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Intellectual gropings and intramural contention over bombing plans in London headquarters during World War II.

THE BEGINNINGS OF AIR TARGETING ¹

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In World War I a certain amount of experience with tactical bombing had been developed, and such conceptions as the establishment of local air supremacy, the isolation of the battlefield, and direct attack on the enemy's troops and emplacements were familiar. Neither these operations, however, nor the German 1940-41 attacks on Great Britain and the Royal Air Force's night offensive developing in 1942 had begun to solve the problems of applying the power of a strategic air force. In strategic bombing the target is the vast structure of economic and civil life which supports the military effort. Until 1943 both the German and the British bomber forces had chosen to belabor that structure at many points simultaneously, both by attacks upon cities and by unsystematic attacks on more precise targets, aiming to bring about some vaguely defined collapse, either economic or political, which would lead to military capitulation.

The American precision bombing forces beginning to arrive in England knew that they would have to start operations on a small scale, limiting themselves at first to attacking a relatively small number of carefully chosen targets. The slow rate of build-up of the U.S. forces in the European theater thus had the virtue that it forced the Air Staff to forego during the first year and a half of operations any such dreams of causing a Wagnerian cataclysm; and by the time full strength and capabilities were reached at the end of February 1944, a well-disciplined air doctrine had crystallized and had been generally accepted.

It was appreciated by the U.S. air officers in London charged with plans at that early period that a precision bombing program would be extraordinarily dependent on detailed

¹ Adapted from the *R & A War Diary*, Vol. V.

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intelligence concerning the location and importance of elements in the enemy's war production structure. They had investigated the sources of British intelligence and the forms in which it was organized, and they had concluded that, while the raw materials for guiding a precision bombing program existed, an intensive search through these materials and critical examination and organization of them would be required if targets were to be well chosen. There was no staff within the air force that could carry out the kind of technical studies envisaged, and civilian aid was invoked.

The Economic Objectives Unit

The civilians in question were a group of scholar-analysts posted to London from the Research and Analysis Branch of the Office of Strategic Services,² eventually augmented by three people from the Board of Economic Warfare. In September 1942 they formed the Economic Objectives Unit, which served the U.S. Strategic Air Force and other British and American headquarters in a semi-independent, advisory status throughout the war. Gradually developing its functions out of particular requirements and situations, EOU ultimately performed four distinct types of services. First, chronologically, were detailed studies of the layouts of targets and the objectives within them whose destruction would cause the greatest loss of production. Second were analyses of enemy industries as target systems, furnishing the basis for calculating the probable returns from systematic attack on alternative target systems against the comparative costs. Third were occasional but important ventures in drafting operational plans. Fourth was the assignment of EOU analysts to particular branches of the air and ground staffs to help guide their execution of the air offensive. These activities taken together constitute the full range of functions for an air force target section.

As a result of the unorthodoxy of its organizational status, however, EOU's contribution was more often informal than formal, more often anonymous than identified; and its voice

²For an account of an earlier pioneering study done by the R & A Branch, and by some of the same analysts, see "The Eastern Front at the Turning Point" in *Intelligence Articles VI 4*, p. A15 ff.

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was but one of many in the shaping of bombing policy. Even to the extent that bombing operations actually took the image for which it argued, it could claim no unique responsibility except perhaps for the tactical attack on the Seine-Loire bridges in connection with the Normandy landings. With this exception its position, until it finally won a place on the Combined Strategic Target Committee in November 1944, was that of serving those who carried the very great burden of persuading the executive authorities to the desired course of action.

Within the informal framework of the whole planning group EOU's part had two distinguishing characteristics. First, it was an intelligence organization at the working level, and in fact the only organization in the theater devoted solely to the development of target intelligence and target thinking. It always remained close to the basic raw information; its papers, even at their most theoretical, stood against a background of reading ground reports, analyzing targets building by building, measuring bridges, cleaning and recording markings from a pile of German ball bearings. It had not only to organize existing information in relevant forms but to guide interrogations, photographic interpretation, and secret intelligence and to seek out new sources to produce the appropriate raw information.

Second, it had thrashed out in its first six months a group of concepts which came close to constituting a general theory of strategic air bombardment. These were refined over the subsequent two years by fresh minds and enriched by experience with actual air operations both strategic and tactical. Thus there grew up within the unit a set of criteria against which any proposed program was explicitly measured. The vitality of the concepts developed is attested by the entrance into the common air intelligence vocabulary of such unlovely but useful phrases as target system, interdiction, cushion, depth, pattern of consumption, pipeline.

At the outbreak of war it was settled air staff policy in both the British and American services that operations and intelligence be sharply separated. In British practice Air Ministry Intelligence and Air Ministry Bomber Operations dealt at arm's length, and neither had any serious influence

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on target policy within RAF Bomber Command. But it was in the nature of precision bombing, as opposed to area bombing, that close liaison between operations and intelligence was required, and EOU's irregular status put it in position to help forge that link. It was an evident lesson of the European experience that classic staff channels and procedures are demonstrably inadequate for the effective conduct of precision air operations.

Aiming Point Reports

The EOU analysts soon discovered that although the British were getting and analyzing a vast amount of data, they were doing little work explicitly addressed to the needs of a precision bombing program. The Ministry of Economic Warfare analyzed a large flow of assorted intelligence mainly to throw light on the over-all German economic position rather than its target vulnerability. The Air Ministry was rapidly improving its knowledge of the German air force and refining its analysis, but the target aspects of the Luftwaffe were, with certain exceptions, neglected. Arrangements were therefore made for EOU to get the raw data, as well as products of analysis, in order to organize it in forms required by the U.S. air force.

The first assignment from the 8th Air Force was to analyze individual industrial targets, specifying the importance of the plant within the industry in question, the function of each of its buildings, the vulnerability of the processes it carried on, its probable rate of recovery after successful attack, and what sections of it should be destroyed to obtain the greatest and longest-lived effects on total output. No guidance was given to EOU at this time with respect to the factories or the industries in which the Air Force was then operationally interested, so that the full range of industry in German Europe was open to the first experimental analyses.

Such an analysis required not only all the data available from ground reports, PW interrogations, and photographic interpretation on the plant in question, but also a visit to at least one British factory carrying out the same process. The layout and operations of such a plant would be thoroughly examined and the judgment of the manager obtained about

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the vulnerability and importance of different sections. Some of the plants visited at this time and reported on in detail were ones producing synthetic oil, ignition equipment, propeller forgings, and motor cars. In November the first sample analyses of German plants, including for example one on the Siemens Cable Works, Berlin, were submitted to and approved by the 8th Air Force, which now indicated the chief current air force target interests to be ball bearings, rubber and tires, and oil. The period of groping thus ended and work could begin purposefully on a relatively limited number of plants. During the succeeding 18 months 285 so-called Aiming Point reports were produced.

These reports were used by the 8th and 15th Air Force bomber commands both as general intelligence summaries and in setting operational aiming points for attack. They also supplied a basis for damage assessment, and they served as a guide to interrogators in the collection of further intelligence. More broadly, they established a definite form for the organization of intelligence for precision bombing purposes and a mode of thinking about precise targets. In their detail and specificity they were an innovation, and British intelligence regarded the EOU interest in particular buildings as an evidence of undue optimism and even of faint morbidity.

In a sense that scepticism was justified. For precision bombing as carried out by the American heavy bombers was, in fact, pattern bombing. Only a few targets, for example synthetic oil plants, had a plant area larger than the minimum bomb pattern, so that in most instances the physical center of the plant could serve as an adequate operational aiming point. Nevertheless these reports lent precision to thinking on target problems and added a new element in target intelligence work.

Theory of Target Selection

The Aiming Point reports involved collecting facts and organizing them in reasonable form, but they did not call for elaborate thinking. They engaged the energy and inventiveness of the EOU staff but not its bent to look for first principles and establish new concepts. It was evident, moreover, that these reports did not reach the heart of the target prob-

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lem. For these reasons the unit began to interest itself in the theory of target choice.

At the close of 1942 there were two conceptions of precision target choice current which called for critical consideration. A gaudy well-illustrated handbook had been issued by a British civilian attached to the Air Ministry which suggested that the optimum form of attack would be on the largest plants in a variety of industries. There was no formal rationale offered; the approach was an extension of that which governed the occasional unsystematic, though sometimes brilliant, RAF precision raids like that on Renault in Paris. The handbook's target list was simply a collection of important but largely unrelated industrial installations. The second theory of target selection was implicit in an air force request to EOU that it consider upon what industries—electric power, for example—the whole of the German economy depended.

By early January 1943 the framework of a target theory had been crystallized and agreed on within EOU and with the U.S. Strategic Air Force target officer, Colonel Richard D. Hughes. Its principles required that targets be chosen in the light of an explicitly defined military aim linked to the full context of the war strategy and especially to its timing, not just in order to weaken the enemy economy generally nor to cause political disruption, that they be chosen by measuring the specific damage to the enemy against the cost and with a view to the ways a mature and resourceful economy can divert the consequences of bomb damage away from the military effort it supports, that the bombing be concentrated on the minimum number of targets whose destruction would achieve the goal set, and that the chosen target system be persistently attacked and kept thoroughly crippled.

The next few months were devoted to acquiring a quantitative grasp of production, stocks, and consumption of key elements in the German war effort. The War Office and Admiralty were badgered for rates of expenditure of German tanks and submarines relative to production and first-line

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strength; the resources of the somewhat reluctant Air Ministry Intelligence were probed; the Ministry of Supply produced figures on components like ball bearings and spark plugs showing the amounts consumed in various military and civilian uses; and a baffled Service of Supply colonel was forced to consider for the first time his normal motor transport wastage rate in the Zone of the Interior. Analysis of such data yielded, not accurate measures, but order-of-magnitude estimates that permitted a systematic comparison of the attractiveness of various target systems. The way in which they were applied to current planning problems is illustrated by a report issued in March on "Production, Wastage, and Military Strength Ratios" as affecting target selection, the introductory summary of which follows:

1. Strength in any armament item may be regarded as a pool which is being constantly depleted by current outflow (wastage) and replenished by current inflow (production and repair). Strength is being maintained when the inflow through production and repair is just equal to the outflow through wastage.
2. If the item is quick-moving, the inflow and outflow in a month bear a high ratio to the size of the pool. This situation is typified by aircraft, where monthly production of combat types is more than one-fourth of first-line strength; repair output raises the ratio.
3. In the case of durable items, the ratios of monthly production and wastage to strength are low. Submarines are the most important item in this category, though the production-strength ratio is several times higher than the wastage-strength because the fleet is growing rapidly.
4. Action by the United Nations to reduce the German strength in these items takes two forms: diminishing the inflow of new production, and accelerating outflow through wastage.
5. There is a strong *prima facie* case for concentrating our efforts on diminishing the *production* of quick-moving items like aircraft, and on increasing the *wastage* of durable ones like submarines.

Another report, in April, addressing itself to the timing of a bombing program in relation to the invasion of the continent, pointed out that the disruption of ball bearing production, for example, would cut down German strength in armaments in the field at a rate dependent on the rates of wastage of each

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type of armament in relation to existing field strength as follows:

Armament type (1)	First Line Strength (2)	Monthly Pro- duction (3)	Monthly Wast- age (4)	Turn-Over Time ($\frac{2}{4}$) (5)
Operational Aircraft . . .	5,000	1,300	1,300	4 months
Fighters	2,000	650	650	3 months
Bombers	2,400	550	550	4 months
Submarines	300	22	6	50 months
Tanks	10,000	1,000	1,000	10 months
Army Trucks	400,000	6,000	8,000	50 months

Considering also the several months' cushion of quantities in stock and pipeline, it concluded:

Thus, in reply to General Arnold's query, it is of obvious importance to carry out a concerted attack on one of the major components [e.g., ball bearings] as long before an invasion of the Continent as is possible. Even making the optimistic assumptions above, fully 5 months would elapse between the ending of bearing production and the reduction of first line fighter strength by 50%. For tanks, it will be noted, the figure is 9 months, while no decisive effect on field strength in other categories is to be expected within reasonably short periods.

From the time of their arrival in Great Britain early in the summer of 1942 to the last days of the war, the American air forces were pressed from various sources and with varying effectiveness to allocate a part or all of their effort to area bombing. This was natural because RAF Bomber Command, the senior air force in the theater, was devoting the bulk of its effort to this type of operation, though RAF staff officers were by no means unanimous in supporting this choice. EOU consistently took the view that daylight flights could, under almost any circumstances, be better devoted to precision operations, and that area bombing could promise no decisive results. A paper in reply to a proposal in 1944 that the Americans join the RAF in its massive attacks on Berlin and so bring the war to an early end, excerpted below, is typical.

With respect to our capabilities, I do not believe we could create social catastrophe in a sufficient number of cities within the narrow span of time required for cumulative effectiveness to enlarge local disasters into national disruption. In this context, the case of Hamburg, which tactically was uniquely situated for this type of attack, is informative. Despite maximum effectiveness, con-

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centration, and continuity, and minimum operational losses, the Germans proved capable of coping with the situation, despite the deep and permanent impression made. Because of its location, size, and the structure of its buildings, Berlin is a very much less attractive target. It is my private view that the rest of Germany would take some modest pleasure in Berlin getting it; and undoubtedly, provision has already been made for the dispersal of administrative centres.

If the German leaders choose to continue the war, there is no reason to believe that they will be incapable of mustering sufficient agencies of relief and repression to avoid a general loss of control over the population. They have proved capable of maintaining control and productive activity in Northern Italy and France, against almost single-minded opposition. No evidence or argument is offered in the paper to show why area bombing, even on the scale envisaged, will cause anarchy or revolution; and there is good reason to believe that the German leaders are governing their view of the war on almost purely military considerations, and would prefer, like the British leaders of 1940-41, that the air superiority mounted against them be dissipated in attacks on cities than against special targets of direct and immediate importance to the war effort.

At an early stage of work on targets, we examined from official German papers the history of collapse in 1918. It was concluded that the collapse came when Ludendorf and others saw clearly that they were defeated in the field and that their manpower and material resources would in a finite time be inadequate to hold any fixed front. These were the operative considerations, not morale, and at a time when a vocal parliamentary peace party was countenanced, when internal controls were childishly lax by present standards, when the Fourteen Points offered the bulk of the population an easy way out, and the food situation was very serious indeed. I believe that collapse will come this time also from the top, and as a result of the military and military supply situation, literally defined.

Policy Planning

The Casablanca directive of 21 January 1943 had set forth five primary targets for air attack and a priority among them:

1. German submarine construction yards
2. The German aircraft industry
3. Transportation
4. The German oil industry
5. Other targets in enemy war industry

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It was soon agreed within the loose-knit target team in London—representatives of the air forces and of the British Air and Economic Warfare ministries and EOU—that the following changes were required to make this directive fit our aims and our capabilities: the attack on the submarine yards should be eliminated or drastically reduced in priority; the attack on the aircraft industry should be narrowed largely to single-engine fighters; an attack on ball bearings should be introduced into the program as a means of affecting German war production as a whole; and the attack on transport and oil should be dropped from immediate consideration.

The submarine problem had begun to be dealt with effectively at sea from the spring of 1943, and in any case it was clear that the attacks on production and bases were making no significant contribution to antisubmarine warfare. As the bomber force grew it was regarded as imperative to remove them from top priority and to clear the way for attack on the main target systems.

With respect to the aircraft industry, it was appreciated by both the Germans and ourselves that the single-engine fighter was their principal hope for maintaining daylight air supremacy over Germany and for continuing effective close support of their armies. It was from our point of view the principal opponent of our daylight bomber force, and its production was steadily rising. It seemed necessary, if at a later date more important sectors of German war production were to be attacked, to remove the threat of the single-engine fighter force, and the attack on SEF production seemed a necessary step for that.

Since the attack on aircraft was essentially defensive, designed to achieve a condition favorable to later offensive actions, it was conceived proper to devote some part of our bombing program to positive attacks affecting other German armaments. Of all the alternatives examined—in addition to fighter aircraft, ball bearings, and oil, studies were done on submarines, synthetic rubber, copper, aluminum, textiles, steel, heavy engineering, grinding wheels and other industries—the ball bearing industry appeared to offer the most economical and most operationally feasible point for impinging by air attack on the whole structure of German war pro-

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duction. It is doubtful that the reason for the ball bearing attacks was fully understood at the time by many within the air forces. They were generally linked to the single-engine fighter: "SEF and ball bearings" was spoken like "damn-yankee," a tribute to effective salesmanship but not clear thinking. Within the planning team, however, it was appreciated that the Germans would almost surely be able to protect fighter aircraft production from the consequences of a ball bearing shortage, especially since the direct attack on fighter production simultaneously planned would diminish the demand for aircraft bearings.

Finally, it was agreed to be essential that the air forces narrow their aim to the target systems that lay within their operational grasp, that they concentrate on a limited set of targets and avoid any divergence. It was evident that serious attack on the German transport system or on oil production, involving literally hundreds of targets, lay well beyond our capabilities in 1943 and that these systems should therefore be dropped from the list of current target priorities. If secondary targets were required for operational reasons, it was suggested that the compact synthetic rubber system and the major tire and motor transport plants be listed; relatively few attacks on these might prove to be militarily significant.

On 10 June 1943, finally, the air force members of the target team managed to get these modifications of the Casablanca directive incorporated into a Chief of Air Staff letter, thus clearing the way for the operations known as "Pointblank" which focussed on fighter aircraft and ball bearings for the next nine months. Although this precision bombing plan was designed for both British and American air forces, the Air Ministry failed notably to force RAF Bomber Command to adhere to it, either in spirit or in letter. Through the rest of 1943 and the early months of 1944 the RAF kept trying to end the war by area raids.

To set priorities and provide week-by-week target guidance in the concentrated attack on the German air force—its production, repair factories, depots, airfields, and aircraft in being—and on ball bearings sanctioned by the 10 June letter, the famous Jockey Committee was formed late in June, including representatives from the working sections of British

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and American air intelligence and from the operational commands. One EOU analyst sat with it from his position on loan to Air Ministry Intelligence. This was the first of the target system working committees. Its deliberations ended some 93 weeks later.

The German Aircraft Industry

Throughout the course of the war, no aspect of intelligence received wider, more continuous, and more devoted attention than the German air force, including aircraft production. It was recognized early that aircraft production bore a more immediate and direct relationship to fighting value at the front line than other forms of armament manufacture, and it was therefore treated rather as a military than an economic subject and handled within the Air Ministry rather than the Ministry of Economic Warfare.

Intelligence on the aircraft industry was sharpened and infused with a special vitality by the fact that photographic interpretation both of aircraft types and of the aircraft industry was in the hands of Flight Officer Constance Babbington-Smith at the Central Interpretation Unit. From 1941 to the end of the war she brought craftsmanship, enthusiasm, and a creative imagination to the analysis. This was of particular importance because the aircraft industry has shallow roots; both the locations and the processes of production were under continuous development and alteration, and the many important changes could be followed with precision only by the study of air photos.

The German air force as a target system thus antedated EOU, and it had not hitherto been necessary for the unit to study aircraft production in detail. Now examining the industry, it found that the airframe production target had the disadvantage of containing few vulnerable or even highly specialized installations, so that damage was not likely to be long-lived in its effects. Aero engines, moreover, seemed more likely to be the limiting factor in German expansion of fighter production, and they were therefore a superior target system. But this target had to be tabled for 1943 because it included a large production capacity in the Berlin area, which we did not expect to be able to attack until late in the year at

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the earliest, and without the Berlin plants it was doubtful if any considerable effect on the single-engine fighter position could be achieved through engines. In the event, Berlin was first attacked in March 1944.

Efforts were therefore devoted both to building up identifications and analyses of the airframe factories for immediate purposes and to the aero engine plants for the future. Some 116 Aiming Point reports were ultimately done on the aircraft industry. Broader studies were also made of the intelligence with respect to the dispersal of production and on the use of floor space measurements in conjunction with other forms of intelligence to figure quantities produced. At the same time a full-scale exploration was made for future targets for the 15th Air Force soon to be based in southern Italy. EOU set to work on the intelligence on southeastern Europe, which was limited by the lack of systematic photoreconnaissance, to discover, evaluate, and array the possible targets in this area. The results served as a guide to reconnaissance as well as the foundation for 15th Air Force target work.

EOU's contribution to the attack on the aircraft industry was thus substantial in the period before the attacks began. But the bulk of the work of following the attacks themselves, re-evaluating the industry and its target significance, discovering new targets, etc., fell to the analysts it had released to work in the Air Ministry and with the 15th Air Force in the Mediterranean.

Few who were in any way associated with the air offensive in Europe will forget 20 February 1944. For at least four months a group of the major aircraft targets in central Germany and northeast Europe had been scheduled for attack in a single operation, a massive incursion deep into the continent. On 11 January a local break in weather had permitted attacks on three of these targets in the northwest, and that day was extremely significant in the success of the American long-range fighter in combat over Germany. But the great test of our capabilities was still awaited; and day after day of impossible weather came and went. Very heavy losses were expected; the operation was accepted as a measure of the feasibility of a mature precision bombing program in daylight. Although some such test was overdue, the decision to mount

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it was clearly one of the great decisions of the war, comparable to that of the British to allocate troops to the Middle East in 1940 and General Eisenhower's judgment on the weather evidence of 6 June 1944.

On a Sunday heavy and gray in London but brilliant over central Germany the operation took place. The losses—22 bombers—were far smaller than had been expected. The enemy's fighters had largely been outmaneuvered, and those that engaged were outfought. The Big Week was on. In succeeding days of freak clear weather the 8th and 15th Air Forces struck with varying success, but on the whole effectively, at most of their top priority targets over the range of single- and twin-engine fighters and ball bearings.

The Big Week showed that the air forces could attack accurately and heavily a considerable number of targets in a mass operation, and at peak strength the German fighter force had suffered tactical defeat over its own bases. The damage done to fighter production was bound to weaken the German force for several months at least. It was therefore demonstrated that the air forces could now undertake to attack additional target systems.

The Switch to Oil

In retrospect, the choice of oil was an obvious next step. It promised, if sedulously pursued, not only to affect the whole German war production structure but also to limit the fighting value of the ground and air forces, and with D day only three months off this was a decisive factor. The oil industry was so located as to offer an excellent distribution of targets, and especially it offered scope for the growing capabilities of the purposeful and efficient 15th Air Force. Although large by older standards, it was a sufficiently limited target system to offer a chance of cutting deep within a reasonably short period of time and to leave some bombing capacity over for containing aircraft and ball bearing production and for striking at attractive concentrations like tank engine production.

Oil as the next major target system was agreed within the planning group before the week of consecutive attacks on the aircraft industry had ended, and EOU's suggested draft of the

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plan, excerpts from which are reproduced below, was completed on 28 February.

The major question of regarding oil refineries and synthetic plants as a target system is whether, in view of the very large number of targets, it can be successfully attacked in its entirety. Until the present, it appeared that a target system of about 50 to 60 targets was beyond Air Force capabilities. In view of the substantial destruction of German fighter production and the consequent lesser fighter opposition, this job may now be within USSTAF and RAF capabilities.

If this be the case, no other target system holds such great promise for hastening German defeat. Stocks of finished petroleum products are sufficient only for several months military operations. The loss of more than 50% of Axis output would directly and materially reduce German military capabilities through reducing tactical and strategic mobility and front-line delivery of supplies. It would indirectly affect military capabilities through weakening High Command morale and industrial ability to produce weapons and supplies.

The extension of attacks to storage facilities in Western Europe might directly impair German mobility in deploying to meet Overlord. Indirect benefit to Overlord would in any case result from the lessened mobility of German divisions in Finland and Norway, Russia, the Balkans, and Italy. . . .

Twenty-three synthetic plants and 31 refineries currently account for over 90 percent of total Axis refinery and synthetic oil output. If the 12 refineries in the Ploesti area are successfully attacked, major refineries elsewhere whether fully or partly working may be followed up; and idle refineries in France, the Low Countries, Italy and Germany must be watched. The undertaking is large; destruction within the next three months of *less than half* of all oil production *will not* affect Overlord or enemy fighting value in the period D plus 30. With present air force capabilities, however, oil offers the most promising system of attack after fighter aircraft and ball bearings, to bring the German armies to the point where their defeat in the field will be assured.

This paper, which included a review of the history of the existing target directive, an evaluation of the extent to which it had been fulfilled, and an examination of ten alternative possible target systems, was sent to Colonel Hughes, who, with General Cabell, recently drawn into planning from an operational group, was charged with the preparation of the U.S. Strategic Air Force plan. The final version drew heavily on the EOU draft and used in their entirety its appendices examining oil and the main alternative target systems.

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The previous history of attacks on oil had been one of disappointment, and Air Chief Marshal Harris had never forgiven the oil experts for recommending them early in the war. He habitually referred to the proponents as the "oily boys." Carried out with inadequate force, accuracy, and persistence—as was inevitable in 1940–1941—the RAF attacks had obviously accomplished little. Even the American attack on Ploesti of August 1943 had achieved no evident military consequences, despite its gallant accuracy. Above all, the enemy's oil position was associated in the public and the military mind with the classic miscalculations of 1939–1940 about the economic weaknesses in the German war production structure. By 1944 it was a mark of sophistication to know that the enemy's oil position was very sound indeed.

On the evening of 5 March 1944, General Cabell and Colonel Hughes presented the final draft to General Spaatz. Major General Anderson had already read the plan and was an advocate of it. Discussion began before dinner and ran into the early hours of the morning around the Park House conference table. Despite the paper's emphasis on completing the attacks on the Pointblank systems, General Spaatz quickly appreciated that it was to all intents and purposes an oil plan. He explored at length the issues at stake, and especially the capabilities of the 8th and 15th Air Forces with respect to the number of targets involved, and he ordered the plan completed for prompt presentation to Air Marshal Portal and General Eisenhower.

There followed a crucial sequence of events at top level which held up the oil offensive for two months. General Eisenhower and Air Marshal Portal deferred decision on the oil plan until a plan prepared by the tactical Allied Expeditionary Air Forces for attacks on French rail targets in connection with Overlord had been examined. On 25 March, therefore, when the issue came to a head, General Eisenhower was presented the false alternatives of the AEAFF rail plan versus the USSTAF oil plan, and the latter was turned down on the grounds that it could not be guaranteed to have any effect on German strength in the west before D day plus 30. In retrospect it seems likely that some tactical effect would probably have been achieved in the west by the end of June, at

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least in the form of lowered stocks held in the field and consequently increased vulnerability to short-run interruptions in local supply. Nothing in the evidence available, however, indicated that this outcome was certain.

USSTAF remained convinced of the validity of the oil target, and in April attacks by the 15th Air Force on the Ploesti marshalling yards were allowed to lap over onto adjacent refineries. In mid-May, under special dispensation from the Supreme Commander, two days of visual bombing in central Germany were devoted to the synthetic oil plants. The impact of these attacks, on top of the damage already done to Ploesti, was on clear evidence very considerable; and oil moved in as a priority target system in the course of June 1944. Profiting from the pattern of the Jockey Committee and the lessons of errors in tactical target planning, a working committee on oil targets, in which EOU was directly represented, was set up on 29 June.

The political battle for oil as a primary target system had not ended, however. From the perspective of AEAFF and then SHAEF (Air), oil was a clamorous and unwanted child, competing for effort they would have preferred to see used against rail transport, and a running battle was fought to the end of the war on the proportion of effort which should be allocated to oil. It should be noted that this battle was confined almost exclusively to the British-based portion of the bomber force. In the Mediterranean the 15th Air Force honorably and thoroughly discharged its responsibilities to the oil target system "and looked around for more when they were through."

The decision to advocate the attack on oil was in an important sense the most significant one taken by the American bomber forces in Europe, for it was through oil that they undoubtedly made their greatest contribution to the war as a whole. In helping to guide them in that decision, and more broadly in developing a system of comparative target analysis which indicated oil as the optimum target at that time, EOU probably was more useful to the strategic bombing program than at any other single point.

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Tactical Targets

The strategic air forces operated under AEAFF, later SHAEF (Air), direction with respect to tactical targets, and at an early stage General Spaatz had vetoed the advocacy by USSTAF of any independent tactical plan. But when Air Chief Marshal Tedder, as Deputy Supreme Commander, backed a plan and a conception with which EOU disagreed, the unit had to oppose it, seeking in diverse places channels to make known its own ideas. This political battle raged from the close of January 1944 to the end of the war in Europe, but most hotly in the four months that preceded D day and the two that followed.

In the course of January the Theater Intelligence Section of G-2 SHAEF issued a paper suggesting various particular transport and army establishment targets which might usefully be attacked before D day in support of the invasion. This document, while attempting soberly to relate air operations to the ground force problem of invasion, was clearly inadequate and, written by army intelligence officers, showed an understandable lack of experience in target planning. On 22 January it was swept aside by a paper entitled "Delay and Disorganization of Enemy Movement by Rail," written by Professor Zuckerman, formerly Air Chief Marshal Tedder's scientific advisor in the Mediterranean and now attached to AEAFF. This paper called for a very large-scale attack on the marshalling yards of France and Belgium analogous to that on the Sicilian and Italian marshalling yards in the summer of 1943.

The Zuckerman plan was sent to USSTAF, which invited EOU's view. EOU saw serious reasons for disagreement and set about investigating the cited experience in the Mediterranean and formulating an alternative plan. It developed that the Sicilian experience was open to serious question as a justification for the attack on marshalling yards and that tactical target thinking in the Mediterranean over the winter of 1943-1944 had moved away from the concept of attack on the whole railway system towards systematic attacks on bridges and line, designed to deny the enemy through rail transport to the front, over some distance behind the front. At the moment when Professor Zuckerman, backed by Tedder,

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was invoking the voice of Mediterranean experience in support of marshalling yards as targets, the air forces in Italy were completing their first full experiment with "Operation Strangle," a systematic attack on a bridge system, having largely abandoned the attempt to achieve significant results from attacks on the marshalling yards of northern Italy.

As a positive alternative to the marshalling yard plan, it was agreed that the optimum pre-D-day tactical program should comprise, first, attack on systems of bridges, junctions, and open stretches of rail designed to deny the enemy through rail access to the bridgehead area, and second, attack on ammunition and fuel dumps, ordnance depots, and other military establishments offering concentrations suitable for bombing. This program would be superior because it would accomplish the disruption of military supply movements by rail more thoroughly than the attack on marshalling yards, and it would do so at much less cost in effort. As a result, heavy bomber effort would be available to begin the strategic attack on oil and to exploit the considerable concentrations of military resources which the Germans had permitted to persist in the west.

To move from the conception of this program to adequate target priority lists required a very considerable mobilization of the intelligence. In one way or another the basic data were collected, and by the end of March the Seine and Loire Bridges and a large number of the more important dumps, headquarters, and so forth had been fully analyzed and tactical aiming point reports prepared. On 17 February an "Outline Plan for Air Support of Overlord" incorporating the bridge and military supplies program was submitted to USSTAF. USSTAF remained reluctant to interfere officially in tactical policy, however, and although urged to present the new tactical plan in connection with the new strategic plan for oil, since the AEF plan had not yet been formally adopted by the Supreme Commander, decided to put the case for oil forward separately.

Thus the oil plan, rather than the bridge and dump plan, appeared as an alternative to the AEF plan, and the Supreme Commander was never informed of the existence of a full-scale rail program alternative to the marshalling yard attacks. USSTAF, feeling unable to advocate an independent

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tactical policy and further limited by not having operational control of the medium bombers and fighter-bombers of the 9th Air Force, now decided explicitly not to set out a formal alternative to the AEAF pre-D-day plan.

EOU turned then to an effort to press its view with components of the Allied forces who were more directly concerned with the formulation of tactical policy. One of its analysts had in the course of his investigations into tactical targets come into contact with the personnel of G-2 SHAEF, whose function it was to represent the Army's needs and wishes with respect to bombing targets at AEAF. There ensued a request from G-2 that he be loaned to them, and at the end of April he took over a desk there and became in effect a member of the G-2 SHAEF staff. His job was to insure that ground force intelligence was fully combed and organized in such a way as to produce targets and evaluations of targets from the tangled evidence; there had hitherto been almost no systematic analysis of tactical targets for operational purposes. He was thus in a position to assist the key figures at G-2 SHAEF in evaluating the effects of the marshalling yard program then under way and to urge that this should be supplanted by tactical attacks on bridges and local supply concentrations, along with strategic attacks on oil, tank factories, ordnance depots, and similar large military concentrations in Germany.

His efforts in these directions, which were completely frank and involved no elements of subterfuge, took the form of innumerable conversations, interim memoranda, and the other paraphernalia of staff work. They were climaxed by two G-2 SHAEF papers issued on 20 May and 7 June 1944, in which EOU had a direct hand, showing the inadequacy of the marshalling yard attacks and putting forward positive alternative proposals.

As with respect to oil, May brought a happy mitigation of the defeat in March of the bridge program. As late as 1 May AEAF had written to the Deputy Supreme Commander citing the cost of destroying the Seine bridges and concluding that this action "can be included in the programme of preparatory operations only if the effort can be spared from other essential commitments." But shortly thereafter, in an experimental attack originally suggested for heavy bombers by General

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Cabell of USSTAF and acted upon by General Smith at AEAF, a handful of Thunderbolt fighter-bombers knocked out the Seine bridge at Vernon and damaged several others. This success stirred a wide realization of the possibilities of bridge attacks and a wave of enthusiasm; and by D day every Seine bridge from Paris to the sea was inoperative, as well as a number of "cover" bridges on the Meuse and elsewhere. In addition, the B-26s and the RAF heavy bombers began to operate against some of the oil and ammunition depots.

By D day some portion of the EOU program had thus in fact been carried out. Before now, curiously, air planning had given little thought to the use of the heavy bombers in support of the fighting after the armies were fully installed on the Continent. It was soon discovered that the same issues existed as in the pre-D-day problem, and the same formulae were supported in each camp. On the whole, the success of the pre-D-day bridge and dump and depot attacks appeared sufficient to justify their continuance. The destruction of the Seine-Loire bridge line, including the connecting link from Mantes to Blois, was completed and fairly held, and the dumps and depots were attacked with greater regularity. The EOU crusade failed, on the other hand, to end the attack on the French marshalling yards; and as a result the full possibilities of a double ring of bridge cuts were never explored, and many known dumps and depots fed the German armies in the field, unattacked.

Frayed End

In the fall of 1944, when the Allied armies were advancing rapidly through France, the transport targets previously current were literally overrun; and with this drain lifted, the heavy bombers devoted themselves to oil as a clear-cut first priority. In addition a Military Supplies Working Committee was set up to formulate tank, truck, and depot targets. For a time it appeared as if the war might end with a straightforward program of bombing oil and weapons targets. But the transport advocates at AEAF, which had now become SHAEF (Air), and SHAEF G-2 recovered from shock and counterattacked towards the end of October. The attack on military supplies was sacrificed and the Working Committee disbanded

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on 23 October. It took the Rundstedt January counteroffensive to revive an interest in German tanks and get the Military Supplies Working Committee reinstated early in 1945.

In this period between late October and the Rundstedt counteroffensive, bombing policy was affected by the belief that the end of the war was imminent. SHAEF (Air) sponsored throughout the period, and the Air Staffs acquiesced in, what was believed to be a short-run heavy bomber policy, namely, attack on German marshalling yards, both proximate and distant from the battle area. The exact mechanism by which such attacks were expected to hasten decision on the ground was not clear, but their sponsors undoubtedly hoped for general economic and military confusion on a scale such as to cause capitulation. Throughout this period oil, nominally still in top priority for the heavy bombers, was somewhat neglected. Very massive tonnage figures were piled up against the German rail system, and the attack on military supplies was virtually abandoned. EOU protested this deviation and advocated a return to priorities which it had suggested late in July 1944:

	Offensive Target Systems	Defensive Target Systems
Priority 1	Oil Production	
Priority 2	(a) Bearing Production	(b) Fighter aircraft production (c) Flying bomb pro- duction (d) Rocket fuel pro- duction
Priority 3	(a) Tank Engine Production (b) Ordnance Depots	
Priority 4	(a) Tank Production (b) Motor Vehicle Production (c) Synthetic Rubber Production (d) Oil Storage	

In the case of priority 1 and 2 targets, thoroughgoing attack on all major elements in the system is required. Priority 3 and 4 targets, however, will be useful even if the target systems are not fully attacked.

The Rundstedt counteroffensive had two sobering effects. First, it showed that a concentrated attack on transport in a limited area proximate to the front could achieve significant

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military results. At the suggestion of Colonel Hughes the whole of the bomber forces had been thrown in at the base of the German salient when the weather cleared a few days after the offensive was launched. These bomber attacks, strongly supported by the fighter-bombers, were effective in denying the flow of supplies forward to the spearheads, and the lesson was read that transport attacks should be limited to systematic efforts to wreck or interdict the transport system in the area behind the front. The bogey of strategic general attack on rail transport was almost, but not quite, laid.

Second, the counteroffensive, in suggesting strongly that the war was not yet over, led to the reintroduction of tanks, jet aircraft, ordnance depots, and other target systems of a military character; and above all it brought oil back into fairly effective first priority.

Because of the creation of the Combined Strategic Targets Committee, EOU's contribution throughout this period was more formal and straightforward than it had ever been before. Its representation here was supplemented by membership on all the target working committees which fed their weekly conclusions up to the CSTC—those on oil, oil depots, and tank and ordnance depots, Jockey, now watching the ominous but tardy German development of jet aircraft, and the transport working committee. It was in the latter that the controversy continued to center, for SHAEF persisted in advocating strategic attack on transport, while the Air Ministry, War Office, EOU, and MEW fought for a limited tactical program. The effectiveness of the Ardennes transport bombing noted above strengthened the hand of those opposing SHAEF and resulted finally in the Ruhr interdiction scheme. But no clean-cut victory was ever won on this issue; a great many non-tactical transport attacks continued to be carried out.

The final issue of this period arose with the Russian advance to the Oder and the crossing of the Rhine by the American First and Third Armies. With these movements came the evident approach of an end to formal hostilities. At peak strength, capable of bombing anywhere in German Europe without serious opposition, the heavy bomber forces sought new means to bring the war to a close. The oil program now

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contained relatively few targets, and these were battered and unattractive. The Ruhr interdiction scheme was virtually complete, and it was soon outmoded by the crossing of the 21st Army Group. Area raids on Berlin, Dresden, and Chemnitz were carried out in conjunction with RAF Bomber Command; a large number of small central German marshalling yards were hit in two spectacular medium-level operations (called Clarion); but no key could be found.

It was the EOU view that no key existed; that, since heavy bombers could not be used, with existing techniques, in close army support, they should continue to do thoroughly the oil and military supply targets capable of affecting the battle over short periods and if possible serve as transport aircraft to fast-moving ground columns.

The last serious planning battle of the war took place between the old antagonists fighting with the old weapons on familiar ground. In April SHAEF (Air) proposed attacking a large number of marshalling yards throughout the length of the central area of Germany still held by German forces. The aim of these attacks was "to exert pressure on the enemy"; it was agreed that they could not stop military movements south to the redoubt area in the Bavarian Alps or have any other clear-cut military effect. EOU and the majority of the CSTC advocated attack on the last of the oil plants and on the ordnance depots on which the retreating Germans were falling back and drawing for supplies. They felt it was intrinsic in the nature of strategic bombing that the heavy bombers should end the war not with a bang but with a whimper.

The issue was settled by the decision of the air commanders that the SHAEF transport plan would be carried out. EOU and the other dissident members of CSTC of course retired from the fray, gaining some comfort, however, from the fact that a sudden advance of the armies eliminated the bulk of the proposed targets before the attack could be mounted.