R·A·F EDUCATIONAL SERVICE

ACTIVITIES IN M·A·A·F

THE LAST TWO YEARS have seen the final stage of the African campaign and the consolidation of the Allied position in that continent, the lifting of the siege of *Malta,* the conquest of the central Mediterranean islands and the driving of the enemy through *Italy* to the northern fringes of the *Apennines.* In what was once a wholly mobile command the stabilised areas have greatly increased, but always there have remained, close to the front, units in which the old circumstances still prevail. It has been the task of the R.A.F. Educational Service to adapt the General Education Scheme to these diverse conditions and it may be claimed that its activities, in spite of the shortage of accommodation and other amenities, have been limited only by lack of staff.

Prior to March, 1943, all educational queries were sent to Headquarters, R.A.F., Middle East, but from that month, when three Education Officers were attached to H.Q., Western Desert, Nos. 205 and 210 Groups respectively, the strength has gradually grown until now it stands at 27—eight below establishment and still small in relation to its commitments.

From Benghazi to Tunis

By July, 1943, what was afterwards to evolve as the Central and Western Mediterranean Area was ready to begin its separate existence with the formation of a new Educational Area for units west of *Benghazi.* To it three officers were appointed, one to No. 214 Group, as Area Education Officer and for units in and east of *Tripoli,* one to No. 114 M.U. for units west thereof, and one to R.A.F. Station, *Castel Benito,* and No. 205 Group units in *Tunisia.*

The General Education Scheme aimed to meet its needs by means of classes and correspondence courses, by the provision of library facilities and through the medium of lectures and discussion groups. Such was the enthusiasm that in spite of the scattered nature of the units, which precluded civilian teachers and threw them back on their own resources, the return for September, 1943, showed a class attendance of some 440. Of these about a quarter were studying Mathematics, more than a half English and Modern Languages and a smaller number Navigation, Shorthand and Bookkeeping.

Photographic class at No. 336 P.R. Wing.

Classes Held in the Open

Nor does this constitute the whole picture, for there were many units which set up classes without waiting for sanction or for official payment, and of these no records exist. Classes were held in tents, in ramshackle huts or even in the open with the outside of a lorry for a blackboard. Some 170 correspondence courses in such subjects as Engineering, Radio and Journalism were approved and as many more deferred pending more basic study by the applicants.

The library position was very difficult, only 550 books being at first available, a number totally inadequate to the needs of 16,000 airmen. Thus, many who were not interested in courses, owing to the long postal delays, and who had no opportunity for class instruction, had this one remaining form of study denied them. Lecturers were rarely available, but especially on the smaller units, which often claimed an attendance of forty per cent. of their strength, voluntary discussion groups were extremely popular.

Later Stages in North Africa

By the end of 1943 most of the units so far catered for, as well as two of their Education Officers, had moved to *Italy*, but in the meantime, on Christmas Day, a new group of six Education Officers arrived from the *United Kingdom* to take up the tale in *North Africa*. Of these three were immediately attached to the larger units and one was sent to join those already teaching English to French personnel in *Morocco*. The Senior Education Officer and the remaining one, both of whom later transferred to *Italy*, constituted the staff at H.Q., M.A.A.F. (*La Marsa*). Since then the establishment has been increased and the work is at present carried on by six officers and one language instructor.

The initial policy of placing Education Officers at larger centres has continued, so that *Blida, Maison Blanche, Setif* and No. 351 M.U. each have their own, while the other units, containing approximately half the total personnel, are under the charge of the Area Education Officer, No. 218 Group, and his assistant. These units are too widely dispersed to be visited as frequently as could be desired, but some measure of satisfaction is obtained through the assistance of airman schoolmasters.

Lack of Accommodation

From the outset the execution of the General Education Scheme was handicapped by lack of

accommodation and equipment, and much improvisation has been necessary, although the situation is now much improved. Fortunate indeed was the Education Officer who could claim the sole right to a tent or marquee for his work; generally he had to compete for accommodation with other station activities. Canteens, dining rooms and offices had all at one time or another to be pressed into service. (The accompanying photographs are a measure of the progress that has been made). The supply of books, at first very small, is still inadequate, but each Education Officer now possesses a library which is fairly wide in scope and the total number of volumes now held is round about five thousand.

In spite of teething troubles, most of the demands made on the Educational Service in *North Africa* have been provided for. Class instruction has been placed on a sound footing at the bigger centres, but only in a few other places has it been possible to arrange for oral instruction, owing partly to the demand in each subject from the smaller units being insufficient and partly to the difficulty of providing suitable instructors.

English, Mathematics and European Languages have, as usual, been the most popular subjects, but the full range has included such diverse matters as Building Construction, Commerce, Economics and Art, and much of the credit for success in these subjects, obviously beyond the capabilities of any one Education Officer, belongs to those personnel who have offered themselves as part-time teachers.

The Purpose of Studies

The total of official correspondence courses in the North African area has reached 750, those in Accountancy, Engineering, Agriculture, Law, Insurance, Secretarial work and Teaching having proved the most popular, while in the Postal Study section, London Matriculation, Electricity and Magnetism and Radio subjects, Motor Mechanics and Diesel Engineering have all received attention.

Most studies are directed toward post-war employment, some students desiring to refresh their previous knowledge, others to reach a definite objective in their career, and although for the most part time has been too short for them to reap their reward, some candidates have already presented themselves for London Matriculation.

As the War nears its end it is expected that men will avail themselves of the opportunities for

Portrait class in progress at No. 336 P.R. Wing.

obtaining a qualification and will offer themselves for professional and vocational examinations.

Progress in Malta

From *North Africa* it is but a short step to *Malta* where conditions are now almost normal. In spite of the fact that airmen are divided into watches, that locally trained airmen live at home and that both the work and the billets of British airmen are often at some distance from Station Headquarters, there is still considerable scope for Educational activities. There are now two Education Officers to meet the needs of the R.A.F. on the island, and two unit reference libraries with eight branches. In the airmen's mess at Air Headquarters there is an Information Room, a Recreation Library and a study room, while the office block houses three good classrooms. Similar amenities are being incorporated into buildings now in course of construction for peace-time use.

Twenty-four classes weekly now meet on the island, about three and a half per cent. of the total British R.A.F. personnel are engaged on official correspondence courses and students are preparing for London Matriculation and other examinations such as those of the Royal Society of Arts, London Chamber of Commerce and the City and Guilds. On one unit there is an arrangement whereby twenty discussion groups meet simultaneously, stopping work for the purpose. A start has been made with the manual side of vocational training at an M.U. where volunteer pupils gain practical experience in the workshops, and it is hoped to extend this scheme to building construction with the assistance of the Air Ministry Directorate of Works.

Early Days in Italy

The first Education Officer in *Italy* took up his duties about two months after the invasion. To-day *Italy* holds about three quarters of the total personnel and two thirds of the Education Officers in the M.A.A.F. Command. The early difficulties were much as they had been in *North Africa*—a shortage of staff, of books and of accommodation. In the first three months

The Art Studio at H.Q., No. 205 Group.

The Library at H.Q., No. 205 Group, in February, 1945.

there were only two Education Officers in the country, one on the Adriatic side and one in the *Naples* area, and even by the late summer of 1944 the number had not risen above seven, although *Italy* was occupied as far north as the Gothic Line.

The greatest initial demand for educational facilities came from D.A.F. units, and to meet it extensive use was made of the services of Education Liaison Officers and airmen on units, most of them schoolmasters, who volunteered to organise classes and to advise on Courses. In addition it was arranged to employ a staff of clerks to stencil copies of Tutorial Courses and of other publications which were in great demand. By the end of March, 1944, over 1,350 men were receiving instruction either in classes or by correspondence courses, although enthusiasm for the latter was damped by long postal delays and by the difficult conditions for private study. In spite of the complete stoppage at one peroid of the supply of pamphlets, the lecture and study group scheme was very successful during this first winter, especially on those units which had acquired the habit in the Desert, and added stimulus in the larger towns was given by a team of Army Lecturers on whom the R.A.F. constantly called for talks on current affairs. Many units also sent representative officers to attend a one-day course in A.B.C.A. at *Bari*.

The Second Phase

During March, 1944, the Senior Education Officer moved from *La Marsa* to *Caserta* and in the months that followed four other members of the Educational Service were added as reinforcements, but nothing could be done with such a small number to keep pace adequately with the rapid movement northward which followed the breaking of the deadlock at *Cassino*.

It was not until the autumn that the arrival of six officers from the *United Kingdom*, and the commissioning of others locally, made possible the first reasonably comprehensive provision of educational facilities throughout *Italy*. Other officers were due to be repatriated, however, and

there are gaps still to be filled. Now, in the early part of 1945, Education Officers are located at H.Q., M.A.A.F. (Unit), at Headquarters, M.A.C.A.F. and B.A.F., and at both Rear and Advanced Headquarters, D.A.F., at Nos. 205 and 214 Groups, at Nos. 239, 283, 287 and 324 Wings and at No. 110 M.U.

Coastal Air Force

Until recently the scattered nature and the exacting duties of Coastal Air Force militated against educational work, but now, as operational demands decrease and as the cessation of hostilities looms ahead, there is a re-awakening of interest. Classes are commencing throughout the command, taken by airman schoolmasters and others who have emerged as teachers from among the personnel on the various units. The administration is in the hands of officers who have volunteered for liaison work with the Education Officer at Headquarters.

Discussion Groups are multiplying apace—scarcely a unit exists which has not at least one, and some of the larger ones have as many as twenty. On several of the Air-Sea Rescue launches the whole crew meets daily and with every meeting become more fluent and better informed on matters of vital importance for the post-war era. All this has been possible only through the inspiring enthusiasm of the Leaders, many of whom have attended two-day courses at Headquartes, and such is the importance of this development that it has been considered necessary to enlist the full-time services of an officer to supervise it, while a mobile team of Discussion Group "experts" is being set up to tour the Command.

Much of the success of the scheme in M.A.C.A.F. can be attributed to the fact that the Groups meet in service hours, and the extension of this practice to cover classes will encourage many airmen to attend them. They will be so organised that they will meet for one hour during service time and for one in the airmen's free time.

A corollary of this development has been the setting up of Information Rooms on units. Accommodation, furniture, heating, literature and exhibition material are everywhere at a premium, but already certain units have opened such rooms and their interesting displays, no less than their comfort, are attracting airmen in increasing numbers.

No. 205 Group

Much of the foregoing may be said to apply, in greater or less degree, to other formations in M.A.A.F. At No. 205 Group there is no shortage of civilian part-time teachers and some of the Italian classes have now passed the elementary stage and are doing much to improve the coversational powers of the students. Mathematics classes comprise all grades from elementary to calculus. Art is gaining in popularity, but the supply of material is still deficient. At present five classes are in progress, some of the work is of a high standard, and one unit in particular combines practical instruction in drawing and painting with lectures on the history of Art. At Headquarters the studio, well equipped with drawing boards and easels made in the carpentry section, is open all day and every day, instruction being given three times weekly by a former member of the staff of United Artists. On one unit a photographic club with a membership of 60 has been in existence for several months.

For the benefit of music lovers a gramophone library has been formed at Group Headquarters and at present consists of 180 classical and light classical records. Units in the area select programmes from those available and in this way several regular music circles are held. The records were bought through Welfare funds and it is hoped to increase the library in number and scope. Two former Cathedral directors of music give their services and one of them conducts the weekly practices of glees and part-songs of the Combined Services' Male Voice Choir whose members are drawn from the Army and R.A.F.

With the introduction of compulsory discussion groups there has been an increased demand for some added degree of background knowledge and to meet it a panel of lecturers has been set up, whose members visit units on request. Reciprocal arrangements exist whereby American lecturers come to British units to talk on politics and social life in the United States, and R.A.F. personnel lecture to the Americans on such subjects as the British Constitution, Local Government and Trades Unionism. In addition Brain Trusts and quizzes are popular, and a start has recently been made with the showing of documentary films from Army and American sources.

Balkan Air Force

It is only since the beginning of this year that an Education Officer has been allotted to B.A.F., but prior to this much had been done to help neighbouring units of this Command by those at Nos. 205 and 214 Groups, and at No. 110 M.U. Class teaching is given in a wide variety of subjects including Serbo-Croat, with the addition of English instruction for Allied personnel.

Music circles have been formed at all Wings and voluntary discussion groups are long established. Following recent training courses for leaders, including one at R.A.F. Station, *Vis*, an organised scheme is being put into effect.

Desert Air Force

From the earliest days in Africa and more particularly after their arrival in *Italy*, there has existed in the Desert Air Force a strong desire for educational facilities, and every effort was made by the Education Officer at No. 214 Group, working through Liaison Officers and unpaid airman schoolmasters, to satisfy this demand. The difficulties were, however, almost insuperable and when, during October, 1944, it was at last possible to attach four Education Officers to the

Information Room, No. 614 Squadron.

formation they were welcomed with tremendous enthusiasm.

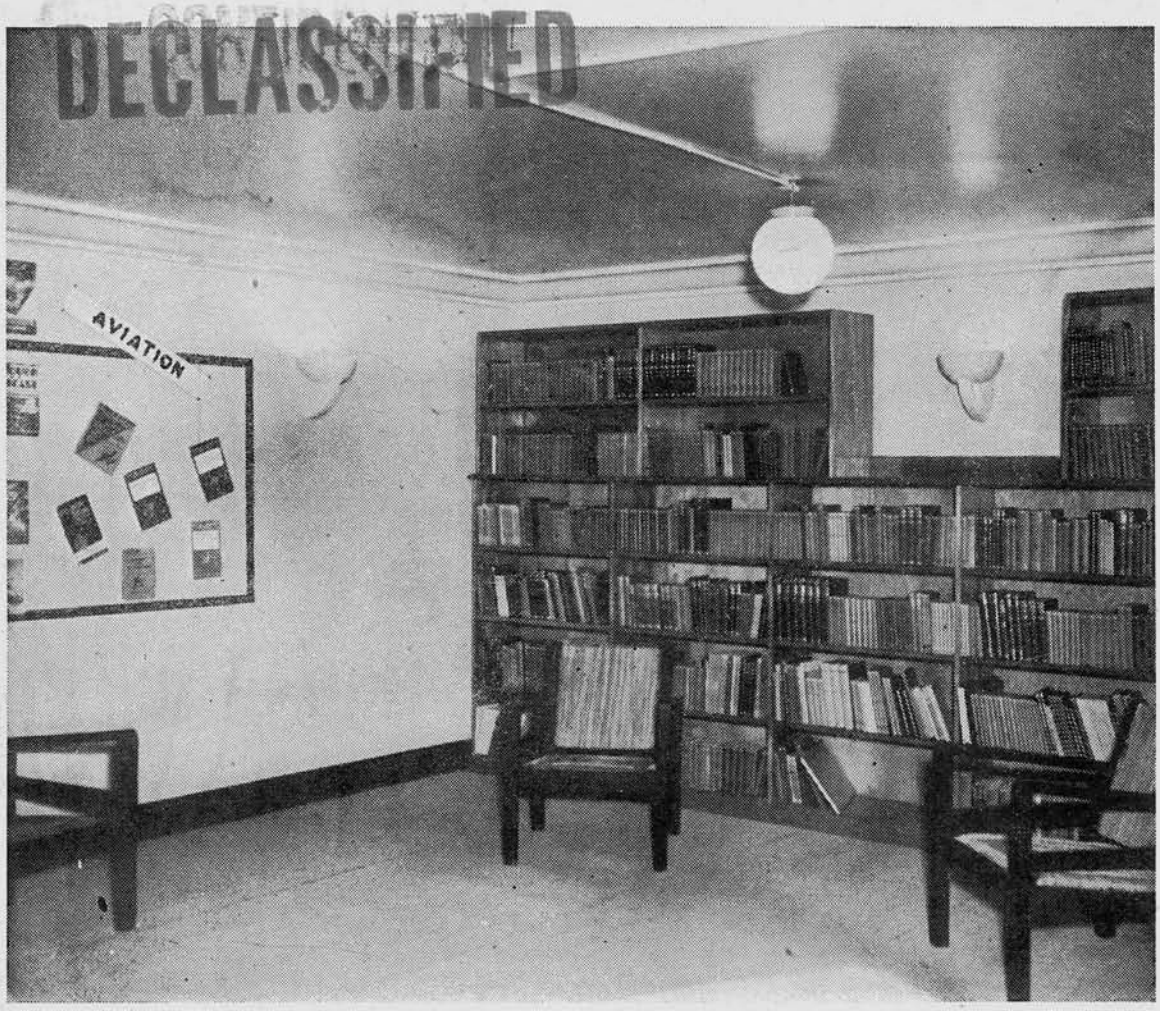
As a result of the co-operation of the units themselves, improvised accommodation was quickly forthcoming, in spite of the many obvious difficulties to be expected in forward areas. Each Education Officer was established in some sort of office, a classroom was found, blackboards appeared as if by magic, of chalk there was some, but of stationery hardly any. Personnel attending the classes had to equip themselves as best they might with pencils, rulers and notebooks, some came equipped with writing pads, others managed to find scrap paper which served the purpose equally well. And so the work began.

The first response was almost overwhelming and to the many other problems was added the shortage of text-books. Some part-time teachers, however, managed to work without them and only in some language classes were there enough for each member to have a copy. At this time each Education Officer had as his complete library one medium-sized box of books which was transported along with his personal kit.

Trying to Keep Warm

With the approach of winter, the main problem confronting all Education Officers was the difficulty of raising the temperature above the point at which concentrated effort on the part of the pupils became impossible. Stoves were supplied, but even two of these together were found to be little more than useless and the eventual solution was an oil-drip fire, constructed by the pupils themselves from a fifty gallon drum, a few feet of piping and a " Jerry Can." As for the tent, which on one unit was used as overflow accommodation, at one time the ink was frozen solid when the day's work began, the gales played havoc with the already gaping seams and the soil on which it stood was of such a peculiar nature that rain water which fell outside came up through the floor after the manner of an artesian well, forming pools and a three-inch layer of mud. The chairs occupied by the Education Officer and his clerk quickly began to subside into the morass and operations had to be temporarily suspended until some approximation to stability could be achieved at a lower level.

In spite of the many obstructions, however, of which that of transport difficulties was not the least, comprehensive programmes of classes were eventually in progress, not only on the Headquarters Units but on a variety of widely dispersed smaller ones which the Education Officers had been able to visit and on which Liaison Officers and airman schoolmasters had been established. At the end of 1944 eighteen in each category had



Library and Reading Room at the Educational Bureau at H.Q. No. 218 Group.

been trained, some 70 classes had been formed at which more than 900 students were attending and over 200 applications had been received for correspondence courses.

Those who have experienced an Italian winter in a forward area will appreciate that great credit is due alike to the Education Officers and to the personnel in the formation who, by diligence and perseverence, achieved such results in make-shift unacademic surroundings and under conditions of great physical discomfort.

The Task of the Future

Now, as the German War approaches its end, the Royal Air Force is faced with a task unprecedented in its history, and one which manifestly cannot be fulfilled by the limited resources of the Education Service alone—a task which is nothing less than to prepare for their return to civil life vast numbers of men and women, most of whom have for long periods been divorced from their normal occupations and many of whom were drawn into its ranks while still on the threshold of adult life.

Some of these men and women had already advanced far along the path of their chosen career, have jobs awaiting them and may even have been fortunate enough to find work in the Service closely akin to their civilian employment. Others again either have no career to which to return or will have had their outlook so broadened, alike by human associations and by contact with hitherto strange lands and customs, as to be no longer content to resume their pre-war calling. Of these some will wish to adapt their service trade to civilian uses while others will aspire to something new, demanding, it may be, a higher standard of general education than that previously attained.

Educational and Vocational Training

All alike face difficult problems of readjustment to enable them to take their place as intelligent and responsible citizens in a devastated world, to understand the ever more complicated machinery

of modern society, and to appreciate the privileges and the duties of life in a democratic community. Prejudice, loose thinking, hasty judgment, self pity and a tendency to lay all misfortunes on a legendary "they," all these weaknesses become doubly dangerous when the individual, released from Service discipline, is free to pass from thoughts and words to action. The airman, moreover, needs help to brace himself against the day when he must leave the economic shelter of the Service to face the open competition of the outside world.

This, outlined in its simplest terms, is the present problem; a problem that increases in complexity with each attempt to find a practical solution, inasmuch as every service man or woman is an individual with his or her special difficulties. It is clear that no scheme, however comprehensive, could cater adequately for each and every one, so infinite is their variety, so comparatively short the time available. The most that can be hoped is to offer general training which may be of use to all and specialised assistance in as many broad categories as may be permitted by the resources already available or able to be provided speedily. On the basis of these considerations the R.A.F. Educational and Vocational Training Scheme, as originally embodied in A.M.O. A.942/44 and since amplified, has been evolved.

Resettlement Training

In that it is common to all, and in that those with a more comprehensive educational and cultural background can be used to help their less fortunate fellows, that aspect of the problem which deals with citizenship or Resettlement Training, to quote the terminology of the A.M.O., is perhaps the most readily soluble. Here the proposal is to rely principally on Discussion Groups, wherein questions of current and future interest can be examined, diverse points of view be expounded and those taking part gradually be trained to acquire the habit of subordinating their own selfish or sectional interests to the common weal.

To a considerable degree this part of the scheme is already in operation and should extend rapidly as more service time becomes available and as more and more men, to whom the British Way and Purpose and other pamphlets are available, pass through the short courses in Leadership. Clubs, lectures, films and broadcasts all have their bearing on Resettlement Training and may be used to supplement the Discussion Group.

Educational Training

Next in order of difficulty there arises the question of Educational Training, which will aim at the improvement of the individual's general background of knowledge and culture rather than to fit him for any specific employment. Here it must be assumed that the students will fall into one or another of three categories—those who are already above Matriculation standard, those who may aspire to a degree on an approach to it and those who must remain content with something else. For the first of these, facilities for correspondence courses and for private study under the guidance of Education Officers and Instructors will be offered and it may be possible, in this theatre, to enlist the help of outside bodies such as the local Universities.

For the second group teaching will be arranged to lead up to the Forces Preliminary Examination, which is being recognised by Universities as carrying certain exemptions for the purpose of admission to particular faculties and colleges. This examination, which is being conducted by the Civil Service Commission, will be in two parts, the first comprising English, General Knowledge (including current affairs and citizenship) and a third subject which, except in specially approved cases, must be either Mathematics or Latin; and the second part embracing two out of a very wide range of subjects including science and languages. Candidates must pass in both parts, which, however, may be taken separately, and needless to say those students who feel able to will be encouraged to matriculate as heretofore.

For the third group, those who wish to improve their general education at a level below the standard of School Certificate, the training will be directed generally towards the R.A.F. War Educational Certificate, which should be of use when seeking those forms of employment for which matriculation is not required. This again is in two parts, only the first of which is compulsory, and an essential preliminary is a certificate on the part of an Education Officer to the effect that the candidate has done satisfactory preparatory work.

In this examination service women are specially catered for, inasmuch as the four subjects in Part I, in three of which the candidate must pass, include Housewifery along with English, Mathematics and General Knowledge. Part II again offers a wide selection, of which the candidate may choose two or, exceptionally, three subjects and his success will be annotated on the certificate already gained.

Vocational Training

Lastly, there is Vocational Training, directed towards improving the qualifications of those who were trained or employed before the war in a civilian occupation, towards the conversion of service trades to peace-time uses, or towards preparation for post-service training in the case of those who had no civil employment before joining the R.A.F. The courses and syllabuses will be laid down by the Air Ministry in collaboration with the Government Department concerned and will, as far as possible, be arranged so as to lead smoothly into the further training that a man may receive after his release. Both manual and non-manual occupations will come within the scheme.

Practical instruction on Stations, courses in basic theoretical subjects necessary for groups

of trades, conversion courses, study syllabuses and text books, attendance at technical schools and colleges—all find their place in the machinery for implementing the plan, which, while it could never cover every aspect of human endeavour, should be able to offer to every individual some knowledge or skill which will have a direct bearing on his civilian occupation.

This then is the plan, which will come into operation at a date to be announced later and probably immediately after the end of hostilities against *Germany*. It is designed for the period prior to the service man's or woman's release, the time of which it will in no wise affect. Training, amounting to about six hours a week, will take place in Service time and will be compulsory.

Recruitment and Training of Instructors

The essential pre-requisite of such a scheme, however, is an adequate supply of properly trained instructors covering a wide range of subjects—several thousand are needed for the Central and Western Mediterranean theatre alone, to supplement the handful of Education Officers and the limited number of part-time teachers and airman schoolmasters who have hitherto borne the burden of the General Education Scheme. There are many professional teachers in the ranks of the R.A.F. and many others who have had experience as Service instructors. The first problem is to persuade them to volunteer for this work, the second to give them the specialised training which will make them effective with a Service audience in novel and rather trying circumstances.

Uncertainty as to conditions of employment for some time made volunteers slow to come forward, but the assurance that the date of their own release and their financial position will remain unaffected should help to overcome their reluctance. Many airmen and some officers in fact stand to gain both in rank and in emoluments.

The training of instructors began in the autumn of 1944 when this Command was allotted a number of vacancies at No. 2 R.A.F. Instructors' School (E.V.T.) at *Heliopolis,* but the really effective start was made in February, 1945, with the opening of No. 8 School at *Lecce* in the south of *Italy*. Here it will be possible to train nearly two hundred instructors a month in courses each lasting a fortnight. The school, which is staffed by specially selected Education Officers sent out from the *United Kingdom,* is for all ranks, and all educational instructors will be taught how to approach citizenship and resettlement problems.

For those who were not professional schoolmasters in civil life, there is instruction in teaching methods, a library is provided and there are facilities for private study. Those who pass through the school cannot necessarily be guaranteed employment as full-time instructors at the end of hostilities, but those who are will as far as possible be allotted to their present units and in the meantime they are encouraged to seek employment as part-time teachers, under the General Education Scheme, in order to keep in practice. The administration of the school and of the E.V.T. scheme as a whole is in the hands of the Training Department; the syllabuses to be followed and the supervision of the teaching are the responsibility of the Education Service, whose officers will be available to offer professional guidance and advice.

The Scheme Must Not Fail

This scheme is ambitious, the more so because it must be carried through at a time of uncertainty and flux, depending much on the co-operation and goodwill of many people, all of whom are feeling the strain of war and of service overseas. Nevertheless, it must not fail. Those for whom it is intended have deserved well of their country and for its sake, as much as for their own, they must not be allowed to go back to civil life ill-equipped for the stupendous task of reconstruction that lies ahead. They will return home the richer by great experiences and by good comradeship, but nothing can wholly compensate them for the "lost years" and it would be intolerable if, through any fault of the Service to which they have given so much, they should feel cheated and at a disadvantage compared to those who have been able to remain in civil employment. The extent to which R.A.F. personnel are able to play in peace the full and honourable part which they have borne in war will be the measure of the Scheme's success and for the R.A.F. Educational Service a test of its own endeavour.

Mobilising A Nation

THE NORMAL PRACTICE of the R.A.F. Mediterranean Review is to publish only original articles or features. In the following article, however, which is reprinted by kind permission of the Times Weekly Edition, departure from that practice is considered to be justified by the revelations contained in the figures quoted from the Government White Paper which clearly indicate the astronomical effort made by the people of the United Kingdom in prosecution of the war.

"For five years men and women have lived and worked under complete blackout. Family life has been broken up, not only by the withdrawal of men and women to the Services, but by evacuation and billeting.

"Production has been made more difficult by the dispersal of factories to frustrate the air attacks of the enemy, and by the need for training new labour to unaccustomed tasks. There have been two long periods when work was carried on under constant and severe air attacks. Since 1940 one and three-quarter million men have given their limited spare time, after long hours of work, for duty with the Home Guard. Most other adult male civilians and many women have performed part-time civil defence and fire guard duties out of working hours."

More People Employed

"Between 1939 and 1944 there was an increase of three and a half million people in the Services or in industrial employment. Two and a quarter million people not previously in industrial employment were brought in and employment was given to one and a quarter million people previously unemployed. Of the total of 22 millions in the middle of 1944,

> "47 per cent., or 10.3 millions, were in the Services or whole time civil defence or employed in engineering, shipbuilding, metals and chemicals—industries mainly concerned in the output of munitions;
>
> "26 per cent., or 5.7 millions, were in agriculture, mining, national and local government service, public utilities, transport, shipping (including the Merchant Navy), and the manufacture of food, drink and tobacco—industries which it has been necessary to maintain or expand during the war;
>
> "27 per cent., or six millions, were in building and civil engineering, the textile, clothing and other manufacturing industries, the distributive trades and civilian services.

"At the middle of 1944 7.6 million persons were engaged in the manufacturing industries (excluding mining), and of these 76 per cent. were engaged on Government work, 20 per cent. on work for the home market, and 4 per cent. in producing goods for export. The scale of mobilisation of man-power achieved has been far greater than was attained in the last war. Ten million men born in the years 1892 to 1926 and 11.6 million women born in the years 1893 to 1926 have been registered for either military service or industrial employment. In addition, there have been registrations of persons with special skill, such as coal miners and shipbuilders.

"At the middle of 1944 out of sixteen million women aged fourteen to 59, 7.1 millions were in the auxiliary services, whole-time civil defence, or industry—an increase of over two and a quarter millions since the beginning of the war, or, counting each woman working part time separately, an increase of nearly two and three quarter millions. At the middle of 1944, 900,000 women were doing part-time work in industry and 350,000 were doing part-time civil defence work. A great number of those who have taken up employment during the war are married women who are doing industrial work in addition to their domestic duties.

Total Armed Strength

"At the middle of 1944 the strength of the armed forces of the United Kingdom (including those locally enlisted abroad) was 4,542,000. The total strength of the British Commonwealth and Empire forces at the middle of 1944 was 8,713,000. The number of men reported as killed, missing, or prisoner of war is not included in this total. If allowance is made for these and for men discharged on medical and other grounds the total number of men who are serving or who have served since the outbreak or war has been over ten millions. The comparable figure for the last war was nine millions.

"The casualties to all ranks of the armed forces of the United Kingdom during the first five years of war, as reported up to September 3rd, 1944, were:—

Killed	176,081
Missing	32,275
Wounded	193,788
Prisoner of War	154,968
Total	563,112

"Casualties to the British Commonwealth and Empire forces during the first five years of war as reported up to 3rd September, 1944, were

925,963, of whom 242,995 were killed, 80,600 missing, 311,500 wounded, and 290,865 prisoner of war.

"From the beginning of the war to August 31st, 1944, 29,629 merchant seaman serving in ships registered in the United Kingdom have been killed by enemy action at sea and 4,173 have been interned by the enemy. The figures exclude the number of merchant seaman who have been wounded or injured.

"In addition to the casualties sustained by the armed forces and the Merchant Navy many civilians in the United Kingdom have been killed or injured and detained in hospital by enemy action. From the beginning of the war to June 12th, 1944, when the flying bomb attacks began, 51,822 people lost their lives and 62,900 were injured and detained in hospital. From June 13th to August 31st, 1944, 5,476 were killed and 15,918 were injured and detained in hospital. The number of civilians killed or injured and detained in hospital in the United Kingdom since the outbreak of war to August 31st, 1944, was 136,116, of whom 57,298 were killed. Of this total killed 7,250 were children and 23,757 were women.

Supply of Munitions

"Of the total supply of munitions produced by, or made available to, the British Commonwealth and Empire since the beginning of the war, it is estimated that about seven-tenths has been produced in the United Kingdom, while about one-tenth has come from other Empire countries—making about four-fifths from British Commonwealth and Empire sources. The remaining one-fifth of the Empire supplies has come from the United States. Of this total American contribution nearly four-fifths has taken the form of lend-lease and the remainder in the form of British cash purchases. All shipping services, as distinct from construction of merchant vessels, have been excluded. The production of war material by the United Kingdom from September, 1939, to June, 1944, was as follows :—

"Naval Vessels. Major naval vessels, 722; Mosquito naval craft 1,386 ; Other naval vessels, 3,636.

"Ground Munitions. Field, medium and heavy artillery equipments, 13,512 ; heavy anti-aircraft equipments, 6,294 ; light anti-aircraft equipments, 15,324 ; machine guns and sub-machine guns, 3,729,921 ; rifles, 2,001,949 ; tanks, 25,116 ; wheeled vehicles for the services, 919,111.

"Aircraft. Total aircraft, 102,609 ; heavy bombers, 10,018 ; medium and light bombers, 17,702 ; fighters, 38,025.

"The increase in ships has called for an even greater increase in naval munitions. It is now necessary to arm regular warships with many offensive and defensive weapons additional to those fitted in the early stages of the war. Moreover, much additional equipment is required in the way of radar and wireless apparatus, control gear, and devices for protection against the various forms of enemy attack, including surface craft, U-boats, aircraft, and mines of the magnetic and other types. In addition practically every merchant ship must be equipped with complete defensive armament, including many of the weapons and devices fitted in war vessels. At one period the amount of merchant shipping in hand for repair was over 2,500,000 gross tons.

Changes in Equipment

"Production of munitions for the ground forces rose steadily from the outbreak of war until early 1943 and there were marked changes in the types of equipment produced. In the case of tank and anti-tank equipments, two-pounders gave place to six-pounders and they, later, were replaced by seventeen-pounders . Ammunition not only grew in weight but also became more complicated and difficult to make. Fighting vehicles now are heavier and more highly powered than they were, and wireless sets and other types of signal equipment have become much more elaborate.

"At the beginning of the war total deliveries of new aircraft were at the rate of 730 a month, and over a quarter of these were trainers. By 1943 the average rate of deliveries had trebled and as measured by structure-weight had increased nearly six-fold ; 2,889 heavy bombers were delivered in the first six months of 1944, compared with only 41 in the whole of 1940. The output of fighters showed an increase from 110 a month in 1939 to 940 a month in the first half of 1944.

"The repair of aircraft has absorbed an appreciable proportion of the capacity of the industry. For every six aircraft newly produced in 1943, four aircraft underwent major repairs in the United Kingdom.

"The iron and steel industry had previously relied on large imports of iron ore. The home output of iron ore has been increased by more than one-half since before the war. The total steel production has been consistently above the pre-war average (notwithstanding the need to increase greatly the proportion of alloy and high-grade steel produced).

"A substantial contribution to the domestic supply of steel has been made by a severe curtailment of our exports of steel products. In the light metals industry magnesium production is more than eleven times the pre-war rate—an achievement which has meant the creation of virtually a new industry.

"Since 1941 our manufacturing resources have been turned from export production to still more urgent uses. The value of United Kingdom commercial exports has fallen from £471,000,000 in 1938 to £232,000,000 in 1943. Attempts have been made, so far as possible, to export goods which do not make great demands on manpower. Thus exports of spirits have been continued. Exports of textiles, which are produced mainly by female labour, have declined less than those

of engineering products. The export of motor-cars and commercial vehicles has virtually ceased since 1941, and the amounts of iron and steel manufactures, machinery and coal sent to overseas markets have been drastically cut.

Increased Taxes

"With a larger number of persons in employment or in the services, increased hours of work and higher money earnings, the total incomes of private persons before taxation rose from £4,779,000,000 to £7,708,000,000 between 1938 and 1943. Most of this increase has, however, been saved or taken by the Government in the form of income-tax and other direct taxes.

"The number of income-tax payers has been increased from 4,000,000 in 1938-39 to 13,000,000 in 1943-44, and the income-tax payable by them from £336,000,000 to £1,183,000,000. Before the war less than 1,000,000 manual wage-earners were liable to income-tax and they paid £3,000,000; in 1943-44 the number increased to 7,000,000 and they paid £200,000,000. A person with an earned income of £10,000 a year now pays more than two-thirds of his income in income-tax and surtax. Of the aggregate incomes of persons with £250 to £500 a year 3 per cent. was paid in income-tax in 1938 and 14½ per cent. in 1942. Of the aggregate incomes of persons with £500 to £1,000 a year, 11 per cent. was paid in income-tax in 1939 and 28 per cent. in 1942. Business and corporate bodies, no less than persons, have been called upon to pay increased taxes during the war. Apart from the increase of income-tax, an excess profits tax of 60 per cent. was imposed in 1939, and this was increased to 100 per cent. in 1940. The tax paid on beer and tobacco alone was more than £600,000,000 in 1943—about two-thirds of the total revenue from all sources collected by the Central Government in a single year before the war.

Food Subsidies

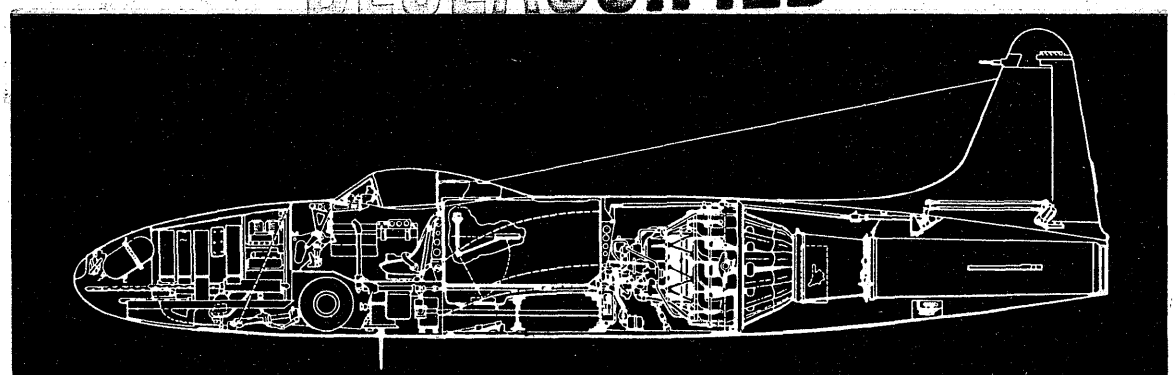
"While the Government has increased taxation on luxury and less essential articles, it has, at the same time, adopted the policy of giving subsidies to keep down the level of prices of food and other essential goods. The amount expended in subsidies for this purpose was £190,000,000 in 1943.

"Private saving (the savings of persons and businesses) have increased from £351,000,000 in 1938 to £1,749,000,000 in 1943. By far the greater part of this increase was accounted for by the rise in personal savings, which increased nearly ninefold between 1938 and 1943.

"Since the war began there has been an increase of about 10 per cent. in the total number of railway passenger journeys. To a considerable extent this rise has been caused by the increased travelling of members of the British forces and of the large number of American and other allied forces stationed in the United Kingdom. The number of passenger train miles is now 30 per cent. below the pre-war level, and the average load carried by passenger trains is 125 per cent. greater than before the war.

"The total number of private cars licensed has fallen from 2,000,000 in August, 1939, to 700,000 at the beginning of 1944, and their use has been restricted to essential purposes. The amount of motor spirit used for private cars is now only about one-eighth of what it was before the war. Considerable restrictions have been imposed on omnibus services.

"Out of about 13,000,000 houses in the United Kingdom at the outbreak of war 4,500,000 have been damaged by enemy action. Of these, 202,000 have been totally destroyed or damaged beyond repair. A substantial number of those seriously damaged are still unhabitable, and the great majority have not yet been fully repaired."



JET PROPULSION

WITH THE INCREASINGLY frequent appearance of ME 262 turbo-jet fighters over both the *Munich* area and Western Front, the announcement from *London* that Gloster Meteors have been in action for some time against flying bombs, and a recent release by *Washington* of advance details of the Bell P.59, it may be opportune to review briefly the course of progress in this new field of aircraft development.

For reasons of security, unfortunately, such a review must exclude all but slender reference to the important strides made in both experimental and production stages by Allied engineers. This aspect it is hoped to cover at a later date. In the meantime, much that is interesting can be found from a study of jet-unit development within the Luftwaffe.

Intelligence summaries have already given an indication of what is happening in *Germany* both on the ground and in the air. These appreciations have been supplemented by accounts of combats —revealing new tactics and startling performance figures—and by tentative details of enemy jet-propelled fighters obtained from captured documents, information given by prisoners of war, and reports on crashed aircraft. This advance intelligence, issued as it became available, has contained, necessarily, a number of statements since found to need modification. It has now been carefully revised and correlated, and, with certain additional notes, forms the basis of this survey.

The Principles of Jet-Propulsion

While all four heat engines—the steam engine, steam turbine, internal combustion engine and gas turbine—convert heat to power through the medium of expanding gasses, the former three rely also on the pressure of the gas against the cylinder head—this varying from approximately 100 lbs. per square inch in the internal combustion engine to 2,300 lbs. per square inch in the steam engine. In the gas turbine, however, energy is provided entirely by the force of expansion, the pressure rise (to only about 75 lbs. per square inch) being purely incidental.

The principle of the gas turbine—which is the principle of jet-propulsion—is fundamentally simple. Air is sucked into a container, compressed, and admitted to a combustion chamber where its oxygen combines with the hydrocarbons of a spray-injected petroleum fuel to produce a hot flame. At 1,000 deg. F. or more, the gas product of this combustion, now by virtue of expansion standing under considerable pressure, is passed at high speed through a venturi nozzle directed against the vanes of a turbine, the shaft of which, in the case of a gas turbine used as a prime mover, is coupled to the secondary mover.

It is in this detail—the *form* in which the energy is transferred—that lies the difference between the gas turbine and the jet-propulsion unit. The latter functions in exactly the same cycle of operations as regards air intake, compression and combustion of gasses, but employs the turbine wheel merely as a component of the machine to drive the impellor, and utilises the energy of the expanding gas, not, as with the gas turbine, to rotate a shaft, but—by process of exhausting this gas through a rear venturi—to produce a thrust, which, by equal and opposite reaction, provides the motive power normally supplied by an internal combustion engine.

The thermal efficiency (percentage of heat energy in the fuel converted into useful energy) of a simple gas turbine is 17 to 22 per cent., depending on operating-temperature and design. A recuperator utilising exhaust heat will raise

this figure to 27 per cent.; two compressors and an intercooler (a device for cooling the air after compression) will increase it to 28 to 30 per cent.; and the fitting of a re-heat combustion chamber and a second turbine will bring the figure up to 30 to 32 per cent. When metals can be developed to stand a temperature of 1,500 deg. or more, the thermal efficiency will be even higher.

With aircraft the importance of this is apparent—a power unit utilising its fuel to maximum efficiency offering the choice of improved performance through a decrease in weight or, alternatively, longer range without proportionate increase in fuel load.

Although all jet-propelled aircraft work on the same basic principle, they must be separated into two distinct classes—those powered by axial-flow turbo-jet units, which draw their oxygen from the atmosphere (the type referred to above), and those in which the oxygen is carried in liquid form within the fuselage or nacelle. In the case of the former, the maximum height capable of achievement will be approximately 67,000 ft.—beyond which level air becomes too thin for compression. For the latter, the limiting factor is entirely one of size—an aircraft with sufficient fuel (ethyl-alcohol and liquid oxygen) being capable, in theory, of flight to the moon.

Basic Types of Unit

As stated above, jet units are of two types—the liquid-rocket jet and the axial-flow turbo-jet. Both utilise the energy of expanding gasses, but differ from each other in mechanism and working. While the forms described below are typical and illustrative of the main characteristics, variations in detail, as with all other engines, will be found in the various units fitted to aircraft.

The mechanism of the rocket-jet unit as employed in the HS.293 glider bomb and the ME.163 fighter (see pages 110 and 117) is as follows. CO_2 at 150 atm. provides pressure to force the two working liquids, hydrogen peroxide and potassium permanganate into the combustion chamber, where initiation is by an explosive charge which punctures a diaphragm in the main air line. The pressure in the combustion chamber is estimated to be 30 atm., the temperature of the gasses prior to emission through the jet is probably about 1,200 deg. C., and the thrust produced thereby is of the order of 1,900 lbs. (N.B.—These figures are for HS.293. Figures for ME.163 not available). Endurance of the HS.293 unit is approximately eleven seconds, and that of the ME.163 unit approximately seven-ten minutes. (N.B.—The abnormally short endurance of these units as compared with other types of power unit may at first sight create a false and unfavourable impression as to their usefulness. It should be kept in mind that power output from a jet-propulsion unit is very high and concentrated, and that it is used only in short bursts—the aircraft or bomb depending in large part on gliding as a planned flight-condition).

By reason of the weight imposed through the necessity of carrying its own oxygen in the fuel, the liquid-rocket unit is of limited use for aircraft and in most types, including the ME.262 twin-unit fighter, the AR.234, the Gloster Meteor, the Bell P.59 and the Lockheed P.80, axial-flow turbo-jet pattern units are employed.

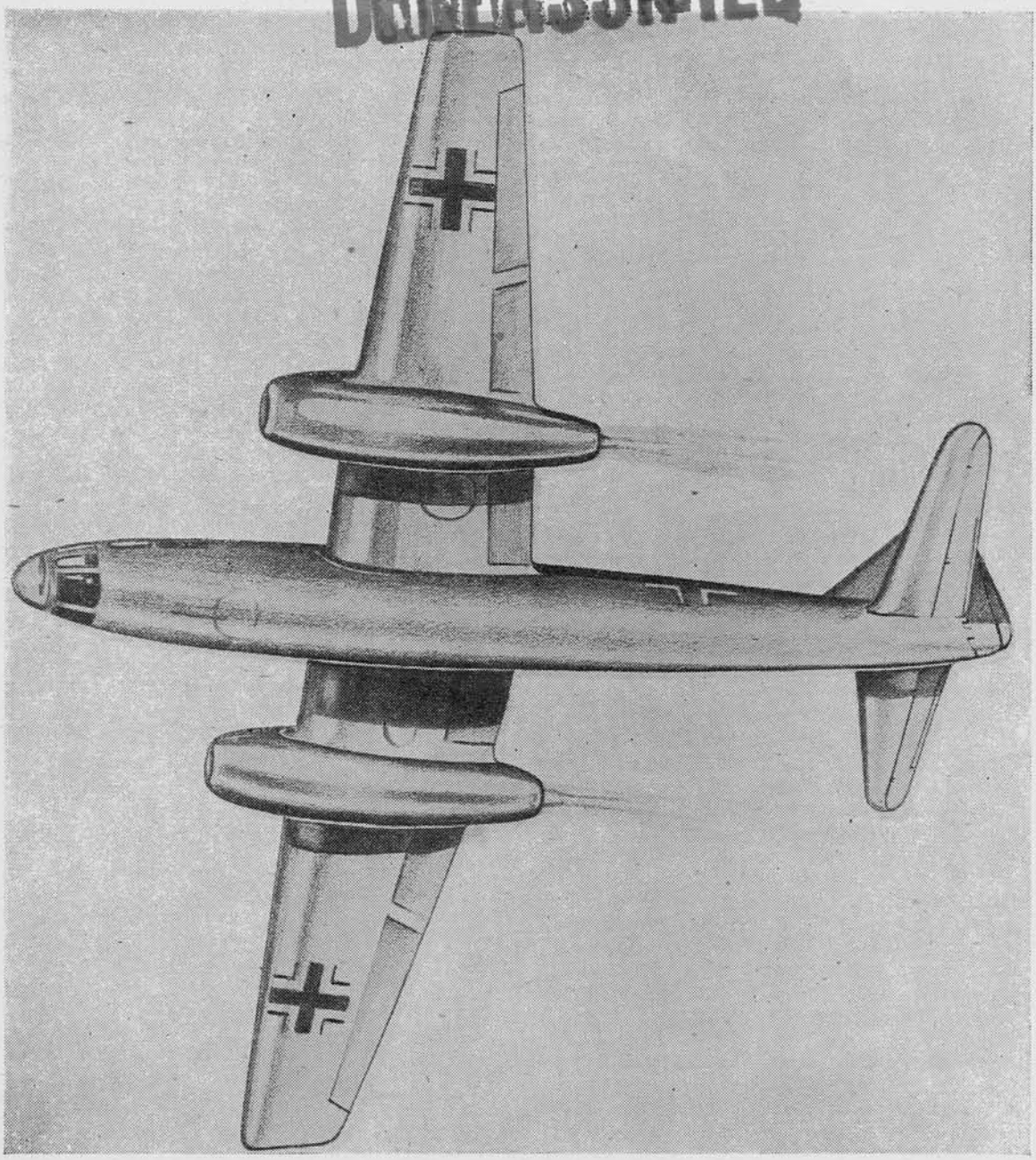
This type of unit has already been described in outline. It operates on diesel oil (or kerosene or low-grade petrol) and is normally set in motion by a small mobile gasolene engine or an electric motor that disengages when the jet-unit starts up. In the case of the ME.262, where the motors are Jumo. 004s, fuel is admitted to each combustion chamber between the eight-stage compressor and the turbine, and the power output is controlled by a streamline valve in the discharge venturi—the estimated maximum speed of the unit being approximately 8,700 R.P.M., the static sea-level thrust approximately 1,950 lbs. and the fuel consumption approximately 440/500 gallons per unit per hour at sea-level.

Four Fuels Employed

The rocket-jet unit installed in the A.4 Long Range Rocket (see page 121) employs four fuels—two main and two subsidiary for driving the turbine—and is contained entirely within the shell casing of the projectile. It works on the bi-liquid principle, whereby ethyl-alcohol and liquid oxygen are combined to produce a high-temperature gas, the gas being exhausted through a venturi in the tail. Components are containers for each fuel (the alcohol tank insulated against freezing), turbine-driven centrifugal pumps for transferring the fuels from tanks to combustion chamber, and a steel venturi closed at the combustion end by a battery of burner cups. As the rate of transfer is very high, both containers are pressurised—the alcohol tank by nitrogen from bottles, and the oxygen tank by a quantity of oxygen by-passed through a heat exchanger and returned in the form of gas. The turbine driving the pumps is operated normally by an independent power unit, using as fuel (possibly) hydrogen peroxide and potassium permanganate solution (see note above on HS.293 and ME.163 units). To combat excessive heat build-up and transfer in the combustion chamber and venturi, this element is double-walled for liquid cooling over the greater part of its length.

In operation, oxygen is passed by pipe line to sprayer roses in each of the burner cups, while alcohol is fed in similar manner to jets in the walls of the cups. The combination of these liquids produces a great quantity of hot gas which, developing considerable pressure through expansion, is exhausted, under control, through a venturi.

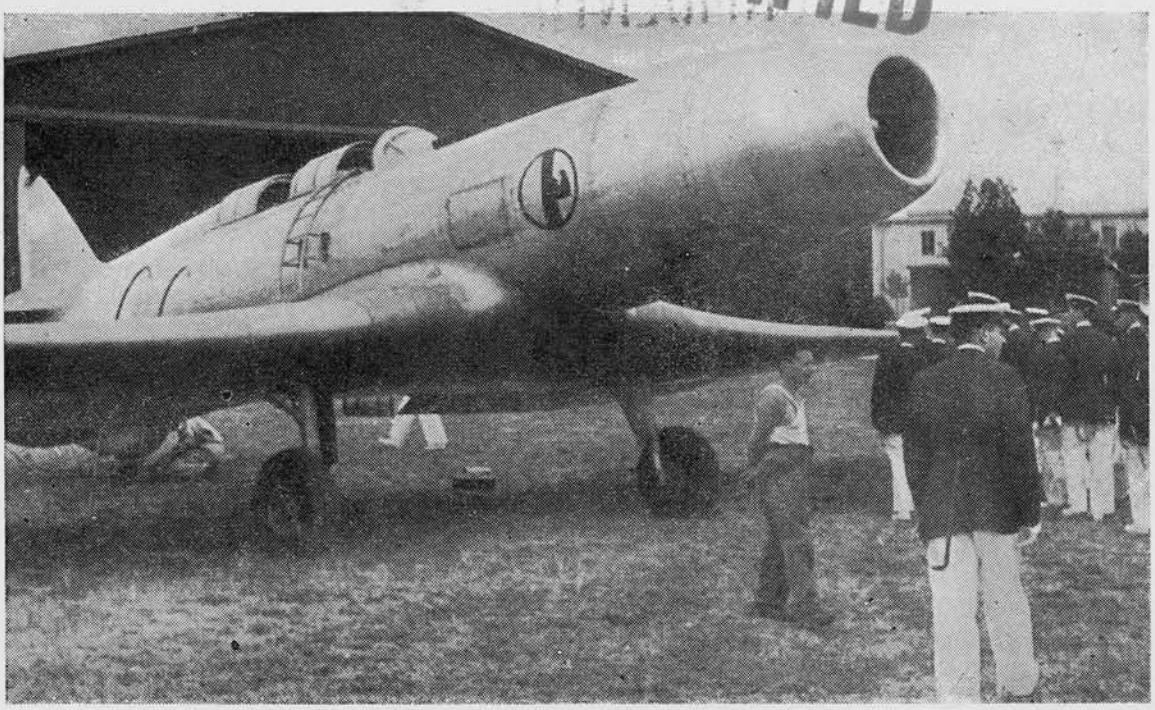
A further variation in jet-propulsion practice is seen in the FZG.76 Flying Bomb, where the power unit consists of a new form of athodyd (impulse-duct engine) surmounted on the fuselage of the bomb. This unit comprises a metal shell, the front containing a rectangular grille incorporating twelve jets and an arrangement of shutters, which close when the pressure inside



Ar. 234. *First seen in the air on* 21*st November,* 1944. *Probably in limited production.*

the shell is greater than that in front of the grille and open when the reverse condition obtains. The jets, disposed in three rows, project into the combustion ends of three venturi tubes, and the charge is ignited by a sparking plug placed approximately 16 ins. to the rear of the grille. Fuel tanks of 150 gallons capacity are carried within the bomb fuselage, together with two wirebound spherical bottles containing compressed air for forcing the fuel up into the combustion chamber.

In operation, a charge of air is admitted by the grille, fuel is forced through the induction pipe and jets, and combustion takes place by electrical ignition. The rise of pressure inside the chamber closes the spring leaves behind the grille, and the expanding gasses expel through the venturi. As the pressure in the combustion



This Caproni "Campini" flew 168 miles in December, 1941.

chamber falls and the shutters open, a fresh charge of air is admitted and the cycle repeated.

The unit operates intermittently in conformity with the opening and closing of the shutters. and produces a noise reminiscent of a single-cylinder motor-cycle engine running slowly. Fuel supply is continuous but fluctuating, being regulated to maintain correct mixture for variations in forward speed and altitude. Ignition during flight is caused by the hot or flaming residue of gas remaining in the duct.

Early Development in Italy

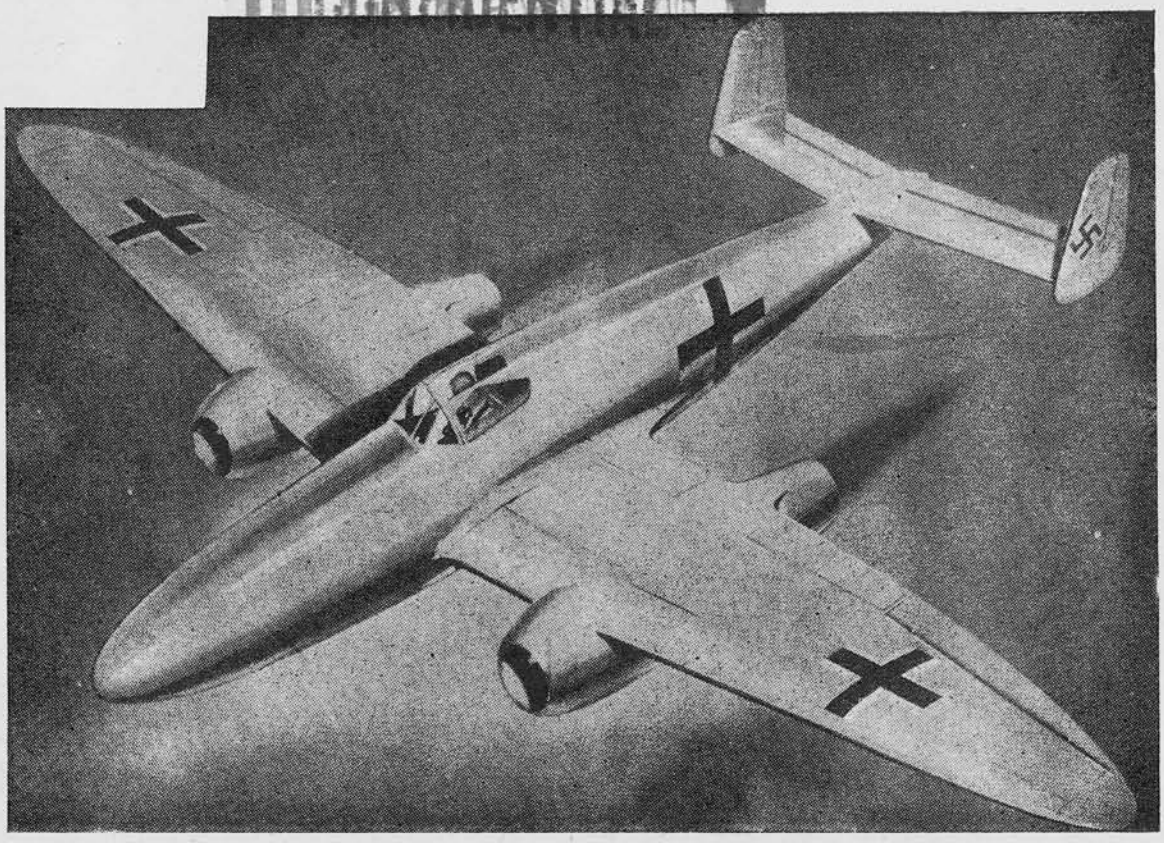
To attempt an historical survey of jet-propulsion development would call for considerably more data than is at present available. The following review, therefore, offers not a comprehensive record, but a resumé of miscellaneous information, presented, so far as is practicable, in chronological order. That details covering the early period are somewhat threadbare and disjointed is acknowledged. The facts available were few, and in most cases of little more than tertiary interest. Of late, however, the straw has been more plentiful and of richer quality. It is hoped that such account as is given of more recent events will, in measure, compensate for the frugality of the opening chapter.

First in the field of jet-propulsion was the all-metal Caproni Campini, produced in *Italy* some time before the war and illustrated above. This aircraft, a low-wing monoplane conventional in appearance but for absence of airscrew and the unusually large cross section of the fuselage at the rear, was powered by a composite unit in which drive for the impellor of the turbo-jet element was supplied by a small internal combustion engine. Figures of performance are conflicting, but the most reliable reports give the maximum speed as approximately 445 m.p.h.

This is probably the only jet-aircraft to reach production stage in *Italy*; certainly no Italian jet-propelled fighters have appeared and, so far as is known, this form of power unit has not been adopted for heavier aircraft.

Progress Made by Germany

Germany, on the other hand, concentrating increasingly on jet-development for something over three years, has made considerable progress, and is now operating at least three types of fighter, in addition to the FZG.76 Flying Bomb, the A.4 Long-range Rocket, and a jet-unit for assisted take-off. The well-known aeronautical authority and last war ace-pilot, Ernst Udet—a power in R.L.M. (German Air Ministry) before his death—sponsored the movement and guided its policy, and all the principal manufacturers, with Messerschmitt in the lead, have aircraft in experimental and/or production stages. Messerschmitt design has been administered by the glider expert, Dr. Lippitsch, and that of Henschel by the direktor, Dr. Henschel. Heinkels for their preliminary research went to the fountain head and engaged Campini himself. Among the leading pilots employed on early testing were



Heinkel 280. *Production of these aircraft, undertaken at Vienna Schwechat, was suspended after the Allied air offensive against German fighter production.*

Hauptmann Wolfgang Spate (a fighter ace and Staffelkapitan in J.G.54) and the famous woman Flugkapitan, Hanna Reitsch—who flew the prototype HE.280 over a year ago.

The operational exploitation of jet-propulsion by *Germany* falls conveniently into three stages. The first dates from the introduction in summer, 1943, of the HS.293 radio-controlled glider bomb —a miniature pilotless aircraft incorporating a 600 kg. bomb, launched from a carrier fixed to the underside of a DO.217 mainplane. This—the first jet-propelled aircraft to be used operationally —was the parent and forerunner of the FZG Flying Bomb, also a pilotless miniature aircraft but one now powered by an improved-type unit utilising atmospheric oxygen and capable of considerably longer endurance.

Flying bombs, as is all too well known, were originally launched against *Southern England* from static platforms sited along a wide length of coast centred on the *Pas de Calais,* and possessed a range of approximately 150 miles. They disclosed marked progress both in the development of jet-units and in their adaptation to aircraft practice, and have led, logically, to the final stage—the introduction of full-size pilot-controlled fighters, capable of outstanding speed and climb, and, when equipped with fuels containing their own oxygen, of revolutionary performance at high altitude.

Rockets, assisted take-off units, and units provided as complementary to internal combustion engines, although important, represent ancillary development and do not mark definite progress stages. Reference to their characteristics and functions is made later.

First Application to Aircraft

The early research and experimental work for the HS.293 jet-propelled radio-controlled glider bomb—stated to be a development, by Dr. Wagner, of a French invention made at *Bensançon*—was undertaken in 1941-1942 by a unit known as E and L Kdo. This unit, based at *Garz* (island of *Usedom,* Baltic Sea) and equipped with DO.217Es, merged later into II/KG.100 and moved in spring, 1943, to *Istres le Tube,* near *Marseilles,* for attacks on Western Mediterranean convoys, and then to *Cognac,* north of *Bordeaux,* for operations in the *Bay of Biscay.*

While no complete specimen of this glider bomb has fallen into Allied hands, sufficient fragments have been recovered for a fair description to be furnished.

The HS.293 is a minature all-metal mid-wing monoplane with a span of 10 ft. 3 ins. and an

overall length of 12 ft. 4 ins. Five feet of the front section of the fuselage comprise a warhead containing a normal Rheinmetall impact fuse and a filling of Amatol or Trialen: the rear portion is hollow and houses a stabilising gyro, a self-destruction device, and the radio-control unit. The power element—a bi-liquid rocket type jet-propulsion unit, as described earlier—is fitted in a sheet-alloy shell suspended below the fuselage, and comes automatically into action when the glider is released from its carrier under the mainplane—control thereafter being by radio from the parent aircraft.

For strikes against shipping at sea and in harbour—the only use to which this weapon has been put, and where, in the Mediterranean, it was normally employed against escort vessels (leaving the JU.88s accompanying the DO.217s to attack the merchant ships with torpedoes)—the bomb was usually released with the DO.217 in level flight, distant three to five miles from the target and at altitude 3,000 to 5,000 ft. Observers report that launching was made not directly at the ship, but when the parent aircraft was flying on a parallel course—thereafter the bomb being turned in towards the target, aiming by eye alone. It is reasonably established that the HS.293 was released at 200 m.p.h. and climbed rapidly, drawing away from the DO.217 during the period in which the thrust was acting and thus coming up into the bomb-aimer's vision. Reaching a speed of approximately 350 to 400 m.p.h. by the time fuel was expanded and thrust cut off, the bomb assumed a steady glide of around 23 deg., flattened out on approaching its target, and finished its flight at approximately 250 m.p.h.

Used regularly in convoy attacks and against invasion shipping off *Salerno* and *Anzio*, this weapon, although causing some sinkings and damage, has not proved formidable. The main drawback seems to have been the difficulty presented to the bomb-aimer in lining up from a moving aircraft. Other explanations offered by prisoners of war indicate trouble with directing mechanism, inefficient assembly, and failures due to humidity entering "loaded" cases in storage.

The FZG.76 Flying Bomb

The FZG.76 Flying Bomb, product of the *Peenemunde* Research Station and successor to the HS.293 glider bomb, made its operational debut on 13th June, 1944, when, shortly after dawn, the first of a series of long anticipated attacks was launched against *Greater London*. It was on small scale, and only four missiles were subsequently located. Although each had exploded, sufficient fragments remained for scientists to assemble a fair description of the weapon and an estimate of its capabilities. This early picture has since been elaborated and modified as a result of fuller examinations, and is now comprehensive.

Apart from the extreme nose and control surfaces which are of light metal, the structure of the FZG.76 Flying Bomb is entirely of steel. Construction is robust, and the design has been simplified for ease of production. The fuselage is of sections bolted together, the centre bay holding two spherical compressed air bottles of 1 ft. 9 ins. diameter and a fuel tank of 150 gallons, the front section enclosing the warhead and magnetic compass, and the rear compartment housing the automatic pilot, gyros, and servo mechanism for operating the control surfaces. The jet-propulsion unit, of the aerothermodynamic duct pattern (impulse-duct engine), following a Schmidt patent of 1943 (described earlier), is contained in a sheet-metal shell, 11 ft. 3 ins. long, surmounted on the rear-half of the fuselage. Two models, distinguishable only in size, have been identified. One has a tapered mainplane of 16 ft. span, the other a wing of parallel chord with squared tips and a span of 17 ft. 6 ins. The smaller model, 25 ft. 4 ins. long overall, carries a warhead comparable in weight and blast effect to the SB.1,000 kg. bomb.

Control of the weapon in flight is effected solely by an automatic pilot monitered by a magnetic compass housed in the nose. The master gyro is caged during the initial acceleration and released automatically as the flying bomb leaves the launching ramp. When the bomb has climbed to a pre-determined height, a barometric capsule, through a servo motor, tilts the mounting of the main gyro gimbol and sets the automatic pilot for level flight—the duration of which is controlled by an air-log.

After the pre-set mileage has been travelled, detonators fired by the air-log unit free a spring-loaded lever on the tail which instantaneously locks the elevators, operates a guillotine to sever the pick-up pipes and lock the rudder, and releases catches to deflect two spoilers below the tail plane, causing the bomb to dive.

While performance figures are very conflicting, well authenticated reports indicate that the true air-speed may be approximately 350 to 400 m.p.h. and the normal operational height about 2,300 ft.

During a period of 80 days systematic bombardment of *Southern England*, the enemy launched more than 8,000 of these bombs, of which approximately 2,300 reached the *Greater London* area. In the first week of the attack about 33 per cent. were intercepted and 35 per cent. found their target; by the end of two and a half months some 70 per cent. of bombs were being shot down and only 9 per cent. getting through the combined defences. On 28th August, 1944, out of 101 bombs which approached the *South Coast*, four only reached *London* and 97 were destroyed. Of the total accounted for over the period, fighters claimed no fewer than 1,900.

Jet-Fighters in Production

Although there is a dearth of information concerning the early development of Messerschmitt jet-fighters, prisoners report experimental work at *Augsburg* as far back as 1940, and have

Provisional Drawing of the ME.262 in flight.

given descriptions of a tailless aircraft, referred to as "Die Motte" (Moth), seen at *Peenemunde* in the spring of 1943. There is evidence also that Eprobungskommando 262, a unit engaged in the perfecting of the ME.262 and in the training of pilots to fly it, was stationed at *Lechfeld* during the early part of 1944.

The "Motte" is now known to be the ME.163, and the P/W who saw it at *Peenemunde* stated that the aircraft jettisoned its wheels after take-off, climbed rapidly at a steep angle, and landed, after a gentle glide, on skids.

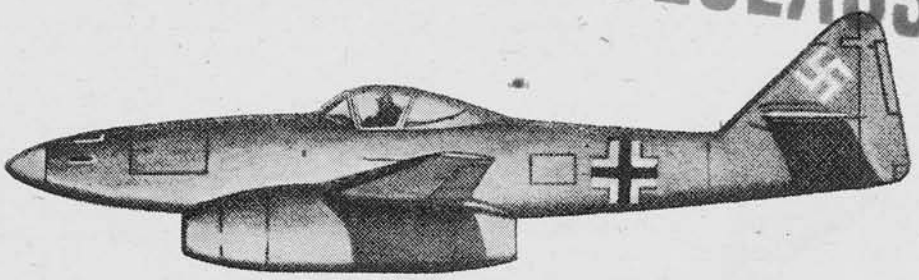
ME.163s, identified at *Zwischenahn* in April, 1944, have appeared recently at *Lechfeld, Jesau, Zwischenahn* and *Wittmundhafen.* Preparations for the operation of these aircraft—the clue to which appears to be a group of five small buildings that apparently play a specialised part in the servicing of the aircraft—have also been observed at *Oranienburg, Brandenburg, Parchim, Ardorf* and other airfields. The first sighting of an ME.163 in the air was by an Eighth Air Force B.17 crew on 25th April, 1944. The enemy kept his distance and there was no combat.

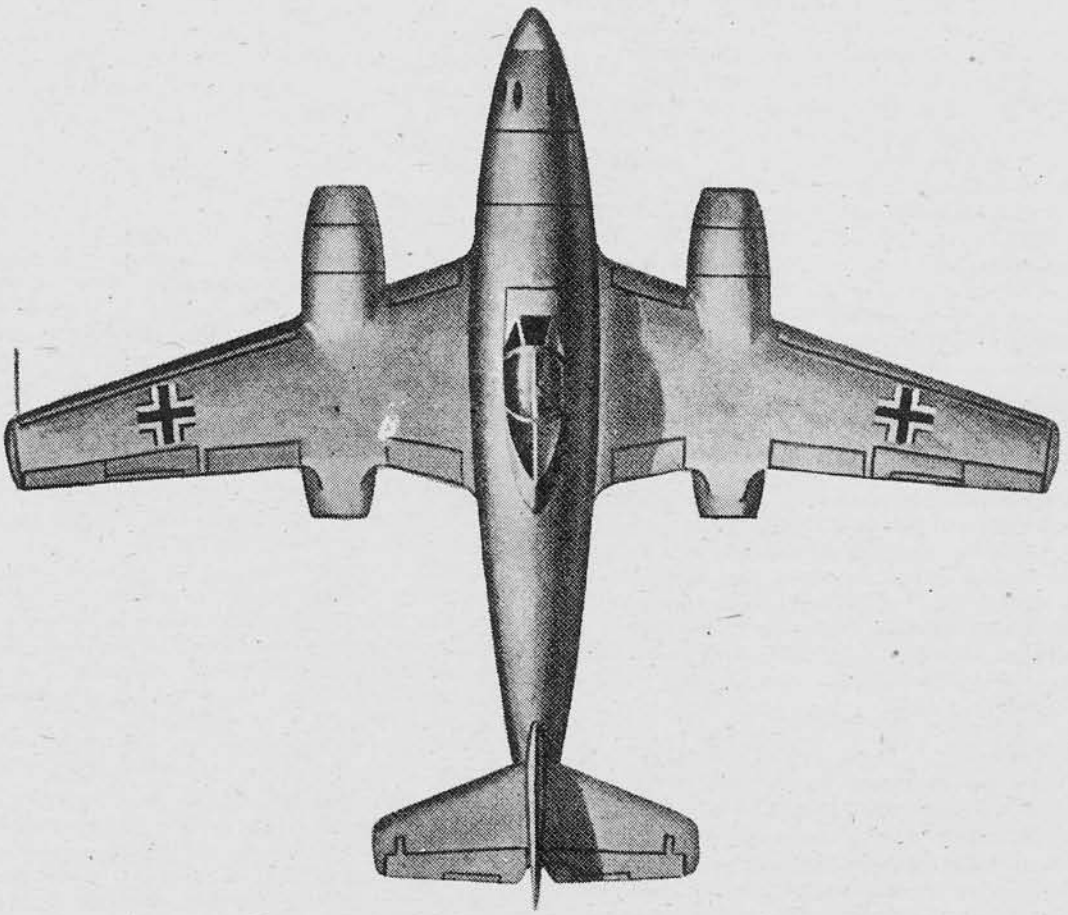
Details of the activity at *Lechfeld,* some of which have since been confirmed, indicate that this was a base for advanced training for the ME.262, and that pilots before handling the new jet-fighter were given dual on ME.110s and ME.410s. An early statement on the ME.262 described the take-off and landing speed as about 150 m.p.h. the maximum speed at 15,000 ft. as approximately 500 m.p.h., and the rate of climb as five minutes to 30,000 ft. Recent combat reports indicate that the figures quoted for this aircraft and for the ME.163 do not exaggerate their performance.

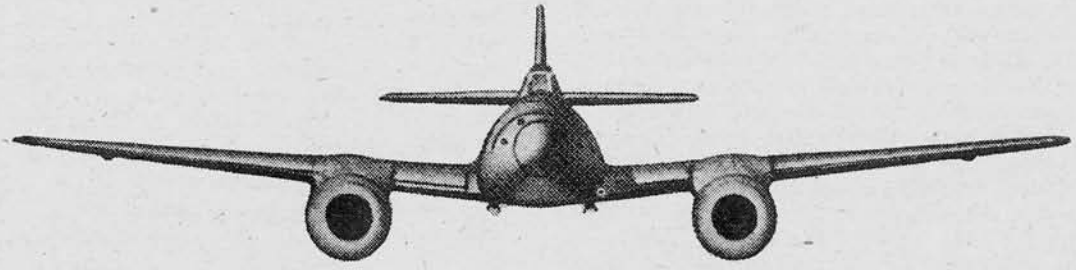
The ME.262, first identified on the ground at *Schwabisch-Hall* on 25th June, 1944, and seen recently in numbers at *Leipham, Augsburg, Kitzingen, Lechfeld, Neuburg* and *Rechlin Larz,* was first met in combat one month later; since which date these aircraft have been increasingly active on both the Western Front and in the *Munich* area. An account of one engagement with a Mosquito follows the detail description of the ME.262 given below.

Production of the ME.262, standing in January, 1944, at approximately 100/150 aircraft per month, may be expected to reach 300/500 a month in the near future; these figures are of notable importance in view of the increasing oil shortage in *Germany.*

In addition to the Messerschmitt programme, Heinkels have two jet-propelled aircraft in the







ME 262

field, the HE.280 and the Heinkel "T." Although *Schwechat (Vienna)* was the scene of considerable HE.280 activity for some time, neither of these aircraft has yet been encountered. Arados have one model, the AR.234, with a speed of approximately 450 to 500 m.p.h., the first of which was seen by an Eighth Air Force formation on 21st November, 1944; Dorniers are known to be busy with jet-propulsion at their *Lowenthal* factory; and another jet-aircraft, provisionally designated the "66," has been seen recently at *Rechlin*.

Development of Airfields

It is apparent that very large airfields are necessary for the ME.262 and ME.163, runways of the minimum length of 2,000 yds. with good approaches being essential. These requirements are an embarrassment to *Germany*, where airfields within the country have been rarely used for basing operational units and where little has been done until recently to improve the G.A.F. stations of 1939.

Reference was made above to certain airfields already identified as associated with the ME.262 and ME.163. To these lists can be added *Giebelstadt, Holn, Hapsten, Lubek Blankensee* and *Muhldorf* in *Germany* itself; *Aalborg, Grove, Skrydatrup, Tiratrup* and *Vandel* in *Denmark;* and *Eggemoen* and *Haslemoen* in *Norway*. These do not constitute the whole. The most striking lengths yet observed are 3,360 yds. at *Hapsten* and 3,250 yds. at *Lechfeld*. The normal average appears to be around 2,200 yds.

From the location of these improved bases it is clear that the enemy is mainly concerned with forming a line of airfields from which jet-fighters can attempt to shut the door to bomber forces routed between *Holland* and *Norway*. At present somewhat less effort is being concentrated in *Southern Germany*, where defence seems to be centred on *Giebelstadt, Schwabisch-Hall, Neuburg, Lechfeld* and *Muhldorf*.

The ME.262 Turbo-Jet Fighter

The ME.262 is given priority in description because it has been seen in the greatest numbers, and appears, up to the moment, to be the enemy's foremost jet-fighter and ground-attack aircraft.

Capture intelligence and statements by prisoners of war describe the ME.262 as a single-seat all-metal mid-wing monoplane of conventional appearance and high finish. It is said to be 34 ft. 9 ins. long, with a single fin and rudder and swept-back square-tipped mainplanes of 41 ft. span, incorporating twin underslung nacelles. Weight and wing-loading are mentioned as approximately 10,000 lbs. and 44.5 lbs. per square foot respectively. The undercarriage, of the retractable tricycle pattern, has short oleo-legs giving minimum clearance when the aircraft is on the ground.

Propulsion is by two Junkers TL axial-flow power units (Jumo 004s), the turbines of which are set in motion by small two-stroke gasolene engines mounted at the front of the motor assemblies. Four self-sealing tanks, containing approximately 400 gallons diesel oil, are installed under and behind the pilot's seat. (N.B.—Additional tankage in the rear part of the fuselage and under the pilot's feet provides a further 180 gallons).

While reported performance figures vary considerably—527 m.p.h. was reached during early trials at *Augsburg*—cruising and maximum speeds may be of the order of 500 and 550-plus m.p.h. respectively. An estimated rate of climb of at least 5,000 ft. per minute at high altitude is probable.

It is interesting to note by comparison that the latest model FW.190 (DB.603 engine), with a wing loading of about 48.5 lbs. per square foot, has a maximum speed of approximately 450 m.p.h. at 23,000 ft. and needs approximately 15 minutes to reach 32,000 ft., while the American Mustang P.51 D (Packard V.1650 engine) has a speed of 437 m.p.h. at 30,000 ft. and needs thirteen minutes to reach this altitude.

Jet-Fighters in Action

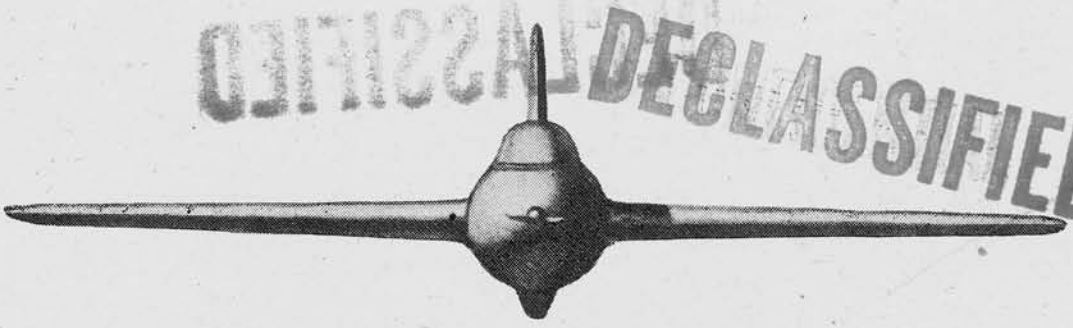
On 25th July, 1944, a P/R Mosquito operating from *Great Britain* was intercepted at 29,000 ft. over *Munich* by a twin-engined fighter believed to be a ME.262. The enemy outdistanced the reconnaissance aircraft and, in an engagement lasting fifteen minutes, delivered attacks at 800 yds. from both rear and below. He was then eluded and the Mosquito, suffering only slight damage, managed to cross the Alps and land in *Italy*.

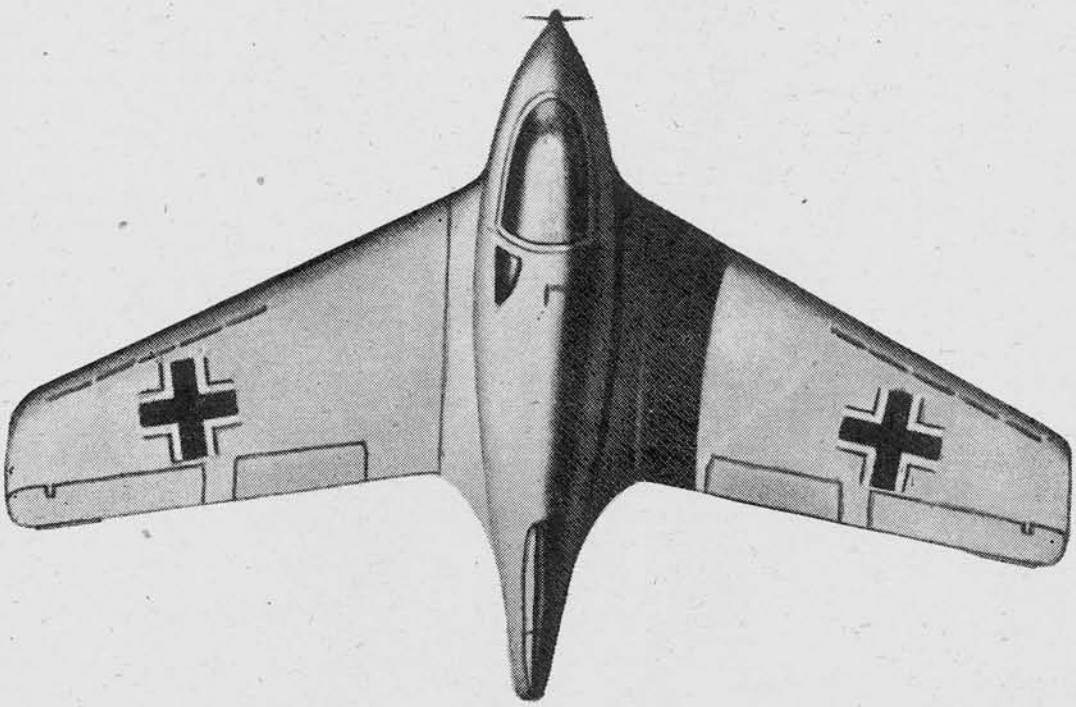
This engagement, the first reported with a jet-propelled aircraft, has since been followed by almost daily combats on the Western Front, by encounters by M.A.A.F. formations attacking industrial targets in *Southern Germany*, and by regular interceptions of aircraft on photo-reconnaissance in and around the *Munich* area. In connection with the latter missions, and as a sidelight on the importance of photographic cover of this sector, it is of interest to note that P/R Mosquitoes now fly with an escort of P.51s or P.38s.

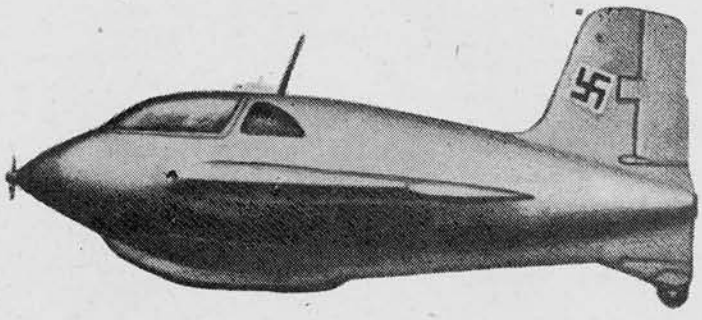
Although the ME.262 is considerably faster and superior in climb to the normal fighter at high altitude, it can be out-turned at any speed and out-climbed at low altitude. For evasive action, climbing turns and steep turns are recommended, while, at heights above 15,000 ft., the half-roll and steep dive has proved effective (the ME.262 cannot be dived at over 30 degs. due to structural limitations). It is also important to remember that the fuel consumption of the jet-fighter is abnormally high at sea-level, and that, for this reason, it is unlikely to continue any engagement at nought feet.

A Mosquito Meets an ME.262

From a wide selection of combat reports the following is chosen as possibly the most illuminating. It concerns a P/R Mosquito over *South Germany* on the afternoon of 15th August, 1944.



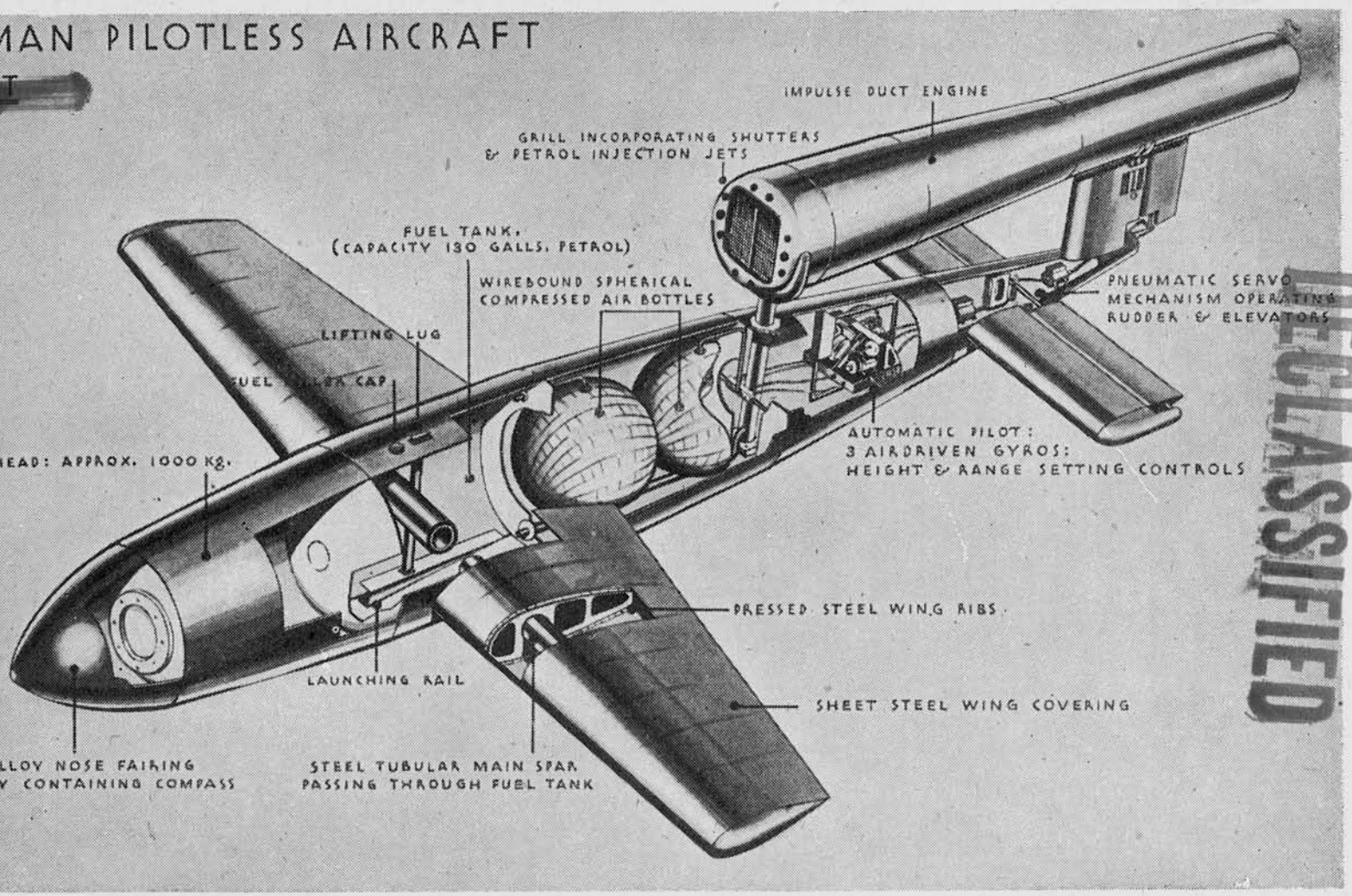




ME 163B

GERMAN PILOTLESS AIRCRAFT

SECRET



This Mosquito—on a mission to photograph *Gunzburg/Leipham* airfield—had an uneventful outward journey, covering the last leg at 30,000 ft. with indicated air-speed 220 m.p.h. On approaching the target the pilot checked all-clear on both sides and made a 90-deg. diving turn on to the aerodrome. He then levelled out for his photographic run, glanced up at the rear mirror —and saw an ME.262, 400 yds. astern and closing rapidly.

Spare tanks were jettisoned, engines given full boost and revs. and the aircraft put into a starboard turn ("Why? Because we usually do a port turn on to the target, and instinctively I thought the enemy would expect me to go that way"). Simultaneously the ME.262 opened up with 30 mm. cannon, hitting the *port* aileron and elevator and demolishing the protruding nacelle. The Mosquito, with throttles jammed and no portside control, started to spin—a semi-flat spin that became tighter and more rapid as the ground grew nearer.

At 19,000 ft., after trying conventional recovery tactics without success, the port pitch-lever was brought back and with this the spin slowed up. Stick and rudder did the rest and the aircraft came on to a level keel. The observer, pinned in the nose, crawled out and gave the I.A.S. in the spin as 420 (true air-speed 580 m.p.h.)—he also reported that the enemy was closing for a second attack.

Unable to take starboard evasive action or exceed 210 m.p.h., the pilot turned again to port—well inside the jet-fighter who tried to follow this manoeuvre but overshot by miles. That the Mosquito was unarmed—with anything but a camera it could have destroyed the ME.262 in the first attack—must now have been evident to the enemy, who came back eleven times (without scoring another hit!), making three attacks head-on, two from the quarter, two from the beam and four more from astern.

This engagement lasted forty minutes, and when eventually the Mosquito escaped into cloud —at 8,500 ft., after a last desperate attempt to ram the ME.262—it was over *Schwaz*, 90 miles from *Leipham*. Here the mountains are 8,000 ft. high. The altimeter *was* working, but most of the other instruments, including the artificial horizon, had by now become unserviceable.

The Mosquito made base. To use the pilot's words on entering the circuit: "Just give us two wheels and we'll be all right." The wish was not granted. The hydraulics had been shot away and the emergency system would not work —nor would the radio. There was only one thing for it—at 400 ft. switches were cut and the aircraft trimmed for a belly landing. Both the pilot and observer "stepped out." They reported that the Merlin engines had been at full-boost for two hours—the normal limit is five minutes—and, although a bit tired, had never missed a beat. Seven minutes petrol remained in the tanks.

The Liquid-Rocket ME.163

The ME.163 fighter, now known to be the Peenemunde 30 or "Die Motte" referred to in prisoner of war statements, is of futuristic appearence with a short bulbous "tear-drop" fuselage, sharply swept-back mainplanes, an abnormally high fin and no horizontal tail surfaces. In addition to the operational model designated the ME.163 B (length 20 ft., span 31 ft., root chord 9 ft.) there is a trainer, the ME.163 A, the span of which may be slightly wider. Both are powered by Walter liquid-rocket units, the trainer having a "cold" unit and emitting a dirty-white smoke, and the fighter employing a "hot" unit which produces greater thrust and emits a blue-tinged flame.

Take-off is normally effected under the aircraft's own power, but may be rocket assisted. Wheels are jettisoned after launching, and the landing made on a centre skid. A gas-driven turbine operates the fuel pumps, and in the fighter version a small propellor in the nose provides energy for generation of current to actuate the aircraft's instruments.

Maximum speed is 525 to 600 m.p.h. and the climb approximately 5,000 ft. per minute at sea-level and 10,000 ft. per minute at 40,000 ft. Endurance at full power, however, is only seven to ten minutes in spite of a fuel tankage stated to be 330 gallons (the reason for the bulbous fuselage). While this endurance may be extended to three-quarters of an hour by intermittent gliding (a planned flight condition and not one enforced), it offers an obvious limitation to the duties for which the aircraft can be employed.

The ME.163, first observed in the air on 25th April, 1944, is now met frequently over *Germany* by Eighth and Fifteenth Air Force bomber formations, and aircraft on photographic reconnaissance missions. It is easily recognised by its stubby deep fuselage and absence of tail—and by the abnormal length of its contrails—and has been reported by pilots as possessing beautiful lines, while appearing very manoeuvrable though somewhat unsteady in flight.

Gunners of one formation put the speed of one ME.163 encountered at 25,000 ft. as over 600 m.p.h. (true air-speed), and stated that it was impossible to track the aircraft with turrets or free guns. Others estimated the climbing angle of this ME.163 at 50 degs. and the rate of climb at this angle as 5,000 ft. per minute. In most engagements the enemy has started his attack in an engineless glide from above, come in from ahead or astern and gone away under power. Attacks so far have met with no conspicuous success and a number of ME.163s have been shot down. The best tactics against this aircraft are probably those already indicated for the ME.262.

Resumé of Other Types

While the two Messerschmitt models described above are the only jet-propelled fighters as yet seen in action, mention has been made of other

Provisional Drawing of the HE.219.

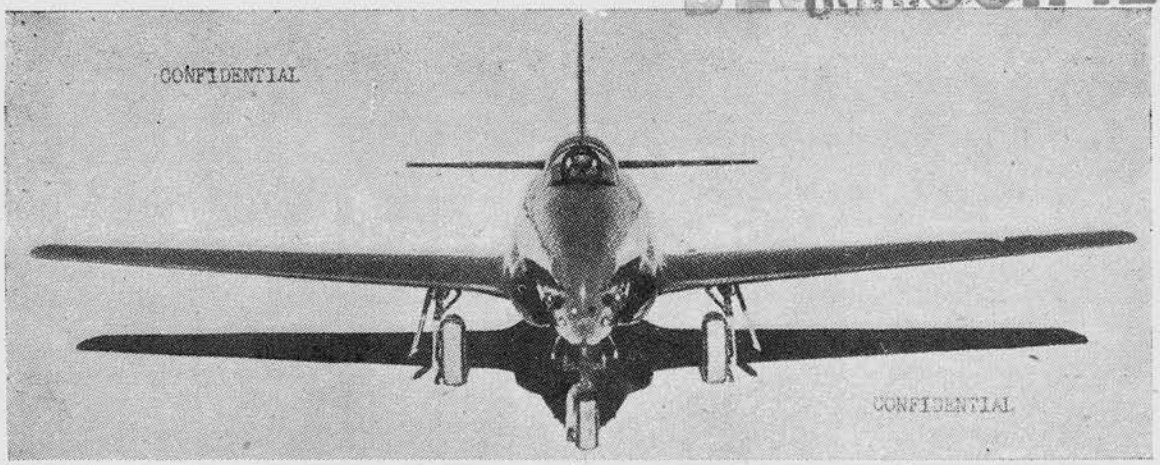
enemy jet-aircraft in experimental and production stages. Such details as are known are given below. They should be treated with considerable reserve.

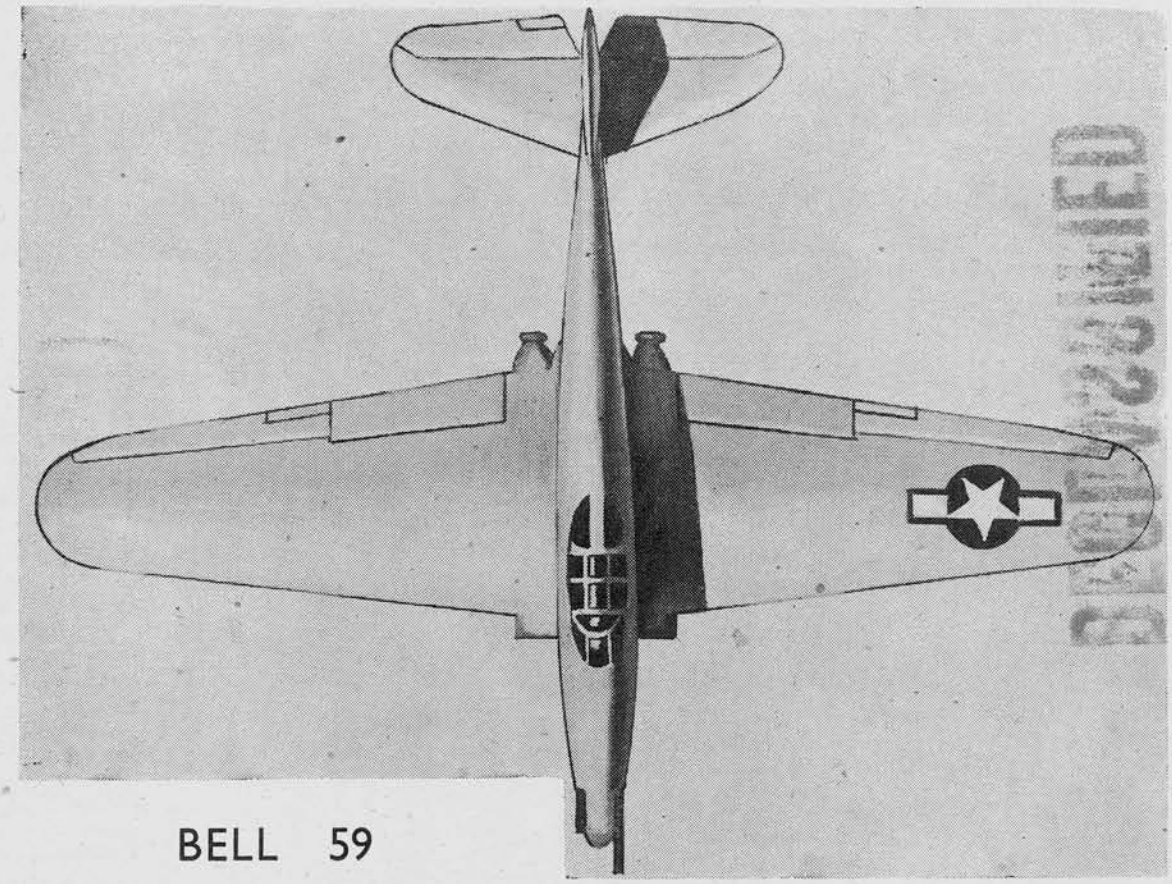
Many prisoners have spoken of the HE.280 and the Heinkel "T"—describing the former as a single-seat twin-ruddered mid-wing monoplane of conventional appearance, powered by two B.M.W. TL axial-flow units (B.M.W. 003s) and having a speed of approximately 500 m.p.h. at 30,000 ft., a rate of climb of 6,000 ft. per minute, and a ceiling of 47,000 ft.: and the latter as a low-wing monoplane with a barrel fuselage, low aspect-ratio mainplanes and a large tail, powered by a liquid-rocket unit and utilising skids in lieu of undercarriage for landing. According to recent information the HE.280 has been abandoned.

Another aircraft mentioned frequently is the AR.234. This fighter was seen by an Eighth Air Force Fighter Group during a mission on 21st November, 1944, but the enemy, though making a pass, did not join combat. It is described as a single-seat twin turbo-jet monoplane having a slim fuselage upswept to a high-set tail unit, high aspect-ratio mainplanes with pronounced taper on trailing edge, single fin and rudder and tricycle undercarriage. Length is 36 ft. to 38 ft. and wing span 45 ft. to 47 ft. Jet-units are stated to be B.M.W., presumably Type 003. Power output of these units is considered comparable with that of the Jumo.004s installed in the ME.262—viz.: sea-level static thrust approximately 1,950 lbs. per unit, and fuel consumption 1.25 lbs. per hour per lb. thrust. Take off is said to be rocket assisted and speed 400 to 500 m.p.h. at 13,000 to 16,000 ft.

Messerschmitt development, in addition to the ME.262 and ME.163, may include a fighter referred to as the Dusenjager Modell Regensburg (Jet-propelled fighter Regensburg model) and another single-seat aircraft designated the ME.328. The Regensburg was reported as about the same size as an ME.109, with a nose resembling the Italian Caproni Campini (indicating a turbo-jet power unit), a speed of 450 m.p.h. at optimum height and a ceiling of 40,000 ft. The ME.328 (the existence of which—actual or projected—has been confirmed from a captured document) is stated to be a single-seat metal aircraft of about 20 ft. span, possessing a maximum speed of 525 m.p.h. In September last, a good source mentioned this aircraft as in production by a firm called Neu-America near *Bressanone*. A suggestion has been ventured that the ME.328 may be employed as a ramming aircraft—there is no confirmation of this, but the very small span and reported low endurance lends credence to the idea.

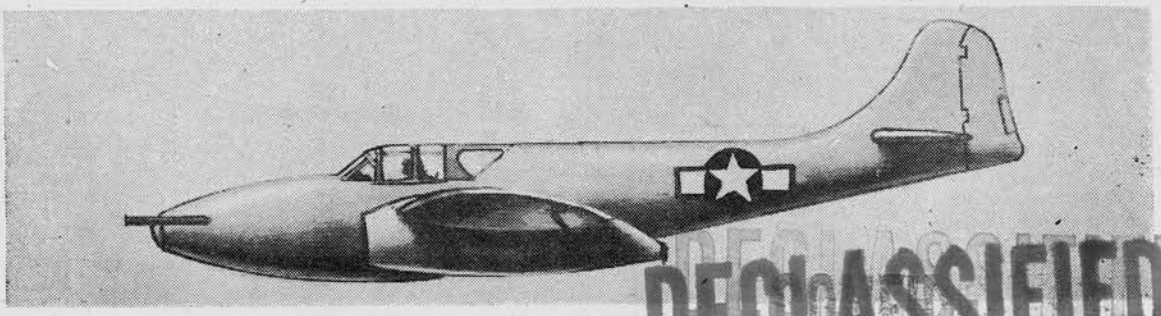
A recently interrogated prisoner, ex-employee at the *Vienna/Schwechat* Heinkel Factory, has provided details of another alleged development—the HE.343. This was described as a four-jet multi-seat mid-wing monoplane, with the tail unit set high in manner similar to the Westland



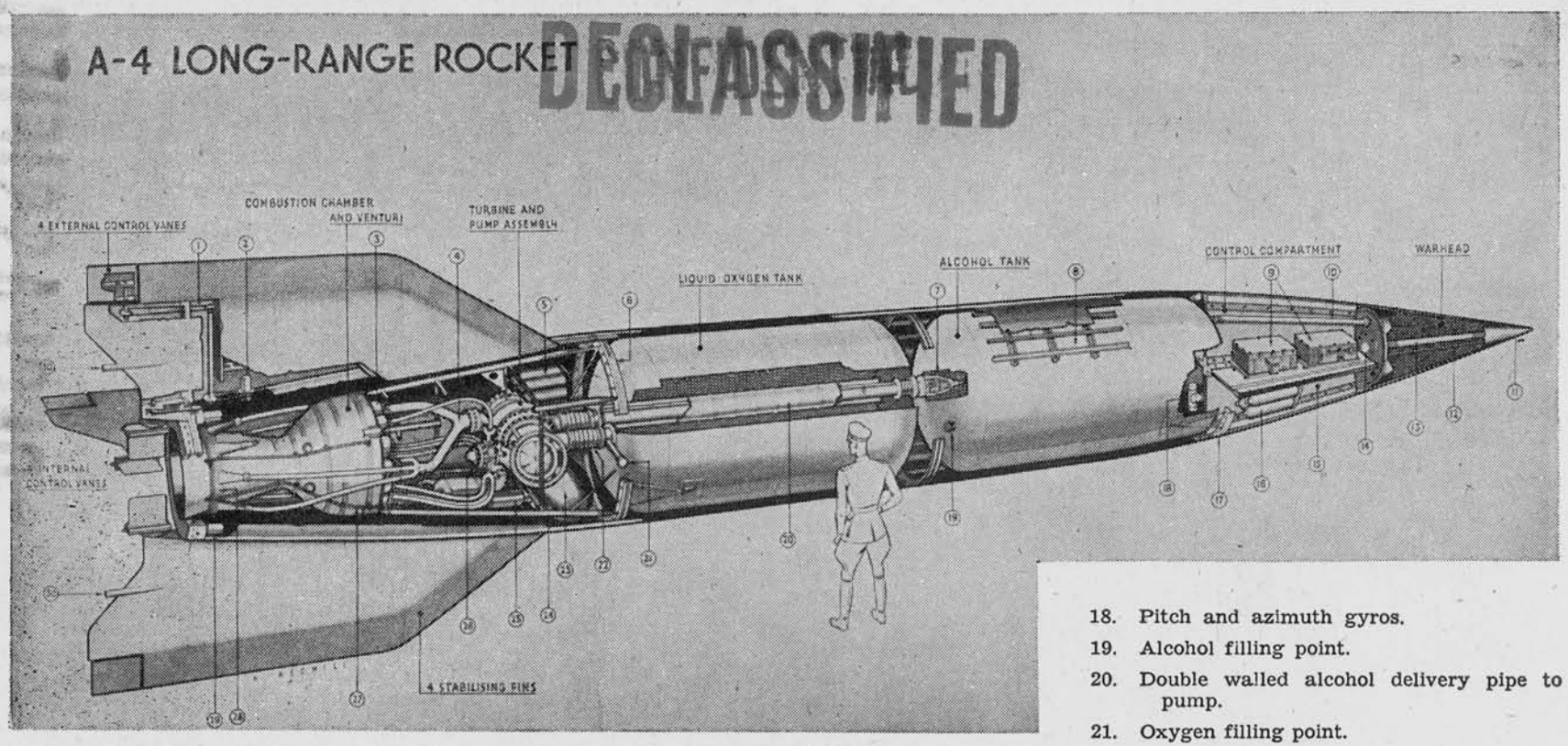


BELL 59

Now in active production in the United States



A-4 LONG-RANGE ROCKET



1. Chain drive to external control vanes.
2. Electric motor.
3. Burner cups.
4. Alcohol supply from pump.
5. Air bottles.
6. Rear joint ring and strong point for transport.
7. Servo-operated alcohol outlet valve.
8. Rocket shell construction.
9. Radio equipment.
10. Pipe leading from alcohol tank to warhead.
11. Nose probably fitted with nose switch, or other device for operating warhead fuze.
12. Conduit carrying wires to nose of warhead.
13. Central exploder tube.
14. Electric fuze for warhead.
15. Plywood frame.
16. Nitrogen bottles.
17. Front joint ring and strong point for transport.
18. Pitch and azimuth gyros.
19. Alcohol filling point.
20. Double walled alcohol delivery pipe to pump.
21. Oxygen filling point.
22. Concertina connections.
23. Hydrogen peroxide tank.
24. Tubular frame holding turbine and pump assembly.
25. Permanganate tank (gas generator unit behind this tank).
26. Oxygen distributor from pump.
27. Alcohol pipes for subsidiary cooling.
28. Alcohol inlet to double wall.
29. Electro-hydraulic servo motors.
30. Aerial leads.

Whirlwind. Two jet-units were reported as mounted under each mainplane, one at the centre of gravity and one forward of it. Apparently this aircraft—if existing—is in very early stage of development. Its length is stated to be about 54 ft. and its wing span slightly higher than this figure.

Like "a Tired Pigeon"

The only other report available comes from *Oranienburg,* and is of a small tailless machine with "tear-drop" fuselage and sharply swept-back mainplanes possessing such marked adhedral that the aircraft at rest, according to the informant, "bore the appearance of a tired pigeon."

Details of this aircraft—for which there is no confirmation—are particularly interesting. The fuselage, circular in cross section, has a maximum diameter of 5 ft. and a length of 11 ft. 6 ins., and the wing roots extend from immediately aft of the plastic nose to within a few inches of the rear end. Except for a large air-inlet duct, the nose is transparent plastic on all sides, while the rear end of the fuselage resembles a cylinder perforated by 25 circular holes.

Although provision is made for a pilot (to lay prone), the informant stated that this aircraft was always flown without one—remote control being from a mobile cabinet on the airfield. No details of launching or landing are available (the former is alleged to take place from a thirty-foot *vertical* metal track), nor is anything known as to performance.

Jet-Units for Supplementary Power

In addition to the use of jet-propulsion for primary power-units in aircraft, it is being adopted for other purposes—in particular to secure extra power for take-off, and to supplement internal combustion engines and thereby give increased speed and/or range to aircraft so provided.

From a number of assisted take-off sets examined, it appears that the apparatus comprises a bi-liquid rocket-type jet-unit (of the pattern used in the HS.293 glider bomb, and similar in principle to the power element of the ME.163) installed in a streamlined light-alloy nacelle. These units are attached to the underside of the aircraft's mainplane and jettisoned after take-off. To enable units to be safely landed and re-used, a self-opening parachute using a static line is incorporated. It has been known for some time that JU.88s have employed jettisonable rocket-units for take-off, control switches being a standard fitting in this aircraft.

Little information is available on supplementary units, although prisoners have stated that experiments to incorporate these in the ME.410, the DO.217 and the HE.219 are in progress. In the case of the ME.410 (two DB.603A2 engines) a turbo-jet unit is said to be fitted in the fuselage and to add approximately 100 m.p.h. to the speed, while with the DO.217 (two B.M.W 801A. engines) the unit is reported as fixed above the fuselage and used only after switching off the internal combustion engines when the aircraft has reached a suitable height. In the HE.219 (two DB.603s) the turbo-jet unit, about 20 ft. long and 3 ft. diameter, is contained in a nacelle below the fuselage at the crossing of the mainplanes. Static thrust at sea-level is estimated at approximately 3,000 lbs.

It is of interest to note in connection with the DO.217, that a further report states that trials were recently carried out at *Hoersching* with a new turbo-jet fighter mounted pick-a-back on the Dornier.

The A.4 Long-Range Rocket

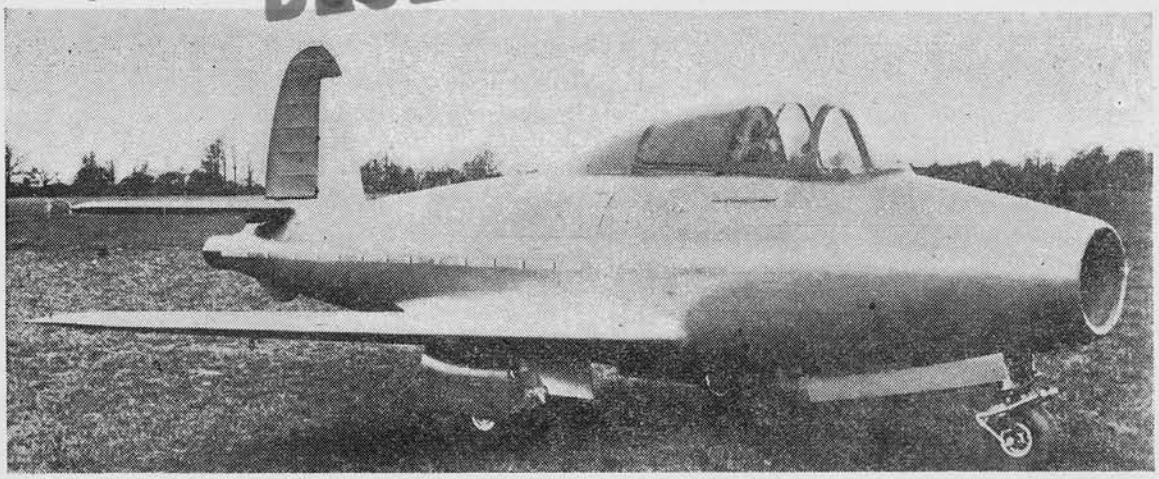
The information given above on jet-propulsion as applied to enemy fighters and take-off units, concludes the resumé so far as aircraft and aircraft ancillary equipment is concerned. One other important development has been seen—the long-range rocket.

Rumours of rockets of enormous dimensions became current towards the end of 1943, when prisoners of war spoke of experiments and trials at *Peenemunde, Luneburger Heide* and the island of *Rugen* with projectiles described vaguely as varying in weight from two to 80 tons. These weapons, reported to be radio-controlled, were alleged to climb almost vertically at comparatively low speed and emit orange flame and clouds of dark grey smoke. Rigid security was enforced at *Peenemunde* and great secrecy surrounded the trials. Crews operating the rockets were, it is stated, known as "Anti-terror Regimenter" (sic).

Best known as the V.2 from German propaganda attempts to picture it as a decisive weapon, the A.4 Long-range Rocket has been in use against *Southern England* since 8th September, 1944. From that date until 31st December, 1944, approximately 350 incidents have occurred in *England,* considerably more in *Belgium,* and a few in *Northern France, Holland* and *Luxembourg.*

The performance of this rocket is phenomenal. With a take-off weight of over twelve tons (of which eight and a half is fuel), it attains a maximum speed of about 5,000 ft. per *second* (3,400 m.p.h.), and after the power has been cut off follows a parabolic path rising to an altitude of between 60 and 70 miles.

For launching, the rocket stands in a vertical position with its four stabilizing fins orientated to conform with the desired azimuth bearing of the target. On ignition, it rises with increasing speed and is controlled for trajectory by a pitch gyro, the axis of which is continually changed through the rotation of a cylindrical drum operating a series of electrical contacts. In flight, the rocket is held on course by an azimuth gyro and governed for range by an integrating accelerometer which not only cuts off the fuel when the correct velocity has been attained (this was done by radio-control in earlier models), but rectifies any time-errors consequent upon a too-steep or too-flat trajectory.



Gloster Meteor—the first R.A.F. jet-propelled aircraft.

4,635 M.P.H. Theoretically Possible

Rockets fired against *England* to date have shown an average range of about 190 miles, the maximum so far being 220 miles. While the velocity of these rockets at fuel cut-off point has been calculated as approximately 5,100 ft. per second (vertical angle of inclination to horizontal at this point being 33 to 39 deg.) a velocity of 6,800 ft. per second (4,635 m.p.h.) is theoretically possible, which, using the optimum angle of 41 deg., would give a range of about 340 miles.

During descent through the atmosphere, resistance slows the speed of the rocket to about 2,500 ft. per second (1,700 m.p.h.) and in the process builds up considerable heat. Although in 25 per cent. of the incidents reported the rocket has disintegrated in the air, possibly due to over-heating, it is of no consequence as the warhead falls intact and explodes in a normal manner.

The A.4 Rocket is 45 ft. 10 ins. long and 5 ft. in diameter. It has a sharply pointed nose, four stabilising fins at the rear end, and in general, shape is fundamentally suited to its supersonic speed. The shell is constructed in much the same form as an aircraft fuselage, with an outer skin spot-welded and rivetted to circumferential formers and longitudinal stringers. In this shell, from front to rear, are a conical warhead (5 ft. 8 ins. long, weight 2,150 lbs., details unknown), a controls compartment (azimuth gyro, pitch gyro, integrating accelerometer, and instruments forming amplifying link between gyros and servo-motors operating control vanes), two main fuel tanks (7,610 lbs. ethyl alcohol and 10,930 lbs. liquid oxygen) and an auxilliary gas generator activating a turbine to drive two centrifugal pumps supplying the fuels to the combustion chamber. The control vanes are eight in number, four within the gas-flow of the venturi and four externally on the outer edges of the fins. A description of the general principle of the propulsion unit is given on page 107. This unit is estimated to produce a maximum thrust of 68,500 lbs. acting for 65 seconds, or with a by-pass in operation, a thrust of 30,000 lbs.

Allied Developments

The importance of the jet-fighter as an instrument of war, the enormous possibilities that the field offers, and the very obvious fact that with development in its bare infancy even a generalisation, seemingly harmless, may supply something to the enemy, is sufficient to make any apology for lack of statement on Allied plans redundant.

That Group Captain Frank Whittle, the leading British authority on jet-propulsion, has been actively engaged on experiments for more than twelve years is known. That the Gloster Meteor was flying in 1941, and has been used operationally with success, is also known. Beyond those facts, so far as *Great Britain* is concerned, silence must reign. On the other side of the Atlantic, the Americans have been busy and at least two manufacturers—Bell and Lockheed—have jet-aircraft in production. No details have been published nor should any be published. Until jet-development has passed from the experimental to the "mass-production off-the-line" stage the less said about *our* plans the better.

Special Operation Against The Brenner Route

CONTINUOUSLY FROM THE late summer of 1942—when the Middle East air forces successfully restricted Rommel's supply of his forward areas by sustained attacks on his lines of communication—a major commitment of the Allied air forces in the Mediterranean theatre has been the blitzing of the enemy's supply routes in order to deny him the power to wage offensive warfare.

The aerial attention paid to particular lines of communication, whether road, railway, sea or air routes, has varied according to the enemy's transportation facilities in the country in which the campaign was fought and the particular stage of the land battle. So far as the Italian campaign is concerned, the most constant air offensive has been necessary to maintain a state of interdiction on enemy-held railway routes; attacks on road and, to a lesser extent, sea communications have from time to time been on a heavy scale—particularly when defeats in the field have set enemy vehicles scurrying along the escape roads—but, in general, these attacks have been subsidiary to those against the railways.

Importance of Brenner Line

Kesselring's retreat from central to northern *Italy,* begun in June, 1944, implied a progressive shortening of his Italian lines of communication and attendant reduced difficulties of supply. By the autumn, when it became clear that the Germans were not going to be easily budged from the deep defence zones south of the *Po,* a clear pattern again became discernible in M.A.A.F's interdictory attacks designed to weaken the enemy's build-up. In general, the Strategic bombers concentrated on cutting the *Brenner, Tarvisio, Postumia* and *Piedicolle* railway routes into north-central and north-eastern *Italy* at their furthest points (the routes into the north-west had been lost to the Germans by the invasion of southern *France*); Tactical medium bombers aimed at creating an inner ring of interdiction on the above-mentioned routes somewhat further south; and both Tactical medium and fighter-bombers combined to cut bridges over the *Po* and railway communications further west.

So long as flying conditions were favourable—that is until mid-September—a satisfactory state of interdiction was maintained on all vital railway routes. With the deterioration of the weather in October, however, it was evident that constant interdiction, particularly on the frontier routes, was impracticable.

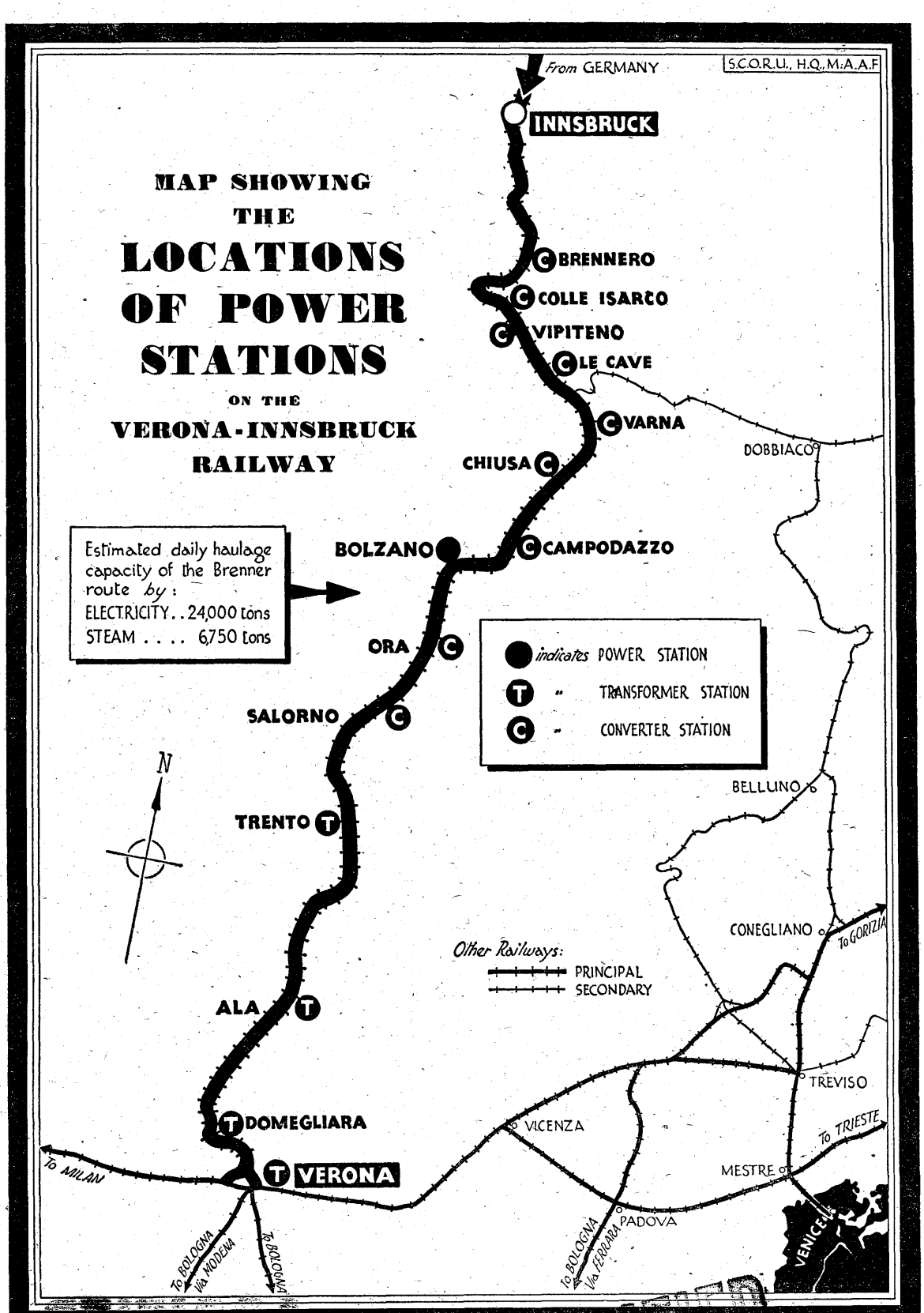
At the outset of the Italian campaign the *Brenner* line (*Innsbruck* to *Verona*) was credited with carrying half of the total rail traffic entering and leaving *Italy,* and, in particular, most strictly military supplies came in via this route. As the enemy's supply position deteriorated in southern *France* and the *Balkans* the importance of the *Brenner* line was correspondingly increased until the route became the all-important link in the enemy's supply system. The limiting of this railway traffic from *Austria* was, accordingly, one of the major tasks confronting the Allied Air Forces.

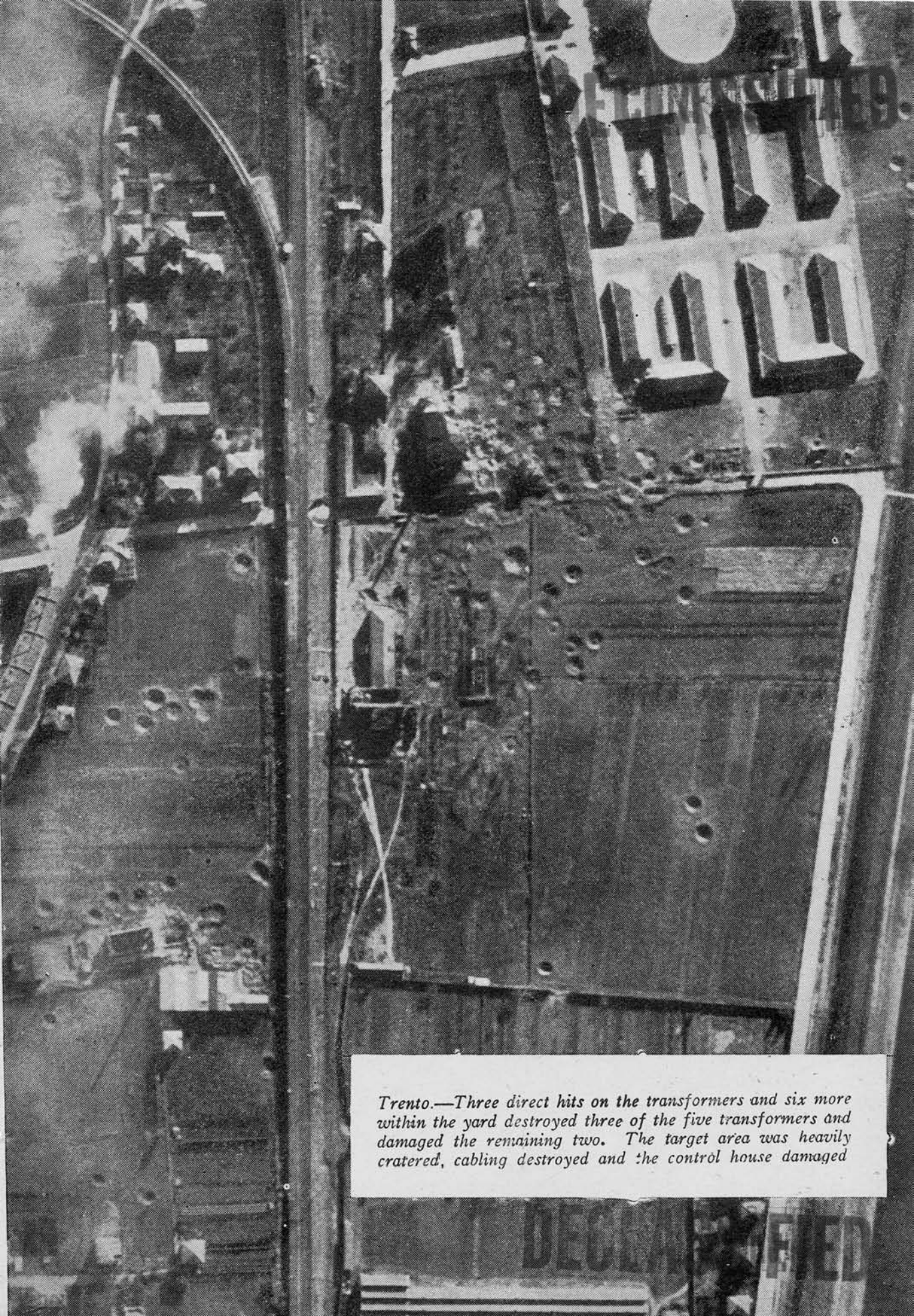
Even when good weather made successful air attacks on the *Brenner* line possible the curtailment of traffic achieved was often disappointing. The fewness of points vulnerable to air assault—principally bridges and viaducts—made it possible for the German engineers to concentrate bridging materials near all target sites and to repair even extensive damage in an astonishingly short time. Moreover, rail diversions had been constructed, or were in process of construction, around most of these vulnerable points. Repeated attacks were necessary, therefore, to maintain the interdiction for a sufficient space of time to have an appreciable effect on the enemy's accumulation of supplies and material. The approach of winter and inevitable bad weather meant that the necessary regularity of attacks could not be kept up.

The Higher Command now believed that the best hope of depleting the enemy's stock in his dumps south of the *Po* lay in devising a bombing programme which aimed at the permanent reduction of the capacity of the *Brenner* line, to be carried out in conjunction with the usual programme for establishing blocks.

The Electrified System

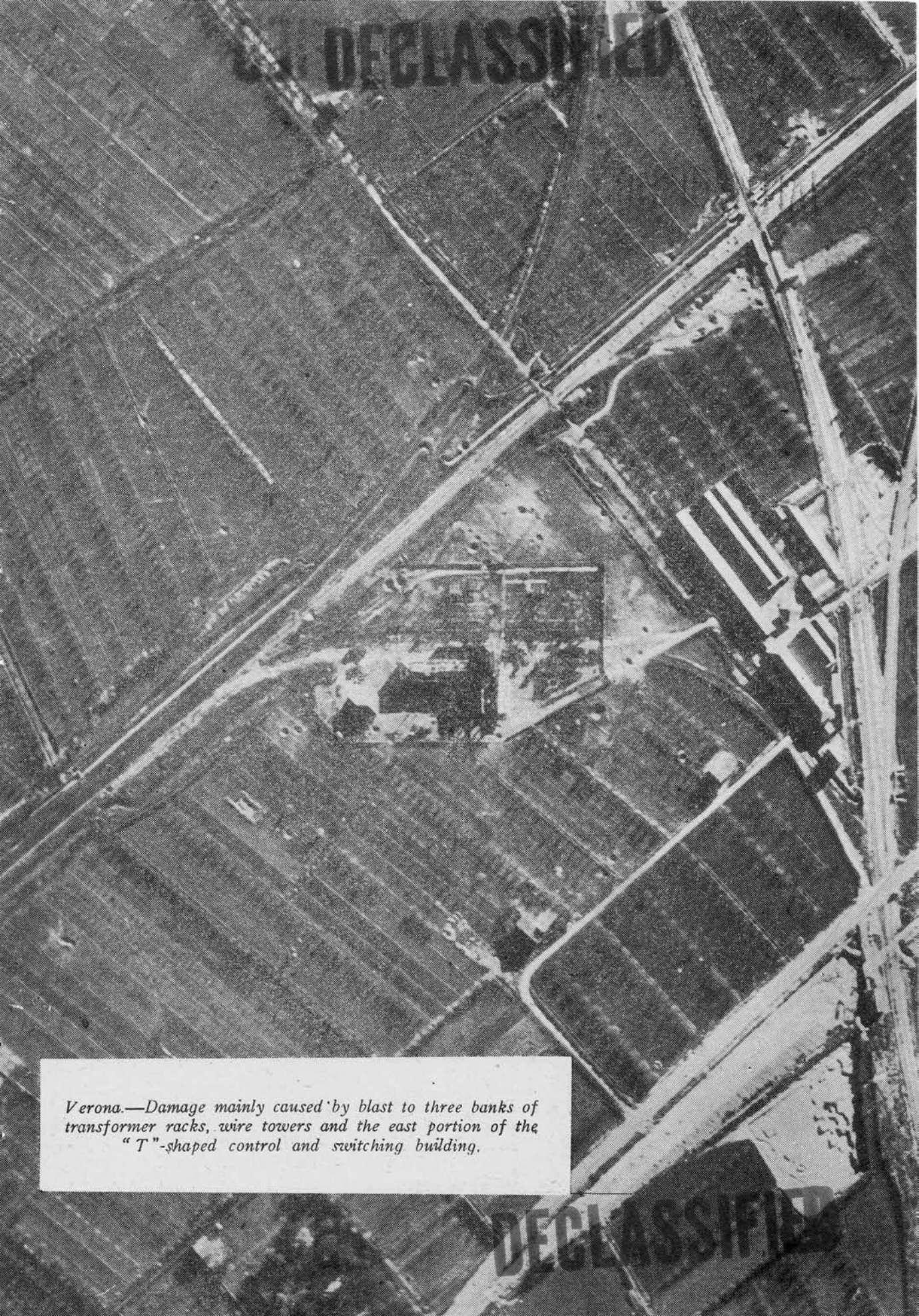
As is the case with most European railways, the *Brenner* route was designed to use electricity for power, which is vastly more efficient than steam power for locomotion where gradients are long and steep. The capacity of the electrified [illegible] in each [illegible] trains daily, each train being [illegible] carrying



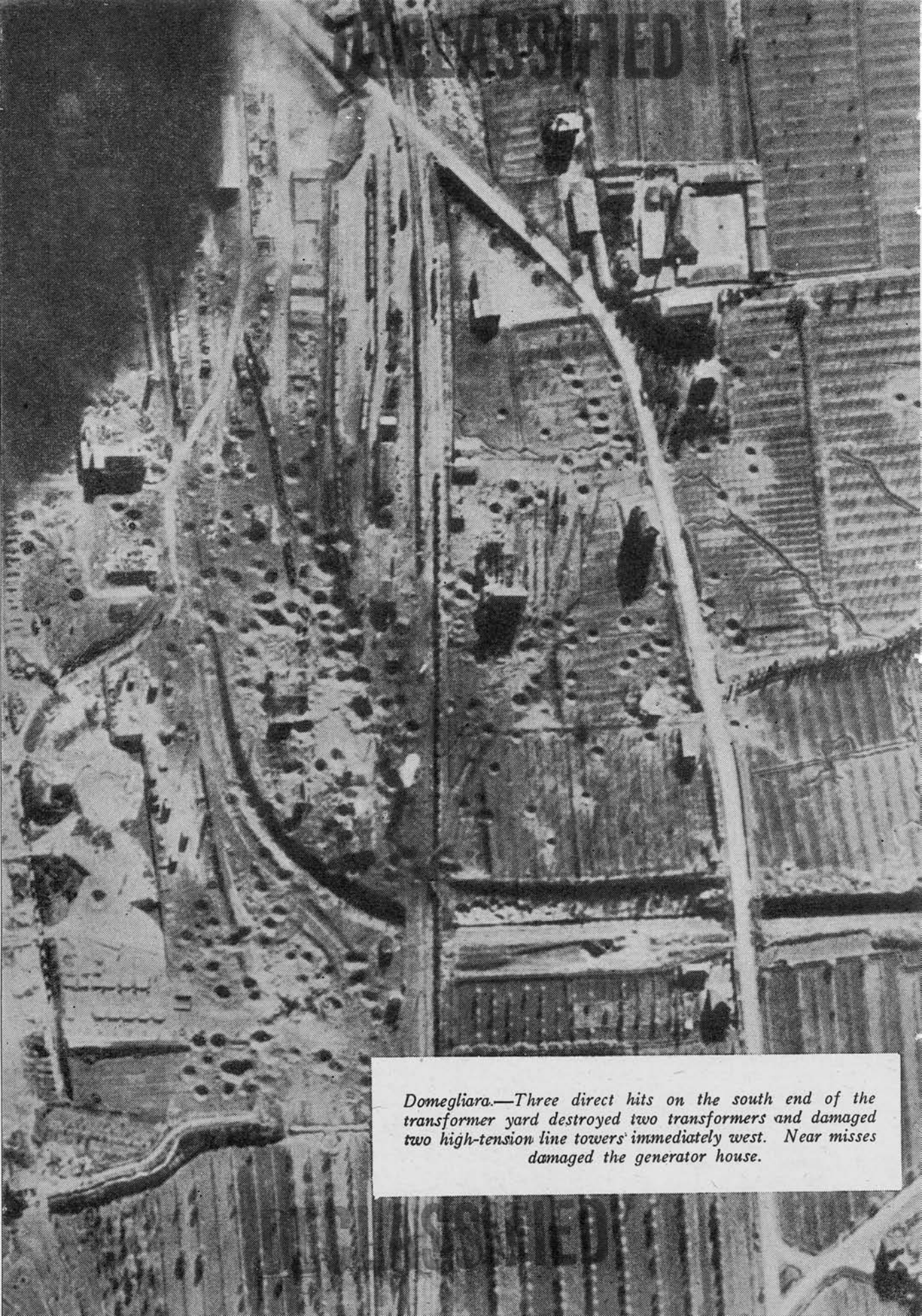


Trento.—Three direct hits on the transformers and six more within the yard destroyed three of the five transformers and damaged the remaining two. The target area was heavily cratered, cabling destroyed and the control house damaged

Ala.—A very heavy concentration of hits on the target area and just to the east. The control house was badly damaged, there were six direct hits on the transformer yard, the transformers apparently being destroyed.



Verona.—Damage mainly caused by blast to three banks of transformer racks, wire towers and the east portion of the "T"-shaped control and switching building.



Domegliara.—Three direct hits on the south end of the transformer yard destroyed two transformers and damaged two high-tension line towers immediately west. Near misses damaged the generator house.

approximately 800 tons of freight through the Pass. Thus about 24,000 tons could be transported daily when the line was in full working order.

Technical specialists of the Italian State Railways estimated that if the Germans could be forced to switch from electric to steam locomotion the capacity of the *Brenner* line would be reduced to 8-10 trains daily. Such steam trains would be able to haul only 675 tons each, making the maximum capacity of the steam-powered line some 6,750 daily—a mere 28 per cent of the electrified line's capacity.

Owing to the plentitude of hydro-electric power in north *Italy*, any attempt to destroy it at its source would be too complicated to be practicable.

The most vulnerable points on the electrified railway system were the power stations—the transformer stations (where power was stepped down from the high voltage of the long distance transmission lines to the operating voltage required for the railway) and the converter stations.

There were fourteen power stations between *Verona* and the *Brenner* Pass, spaced ten miles apart on the severest gradients and twice that distance along less steep stretches. These power stations were so designed and located, however, that the removal of any one of them would not cause any appreciable disruption of the system; it needed, in fact, the elimination of three consecutive stations to make electric locomotion impossible on the section of the line between the outer destroyed stations.

It had to be borne in mind, also, that even after success had been achieved in destroying the power stations repeat raids would probably be necessary to prevent the employment of immediately available replacement equipment and, less likely, the use of mobile power stations as makeshifts for the destroyed permanent stations.

The Power Stations Considered as Targets

The locations of the power stations on the *Verona-Innsbruck* line are indicated on the map on page 124. They consisted of two main types—the big transformer stations on the D.C. section of the line *Verona* to *Trento* and the smaller converter stations on the A.C. section running from *Trento* northwards.

So far as the transformer stations were concerned, the parts most vulnerable to air attack were the actual transformer units, normally located in the open close to the buildings wherein the control panels were housed. For an effective attack, therefore, bombs had to penetrate the buildings and detonate at ground level in order to destroy the housed equipment, while fuzing had to be for maximum fragmentation to destroy the unit outside. In respect of the latter the fracture of the case of the transformer by bomb fragments or better still by rocket projectiles would cause the unit to burn out and would render necessary the major repair job of re-winding them.

In the converter stations all the vital parts were located in the buildings, normally on the ground and first floors. The converter equipment was solidly constructed and destruction could best be accomplished by bombs fuzed to detonate at ground level so that penetration of the casing could be effected.

The "Bingo" Plan

Taking into consideration the facts mentioned in the foregoing sections, Headquarters, Mediterranean Allied Tactical Air Force during the last week in October, 1944, issued its plan—under the code name of Operation "Bingo"—for the destruction of the electrified system of the *Brenner* line in conjuction with the bombing of other vulnerable points.

The Tactical Air Force was to be made responsible for the destruction of four transformer stations, namely: (a) three miles south-west of *Verona*, (b) near *Domegliara*, (c) at *Ala* and (d) at *Trento*. In particular, the Desert Air Force was instructed to eliminate the station near *Verona*, while the medium bombers of the 57th Bombardment Wing and the fighter-bombers of the XXII Tactical Air Command were to destroy the other three stations. Meanwhile, the 42nd Bombardment Wing medium bombers were to operate in force in order to create as many blocks as possible on the section of the line between *Domegliara* and *Trento*.

The M.A.T.A.F. attacks were to be supplemented by Strategic Air Force heavy bomber assaults against the converter station at *Salorno*, the one south of *Ora* and the power station south-west of *Bolzano*. In addition, other forces of heavy bombers were to create as many blocks as possible on the *Trento-Innsbruck* section of the line. The target times of the Strategic Air Force's attacks were to be so arranged as to provide the maximum diversion.

Detailed and accurate descriptions of the targets were drawn up from all available Intelligence sources and full information was provided of the enemy's flak defences.

On the basis of the evidence provided by bomb-damage analyses of previous attacks on power plants the use of 500 lb. G.P. bombs with .1 and .01 fuzings was directed as being the most effective, and rocket projectiles were to be employed where possible against exposed transformer units.

The XXII Tactical Air Command was to undertake area cover commitments for the Tactical attacks and the M.A.S.A.F. fighters were responsible for any additional protection required by the heavy bombers.

"Bingo" in Operation

A week of bad flying weather followed the issuing of the "Bingo" directive and the

operation could not be executed before the morning of 6th November. On that date "Bingo" was activated according to plan.

The *Verona* transformer station was attacked by twelve rocket-firing U.S. Thunderbolts (P.47s) and 22 Kittyhawks with bombs; 21 strikes were scored with rockets on the transformer and four on the buildings and fourteen direct bomb hits on the main buildings and two on the transformer. The *Domegliara* transformer station was bombed by 36 U.S. Mitchells (B. 25s) and sixteen U.S. Thunderbolts; later photographic reconnaissance showed that, besides other damage, two transformers were destroyed. The transformer station at *Ala* was attacked by 36 U.S. Mitchells and seventeen U.S. Thunderbolts (the latter employing both bombs and rockets); photographic reconnaissance revealed that the control house was heavily damaged and all the transformers were apparently destroyed. The fourth station, at *Trento,* was bombed by 30 U.S. Mitchells (including six "window"-droppers) and sixteen U.S. Thunderbolts, while an anti-flak mission was flown by several more U.S. Thunderbolts to afford protection for the Mitchells; later photographic evidence showed that three transformers were destroyed and the remaining two probably damaged, and the control house was damaged and the cabling destroyed.

Enemy opposition failed utterly to interfere with these missions. Several enemy fighters made unaggressive ineffective passes at formations over *Domegliara* and *Trento*, but the only damage suffered by the Tactical aircraft in the above-mentioned attacks was the holing of a few aircraft by flak.

Closely co-ordinated with the attacks on the four transformer stations was the effort directed against rail targets on the *Verona-Trento* section of the line by U.S. Marauders, which flew 103 sorties in the course of six missions. These succeeded in creating seven blocks between *Rovereto* and *Verona*. No enemy opposition was experienced and no losses incurred.

Meanwhile, the Strategic Air Force was implementing its part of the "Bingo" plan, 25 U.S. Liberators (B. 24s) with 46 escorting U.S. Lightnings (P. 38s) being sent to attack the three assigned targets. Although the target areas at *Salorno, Ora* and *Bolzano* were covered, photographic reconnaissance revealed no serious damage to any of the power stations. Intense heavy flak was encountered by some of the attacking aircraft, but no losses or damage were sustained.

On the following day, 7th November, the Strategic Air Force completed its task of creating as many blocks as possible on the route north of *Trento*. Over 190 U.S. Liberators, well escorted by U.S. Mustangs (P.51s), pressed home their attacks on the line, dropping approximately 470 tons of bombs. Hits were scored on a long stretch of the line and explosions were caused among rolling stock at two yards: of the bridges hit those over the *Isarco* and *Adige* rivers at *Albes* and *Ora*, respectively, received most damage.

Success of "Bingo"

The success achieved by operation "Bingo" in forcing the switching over from electric to steam power on the *Brenner* route between *Verona* and *Trento* was confirmed both by photographic interpretation and ground reports.

For several weeks after the operation this section of the line was covered by reconnaissance aircraft about three times a day whenever practicable. During this time only steam locomotion activity was observed; moreover, the presence of long road convoys along sections of the route probably indicated that steam locomotives were also not over-plentiful.

Meanwhile, reliable agents' reports continued to come in stressing the cessation of electric traction and a considerable lightening of traffic on the line. Typical statements read: "18th November—No *Brenner* traffic passed through the main yard at *Verona* between 3rd and 12th November". "25th November—Due to damage to four electric sub-stations on the *Brenner* line, only steam locomotion operates between *Verona* and *Trento*".

"Bingo", it was evident, had justified the highest hopes of its planners.

Mining Of The Danube By No. 205 Group

THE RIVER DANUBE, second largest river in *Europe*, rises in the *Black Forest* region; it is joined in its course of 1,720 miles by nine major tributaries, the rivers *Inn, March, Waag, Drava, Tisa, Sava, Morava, Seret* and *Prut,* and finally debouches into the *Black Sea.* It is shared by six countries—*Germany* (including *Bohemia* and *Moravia*), *Austria, Hungary, Yugoslavia, Rumania* and *Bulgaria.* Owing to navigation problems which may have arisen between the above countries, the *Danube* was made an international river and before the war was controlled by *Britain, France, Italy* and *Rumania.*

The river is navigable for 1,500 miles. River steamers can reach *Ratisbon* in *Germany* and sea-going vessels can penetrate to *Turnu Severin,* just east of the *Iron Gates;* but for two months during the winter navigation is made difficult by floating or fixed ice, particularly in the lower courses of the river.

The larger river ports such as *Braila, Rusciuk, Giurgiu, Turnu Severin, Belgrade, Novi Sad* and *Budapest* are well equipped with storage and loading facilities capable of handling the enormous quantities of grain, fodder, oil seeds and other agricultural products of the *Balkans;* the oil products of the Rumanian oil fields centred at *Ploesti;* and the coal from the *Pernik* mines, the most important centre of coal production in the *Balkans.* Bottlenecks are few, the only one worthy of note being the famous *Iron Gates* where the river flows through a deep gorge in the *Orsova* area.

The *Transylvanian Alps* and the mountains of *Yugoslavia* increase the difficulties of road and railway engineering in the *Balkans,* but in the *Danube* nature has provided a natural water gap capable of transporting 10,000 tons of material daily.

A Lifeline to Germany

It is a natural tendency to think of the river *Danube* in the terms of "blue"—"Strauss"—"Vienna"—"waltzing," but in Nazi eyes it stood for communication between the Third Reich and the vast grain lands of *Hungary;* a lifeline to the Rumanian oil fields; a link with *Turkey;* and a strategic route to the Russian front. It is estimated that, during 1942, 8,000,000 tons of material reached *Germany* via the *Danube* alone.

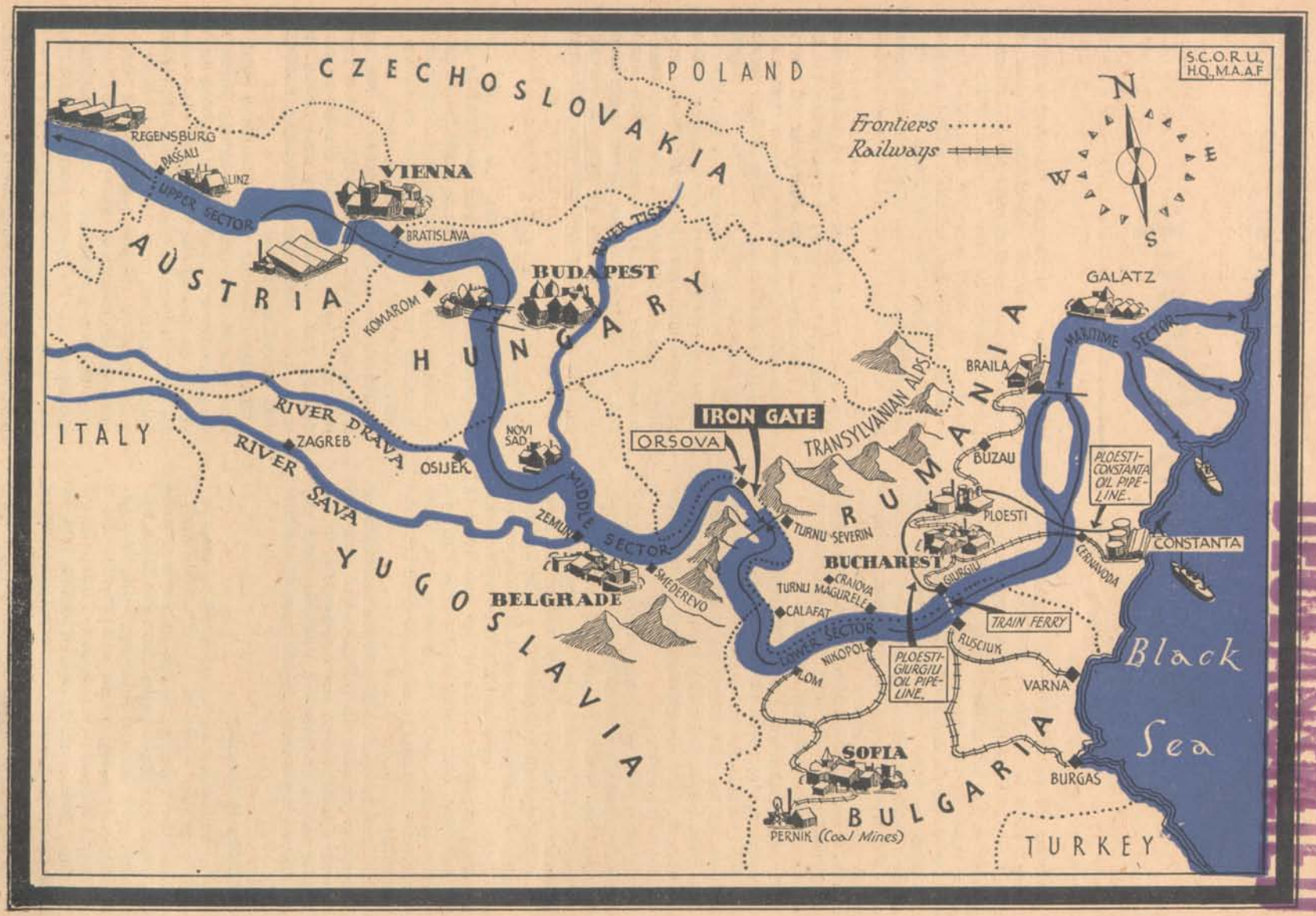
The river carries loads vastly superior to those of the inadequate Balkan railway system. One "Rhine-type" barge can carry 1,000 tons; compare the advantages of loading one such vessel against the disadvantages of loading 100 ten-ton railway wagons. These conditions, ideal for handling large quantities of coal, grain, oil seeds and fodder, are invaluable when the question of oil transport is considered; there is no comparison between the vulnerable, expensive oil tank wagon and the easily handled bulk loads of the barge.

A quick review of the Axis oil position clearly indicates the importance that *Ploesti* held in their war economy. At the beginning of the war 60 per cent. of *Germany's* oil, apart from a small quantity obtained from wells inside *Germany,* came from the great Rumanian oil refineries centred at *Ploesti. Rumania* was then the fourth largest producer in the world, having refineries at *Ploesti* and pipe lines to *Constanta* on the *Black Sea* and to *Giurgiu,* the port used for transhipment of oil to *Germany.* One hundred and fifty thousand tons of oil per month reached *Germany,* being carried by barge to *Vienna* or *Bratislava* where it was transferred into oil tank wagons.

Increased Traffic in 1944

When the Axis lost the use of the *Lwow-Cernauti* railway, they were compelled to divert an increasing volume of military traffic to the vulnerable and already overloaded Hungarian and Rumanian railway system. The mounting air offensive of M.A.A.F. against these lines of communication made it necessary to find some alternative method of transport, and a project was put in hand to make still greater use of the *Danube.* At this time there were 250-300 tugs on the river, each capable of pulling 1,200-1,500 tons carried in barges.

With the exception of the *Iron Gates* canal, the river has no bottleneck marshalling yards, and barges make very uneconomical bombing targets, as they can be dispersed along the river. Hence for bulky and non-perishable goods, not requiring quick transport, the river was ideal for maintaining a steady, uninterrupted flow of material into *Germany.* By the middle of March, 1944, the new programme of river transport was developing and the greater part of the oil traffic was being diverted from the railways to the river. Between October, 1943, and February, 1944, river traffic increased until it was estimated



to exceed rail traffic by 28 per cent; in March, 1944, it was stepped up to 200 per cent. over the corresponding rail traffic. It was clear, therefore, that even a temporary stoppage of river traffic at this juncture would have far-reaching effect on *Germany's* war potential.

In consequence, plans were made by M.A.A.F. to mine stretches of the river at a time when the Soviet forces had crossed the river *Dniester* and were in a strategic position for opening a summer offensive through the *Galatz* gap into the basin of the lower *Danube*.

The Mining Offensive Begins

The second week in April at a time when the *Danube* was by far the most important single transport route in *Eastern Europe,* saw the opening of the mining offensive (Operation "Gardening") by aircraft of No. 205 Group, in close liaison with naval specialists. These were not the first mines to drop in Danubian waters, as, during 1941, magnetic mines were probably dropped from ships or laid from the shore by partisans, and during 1943 the Russians laid a few mines from aircraft between *Giurgiu* and the sea. But at no time was the mining of sufficient magnitude to disrupt shipping until the R.A.F. operations between April and October, 1944, when the river was effectively mined, reaching maximum intensity in August.

The mine-laying aircraft were originally despatched during "moon" periods, as the success of the operation depended largely on good visibility and reasonable illumination from the moon. Later on successful experiments were made during "non-moon" periods with flare illumination by pathfinder aircraft, and it was found possible to mine any given stretch of the river at any period of the month.

Tactics in mine-laying varied according to the part of the river over which the aircraft were operating. When the depth of the water permitted, high level drops were made, but in shallow areas the average height of release was 200 ft. Much lower altitudes have been known, 40 or 50 ft. being fairly common.

During the whole of the mining period 428 aircraft were despatched and only ten of these failed to return. Several members of the missing aircrews escaped from captivity and were repatriated when *Rumania* fell.

The First No. 205 Group Mission

The first mission of three Liberators and nineteen Wellingtons was airborne on the night of 8/9th April and 40 mines were dropped near *Belgrade.* By 15th April a further 137 mines were added, so that by the end of the month there was a considerable number of mines somewhere in the river, setting the enemy the beginning of a problem that was to last until the advancing Russian forces denied the Axis the use of the river.

During May, 364 mines were dropped by forces of Liberators and Wellingtons. From the night of 31st May/1st June there was no mining until 1st/2nd July when the offensive was re-opened with the largest mission of the operation. Seventeen Liberators and 57 Wellingtons were despatched and successfully laid 96 1,000-lb. mines and 96 1,500-lb. mines. Enemy opposition was encountered and four of our aircraft were missing, this being the occasion of our heaviest loss. The attack was pressed home the following night when ten Liberators added 60 mines. There were no further operations during July until the 30th/31st when another large force of aircraft dropped 177 mines.

During August Wellingtons did not join in the "Gardening" operation; Liberators, operating in groups of two to thirteen, were sent out at more frequent intervals to drop a total of 222 mines. Three attacks were made in September when eleven Liberators and 48 Wellingtons dropped 139 mines.

The last mission of this venture was airborne on 4/5th October when four Liberators and eighteen Wellingtons released the last load of 57 mines over areas in *Hungary,* west of *Budapest,* north of *Gyor* and west of *Estergom.* To the Nazis, frantically withdrawing essential equipment from their crumbling Balkan "Empire," this stumbling block at their back door caused endless trouble.

German Counter-Measures

The immediate results of the first mining attacks indicated that the Germans were taken by surprise. The organisation of defensive measures to combat the mining was immediately put in hand, but was not operating satisfactorily until the middle of August. The "Counter-Measures" organisation consisted of :—

(a) Information regarding mine-laying from the air.
(b) Minesweeping.
(c) De-magnetising of vessels.
(d) Anti-aircraft measures, including fighter opposition.

(a) Information

Information was obtained from frontier guards posted at intervals along the banks of the river, police and territorial units, anti-aircraft units, military port commanders, shipping personnel and interchange of information between Bulgarian and German units. The main items of information required were the date, place, number of aircraft operating and the height at which the mines were released. Information was checked by unit commanders and military port authorities, the original version, together with the verified information, being immediately transmitted to headquarters by the adequate telephone system which inter-connected all sources of information along the river.

(b) Minesweeping

Authority for operations by minesweeping vessels was given by Navy headquarters for the

Rumanian vessels; for German vessels by the commanders of the respective river sectors. The "maritime sector" formed that part of the river from the sea up to *Braila*, with headquarters at *Galatz*; the "lower *Danube* sector" from *Braila* to *Turnu Severin*, with headquarters at *Giurgiu*; the "middle *Danube* sector" from *Turnu Severin* to *Budapest*, with headquarters at *Belgrade*.

Minesweeping equipment consisted of tug-boats equipped to sweep magnetic or acoustic mines, or both, and one squadron of minesweeping JU.52s fitted with mine-detonating rings. Many vessels also were modified to act as minesweepers. For instance, the Serbian tug-boat "Jug Bogdan" (450 horse-power) was taken over by the German authorities and fitted out as a minesweeper with a magnetic sweep made up of seven metal paravanes arranged in a diamond pattern and inter-connected by an insulated cable to a transformer on the after deck; an acoustic sweep, activated by its movement through the water, was carried in front of the vessel. The captain of the tug described the minesweeping personnel allocated to the vessel as one captain (minesweeping), who directed operations *from the shore*, and seven Naval ratings, all of whom were thoroughly terrified of mines. It is interesting, and not surprising, to note that no mine was ever exploded during operations by this vessel.

With this method of minesweeping the cable was often damaged by irregularities in the river bed or by floating debris, while the paravanes were affected by currents or whirlpools. Another method was tried in which individual generators, supported by floats, were towed at regularly spaced intervals. This proved a failure and was abandoned. The Germans improved on these methods by passing the cable over two or three old barges, which gave a broader sweeping field, together with more speed and safety.

When mines had been dropped in the Rumanian part of the river, M.D.R. aircraft swept the area for shallow mines and those of high sensitivity, followed by Rumanian vessels concentrating on the mined zone, while German and Bulgarian vessels maintained continual sweeping operations up-river from *Giurgiu*, until the area was thought to be safe.

Up to the end of July the river was considered safe for shipping after 24 sweeping operations had been carried out. After July, however, the difficulties of the German Anti-Mining Organisation were increased greatly by the introduction of a timing device in magnetic mines, which allowed them to remain unexploded at the bottom of the river for an indeterminate period and rendered ineffective the 24 sweepings estimate.

For example, following the mining of the *Giurgiu* area on the night of 30th July, 60 sweeping operations in the following four days failed to clear the river and Rumanian shipping was stopped for seven days. On account of this new factor of uncertainty, minesweeping was continued incessantly, the risk of losing vessels was accepted and shipping was no longer held up. As the situation on the Rumanian *Danube* deteriorated, the extreme measure was adopted of allowing old vessels to drift down the river and explode the mines. This was probably done owing to the shortage of minesweeping elements, which were always in short supply in this area, having probably been withdrawn to combat the increased air mining of the Hungarian *Danube*.

The M.D.R. aircraft are reported to have given better results than surface vessels, although two JU.52s were destroyed by explosion of the mines which they had detonated near *Komarom* about 12th June. Two other M.D.R. aircraft were destroyed by Allied fighters.

(c) De-Magnetising

A de-magnetising station was erected at *Rusciuk*, where all Rumanian and foreign vessels were de-magnetised. A second station was started, but never finished, at *Braila*. During the latter part of June and in early July, the Germans were reported to be financing the building of both wooden and concrete barges to neutralise the effects of magnetic mines, but such vessels were never seen in use.

(d) Opposition to Our Aircraft

Flak positions were established along the banks of the river in the areas most susceptible to mining. These were mostly light flak guns and, owing to the height from which the aircraft dropped their mines, fired fully depressed, forming a low curtain of flak over the river.

The anti-aircraft equipment of vessels was never completed, as mining was done at night and usually in areas away from the ports. Flak barges, however, were equipped and placed at strategic points, aerial reconnaissance discovering four or five of these vessels between *Novi Sad* and *Belgrade*.

Three squadrons of night fighters were in operation over the Rumanian sector of the river, operating from *Otopeni (Bucharest)* and *Zilistea* (near *Buzau*). Their results were never satisfactory owing to the poor spotting service in *Yugoslavia*, coupled with the slow transmission of orders, which did not allow them to take off in sufficient time to intercept the mine-laying aircraft, particularly when they were operating over the *Middle Danube*.

A balloon barrage existed at *Novi Sad* and intruder aircraft reported a barrage at 1,000 ft. over *Zemun (Belgrade)*. On the Rumanian *Danube*, an ambitious scheme was projected to cover the river with a protective balloon barrage in conjunction with light flak positions and searchlights. The programme also provided for two balloon companies (48 balloons) seaward from *Giurgiu*. Work on these projects was begun, but never completed.

RESULTS OF THE MINING

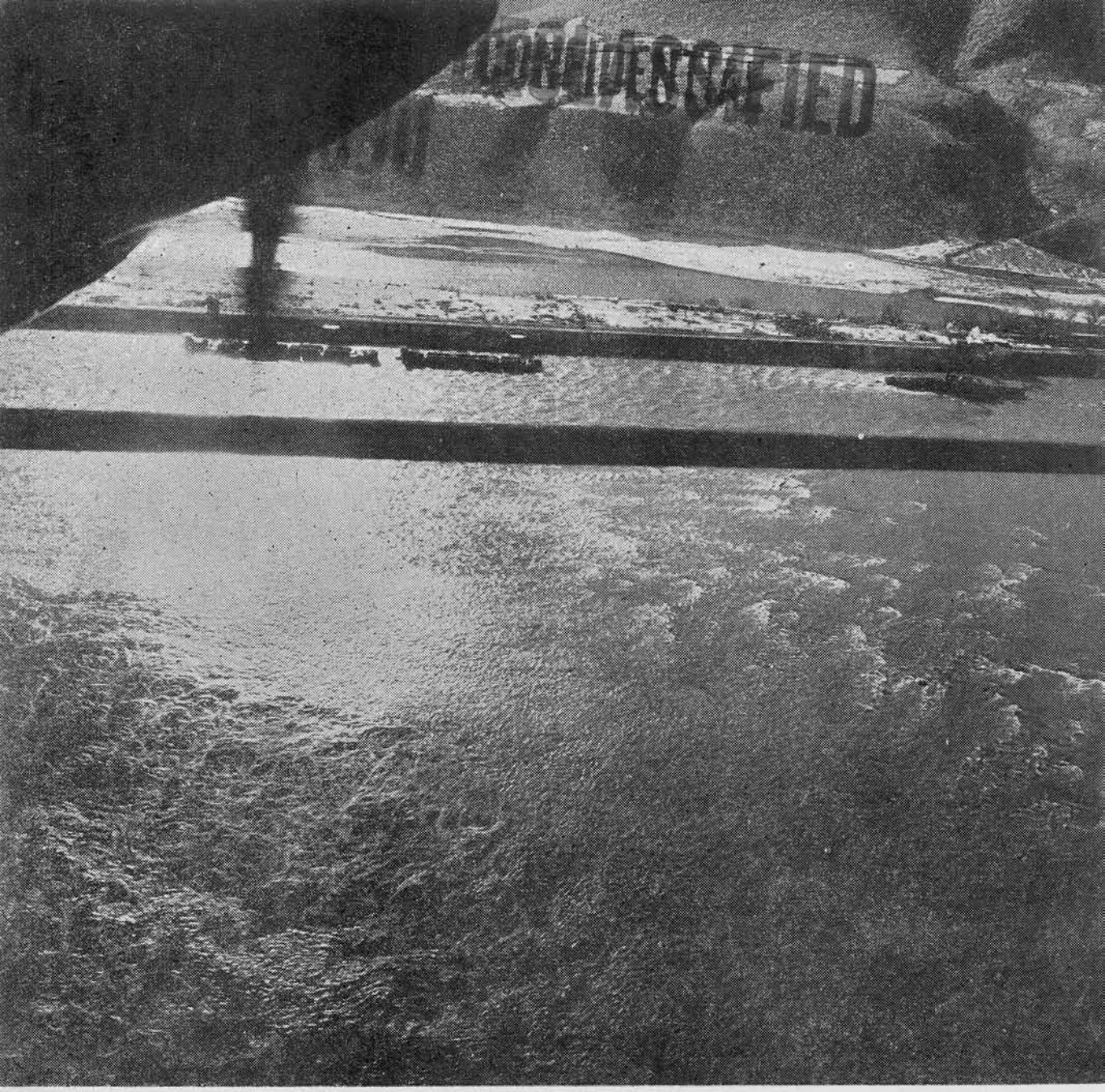
(a) Shipping

The surprise and unpreparedness of the enemy at the time of the first mining operation was

The Danube passing through a gorge in the Transylvanian mountains.

particularly noticeable in the busy stretch of river between *Giurgiu* and *Bratislava*, where several vessels were sunk and shipping, generally, brought to a standstill.

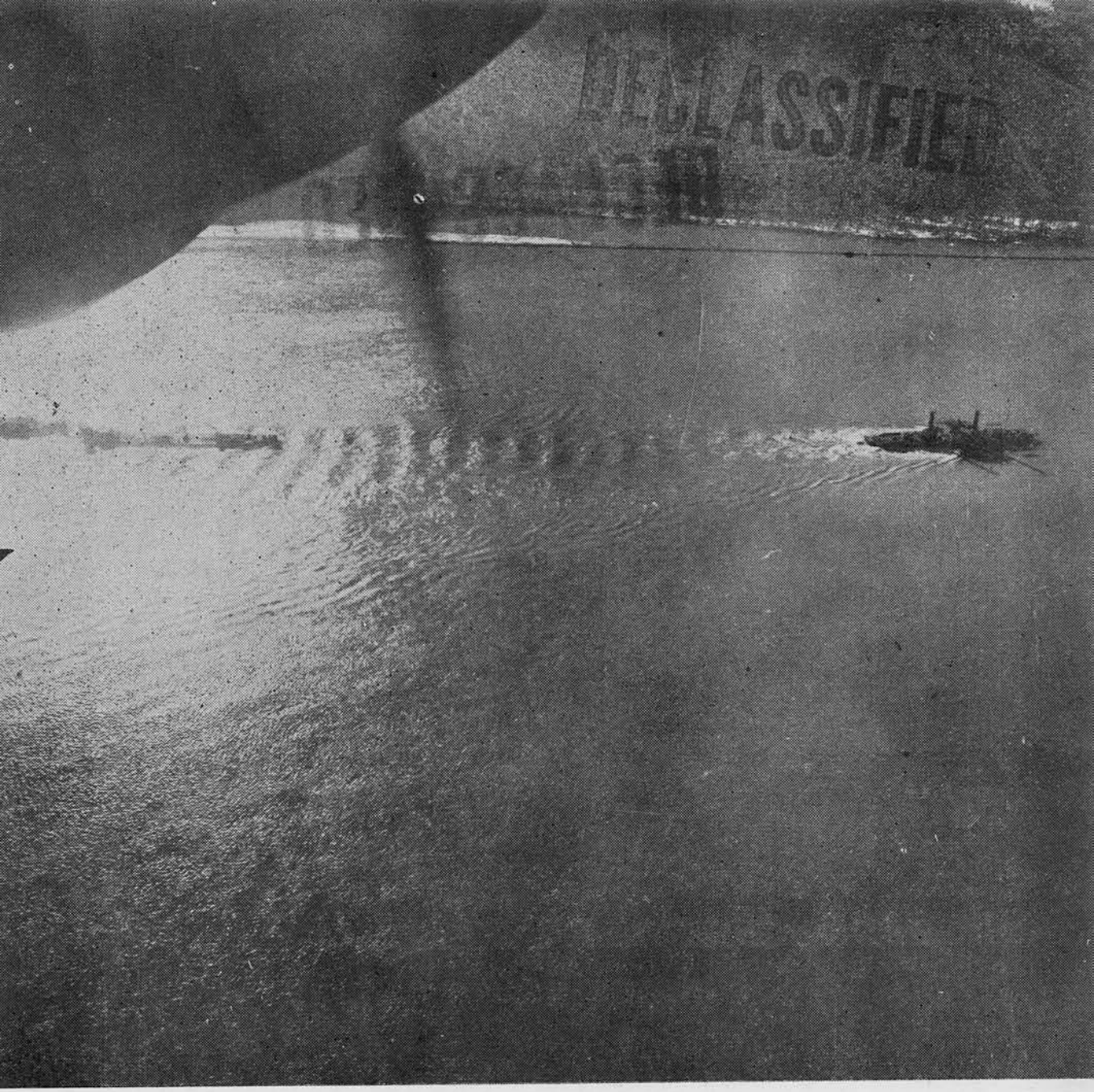
In May, reports began to show the cumulative effect of mine-laying; coal traffic was virtually suspended, as the Bulgarian ports were overcrowded; storage concerns refused to accept responsibility for goods owing to the danger of Allied air attacks; and one *Budapest* shipping firm went into liquidation as a result of loss by mining. In the middle of May, a large consignment of machinery was held up at *Regensburg* awaiting towage to *Budapest*, while goods for *Sofia* were delayed owing to the suspension of river traffic. Certain areas of the river were re-opened about 20th May, but the river between *Vienna* and *Rusciuk* was again closed by the end of the month. On 1st June, a Hungarian wireless station, presumably acting on instructions from the Germans, warned all shipping between *Goenuye* and *Piszke* to stand still until further notice. During the first week of June photographs showed the *Iron Gates* canal to be out of action as a result of Allied bombing; it is estimated that 60,000 tons of goods were held up at this point.



View of the "Iron Gates" Canal, showing the locomotive towing system.

Similar conditions were reported all along the river. For example, barges loaded at *Szistov* at the end of April were still there on 10th June; barges laden with Hungarian goods destined for *Turkey* did not leave their port of departure, but were unloaded again. Photographs showed more than 100 barges dispersed along the banks of the rivers *Danube* and *Sava*, while the *Begej* canal, between *Titel* and *Ecka*, was filled with inactive barges. All traffic was suspended between *Mohacs* and *Belgrade*, and even the *Giurgiu-Rusciuk* train-ferry was dispersed two and a half miles up-stream away from the danger area.

During the first three weeks of July oil shipments from *Ploesti* amounted to only 59 barge loads. Even these were not moved without difficulty, as on 12th July the *Iron Gates* canal was impassable and on the following day the whole river was closed between *Budapest* and *Rusciuk*. The captain of the Slovak tanker, S.D.P.5, has since stated that a tanker normally made nine return journeys from *Giurgiu* to *Bratislava* each year, whereas in the summer of 1944 it took him four months to go from *Giurgiu* to *Bogoljevo* and back; nor did he know of any tanker making more than one return journey in



River tug and barges seen below Turnu Severin.

the same period. Oil shipments had previously been transferred to railway tank wagons at *Budapest*, but were now being taken only as far as *Novi Sad*. Photographic reconnaissance showed that the cranes, used for lifting the tanks on to the railway wagons, had been moved to *Novi Sad*. This saved nearly half the distance from *Ploesti* by water, but it was "robbing Peter to pay Paul," as the railways were already overburdened and suffering under the hammer blows of the Fifteenth Air Force.

During July the German authorities took full control of all shipping, as agents were unable to state the location of their barges at any given time. River patrol boats, armed with machine-guns, were instituted by the Germans, no doubt to bolster the sagging morale of the Danubian sailors.

Disorganisation and labour shortages were acute at the ports and, even with the reduction in river traffic, shipments were being delayed owing to the lack of dock workers. The desertion of crews from their vessels and absenteeism on the docks made it necessary to use prisoners of war. Russian prisoners worked on German and Hungarian ships; Italian prisoners worked on

Concentrations of barges on the River Danube at Turnu Severin.

Serb and Croat ships. At one period in July there were 30 loaded barges at *Zemun,* idle for lack of crews. Compulsion was general, but in spite of this, accidents increased and delays accumulated. It was reported, for example, that goods despatched from *Germany* at the beginning of April had not arrived in *Rumania* at the end of July.

As previously mentioned, the *Iron Gates* portion of the *Danube* which runs through a deep gorge at *Orsova* forms the only serious bottleneck on the river and presents difficult problems of navigation. Shipping can proceed only during daylight and tugs of more than 1,000 horse-power are required to tow barges against the swift current.

From October, 1943, twelve "Cataract" tugs were engaged solely in towing oil tankers and, until December, an average of 20 tankers passed up river daily. In the first three months of 1944, this was reduced to twelve tankers daily, but in late March the number rose again to its previous autumn level. On 16th April the first mines were reported and the subsequent results were catastrophic. Not more than 80 tankers reached the upper river between May and early August, including many which were discharged into oil

tank wagons at *Smederevo, Zemun, Novi Sad* and *Apatin.*

In a bombing attack on the *Iron Gates* canal in May the towing railway was cut and one locomotive was damaged. Both towing railways were inactive thereafter for ten days, causing a reduction of 50 per cent. in the canal's capacity. The actual effect on traffic was less, owing to the small amount of movement as a result of Allied mine-laying.

Casualties to vessels continued in all parts of the river; it is estimated that between 6th April and 31st August 60 to 70 tugs and well over 200 barges were sunk and many more damaged.

(b) River Organisation

The disorganisation of traffic by repeated mine-laying and the operational shortage of barges caused congestion at a number of ports, where storage facilities were inadequate to meet the increased demands. The natural hesitancy of shipowners (and their crews) to operate in the mined areas caused friction between the Wehrmacht and the various concerns dealing with the organisation of river traffic. When the amount of military traffic was quite small, the control of freight movements was in the hands of the "Frachtenleitstellen" (Freight Control Bureau), which allocated priorities according to the needs of the Reich. This organisation broke down under the confusion caused by the mining and the German High Command took charge of the situation. The Royal Hungarian Sea and River Shipping Company was taken over by the Wehrmacht for the transport of military supplies; the Under-Secretary for the Rumanian Navy was empowered to seize river craft for military transport at any time; and barges were widely requisitioned.

Some of the more interesting results of the disorganisation of river control were the temporary cessation of coal traffic from the *Pernik* mines owing to the lack of storage facilities; the increase of freightage rates by 60 per cent.; the refusal of underwriters to insure cargoes; the inability to locate shipping; the request to *Turkey* to cease routeing consignments via the *Danube;* the authorisation of a loan of 200 million Lei for the improvement of shipping; and the increase of premiums for speed and successful night operations.

Reports from the enemy press indicated the additional administration required to overcome the chaos in shipping organisation. One read as follows:—

"*Danube* freight rates inside *Croatia* have been doubled, probably in order to discourage internal traffic with the object of conserving shipping space for longer hauls. Charges for goods warehoused for more than two months in *Budapest* free port have, with certain exceptions, been increased tenfold; this is the latest in a series of measures aimed at reducing the congestion which has occurred as a result of the dislocation of *Danube* traffic, and at achieving a greater degree of dispersal against Allied air attacks. The exceptions are (i) goods already stored under long term contracts; (ii) goods stored to the order of Government or municipal departments; (iii) wool, grain stored in silo, pulses, grass seeds, oil seeds, fodder, plant seeds, millet and vetches. Air raid emergency stocks thus appear to be among the goods exempted.

"Where Allied action makes the use of a normal route temporarily impossible, the Government has been compelled to bear the extra charges involved in diverting traffic over dearer routes. Thus the area Freight Control Office at *Munich* has decided that in cases where goods, which would normally have been dispatched by a combined rail-*Danube* route via *Regensburg, Deggendorf* or *Passau,* are diverted by the Freight Control Bureau (Frachtenleitstellen) owing to *force majeure* through another transhipment port involving higher freight charges, application can be made to the Reichsbahn for a refund of the excess."

(c) Periods When the River was Closed

The following figures show the periods when navigation was suspended for German or Rumanian vessels between 9th April and 18th August, 1944. Only the most significant dates are shown below.

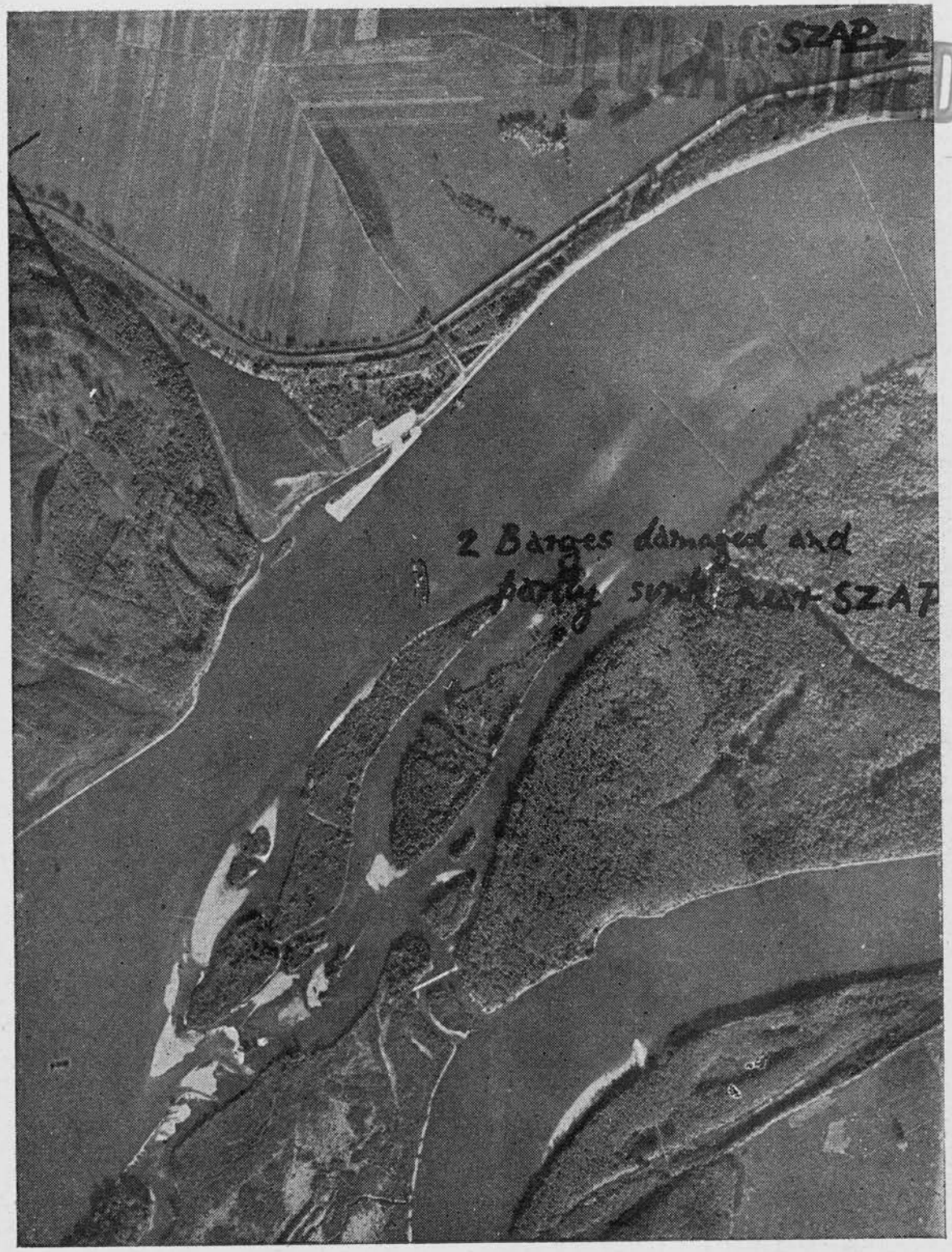
Following the initial mining, the river was closed for 20 days between *Turnu Severin* and *Belgrade* to both German and Rumanian vessels, and from *Moldova* to *Belgrade* for a further sixteen days to Rumanian vessels only. Between 12th April and 23rd May, Rumanian shipping was denied the use of the *Sulina* canal for 21 days, the *Kilia* canal for one day, the *Saint George* canal for three days and the *Stari Stambul* canal for eighteen days. In the middle of May Rumanian vessels were again stopped for a period of six days between *Harsova* and *Cerna Voda,* and between *Ternu Magurele* and *Braila;* also for a period of five days between *Giurgiu* and *Pietra Sani.* From 21st May to 9th June, both German and Rumanian shipping were intermittently held up between *Moldova* and *Belgrade,* and the *Stari Stambul* canal was again closed to Rumanian shipping for seventeen days. Stretches of the river between *Belgrade* and the *Iron Gates* and areas east of *Giurgiu* were closed for periods of two to four days at a time during the month. During July long stretches of the river between *Giurgiu* and *Belgrade* were closed for periods of up to a week at a time; in fact, there were only three to four days during the month when the river was clear.

A similar state of affairs continued through August and for only one week, up to 18th August, was the river clear from *Giurgiu* to the *Iron Gates,* although German shipping continued to use it for all but four days during this period.

Night-Fighter Attacks by Coastal Air Force

In support of the many operations by No. 205 Group, night-fighters of M.A.C.A.F. attacked

Barge sunk by mining to the west of Komarom.



Result of mining near Szap.

river craft with cannon fire, using road and railway objectives as alternative targets. During the ten-day moon period at the end of June and in early July, Beaufighters of No. 255 Squadron made twelve patrols covering the river *Sava* from *Bos Samac* in *Yugoslavia* to its point of confluence with the *Danube*, nearly 200 miles to the east, and the *Danube* from *Baja* downstream for 250 miles to *Bubravica*. The round trip averaged 900 miles, and in anything but clear weather the terrain over which the aircraft flew rendered the venture extremely hazardous.

The first intruder attack during the night of 29/30th June was exceptionally successful, when a group of barges north of *Slankament* was straffed. Oil barges, 200 ft. in length, exploded with vivid red and orange flashes and within fifteen seconds a cloud of oil smoke had risen to 1,000 ft. From a distance of 45 miles, ten hulks could be seen burning down to the water line. Four other barges and a tug-boat were also effectively straffed.

On the night of 30th June/1st July the aircraft turned back, as overcast in the target area obscured the moon. The second and third successful penetrations on the nights of 1st/2nd and 2nd/3rd July found the element of surprise lacking, as the enemy had apparently reorganised his ground defences. During this and later missions, progressive A.A. opposition was encountered. Two low-flying Beaufighters reported being illuminated correctly and suddenly by searchlights on either side of the river; as no flak was experienced it was presumed that the searchlights were radar controlled and intended as directional aids to night-fighters. Incidentally it was heard later that, as a result of the searchlight exposure, our aircraft had been identified as Marauders! Barrage balloons were also encountered, but in spite of these increased defences, successful attacks were made on 45 "Rhine-type" barges (1,000 tons), three tug-boats and nine smaller vessels, inflicting varying degrees of damage. A large vessel (300 ft. long, 60 ft. beam) with superstructure was seen jutting out from its mooring berth; three long bursts of cannon fire left the vessel severely damaged.

During the next four nights (4th to 7th July), only one aircraft managed to reach the *Danube* area, damaging one 300-ft. barge.

On the night of 8/9th July four aircraft again covered the area damaging eighteen to twenty "Rhine-type" barges and six 100-foot barges. Night-fighter opposition (some using rockets) was encountered, but without conclusive results.

Altogether, eight large oil barges and their cargoes were destroyed and 102 other vessels damaged, representing 100,000 tons of shipping.

Results of the Operations

A general survey shows the following outstanding results of the operations:—

(a) Between April and August, 1944, German priority traffic on the *Danube* was reduced by at least 60 per cent. and normal traffic by 70 to 80 per cent.

(b) The effects of the air offensive against communications and oil production were materially increased.

(c) The enemy was forced to deploy flak positions, balloons and observation posts along the *Danube;* to divert considerable numbers of skilled minesweeping personnel (both naval and air) at a time when their services were required elsewhere; and to put considerable strain on his reserves of manpower to replace and correct disaffected elements.

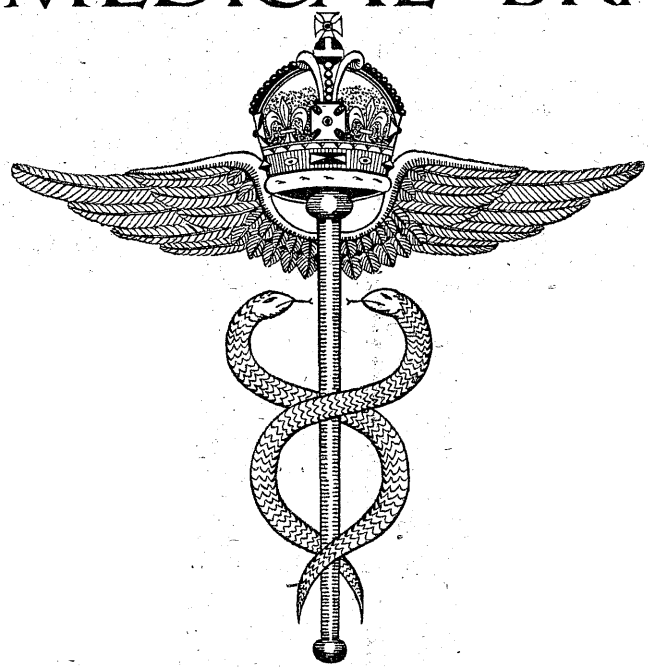
(d) Considerable aid was given to the Russian forces in their westward drive. The transportation of enemy reinforcements to the Russian front suffered considerable delays owing to the lack of minesweeping equipment.

(e) The loss of oil and shipping must have had far-reaching results on other fronts. It is interesting to note the increased use of bullock and horse transport by the Axis forces during 1944; one German prisoner is quoted as having seen "a Tiger tank being towed along the *Cesena-Forli* road by sixteen oxen."

As a result of the tenacity and bravery of the aircrews, and the unselfish labour of the ground crews, the operations over the *Danube* fastened a tourniquet firmly on one of the greatest lifelines of the Third Reich. Instead of bringing the life-giving oil needed in modern warfare, the *Danube* was finally an avenue of retreat used to salvage essential equipment from the Balkan states, now the amputated limbs of a dying *Germany*.

The situation is admirably summed up by the following extract from the Commanding General's talk to press correspondents in *Rome:* "There was the effective work done by the Wellingtons and R.A.F. Liberators in mining the *Danube* river at a time when the river traffic was helping the Hun oppose the Red Army. Between early April and October eighteen attacks were made; 1,382 mines were laid in the *Danube*. The mines were dropped at night from altitudes of less than 300 ft. Great skill in navigation, great courage in flying through flak and mountain terrain were required of the aircrews who did this job. More than 60 tugs and 200 barges were sunk and the time it took for a barge to make a round trip on the *Danube* between *Giurgiu* and *Vienna* was tripled. For long periods traffic on the *Danube* had to be suspended."

R·A·F MEDICAL BRANCH



MALARIA CONTROL IN CORSICA

THE CAMPAIGN in the Central Mediterranean area has given the medical authorities of all services a full measure of responsibility in planning and waging a constant attack on those enemies of the fighting man which can, without smoke or noise, melt away armies and air forces in a very short space of time.

Although the dysenteries and typhus, enteric fever and other pests demanded constant vigilance, and received it, it is unquestionably the threat of malaria that caused the greatest anxiety.

The following account is, therefore, concerned with the efforts that were made to overcome the danger to our fighting services on the island of *Corsica* from an airborne attack by mosquitoes many times more deadly than any series of attacks that could be launched by the Luftwaffe.

Methods of Defence

Before describing the action taken in *Corsica,* however, it may be of interest to mention briefly the general methods of defence used against malaria.

This defence is best conducted by attack against mosquitoes as carriers of the disease at all stages of their life cycle, and by the protection of men firstly by nets against bites and secondly against the results of bites by those mosquitoes that evade the net defences.

The chief methods fall under five headings :—

(i) Destruction of the adult mosquito by swat and hand sprayers.

(ii) Destruction at the larval stage of the mosquito.

(iii) Destruction of the breeding places of mosquitoes.

(iv) Protection of man against mosquito bites by the use of nets and deterrents, long garments and special garments at night, etc.

(v) Protection of man against malaria even though bitten by mosquitoes, by the regular taking of mepacrine (atebrine) in small doses.

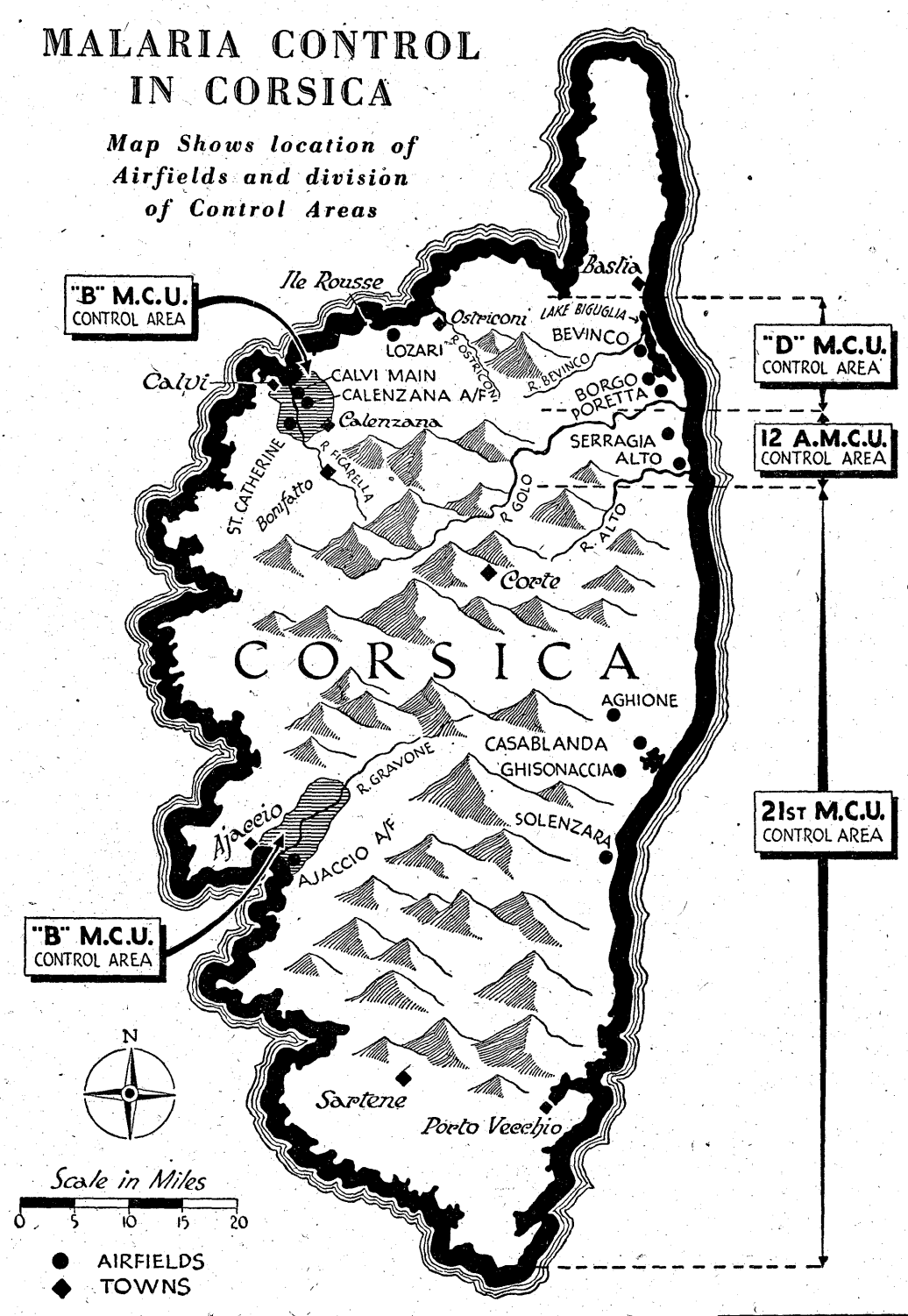
Of these it is proposed to describe only two of the methods, the second and third given above, as the others are sufficiently well known.

Aerial Dusting with Paris Green

Mosquitoe larvae are surface feeders and breathe by means of a tube while lying at the water surface.

MALARIA CONTROL IN CORSICA

Map Shows location of Airfields and division of Control Areas



S.C.O.R.U. H.Q., M.A.A.F.

Destruction of larvae can, therefore, be brought about by the introduction on the surface of the water of either oil, to bring about suffocation, or a poison.

Paris Green is a substance, poisonous to mosquito larvae, very light in weight and finely powdered, which is easily handled and cheap. A mixture is made using Paris Green with lime or road dust as a diluent. The value of this material when used from aircraft will be appreciated in the case of areas inaccessible from the ground, exisiting in *Corsica* in the form of large tracts of marshland. In this manner it is possible to distribute poison on the surface of large areas of water, thereby ensuring that the great proportion of larvae will never reach the adult stage. By this method alone it is estimated that potential malaria carriers are reduced by 90 per cent.

Malaria in Corsica

By virtue of its geographical position, *Corsica* possessed a unique strategic value to the Allies in 1944. In May, when the Germans were entrenched at *Cassino,* it was well ahead of the Gustav Line and invaluable as a base for aircraft engaged on traffic interdiction. A month later it became the stepping-off point for an assault on *Elba,* and in August it provided the main assembly area and air base for the invasion of *Southern France.*

Malaria is rife in *Corsica.* It is regarded by the population as an ever-present scourge, and it caused the Germans considerable anxiety in 1943 when incidence of the disease was very high in their forces of occupation. The country is wild and mountainous with a narrow low-lying belt along the eastern shore, criss-crossed by numerous streams and interspersed with many acres of marshland. The streams, mostly small and fast-moving, drain into the coastal plain and dry up in the summer, leaving pools which, often overgrown and difficult to locate, provide ideal breeding grounds for anophelene mosquitoes. Before the war, as part of a malaria control and land-reclamation scheme, the French constructed a canal and pumping system for the marshes along the shores of *Lake Biguglia* and in the coastal area as far south as the *Alto* river. All pumping stations, however, were destroyed or damaged by the enemy before his evacuation of the island.

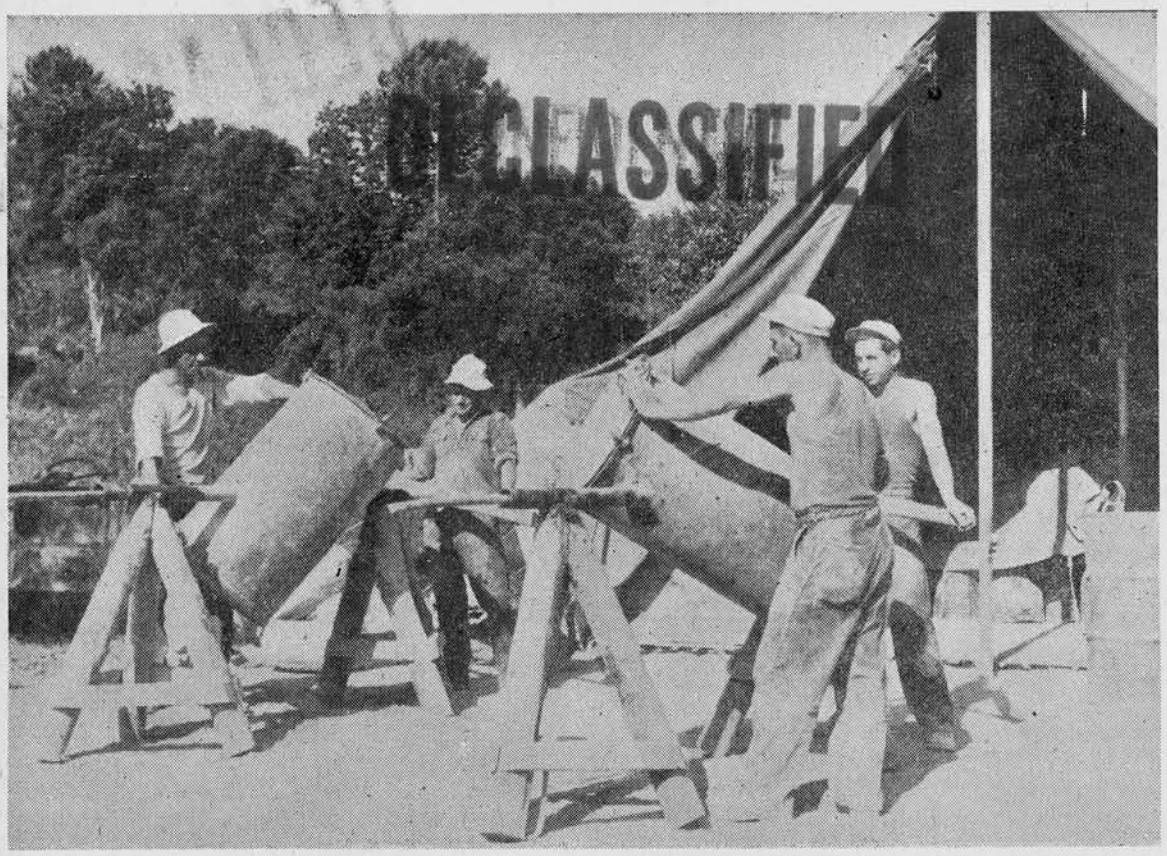
At least ten species of anopheles mosquito have been identified in *Corsica.* The most common during May and June, 1944, was Anopheles claviger, and in July and August, Anopheles maculipennis. Although through the season April-October, 1944, the principal vector was probably Anopheles maculipennis, Anopheles claviger was also thought to be a carrier as malaria occurred in areas where only this species was identified.

Analysis of Requirements

In January, 1944, following a survey of *Corsica* by U.S. Army Malaria Control Detachment 2655, a memoran[illegible] recommendations was presented c[illegible] areas of the island. This m[illegible] both the magnitude of the [illegible] by which malaria control co[illegible] stated :-

1. Little control should be required in the [illegible] and town area of *Ajaccio,* but extensive measures will be necessary for the airfield (three miles east of the town). Water to be controlled comprises ten acres of marshes and 30 miles of streams. Paris Green applied with rotary hand dusters is recommended as larvicide.
2. No control should be necessary in the *Corte* area, as this sector is in the central mountainous part of the island.
3. Port and town area of *Calvi* should require little control, but the airfield (two miles E.S.E. of the town) and proposed landing strip (four miles S.S.E. of the town) will need extensive measures. Water to be controlled comprises 70 acres of marsh and 27 miles of streams. Paris Green is recommended, application to be by rotary hand-dusters except for marshland which will require aircraft dusting.
4. The small port and town of *Ile Rousse* should not require control. Two miles of streams, however, will need Paris Green applied by hand dusting.
5. No mosquito control should be necessary in the *Bastia* (5) or *Porto Vecchio* (6) areas.
7. *Borgo* is the area of low flat coastal plain. There is one airfield existing (three miles N.E. of the town) and six new airfields are planned. In addition various parts of the plain will be used for bivouac sites. Malaria control will be necessary over the whole area. Water comprises 3,500 acres of open pond (25 per cent. needing control), 500 acres of marsh and 64 miles of streams. Paris Green is recommended as larvicide, application on streams to be by rotary hand-dusters and on marsh and ponds by aircraft dusting.
8. The *Ghisonnaccia* sector is also an area of low flat coastal plain. One airfield exists (east edge of *Gare Ghisonnaccia*) and seven more are planned. Various parts of the plain may be used as bivouac sites and malaria control will be necessary over the whole area. Water comprises 3,750 acres of open pond (25 per cent. needing control), 700 acres of marsh, 550 acres of flooded land and 136 miles of streams. Recommendations are as for *Borgo* area.

A summary of the requirements set out above disclosed that larvae control would be necessary on 2,413 acres of open pond, 1,280 acres of marsh and 259 miles of stream. It would also call for spray killing of adult mosquitoes in 800 structures and for the provision of approximately 4,000 square yards of window screening.



Yugoslav labourers mixing Paris Green.

Division of Responsibility

As a result of the survey undertaken in January, responsibility for anti-malaria measures in the *Calvi* and *Ajaccio* areas and over the eastern coastal plain north of the *Alto* river was delegated to the R.A.F., leaving the French to supervise the large towns and the Americans to control the remainder of the island.

For this task the R.A.F. had available No. 12 A.M.C.U. (ex *Levant*) and two Army M.C.Us on temporary attachment. At the commencement of operations in April, 1944, No. 12 A.M.C.U. was allotted the area between the *Golo* and *Alto* rivers, "B" M.C.U. the *Calvi* and *Ajaccio* sectors, and "D" M.C.U. the area north of the *Golo* river. At the end of May, when *Serragia* airfield was occupied, "D" unit took over territory from south of its original boundary up to this airfield, the area reverting to No. 12 A.M.C.U. in August on increase in establishment of that unit. From the *Alto* river to the southern tip of the island, control was exercised by the American unit, 21st M.C.U.

Strength of No. 12 A.M.C.U. before its increase in establishment was one Flight Sergeant and seven airmen, while that of each of the Army M.C.Us was one Officer, one Sergeant and six other ranks. In addition to the Service personnel, approximately 230 Yugoslavs—conscripted originally by the Italians for duty in *Sardinia*—were employed as labourers. It is satisfactory to note that these men turned out to be prodigious workers and that their efforts contributed in no small measure to the success of the undertaking.

Methods Selected for Control

The large areas of waterways, ponds and marshland being regarded as the major and most urgent commitment, measures chosen for their control were those considered most likely to prove satisfactory in the shortest period of time —viz: heavy oiling on the water and aircraft dusting over the marshland.

While most of the stream-oiling was done by knapsack sprayers, many of the larger areas were covered by pressure pumps operated from trucks. "D" M.C.U., controlling the seventeen miles of canals from the *Bevinco* airfield to *Alto*, used an American chemical warfare decontamination wagon mounted on a ten-wheeler chassis, this vehicle carrying 300 gallons and providing a spray at 200/250 lbs. pressure which

penetrated the thickest reeds and burnt up the vegetation, causing decomposition on the surface of the water. The heaviest concentration of oil by this method was about one gallon to 200 square feet.

In the area further south, No. 12 A.M.C.U. adopted the same principle, using a fully-rotary hand petrol-pump bolted to the side of a truck. They also experimented with a motor-driven orchard sprayer, but the result was less satisfactory than that obtained with the rotary pump as the sprayer did not maintain a sufficient pressure to drive oil through the dense vegetation.

Most of the oil used was grade 2 Diesel, this being easily obtainable and appearing to have a less injurious effect upon rubber parts than did Malariol. In the concentration in which oil was used, Malariol appeared to have no appreciable advantage.

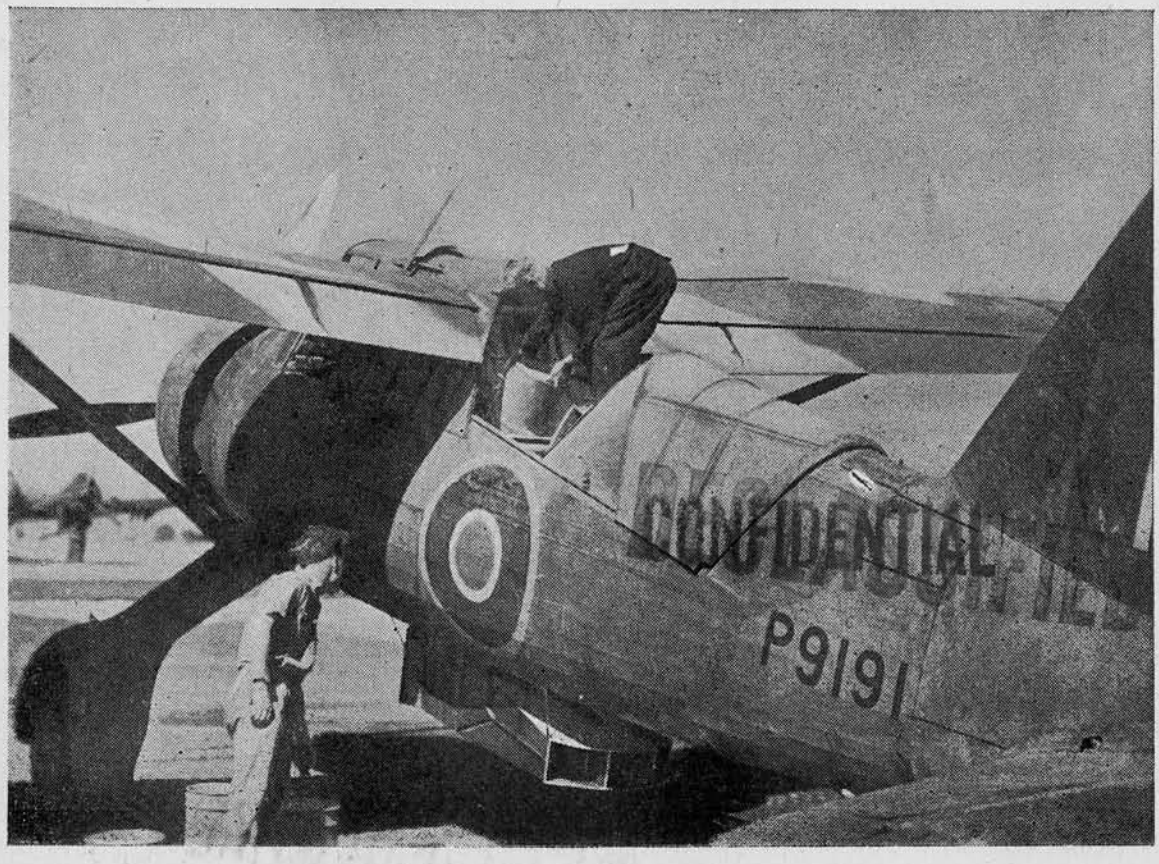
For the extensive marshes which stretch for about eighteen miles along the east coast, 50 yards across at their northern extremity by the upper end of *Lake Biguglia* and three quarters of a mile wide at the lower end of the lake by *Poretta* airfield, aircraft dusting with Paris Green was the only practicable method of cover. In most places these districts were heavily overgrown with reeds, and in some cases trees and bushes added to the difficulty of searching out the swamp areas.

Aircraft dusting was also employed around the airfield and along the *Gravone* river at *Ajaccio,* over the stream at *Lozari,* over the marsh and river at *Ostriconi* and in the *Calvi* area.

Most of the work fell to a Lysander (two were provided, but one remained unserviceable for the whole period), but some was undertaken by an American Boston and on a few occasions an Argus was employed. The Boston had the great advantage of carrying one and a half tons of dusting compound, and could cover the whole of the British area in five hours twenty minutes, whereas the Lysander, although superior for operating in confined spaces, carried only 300 lbs. The Argus was unsatisfactory, being underpowered and slow to respond to the controls—the latter a serious handicap in this type of work.

The mixture used was 25-33 per cent. Paris Green diluted with lime of diatomaceous earth. Of the 100,650 lbs. used, 68,300 lbs. were distributed by the Boston and 32,350 lbs. by the Lysander. While only about 10 per cent.

Loading a Lysander.



was considered to have been profitably expended, it is thought that such of the dust as fell on breeding places killed approximately 90 per cent. of the larvae. Evidence in support of this was found at *Poretta* pumping station where as a result of 112 adult anopheles killed during June and July, no mosquitoes were identified in August or September.

Resume of District Control

The preceding paragraph gives in outline the general plan followed for the wide expanses of water and marsh. Notes below cover the more important of the local areas and indicate the work carried out in each case.

Bevinco airfield was the most important of the five airfields on the east coast and was considered likely to be the most malarious. Half a mile to the north lay the *Bevinco* river, which in this part of its course dried up during summer, leaving pool formations. Between the airfield and the river was a low-lying area of market garden with two canals and a network of neglected ditches, and on its east side ran a collecting canal bordered by about 70 yards of marsh. The only dry area was that to the west.

All the ditches were cleared out and treated by knapsack oilers, the canals oiled by bowser and the area on the east side dusted by aircraft.

Borgo airfield lay two and a half miles south of *Bevinco,* and three quarters of a mile from the canal and marshes forming the edge of *Lake Biguglia.* North-east and west of the field was the *Rau de Rasignini,* south of the runway was an area of seepage, and east a dry irrigation canal.

Treatment here followed the measures used at *Bevinco*—air dusting of the canal and marshland, knapsack oiling of the upper reaches of the *Rau de Rasignini,* and bowser spraying of the lower and broader waterways.

Poretta airfield, two miles south-east of *Borgo,* was just north of the *Golo* river and adjoined a canal two and a half miles long and overgrown with blackthorn and reeds. It was also within one mile of the canals and marshes forming the border of the southern end of *Like Biguglia*—these about three-quarters of a mile wide.

After cutting the main canal from its source, it was first cleared and trenched from the swamp backwards to the river and then oiled by bowser. The marshes, impossible to cross even when labourers were clad in thigh boots, were dusted by aircraft.

Oiling with a decontamination truck at Serragia.

A Lysander dusting the edge of Lake Biguglia.

Serragia airfield, south of the *Golo* and just north of the *Rau de Serragia,* had an area of marshland and two canals, the nearest half a mile from the runway. As with others, the canals were bowser-oiled and the marshes along the coast dusted from the air.

Alto, the remaining airfield north of the river, was bordered on its eastern and northern sides by a heavily overgrown network of drains (tributaries of the canals adjoining *Serragia* airfield). There were also marshes east and north-east of the site.

A considerable amount of heavy manual work was required to clear this area. After preparation, part of the drain network was oiled by knapsacks and the remainder by bowser. All marshes were air dusted and the lower four miles of the river cleared and oiled.

The districts described above were the most heavily populated by Service personnel, and consequently it was essential to search-out and deal with all probable anophelene breeding grounds. Throughout this area there were numerous rocky streams originating in the mountains, which tended to dry up east of the main road while holding water in pools in the upper reaches. Much time and labour was expended in canalizing and oiling, and all the major waterways and pockets were brought under control.

On the west side of the Island, *Ajaccio* and *Calvi* were the principal areas, with *Lozari* a minor area.

Ajaccio was the headquarters of the Northern Base Section organisation and the majority of units were camped along the *Ajaccio-Corte* road. The problem here was more simple of solution and consisted of clearing and oiling drains and attending to wet areas caused through leaks from the open concrete canal carrying the town's water supply. The other area was the airfield on the delta at the mouth of the *Gravone* river, and for control of this the northern branch of the river was cleared and canalized. On the west side heavily overgrown ditches were cleared and in the centre sector five miles of the *Gravone* river was air dusted.

Calvi had three airfields, one opposite the railway station (*Calvi Main*), another between the *Ficarella* and the *Calvi-Bonifatto* road (*St. Catherine*) and the third along the *Calvi-Calenzana* road *(Calonzana). Calvi Main* was bordered by the lower reaches of the rivers *Fiume Secco* and *De Ficarella, St. Catherine* had a series of small streams west of the runway, and *Calonzana* formed a watershed for the *Rau de*

Bartasca. Oiling and air dusting were adopted as for other aerodromes.

Lozari was a beach used first as a Rest Camp, then as a landing ground and finally as a training camp for A.A. gunners. The only danger area was a small stream at the western end, and this was cleared, oiled and air dusted.

Pumping Stations and Canals

Reference was made earlier to a canal and pumping system constructed by the French before the war for malaria control and land reclamation along the shores of *Lake Biguglia* and the coastal marshes of the *Alto* river.

Each section of this system comprised a collecting canal, at the centre of which was a pumping station for transferring the water back to the lake or into the sea as was most convenient. All seven stations had been either destroyed or damaged by the Germans, with result that the marshes which lay between the five airfields *Bevinco, Borgo, Poretta, Serragia* and *Alto* were constantly under flood.

The most northerly station had only a few breaks in the wire, and these were repaired and the station put into action for a short time. The next one, by the *Bevingo* airfield, had been damaged by a hand grenade and was repairable. The three stations *Bevinco-Borgo, Borgo* and *Poretta* were supplied by a common line which had been destroyed, and the station near *Borgo* was completely wrecked. The two southern stations, opposite *Serragia* and *Alto* airfields, were in good order but the line supplying them had been destroyed.

A plan to control the level of these canals would have been practicable had suitable pumps been available. They were not.

Investment and Dividend

In addition to the 100,650 lbs. of Paris Green aircraft dusting referred to above, units under the administration of R.A.F. Medical Branch undertook 100,383 yards of clearing, 26,851 yards of new ditching and 199,760 yards of maintenance. They expended 31,613 gallons of oil on larviciding and sprayed over 4,000 rooms in 856 buildings.

The most important fact of the season, and the practical result of the undertaking, was that no unit suffered operationally from the effects of malaria. For the R.A.F. only 4 per cent. of personnel became cases during April and May, 6 per cent. in June and 10 per cent. in July and

Oiling with a converted petrol pump at Alto.

A typical breeding ground—the marsh of Poretta.

August. In the American forces the rate was more steady and averaged 5 per cent. over the five months April-August, 1944.

In conclusion, it may be said that the finest defences against mosquitoes and malaria will fail unless every member of the fighting forces and ancillary services does his or her share in the all-out campaign, and it is, therefore, only fair that a share of the victory that was undoubtedly achieved over the mosquito in *Corsica* should go to every man or woman who supported actively, and at times at the expense of personal comfort, this all-out effort. Their co-operation is gratefully acknowledged.

NO. 4 NAVAL FIGHTER WING

IN THE MEDITERRANEAN — 1944

IT IS AN ELEMENTARY principle that an amphibious landing, carried out beyond the range of single-engined land-based aircraft, must be supported by carrier-borne aircraft.

While Britain was still on the defensive, this principle was considered by the Admiralty and plans were gradually developed for future large-scale offensives. In 1942, two "experimental runs" were made by squadrons operating from aircraft carriers, first in the British landings on *Madagascar* and then with the British and American landings in *North Africa*. For these operations little progress had been made in liaison with the Army and the Naval air support was mainly confined to fighter protection over the convoys and beaches.

By 1943 the next stage in carrier-borne support was completed when short-range fighter cover for the Allied landings at *Salerno* was given. Five small carriers, known then as "Escort Carriers", provided continuous fighter cover of 24 aircraft over the beachhead for four days. Two fleet carriers operated further out to sea with anti-submarine patrols and fighter protection for both carrier forces. When the beachheads had been secured and landing strips completed, a formation of 24 Seafires landed ashore from the escort carriers to provide support for the Army, while short-range fighters of the R.A.F. began to come in from the south.

The carrier-borne activity over *Salerno* was still confined to fighter protection, but it provided the first proof of our ability to operate continuous missions from small carriers in company. The "baby flat-tops" which featured at *Salerno* consisted of H.M. Ships "Hunter," "Attacker," "Stalker" and "Battler"; H.M.S. "Unicorn," a carrier of medium size, brought the force up to five.

Formation of the Wing

After *Salerno* the first three carriers mentioned above were formed into a force and equipped for the special role of the assault, each being given a squadron of 20 aircraft. These squadrons, equipped with Seafires as before, became No. 4 Naval Fighter Wing.

In September, 1943, No. 4 Naval Fighter Wing started training for its new role of Army Support on a grand scale. By 1st January, 1944, each squadron would have to be capable of carrying out every one of the following roles:—

Air Fighting.
Tactical Reconnaissance.
Photographic Reconnaissance, with Vertical and Oblique Cameras.
Artillery Reconnaissance.
Bombardment Spotting.
Ground Attack.
Dive and Low-Level Bombing.

R.A.F. pilots, experienced in these roles, were attached to the Wing to train the pilots. An Air Liaison Section, consisting of a Major, a Captain and two clerks, was attached to each squadron to co-ordinate training with Army requirements on the same basis as had already been developed

by Desert and Tactical Air Forces. A Wing Leader was appointed to supervise Air and Ground training and to lead the Wing in action.

Army Support Training

The Wing prepared for operations in the Far East until January, 1944, when it was learned that there was to be an operation "elsewhere" beforehand. The delay gave time for further intensive Army Support training in conjunction with British and American Army units. Some idea of the scale of the work carried out in those seven weeks can be judged by the output of over 15,000 prints from the squadron photographic sections.

June, 1944, found the Wing in the Mediterranean and the pilots, whose previous hopes had been bent towards the Second Front, realised that the next job would be the invasion of the *South of France*. More Close Support training was undertaken in the Western Mediterranean with American Assault Forces, both from the ships and from the shore. The final dress rehearsal was carried out when Naval pilots from No. 4 Wing were attached to R.A.F. and S.A.A.F. squadrons with the Desert Air Force operating in *Italy*. In all, Naval pilots carried out some 700 sorties in *Italy* and operated in all the roles they would be expected to perform later.

Land Operations in Italy

The welcome that the Naval pilots received from the Reconnaissance and Fighter-Bomber Wings in *Italy* remains as only a memory in the wealth of operational lessons that were absorbed. At first pilots flew as number two to the veterans of Nos. 208 R.A.F. and 40 S.A.A.F. Squadrons on Tac/R and Arty/R and found that they were able to observe only a fraction of the movement seen by their leaders. But with each trip the information they brought back became fuller, and the Naval pilots were briefed to lead important missions as soon as they were considered sufficiently at home in the battle area.

Squadron personnel were split among bomber and fighter Wings, so that experience could be gained in all types of missions and the lessons passed on when they re-joined ship.

Parties of pilots were taken to the front to obtain a good picture of the conditions of the ground forces fighting south of *Arezzo*, and they brought a smile to the face of many veterans of of the Eighth Army when they saw the Navy trucks drive nonchalantly by, their dark blue covered with dust and the trucks filled with souvenirs of the land battle.

The encouragement given by both Army and Air Force and the great value of the experience gained formed a firm base and No. 4 Naval Fighter Wing confidently awaited its first operation.

Task Force 88 Formed

In preparation for the invasion of southern *France*, the three carriers were joined by a fourth squadron in H.M.S. "Khe[illegible]" [illegible] of Task Force 88, consisting [illegible] carriers under the command of Rear-Admiral [illegible] Troubridge, D.S.O. Two American carriers also joined the force, making a total of nine.

This was divided into two groups, the second including the two American carriers and H.M.S. "Hunter" and "Stalker" under the Flag of Rear-Admiral C. T. Durgin, U.S.N. This group sailed as a diversion to *Alexandria*, which gave opportunities to co-ordinate flying staff work and station keeping, and in four days a firm understanding had been reached between the British and U.S. carriers.

Invasion of Southern France

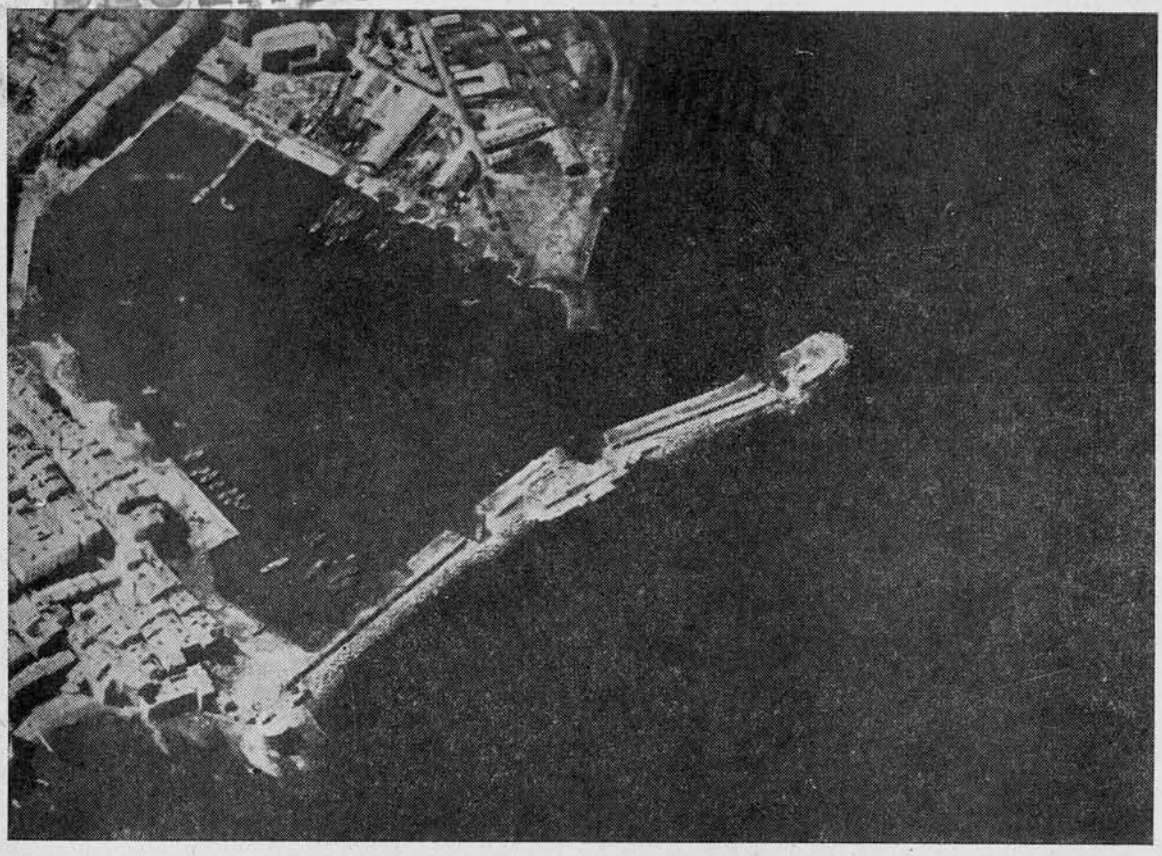
On 15th August, 1944, the two groups of carriers, bearing a mixed collection of Seafire, Hellcat and Wildcat squadrons, commenced operations off the south coast of *France* at *St. Tropez*. While R.A.F. and U.S.A.A.F. squadrons based on *Corsica* covered the eastern landings, the two assault divisions to the west received their close support from Naval aircraft. For thirteen days the squadrons operated continuously in the coastal area between *Bezier* and *Cannes* and up to 100 miles inland.

Success was achieved in all the roles in which pilots had been trained. The first days of the operation found a large proportion of one group's effort flown as fighter cover over our own force and standing patrols over the beaches, but as the complete absence of the Luftwaffe became normal, force cover was abandoned and every available sortie was flown to support the rapid advance inland of the assaulting divisions.

The full potentiality of Tac/R by the Naval force was not quickly appreciated, but it provided the majority of the information from which the A.L.Os built up the tactical picture of the land battle, and this vital information was passed to Army H.Q., first in the H.Q. Ship and then ashore by any available channel. The movement of 11th Panzer Division in its counter-attack role was one of those quickly spotted by the pilots and both tanks and transports were dealt with severely. Out of some 500 vehicles of this division known to have moved south, 300 were found abandoned on the roads when the American divisions overran the area.

The flak positions around the main centres of resistance—*Toulon, Marseilles* and *Avignon*—were the chief enemies that the pilots had to avoid, but the experience gained in *Italy* helped them to keep out of trouble.

The French battleship "Strasbourg" was bombarded by Naval units under the direction of Seafire pilots as she lay at *Toulon*. Enemy coastal batteries were put out of action by Seafire pilots directing the guns of the British, American and French battleships on their emplacements so effectively that by D plus 5 enemy guns remained silent for fear of the eagle eye of the pilots overhead, who would immediately call for fire



St. Tropez harbour with quays demolished on "D"-Day, 15th August, 1944, photographed by an aircraft of No. 4 Naval Fighter Wing.

from the bombarding ships to be brought down as soon as the enemy flashes were spotted.

Information Passed Quickly

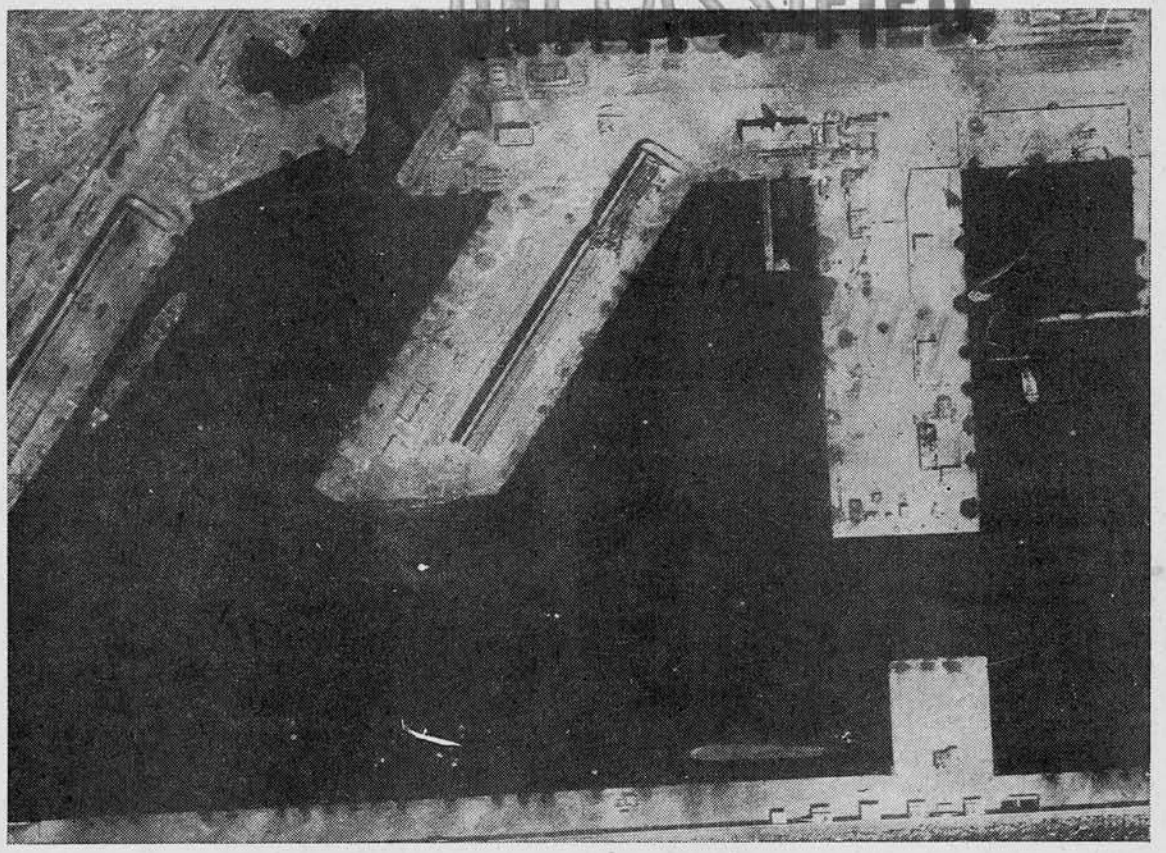
On D plus 3 it was feared that the enemy 15th Panzer Division was moving east to *Marseilles* from the *Bezier-Toulouse* area. A rapid move of the carrier group to the west and Tac/R by Seafire pilots provided vital information that this was incorrect and no movement was taking place from the west. All information gleaned by pilots, whether from reconnaissance or close support missions, was passed by the Air Liaison Sections on board the carriers to the American H.Q. Ship anchored inshore. Here it was sifted and passed to the Army ashore. Requests from the Army for close support or reconnaissance were passed through the H.Q. Ship to the carrier force : within 30 minutes of the demand aircraft were taking off from the carriers, and often within an hour they were over the target area.

There were two good examples of this close support. On 17th August, the Army complained that their troops on *Port Cros Island* were being held up by a German garrison in the castle at the north-west end of the island and that Naval units could not bombard the enemy mortar positions owing to the intervention of a high ridge of land. At 10.00 hours, 50 Naval fighter-bombers launched an attack with bombs, rockets and cannon fire—and the German garrison immediately surrendered.

On 23rd August, the Army asked for an attack on a heavily defended column of the enemy retreating northwards along the road from *Orange*. In spite of intense flak, very poor weather and approaching dusk, 20 Naval aircraft attacked this column less than 500 yards from our own forces. One hour later the enemy column was overrun.

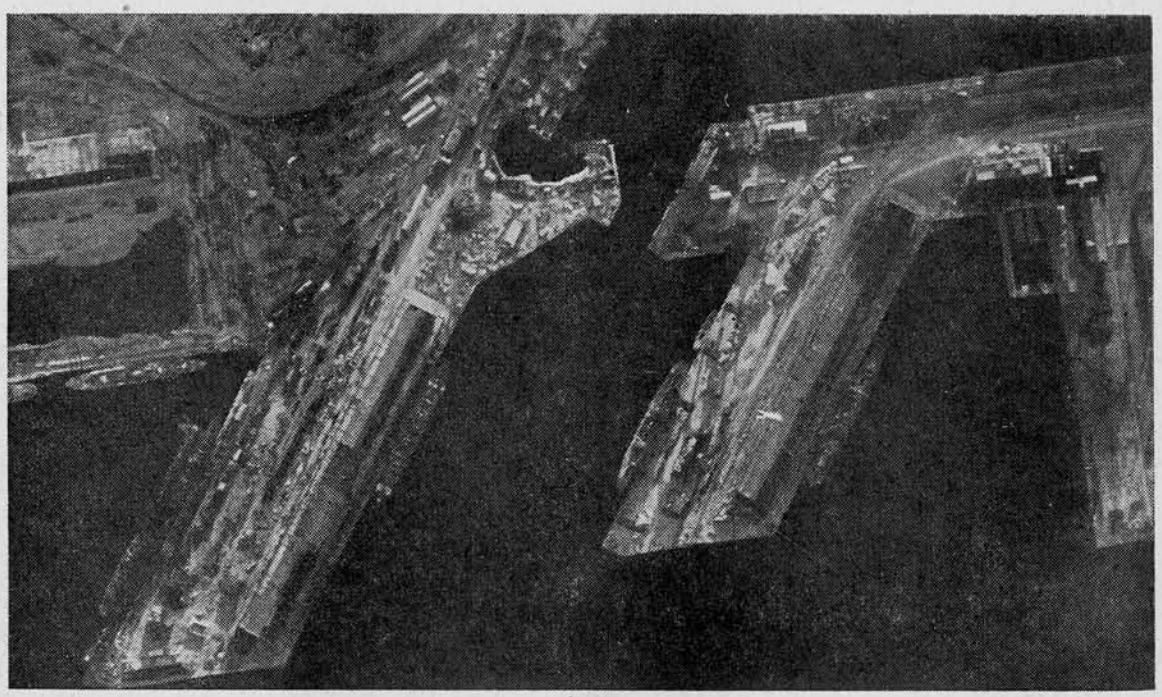
Difficulties of Landing

It is not an easy matter to land a Seafire on the deck after a long sortie. The deck of an assault carrier allows the pilot 400 ft. to work from for take-off and only two-thirds of this for landing. Of this two-thirds only the first half is safe for his touch-down because if the pilot lands in the second half, he is likely to damage his aircraft in the barriers. If he fails to catch any one of the arrestor wires he will certainly write-off his own aircraft and probably damage some of those parked forward of the barriers;



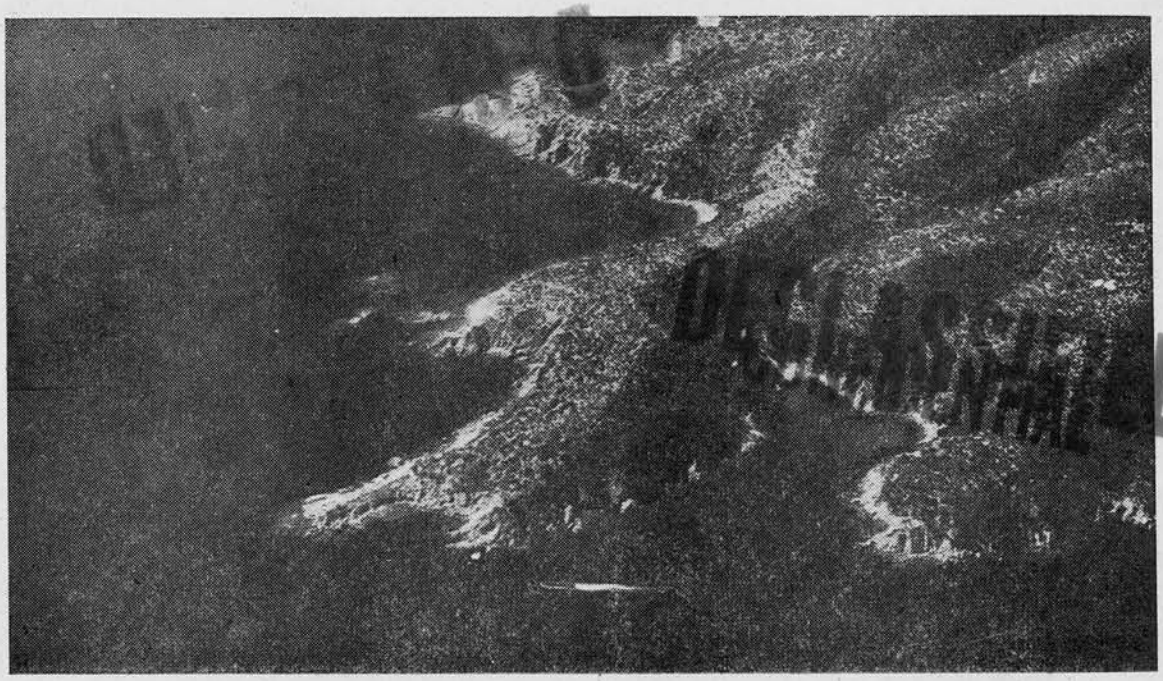
Above:—*Reconnaissance photograph by No. 4 Naval Fighter Wing on 20th August, 1944, before demolitions in Marseilles dock area by the Germans.*

Below:—*Further reconnaissance six days later revealing demolition damage.*



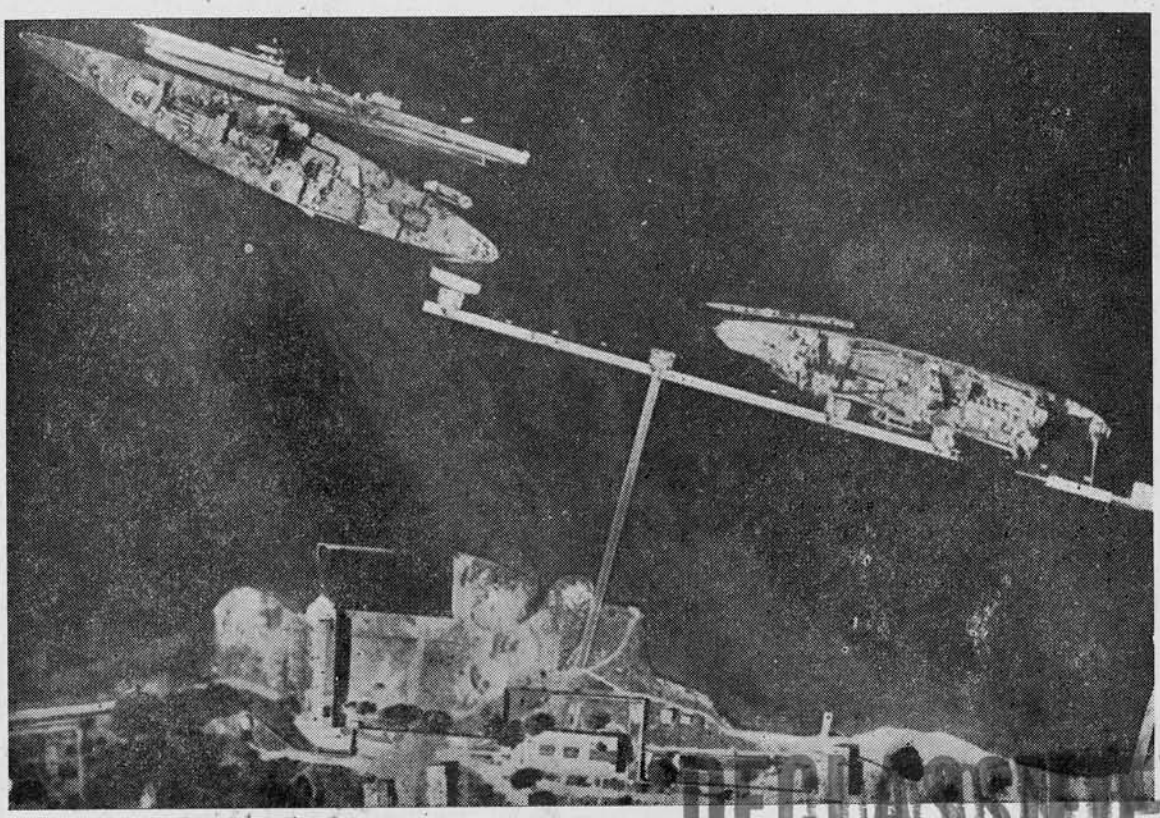
Siebel-Ferry and Flak Ship before attack by Seafires.

Siebel-Ferry later seen to be sinking.



A motor vessel creeping up to Salonika. It was destroyed later by a Seafire attack.

The French Battleship "Strasbourg" disabled after Naval bombardment combined with spotting by Seafires of No. 4 Naval Fighter Wing.



Seafires of No. 4 Naval Fighter Wing on patrol over Piraeus.

for the first few days of the operation there was little or no wind and this meant that the relative speed of the aircraft to the deck of the carrier was proportionately high. In spite of these conditions, however, there were very few accidents and, in fact, throughout the operation it was found unnecessary to embark any reserve aircraft.

Sixteen hundred and forty-four sorties involving some 2,600 operational flying hours were flown from the seven British carriers during the operation and, although previously five days operations had been considered the maximum, it was found that carriers could operate for at least two periods of five days if a clear 48-hours break was given in order to relieve the strain on pilots, staff and deck handling parties.

About 300 of the total sorties were reconnaissance, bombardment spotting and photographic, and some of the photographs produced—particularly those of *Marseilles* harbour before and after demolition by the Germans—were of great value to the Army. In addition to the bag of destroyed vehicles, the morale effect of having Seafires ready to bring down Naval gunfire on any German battery that opened up against the Allied armada was an important contribution by the carrier force.

Operations in the Aegean

After the excitement of this operation had died down, No. 4 Wing sailed to *Alexandria,* to collect new aircraft and to prepare to chase the Germans out of the Aegean.

In daylight on 15th September some of the ships carrying the Wing, with the Hellcat squadron in H.M.S. "Emperor," entered the Aegean within range of the German shore batteries on *Crete,* while others were detached at points of vantage around the southern shore. During the nine weeks until 20th November from one to four carriers were continuously on patrol between *Crete* and *Salonika.*

These operations were of an entirely new type, because, although the object was to destroy Germans, the carriers and the cruisers and destroyers operating with them as Force "A" were without direct communication with the Army, which by now had landed on the mainland of *Greece* and was forcing its way to *Athens.* Attacks were made on *Crete,* on many of the smaller islands, and on the rail and road communications along the eastern coast of *Greece* itself. The missions were mainly devoted to softening-up attacks and spotting for Naval bombardment before landings by Royal Marines or Commandos, but harassing attacks were made on the enemy's

sea and land communications with the object of destroying the Hun and hastening the liberation of *Greece*.

Miscellaneous Targets

The island of *Melos* was found to be a heavily defended outpost and many sorties were flown against this strongpoint. As the German force attempted to retreat up the east coast of *Greece* to *Salonika* on the only escape route left to them by the increasing activity of Marshal Tito's forces to the north, Seafires and Hellcats again and again destroyed trains and cut the railway line which runs parallel with the coast. Continuous reconnaissance and photography by the Tac/R Seafires produced many good targets for the Seafire fighter-bombers, and the German plan for withdrawal by this route was eventually abandoned.

In all, between 7th and 20th October, 1944, thirteen engines and 54 trucks were claimed as destroyed and a further five engines and 97 trucks damaged by Naval air attack, in addition to large numbers of merchant ships and enemy minor war vessels destroyed by the joint effort of air and Naval attack. The Germans had lost so much of their transport by internal and air and sea attack that the final evacuation had to be carried out mainly on foot by night through the mountains of *Northern Greece*.

Success Against Shipping

Two of the squadrons of No. 4 Naval Fighter Wing had particular success against enemy shipping in the Aegean, bombing missions accounting for one 2,000 ton motor vessel, one 1,000-ton merchant ship and a 500-ton ship sunk by bombing attack, in addition to many large caiques, Siebel-ferries and barges which were caught in a game of "cat-and-mouse" as they attempted to slip into the island harbours to evacuate the German garrisons.

Since no enemy aircraft had been encountered during the operations off the south of *France*, the pilots hoped they would be lucky enough to find transport aircraft in the Aegean, but these had already been dealt with successfully by R.A.F. Beaufighters intruding by night into the German air escape routes. Two aircraft were destroyed, however, by Seafires of No. 4 Naval Fighter Wing—a DO.24 in *Volos* harbour and a JU.88 over *Athens* on 16th October.

On 18th September, a number of B.V.222s and H.E.115s were discovered at anchor in *Suda Bay*. An attempt was made to destroy these by dive-bombing with Seafires, but cloud conditions prevented accuracy. A low-level attack by 24 Seafires was arranged for the following day, but due to the recall of the carriers had to be cancelled.

Capture of Levita and Private Wars

On 5th October, H.M.S. "Hunter" provided air support for the entirely Naval capture of the island of *Levita*, where the German garrison maintained a W/T station, traffic from which was intercepted reporting on the movements of our own forces. A boarding party from H.M.S. "Catterick" and "Aurora" landed successfully and were dismayed to find that the only visible opposition consisted of herds of goats, and immediately queried the accuracy of the Tac/R pilot who had reported German activity at dawn. The Tac/R report was found by the Marines to be only too true half-an-hour later when the German garrison put up a stiff fight in the centre of the island before finally capitulating and returning as prisoners of war on board the destroyers.

Another operation of some interest was carried out in support of the Army landing party on the island of *Piscopi*, north-west of *Rhodes*, on 29th October. A signal was received that a British force had captured the island on the previous day and that all the German prisoners had been taken in a cruiser to *Alexandria*. During the night, however, the Germans on *Rhodes* had retaliated and a raiding party had landed on the island and cornered the small British garrison. A Greek destroyer and four Seafires were sent to the rescue and the Germans were discovered in the southern half of the island while the British occupied a corner in the north. Seafire pilots found two German landing craft in a harbour on the south-east coast and passed this information back to their carrier and to the destroyer. The destroyer first bombarded the landing craft and then later successfully evacuated the British landing party, while a flight of Seafires also bombed the landing craft and straffed the area held by the Germans.

Following the Aegean operation, No. 4 Naval Fighter Wing returned to the United Kingdom, where, after two weeks' leave, and assisted by many new personnel, it once again resumed training for future employment.

Enemy Ingenuity versus Allied Interdiction

A FEATURE OF THE Italian campaign from the autumn of 1943 onwards has been the Allied attempt to cause interdiction by air to the enemy's lines of supply and communication. The theory was that the Germans, weakened through lack of essentials, would find it difficult to fight successfully on the defensive, let alone build up sufficient reserves to indulge in offensive operations.

The steps taken by the Allies to bring about this state of affairs, by a carefully calculated bombing policy designed to destroy bridges, cut railway lines and disrupt marshalling yards, have been described fully in previous numbers of the Review and are also referred to elsewhere in this issue.

The Germans naturally did not take the treatment meted out to them lying down and, in this article, it is proposed to indicate briefly how, by counter-measures to our interdiction policy, they contrived to maintain their armies in the field.

Masters of Improvisation

All through this war the Germans have proved themselves to be masters of improvisation. This fact is evident from the way in which they have kept their much-bombed factories going, while another typical case in point was the Greek campaign in 1941, during which the advancing Germans got their men and machinery through places that demolitions were thought to have rendered impassable. Similarly, for a defensive campaign, the dour struggle for *Italy* has all along provided samples of their skill and ingenuity.

This is certainly true as far as their speedy reactions to our interdiction policy were concerned. Although they have continued to retreat northwards under Allied pressure, that retreat has never developed into a rout and, in spite of the harassing of their life lines, a sufficiency of supplies has contrived to seep through.

In making this possible, the Germans knew that they could expect precious little protection from the Luftwaffe and, for any defence of vital points, would have to rely exclusively on smoke screens and A.A. guns. As these could never be ubiquitous—although considerable use was made of specially equipped flak-trains for protecting threatened points—the Germans had to be prepared to face two major repair or improvisation problems—(a) railways and (b) bridges.

For this task they could call on the vast resources of the Todt Organisation for all planning and direction. Although certain jobs were on occasion assigned to German Army Engineers, direct supervision of work was normally turned over to private engineering firms. These firms furnished some of the necessary equipment and the supervisory crews, but most of the actual labour was carried out by Italians who were pressed into service.

The Railway Problem

In facing the railway interdiction problem as a whole, it cannot be denied that the German repair organisation has, through long practice, reached a high degree of efficiency. As soon as the bombers departed, the repair machinery was set in motion; every advantage was taken of spells of bad weather that reduced both our bomber and reconnaissance effort; and repair work was finally brought to such a pitch that constant attacks have been necessary if a line were to be kept anything like permanently cut.

The German policy, therefore, has been to accept the fact that many tracks would be knocked out again and again, but to strain every nerve to keep at least the minimum open for essential traffic.

To bring this about, they had the following alternatives:—

(i) Repair of damage as quickly as possible.
(ii) Diversion of traffic and use of minor lines where practicable, with reliance on roads, if unavoidable, for circumventing rail blocks.

Mobile Repair Crews

For repair work, the Germans eventually evolved a system that has stood them in good stead. The core of this system comprises a number of highly-trained, highly-mobile repair crews, capable of being rushed to any damaged section of the line at a moment's notice.

Headquarters of the various crews are located at large rail centres, from which detachments are dispersed to "waiting" stations. The entire railway network is divided up among these crews, all of which are thoroughly briefed on the most important sections in their area so that, if one of these is damaged, all planning and preliminary measures for repair have already been accomplished.

The outfits themselves have been described by prisoners as consisting of the following:—

(a) One rail car carrying three to nine expert technicians, with various files containing information on possible repair measures and other technical details.
(b) Two to four workshop cars carrying welding equipment, cranes, tools, spare parts and so forth.
(c) One to two cars for spare rails and large replacement parts.
(d) One to two cars for cement, gravel, stone blocks, etc., for road bend construction.
(e) One to two cars for crews' quarters and kitchen facilities.

The Crews Go to Work

When an air raid is reported, the crews in that area are immediately warned and, in the event of damage occurring, exact information as to location and extent is telephoned or radioed to the headquarters concerned. From there the necessary instructions are radioed direct to the repair trains, details being added while the train is in motion.

In some cases small emergency trains, carrying unskilled workers, reach the scene before the better-equipped crews; their task is to clear away the rubble and so on, enabling repairs to begin as soon as the expert technicians arrive.

As regards the types of repair work that have had to be performed, prisoners have indicated that, while repair to actual tracks was comparatively easy, landslides caused a great deal of delay. According to one statement, for example, traffic on the *Brenner Pass* line was interrupted for eight days when bombs fell in such a way as to cover about half a mile of track at a bend with debris; the repair work consisted almost exclusively of excavation, little damage having been done to the actual rails.

Diversion of Traffic

An alternative to actual repair work, pure and simple, is provided by the possibility of traffic diversion to branch lines where such lines are available.

The Germans soon became adroit at this re-routeing and, by carefully analysing all potential railway targets, had a knack of being able to keep open at least one line to which traffic could be switched in order to avoid damaged areas. Alternative lines are always available in the marshalling yards, so that complete paralysis can normally be quickly overcome. To avoid congestion in the larger yards, the widest possible use has been made of side tracks as off-loading points.

In the event of there being no chance of a detour line, the enemy has naturally had to fall back on the roads. This, however, is an inconvenient procedure used only as a last resort.

One of the few advantages of road traffic is that the roads themselves are, on the whole, less liable to severe damage than the rail tracks and are consequently easier to keep serviceable. Even when bridges are concerned, it is [illegible] simpler matter to make sufficient repairs to let road traffic through than is the case with rail traffic.

The Bridge Problem

This brings us to the problem of bridge repair in general—a problem that must have been a constant nightmare to the Germans throughout the Italian campaign.

Italy is a country in which bridges abound and, whether they liked it or not, the Germans had to make an effort to keep a proportion of them serviceable. They faced up to the bridge situation with their usual thoroughness and, as they did with the railways, contrived to find an answer to the question of getting supplies across.

As far as the minor bridges are concerned, the problem has not been too tough. Efficient planning in advance and the use of a certain amount of prefabrication are two factors that have helped to ensure speedy repair work. New bridges of from ten to twelve metres can, it is estimated, be erected in from two to ten days, depending on local conditions, and sometimes sufficient temporary repairs can be effected in a matter of hours.

Preparing for Trouble

If a major bridge is destroyed, however, the problem naturally assumes considerable proportions. Here preparation is the keynote. Bridge-building materials are accumulated at strategic points and, in anticipation of trouble, emergency lines may be laid in advance from a main R.R. bridge to an auxiliary bridge or to a location where a temporary bridge can be erected at short notice. If necessary, complete loop lines may be built to avoid existing bridges and to afford fewer points for possible blocks.

There is always the added anxiety, however, that even if the engineering work is successfully accomplished, no guarantee exists that another air attack will not undo the result of weeks of labour by knocking the bridge down again. At the *Po* crossing at *Ostiglia,* for instance, when the permanent bridge was destroyed, the Germans quickly erected a wooden structure to carry the railway — only to see it written-off after two or three days' serviceability.

Although they have had some remarkable engineering feats to their credit, the time came when the Germans were forced to adopt other measures. As regards the *Po* river bridges — which offer the most convenient and typical study — these measures are: —

(i) The use of pontoon bridges.
(ii) The use of ferries.
(iii) A system of deception.

Night Use of Pontoon Bridges

The use of pontoon bridges and ferries is by no means an ideal substitute for the permanent R.R. bridges, but is one that allows at least the minimum essential requirements to reach the troops south of the river.

In the case of pontoon bridges, as these are clearly far too vulnerable in the event of a day attack, the Germans devised a scheme whereby the various sections are scattered along the river bank, assembled at dusk, used during the hours of darkness and dismantled again before daybreak, the sections being scattered as before. To give added security, the changes are rung on a series of pontoon bridges, one being assembled one night and another in a different locality on the next night.

This scheme, although it does not enable the enemy to bring over the tonnage he would no doubt like, has the advantage that the bridges are not there when our day bombers or P/R aircraft are on the scene to catch them. Night photography offers obvious difficulties and the attempts that have been made to destroy the pontoons while in use have not so far had the desired effect.

The Ferry System

The chief drawback to the pontoons is the fact that there are apparently none with a capacity in excess of 25 tons. An alternative, however, exists in the ferry crossings, of which no fewer than 56 have been spotted by P/R.

These ferries, which are almost as important as the pontoons in the enemy's improvisation policy, vary considerably in capacity—from hand-pulled boats carrying only personnel and light stores to train ferries capable of carrying two or three loaded rail cars on each trip.

Each rail ferry is normally located near a former rail crossing point and, leading off from the main rail lines, the Germans have constructed a spur line on an earth bank. This runs down to the ferry terminus, where facilities are provided for transferring cars from the rails to the ferry boats.

Similarly, M.T. ferries with capacities of over 70 tons have been created, consisting of two or more pontoon boats lashed together and capable of carrying several loaded lorries, with fifteen or twenty men. The usual power unit consists of small tugs or two or three outboard motors.

As they are used principally at night, the ferries have not provided good targets for our aircraft.

Pipe Lines Across the River

A third alternative—at least for the moving of fuel across the *Po*—is the use of pipe lines. There is evidence of a number of these, the enemy having constructed rail diversions leading off from main lines to transfer points, where the oil is unloaded from cars and pumped across the river to cars waiting on the opposite side.

The transfer points are well camouflaged, but in certain cases the actual pipe line can be traced from photographs up to the river bank.

Elaborate Attempts at Deception

Apart from these methods for getting supplies across the river, the Germans have also adopted another subterfuge—deception.

This deception scheme began to show itself in December, when it was noticed that there were several unexplained delays in the repair of certain key rail bridges and several apparent inconsistencies in maintaining them as serviceable.

A detailed study of air photographs provided the solution to the mystery by revealing the fact that:—

(a) Certain damaged bridges were repaired only up to a point so that, although they appeared impassable, they could be repaired completely in only a few hours.
(b) Certain serviceable bridges were made to appear impassable by the removal of one or more short spans, which could, however, be replaced when necessary with little delay.

The reason for these curious goings-on is clearly that the enemy hopes to put our P/R and intelligence off the scent and so protect the bridges in question against the possibility of attack.

A study of the railway network as a whole reveals the fact that such subterfuges have been resorted to under various circumstances:—

(a) When a convenient by-pass route is open to carry the necessary traffic.
(b) When other bridges on the same line are undergoing repairs and it is not considered wise to make one bridge completely serviceable until the entire line can be opened.
(c) When a diversion is open, enabling the semi-repaired bridge to be kept in reserve.
(d) When there is a chance to use a bridge by night only, taking out one or more spans before daybreak.

This deception scheme is an ingenious one—but valuable only so long as the reasons behind it remained obscure.

Pros and Cons of the Interdiction Battle

Looking back on the interdiction battle, what conclusions can be reached?

For our part, it may be said that the interdiction policy has undoubtedly helped our land forces, in that it has made impossible any chance that the enemy might have had of launching a sustained offensive; it played a vital part in making the *Anzio* landing a practicable proposition and ensuring the capture of *Rome;* and it has thrown a great and constant strain on the enemy's already over-taxed resources in both manpower and material.

On the German side it may equally truthfully be said that by determination and ingenuity—to which should be added the outside factors of intermittent bad weather and heavy Allied air commitments elsewhere—they have avoided a complete supply stranglehold and have contrived to provide their armies with sufficie[illegible]ans to fight a dogged delaying a[illegible]*aly*.

The Magnetic Sweeper

IN APRIL, 1944, No. 236 Medium Night Bomber Wing began to experience a greatly increased incidence of aircraft tyre failures due to small, deep cuts, a wastage that increased to such an extent that the normal supply of replacement outer covers could not keep pace with the demand. The position became so desperate by the end of the month that no fewer than seventeen aircraft from the Wing were grounded through lack of tyres.

The cause of this sudden increase in tyre wastage was not apparent at first as the Wing had been operating from the same airfield for over three months without an undue amount of tyre trouble, and it was not until a searching inspection of the dispersal areas was made that the cause was revealed. The whole area was found to be littered with splinters from American fragmentation bombs, a legacy from the U.S.A.A.F. attacks the previous year prior to the invasion of *Italy*. Added to this there was further extensive metal contamination by thousands of wood screws, nails and fittings, the result of fires that had been made by ground crews from ammunition and packing boxes during the winter.

Hidden by the Mud

During the winter months all this metal had lain harmless under a covering of mud, but directly the ground hardened on the advent of fine weather the top soil had blown away and exposed the razor sharp edges embedded in the ideal matrix of hardened mud.

Extensive and intensive sweeps were immediately made of the affected area by lines of personnel walking slowly across the airfield, but although these sweeps did produce a rich haul of the larger and more obvious metal fragments, the great majority of the small and most dangerous splinters still eluded detection, as by now they had rusted to a colour identical to that of the ground.

The operational tyre "life" had by now fallen to an average of two take-offs and landings per tyre and an immediate solution was imperative if the Wing were not to be completely grounded. The only answer appeared to be the construction and operation of a large and powerful magnet that could be used to comb the dispersal areas. The Engineering and Electrical staffs of the Wing put their heads together to produce a "Magnetic Sweeper" that was christened by certain irresponsible parties as the "Snifter."

Various Types of "Snifter"

The Mark I Snifter proved to be a failure and never reached the production stage. Mark II was successful, but neither powerful nor robust enough. By improving and rebuilding this original machine, however, a Mark V Snifter was evolved that proved to be the answer to all the problems.

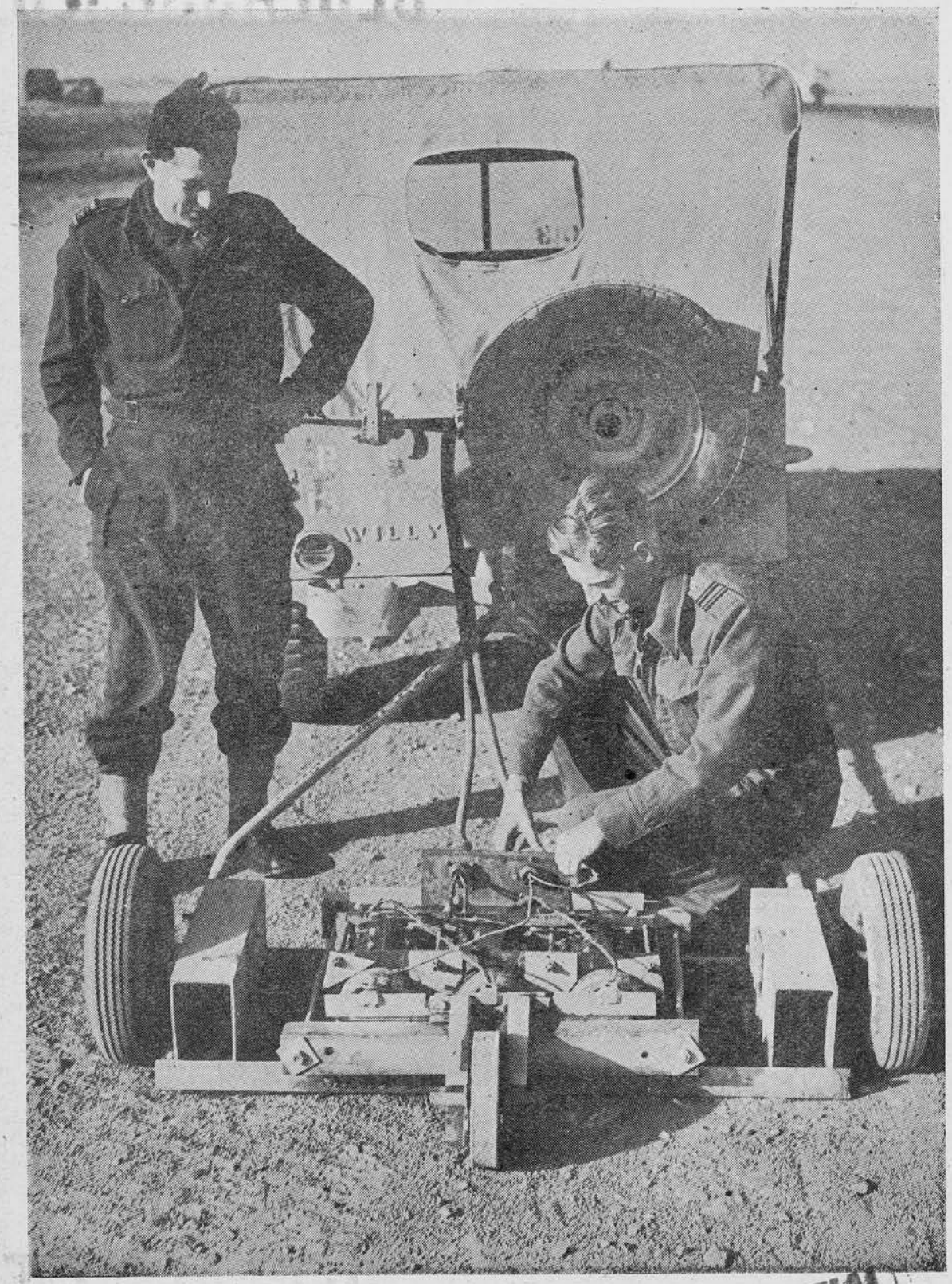
Three field coils with laminated soft iron cores and bridge pieces were obtained from a high tension transformer found amid the rubble of a nearby bombed technical school. These coils were mounted on a chassis made from two four-feet lengths of "H" section girder, these chassis members also forming the magnet poles. By suitably mounting two pneumatic tyred wheels at either end of the chassis together with small leading and traveller wheels, the whole assembly could be towed over the ground with the poles some inch and a half above the ground surface.

To energise the field coils a 24 volt, 40 amp. Petrol Electric set was mounted in the back of the towing vehicle, this vehicle being equipped with a suitable switchboard to enable the current to be switched off when it became necessary to remove the haul of sweepings.

Producing a Swept Lane

By towing the "Magnetic Sweeper" at a slow walking pace over the area to be cleared, an effectively swept lane four feet wide was produced. At approximately every hundred yards the current was switched off and the "catch" collected. It was found in operation that metal objects below the surface of the ground and hitherto unnoticed were drawn up, and as the work proceeded in cleaning up the airfield a remarkably varied collection of metal objects, including armour-piercing bullets, bomb splinters, A.G.S. items and S.A.A. belt clips, was obtained.

The Snifter was operated all through the summer until the arrival of wet weather in October rendered its operation unnecessary. The success of its activities may be judged by the fact that by November the average number of operational take-offs and landings per tyre had more than trebled.



The "Snifter" being set for use on the runway of an airfield in southern Italy.

The magnetic sweeper hooked to the back of a jeep, photographed on the runway before setting out on its daily combing operation.

An extraordinary collection of pieces of metal—jagged bomb splinters, bullets, rusty nails and bits of tin—picked up by the "Snifter."

IT IS PLEASING to record that the crop of extracts from the Operations Record Books and Squadron Diaries for the period under review is a richer harvest than in the previous quarter. Thanks are due particularly to the War Diary Section, Advanced S.A.A.F. Headquarters, C.M.F,. for active co-operation and the provision of many of the high-lights.

No. 1. A Rapid Pick Up

(From No. 7 Squadron, S.A.A.F.)

21st October, 1944. The second mission, led by Capt. M., was on its way out to bomb gun positions, when they heard tanks reported. They went to the area given, but saw none, and so proceeded to bomb their original target, obtaining hits in the target area where gun pits were observed. Two cars were destroyed and a third damaged when the flight was straffing in the area north of lake *Commachio*. It was here that Capt. M.'s aircraft was hit, in all probability by his own ricochets, and as he crossed the coast on the way home glycol was seen streaming from the aircraft. He headed out to sea, and when about fifteen miles off the coast, abandoned the aircraft as the temperatures were rising rapidly. Two aircraft of his flight remained with him, the others returning to base owing to fuel shortage.

In this case, both Lts. S. and Van D. are to be commended on the way in which they handled the incident. Lt. S. went down low to watch him alight and satisfy himself that Capt. M. was safely in his dinghy, whilst Lt. Van D. stayed up, transmitting for a fix. As they themselves were about to leave, owing to fuel running low, an A.S.R. Warwick arrived on the scene, and dropped a larger dinghy and marker floats. Two Mustangs were also directed over the dinghy by "Commander." The efficiency of the A.S.R. organisation can be gauged by the fact that, after

baling out at 11.35 hours, Capt. M. was picked up by a Catalina at 12.15 hours.

No. 2. How the Other Half Lives

(From No. 15 Squadron, S.A.A.F.)

The 14th and 15th November, 1944, were two more days of rain which isolated the Squadron more than ever from the outside world. The only remaining road from the camp to the runway was almost impassable, and frequent hold-ups occurred due to trucks becoming bogged or sliding off into the ditches. This was proving an ever increasing hardship to our ground crews on their way to and from the aircraft, to the aircrews getting to their aircraft for operations, and more especially to the Armament Section who had to haul their bombs out of the mud and take them out to the aircraft. Bombing up is, at the best of times, a difficult task, but for the armourers to handle very cold muddy bombs, and to trample under the aircraft in mud at least six inches deep, and to bomb up and fuze all their aircraft at least twice a day, is one of the greatest hardships that any man can undertake; but it is a task that is helping to defeat the enemy in *Italy* and deserves the highest praise. Not only have all these armourers and "erks" to work in the mud, but they have to live in it—their messes are deep in mud, and their living tents are surrounded by mud and very often under water due to the rains.

No. 3. The General Wants to See You

(From No. 417 Squadron, R.C.A.F.)

24th October, 1944. Leading a section of six aircraft on a Rover Paddy operation and nickelling raid over enemy territory in the *Cecina* area, P/O H. encountered considerable heavy flak. After the show was over he was heading back to rendezvous with his No. 3 at 8,000 feet, when he noticed the glycol leaking. The engine spluttered, the cockpit filled with smoke, and when over friendly territory once more P/O H. decided it was time to bale out. After initial difficulty in getting clear, he drifted down safely to a waiting crowd of what he described later as "thousands of Iti's." Immediately on landing he was offered a jug of vino by an Italian; at the same time a British soldier informed him nonchalantly that "The General wants to see you."

P/O H. was then taken in a jeep to Headquarters, where he found Generals B. and H. waiting for him. They provided him with some rum, and informed him that he was just in time for dinner. During the meal the conversation turned on our Rover Paddy operations, and the Generals praised the air force's efficient co-operation with Army.

P/O H. returned to the Squadron in General B's Auster, much to his disgust for, in his own words, "The N.C.O. offered me the jeep for three days. Can you beat that? And I had to take the Auster."

No. 4. To Jettison or [illegible] Jettison

(From No. 1 Squadron, S.A.A.F.)

14th December. The six aircraft took off at 14.05 hours with Lt. H. B. leading; Lt. [illegible]. was flying No. 6 in the formation and was the last to take off. Just as he was picking up his wheels after becoming airborne his bomb was seen to fall. The aircraft began losing height and it is thought that he jettisoned his bomb as he expected to make a belly landing. The 500-lb. bomb exploded, almost disintegrating the Spitfire, the remains of which skidded along the runway for a few yards, a blazing mass. No. 2 Squadron ambulance and our fire tender were on duty; both were damaged by shrapnel.

The driver of our fire tender, A/M C. and his N.M.C. crew put up a good show endeavouring to put out the blaze, remaining within a few feet of the wreckage although 20-mm. cannon shells were exploding continuously. A native Corporal of the fire crew was seriously wounded when the bomb exploded. He was taken to hospital, suffering from a compound fracture of the left hand and wrist, a serious abdominal wound in the left side, and a wound in the upper right arm. Three more details were slightly injured, and some aircraft were holed by shrapnel. M. must have be killed instantly by the explosion.

Because of the hole made in the runway by the bomb, the other three aircraft were diverted to *Beliaria,* and the pilots spent the night there.

27th December. As J. R. took off, black smoke was seen to pour from his engine. He called control for an emergency landing, but his engine cut and he was unable to get round in time so force-landed near route 9 about a mile from our 'drome. Remembering what had happened when B. M. jettisoned his bomb, J. R. decided to crash land with his bomb on. His Spitfire hit some trees, a wing was torn off, and so, fortunately, was the bomb; the aircraft slewed round, and came to rest upside down, with J. R. pinned securely inside it. As it was near the main road help was available almost immediately. Major L. with two of our officers, dashed off in a jeep to the crash, but it was fully half an hour before J. R. could be extricated from the crushed, inverted cockpit. It was extraordinarily lucky that the aircraft did not flame on crashing; J. R. was admitted to No. 5 C.C.S. suffering only from shock and minor abrasions.

No. 5. A Vino (or Six) Well Earned

(From No. 213 Squadron)

October, 1944. "As leader of a formation of four Mustangs I was briefed to strafe a concentration of six troop trains north-west of *Gorgope-Salonika*. We were flying at nought feet on the west side of the railway tracks when we came across a train, which we straffed, severely damaging the locomotive; continuing on our course we suddenly saw our target on the starboard side. We turned in to attack and went straight down the track at 300 m.p.h. and opened

fire on the first train—the locomotive suffered severe damage and numbers of troops were caught by our hail of fire. I carried on straffing the other trains; while doing so the aircraft suddenly shuddered, went out of control, and the port mainplane struck some object. Four feet of the mainplane and all but a foot of the aileron were torn off—the windscreen was also shattered. The aircraft almost rolled to the left. I stopped it doing so by applying full starboard aileron and full revs. and boost, and also endeavoured to use starboard rudder but this was ineffective because, as I found out later, it had been shot away.

I called up the formation and told them that 'I had had it,' fully intending to crash land in the nearest field. To my amazement I realised that the aircraft might still fly on for a while—well, it didn't actually fly in the true sense of the word, it just wallowed round the sky, so I tried to gain height in order to bale out. On reaching 1,000 feet I called up my No. 3 telling him the course to base and to take the lead. I would try to follow. I then surveyed the damage to my aircraft, and to my surprise there was a 50-foot length of fencing wire wound inside the spinner at the back of the airscrew. This wire trailed back under the starboard mainplane and over the tail plane. From the port mainplane there was another piece of fencing wire about fifteen feet long trailing back. I realised that I couldn't bale out very safely in case I got tangled with the wire. The compass was spinning round like a top and absolutely useless, and the master compass had been torn away when I lost a piece of my port mainplane. I then looked round the cockpit for something with which to tie the control column to the starboard side as my arms could not stand the strain of holding the control column over for an hour. I failed to find anything, so lifted my right leg over to the left of the control column, and found this helped quite a lot. I continued climbing and eventually crossed the mountains and enemy coast at 12,000 feet.

I fired the remainder of the ammunition into the sea and increased revs. to use surplus petrol—this also lightened the aircraft. An hour after being hit I arrived over base and asked my No. 3 to inform flying control that I was in bad shape and that I wanted to land into wind on the longest runway possible. I couldn't speak to flying control as the radio mast had been carried away and transmission was very weak. I jettisoned my load and made my approach but I couldn't turn the aircraft on to the runway so I went round again; this time I made a colossal circuit, lining straight on the runway at 1,000 feet. I lowered my wheels and flaps at 200 m.p.h. as it was the only way I could slow the aircraft because the throttle had jammed open; I continued the approach at 180 m.p.h. and somehow or other managed to pull the throttle back just before I touched down at 170 m.p.h.; with braking I stopped the aircraft and taxied to dispersal. I jumped out (and heavens was I glad to be out!) and surveyed the damage. [illegible] the rudder had disappeared and also the top of the fin; the airscrew was badly chipped and the spinner smashed in. I spent considerable time smoking many cigarettes and trying to explain to the onlookers who had gathered round how I flew this badly battered Mustang home. I couldn't really tell them as I didn't know myself how I did fly it back. I reckon it was just a miracle, and it was my "Beautiful L'—the best Mustang ever and I was determined to bring her back and land her whatever else. I then retired to the mess and got down to a Vino (or six)."

No. 6. Found by a Catalina

(From No. 265 Squadron)

On 26th October, 1944, F/Lt. L., flying Catalina A/265, was ordered to carry out a photographic reconnaissance of *Bassas Da India,* a coral reef in position 21.27 S, 39.45 E, and also of *Ile Europa,* a French possession lying about 205 miles west of *Tulear.*

Bassas Da India was covered first and the reconnaissance completed. A/265 set course for *Ile Europa,* making a land fall at North point, where the reconnaissance of the island was to commence. Before any photographs were taken, however, a company of men, 55 in number, were seen on the beach making efforts to attract the aircraft's attention. The photographic reconnaissance was abandoned and efforts directed towards getting into communication with the party. Messages were dropped in Sea Marker containers, weighted with food, directing the party to lower their flag if they were in distress, and this was done.

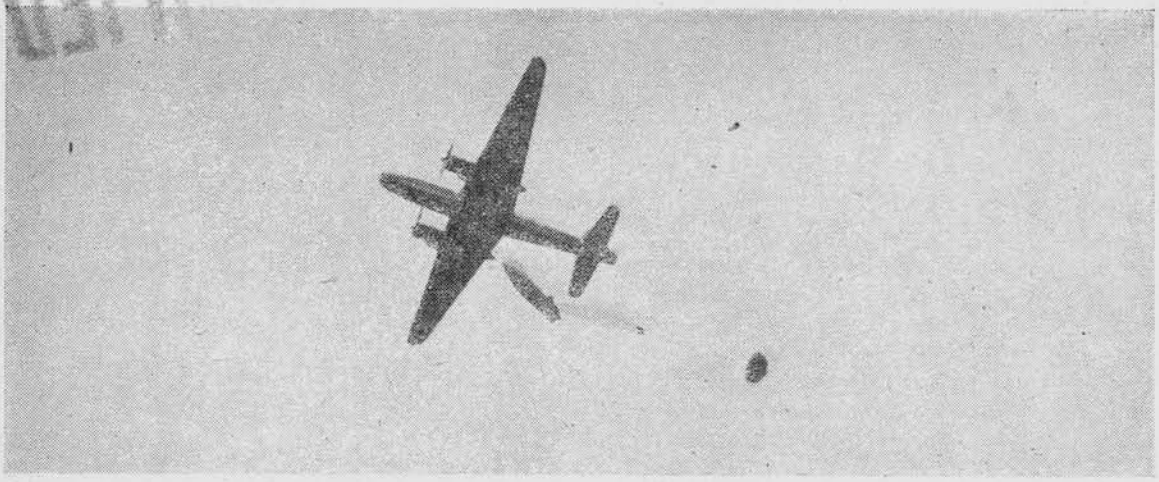
It transpired that the men were survivors from S.S. "Radbury," torpedoed in the *Mozambique Channel* on 13th August, and were all Chinese with the exception of several D.E.M.S. ratings, the Master having been lost with his ship. Return messages were passed up from the beach by marking out large letters on a black tarpaulin and by arranging debris on the sand.

The survivors stated that they had food for only one more day.

All details were passed to control, and before the aircraft left, owing to P.L.E., further supplies of food, water, cigarettes and a first-aid kit were dropped.

A/265 took off early on 27th October with additional supplies for the survivors, who were taken off on the morning of the 28th by H.M.S. "Linaria," on passage northwards through the *Mozambique Channel,* having been diverted to the Island. They were given passage to *Mombasa.*

The Southern Indian Ocean pilot states that goats, turtles and poultry are to be found on *Ile Europa,* and that the Island is inhabited by some Mulattoes. It is felt that the pilot is somewhat optimistic, or perhaps out of date, and that the survivors were fortunate indeed to be sighted by the aircraft on a chance visit.



The lifeboat is released by the aircraft (see extract No. 8).

It is also thought that it might be an idea to have a routine check up of lonely reefs and atolls in future when ships are lost and lifeboats, which are known to have been launched, cannot be accounted for.

No. 7. Tense Moments

(From No. 60 Squadron, S.A.A.F.)

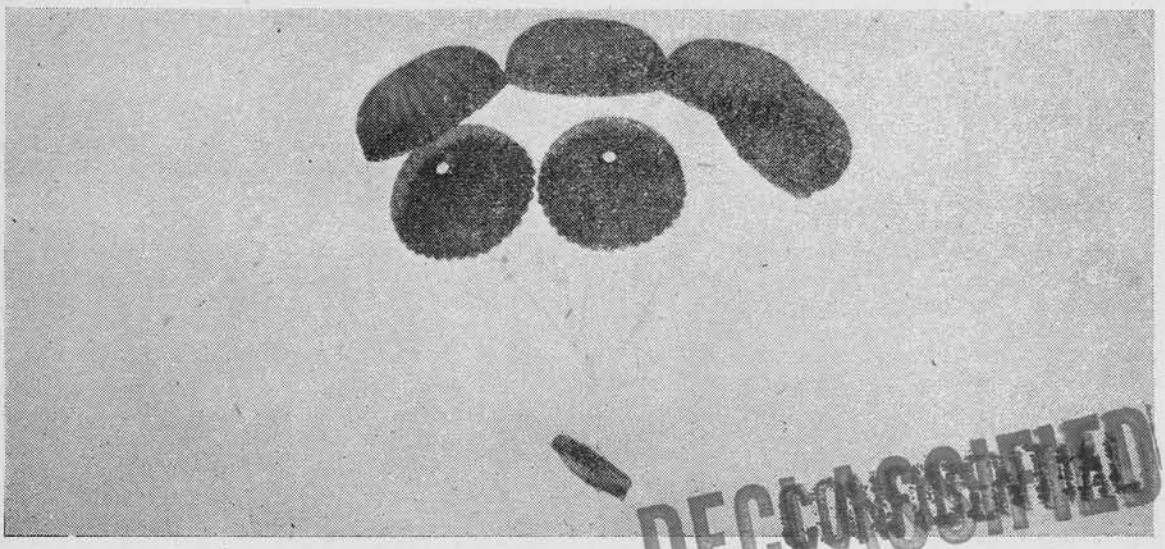
December, 1944. Individual sorties worthy of notice include one on the 6th when the navigator, having sustained head injuries due to flak in the *Pilsen* area, became unconscious and removed his oxygen mask while still partly in the bomb-aimer's cockpit. The pilot succeeded in getting the mask on again before fatal anoxaemia had set in, applied first aid dressings, and overcame the observer's struggles during temporary hysteria as he became conscious again, meanwhile maintaining control of the aircraft in spite of difficult weather conditions and further flak en route to base. The observer recovered sufficiently to assist later in navigating home.

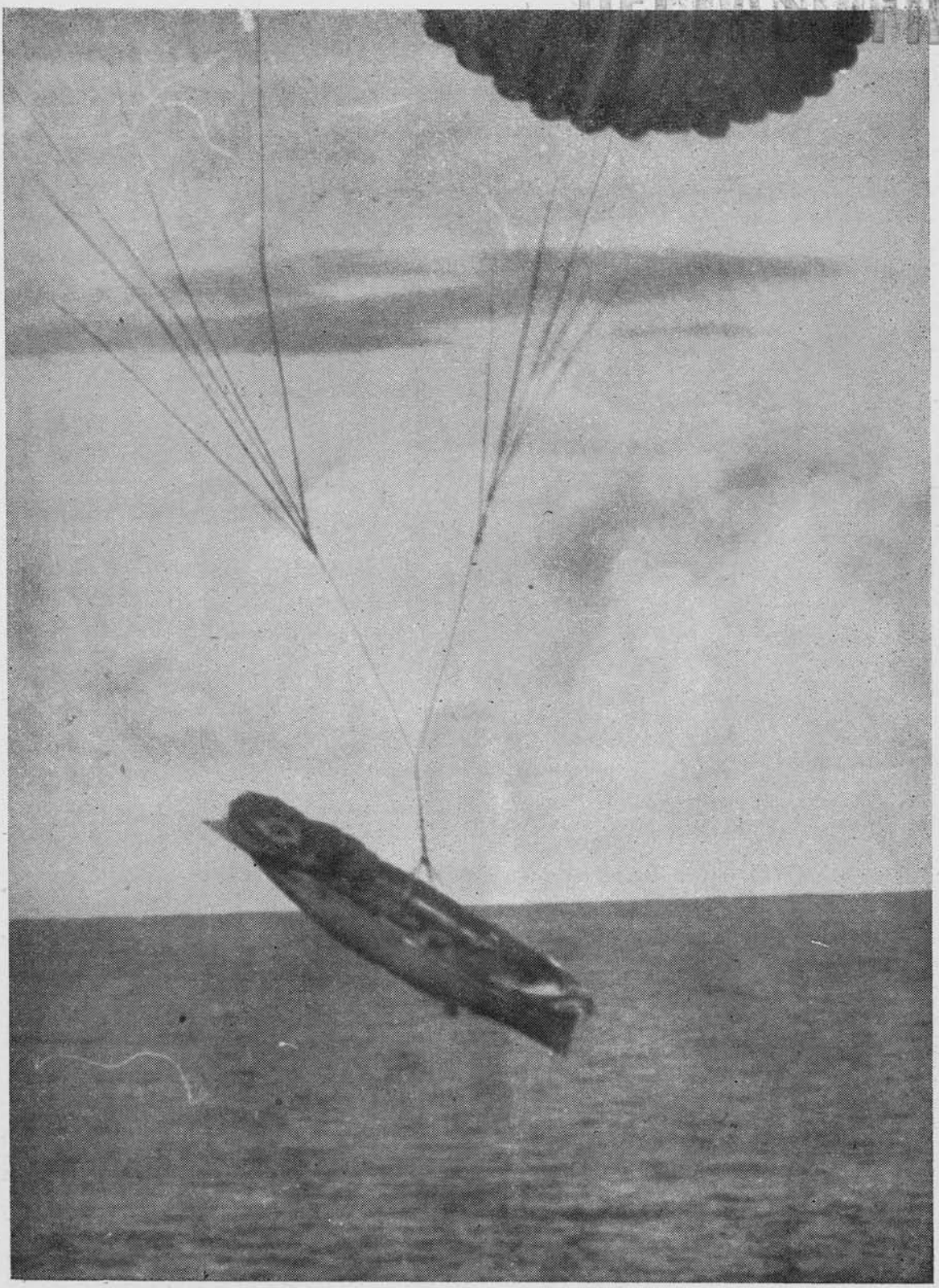
No. 8. A Perfect Exercise

(From No. 294 Squadron)

14th December, 1944. An airborne lifeboat drop exercise was carried out to-day with conspicuous success. The exercise commenced with a crew of five officers being left in an "M" type dinghy about eight miles out to sea from *Aboukir*. On the initial approach of the Warwick a flame float was dropped which failed to operate; two floats were dropped on the next circuit, both of which fired; the Warwick then made a wide

The parachutes open.





The lifeboat approaches the sea.

circuit and approached into wind. The airborne lifeboat was seen to release immediately above the dinghy, all parachutes developed and a perfect drop was accomplished, the lifeboat landing approximately 20 to 25 yards away from the dinghy. The crew of the dinghy had no difficulty in reaching the lifeboat and boarding it was easily accomplished.

No. 9. Value of Reliable Reconnaissance

(From No. 40 Squadron, S.A.A.F.)

December, 1944. This particular recce was despatched to the *Medecina-Lugo-Imola* areas for the purpose of observing enemy road traffic. The pilot concerned pinpointed a total of 175 M.T. and nine tank transporters on the roads in these areas. Fifty of the M.T. were seen stationary in a town at M2742; the target was flashed to "Commander," but owing to the lateness of the hour (approximately 16.00 hours) it could not be attacked. Nevertheless, on the information collated by this pilot the Eighth Army were able to deduce that reinforcements were being sent down to this front and that a counter-attack could be expected, most probably against our bridgehead across the *Montone* river in the area south-west of *Faenza*. This deduction proved correct when at 04.00 hours on the 9th December the enemy attacked in strength in the area anticipated. Needless to say the Army were not caught off guard, being forewarned they were forearmed, and they succeeded in beating back all the German attacks. The enemy reinforcements referred to were later identified as the 90th Panzer Grenadiers.

No. 10. Homer Nods

(From No. 459 Squadron, R.A.A.F.)

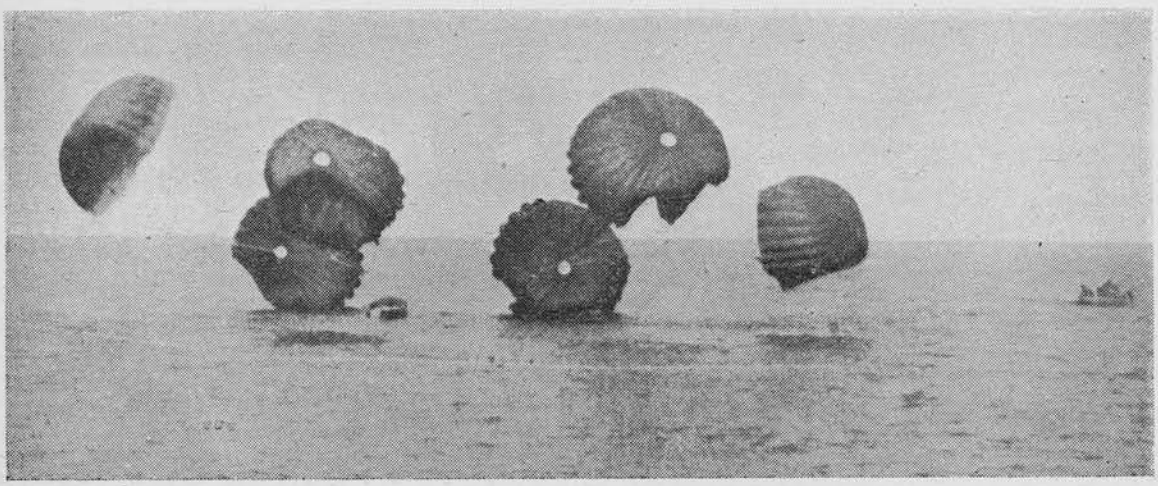
October, 1944. This month's notable visitor was F/Lt. P., who was with the squadron for some fourteen days, in order to collect the material to enable him to "shoot our line," with a view to subsequent publication in the Press. In respect of one story at least, the joke is definitely on him. He wrote an article about our part in the "reduction" of *Melos* and sent it on in anticipation of the island's fall. Unfortunately *Melos* obstinately refused to be "reduced" so he is just a little ahead of the news. He is in good company however . . . the B.B.C. has announced the fall of *Melos*—Homer nods. *(Editor's note—March, 1945. The enemy is still in occupation of Melos).*

No. 11. A Clever Piece of Salvage Work

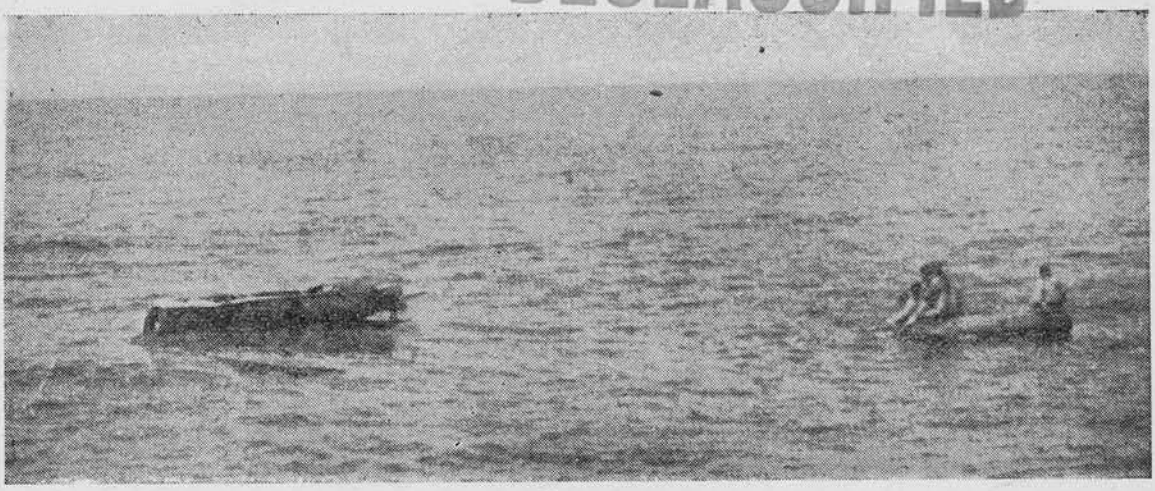
(From No. 119 Maintenance Unit)

Qatar. November, 1944. At the end of last month the party sent to salvage Warwick B.V. 357 found themselves almost at the end of their tether and yet faced with what, at first, seemed an impossible task. They had worked very well under most difficult conditions; were all suffering from desert sores and general seediness, and all they had to show for their trouble was a perfectly serviceable aircraft entirely surrounded by soft sand. Two hundred yards away was a possible take-off strip, but the job of getting the Warwick across the intervening space was one at which the stoutest heart might falter.

It was decided to form a road of timber over which the aircraft could be taxied, but it was obviously impracticable to convey from *Bahrein* sufficient for the whole distance. The journey has to be made by dhow, not a very rapid means of transport, and a single trip takes five or six hours. However, the journey was made to *Bahrein* and enough timber procured to make a road of fifty yards or so in length. It was shipped to the peninsula and lugged by the almost exhausted, but once more enthusiastic airmen, to the scene of action.



The parachutes subside as the lifeboat floats.



Crew of the dinghy approaching the lifeboat.

Everything went well, and in due course the first stage was complete and the aircraft ready for taxying. But now arose another snag ; who was to do the taxying? The pilot had returned to *Shaibah* and it was obviously out of the question to signal for him until the aircraft was in a position for take-off. Pilots are not famed for their patience when waiting for aircraft, and hanging around just to do the odd spot of taxying would be almost certain to upset the most angelic of the breed. In the case of this particular pilot it was certain—but we must get back to the Warwick.

One of the airmen, whose knowledge of K.Rs does him credit, stated that only qualified pilots can taxy Service aircraft. It was contended by another that the ! ! ! ! writer of K.Rs. had never been faced with the job of getting a heavy aircraft off the *Qatar* peninsula. The majority considered this a good point, and it was decided to suspend this paragraph of K.Rs. for the duration of the salvage operation. A Corporal fitter finally did the taxying, and did it most proficiently.

The work proceeded smartly. When one section of the road was completed the Warwick was taxied along it and the next section was started. At last the glad day arrived when the camel track was reached and word was sent to *Bahrein* that the pilot was required. The signal reached *Shaibah* on 2nd November and W/Cdr. G-M. left for the scene of action the same evening.

Taking off was a tricky business, as the track was narrow and had rocks along the sides. Further to complicate matters, there was a bend about half way, and this had to be negotiated at speed, a requirement not usually considered desirable on a take-off run. W/Cdr. G-M., however, proved capable of coping with the situation, and on the second attempt made a perfect take-off and flew the aircraft first to

All aboard . . . successful conclusion to the exercise.

Bahrein, and then, after refuelling, on to *Shaiban*. The gratification of the salvage party when the Warwick was seen to be airborne was considerable, and it was generally felt that the successful ending more than repaid them for the long and arduous work involved.

The entire salvage operation from start to finish was difficult in the extreme, and the manner in which it was tackled, and the successful ending, reflect the greatest credit on F/Lt. M., the engineer officer in charge ; on each and every airman in the party ; and finally on W/Cdr. G-M., who had to make what can only be described as a very chancy take-off.

No. 12. Satisfactory Results

(From No. 25 Squadron, S.A.A.F.)

11th October. Two Venturas took off this morning for *Brindisi* where they had to collect some special pamphlets to be dropped over the island of *Corfu*. Events in south *Albania* were moving swiftly to a climax and both *Delvine* and *Sarande* had fallen into Allied hands. The leaflets were addressed to the Commander of the German Garrison at *Corfu*. They explained the gravity and hopelessness of the situation to him and his trapped garrison and called upon him to surrender within 36 hours. If no surrender had been made after the time limit the island and town would be subjected to an all-out air assault. If he desired to surrender a white cross was to be displayed in the town square and the adjacent aerodrome. A special envoy had to be sent to *Sarande* as well, by boat.

The Venturas dropped their pamphlets, 285 packets containing 4,000 each, on specially planned runs and felt confident that most of them had reached the enemy. As a result a large crop of white flags were reported by Spitfire pilots operating in the area, and the complete surrender of the garrison was reported the next day.

No. 13. The Biter Bit

(From No. 1 Squadron, S.A.A.F.)

23rd November. Lt. H. led the next formation at 10.10 hours. A Timothy show had been laid on, but the weather deteriorated to such an extent that the kites were ordered to be de-bombed and the pilots to carry out a Timothy straffing show. As our aircraft arrived, a line of white smoke shells, bounded at either end by red smoke, was laid down, and the aircraft had to strafe the area north-west of that, to the river *Lamone*. Each pilot carried out six straffing runs, selecting about two houses in each run. The damage caused was considerable. A house which H. straffed was seen to catch fire, and in another, which F. De W. went for, a small explosion occurred. On this show 1,130 20-mm. shells were fired, 800 .5 inch shells, and 4,100 rounds of .303 inch. It was no doubt an inspiring sight to our troops to see the six Spitfires playing merry hell with the enemy defences which had been holding them up. Early in the war the Germans used their dive-bombers with great effect as a close support weapon for their ground forces when their armour drove through the Allied lines. We are using these principles now with many refinements, and the signals of appreciation from the Army show how successful they are.

ACKNOWLEDGMENT

is due to the

Officers Commanding

HEADQUARTERS, ROYAL AIR FORCE, MIDDLE EAST

THE MEDITERRANEAN ALLIED STRATEGIC AIR FORCE

THE MEDITERRANEAN ALLIED TACTICAL AIR FORCE

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