

AIR HISTORICAL BRANCH

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DEVELOPMENT OF THE GERMAN GROUND
ATTACK ARM AND PRINCIPLES GOVERNING
ITS OPERATIONS UP TO THE END OF 1944.

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TRANSLATOR'S NOTE

The L.D.V. and D.(Luft)g series which are quoted in this study were German Air Ministry Publications corresponding approximately to our Air Publications.

The L.D.V. series was mainly concerned with administrative and organisational matters, while the D.(Luft)g series, classified Secret, dealt with tactical, operational, and technical subjects.

- I. The formation of the ground attack arm and its development before and during the war.
- II. Tasks, organisation, equipment and tactics of the ground attack units.
- III. Present possibilities for ground attack operations.
- IV. Lessons learnt from the course of past operations, and prospects for the future.

I. THE FORMATION OF THE GROUND ATTACK ARM AND ITS DEVELOPMENT BEFORE AND DURING THE WAR.

In the course of the war, the ground attack aircraft has gained ever growing significance as an important factor on the battle-field. Whereas before, and at the beginning of this war, only a small number of ground attack formations was available, there has during the course of the war, been a steady extension of this arm of the service.

Among the Enemy powers, there was contention as to whether ground attack units should be regarded as a special branch of the service, or whether their tasks should be taken over by fighters and bombers. In this connection, the development of the "attack" aircraft, as carried out in America particularly, is worthy of attention. In other countries, light bombers or multi-purpose aircraft had been developed for the tasks of ground attack aircraft.

The experiences of this war, however, have shown that the ground attack aircraft is a weapon which can no longer be ignored. In the operation of modernly equipped forces, the ground attack aircraft plays a part as important as that of the bomber, fighter, reconnaissance aircraft and tank.

The importance of the moral and material effect of low flying aircraft was recognised during the Battle of the Somme in 1916. Single so-called "Infantry-aircraft" (aircraft attached to divisions for battle tasks of all kinds) were employed for the recognition of our advanced positions or for the purpose of supplying isolated groups, with ammunition, food and equipment. These aircraft attacked enemy machine gun positions, reserves, and batteries from low level with machine gun fire and bombs.

Not until the Battle of Flanders, however, were organisational and tactical deductions drawn from these individual results. In an attack on the coast in range of the 4th Army area on July 10th 1917, an independent Staffel of Bomber Geschwader 1, which was in the process of re-equipping, escorted our own attacking troops for the first time.

The effect on friend and foe alike was recognised as exceptionally great. In consequence, the "Schutzstaffeln", (i.e. the escort aircraft attached to divisions for battle tasks as independent Staffels), were gradually renamed "Schlachtfliegerstaffeln" or "Schlachtstaffelgruppen" (a Gruppe of 4-6 Staffel) by March 1918, and were re-equipped.

The question of whether a light, fast and easily manoeuvrable aircraft or a heavy, armoured type should be introduced, was settled in favour of a light aircraft at a meeting of "Schlachtstaffel" pilots held in the

late autumn of 1917. (Halberstädter CL IV and Hannoveraner CL V, single strut bi-planes with 160 H.P. Mercedes, 3 hour duration, speed of 190 km. per hour approx.)

Strongly armoured twin-seater AEG aircraft were also used, from which the observer attacked ground targets in the main battle-field with a movable 2 cm. (Becker) cannon or small 1 kg. fragmentation bombs (known as "Fliegermaus").

These very vulnerable types were later replaced by a Junkers all metal aircraft with an armament of:- 2 fixed machine guns for the pilot, 1 moveable machine gun for the gunner, 6-8 bombs (10 kg.) with highly sensitive fuses and occasionally mortar bombs. Up to March 1918 a total of 38 such ground attack Staffeln were formed. A special ground attack school trained the flying personnel, which consisted of N.C.O's and O.R's up to and including the Staffel leader.

In the fighting early in the year during the great battle in France and particularly in the last offensive and defensive battles from June to Autumn 1918, these formations were used successfully in attack and defence, particularly in the heavy fighting during the attempted breakthrough near St. Quentin on 21st March, and subsequently against enemy reserves, supplies and columns on the Roman road, and against the Somme and canal bridges near Noyon, Ham, Chauny and Peronne, bridges on the Aisne and Veille and against airfields around Soissons.

The ground attack Staffeln thus developed into an extremely effective and mobile reserve weapon for attack and defence.

The Versailles Treaty had destroyed German air power, and in the reconstruction of the Air Force in 1935 no plans were made for the formation of ground attack units. The main emphasis was placed on the creation of bomber and fighter units.

As regards Army-Air Force co-operation, it was laid down that in decisive battles the Air Force must give support to the Army. (para.120, L.Dv. 16, 1935). To this end the bomber forces should operate behind the enemy's operational area. In the battle area itself, there were no suitable targets for the bomber forces (para 125, L.Dv. 16, 1935). The results obtainable by bomber forces were not considered to be worth the outlay. When available, fighter and reconnaissance aircraft were at that time considered more suitable for operations over the battle area.

Nevertheless, these special requirements were kept in mind during the course of technical development, and the light dive-bomber was included in the specifications made at that time. The first type produced was the Hs.123, which was developed on the lines of the Curtis "Helldiver".

L.Dv.16 (1937) refers to the possibilities of employing ground attack aircraft over the battle area, but the traditional conception of these aircraft dating from World War I had not yet changed. In the new edition of L.Dv.16 (1937/40), dealing with Army co-operation, the principle was expounded, that the operations of the Air Force generally have an indirect effect on the military operations of the other Armed Services (para.120, L.Dv.16(1940)).

For Army co-operation, the use of reconnaissance aircraft, Flak artillery and aircraft reporting companies was foreseen; also that of fighters, when the ground situation demanded it, and the situation of the entire war permitted (paras.120 and 121, L.Dv.16(1940)).

Paragraphs 129 and 130 of L.Dv.16(1940) then proposed the use of bombers near to the front-line. Mass attacks, mainly at low-level, against

reserves or movements in the rear and against the retreating enemy were also discussed here, and these were credited with striking results, particularly as regards their effect on morale.

These principles show that the employment of the Air Force in close support of the Army had to be expected. The creation of units exclusively for this purpose, had not yet been considered, and the conception of ground attack units as such was still lacking. These principles may also have been influenced by the belief that air attacks against scattered formations in frontal areas or against troops in re-inforced positions had in general little effect. (para.130, L.Dv.16 (1940)).

At this time, the great military powers were concentrating on the development of the so-called strategical Air Force which it was intended to induce quick decisions. These aircraft were, and still are, unsuitable for regular employment in close support of the Army.

Development of ground attack units was particularly advanced in the U.S.A., in other countries opinion was divided and consequently no special type of aircraft was developed. The types of aircraft which might have been used for intensive ground attack work were unable to give the necessary support to the ground troops because of their low pay-load, light armament and extreme vulnerability.

Modern tactics and technique for the employment of ground attack units had to be developed. Their possibilities had not yet been fully studied or confirmed, and this state of affairs probably led to the failure to recognize the ground attack units as an important aid to land warfare. The same ideas evidently predominated in the camp of our present enemies. This can only be explained by the fact that little or nothing had been done to develop the ground attack arm after the end of World War I, in which our enemies were victorious.

With the Spanish Civil War came a reversal of previous conceptions regarding the employment of the Air Force in direct support of the Army with units specially equipped and trained for the task. The "Condor" Legion, which successfully experimented with ground attack sorties, acquired much valuable experience. It is an interesting fact that this result was brought about indirectly.

At the beginning of 1937, the "Condor" Legion had at its disposal one fighter Gruppe, equipped with He 51's. It now transpired that this aircraft was no match for the opposing fighters, which had appeared at the same time as the "Rata" and "Curtiss" types, both of which were superior to the He 51 in speed and armament. As a result of this, and of the consequent losses, the German Command had the choice of either withdrawing the He 51 from the battle, or of employing it in another way. The solution was found, - to employ the He 51 fighter Staffeln as low - level and ground attack aircraft.

In co-operation with the ground troops and our own reconnaissance formations, these Staffeln were now used in direct support of the Army on the battlefield. Methods and tactics were quickly improved and offensive and defensive operations were soon carried out by Franco's troops solely with the assistance of the ground attack units. The ground attack aircraft thus played a decisive part in these operations. Fully appreciating the importance of this innovation, the High Command of the Spanish Air Force formed its own additional ground attack units.

The importance of the support given by the ground attack aircraft to the troops in the Spanish Civil War can be judged from the high German and Spanish decorations awarded to the Commander of the ground attack units

after the end of the war. The importance of the ground attack unit had already been recognised by the General Staff of the German Air Force during the Civil War.

As the possibility of a war had to be considered in 1938 before the occupation of the Sudetenland, the immediate formation of 5 ground attack Gruppen (at that time, Gruppen 10; 20, 40, 40 and 50) was ordered. Between 1st July and 1st September, previously untrained pilots had to be trained as operational ground attack pilots. Four of these five Gruppen were re-equipped with Ju 87's after November 1938 and joined the existing dive-bomber Gruppen.

Technical research led to the development of the twin-engined Fw.189 with armour-plated cabin. This type fell short of expectations, it was consequently not employed as a low-level aircraft, but was used later for close range reconnaissance operations.

At first, the Ju 87 formations did not belong to the ground attack units and therefore only one ground attack Gruppe was available at the outbreak of war in 1939. (II Schlacht/Training Geschwader.2 (Hs 123's). was formed from Schlachtgruppe 20 on 1.11.38). The Ju 87 formations were neither bomber nor ground attack units, but formed an independent arm in the German Air Force as dive-bombers. Their task did not consist in close support of the Army but was the attacking of strategic targets within their range.

D(Luft)g. 1911 of September 1940 states: "The main task of dive bombers is to attack small static enemy positions of vital military importance. The manoeuvrability of the dive-bomber and its armament make it suitable for attacks on living and mobile targets; e.g.:- railway trains, tanks and mechanised supply columns, warships and merchant ships of all kinds, troop concentrations and columns on the march".

The campaign in the West, however, had caused a considerable change in duties, and in the meantime, close support of the Army had become as important as attacks on the targets specified in D(Luft)g. 1911; during the subsequent course of the war close support of the Army proved to be the main task of the dive-bombers.

Although the Ju.87 formations appear under the designation of "dive-bombers" up to 1943, they must, nevertheless, like the Hs 123, Hs 129 and Me 110 formations, be regarded as ground-attack units.

The re-naming of dive-bombers as ground attack aircraft began on 5.10.43. Up to that time, there was no Air Officer in charge. Had there been one, he would surely have introduced a uniform designation for all formations. It was partly on account of this that the designation "Stukas" continued to be used for so long; in addition, this word had become universally known by the great successes of the units. In Poland and in the Western Campaign, "Stuka" was to our enemies synonymous with destruction, death, fear and panic.

A noteworthy event in the further development of the ground attack arm was the alteration effected in the Me 109 fighter and the Me 110 long range fighter or heavy fighter. The Me 109 was converted to carry a 200 or 500 kg bomb, thus creating a new and controversial class of aircraft - fighter - bomber ("Jabo") added to fighters or bombers.

The Me 110 was likewise equipped with bombs, and was employed on low-level attacks on ground targets with its very effective fixed armament.

The lack of a uniform organisation was, however, prejudicial to the ground attack arm in the course of the war. Whilst the Hs 123, Hs 129, Me 109, Me 110 and Fw 190 formations were, as ground attack aircraft, fighter bombers

and high speed bombers, under the control of the A.O. for Fighters (Air Inspectorate 3), the Ju 87 formation were under the A.O. for Bombers (Air Inspectorate 2).

The ground attack arm, which had proved to be increasingly important during the course of the war, thus had two heads, a situation whose disadvantages were not however obvious until 1942. Up to that time, no particular tactical or technical difficulties arose, partly because we had air superiority on all fronts.

It is clear, however, that a separate Air Officer would have looked after the interests of the ground attack arm quite differently and with much more vigour than two Air Officers who still had to contend with their main tasks, - the fighter arm in one case and the bomber arm in the other. In the course of the war, these Officers were so much concerned with the development of their own special arm, that the interests of ground attack (especially as represented by the Me 109 fighter bomber and Me 110) could only be considered to a very small extent.

The development of the war, however, demanded another solution. In view of the difficulties under which the ground attack formations had to fight in all theatres of war, particularly in the South, the ever increasing enemy defences, the specialisation of day and night operations and the special tactics against tanks, new technical developments and the replacement of obsolete aircraft became essential.

The constantly changing situation led to a multiplication of armament. For example the "Waffenbombe" (so-called "Giesskanne" - "watering can") with a number of fixed machine guns, enclosed obliquely near the bottom, was introduced. Me 109's, Me 110's and Ju 87's were also equipped with 2 kg. fragmentation bombs. The installation of the 3 cm machine cannon 101 in the Me 110, which had exceptional success in attacks on tanks, must also be mentioned here.

Direction by a separate Air Officer therefore became still more necessary. On 7.9.1943 the post of A.O. for Close Support was created, embracing all ground attack formations, and on 7.10.43, was designated A.O. for Ground Attack.

The Stuka (Ju 87), ground attack (Fw 190), high speed bomber (Fw 190) and tank buster (Hs 129 and Ju 87) were included under the new designation - "Ground attack, tank buster and night ground attack formations". The Me 110 formations, however, remained as heavy fighters with the A.O. Fighters.

Uniformity as regards both tactics and training of cadets resulted from this time onwards. The interests of the ground attack arm, particularly in the field of tactical and technical development, were followed with the greatest care and energy.

The units provided for ground attack operations were equipped with Hs 123's and Ju 87's before the war, and they also entered the war with these types. The Ju 87 is still used in a few units today as a front-line aircraft, and during the war has been continually improved in different series. The performance, however, was much inferior to that of enemy fighters, whose strength first became noticeable in Malta and Africa.

From then onwards, operations with Ju.87's demanded strong fighter escorts. As a result of the general air situation, and withdrawal of fighters from other fronts for the defence of the Reich - still less forces were available for fighter escorts, and the conversion of the Ju.87 formations became essential. It was planned for all day ground attack

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formations, and has already been carried out in most units. The Ju.87 has been replaced by the Fw.190.

The He 123 units, already obsolete before the beginning of the war, had, as a result of their losses in the course of the war, also to be re-equipped with Me 109's and Hs.129's at first, and later with Fw.190's.

The tank buster units are equipped with Hs.129's and Ju.87's. Two Fw 190 Staffeln are operating with Panzerschreck and 3-4 others are being re-equipped, while the use of Fw.190's with Panzerblitz is planned.

Various bombs up to 1800 kgs. (Ju 87) are used and 250 and 500 kg. bombs are normally carried in the fuselage, while 50 and 70 kg. bombs are loaded under the wings. Jettisonable containers of SD1, SD2, SD10, and more recently of SD4 HL bombs are being used in ever increasing numbers for attacks on tanks.

The calibre of aircraft armament has also developed during the war. The M.G.15 and 17 came into use at the outbreak of war, but the former has now been replaced by the M.G.81 and the M.G.131, 151 and 2 cm cannons have been introduced in place of the M.G.17 as fixed aircraft armament. The 3 cm. (Me 110 and Hs 129) and 3.7 cm. (Ju 87) cannons are being introduced as special weapons for tank combats (the 3.7 cm cannon was used in Me 110's). One Hs 129 B-3 Staffel is also operating with 7.5 cm cannons (7.5 cm anti-tank cannon 40).

Before, and at the beginning of the war, radio equipment consisted of the Fu.Ge.7a, which was later replaced by the 7c, while Fu.Ge.16 came into operation in the Fw.190. In the course of the war, Peil-G 4 was first used by Ju 87 units in Africa. Fw.190's are equipped with Fu.Ge.16ZS (homing equipment - ground attack), ZVG 16 (homing and sensing equipment) for homing after visual contact. Some were equipped later with Fu.Ge.25a (I.F.F. radar) for special operations (radar fighter and bomber control)

One ground attack Gruppe (Hs 123's), one Geschwaderstab and 9 Gruppen with Ju 87's were available at the outbreak of war. (Data taken from operation reports of Q.M.G. 6th Abteilung). In August 1943, 2 Geschwaderstäbe with 2 Gruppen of 4 Staffeln each were in operation with the Air Officer for Fighters as ground attack units (this includes the old Hs.123 Gruppe).

The strength of the Ju.87 formations in August 1943 was 4 Geschwaderstäbe of 3 Gruppen each and one independent Gruppe, and during the course of the war 3 new Geschwaderstäbe and 4 new Gruppen have been formed.

The concentration of all ground attack units under the Air Officer for Ground Attack gave the following strengths:-

- 6 Geschwaderstäbe with a total of 17 Gruppen
- 1 independent Gruppe
- 1 tank buster Gruppe
- 4 tank buster Staffeln with 4 Geschwadern.

The night ground attack units came into operation at the end of 1942 for the first time, and up to August 1943, 2 Gruppenstäbe and 13 operational Staffeln were available. Meanwhile the night ground attack arm had increased to 9 Gruppenstäbe and 26 Staffeln.

The training of cadets was carried out by the units themselves until the beginning of the war, when the task had to be transferred from them on

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operational grounds. This led to the formation of reserve training Staffeln with the Geschwadern and of an independent Gruppe for the training of aircrew. At first they only trained cadets for their own units, but owing to heavy losses suffered by front-line units, transfers and weather conditions, these Staffeln could not always supply the necessary personnel, and it often became necessary to supply them from other reserve training Staffeln.

All Ju.87 reserve training Staffeln were embodied in one training unit in 1943 and after the appointment of the Air Officer for Ground Attack, all training units of ground attack formations were concentrated into one Ju 87 reserve training Geschwader and one Fw 190 ground attack reserve training Gruppe. With the conversion to Fw 190's, a further concentration of all reserve training units for day and night ground attack into ground attack Geschwader 151 was carried out in May 1944. Training is now uniformly organised and presents no difficulties.

At the same time, the necessity of equipping ground attack units with aircraft and arms developed for their special tasks becomes still more apparent, as converted aircraft of other branches of the service can at the best only be considered as temporary expedients.

II. TASKS, ORGANISATION, EQUIPMENT AND TACTICS OF THE GROUND
ATTACK UNITS.

The tasks and possible uses of ground attack aircraft were originally specified in D(Luft) 1911 of September, 1940. The varied nature of war events has led to the evolution of certain basic principles, and deepening completely new objectives have also arisen.

The tactics of the ground attack units, like those of other branches of the service, are subject to continuous development, and new changes will also appear in the future. It will always be the task of the High Command and even more so that of the unit commanders, to adapt tactics to actual conditions and possibilities, so that the greatest possible effect will be achieved with the smallest possible losses.

These tactics will have to be adapted to our own objectives and to the enemy's situation (particularly the air situation), to the technical position of both sides at the time, to the enemy's mode of fighting, and to the geographical and climatic conditions of individual theatres of war.

Below are enumerated some of the principal changes in ground attack tactics:-

- (a) No difficulties were experienced in operations by Schwärmen (4-5 aircraft) and Staffeln as long as we had air superiority, but with the growth of enemy fighter defences, these attacks became of necessity impossible unless carried out in bad weather conditions. The provision of a strengthened fighter escort also became necessary.
- (b) The air superiority gained by the enemy made it impossible to operate ground attack formations on isolated fronts, because there were insufficient fighters available for escort duties.
- (c) For the same reason it was urgently necessary to accelerate the conversion of units equipped with obsolete types of aircraft.
- (d) Bombing attacks on tanks were very unsatisfactory, which led to the creation of special formations, - tank-busters.
- (e) Armour plating became necessary with the increase in armament of enemy fighters.
- (f) Co-operation with the Army produced many improvements during the course of the war. Before the war, only ground signalling strips were available as means of communications, but since then several improvements in the recognition service have resulted in closer and quicker co-operation with the Army. Ground signals were improved and smoke puffs and signal cartridges introduced. Ground attack control officers (Fliegerleitoffiziere (Schlacht)) are employed with troops fighting at the main point of attack. By means of R/T communications it is possible to indicate targets and changes in the front line and targets during the approach, and to give reports on the weather and enemy fighters direct to the aircraft from the front.
- (g) The introduction of the F.W. 190 as a ground attack aircraft at first made the provision of fighter escorts unnecessary but subsequently its operation became impossible without fighter escort on some fronts owing to enemy air superiority.

The above mentioned examples show clearly how much tactics are subject to changes due to various factors, and technical development of aircraft, armament and armour-plating must keep pace with these developments.

At present the employment of ground attack formations is governed by the following principles:-

Ground attack units support the troops on the battlefield and the efficacy of this support can decisively influence the operations of the three Services. In direct support of the Army, the attacking of enemy troops in the field is exclusively the task of ground attack formations and only in an emergency should fighter and heavy fighter formations be drawn into these tasks.

Ground attack operations are directed against such targets on the battlefield (up to 30 km. behind the front line), which cannot be seen or destroyed by ground troops or which lie out of range of their heavy artillery. Targets, which can be attacked by the Army, particularly with artillery fire, should not be attacked by ground attack units.

Ground attack operations take the form of repeated attacks on concentrations of weapons, troop movements, heavy guns, H.Q.'s and supplies on the battlefield, they weaken the enemy's morale and oblige him to conduct both his offensive and defensive operations from concealed positions. The ground attack units thus save lives among our own ground troops, and facilitate airborne troop movements.

Indirect support of the ground troops can also be carried out in special circumstances by means of operations in the tactical area (up to 100 km. behind the front), in which case the targets are troop concentrations, traffic routes and Headquarters installations. By this means, the enemy can be surprised and weakened, often to such an extent that his operations are hindered or considerably delayed. Operations of this nature, however, are dependent as much on the enemy's ground and air situation as on our own strength.

Support of our own airborne undertakings as well as the destruction of enemy airborne troops is a task for ground attack aircraft and operations of this kind are of great importance.

Naval support operations prepare the way for our own landings and attack those of the enemy; in this connection, the main target of the ground attack aircraft is to attack enemy landing units as early as possible. The beginning of landing operations is, according to our experience generally delayed until night time, and consequently the attacks fall on ships running up to the coast. Ground attack formations are thus unable to counter-attack until after the landings and supply ships with personnel and equipment remain the target until the ground situation and the demands of our Army and Navy necessitate support operations. An effective attack on enemy landings can only be carried out with a strong fighter escort and a concentration of all available forces, as landings take place under cover of strong enemy fighter formations.

The actual task in hand will thus determine the choice of the most suitable means of attack. Sizes and types of bombs will have to be chosen according to the target, and it must also be decided whether bombs or cannons are to be used. Rocket projectiles as used by the enemy for low level attacks, demand special attention.

In a similar way, the type of attack (low level, glide, dive or high level) must be correctly chosen and applied according to the location and type of the target. The enemy's development of ricochet-bombing for attacking dug-outs can be taken as an example of how ground attack aircraft can be successfully employed, where other methods of attack have failed.

The ground attack formations consist of ground attack, tank buster and night ground attack units. Ground attack formations usually comprise Geschwader of 3 Gruppen each, with 3 Staffeln. Hs.129 tank busters form one Gruppe and four Ju.87 tank buster units are attached

to ground attack Geschwadern as the 10th Staffel. Night ground attack aircraft are formed into Gruppen of 2 - 4 Staffeln, which can be employed independently at any time as the situation demands.

The ground attack units are mainly equipped with F.W.190's; only a few Ju.87 formations are still in use, and their conversion to F.W.190's is planned. (Position at Aug. 1944: two Ju.87 Gruppen still operating - 2 Gruppen being converted). The F.W.190, originally built as a fighter has kept its speed and manoeuvrability and has effective fixed armament and a bomb load of up to 500 kg. The performance of the Ju.87 ground attack aircraft is very much inferior to that of enemy fighters; its main advantage is its heavy bomb load.

Ju.87 G's and Hs.129's are used as tank busters; both of these aircraft are very slow due to their weight and to the unfavourable installation from the aerodynamic point of view of their special anti-tank armament. (this does not apply to the Hs. 129 B2 with machine cannon 103).

Ju.87's and Fw.190's are being used more and more as night ground attack aircraft while a few efficient captured types are also coming into operation.

The ground attack aircraft's principal weapon is the bomb, and much importance has been attached to the jettisonable container with small fragmentation and hollow charge bombs. In addition to the material effect of the weapons, the moral effect is particularly great. The release of large containers full of small fragmentation bombs is very effective, as is also, although to a lesser extent, that of incendiary and smoke bombs.

Because of the varied nature of their duties it is necessary for ground attack personnel to be proficient in the use of all weapons suitable for their attacks.

Ground attack aircraft are equipped with normal and heavy machine guns and 2 cm. cannons according to types. The guns are fixed or moveable and are effective against troops and vehicles. Anti-tank guns up to 3.7 cms. are the main equipment of tank-busters, and with special ammunition they have great success against enemy tanks and armoured vehicles.

In low-level operations with heavy bombs, the danger to our ground attack aircraft must not be under-estimated. If fuzes with long delays (to avoid endangering our own aircraft) are used, accuracy is reduced because unless sticky bombs can be used, the bomb will often bounce. Attention is also drawn to the penetrating capacity of the bombs (angle of impact and speed), which is greatly reduced in low-level attacks.

Direct Army support operations take the ground attack aircraft into the critical areas of the ground fighting, and such support is only completely successful if by means of close co-operation between the Army and Air Force, immediate advantage is taken by the Army of the effect of the air attack.

During days of heavy fighting, operations are carried out without a pause. New operational orders must be ready when the formation lands, so that the time required for servicing the aircraft can be utilised for the briefing of crews. In the case of heavy operations being sustained over a long period, a rest of 12 or 24 hours must be ordered from time to time by the Command, in order to prevent a decline in efficiency and technical serviceability.

The situation on the battlefield determines the course of possible ground attack operations, and the enemy's ground and air situation in relation to the strength of our available forces and types of aircraft, the weather situation and the terrain must be taken into consideration. On account of its great inferiority the Ju.87 cannot

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operate during the daytime without a fighter escort.

The fast Fw.190 has so far been able to carry out its tasks on the Eastern Front without fighter escort, and because of its high performance can also if necessary perform the duties of an escort fighter for Ju.87 formations. With air supremacy in the hands of the enemy, the provision of fighter escorts is also necessary for Fw.190's, because during the target approach, in climbing and on account of their bomb-load, they are inferior in speed and manoeuvrability to the great number of enemy fighters employed. In addition to strong fighter escorts, the overwhelming enemy air superiority experienced in all enemy landings up to now demands the concentration of all available ground attack and fighter units for one task, if success on the battlefield is to be won.

The fighter escort is a decisive factor in the success of ground attack operations. The strength of the escort is dependent on the situation and the type of aircraft employed and it should be remembered that if Fw.190's have to act as fighter escort the efficacy of these Gruppen as ground attack units will be reduced.

During training it should be borne in mind that every ground attack pilot may have to perform fighter escort duties. It is desirable to keep the same fighter and ground attack formations together for a long time, as personal friendships between unit commanders and crews make for better co-operation and reduced friction. The rendezvous between the units usually takes place over the fighter aerodrome, but the enemy's great air superiority in heavy ground attacks, sometimes makes it necessary for our ground attack formations to meet at any rate part of the fighters over their own aerodromes.

Ground attack operations usually take the aircraft over enemy strong-points, which are protected by strong fighter and Flak forces. Light and medium, quick-firing rocket projectors as well as A.A. machine guns are the most dangerous. Concentrated heavy Flak forces the ground attack formation to greater heights during the target approach, rendering identification of target and co-operation with the ground troops (aircraft recognition service) more difficult. To reduce the effect of enemy defences we must use the following tactics:- approach from the sun, utilise cloud cover, attack simultaneously from different directions, and make simultaneous attacks on the ground defences by elements of the ground attack formation, Army weapons or our own Flak artillery.

The great manoeuvrability of the night ground attack aircraft reduces the success of the enemy night fighter defences and their ceiling enables them to escape the light weapons of the ground defences.

The minimum weather conditions for the operation of modern ground attack aircraft are considered to be a cloud base of 300 m. and visibility of 2 - 3 km. Formation attacks on targets heavily defended by A.A. are impossible with 10/10 cloud under 2000 m. and in these conditions only small formations with specially trained crews can operate. A cloudless sky renders a surprise approach more difficult whereas medium, broken cloudiness of 3 - 5 tenths, which enables an approach to be made under cover, is particularly favourable for the attack.

The terrain has a decisive influence on operations. Poorly defended strips of land such as marshy areas, lakes and woods are very suitable for the purpose of rallying and target approach and departure. Low-level approaches will be made on sectors of the front protected by radar.

The closest co-operation with the ground troops is necessary if full advantage is to be taken of the operation and if mistaken attacks on our own troops are to be avoided recognition of our troops, particularly in the front line, and the use of signal cartridges are essential

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conditions in this connection. Amicable exchanges of experiences regarding recognition problems have frequently taken place with the Army, and numerous innovations and improvements resulted.

In the framework of Army/Air Force, co-operation, Control Officers (Ground Attack) were introduced by the Air Force Operational Commands in ground units employed at Key points of the ground fighting. They were equipped with armoured vehicles and wireless sets, as used by the flying units. The Control Officer has the task of directing the formations to their target by R/T, informing them of local changes in the target and front line during the flight and warning them of the weather and air and ground defences; he is not however, entitled to issue orders.

In the course of the war, the following current operational principles have been proved.

The great success of the ground attack operations is due to the effect of this concentrated form of attack. Attacks should therefore generally be carried out in Gruppe strength (20-30 aircraft) and only in exceptional cases in Staffel strength (8-10 aircraft). With suitable training, smaller units can carry out bad weather attacks in Rotte (2-3 aircraft) or Schwarm (4-5 aircraft) strength.

Centres of resistance such as infantry strong points, anti-tank and artillery emplacements, tanks etc, which do not always justify operations in Gruppe strength, are often found in the path of our offensive. These targets are repeatedly attacked by Rotten and Schwarme. The commanders of these units must possess considerable tactical skill. Operations of this kind are not practicable in the face of enemy air superiority.

In mobile warfare the ground attack pilots seek out their own targets where fighting is heaviest. They ensure the rapid elimination of enemy defences and the protection of our offensive movements and withdrawals and also carry out tactical operations in the vicinity of the front.

The recognition of targets is facilitated by co-operation with the Ground Attack Control Officers and by the use of signal cartridges by the Army.

Given air superiority, several successive bomb and machine-gun attacks can be made during the same operation. In the face of enemy air superiority, formations of obsolete aircraft (Ju.87) will generally make a single bombing attack and use their machine guns while leaving the target, whereas formations of modern aircraft (FW.190) will be able to remain over the battlefield for a longer time. If the enemy has overwhelming air superiority, even the FW.190 will only be able to make a single attack.

Tank-buster attacks, usually made by 2-4 aircraft, are particularly directed against tanks and armoured vehicles which have broken through. They can usefully be employed simultaneously with ground attack aircraft, which neutralise the enemy ground defences by bombing and machine-gun attacks, while the tank busters destroy their objectives with their special weapons.

Tank busters are not suitable for attacks on tank assembly positions, as the strong fighter and Flak defences, usually found in the vicinity cause heavy losses to these special aircraft. Tank assembly positions and tanks in battle should therefore be attacked by massed ground attack formations with large H.E. and fragmentation bombs. Considerably greater successes have recently been achieved by the use of jettisonable containers filled with SD.4HL bombs.

On account of the increased defences, it is necessary to approach the tank assembly positions at an altitude above 3000 m. Formations are forbidden to make prolonged searches for the target, and position, size and defences must be ascertained before the operation.

It is necessary to have target pictures before attacking artillery positions because visual recognition of a site from the air is not practicable unless it is firing. If several batteries are attacked simultaneously, a dispersal of effect will result, with a consequent reduction in destruction. 8-10 aircraft per battery should be allowed.

Attacks on centres of resistance and strong points necessitate careful briefing and the use of aerial photographs and large scale maps. In addition, last minute instructions are transmitted through the Ground Attack Control Officer, and the firing of signal cartridges also facilitates the locating of the target when conditions are suitable, the dropping of the first bombs by the leader of the formation can be a useful guide. Heavy bombs are the most effective against well fortified emplacements while large numbers of small bombs have the best effect against dispersed field positions.

Ground attack operations against railways seldom cause any permanent damage and these attacks should be left to heavy bomber formations. On the other hand, ground attacks with bombs and machine guns against trains and loading and unloading installations are often of value.

By means of sustained bombing attacks spread over the entire night, the night ground attack aircraft weaken the enemy's physical and moral powers of resistance. Additional losses in men and material are also inflicted on the enemy by the bombing of Flak and artillery sites and of garrison towns and villages.

Ground attack aircraft will in general only operate against shipping during landing undertakings. When possible, the aircraft fly in from the sea in order to achieve the maximum surprise effect. It will then also be possible for damaged aircraft to reach land. With these tactics, the increased danger of being fired on by our troops should be remembered. Only heavy H.E. and fragmentation bombs are likely to prove successful against armoured ships and landing craft. Aerial Torpedoes, (BT) the destructive effect of whose detonation, under the keel, is great, may be used against larger shipping targets.

In favourable conditions,

1 BT.400 (weight - 400 kgs., explosive - 200 kgs.) can sink a freighter up to 500 GRT.

1 BT.700 (weight - 700 kgs., explosive - 350 kgs.) can sink a cruiser and

1 BT.1400 (weight - 1400 kgs., explosive - 1100 kgs.) can sink a battleship.

The required accuracy and angle of immersion can be achieved by means of a special bombsight. The use of small fragmentation bombs is only recommended against lighter ships. AB-SD-4-HL bombs can be used against tank landing craft, and small vessels can be heavily attacked with cannon fire.

As enemy landings are covered by very large fighter forces, air ground attack operations can only be successful if adequate fighter protection is available, and Ju.87's cannot be used for these operations.

Ju.87 and Hs.129 tank busters can be successfully used against small landing craft in poorly defended sea and swamp areas, rivers etc.

Uniformity of maps and of reporting methods are essential conditions for successful co-operation with the Army.

Ground attack pilots generally use 1:500,000 and 1:300,000 maps for approaching and leaving the target, but for target location the 1:100,000 map is necessary. Particular importance is attached to aerial photographs, because on static fronts they usually provide valuable information for mapping purposes.

Ground attack formations must establish and maintain close contact with reconnaissance units in their operational vicinity. Such co-operation ensures the most rapid exchange of aerial photographs and reconnaissance reports.

Reliable signals communications within the formation and from the formation to Command, as well as R/T link with the Ground Attack Control Officers, are necessary in every ground attack operation. Line and radio communications must also be available in order to permit transmission of orders and reports should signals communications be severed.

As regards R/T, Ground Attack formations and their fighter escort should if possible work on the same frequency, ensuring the best possible co-operation. High security consciousness is an essential condition.

The operational aerodromes of the ground attack formations lie close behind the front, but enemy air superiority will often make it necessary to use airfields lying further back. Camouflage measures should be taken and shelter and reserve runways constructed in order to restore serviceability quickly and avoid unnecessary losses in the event of enemy air attack.

III. PRESENT POSSIBILITIES FOR GROUND ATTACK OPERATIONS.

The air superiority of the enemy and our own fuel position are the sole factors determining the extent and possibilities of future ground attack operations. Surprise attacks carried out under particularly favourable weather conditions or at dusk, have become very much more difficult owing to the enemy's highly developed Radar system in which the Fu MG is being used to an increasing extent.

Up to 1941, we possessed air supremacy in every theatre of war; from then onwards the position in the air began to change to Germany's disadvantage, at first slowly, but later with increasing speed.

Before 1941, every new campaign began with the most ruthless raids on the enemy air force and ground organisation. These large scale operations in which a number of ground attack aircraft always took part, either eliminated a part of the enemy air forces altogether, or severely undermined their striking power.

Our air supremacy at this time made it possible for the ground attack units to operate successfully with only a small fighter escort thus helping to achieve our great victories in the various campaigns, in spite of the fact that the aircraft of these ground strafe units were even at the beginning of the war greatly inferior to the enemy fighters.

The first difficulties in ground attack operations were felt in Africa in 1942. The overwhelming enemy air superiority encountered in this theatre forced us to send as many as 30 Mc.109's out to escort a force of between 8 and 12 Ju.87's.

The effects of steadily increasing and now completely unhindered Allied aircraft production are becoming more and more noticeable.

The first Fw.190 ground attack units to operate in Africa also required a fighter escort although they had originally been used because it was hoped that owing to their high capacity they would not require a fighter escort, and the small available fighter forces would thus be freed for other missions. Enemy air superiority was however so overwhelming that this hope was never realised.

The British and American air forces were meanwhile becoming steadily stronger. Units of Ju.87's suffered heavy losses in every operation on the Anglo-American fronts, and were consequently moved to other theatres of war.

Owing to the steadily increasing strength of the enemy air forces, the Fw.190 ground attack units had to be given stronger and stronger fighter escorts. There was, however, a shortage of fighter aircraft in Italy in the spring of 1944, and also later during the invasion of Normandy, and a decline in operations was therefore inevitable.

Ground attack aircraft invariably met extremely heavy enemy fighter opposition; they no longer afforded any decisive support to the land forces, and the heavy losses incurred rose ultimately to a level out of all proportion to the successes achieved.

The transfer of fighter units for the defence of the Reich led to a drastic weakening of the other battle fronts, despite the fact that the situation on these fronts demanded more and more fighter aircraft for defensive operations. In Italy, the necessary fighter escort could only be provided for an average of one ground attack sortie per day.

These circumstances, due to the air supremacy of the enemy, eventually made all ground attack operations impossible. With the exception of the night ground attack units, all ground attack aircraft were withdrawn from the Southern and Western fronts and transferred to the Eastern Front.

Ground attack formations can operate without difficulty against the Russians. Even Ju.87 formations can operate by day, given a sufficient fighter escort, at all points except where the Russians have set up a concentrated fighter defence. Fw.190 formations can also operate without a fighter escort.

We are still in a position to repel the Russian fighter attacks, although their aircraft are now numerically superior to the German fighter force.

It must however, not be forgotten that the Russian aircraft are rapidly developing and will soon reach the standard of the German and Anglo-American types.

The conversion of the last Ju.87 units to Fw.190 had been planned for the Summer of 1944. It was however, not fully realised because the critical position on the Eastern Front demanded the use of every available aircraft and crew. Circumstances were therefore not propitious for the withdrawal of the Ju.87 units for conversion to Fw.190's.

As soon as the Eastern front had been stabilised, a new problem arose which again prevented the intended conversion. Supplies of C 3, the aircraft fuel used by the Fw.190's were very limited, whereas B 4, (for the Ju.87's), was available in substantially greater quantities. The last of the Ju.87 units therefore remained in use.

Thanks to the conversion to Fw.190's, the Ju.87's which had been withdrawn from the front could now be placed at the disposal of the night ground attack units, who thus acquired an aircraft with a greater pay load and better armament than they had had before.

The Ju.87 has a further advantage over all other aircraft models used for night ground strafing in its suitability for precision bombing. This has brought far greater successes against the enemy, and these were further increased by improved training courses and improved operational tactics. The planned conversion to Fw.190's, and the development of new bombing methods, even in difficult weather conditions, - are both proceeding rapidly. Night ground attack will thus remain an effective fighting weapon.

The severe shortage of aircraft fuel has also an effect on the ground attack units. Priority is given to fighters and owing to the fuel shortage only such operations as are essential for the land battles can be contemplated at present.

New developments in enemy Radar and especially the greater use of the Fu MG - have also added to our difficulties.

It has been noticed both in Italy and on the invasion front that the enemy fighter screens over the centre of the battle, in themselves strong enough to oppose our attacks, are further reinforced by 'emergency' fighters taking off as soon as our target has been ascertained. This has very often led to our ground attack formations and their fighter escort being intercepted before reaching their objective.

No details are so far available concerning the use of the Fu MG on the Eastern Front.

IV. LESSONS LEARNT FROM THE COURSE OF PAST OPERATIONS
AND PROSPECTS FOR THE FUTURE.

The lessons learnt from ground attack operations up to the present time have resulted in new principles of warfare. To these may be added some further general remarks.

After the first World War the German Air Force was the first to recognise the great importance of ground attack aircraft. Independent units were set up and successfully employed during the war.

Our enemies also recognised the successes and possibilities of ground attack and consequently began to form units of their own. The Allies thus modelled their organisation and operations on the German pattern.

Compared with those of the Allies the German ground attack units have been but little expanded during the war. On 1.6.44 the Soviets had an estimated total of 5.120 ground attack aircraft; a month later the Allies had a total of 7.270 close support aircraft in England, France and the Mediterranean, while Germany at that time had a total of 1.005 ground strafers at her disposal. (From an OKL report)

During the course of the war both sides have learnt that real successes can only be achieved when air supremacy has been won. It is then possible, apart from direct army support operations, to make tactical sorties with or without fighter escort.

These operations become considerably more difficult when the enemy is in possession of air supremacy. A stronger fighter escort is necessary, small units are practically unable to operate, and the time our aircraft can remain over the front, the number of sorties, and consequently the effects on the enemy, are greatly reduced.

Overwhelming enemy air supremacy may necessitate the use of airfields far behind the lines, and make it impossible for several bombing runs to be made during a single raid.

Furthermore, unless we have a sufficiently strong fighter force at our disposal overwhelming enemy air supremacy may prevent air operations in certain frontal sectors. This is the state of affairs on the Western and Southern Fronts, but even in these areas we must attempt to carry out ground attack sorties in support of the hard pressed land forces. This can only be achieved if the enemy fighter strength can be reduced and that of the Luftwaffe increased on all fronts. First of all, our fighter units must be equipped with new aircraft types superior to the enemy's.

However justified is the demand made by the Air Officer for Ground Attack for Do 335's, its fulfilment would hinder the attainment of our primary aim, - the breaking of enemy air supremacy. Once a reinforced German fighter force has levelled out the disparity between the opposing air forces, or even achieved German air supremacy, the flying speed of the Do 335 ground attack aircraft will be of secondary importance. With the fighter escort which will then be available, FW 190's will be able to carry out ground attack operations on all fronts.

At present, ground attack operations are possible only on the Eastern Front. Should the Russians reinforce their Radar stations behind the front, and should, as is by no means impossible, American and English fighter units be transferred to the Eastern theatre of war, operations on this front may also become impossible for so long as the present shortage of fighter aircraft persists.

Owing to the present air situation, we may therefore decide to incorporate at any rate the FW 190 ground attack units into the fighter units with a view to the strengthening of our fighter defences.

Certain considerations speak against such a move:

1. While our lines in the East are weak, the ground attack formations are our only weapon of attack, and one, which thanks to its speed and manoeuvrability, can successfully be employed against surprise attacks and break through.
2. The cessation of all ground attack sorties by day would inevitably have an effect on the spirit and the morale of the army. We must remember that since 1939 the German Army has never fought a major offensive or defensive battle without air support, and that enemy ground attack activity is increasing. Without direct air support, both offensive and long term defensive operations are inconceivable.
3. It is therefore essential to maintain a solid nucleus of ground attack units.

As regards future prospects, the following possibilities should be considered:-

(a) As soon as the land fighting and the aircraft fuel position permit, the conversion of the remaining Ju 87 units to FW 190's would be of considerable value. FW 190 formations could then operate without fighter escort and the fighter forces hitherto employed on escort duties could be freed for other tasks. The Ju 87's thus made available could be used for night ground attack operations.

(b) Since Russia is evidently increasing her fighter strength and undertaking the conversion of units to more modern aircraft, the possibility of increased attacks on the Eastern front must also be reckoned with. Such an emergency can best be met by intensified training among the reserve fighter units.

(c) The strict operational limitations now imposed on anti-tank aircraft will have to be remedied by new tactical and technical devices. The new FW 190's equipped with "Panzerschreck" and "Panzerblitz" which are at the moment undergoing successful tests will soon be ready for operational use. The possibilities of rocket projectiles and ricochet methods must be studied, and, should they promise a reasonable element of success, they must be developed and personnel trained in their use.

Should operational results prove satisfactory the Ju 77's and Hs 129's could be withdrawn, and all day ground attack units would then be uniformly armed and equipped.

(d) The already strengthened night ground attack units will have to be developed to an even greater degree of efficacy. This can best be achieved by supplying them with more Ju 87's. Their present dependence on weather conditions must be eliminated and in this connection, the use of the "Egon" aircraft RDF instrument, facilitating operations in bad weather conditions and target location, offers great possibilities.

(e) As the shortage of aircraft fuel is likely to continue for some time, ground attack operations also remain on a limited scale. During this period of relative inactivity our commanders and the ground attack units will have to watch closely enemy ground attack tactics, so that any new developments can speedily be observed, tested, and employed should the opportunity arise.

The varied nature of ground attack operations demands extensive training and equipment. We must, however, never diverge from the fundamental principle that ground attack is, and must remain, the instrument of the Air Force, its main purpose being the purely tactical support of any major land operation.

Army Commanders must not expect ground attack aircraft to be placed at their disposal in unlimited numbers, nor that the Air Force will undertake tasks which could equally well be carried out by the Army themselves with the possible aid of air observation.

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