German Aircraft*

No. I

THE history of the German aircraft industry during the war is one of ceaseless endeavour to overtake and hold technical superiority over the Allies. In spite of all that German industry and ingenuity could contrive, the fact remains that German aircraft, even in the earliest days of the war, could not wrest air supremacy from the British, and later from the Allies. The most notable example of this failure is probably the Battle of Britain, when, although the Luftwaffe had undoubted numerical superiority over the R.A.F., the combination of superior performance of British fighters and the pilots who flew them and inspired tactics produced a defeat from which the Luftwaffe never really recovered. Apart from a brief moment when the F.W.190 appeared to offer a hope of revival for the Luftwaffe fighter force, superiority in this class was maintained until the German collapse.

ME 262 A SINGLE-SEAT JET-PROPELLED FIGHTER

Although the German bomber force was adequate for its intended purpose, as a weapon to overwhelm and terrorise small nations, that *rôle* failed when the Luftwaffe was turned against this country. There was, consequently, nothing to take its place as a strategic bombing force, owing to the lack of long-term planning. The Germans produced nothing to equal the "Lancaster," either in performance or as a weight carrier. Frenzied attempts were made to manufacture the Heinkel 177 in sufficient numbers to build up a new bomber force, but it was a failure from the start, and although many of the teething troubles were eradicated it never became a serious menace. There were, of course, many other experiments with heavy bombers, but little had appeared at the time of Germany's collapse to challenge Allied superiority in this field.

German experiments in jet propulsion and rocket-assisted take-off produced much that was revolutionary in aircraft performance and design. British and American developments in this direction still remain a secret, and there is, at the moment, no means of comparing Allied progress with that of Germany. It appears, however, that one of the main difficulties confronting the Germans was a lack of endurance, and although some of the performance figures appear to be staggering, in actual fact they could be maintained for such a small space of time as to make them doubtful quantities in operation. Whether these particular difficulties would have been overcome under the stress of the tremendous Allied bombing offensive, can only be a matter for speculation at the moment.

To sum up, it would seem that the German aircraft and aero-engine designers suffered mainly from a lack of co-ordination and direction from above. They appeared to be engaged in frantic competition with each other to produce a weapon which would overcome Allied superiority and turn the air war in their favour. Many prototypes were produced only to be scrapped in favour of a design which seemed to offer greater possibilities. Consequently, the Luftwaffe suffered always from a shortage of orthodox aircraft able to challenge the air superiority of the Allies built upon sound progressive plans rigidly adhered to.

In the following notes German aircraft are briefly discussed according to class.

SINGLE-SEAT FIGHTERS

Single-seat fighters were by far the most important category in Germany during the later phases of the war, and the most interesting from the technical standpoint. They will, accordingly be dealt with first.

It is a significant fact that apart from the jet-propelled types, which will be dealt with later, the Germans used only two basic designs of single-seat fighter, whereas the Allies employed at least a dozen. Standardisation of these two types (Me.109 and Fw.190) was an excellent thing from the view point of production and maintenance, but meant that to offset the progressive modernisation of the "Spitfire" and the introduction by the Allies of new fighter types, ceaseless improvement was imperative. This is particularly well illustrated in the case of the Me.109, now about ten years old. In 1937 the Me. 109A had 500 H.P. and was slower than the "Hurricane." At the end of the war, its most modern descendant—the 109K—had nearly 2000 H.P., was about as fast as the "Mustang," and had ten times the fire power of the original 109.

ME 163 B ROCKET - PROPELLED INTERCEPTOR

In conjunction with the GM.1 (nitrous oxide) and MW. 50 (methanol) power-boosting systems, engine and airframe improvements enabled the 109 throughout the war to tackle our fighters at least on something approaching equal terms. But high performance was not all that was demanded. The American daylight heavy-bomber offensive called for heavier fire power, so the armament of the Me.109 was gradually stepped up from one 20 mm. gun and two light machine guns—this was the standard armament in 1941—to three guns of 20 mm. or 30 mm. calibre, and two of 0·5in. bore. That was a very heavy load for a small fighter, and its resistance and weight detracted appreciably from the increased performance allowed by the newer engines and power-boosting systems.

As an alternative to the wing guns on the Me.109, a pair of 21 cm. rocket projectiles were sometimes hung below the wings for attacking "Fortresses" and "Liberators." At one time this 21 cm. rocket seemed menacing, but it soon proved to be very inaccurate.

So much for the Me.109, the mainstay of the German day-fighter force. A fine aeroplane, but a poor second to the "Spitfire," "Mustang," or "Tempest." Professor Messerschmitt did attempt to build better fighters—the 209 and 309—but neither of these was enough to warrant retooling for production. The 309 was, nevertheless, an interesting design with a tricycle undercarriage. Contrary to reports, neither the 209 nor the 309 ever became operational.

The introduction of the radial-engined Fw.190A in 1942 gave the Germans a temporary superiority in performance at medium height. This excellent little aircraft remained in service until the end as a general-purpose fighter, bomber, and low-level attack aircraft. It was capable of carrying a 4000 lb. bomb, but a more normal load was 1000 lb. to 1500 lb. Its armament and handling characteristics were admirable, but poor altitude performance, due to the characteristics of the HMW 801 engine, was a very serious drawback. Towards the end, the Fw.190 was fitted with a liquid-cooled Jumo 213 engine. This was the so-called "long-nosed 190" or the 190 D. Eventually, it was completely redesigned as the Ta.152, virtually a new type. This Ta.152, although not so spectacular as the jet fighters, has an excellent performance, particularly one version of it, known as the 152 H. This aircraft has an amazingly long wing span—nearly half as much again as the "Spitfire." This feature, together with the two-stage supercharger of the Jumo 213 engine, gives it a very high performance at altitude. The top speed is over 460 m.p.h. at 41.000ft. Kurt Tank, the designer, whose practice it was to fly all aircraft of his own design, tells with some satisfaction how, when testing a Ta.152 H a few weeks before the collapse, he outstripped a flight of pursuing "Mustangs." The 152 H was coming into service when Germany capitulated.

An even more remarkable high-altitude

* Air Ministry News Service.

fighter under development was of Blohm and Voss design—the Bv.155. This has a liquid-cooled DB 603 engine, with a special turbo-supercharger known as the TK 15, and was expected to attain its top speed of nearly 430 m.p.h. at over 50,000ft.—above the ceiling of present-day fighters. Had this Bv.155 come into service, it might have set some new problems.

One of the newest single-seat fighters using conventional engines, or Otto engines, as the Germans call them, was the Do.335—the strange aircraft with a propeller fore and aft. Dorniers prepared the basic designs for the 335 several years ago, but were only recently authorised to proceed with development work. The single-seat 335 day fighter was not used operationally, but was a promising design with three high-velocity 30 mm. guns and two 20 mm. guns. The top speed was over 470 m.p.h. There was a project for installing a turbo-jet unit in place of the rear engine.

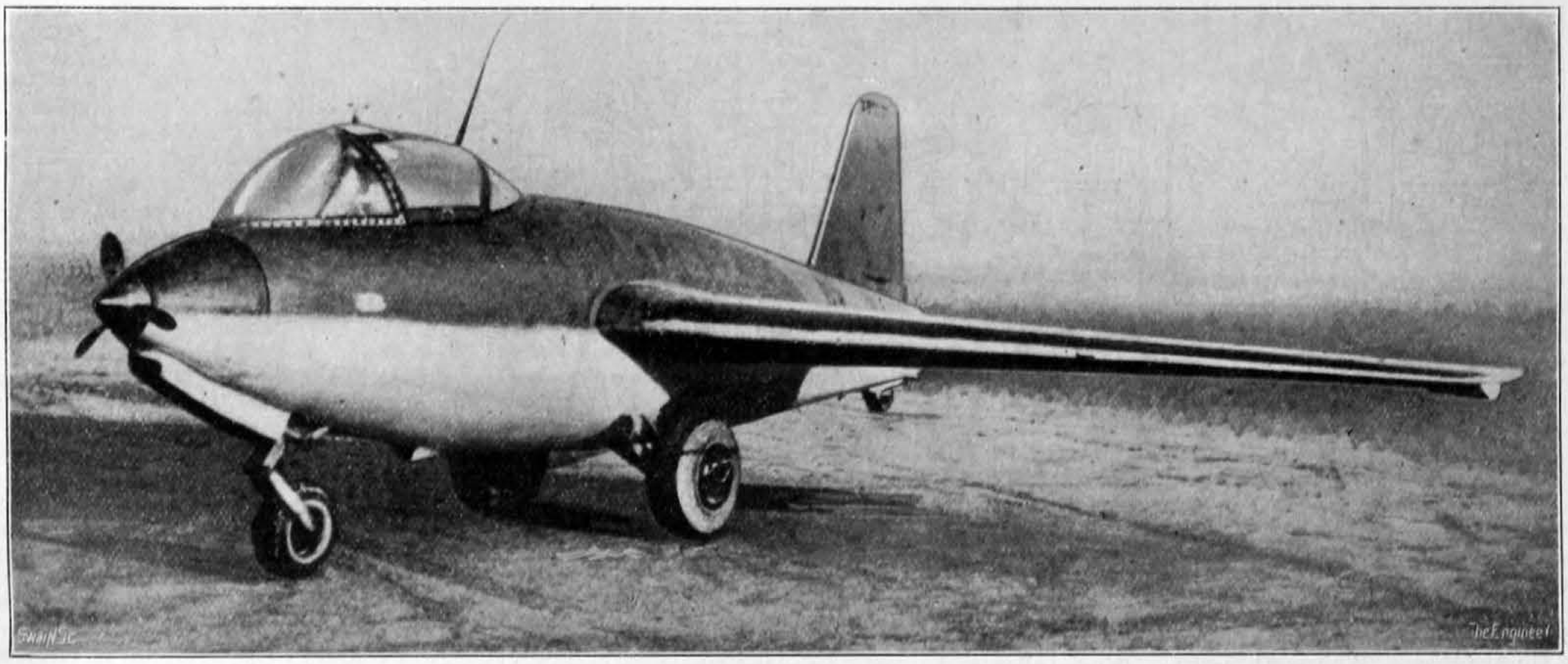
Sufficient has already been published to show that the Germans were quick to appreciate the advantages offered by jet propulsion. The term " jet propulsion," it should be remembered, covers not only turbo-jet units as used in the apparent towards the end, and highly specialised rocket-propelled interceptors of various designs with extremely short duration were under development.

One type actually went into service several months before the collapse. This was the amazing little Me.163 " Komet," a semi-tailless design, capable of a level speed of about 550 m.p.h., and able to climb to 30,000ft. in just over 2½ min. The Me.163 normally took off under its own power, jettisoned its wheels and landed on a skid. It was armed with two 30 mm. guns and was built partly of wood. In order to increase the endurance, a later model, the 163 C, had a special rocket unit incorporating a second jet, to give cruising economy. The endurance under power was about 12 min. and the maximum speed 590 m.p.h.

The development of the 163 was finally taken over by Junkers, who designed an aircraft of similar characteristics, which they called the Ju.248 (later the 263). This 263 was designed to climb to 49,000ft. (far above the operating height of our bombers) in 3 min.

Rocket-propelled interceptors of this sort were comparatively quick and cheap to build, but were very seriously handicapped by their was designed for a speed of 590 m.p.h., and an endurance of up to 3 hours. The Messerschmitt was generally similar. One version of the Ta.183 was to have a liquid rocket above the turbo-jet tail pipe to improve climb and emergency speed.

The performance of some of these German jet fighters, particularly the 163 and 263, is quite staggering judged by the standards of 1939, but the enemy was developing a " last-ditch " project which would have made them seem sluggish. This was the Natter or Viper, a project of the Bachem concern. Although Natter is rightly classed as an aircraft because it has wings, controls, and a pilot, its proposed method of employment was such that it might be regarded as a piloted Flak rocket. Natter, or the BP 20, to give it its number, was a tiny aircraft of about 18ft. span and powered by a liquid rocket, as installed in the Me.163. It was to take off vertically with the assistance of auxiliary rockets, climb at the rate of about 37,000ft. a minute, and destroy a bomber with its battery of rocket projectiles. This being accomplished, the pilot was to be ejected and descend by parachute. Simultaneously, the rear half of the fuselage containing the liquid



JU.263—ROCKET PROPELLED INTERCEPTOR FIGHTER

British jet fighters, but liquid rockets, almost exclusively a German development.

The first jet-propelled aircraft to fly in Germany—or, for that matter, in any country—was a Heinkel, the He.178, a counterpart of our Gloster-Whittle. This little single-seater made its first flight on August 27th, 1939, four days before the Germans marched into Poland. The 178 had an experimental Heinkel turbo-jet unit with a thrust of only 1000 lb. It was purely a flying test bed and was not developed for military purposes, but it did provide useful data for the construction of the twin-jet He.280 fighter which flew in 1941. The 280 was an attractive-looking aircraft, but tests showed that it did not hold the same promise as a contemporary Messerschmitt design, the now-famous Me.262.

Work on the Me.262 (known also as " Sturmvogel ") was started in 1939, and it flew in 1940 with a conventional Junkers engine and propeller. In 1941 two Heinkel turbo-jets were installed, but the aircraft did not take off, as it was found to be under-powered. In July, 1942, Junkers jet units were installed and an intensive development programme commenced.

The standard Me.262A single-seater, which was in service at the time of the collapse, had a top speed of 525 m.p.h. at 23.000ft., and a service ceiling of just under 40,000ft. It carried over 500 gallons of fuel and was armed with four 30 mm. guns. The bomb load was 500 lb. or 1000 lb. Handling qualities, considering its high performance, were good, and the landing speed not unduly high, about 120 m.p.h. This emphasis on rapid climb became increasingly short endurance in the air. It was accordingly decided to produce a cheap fighter with a lower performance and a longer duration, and the Heinkel Company was instructed to develop the aircraft which we now know as the He.162 or " Volksjager "—the People's Fighter. Design work on the 162 was started on September 23rd, 1944, and the first flight was made on December 6th, 1944. It was not surprising that some fairly serious teething troubles were experienced. For example, on the second flight the leading edge of the wing collapsed and the aircraft broke up in the air. This did not seriously hinder the development programme, and after considerable modification to the wing the aircraft was ready for issue to squadrons. We have examined and flown a number of these " Volksjagers." They are largely of wooden construction, have a tricycle undercarriage, a catapult seat, and are powered with a single BWM turbo-jet unit mounted above the fuselage. Their speed is about 500–520 m.p.h., and the armament a pair of 20 mm. or 30 mm. guns. Landing and take-off are difficult for inexperienced pilots, but credit must be given to the Germans for having produced what they set out to produce—a cheap fighter with a better performance than standard Allied types.

The single-jet lay-out is, of course, very attractive to designers, and both Focke-Wulf and Messerschmitt were working on new fighters with one turbo-jet unit. The Focke-Wulf effort—the Ta.183—had a jet unit in the fuselage, a very sharply swept-back wing, and a strange, but theoretically efficient tail unit. It rocket would break off and itself descend by parachute. The aircraft was designed for quantity production in small wood-working shops. It was also attractive in that it would reduce the training of pilots to a minimum.

Published reports have referred to a development of the flying bomb intended for use as a fighter. The fact is that the power of the impulse duct engine as used on the V 1 falls off rapidly with height, so that a fighter with such an engine would have a very limited application.

(*To be continued*)

CAPTURED LIFEBOATS.—The last that the Royal National Lifeboat Institution heard of its lifeboats in Jersey and Guernsey before the German occupation was on June 29th, 1940. They had been ordered to sail for Cowes, but that afternoon Jersey telephoned that the Governor would like to keep the lifeboat. The Institution agreed, and heard nothing more for three years. Then, in June, 1943, a cryptic message came from Jersey, on a printed form of the German Red Cross, from which the Institution knew that the boat was at her station and seaworthy. Again nothing was heard for two years until the war in Europe was ended. When the chief inspector visited the two Channel Island stations in June, 1945, he found that the Guernsey boat, which had been armed by the Germans with two guns and used as a fishery patrol boat, had been so mishandled that she was unfit for lifeboat work. The Jersey boat was in better case. She, too, had been used by the Germans, but she had also gone out five times as a lifeboat, with her crew under German guards, and had rescued thirty-five lives. After overhaul and repair she will return to the Institution's fleet.

tion is free again the world will realise that for self-sufficiency in mineral supplies the Russian Union will follow closely the British Empire, with the United States as a very good third.

It seems, therefore, that Professor Leith's generalisation with regard to mineral deficiency in the East, as contrasted with the Atlantic lands, will need some modification; and, if that be so regarding Russia, it might be wise to await further knowledge with regard to the great areas of China, where also there has been little but a sketchy geological survey—nothing more detailed than the skimpy surveys encouraged by our own Governments in the Empire.

There is another generalisation of Professor Leith's which requires some qualification. He has asserted on various occasions that the world generally has now been so thoroughly explored that the chances of further disturbing discoveries being made are becoming small enough to be almost negligible. That may quite well be so in the case of ores of iron, copper, lead, and zinc, which are raised in large tonnages, partly because of the increasing habit of working on a large scale and to the neglect of small deposits of these important minerals; but there seems still to be some room for shocks to occur as a result of unexpected discoveries of the rarer metals, which are finding new uses, through your agency, as the constituents of alloys. After all, in times of emergency it is small comfort to have a surplus of one mineral and still to have no supplies of another which is of equal importance.

With the development of aviation during the war, and the promise of further increases in speed and carrying capacity, small differences in the composition of alloys will continue to reveal very serious advantages in efficiency, so that it is with regard to the minor metals that we may expect surprises, especially in areas such as Central Africa and some half-dozen other large areas which have not been searched by geologists, either empirically or on scientific lines. In both East and West Africa we have recently been getting most extraordinary surprises by the discovery of new minerals which were never expected in those regions.

In America the discussion of mineral supplies under conditions of war is not an unpleasant subject, because the United States can supply from domestic sources most of their own requirements, apart from about a dozen minerals which they call strategic. In this country, where we could not provide our military requirements with as many as a dozen minerals, our political leaders, both before the first World War and after, seem to have put aside the question as far too disagreeable for discussion. Soon after the last war the Government of the United States amended the National Defence Act to provide that the Assistant Secretary for War be charged with "assurance of adequate provision for the mobilisation of materials and industrial organisations for war needs." It is thus the business of a State Department over there to devise measures for ensuring that America can rely on a sufficient supply of minerals.

That is regarded as a very easy problem so long as the British Navy is friendly. That is not my own phrase; it is actually what they say. The Atlantic then gives them access to bauxite from Guiana and from the Gold Coast and to manganese (which is a real need in America, or was in the last war) from the Gold Coast and Brazil. What cannot be produced from domestic sources in the United States can be obtained somewhere in one of the lands bordering the Atlantic.

The British Empire as a whole has fewer deficiencies of strategic minerals in kind, but by no means always in quantity, and our supplies, unlike those of the United States, are widely scattered and separated geographically from one another. The United Kingdom, however, is still the chief manufacturing centre of the Empire, and the one part of it which can produce fewer minerals of war necessity than any Dominion.

I should like to repeat, as apposite, two sentences from the tail end of my Presidential Address to the British Association sixteen years ago. One is this: "There is now little real difference between materials required to maintain an army on a war footing and those that are essential to the necessary activities of the civilian population; the materials essential for one purpose can be converted into articles required for the other." The other sentence is: "The only two nations that can fight for long on their own natural resources are the British Empire and the United States." We owe to Germany a qualified form of thanks for strengthening the chain required to bind in closer friendship these two great English-speaking groups, who between them control two-thirds of the mineral supplies of the world.

German Aircraft*

No. II—*(Continued from page 231, September 21st)*

Twin-Engine Fighters

We now have to consider the twin-engined fighters—destroyers or heavy fighters, as the Germans call them—and more important, the night fighters.

The twin-engined Me.110 will be remembered from the Battle of Britain days. As an escort fighter this type, despite its high performance and heavy fire power, proved very vulnerable to our "Spitfires" and "Hurricanes," and was eventually relegated to home defence and night-fighting duties. With refinements, it remained in service until the end. At one time production was actually increased. That was when the shortcomings of its intended successor—the Me.410—became apparent.

The Me.110 and Do.217 night fighters, although operated for a long period against our night bombing offensive, were not nearly so popular nor so successful as the fighter variants of that excellent aircraft the Ju.88. To give an idea of what our bombers were up against towards the end, the following facts are quoted relative to the 88 G night fighter which was standard equipment in the last months of the war:—

First, it had modern and efficient Radar equipment. As it had been developed from the Ju.88 bomber, it had an ample endurance—about 5 hours—and first-rate handling qualities, a very important consideration for operation at night. It had ample accommodation for its crew of three and was armed with a compact battery of four 20 mm. guns firing forward and two similar guns fixed in the fuselage and firing obliquely upwards. This oblique installation —"Schrage Musik," as the Germans call it—was used to make surprise attacks from below. It was fitted to all types of German night fighters during 1944 and 1945. Finally, the Ju.88 night fighter had a reasonable margin of speed over our bombers. The latest version, in fact, was nearly as fast as our night fighter "Mosquito," which is a surprisingly good performance for a large aircraft. The Ju.388 night fighter with highly supercharged Jumo 213 or BMW 801 engines, which was about to be issued to night-fighter units, could carry a heavier armament load and also had something approaching "Mosquito" performance.

Reference has been made from time to time in these notes to the "Mosquito." This is inevitable, for this type was the standard by which the Germans judged their twin-engine fighters. There was great rejoicing in the German Air Ministry when one of their new He.219 night fighters succeeded in shooting down a "Mosquito" at night, but the 219 was not used extensively, and was generally less efficient than our latest "Mosquitos."

Another fast twin-engined night fighter which was just coming into service was a Focke-Wulf type, the Ta.154, often known as the "German Mosquito." This not only resembled the "Mosquito" in general appearance (except that it had a tricycle undercarriage), but it was built of wood.

It soon became apparent to the Germans that if they were going to catch our "Mosquitos" at night they would have to use aircraft of exceptionally high performance, and they planned to operate two-seater night-fighter versions of the Me.262 and Ar.234 jet-propelled aircraft, in addition to a two-seat night-fighter version of the Do.335. A few squadrons of these aircraft would, of course, have been an embarrassment, but they did not materialise.

AR 234 B JET-PROPELLED BOMBER

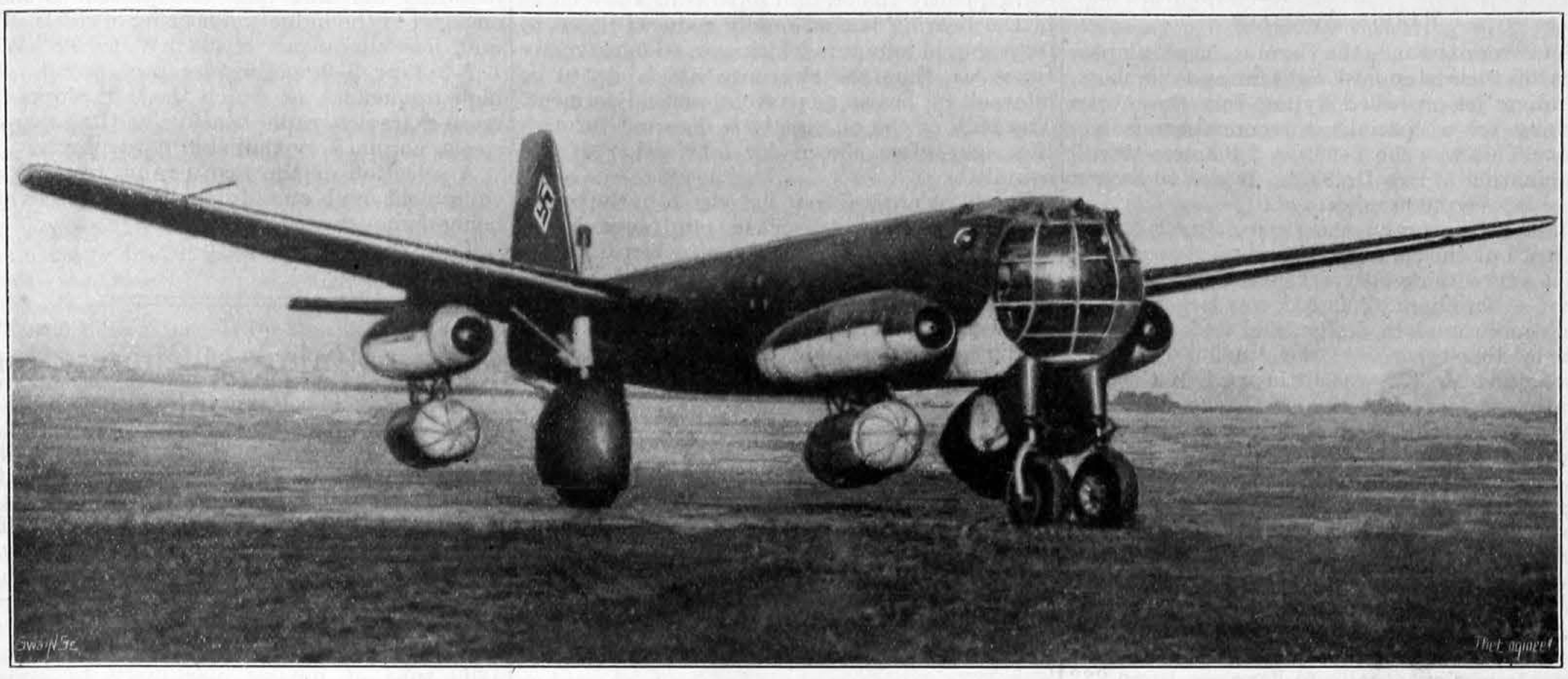
Bombers

German fighters have now been covered in general terms. It is not proposed to deal at the same length with the bombers, because these were of less technical interest and there are fewer types to consider.

At the beginning of the war the standard German bombers were the He.111, Do.17, and Ju.88. The Do.17 soon disappeared from service but the He.111 and the Ju.88 remained to the end. Their bomb loads were comparatively small, but the He.111 was successfully adapted to carry a single flying bomb externally. The Ju.88 was developed into the Ju.188, with improved crew accommodation and better

* Air Ministry News Service.

TWO GERMAN BOMBER AIRCRAFT



JU 287 JET-PROPELLED BOMBER

JU 388 BOMBER

performance, and eventually into the 388. The 388 bomber was a promising aircraft which would eventually have been fitted with two of the big 24-cylinder Jumo 222 engines. It was calculated that these would have given it a speed of about 430 m.p.h. at over 37,000ft.

The dismal story of the development of the He.177 is already known. Fires in the air, structural failures, and inferior performance all contributed towards the unpopularity of this big counterpart of the "Lancaster" and "Halifax," although towards the end it was a much more reasonable proposition. It was designed to take two Daimler Benz "double engines," but later four separate DB 603 engines were tried experimentally. The result was more encouraging but development was not continued.

The He.177 was not, as many people believe, the only big bomber developed by the Germans. Junkers had designed a bomber version of the four-engined Ju.290 and the six-engined 390. The 390 was originally produced as a transport, and was a very impressive aircraft in size and carrying capacity. It was more than half as big again as the "Lancaster," and, carrying 7500 gallons of fuel had a theoretical range of nearly 5000 miles. The bomber version was to be armed with ten 20 mm. guns in turrets.

Farman in France was developing for Heinkel the He.274 four-engined high-altitude bomber with pressure cabin—the last of a series of experimental high-flying bombers which included the Ju.86 P and R, which operated ineffectively against this country in 1942, and the He.130, which had an engine in the fuselage to supercharge the two wing engines.

Messerschmitt's big bomber was the Me.264, which looked rather like a large slim "Liberator" and was designed to bomb New York. The 264 flew only as a prototype, and it was intended for the attainment of maximum range at the expense of armament and other items. To support its tremendous weight at take off, two extra wheels were fitted, and were jettisoned once the aircraft became airborne. There was a project to fit two jet-propulsion units, in addition to the four engines, to give high speed for short periods.

Focke-Wulf had also studied a big bomber—a six-engined Ta.400. This was designed to carry 22,000 lb. of bombs and to be armed with sixteen guns, of which four were in a tail turret. Again, it was proposed that one version should have two auxiliary jet units to increase the emergency speed.

Jet-propelled bombers were, of course, very attractive to the Germans. The 262 was operated as a light bomber, but for this work it was inferior to an Arado product, the Ar.234. The version used operationally, the 234 B, of which we have already flown examples, could carry up to 4000 lb. of bombs, although a more normal load was 2000 lb. It was rather slower than the 262, having a top speed of about 470 m.p.h., but, in general, it was a highly successful design. Before the collapse, the Germans had flown a development of this type, the 234 C, fitted with four BMW 003 jets. This was possibly the fastest bomber in the world, with a speed of over 540 m.p.h. Even so, the 234 C did not represent the last word in jet-propelled bombers at the time of the collapse. Junkers had already flown an aircraft—the Ju.287—powered with six BMW 003 jet units. These were eventually to be replaced by only two units of very high output. Apart from its propulsive system, the most striking feature of the 287 was its sharply swept-forward wing, giving it the appearance of a tail-first aircraft. This sweep forward was not only advantageous aerodynamically, but was supposed to improve handling qualities at low speeds. It had a maximum designed bomb load of nearly 10,000 lb., and a range of 1175 miles, with a bomb load of 3 tons. Its maximum speed was over 530 m.p.h., which is very credit-able, particularly as, in addition to the bomb load, the aircraft was to carry a crew of three.

Reconnaissance Aircraft, Transports, and Marine Aircraft

For reconnaissance the Germans used adaptations of their standard fighters and bombers, including jet-propelled types, but they were working on a specialised reconnaissance aircraft. This was the 8–635, a "Siamese-twin" combination of two Do.335s. It was to have a range of over 4000 miles.

Of the transports, the trusty Ju.52 is well known, but the Ju.352, its modern descendant, which was coming into service towards the end, is not so familiar. This 352 was larger and of much more modern design, and had a retractable loading ramp like the Ju.290. The big six-engined Me.323 was little used in the last months.

Arado had the most imaginative design of transport aircraft—the Ar.232. This strange, yet efficient, creation could have two or four engines, and was fitted with an undercarriage like a centipede. It was designed to kneel like a camel or elephant for easy loading.

Among the marine aircraft, the most important types were the six-engined Bv.222 and Bv.238 transports. The 238 was much larger than our "Shetland" and weighed about 90 tons. It was eventually to have six Jumo 222 engines.

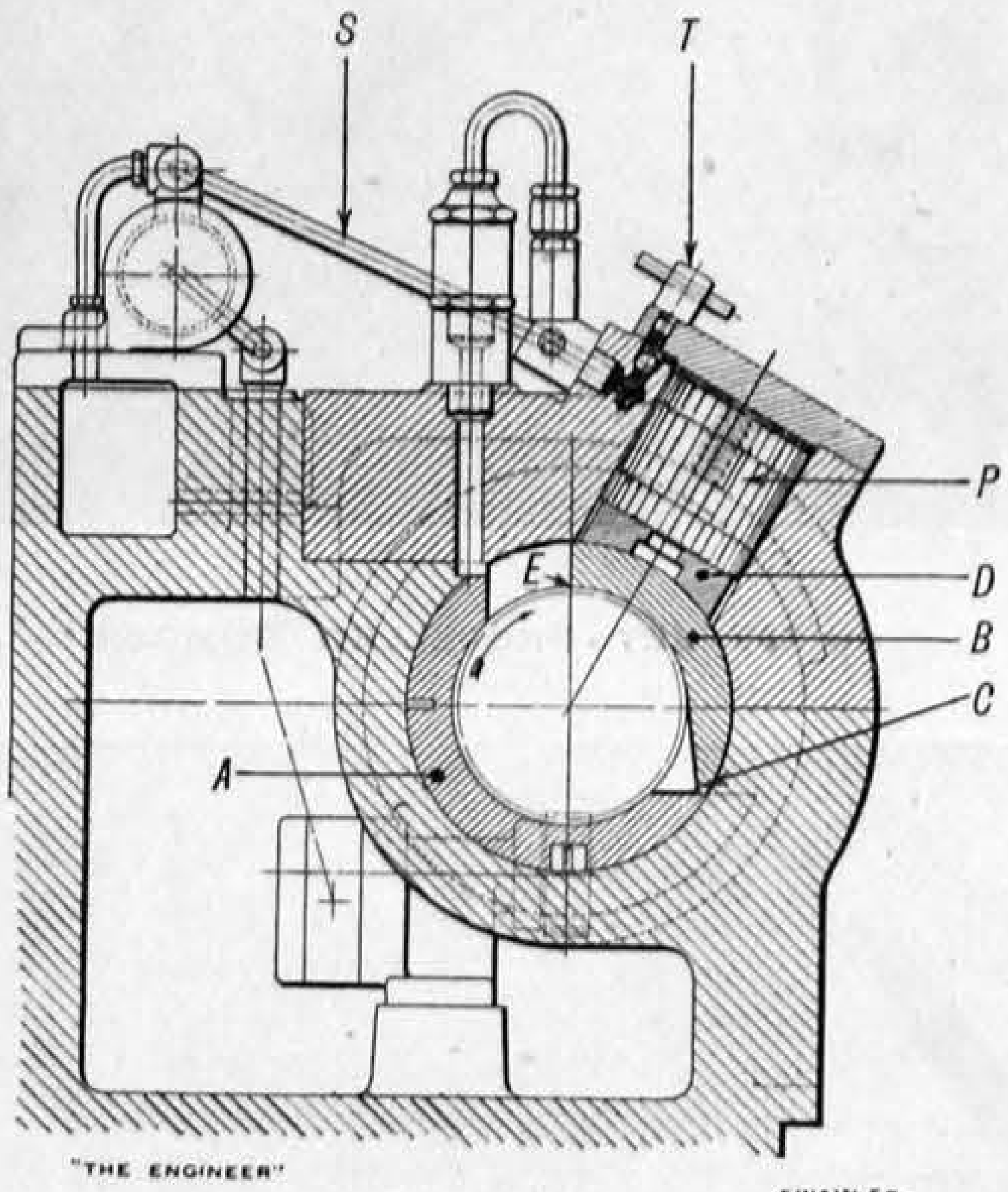
The foregoing notes will suffice to show that German aircraft development was far from stagnant even in the last days. Many new types of great technical interest which, for various reasons, have not been mentioned, were under development or on the drawing-boards, including a helicopter with vanes rotated by jet propulsion and a jet-propelled dive bomber and ground-strafing aircraft, to replace the old Ju.87, with the pilot lying prone.

"Hydrauto" Bearings for Wheel Spindles

The accompanying drawing shows the arrangement of the latest type of "Hydrauto" bearing used by the Churchill Machine Tool Company, Ltd., of Broadheath, near Manchester, for grinding wheelhead spindles of nearly all its grinding machines. This bearing is self-adjusting and automatically maintains under all conditions, it is claimed, the minimum thickness of oil film between the nitralloy spindle and its bearing. In the ordinary type of bearing, adjusted by hand, a definite clearance must always be allowed between the spindle and the bearing. For example, in a spindle 3in. in diameter it is a usual practice to allow 0·003in. for running clearance. If such a hand-adjusted bearing is given less allowance than 0·003in. there is always a danger of seizing. On many grinding operations it is necessary to finish work to within 0·0001in. Obviously, the firm points out, if a grinding wheel spindle is floating in an oil film, in a set diameter of hole which is 0·003in. larger than the spindle, the axis of the spindle is never in a definite position, the wheel and the spindle float indefinitely and the periphery of the grinding wheel gives a slightly blurred outline, which can be distinguished by sound when the wheel is trued with a diamond.

In the "Hydrauto" bearing the lower portion of the bearing A is very securely fixed in the body of the casting. The upper portion of the bearing B is free to bear without restraint on the spindle. The heel C prevents B from moving round with the spindle rotation. A distance piece D rests on B and the piston P is kept on the distance piece by a light spring. The shallow chamber above the piston is completely filled with oil fed from the supply pipe S. The oil flows past the non-return ball valve so that once it has passed into the chamber above the piston it cannot escape. A bleeder plug T, when released slightly, allows any small bubbles of air to be carried away with the escaping oil. It is essential that no air bubbles remain in the chamber above the piston. As the wheel spindle rotates it will be realised that the piston followed up by oil at a very low pressure will always tend to move downwards, but is prevented from rising by the non-return ball valve; consequently the oil film separating the spindle in the bearing is continually reduced down to its practical minimum thickness, which is many times less than the clearance which has to be allowed in bearings without self-adjustment. The bulk of the oil supply is diverted through the sight glass shown for lubrication of the spindle.

It will be noticed that the edge E of the upper part of the bearing is sharp and there is no wedge-shaped lead-in for the oil when it passes between the spindle and the bearing. This sharp edge helps to maintain the oil film at its minimum thickness. A lead-in at this point would increase the thickness of the oil film. In



"HYDRAUTO" BEARING

practice it has been found that the minimum thickness of oil film given by the "Hydrauto" bearing maintains the bearing at a relatively low temperature. Any increase in thickness of the oil film results in violent turbulence of oil and there is an immediate increase in the temperature of the wheel head to the extent that is common in the ordinary type of bearing.

A Radio Heating Exhibition

The wide range of industrial processes to which its system of heating may be applied is being shown by Rediffusion, Ltd., Broomhill Road, London, S.W.18, at an exhibition in London. Known as the "Redifon Radio" system, it is based upon the treatment of materials by induction and dielectric methods at radio frequencies up to more than 100 megacycles per second. The numerous exhibits incorporating the firm's heating units are varied and interesting, and illustrate the system applied to process working in plastics, rubber, wood, metals, chemicals, &c. Its ability to produce controlled heat uniformly through materials adapts the system to many drying processes, particularly where the material handled is sensitive to temperature.

Demonstrations with plastic moulding plant show that by incorporating "Radio" moulding powder preheaters there is a substantial saving in curing time and moulding quality is improved. Units are shown with powder preheating cabinets having capacities varying between 3 oz. and 5 lb. The adaptability of the system is evident in the drying section of the exhibition, where units are shown engaged in the bulk drying of wool, refractory bricks, pharmaceutical and chemical products, plaster moulds, &c. Drying is effected rapidly and without detriment to the materials being processed. A further application is the incorporation of a heating unit with glueing assembly jigs for wooden articles, which are completed at speeds far in excess of those of normal drying procedure.

In the metallurgical section the largest unit made by the firm up to the present is shown engaged in the induction heating of steels. This unit has an output of 25 kW to 30 kW at 1·7–3·4 or 5–9 megacycles per second. The high frequencies at which the unit works promote extremely rapid heating, and, with special steels, permit very thin skin hardening.

A selection of the firm's radio transmission equipment and amplifying equipment is also being demonstrated.

The exhibition closes to-day.

Coal Mining Machinery for Europe

According to an official announcement made in Washington on Thursday, August 23rd, the United Nations Relief and Rehabilitation Administration is to make a concentrated effort to relieve the critical coal shortage by supplying desperately needed mining machinery to those European nations capable of large coal production. Mr. Roy F. Hendrickson, the Acting Director-General, stated that a shipment of 1200 tons of mining machinery to Poland, Yugoslavia, and Czechoslovakia would be made in September. Of this total, 700 tons will be shipped from the United Kingdom and 500 tons from the United States. Poland reports that it is producing coal at the rate of about 45,000 tons per day. An increase to 60,000 tons per day is expected within a month or so, which should bring the production rate to about 18,000,000 tons per annum. With adequate machinery to work the mines, including the Silesian mines now under her control, Poland has a potential capacity of 100,000,000 tons a year. This production would leave an export balance, after meeting all of her own needs, of between 70,000,000 and 80,000,000 tons, sufficient to care for substantial needs in Central and Northern Europe. In South-Eastern Europe, Yugoslavia is reported to be producing about 100,000 tons per month, far less than her minimum needs of 3,000,000 tons a year. With additional machinery she is certain that she can raise her production to a point where she would be able to meet her own requirements and export 30,000 to 40,000 tons monthly. Her exports would then be sufficient for the industrial needs of Greece, for whom "Unrra" must now provide 26,000 tons monthly, of which 18,000 tons comes from South Africa and 8000 tons from the United States. The present minimum coal needs of Czechoslovakia are 11,000,000 tons a year. With machinery to work her mines properly she could attain her pre-war production of 30,000,000 tons, which would not only satisfy her own requirements, but would allow her to export several million tons. Mr. Hendrickson stated that the Administration was negotiating for the diversion of £325,000 worth of machinery from lend-lease supplies; £900,000 worth of machinery had already been requested, of which about 80 per cent. would come from the United Kingdom. The world shortage of coal has compelled "Unrra" to raise its demands, and it was hoped to increase the programme by £1,500,000. The equipment was most urgently needed, and if it was made available it would go a long way in meeting the present coal crisis.

Bulimba Turbo-Alternator.—The 25,000-kW turbo-alternator built by C. A. Parsons and Co., Ltd., during the war for installation at the Bulimba power station of the City Electric Light Company, Ltd., Brisbane, Queensland, has now been in service for a year and as the chairman of the company publicly announced, has considerably improved the power station efficiency. It has now been announced that the directors of the Brisbane Company propose to affix to the machine a plate inscribed as follows:—"This machine is a tribute to British steadfastness and courage. British workmen made it while Britain was being ruthlessly bombed; and in 1941 British seamen carried it to us through many perils. *En route* they brought succour to Malta."