prepare a written report on each project. This, they were generally willing to do. If they said they needed two days we would order them to have it ready to pick up in one day. Most scientists are proud of their accomplishments and are anxious to advertise their successes, even to their conquerors, if their name appears as the author of their report.

In Berlin, we were told by several top-notch scientists and industrialists that the Russians paid the German scientists so much per page for their reports. These same people in Berlin told us that the Russians had made key German scientists such attractive offers to go to Russia to continue their research projects that they couldn't afford to refuse. The offers were, a high salary, good laboratory facilities and the privilege of taking their families with them. One such individual was Dr. Steenbeck, the best scientist in Germany on nuclear physics and the cyclotron. His equipment and all reports of his work accompanied him. Prof. Eitel, whom we interrogated, an internationally known ceramics specialist, was leaving for Russia shortly thereafter. He was taking his complete, huge library as well as his family. He said that he would have preferred to work for the British or the U.S., but his work was his life and it made little difference where he did it.

I have given considerable thought to the question of how our technical investigations of Germany could have been improved. All in all, I feel that the job was very well done under the conditions, and that few improvements could be made. Any system, of necessity, has to be sufficiently flexible to cover numerous possible strategies of the Armed Forces and surprises of the enemy.

There were many complaints of duplication of effort, such as one particular target having been investigated by as many as 30 different investigator teams. Calm analysis dictates that this may not have been so unreasonable. I doubt that a fewer number of teams could do a satisfactory job of investigating a large corporation, such as U.S. Steel, General Motors, or a large laboratory, such as Bell Telephone Laboratories.

There have been complaints that the British and the U.S. investigators should not have been combined into investigator teams. My personal feeling is that the U.S. gained at least as much as they gave by this cooperation and that our close association in CIOS activities has established the fact that a country's scientists are its best ambassadors.

Very little clear thinking was directed toward the German documents problem. It was a problem throughout the whole investigation of Germany. Everyone knew it was not handled properly but no one appeared to know the answer. For example, suppose the first team at a target was interested in chemicals. Since most investigators couldn't read German, that team, to be certain of getting all the information possible, would evacuate practically all the documents at that target to some location in London. In the group would be valuable documents on plastics, rubber, metallurgy and fuels. The result was that the information on subjects, other than chemicals, would probably not reach the proper technicians for analysis and appraisal until long after the war was over and all qualified specialists were scattered back into civilian activities. Also, when that particular target ~~is~~ was visited later by plastics, rubber or metallurgical specialists they couldn't do a satisfactory job because the scientists they interrogated require their documents and records for references. Divorce a scientist from his reports and records and you reduce his value at least 50%.

This problem could be solved by leaving all documents and records at the establishment, under guard, until that particular target had been completely investigated by all concerned. Instead of evacuating tons of valueless documents out of a conquered country, leave them at the targets until they can be sorted and classified into subjects. Then, qualified technicians should choose which few documents are of sufficient value to justify evacuation and translation. In the meantime, all documents are available on the spot for the preparation of reports by the scientists concerned and for perusal by all investigators who visit the target.

Experience with documents in the Technical Intelligence Branch shows that less than 1% of all evacuated German documents are of sufficient interest to justify translating.

This history would not be complete without reference to the fact that the Ordnance mission was directed specifically by the Research and Development Service, Office, Chief of Ordnance, under the leadership of Major General G.M. Barnes and Colonel S. B. Ritchie.

C. H. Corey
Lt Col, Ord Dept

27 February 1946

As has many times been said, this is a mechanized war, a war in which the officers and engineers responsible for the design and production of U.S. ordnance materiel must assume a large portion of the total effort necessary for victory. This mechanization has necessitated an enlargement of the traditional military concept of "intelligence". Combat, tactical and strategic intelligence are still of great importance, but a new field of intelligence of equal value ~~as~~ to the other field has been added - technical intelligence.

In order to design and produce weapons superior to those of the enemy, these officers and engineers must know what the enemy has done in the production of his own weapons, what he is now doing and what he plans to do. As Ordnance Intelligence officers, you are a very important cog in the machinery which has been set up to supply information on enemy ordnance to those responsible for the design of U.S. ordnance.

It is now my purpose to explain to you the machinery of ordnance technical intelligence. Because information on enemy ordnance is primarily ~~intended for~~ used in the design of U.S. ordnance, the organization comes within the Research & Development Service which is under the leadership of General Barnes. The particular office charged with the operation is the Technical Intelligence Branch in the Research of foreign ordnance under the supervision of the Technical Intelligence Branch thereof.

The Foreign Materiel Branch advises the Technical Intelligence Branch of the arrival of the item. Thereupon, the Technical Intelligence Branch contacts the appropriate Development Divisions in the Office, Chief of Ordnance and prepares a complete correlated directive for the test and examination of that item. This coordination is important. As mahy as three or four Divisions may be interested in one item of enemy ordnance and it is important that as much information as possible be obtained from the relatively limited amounts of enemy materiel available in this country.

A firing program carried out according to such a directive will give complete information concerning the item. If the item should be an antitank gun for example, the weight of the piece in firing position and in traveling position will be obtained, the muzzle velocity, ballistic limits of the projectiles fired, hop records, maximum - minimum elevation and traverses, ~~traverse~~ etc. If extra gun tubes are available, they are sent to Watertown Arsenal for metallurgical examination. The arsenal also conducts metallurgical examinations on samples of foreign armor plate.

A tank is given the same standard test as the U.S. pilot model. If enough tanks are available, their vulnerability to U.S. weapons is determined. This has been done with respect to the German Mk. III, IV and VI tanks. It is now being done against the German Mk V or "Panther" tank.

Small arms ammunition and cartridge cases for all calibers are sent to Frankford Arsenal. Ammunition is sent to Picatinny Arsenal where chemical analyses are made of the explosive, primer and detonator, etc. Complete working drawings are also made of the complete round and particularly of the fuzes. 5 Cooperation of Other Govt. Agencies Govs Aircraft – Scient Industry

Many metallurgical examinations of samples from enemy equipment are conducted by Battelle Memorial Institute working under the auspices of the War Metallurgy Committee of the National Research Council. These examinations are particularly concerned with methods of manufacturing and the use of alloys to determine new methods of manufacture and the possible existence of shortages in enemy resources.

Fire control instruments are sent to Frankford Arsenal.

At the request of the Ordnance Department, the War Engineering Board of the Society of Automotive [illegible] engineering analysis of all enemy tank and automotive equipment. Nationally recognized experts in

[illegible]

by the Engineering Board ~~and~~ These experts have reviewed all [illegible] automotive equipment at the Foreign Materiel Branch and have selected those features of enemy design which differ from U.S. design and which appear to be worthy of careful examination and test. The board has made arrangements whereby these items so selected will be examined by firms manufacturing comparable U.S. automotive components.

The extent of all this work can best be appreciated by stating that during 1944 507 examinations on enemy equipment have been initiated. ~~Typical~~ ~~are the~~ firing of the German 75 KwK 42, 88mm Flak 41 and 88mm Pak 43/41 and 88 Pak 43 to obtain information used in the design of a new U.S. 90mm APHE projectile.

6 Benefits

1. Public Idea for new items

This examination of enemy ordnance has paid dividends. In addition to giving the designers of U.S. ordnance information necessary to design effective countermeasures, it has disclosed ~~many~~ numerous design features which have been adopted in U.S. ordnance. Typical examples are: the sealing disc in the tracer cavity of German 20mm ammunition which has been adopted for use in the U.S. 20 and 40mm ammunition, the U.S. caliber 60 machine gun is an ~~exact~~ copy of the German aircraft machine gun MG 151/20. An experimental [illegible] gun is a copy of the German MG 34 and 42. The German Flak fuzes have been copied exactly; the Russian 12cm mortar captured by the Germans is being copied in the U.S. 12cm mortar. Many features of the German rangefinders have been embodied in the design of U.S. rangefinders.

After the examination, the enemy ordnance materiel is placed in the Foreign Materiel Museum which is operated by the Foreign Materiel Branch. This museum is visited by hundreds of persons each month including trainees from the Ordnance Replacement Training Center, Camp Meade, Fort Belvoir, etc., and more important, by officers and engineers engaged in the Development of U.S. materiel and by engineers from private facilities who are working with the Ordnance Department. Frequently items which have been examined and which have been placed in the museum are withdrawn from the museum and given further tests when a new development project is assigned to the Research and Development Service. ~~As an example,~~ the German 50cm mortar was recently fired to determine the performance characteristics of the fuzes when the Ammunition Development Division received a project to develop a mortar fuze with delay ?
arming. 1 Manuals etc

So far, I have not yet mentioned a third but very important use which is made of the materiel sent back to this country by the Intelligence Teams.

Information obtained from this examination is used in the preparation of training manuals, circulars, bulletins etc. which are prepared to train U.S. combat troops in the use of captured equipment. Copies of the reports on all examinations are supplied to G-2 WDGS and to the agencies charged with the dissemination of such information. The Ordnance Department is not charged with the training of combat troops, but it is called upon to edit technically all the publications on enemy equipment which are distributed to the troops. INSERT

You will encounter great difficulties and perhaps considerable danger in recovering items of enemy ordnance and in shipping them to the United States. I hope that in telling you of the use made of this materiel here in this country I have impressed upon you the importance of the work you are about to undertake. You are about to form a very vital part in the over-all Ordnance mission. 8

1. Rumors
2. Return from Unit
3. Packing for Shipment

INSERT

I have already mentioned that tests have been donducted to determine the vulnerability of German tanks to U.S. antitank weapons. Such information, in addition to being used by the designers of U.S. ordnance materiel, is very valuable to the combat troops in developing battle techniques. Information is

[illegible]

Presented by

COLONEL J. H. FRYE

at the

ANNUAL MEETING OF THE SOCIETY OF AUTOMOTIVE ENGINEERS

DETROIT, MICHIGAN

10 JANUARY 1945

MR. CHAIRMAN, MEMBERS OF THE SOCIETY OF AUTOMOTIVE ENGINEERS, LADIES AND GENTLEMEN:

A nation's ability to wage war can be measured by its capacity to produce and fabricate metals. History tells us that the Assyrian Army was the first to be fully equipped with iron weapons (about 700 B.C.) and their superior arms made them invincible in conquering Babylon and Egypt. Caesar found the uncivilized tribes of Briton using iron bars for currency, while raiding Norsemen prized iron cooking pots far more than gold or jewels. In a broad sense, the value of iron and steel has not changed greatly, and it is because of this nation's great capacity to produce and fabricate tremendous quantities of essential metals that there could be no doubt about the outcome of the war. The wide range of metals and metallurgy that enters into automotive materiel offers an excellent opportunity to expand our knowledge of the enemy through a metallurgical study of their vehicles.

At the outset of the war, the Ordnance Department recognized the importance of being familiar with enemy materiel. Technical Intelligence field teams were organized, and assigned to our armies to accompany them on the first assault waves of an attack. A Foreign Materiel Branch was established at the Ordnance Research and Development Center, Aberdeen Proving Ground, to receive, proof test, and arrange this captured material for engineering studies. The whole is supervised and coordinated by the Technical Intelligence Branch, Research and Materials Division. Over 1400 different types of enemy weapons, ammunition and automotive vehicles have been received and examined.

Germany has been actively engaged in technical intelligence work since the beginning of the war, but the Japanese have been shortsighted in this respect.

German weapons are good and are being constantly improved, indicative of the generally accepted opinion of German ingenuity and engineering ability. In general, they represent good engineering and design principles. On the other hand, Japan has been accumulating stock piles of finished war materiel for the past ten or fifteen years. Much of this equipment was made in foreign countries, notably Germany, while that made in Japan was normally produced according to standards and designs which were acceptable at the time of their construction. The Japanese have not demonstrated automotive and metallurgical engineering ability and ingenuity beyond that which would be commonly expected of them. A review of the enemy availability and supply situation, in regard to the principal engineering materials, will assist in evaluating their existing metallurgical practices, and possibly in foreseeing future changes.

Of all materials, steel is perhaps most essential and used in the greatest volume. The German steel industry is second only to that of the United States, with an annual capacity of nearly thirty million ingot tons. At the height of her military successes there was a potential capacity, including that of occupied countries, of over fifty million tons, but it is unlikely that <u>that</u> tonnage was ever reached. Since that time, the production of France, Belgium, Luxembourg, Roumania and Italy has been lost to her, and the present available tonnage is approximately twenty-five million tons. Nearly two-thirds of the German steel production capacity lies in the Ruhr Valley and approximately 10% in the Saar. Although Germany has a limited production of manganese, there can be little doubt that a considerable stockpile of ore has been created through the operation of the Nikopol mines. The Balkans have provided large quantities of essential alloying ores, and their loss, and those of other liberated countries, will unquestionably require some adjustments in her steel making practices, although again it may be expected that large stockpiles have been created.

Copper is the most critical metal to the German war economy. This is emphasized by the confiscation of electrical lines, church bells, statues, utensils, boilers and pipes throughout Germany and occupied nations, and the extensive substitution that has been practiced. Magnesium is available in abundant quantities and there is sufficient refining capacity for aluminum to provide 200,000 tons above requirements. This excess can be substituted for copper and other metals of less favorable availability.

To evaluate the German material situation, consideration must be given to the stockpiles of basic materials and scrap which were confiscated from occupied countries. Also, large quantities of tanks, guns and other materiel were captured and, while a few of such items were accepted and used, such as the Czech 38 tank chassis and the Polish 7.92 mm gun, this captured materiel served principally as important mines for ferrous and non-ferrous materials. The prewar materiel of most countries was made without substitution or materiel restrictions, and the use of nickel up to 5%, molybdenum up to .5%, and chromium in quantities as high as 2%, were used in prewar armor and gun tubes and comparatively as rich alloys in constructional steels. Likewise, copper, aluminum and other non-ferrous metals were used most profusely. The efficient German salvage organization rigidly enforced segregation and the utilization of the materials to the fullest extent.

There can be no doubt that Germany fully recognized her short-comings in raw materials and by various means has so far circumvented this disadvantage. Chromium, silicon and manganese were her most available ferro-alloying elements so considerable technical work was done to develop suitable steel chemistries.

The Japanese material situation is quite different from that of the Germans. Although Japan has conquered territories extremely rich in minerals and other basic materials, she is very vulnerable through shipping hazards. However, a stockpiling program was initiated in the early 1930's and deficient materials were purchased in great quantities. Simultaneously, an industrial program was inaugurated, and mining and manufacturing capacities within the inner zone were developed to the maximum extent. No doubt Japan was aware that a long term development in the conquered southern areas could not be accomplished, and she concentrated on obtaining the quick assets of essential products. Japanese industrial strength lies in the North, but they have had possession of the southern areas long enough to milk them of supplies. It would be unwise to assume that raw material requirements cannot be met for considerable time. It would seem more reasonable to expect inadequate manufacturing and fabricating facilities for the production of war materiel.

During 1942, Japan produced approximately eleven million ingot tons of steel, and it is possible that this may have been increased 25% during 1944. With the exception of some alloying elements, basic materials for steel making are available. Many of the necessary ferro-alloying elements and non-ferrous metals, except aluminum and magnesium, will prove extremely critical as stockpiles are continuously being depleted.

However, Japan, stockpiled the finished equipment of every kind, consequently, many of their automotive vehicles do not represent their present metallurgical capabilities. Many of these vehicles were copies of American or other foreign designs. As an example, the Jap 1-1/2 ton cargo truck is almost an exact copy of the 1939 Chevrolet, and, insofar as practicable, they have copied the metallurgical practices, as well as design principles. A table of chemistries and treatments of some components of this vehicle are included in the paper, but they are not of sufficient interest to spend time on this afternoon.

Instead, we have some slides that show some of the more interesting data of German vehicles.

(SLIDE 4)

This slide shows a portion of the German constructional steel specifications. These specifications were translated from a German materials handbook published at Essen in 1943, whose foreword naively stated "All translations into enemy languages are prohibited." The first group, DIN 1611-A, has no chemistry requirements. There is an error in the caption of Steel B; instead of reading "Carbon content not fixed by purchaser," it should read "Only carbon content is fixed by purchaser." There are four principal types of carburizing steels: straight carbon, MN-CR, CR-MO, and CR-NI. The nickel compositions have not been used in automotive vehicles, apparently being reserved for aircraft and other very special needs.

(SLIDE 5)

The next slide shows the medium carbon grades of this specification, and the same general pattern exists. There is one manganese-silicon grade, DIN 1665, VMS/135, while VMC has reasonably high silicon. In the earlier vehicles, the [illegible]-molybdenum grades were used extensively, but later vehicles are made almost exclusively from carbon steels, chrome-manganese and, to a lesser extent, chrome-silicon types, indicating an increasing a possible shortage of molybdenum.

(SLIDE 6)

This slide shows the mainshaft sub-assembly of the German Volkswagen. This was the much advertised "People's Car" which Hitler promised to place in every garage. The main shaft is made from steel comparable with SAE 4137, and quenched and tempered to Rc 49 - 52. The spur gears are .38 C chrome-molybdenum steel similar to 4140 except low manganese. These gears were case hardened to a depth of .008". The case hardness was Rc 64 and core 49.

(SLIDE 7)

The upper left micrograph shows the structure of the mainshaft. It appears to have been quenched out and tempered at a low temperature. The right micrograph shows the core structure of the smaller spur gear. Contains martensite with some bainite. The case is the lower figure.

(SLIDE 8)

All of the important gears in the Volkswagen were case hardened, and the more highly stressed ones were medium carbon chrome molybdenum steels. This table summarizes the essential gear practice in the vehicle. The high case and core hardness valves are noteworthy as are some of the case depths. The carburizing of medium carbon steel gears and development of high case and core hardness values are in keeping with the thinking of our automotive metallurgists, but the carbon content and the core hardness in this vehicle are somewhat higher. The spline shaft and driving pinion and the reduction gear are the only low carbon alloy steel gears in the group. The timing gear is made from essentially SAE 1045 and has a .040" case. Note that all but two of these gears are made from chrome-molybdenum steel and all of the analyses conform [illegible] German specifications.

(SLIDE 9)

This shows the macrograph of a cross section of the Volkswagen crankshaft. It was machined from a one piece forging and induction hardened on the throws to a hardness of Rc 56 - 58 while the unhardened portions had a hardness of Rc 23 - 27. It is an excellent forging job, but the induction hardened areas do penetrate the radii on the throws. Also, some of the radii are inclined to be sharp.

(SLIDE 10)

This slide shows the cam shaft of the Volkswagen. It is a grey iron casting whose bearing surfaces were flame hardened. Flame hardening produces the fuzzy appearance at the bottom of the hardened areas whereas induction hardening generally leaves a sharp line of demarcation. The hardened areas had a Rockwell C hardness of 47 - 48 and the structure was essentially of white iron. The shaft was a normal grey iron with a Rockwell C of 15 - 22.

(SLIDE 11)

This is a driving pinion and spline shaft sub-assembly, and of interest from the design as well as the metallurgical point of view. Rollers are used as splines. Made from German VC Mc 125, which is similar to SAE 4125, these rollers were carburized .020" and have a case hardness of Rc 60 - 65, and a core hardness of Rc 38. The spline shaft and driving pinion is low carbon, manganese-chrome-molybdenum steel, German EC Mo 100, which was carburized and heat treated to a case hardness of Rc 62 and the core of Rc 26. Note the use of helical gears.

(SLIDE 12)

These are micrographs showing the structure of the rear axle shaft. The top micrograph shows that of the forged tongue, while the bottom shows the structure of the shaft proper. This shaft is made from medium carbon chrome-molybdenum bar steel which had been hot upset on one end. The shaft was gradiantly quenched, obtaining a hardness of Rc 28 - 34 on the shaft and 45 - 48 on the tongue. It appears that the cooling rate was not rapid enough to obtain the optimum hardening.

(SLIDE 13)

This cross section of the transmission case is one of the most interesting non-ferrous parts in the Volkswagen. It is a sand cast magnesium alloy of rather intricate design, and unusually free from porosity and other defects. The casting was given a dichromate treatment to inhibit corrosion. There were several other magnesium parts in this vehicle including the cam shaft timing gear.

(SLIDE 14)

The German 8 ton half track prime mover and personnel carrier, is one of the principal prime movers of the German Army, and is extremely important to mobile warfare. The Germans designate half tracks by their towing capacity, hence the name of 8 ton. This vehicle is actually three-quarter track. There are many interesting metallurgical features. This slide shows the gear compositions and metallurgical practices which were used in the vehicle. The timing gear was made from carbon-chrome steel, the Universal spline from manganese-chrome, and the remainder from chrome-molybdenum carburizing grades. All were heavily carburized but in these instances low carbon steels were used, 30 carbon being the maximum. High case hardness values continue, although only the universal spline and transmission gear have relatively high core hardness values.

In most other components the steel chemistries followed those found in the Volkswagen, but several nickel alloys were used. The main shaft is made from Krupp analysis and is believed that the alloy content is higher than needed. It has a DI factor of about 9, which can be met with much lower alloy, such as German VC Mo 240. It is believed that this case is an exception, and this analysis was used as a matter of expediency, perhaps to utilize confiscated or diverted steel.

(SLIDE 15)

This slide shows the half track crankshaft. It is made from chrome molybdenum steel to which about 1/2% nickel was added.

(SLIDE 16)

This shows a macrograph of No. 3 and No. 4 throws. A considerable amount of machine work is indicated by the cutting of the forging flow lines. The excellence of the induction hardening of the bearing areas can be noted. In this crankshaft the fillets are well formed and in no instance do the hardened areas enter into the fillets. The hardness of the throws was Rc 53 while that of the shaft proper ranged from 27 - 33.

(SLIDE 17)

This shows the macroetch of the reverse sliding gear on an 8-ton half track. It was made from German EC Mo 100 which is low carbon chrome molybdenum type, and is a good illustration of German forging practice.

(SLIDE 18)

This slide shows a macrograph of the teeth of the reverse sliding gear. The case depth was approximately .020" and had a Rockwell C of 61 with the core hardness of Rc 38.

(SLIDE 19)

A German vehicle of the heavy duty type which was made a year or so later than the half track has been metallurgically surveyed.

This slide shows No. 3 and 4 throws of the crankshaft of this vehicle. It will be noted that the hardened areas have not been carried into the fillets. This crankshaft was made essentially from SAE 1345 steel, with small additions of chrome .14% and vanadium .04%. The crankshaft is rather large in diameter and operates in roller bearings.

(SLIDE 20)

The intake valves are made from medium carbon, low nickel, high chromium steel, and the 1-1/2% chromium seems somewhat higher than necessary. The exhaust valves shown here are made by drilling a bar and hot upsetting the end. The cavity is filled with sodium, through the hole in the head, which is later sealed with 18-8 welding rod. It is made from silchrome type of steel.

(SLIDE 21)

This slide is a macrograph of a section of a heavy duty mainshaft, and it is interesting because of the processing method used. The mainshaft is .30 carbon manganese steel similar to SAE 1036 and the clutch gear from a .44 carbon chrome manganese steel forging. After machining, the two are welded to form an integral unit. Although complete penetration through the weld joint has not been obtained, it appears that the weld area has sufficient strength to meet stress requirements.

(SLIDE 22)

This slide shows a heavy duty transmission gear. It is of interest largely because of the bolted type of construction and the large number of bolts which have been used.

(SLIDE 23)

This slide shows a macrograph of a transmission gear shaft and is illustrative of German forging practice.

(SLIDE 24)

This slide shows a summary of the composition and heat treatment of some of the principal gears in a heavy duty engine and transmission. The carbon content is generally that of normal carburizing quality; there has been no molybdenum type of steels used, and high case hardness values are the general rule. The timing gear has been nitrided. The starter gear has a low hardness. The absence of molybdenum may indicate that conservation was required since the time of production of the Volkswagen and half track.

(SLIDE 25)

This is the hardenability curve based on standard Jominy tests

MATERIAL FOR THE FRANKLIN INSTITUTE ARTICLE - TECHNICAL INTELLIGENCE SE.

Much has been written of the fine work done by Ordnance Intelligence representatives in all the Theaters of War. They accomplished their mission against all adversities and as Colonel S. B. Ritchie, Chief of Research and Materials Division stated "They were the Eyes and the Ears of the Office of the Chief of Ordnance."

These Ordnance men went right up to the front lines, worked with the combat troops, advanced with them, and suffered the same hardships as the front line soldiers.

The significance of their achievements is indicated by the vast quantity of captured enemy materiel sent back to this country for examination and analysis. Although the total tonnage is not exactly known, we may estimate that approximately 100,000 tons were received in this country. This materiel included everything from the smallest piece of captured Enemy Ordnance up to the huge 28cm K-5(E) "Anzio Annie" which fires projectiles up to 53 miles in range.

Most of the new types of enemy materiel located were generally found in the front lines or so far forward that it was impossible, sometimes, for great periods of time, to recover it for immediate shipment to this country. This occasioned these specially trained Ordnance men to examine the materiel on the spot, often under fire and to find the latest data for transmission back.

Information obtained from the great volume of both preliminary and final reports played an important role in enabling the United States to maintain its advantage in the fighting tools the Ordnance Department provided for the Allied forces.

In addition, these representatives gave invaluable information and help to the troops in the field. They did everything from taking the mystery out of the enemy weapons by explaining and training the troops in their use and mechanism to actually acting as bomb disposal men, defuzing and detonating dangerously located missiles which some times contained new type fuzes that had never been seen or heard of before including anti-disturbance type.

The following excerpts taken from Activities Reports present a brief summary of the invaluable work done by the Ordnance intelligence representatives, a great portion of which was done in addition to their assigned mission.

a. One report from First Army in Ovember of 1944 states "During this period, members of the Unit cooperated with the Ordnance Section in the obtaining of approximately 50 - 10.5cm le.F.H. 18/40 howitzers. This involved a trip by the Ordnance intelligence artillery officer to Falaise in order to supervise cannailization and evacuation of these to Communication Zone in Paris. The Ordnance Intelligence ammunition officer during the same period inventoried various enemy ammunition dumps for ammunition. The guns and ammunition are to be used by First Army units in order to conserve U.S. Ordnance equipment as much as possible in forthcoming coperations."

b. Colonel Toftoy, in reporting on the activity for one period states that in one 24 hour period, our troops had fired over 10,000 rounds of German 105mm ammunition which in his opinion may have been greatly accredited to the "on-the-spot" field work of the Technical Intelligence teams.

c. In the Pacific, these teams performed varied and unusual tasks above and beyond their normal responsibilities and of the original groups of five officers and ten men sent to the Pacific, 3 officers and 4 enlisted men received decorations for outstanding service performed over and above the call of duty.

In one particular instance, on Luzon, Jap rockets were being fired at our men for the first time. The unfamiliar sound and flashes created, resulted in an unusual increase in hospitalized mental cases among our troops. However, after some of the rocket launching sights with equipment were captured, the Technical Intelligence officer with that division trained a few crews of our men in the use of the captured rockets and began to fire them back at the Japs. This action and application of first-hand knowledge of Japanese weapons caused the mental cases of our men to drop appreciably and the officer was recognized by the division for his work in being awarded the Bronze Star.

Another officer during the battle of Leyte in the Philippines compiled range tables from actual firing of Japanese mortar ammunition in our own mortars and as a direct result of this work, over 5500 rounds of Japanese mortar ammunition were utilized in one week to augment our own critical supply.

Many other true incidents could be sighted with regards to this small group of "Eyes & Ears of the Ordnance Department" who started out in the latter part of 1942 to be our Ordnance field investigators for acquiring exact technical information in keeping abreast of enemy developments.