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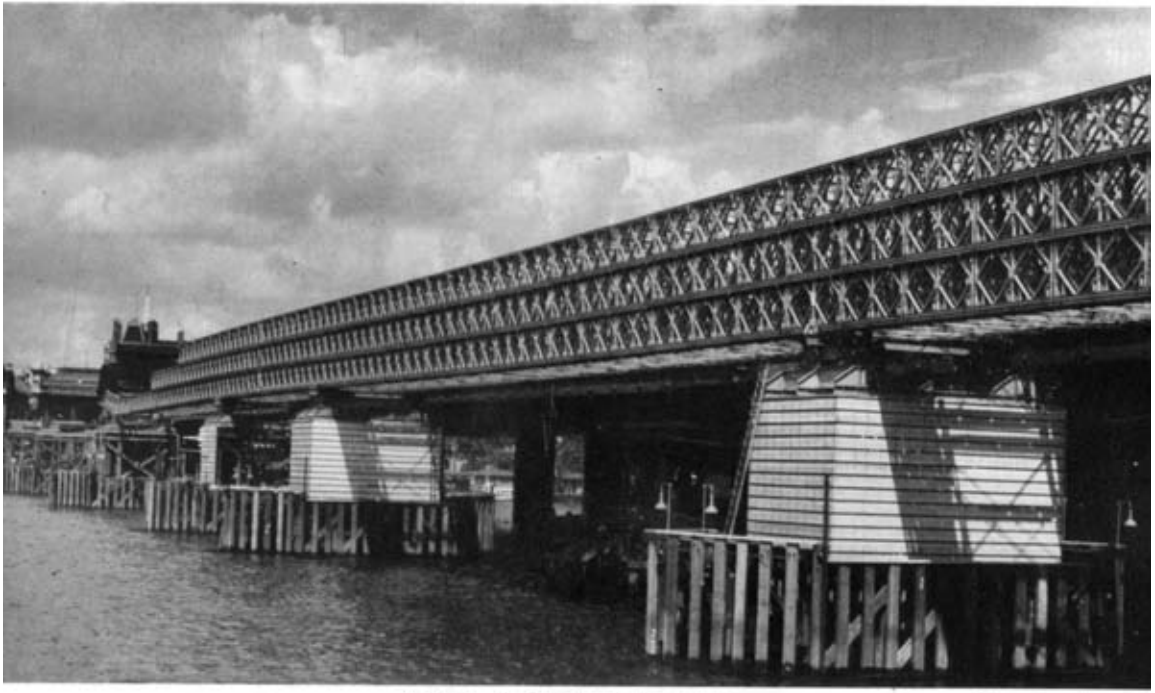


Photo 1.—View from South Bank, 10.7.50. *(Crown copyright reserved)*

Sapper Bridge

SAPPER BRIDGE

By LIEUTENANT-COLONEL P. A. EASTON, O.B.E., R.E.

PREFACE

THIS article refers to the construction of the Bailey bridge across the Thames, to carry foot traffic from the north bank to the area of the Festival of Britain on the south bank of the river. It is not a technical article but is a narrative of events and a description of the work in general terms and does not include remarks regarding the construction of the approaches, which work was carried out under arrangements by the L.C.C.

In September, 1949, information was given to 36 Army Engineer Regiment that a Bailey bridge was to be put across the river in the late spring of 1950 for use in connexion with the Festival of Britain and that the regiment would carry out the work under the orders of the Chief Engineer, London District. Details of design and consideration of methods of construction were still in progress.

FACTORS

The implications of this information were varied and all formed factors in deciding how the job would be undertaken. The main implications were as follows :—

(*a*) *Strengths.*—This was perhaps the biggest difficulty. Special training and rehearsal for the job would be essential. Replacement of trained men, due for release, by untrained reinforcements during the period of construction could not be contemplated.

During the period April to August, both months inclusive, 320 men were due to leave the regiment on release or discharge. Their replacement would be essential some time before construction began in order that preliminary training could first be given.

A tribute must here be paid to Records. After a preliminary argument with the Hollerith Machine, Officer i/c R.E. Records agreed that the figures, produced by the regiment, were correct and "found" the requisite bodies by methods only known to himself.

(*b*) *Preliminary Training.*—Few officers or senior N.C.Os. in the regiment had ever been engaged in the construction of a large Bailey

bridge. Preliminary training was necessary, as certain special parts were included in the design and as special methods of construction and launching were to be followed.

There was the usual struggle between conflicting demands on the employment of the Regiment, but at last a period of one month was obtained for preliminary training. As many of the junior N.C.Os. and Sappers were new to Bailey bridge construction, and as time was short, training was carried out only for those tasks to be found in the construction of this bridge and was not of a general nature.

(*c*) *Specialists.*—What would be required? A visit to the Chief Engineer gave some idea and again Records came to the rescue and posted crane operators and steel erectors. Winch operators were found within the resources of the regiment and given a special course of training at Marchwood. Under this heading can also be included a platoon of the Royal Pioneer Corps to work with the stores troop and a detachment of a Water Transport Company of the R.A.S.C. for work on the river.

(*d*) *Administration.*—This subject produced many headaches and required much improvisation and organization. The main problems were accommodation, feeding, transport and clothing.

Suitable accommodation, after much search, was found at no less a place than Wormwood Scrubbs where an old A.A. camp just accommodated the whole detachment and also had the added convenience of being next to No. 6 C.E.D., where stores were being assembled. There was no occasion to use the other and better known amenities of the site.

The decision to work two shifts and to provide a " hot snack " in the middle of each shift put a heavy load on the cookhouse staff at a time when T.A. camps were putting many calls on the limited number of A.C.C. When two shifts were employed on the work cooking would continue throughout the day from 0300 until 2200 hrs.

After much search and a certain amount of argument, T.C.Vs. were found for convoy between the camp and site, a journey of forty minutes.

As the army was on parade, obviously working clothes had to be of a higher standard than the denim that is normally found in everyday use. A special issue of clothing was made, which included four new sets of denims. Day-to-day squadron administration had to continue as the demands for returns and present-day office " chores " could not be relaxed even for the Festival of Britain. Administration was therefore carried out by leaving Squadron Seconds-in-Command with small administration staffs at Maidstone and providing a central camp administrative staff for local administration of the camp and at the site.

General Description (Photo No. 1)

The bridge would be triple-triple, standard, widened Bailey bridge, of a total length of 1,060 ft. In order to prevent interference with navigation, the roadway of the bridge was to be at the same level as the roadway of the Charing Cross railway bridge, resulting in a height of 30 ft. above ground level at the building site on the south bank, and 60 ft. above the river at low tide. In order to clear the scaffolding around the damaged pier of the Charing Cross railway bridge, the bridge would be constructed 40 ft. up-stream from Charing Cross Bridge, and in order to link up with a concourse from Whitehall Gardens and Charing Cross underground station on the north bank, the southern span of 170 ft. was to be detached from the main span on the northern (No. 1) pier and be swivelled through 7½ deg. in order to rest on a Portal Frame (Photo No. 2) adjacent to the main railway bridge. It may here be mentioned that this fact was alleged to cause a general suspicion in Fleet Street that the Sappers had built the bridge "forty feet out," despite the fact that the piers had been very carefully aligned prior to construction. The southern span of 130 ft. was treated as a simply supported span resting on the southernmost pier and a temporary pier on the south bank, pending its eventual support on a restaurant, to be constructed later by the L.C.C.

Major important factors affecting the design of the bridge and departures from the normal methods of construction were as follows:

(*a*) *Wind and Load.*—The bridge was designed to carry a traffic of 8,000 foot passengers an hour. For purposes of calculations, the maximum wind pressure would be in the nature of 90 m.p.h. Sway bracing in the lower storey was doubled, with single sway bracing in the upper storey. Specially strong bracing frames were inserted vertically between panels at junctions immediately over piers. Extreme care was taken to ensure that all panel pins were made fast by the insertion of split pins and that all nuts had been screwed really tight.

(*b*) Expansion was calculated as being approximately five inches. Two-way expansion was provided by welding the bridge to the top hamper on No. 3 pier.

(*c*) To "skew" the northern span through 7½ deg. required careful organization and special stores, and will be dealt with later in this article.

The construction of piers in the river was undertaken by the L.C.C. As the Bakerloo Tube ran directly under the line of piers, it was a matter for real experts, who would not drive the piers too hard, or too deep. Steel caps were provided to which were fixed two balance beams, positioned transversely across the pier by an

R.S.J. distance plate. Each balance beam in turn carried rocking rollers in front of and behind the distance piece. The checking of levels and alignment of balance beam assemblies was in the hands of a detachment of R.E. Survey.

The fact that construction of piers was not completed before the launching of the bridge started, tended to increase the difficulties of checking for level and alignment.

The northern pier (Photo No. 3) instead of carrying a balance beam assembly, carried a steel platform and dowel pin and plate to allow for (*a*) the skewing and keying of the skew span over the embankment. (*b*) Expansion.

The final pier or portal frame is shown in Photo No. 2, which in turn shows clearly the necessity for careful check of level, and alignment before this span was allowed to rest on the end rollers.

To give the requisite height above water level, the bridge had to be constructed on and boomed out from a platform 30 ft. above ground level at the building site on the south bank. A launching platform was constructed, which consisted of 100-ft. Triple-Single Bailey resting on four Bailey piers bolted to concrete foundations (see Photo No. 4). On each Triple-Single boom were bolted launching rollers, on to which with the aid of a Henderson steam crane, booms, constructed on the ground, were hoisted by crane and connected up. The Triple-Single platform was decked, and on rails fixed to this deck a specially constructed trolley, pinned to the tail of the bridge, boomed out or withdrew the bridge by means of forward and rear tackles. Tackles through snatch blocks on anchor beams at the ends of the platform, led 4-in. S.W.R. cables to two pairs of petrol-driven winches fixed to foundations below the launching platform. Control was by " Walkie-Talkie."

Owing to the restricted construction site, which seemed to shrink smaller and smaller as "D-day " of work got nearer, the total length of platform was reduced to 100 ft. This length included, of course, the length of the launching trolley of 20 ft., thus allowing only the maximum length of 80 ft. for building. The implications on booming out of the first span, 130 ft., can easily be appreciated.

To provide an area on either side for working parties, a Bailey footwalk was attached on the down-stream side of the platform and along the whole length of the up-stream side was constructed a platform of tubular scaffolding. An amusing incident occurred after a particularly heavy assault by " the Press " when one reporter found the height to be too great before descending and had to be lowered by a rope, photographed by a small platoon of rivals who had already reached " terra firma."

The most speedy and economical method of construction and launching with available resources called for considerable thought.

Photo 2.—Portal Frame on North Bank. The white line in the foreground indicates boundary of District Line Tube from Charing Cross towards Westminster.
(Crown copyright reserved)

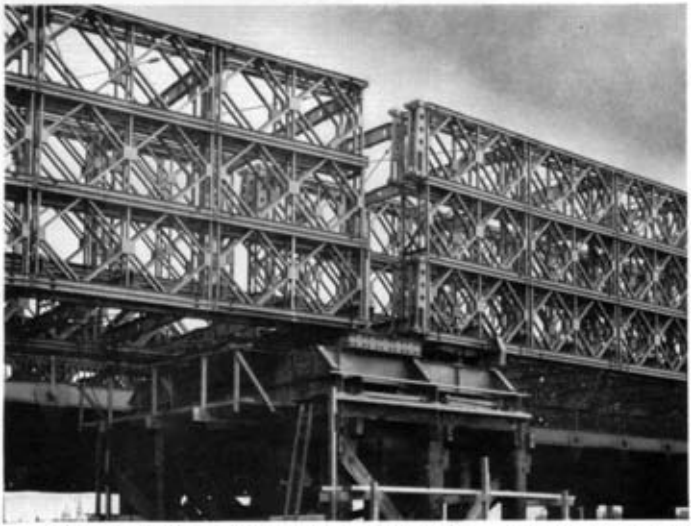


Photo 3.—North pier (No. 1) showing special assembly. *(Crown copyright reserved)*

Sapper Bridge 2,3

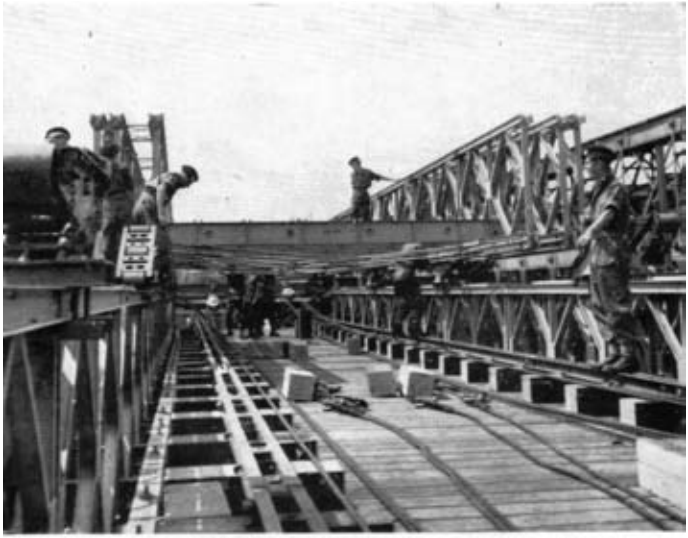


Photo 4.—Launching platform. *(Crown copyright reserved)*

Photo 5.—Erecting temporary pier on North Bank. *(Crown copyright reserved)*

Sapper Bridge 4,5

The principle to be followed was, to construct a length of bridge and boom out for a specified distance by means of the trolley, to withdraw the trolley and then to add a further portion to the tail, boom out and repeat.

For lifting booms, a Henderson steam crane, with a jib of 120 ft. in length, had been procured from the Transportation Training Centre at Marchwood, who provided a party for erection, assisted by steelwork erectors from the regiment. Two operators were "found" by Records, who were capable of handling this crane, unusual to an Army Engineer Regiment. It is only right to mention at this stage the prowess of one of these operators, who incidentally came from a family of crane operators and who was capable of operating with almost complete nonchalance the lifting and lowering of an 80-ft. truss, weighing approximately six tons, to within half an inch of its desired level.

The following general method was decided in principle. Booms of up to 80 ft. (normally 60 ft.) of "Triple-Single" were constructed on decauville trolleys on the ground. Completed booms were pushed forward until they came under the jib of the crane, where they were lifted into position on the launching platform or on to already located lower storeys as the case may be. This method worked smoothly, provided two booms were completed and ready for lifting into position before a shift began work. Care was exercised to ensure that the booms for the top storey were inverted, in order that transoms could be "underslung." During normal construction a squadron could build and boom forward 60 ft. in a shift of seven hours with a half-hour break.

Organization was as follows :—

One Troop	On the platform. Constructing bridge from booms, already constructed on the ground, securing and fixing accessories, e.g., transoms, sway bracing, etc. At end of construction in charge of launching.
One Troop	Responsible for hoisting booms and sending up all accessories.
One Troop	Construction of booms (normally 60-ft. Triple-Single) on decauville trolleys.

Difficulties were, of course, encountered, but were overcome without undue delay. The principal difficulties were as follows :—

(*a*) The underslinging of upper transoms required very careful locating by the crane. Any failure in bolts not being absolutely tight caused a distortion in the general alignment of the bridge, which, although very slight, made difficult the exact positioning of the upper

transoms. This was overcome by rigid supervision and by positioning transoms starting from the front end and working towards the tail.

(*b*) The insertion of special bracing frames, thicker than the normal type, again delayed progress. However, these were only required at points where the eventual position of the bridge required junctions of panels to be over centres of the first five piers.

(*c*) The extra weight of standard widened transoms reduced speed in fixing in the top storey.

The sequence of work was therefore as follows :—

On arrival two booms for the lower storey, left in readiness by the previous shift, were immediately hoisted and placed in position by two troops working in close co-operation. Transoms were hoisted and fixed and double sway bracing was placed in position and carefully adjusted to ensure rigidity and line. This Triple-Single portion was attached to the tail of the existing bridge.

The two centre booms were hoisted into position, and secured. Then followed the two booms for the top storey, followed in turn by transoms and sway bracing. The time required for constructing and attaching lengths of 60 ft. of Triple-Single ready for launching varied between six and a half and eight hours. Construction by one troop of six 60-ft. Triple-Single booms took a fairly even time throughout of eight hours.

The third troop began to construct Triple-Single booms with a task of six for the shift of seven hours. These booms were then ready for the next shift.

The method described was the method adopted as the result of research during training. Various factors, however, intervened which militated against construction as was at first hoped, and booming out on the "sausage machine" principle by 80-ft. lengths. The length of prefabricated booms was reduced to 60 ft. for normal working, so allowing time for insertion of "specials" and careful checking of all parts.

Whereas the launching of the main portion of the bridge presented no particular difficulties, the construction of the skew span had given cause for considerable thought to the designers. One of the main factors was time, as the launching of a bridge over the Victoria Embankment would demand the closing of the road to traffic.

The principle that was to be followed was as follows :—

To erect a temporary pier on the Victoria Embankment (see Photo No. 5) on which the forward span of the bridge was to rest, to remove the launching nose, to "break" the bridge on the northern pier (No. 1) and to skew the bridge by special traversing gear and a special system of rollers on the temporary pier until the forward

span reached the final alignment. To jack down on the portal frame and to remove the temporary pier. It sounded easy!

The maximum time that could be allowed by the Metropolitan Police was sixty hours, from Friday evening until Monday morning. Again week-ends were restricted owing to various traffic problems in London of which the fact that the Strand was "up for repairs" played no little part. While details will be given later in this article, two very relevant factors may here be mentioned.

(*a*) The fact that the District Underground passed closely under the roadway restricted the location of the temporary pier and the movement of cranes.

(*b*) A representative of the L.C.C. Tramway Authorities remained at the site in a state of alarm in case a metal object should drop below the road on to the live rail.

Much depended upon how long it would take to "break the span." The point of contra-flexure had been most carefully computed by the designers. Would the pins come out as and when required?

It was not only with relief but with astonishment to the less technical minded that this operation of removing the pins took only twenty minutes.

The method of skewing had been the subject of considerable thought by the designers, especially with the limited amount of time at their disposal. The system adopted was by preparing an all-steel deck to the temporary pier using spare chord reinforcement, and by traversing on rails and jacks the front span, whose weight had first been taken on a ball-and-socket joint.

By the allotted time the bridge was skewed into position, but removal of the temporary pier had to be put off until the next night.

Organization

Consideration of the organization of the task is of interest. For almost a year before construction started, the design of the bridge had been in the hands of the Chief Engineer, London District and his staff and the staff of the Experimental Establishment at Christchurch (M.E.X.E.). Time had not been too great and inability to obtain correct special stores, both for the bridge and for launching, had on occasions caused changes in design. Finally the design had to obtain approval from the L.C.C., for whom the army was carrying out the job.

The situation, as far as the regiment was concerned, was that it was a working party for the Chief Engineer, London District, who appointed a S.O.R.E. in technical charge of all operations.

In addition to 36 Army Engineer Regiment, the following units and detachments were placed " under command."

R.E.	Det. from School of Mil. Survey
R.A.S.C.	Det. 579 Coy. (Motor Transport)
R.A.S.C.	Det. 632 Coy. (Water Transport)
R.P.C.	One section 371 Coy. 71 Group.

Detachments from the Territorial Army carried out work on three week-ends.

Total numbers required from the regiment were at first undetermined, but certain factors produced an answer in the end.

(*a*) Numbers for building would be in the region of eighty to one hundred men. This represented the working strength of one engineer squadron on Lower Establishment.

(*b*) Stores would play a vital part. The Stores Troop, assisted by a section of Royal Pioneer Corps were adequate, but its strength only permitted the working of one long shift instead of two shorter shifts.

(*c*) Allowing for unexpected delays there was not too much time. As work was to take place in mid-summer, two shifts were worked, each of eight hours, i.e., two squadrons.

(*d*) A strong and efficient administrative staff would be required to operate two shifts in camp and at the site.

Eventually a total of some four hundred, Officers, W.Os., N.C.Os. and Sappers were employed.

The job was therefore organized from the following units :—

Construction and launching	57 and 58 Engineer Squadrons, less rear parties.
Winch party	24 Engineer Squadron (detachment).
Stores and Workshops	20 Engineer Park Squadron.
Camp Admin. Party	A composite party from all squadrons.

The section of Royal Pioneer Corps was placed under command of the stores section of the Field Park Squadron.

Responsibility for the execution of the work was that of the Chief Engineer, London District, who located a S.O.R.E. at the site in technical charge of the work. Organization of the work remained in the hands of the regiment, but the staff officer, as the representative of O.C. Work, was technically responsible for the standard of work and for inspection of each portion of the bridge before launching.

To assist in supervision and in technical assistance, two Q.M.S.Is. were attached to the staff officer, and acted under his orders. A Q.M.S.I. was also attached to each squadron to give technical assistance to squadron commanders, and to work with the staff officer of the Chief Engineer.

The staff of the Chief Engineer, together with that from M.E.X.E., had worked out detailed construction schedules, breaking the construction up into phases and enumerating the stores for each phase.

After careful examination of the schedules, it was decided first to give special training to officers and senior N.C.Os.

On the floor of a gymnasium in the unit lines was marked out the plan of the building site to the same scale as the Model Bailey equipment. A piece of tubular scaffolding was cut to resemble the crane jib, and Officers and senior N.C.Os. were taken through the whole course of construction and launching, phase by phase. This period lasted a week and well repaid the trouble.

Training of junior N.C.Os. and Sappers was carried out at Wouldham, where instruction was given in certain main features of construction. Owing to lack of equipment, there could be no training in launching. In addition, all ranks were given revision in the use of jacks, packing and the various tools. Before the launching of the skew span additional instruction was given in Wormwood Scrubbs camp, closer to the time of work. This training proved a valuable test of the organization of the work and gave data which enabled preparation of a programme of work.

Stores

Ordering stores had been the responsibility of the Chief Engineer. In addition to the normal stores for a S.W.B.B., many stores had to be specially constructed, some in Army Workshops and some by civil firms. Two examples are : the launching trolley and anchor beams were constructed in 14 Command Workshops at Ashford, and cables for launching tackles were obtained through the Admiralty. All stores were to be consigned to No. 6 C.E.D. at Wormwood Scrubbs and many a hair began to take on a " greyish " hue as the time for arrival drew near. O.C. No. 6 C.E.D. in turn handed over stores to the Stores Troop of 20 Engineer Park Squadron, which had arrived at Wormwood Scrubbs one month before work was due to start.

To the Stores Troop, assisted by the section of R.P.C. and the M.T. Company., R.A.S.C., fell the responsibility of checking all stores in at Wormwood Scrubbs, accounting on tally cards, organizing movement to the site in accordance with construction schedules and taking on tally card charge at the site. An exercise had been held in the regiment some months earlier which produced a drill for the organization and tasks of the Stores Troop, which in this case handled approximately 1,000 tons of stores, many of them being of a special type and for a special purpose. Coles cranes operated by operators from the Plant Troop were used for loading and unloading. Few realized their responsibilities more than the members of the

Stores Troop and the attached section from the Royal Pioneer Corps. Their careful work ensured a smooth flow of stores to the site throughout the construction and at no time was work delayed for stores.

Progress of the Work

A programme of work was carefully calculated before the start of work and issued as a target. Certain assumptions had to be made, e.g., (*a*) piers would be ready before the bridge; (*b*) the site would be ready, as laid down when squadrons arrived. For a variety of reasons everything was not ready as hoped. Time, however, had been allowed for the unexpected.

Reference must now be made to the much published disaster, which occurred just before the first span of 130 ft. reached pier No. 6, the first pier from the south bank, where construction took place. Owing to the fixing of chord reinforcement, additional to that contained in the original design, the adjustment of balance was too fine with the result that the front end of the bridge slowly dropped into the water, when only two feet short of No. 6 pier. The situation was made more complicated by the fact that a sea-wall of expensive granite had just been completed beneath the bridge and any damage to this could not be contemplated. Removal had therefore to be carried out by dismantling, instead of by hauling out over the wall under cover of night, as all would have preferred. This dismantling inevitably took time and was carried out in the full public eye, much to the discomfiture of all concerned. Many a sapper had a lot to say about the granite wall. All would have willingly torn the bridge to pieces during the night, had they been allowed.

That portion of the bridge, which had not dropped into the water, was dismantled and every piece was tested later by the staff of C.I.E.M.E. before it was again incorporated into the bridge.

After the first span had been extricated from the river, work proceeded once more with additional safety precautions and proceeded relatively smoothly until the north bank was reached.

Owing to the fact that the method of launching over the Victoria Embankment was not decided until only a few days before work started, rehearsal was not possible and progress was not as smooth as had first been hoped.

It had been agreed with the Metropolitan Police that the week-end 14th–17th July would be the time for this work to take place. Work started at 1800 hrs. on Friday, 14th July. By 0600 hrs. on Monday, 17th July, the launching nose had been removed, the forward span of 170 ft. had been disconnected from the main bridge over pier No. 1, and had been swivelled and jacked down on to its final resting place on the portal frame. The work of dismantling the temporary

pier, "thickening up" the forward portion of the bridge and decking down was deferred till Monday night. Pouring rain and a high wind had much to do with the deferment of final dismantling.

Workshops

Mention has not so far been made of a workshop site. Although at the outset it was not clear what jobs would be required from workshops, other than welding and small tasks, it was decided to locate the Workshops Troop at the site complete with all its machinery. As things turned out, the Workshops Troop was more than fully occupied during the whole period in constructing special parts, hitherto unforeseen acetylene welding and adapting stock parts to special uses. For his work in charge of workshops and for his inventive genius, the staff sergeant attached to the Workshops Troop was awarded the British Empire Medal.

Conclusion

(*a*) *Morale.*—The first news that the regiment was to build a bridge was a terific fillip to the morale of the regiment. Hence it was very necessary that every squadron should take part in one way or the other. The disaster when the first span of the bridge fell into the river acted as only a temporary set-back. Now that the bridge is completed, it is still talked about with pride.

(*b*) *Organization.*—The organization of stores, linked with workshops production, needs careful study in a task of this nature, coupled with organization of transport and the employment of cranes. The study of this aspect, well before work began, paid an ample dividend and no alteration or amendment to the original plan was required.

The task required considerable improvisation in organizing the administration. Working on a Lower Establishment for an Army Engineer Regiment strained the resources of the regiment to the limit in Officers and N.C.Os. It may be added here that at the same time the regiment was also providing an administrative staff for a T.A. Camp.

(*c*) *Engineer power.*—This task revealed the full power of an Army Engineer Regiment on its present establishment (1950) and showed what really could be accomplished technically.

(*d*) *Co-operation with other arms.*—Under command of the regiment were the following units :—

579 Coy. (Motor Transport) R.A.S.C.
Det. 632 Coy. (Water Transport) R.A.S.C.
Sec. 371 Coy. 71 Group R.P.C.

In addition a detachment from R.E. Survey and No. 6 C.E.D. played a big part. All worked hard and smoothly in a common effort.

(*e*) It is difficult to decide where the word conclusion really fits in a task of this nature. As the Engineer-in-Chief asked at the time of one of his inspections, " Well, how are you going to take it down ? " perhaps conclusion is the wrong word. Nevertheless, on the completion of a job of this nature, there must be some deductions or conclusions about which some points are given below.

The completion of the construction of this bridge caused a tremendous uplift in the morale of the regiment. The mere fact that the regiment was to carry out the work did a lot to their respect. The completion rounded the matter off. Many a National Service soldier will feel a better man for having taken part in this work when he reaches his T.A. unit.

To execute the job correctly required a high standard of command and leadership on the part of Officers and N.C.Os. The demands of present-day peace-time soldiering coupled with ever-changing populations gives little scope to a proper spirit of command to junior leaders, so that when a junior N.C.O. was heard to say to six older sappers, " I don't care a —— what you say, that transom goes there " (and it did), some advantage can be said to be gained.

Advantages gained to training in the execution of this task were undoubtedly great. For probably the first time in their service, a majority of Officers, N.C.Os. and Sappers took part in a major engineering task, which had been carefully planned and organized and which had many ancillaries all " geared in " e.g., workshops and store dump at site, special welfare and safety arrangements, cranes both small and large. There was, of course, the value of lessons drawn from the construction of a large Bailey bridge. There were the lessons of organization and administration of a major task, coupled with proper decentralization of responsibility. There was the value to training of manual dexterity and trade efficiency.

Finally there was the great object lesson that unless all worked as a team, Officers and Sappers, Royal Engineers and Other Arms, a job will not be accomplished either in time or efficiently. These lessons are now absorbed and while all ranks were proud of the part they played in the much advertised construction of Sapper Bridge, most will admit that it was with relief that the final chess was laid and word was received that the bridge had been handed over.

CLAUSEWITZ AND THE COLD WAR

By MAJOR-GENERAL B. T. WILSON, C.B., D.S.O.

CLAUSEWITZ'S first writings about war were in the form of short essays only loosely connected with one another. He looked on them as "grains" of knowledge, interesting not only in themselves but also in what those experienced in war could derive from them. Having an urge to system, which is not, however, very apparent in his book, he later on developed these "grains" into his famous treatise *Vom Kriege*, which a reader not yet acquainted with battlefields would be able to read with profit. "My ambition was to write a book that would not be forgotten in two or three years and which would be opened more than once by anyone interested in war."

His aim has been amply realized for it is nearly 120 years since the book was first published and it is still very much alive. Soldiers and statesmen on the Continent have studied it with great attention and often seem to have based their conduct of land warfare much in accordance with the principles which it lays down. British soldiers, however, do not appear to delve into Clausewitz with feverish enthusiasm. The English translation in three volumes from a famous military library had a forbidding slip of paper gummed to the frontispiece of Vol. II marked "Not for youngsters." Vol. I had been taken out eighteen times, Vol. II twelve times and Vol. III only ten times in eighteen years! As Vol. III contains the chapter "Plan of War" it is evident that we do not tend to plan wars: we rather prefer to have wars thrust upon us.

But for those who do plan wars, Clausewitz is a veritable feast. One can well imagine Hitler browsing through its pages* during the enforced leisure of his imprisonment after the Munich "Putsch." The stern-faced members of the Politbureau possibly open the book more than once in a while to see whether the oracle throws any light on their problems of war and peace. It might even happen that the "why" or the "wherefore" of such strange phenomena as the "war of nerves" and the "cold war" would be explained by reading carefully through *Vom Kriege*.

At first sight this would not appear to be very probable because although the threat of war has constantly been used to gain political ends without fighting for them, there is something quite novel in the scale and scope of the two procedures. They are, moreover, quite different from each other.

Hitler was a neurotic who could whip up the well-educated German people to a state of almost hysterical enthusiasm for war

* Hitler made a reference to the "great Clausewitz" in his final testament to the German people, dated 29th April, 1945.

and when he threatened, the tension produced was of a momentous kind and the issue of peace or war hung by a thread.

But the less educated peoples of the U.S.S.R. are seemingly not consumed with any burning enthusiasm to embark on a war of aggression. They appear to be obedient but passive. Their leaders have so far acted with great deliberation, both in pursuing political aims and also in the recourse to force. The extreme tension of Hitler's "war of nerves" does not suit the endless patience of the Russian temperament. A Russian object seems to be pursued on an extremely long term basis regardless of setbacks and repeated failure. The possession of the Crimea had been an ambition of centuries before it was finally acquired from the Turks in the time of Catherine the Great. The russification of eastern Siberia and central Asia has been a very gradual achievement more like the slow advance of the tide than the furious onset of a storm.

Clausewitz, who was for many years in the Russian service, makes a pregnant comment on Poland, which he mentions as an exception to the usual rule that a nation defending itself in Europe can generally rely on foreign aid in the preservation of its sovereignty—"Long before the partition of Poland, the Russians had *penetrated* the country and the idea of its independence had ceased. Had it not been partitioned, Poland must have inevitably become a Russian province. There is as little to cause wonder in the noiseless downfall of Poland, as in the silent Russian conquest of the Crimean Tartars."

Poland has to-day, to all intents, finally become a Russian province but it has taken a very long time to bring about. Seen in historical perspective, therefore, there is nothing really new in the Russian "cold war," which is the old patient penetration procedure, quickened up by the cataclysmic disturbances of the times.

There may be, therefore, passages in Clausewitz which do illuminate some of the puzzling aspects of the "cold war." But before proceeding to examine them, a glance at some of his basic conceptions is advisable for they run like a thread through the whole of his treatise.

Basic Conceptions

1. "War is a mere continuation of policy by other means."

This famous saying requires little comment. It seems obvious enough now but it was a novel idea when it was written. Even in 1914–18 friction between statesmen and soldiers was more pronounced than a fuller understanding of the axiom would have permitted. In the last war the political leaders of the warring nations exercised a tight and vital control of higher strategy. Such control is certain in the total warfare of the future.

2. "The defensive is in itself stronger than the offensive."

This postulate seems at first sight to be contradictory especially after a war which rewarded the offensive with such overwhelming

victories. Clausewitz points out that if the offensive were the stronger form of war, all would attack and there would be no defensive. He considers the " state of expectancy " of the defence to be its great advantage, for it wards off the blow and then strikes back. In decisive war there is no question of passive defence. The American conduct of the Korean war is a classic example of the correct use of the defensive. One can feel sure that Clausewitz would have admired it.

3. " There may be wars of all degrees of importance from a war of extermination down to the mere use of an army of observation."

To this remark might be added " or even to the threats of war implicit in a so-called ' war of nerves ' or in a ' cold war '. "

4. " Although there are many ways to one's object in war, the destruction of the enemy's armed force is always the superior and more effectual means, to which all others must give way."

War which goes headlong for a decisive result cancels out the lesser forms.

Having thus mentioned the four main conceptions of Clausewitz's philosophy of war, the way is clear for some ideas which bear particularly on the present-day " cold war."

Ideas Which Bear on the Cold War

5. " Most reports are false and the timidity of man acts as a multiplier of lies and untruths. Everyone is inclined to magnify the bad in some measure."

The Iron Curtain prevents the West from acquiring a true picture of the U.S.S.R. The " fog " of the " cold war " is one of its chief features. Reports about the military strength of the U.S.S.R. may be greatly exaggerated.

6. " Lastly, even the final decision of a whole war is not to be regarded as absolute. The conquered state often sees in it only a passing evil."

Germany thought like that after 1914–18. Her present prostration is the root cause of the " cold war."

7. " The political object as the original motive of the war will be the standard for determining both the aim of the military force and also the amount of effort to be made."

The political object of the U.S.S.R. is to spread Communism throughout the whole world. This brings them into conflict with political opponents, who together are bigger and potentially far more powerful. Even the conquest of Europe would not end the struggle. The required effort is therefore stupendous.

8. " War does not spring up quite suddenly : it does not spread to the full in a moment."

The " cold war " has been going on for several years and has not yet spread to the full.

9. "On the other hand it is well known that there are troops in the service of European powers at the present moment who would be dispersed by a few cannon shots."

This was true in 1831 and is true now. Very high standards of training are necessary to transform the inhabitants of an urban democracy into effective soldiers—especially if they are suddenly to be thrust into a defensive battle. Only particularly capable commanders can train and lead troops in modern war : they are more difficult to find than good staff officers.

10. "A system of terror is not at the command of any but a revolutionary government."

This has a familiar ring !

11. "As soon as ever one of the two parties proposes to himself a new positive object and takes active steps towards it, even if it is only by preparations, and as soon as the adversary opposes them, there is tension of powers. This lasts until the decision takes place—that is until one party either gives up his object or the other has conceded it to him."

It would be difficult to set down a better description of the course of the "cold war."

12. "Superiority in numbers is, in tactics as well as in strategy, the most general principle of victory."

"We may search modern history in vain for a battle in which an army has beaten another double its own strength."

"At certain periods in history a superiority in the organization and equipment of an army has given a great moral preponderance."

"The weaker the force the more moderate must be the object it proposes to itself and the shorter time it will last."

Even in the atom age superiority of numbers will continue to be a decisive factor, but the question of how best to use it in a global war is very difficult to answer. If there were no air power, "big battalions" would still win but there is a growing possibility that masses of divisions are not the best instrument for the "continuance of policy by other means."

13. "If the offensive should discover some new and powerful element which it can bring to its assistance, then the defence must again alter its method."

Air power and armour are potent new elements which are developing to their full potential. The defence requires to study to defend in great depth using "hedgehogs" and lines of obstacles to unbalance the attack so as to produce favourable conditions for a large scale decisive assumption of the offensive.

14. "A conqueror is always a lover of peace : he would like to make his entry into our state unopposed. It is precisely that side which has to defend itself which should always be armed against surprise."

The U.S.S.R. sponsored "peace declaration" bears this out ?

15. " The offensive need not be the easy and certain form of war, which it is in the gloomy imagination of those who can see only helplessness and apathy in the defence."

Troops likely to be thrown on the defensive, should be taught vividly in peace-time, that they will defend at first the more certainly to defeat the enemy. A modern defensive battle makes great demands on the morale of the defenders. Korea is a wonderful object lesson.

16. " The direct defence of a river when the masses of troops are considerable, the river large and other circumstances are favourable may be regarded as a very good defensive means and may yield results to which commanders in modern times have given too little attention . . . All depends on the means of crossing."

Clausewitz reckoned that 60,000 men on the near side of the lower Rhine could watch 120 miles of it and make the crossing from the far side an extremely expensive operation for 120,000 of the enemy. The present-day means of crossing are, of course, far superior to anything that existed then and many other new factors have to be considered. On balance a broad river is still a formidable obstacle useful for decisive defence and there are many broad rivers which invaders from the East would have to cross.

17. " Key positions are very rarely indeed to be found."

A useful " debunking " comment. Armies constantly lose so-called " key positions " without serious results.

18. " Formerly fortresses were only built for the defence and protection of the inhabitants. This use of fortresses has been too little regarded in modern times. If there was a country in which not only all great and rich cities but all populous places as well were fortified and defended by the inhabitants, the talent as well as the force of will of the enemy's General would sink to nothing."

Home guards and " hedgehogs " come to mind on reading this paragraph.

19. " The retreat into the interior of the country should as a rule be made directly before the enemy and as slowly as possible with an army which has not suffered decisive defeat and is undivided."

Cf. Korea.

20. " It would be a great mistake to suppose that there neither is nor can be any instance elsewhere of the same defence as was practised in Russia in 1812."

21. " Unless the defender has an immediate great decision in view, he is obliged to take his measures the sooner of the two, which gives the assailant the advantage of playing the last hand."

After Korea, what ?

22. " No war should be started without first seeking a reply to the question ' What is to be attained by it and during its course ? ' "

The U.S.S.R. would find this question most difficult to answer.

23. "If policy is grand and powerful so also will be the war, so that it may be carried to the point at which war attains its absolute form."

It would be difficult to describe as "grand and powerful" a policy which finds expression in such measures as the Berlin blockade, in niggling there over transportation details, in the petty use of the "veto" and in the incitement to war of puppet states. Such a policy is opportunist and naïve rather than grand and powerful. It would in fact be difficult to imagine a course of action more calculated to alarm the Western world and more certain to force it to take the measures to defend itself, which are now in hand. Conceivably the U.S.S.R. are in a sea of troubles themselves and desire to add to those of the West, without any intention of becoming involved themselves in real war which they know full well would certainly be of the "absolute" kind.

24. "The Tartars seek new abodes. They march out as a nation with their wives and children. They are therefore greater than any other army in point of numbers and their object is to make the enemy submit or to expel him altogether. By these means they would soon overthrow everything before them, if a high degree of civilization could be made compatible with such a condition."

They would, however, find it difficult to cross the oceans.

25. "Russia can only be subdued by its own weakness and the effects of internal dissension: the country must be agitated to its very centre." Judging by past history the thing NOT to do is to march on Moscow!

26. "An attack designed to destroy the enemy which has not the boldness to shoot like an arrow directly at the heart of the enemy's power can never hit the mark."

This is a mark which Hitler missed. He failed to attack Great Britain.

27. "Is it better to mix up the troops of different Powers so that each Army is composed of troops of different powers as was done in 1813 or 1814, or to keep them separate? Plainly the first is the most salutary plan."

Clausewitz points out that the Czar Alexander placed his troops under Prussian and Austrian commanders although the Russian Army was the largest of the three. The same problem will crop up again in the organization of the armies for the defence of Western Europe.

28. "When an object at the very beginning of a war is beyond our strength, it will always remain so. . . . There is only one result in absolute war and that is the final result . . . The more necessary it is not to take the first step without reflecting what may be the last."

It is to be hoped that the rulers of the U.S.S.R. will think over these wise remarks and not adopt the attitude of Hitler who, when he had made war with Poland, Great Britain and France inevitable, exclaimed " No matter ! The Germans have everything to gain by war and nothing to lose." Seldom has a prophet been so terribly wrong !

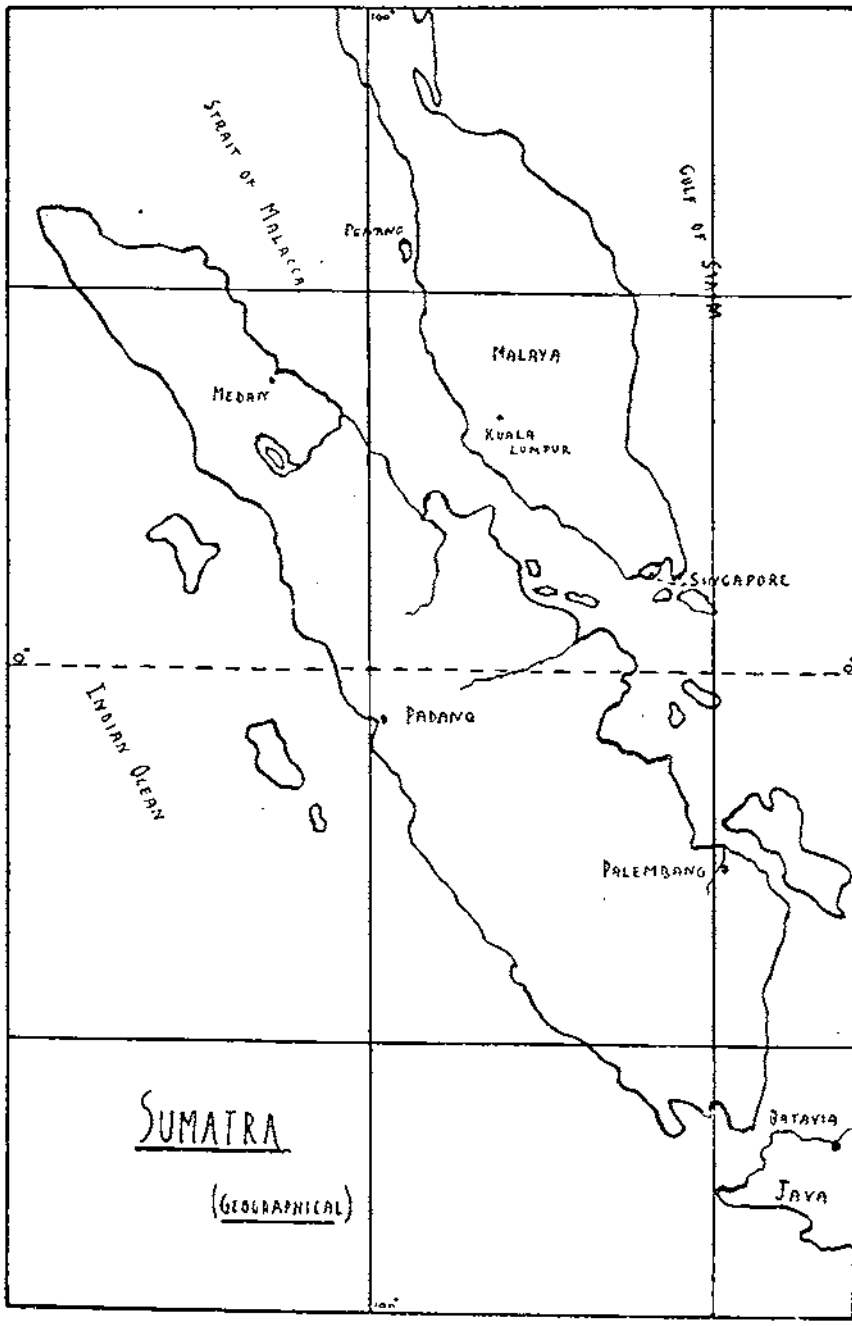
Clausewitz ends his treatise with a sketch plan of campaign for a war against France waged by Austria, Germany, the Netherlands and England. There is now no great interest in his plan, but two of its details are worth mentioning.

The first one is that Switzerland is allotted the rôle of a neutral than can look after herself with her own forces and that her country would be a useful " point d'appui " on the Upper Rhine. Switzerland has carried out this rôle very adequately during several considerable wars during the last hundred years and seems likely to continue to do so. At the present time she is in the process of equipping herself with a large number of medium tanks and seems fully aware of what might again be required of her.

The second point related to the " English " army and suggests that only half of it should fight on the Continent and that the other half should be retained in England to threaten a landing on the French coast. This, says Clausewitz, would keep two or three times as many French troops busy at coast defence.

It is significant that Clausewitz should make this suggestion, as there is only one other mention of the sea in his whole book and that is to remark, when discussing the subsistence of armies, that war tends to fix itself along high roads, near populous towns, in fertile valleys or *along such sea coasts as are well frequented !*

Clausewitz seems, in fact, to have avoided thinking about sea power, although he must have noticed how his hero Napoleon was thwarted in his ambitions by the English fleets. This absence of reference to the sea seems to show that he was not a man of action who thought deeply on how to dominate the world. He was not, in fact, even a good commander of troops but being of a philosophical bent was content brilliantly to analyse the land warfare which, for so many years, he had seen with his own eyes unfolding itself on the battlefields of the French revolution and Napoleon. No glorification of war is to be found in his book nor is he a special advocate of the offensive and nothing but the offensive. His treatment of war is severely objective. He had no scruples about the planning of aggressive wars and it would have seemed to him absurd that one day it would be considered criminal to do so. Decisive war was to him " an act of violence pushed to its utmost bounds," which is probably what it will continue to be.


STRAIT OF MALACCA
PENANG
GULF OF SIAM
MALAYA
MEDAN
KUALA LUMPUR
SINGAPORE
0°
INDIAN OCEAN
PADANG
PALEMBANG
BATAVIA
JAVA
SUMATRA
(GEOGRAPHICAL)

SUMATRA 1945 - 46

By MAJOR J. S. R. SHAVE, M.C., R.E.

IN 1949 the world took a renewed interest in the Netherlands East Indies. By a combined " police action," Dutch naval, army and air force units brought about an effective coup against the so-called republican state of Indonesia. A review of the British and Indian occupation of Sumatra which ended in December, 1946, may be of interest to readers who do not understand reasons for the Dutch action, or who perhaps may wonder why we ever occupied the East Indies at all. I shall commence with a little topography and a sketch of the events which led up to the occupation in September 1945. Although the review is made from the divisional engineer viewpoint, experiences are typical of those encountered by all arms during the occupation.

A glance at the map shows that Sumatra is a huge island which straddles the equator, it is over 1,000 miles long and widens from about 150 miles in the north to about 300 miles in the south. By European standards communications are very limited, vast areas of the interior are of impenetrable marsh or densely forested mountains. The narrative chiefly concerns three towns only, Medan the capital, a small city in the north-east opposite the coast of Malaya, Padang, a small town on the west coast just south of the equator, and Palembang an important town near the oil refineries of Ploesti on the Palembang river in the south-east.

Focused round the islands of Java and Sumatra, her " Indian " empire was a source of great pride and wealth to Holland. In common with those of France, the Dutch colonies played a more integral part in the home life of the mother country than those of the British Empire. The majority of Dutch families have close ties with relatives or friends in their beloved " India." Another reason for stronger ties with the mother country is that intermarriage with native people does not bear the stigma attached to it in most British possessions.

Following the lightning Japanese invasion and conquest of Sumatra, the Dutch colonials found their liberty increasingly restricted until most of the women were interned in camps in Java or Sumatra whilst their menfolk were sent off to slave labour in Malaya, Siam and Indo-China. There they remainded under conditions of increasing savagery and hardship for three years.

In common with the indigenous peoples of other countries bordering the equator, the natives of Sumatra are prolific and vary in outlook and education from the head hunter to the university graduate. Islamic religion is a great influence amongst these natives and generally they were more friendly disposed to Mohammedan troops than to any others during the Indian occupation. Although there is an important oilfield in the south-east, the main industry of the vast country is agriculture, rice, tobacco, rubber, palm oil and other tropical products were exported in large quantities before the war. The loss of their markets in India, Europe and elsewhere brought great hardships to these agrarian peoples. The plight of many thousands became desperate and in common with the peoples of other countries " liberated " by totalitarian powers they tended to drift away from the standards of the civilization so painfully built up during decades of Dutch occupation. Encouraged by the Japanese, in the belief that Dutch rule was broken for ever, reactionary groups of the more educated natives proclaimed the birth of the republican state of Indonesia. Extremists joined one or other of the militant secret societies which flourished under Japanese rule, the " Black Buffalo " organization was the principal society in Sumatra. The novelty of " liberation " by the Japanese soon wore extremely thin and the natives found themselves very much worse off than they had been under Netherlands rule. Unfortunately, the illusion of the future might of their young, virile and populous republic with its immense natural resources was a tempting bait to offer all who would resist the efforts of the Dutch to return and to restore law and order on the European model. The republican army, with Japanese war material and Japanese instructors was sworn to oppose any attempt to reoccupy the colonies.

The sudden collapse of Japan faced the allies with great problems in the Indies, problems with which a recently prostrate Holland was quite unable to deal. Many thousands of released allied prisoners of war and internees (RAPWI), had to be succoured and evacuated. Thousands of Japanese troops had to be rounded up, disarmed, and eventually repatriated. Although the activities of hostile terrorists and republican guerillas had to be curbed in order to carry out the two major tasks, there was no allied intention to interfere with the purely domestic problems of the Netherlands and the republic of Indonesia.

To fulfil our obligations to the allied cause, H.Q. 15 Corps was set up in Batavia the capital of Java, and a large force of Indian divisions with the British 5 Para. Bde. occupied that island. 26 Ind. Div., less one brigade, was put into Sumatra to carry out the aforesaid tasks there. Divisional headquarters was set up in Padang in September 1945, 71 Bde. was also grouped in the Padang area, one

battalion occupying Fort de Koek, some forty miles to the north. Padang airfield, although seven miles from the town, was constructed of reinforced concrete and was in a considerably better state of repair than other runways in the island. The small port of Emmahaven four miles away was the only other means of access to the district. Accommodation in Padang was very limited but for tactical reasons it was the first location of divisional headquarters during the occupation.

To Medan went 4 Bde. and a composite group of divisional troops which were known as the "Gunners Brigade". Although the airfield at Medan was very short and in poor condition, it was on the outskirts of the town. Also the port facilities offered by Belawan a dozen miles away, were the best available in Sumatra.

For several months Palembang was occupied solely by a battalion of the Burma Rifles from 5 Ind. Div. This battalion controlled the situation extremely well initially, but later it had to be considerably reinforced.

C.R.E. 26 Ind. Div., initially Lieut.-Colonel H. C. G. Richards, M.B.E., and subsequently Lieut.-Colonel D. W. R. Walker, M.B.E., commanded a mixed force. The divisional engineers comprised :—

H.Q. R.I.E.	...	K.G.V.O. Bengal S. and M.
72 Ind. Fd. Coy.	...	K.G.V.O. Bengal S. and M.
28 Ind. Fd. Coy.	...	Royal Bombay S. and M.
98 Ind. Fd. Coy.	...	Royal Bombay S. and M.
328 Ind. Fd. Pk. Coy.	...	Royal Bombay S. and M.

In addition there were under command, a platoon of an E. and M. company, 713 Ind. Mech. Eqpt. Pl. and a detachment from 458 Forward Airfield Engineers. The engineer strength in Sumatra was further reinforced at a later date by an engineer battalion and a British works section.

The initial distribution of engineer units was as follows :—

Padang	...	H.Q. R.I.E. 28 Coy. with a detachment of 328 Fd. Pk. Coy.
Medan	...	72 Coy. (In support of 4 Bde.). 98 Coy. (O.C. 98 Coy. was also D.C.R.E. Medan). 328 Fd. Pk. Coy. less one platoon. All attached engineer troops.
Palembang		Nil. (It was later found necessary to send a platoon from 28 Coy. In the meantime O.C. 28 Coy. was responsible for maintenance.)

The initial landings and occupation went smoothly and the divisional engineers were able to commence work at once on the numerous tasks awaiting them.

Amongst urgent engineer problems which faced the C.R.E. were the following :—

Resurfacing and extension of Medan airfield.
Provision and safeguarding of water supply.
Organization and maintenance of an E.S.D. for defence and maintenance stores.
Route recce where possible throughout Sumatra.
Control and safeguarding of power stations and other services.

Engineer parties accompanied armed convoys which penetrated from Padang to Medan and from Padang to Palembang, but these routes were quickly closed by Indonesians. No other lengthy route reconnaissance was possible, but much local information was gained in the areas of the three occupied towns.

Extension and resurfacing of Medan airfield was directed by Major Soule, O.C. Det. 458 F.A.E. Working for him were 98 Fd. Coy., 713 Mech. Eqpt. Pl. and 72 Fd. Coy. when available. The runway was extended from 900 yds. to 1,400 yds. and surfaced with P.B.S. Full dispersal and flying control facilities were provided. Rain was an obstacle but despite daily tropical downpours the work was soon put well in hand. The transformation of this airfield into a serviceable all-weather strip was a major tactical achievement and enabled divisional headquarters to move up to Medan at a later date.

Throughout the period of occupation the reaction by guerillas against the occupying forces steadily increased. By every means within their power, from all-round blockade of each town to open terrorism the Indonesians sought to make our position untenable. Palembang district remained untroubled for several months but eventually the situation there also deteriorated.

As areas became more unsafe, freedom of movement had to be increasingly restricted until each occupied town resembled a beleaguered camp surrounded by barbed wire and road blocks, with curfew stringently enforced. Early in December, 1945, the B.M. of 71 Bde. and a member of the British nursing staff of 124 I.G.H. at Padang were murdered on the beach near Emmahaven. The vigorous action which followed included the shooting of the murderers and the burning of the Kampoeng which housed them, but as a further precaution all British women were evacuated to Medan.

Early engineer activities in Padang were chiefly concerned with water supply and general maintenance of units. A considerable tonnage of stores was also brought up from Emmahaven where they had been unloaded from ships by a small port operating unit. The increased load on the limited electricity supply, coupled with the arrears of maintenance, caused many breakdowns in the system.

Throughout their stay in Padang, 28 Coy. employed a civilian, a diminutive Madrasi named " Felix " to carry out line repairs. Felix worked like a Trojan at all hours of the day and night and often in most foul weather. Amongst the first security precautions at Padang was the closing of routes leading into the town. To block one road completely 28 Coy. demolished a heavy reinforced concrete bridge. As the garrison of Padang drew itself closer into the town, it became apparent that divisional headquarters would have to move to Medan which offered more accommodation and better contact with the outside world. Rapid progress on Medan airfield soon made it serviceable to Dakotas in all weathers and so established a firm link with 15 Corps H.Q. in Batavia and with Kuala Lumpur and Singapore. In contrast with this it became quite a hazardous undertaking to reach Padang airfield from Padang, and it was soon only possible by day in well armed convoy.

In March, 1946, divisional headquarters moved to Medan by sea. The arrival of a British works section commanded by Major J. Todd removed the burden of duties as D.C.R.E. Medan from the shoulders of O.C. 98 Coy. and provided the C.R.E. with a much needed force who were skilled in the ways of works services. An engineer battalion—No. 11 of the Sialkot group—arrived as further reinforcements. With a team at hand to organize civil contracts and the additional labour from the engineer battalion, the C.R.E. was able to embark upon an ambitious programme of rehabilitation for the city of Medan.

The year 1946 was one of continued unsettlement for many units in the far east. With several leave schemes, demobilization and repatriation at their height one continually met new faces amongst officers and men of the divisional engineers.

Soon after the move of divisional headquarters other changes occurred in the Padang garrison, necessitated by trouble at Palembang. The 1st Bn. Lincolnshire Regt. and H.Q. 71 Bde. moved to Palembang to assist the Burma Rifles. The decrease in strength at Padang necessitated the evacuation of Fort de Koek and the division of Padang into smaller defended localities or " blocks." The " South Rapwi Block " was defended by the 1st Bn. Royal Garwhal Rifles, the " North Rapwi Block " was held by the 8/8 Battalion Punjab Regiment, and the " Hospital Block ", in which 48 Ind. Fd. Amb. opened a C.C.S., was garrisoned by 28 Ind. Fd. Coy.

28 Coy. remained the only engineer troops in the Padang Bde. until the evacuation in November. Weakened by the detachment of its Sikh platoon for the maintenance of Palembang, and with thirty or more men manning posts throughout the night, the company was forced to work hard to carry out its small engineer commitments.

The hospital block was organized for all-round defence, each

platoon having sandbagged posts to occupy during an alarm. Troops available for defence were :—H.Q. Pl. (three caste), No. 1 Pl. (P.M.) and No. 2 Pl. (Mahratta). Posts were lightly manned by day but were linked by patrols and carried double sentries after dark. One officer was on duty each night and would quietly visit posts in turn, always taking care to approach them from inside the hospital. During one of these nocturnal prowlings a certain officer, who shall be nameless, found himself at the foot of a disused well, which fortunately had become half filled with rotten vegetation. No. 1 Pl. (Lieut. A. J. McKerracher) and No. 2 Pl. (Lieut. D. G. Raschen) were allotted maintenance duties for the other blocks and as far as possible shared outside work which came up from time to time. Occasionally there was work to be done at the airfield or down at the port of Emmahaven, at other times an engineer party would accompany a company fighting patrol to an outlying Kampoeng.

The routine of occupation was frequently enlivened by "incidents" with Indonesians. The occupying forces found difficulty in remaining neutral in the Dutch-Indonesian quarrel and were sometimes forced to take action, but never did so without provocation. Marauding guerillas, snipers, grenade throwers and other unsociables tended to ambush convoys or to creep into towns after dark to cause unpleasantness. Punitive sorties were made on several occasions, particularly from Medan, where a battalion of South Wales Borderers were adept at the lightning execution of flying raids. They would be assisted on such occasions by scout cars of the divisional reconnaissance regiment (Duke of Wellington Regt.). Parties from 72 Coy. sometimes accompanied raiding columns.

Life in Medan became much more orderly than elsewhere in Sumatra. The high proportion of infantry enabled engineers to be released from most of the guarding and protective duties undertaken by the occupying forces. An extensive programme of engineer work was planned and carried out in order to set the city on its feet again before the handover to Dutch forces late in the year. 11 Engineer Bn. completed the surface dressing of all roads in Medan and repaired the route to the port of Belawan. The safety of the city water supply was ensured by the move of 98 Coy into the area of the city waterworks and swimming pool. The company also installed two large pumps on the river bank with an 8-in. main feeding the swimming pool as an emergency reservoir.

Wherever possible the engineers did all they could to assist the recreational activities of the division. All units laid several small hockey pitches surfaced with P.B.S. to enable "six-a-side" to be played. 72 Coy. laid two full-sized pitches in a similar manner and a divisional tournament was arranged.

The British Works Section under Major Todd and later under

Major B. H. Holloway accomplished much during their comparatively short stay. Their work included the production of some 10,000 charpoys, the construction of two hutted camps, and an extensive programme of redecoration, which restored Medan to its former picturesque glory.

After completion of the airfield task, the detachment of 458 F.A.E. rejoined its parent unit in Batavia. 713 Mech. Eqpt. Pl. was attached to 328 Fd. Pk. and its plant was used to carry out much jungle clearance for building sites and sports grounds.

The unit upon which undoubtedly the greatest demands were made over a long period was 328 Fd. Pk. Coy. under the command of Major Dunne. At their cramped location in a poor quarter in the town centre an E.S.D. with 2,000 tons of stores was organized. It was in this most unsuitable location that a building collapsed and put many of the stores platoon out of action. Soon after this accident, the South Wales Borderers were disbanded and the field park company was able to move into the school which they had occupied. The activities of the company at this time included the operation of a stone-crushing plant which supplied the airfield and all road works in Medan. A large proportion of the company transport was used daily by the divisional M.T. pool for carrying stores up from the port into the city.

Two months after their move to the school the C.R.E. found it necessary to ask 328 Coy. to move again, this time some five miles out on the road to Belawan where a very large railway workshops was sited. The railway to the port was falling into a sad state of repair under Indonesian control and the C.R.E. decided we could operate the whole thing more efficiently ourselves. 328 Coy. accordingly moved to the workshops, reclaimed the site from the jungle, built themselves a hutted camp and quickly organized large engineering and woodworking shops which carried out work for both Dutch and British.

Throughout 1946, the divisional task in Sumatra progressed steadily. All Japanese who surrendered were finally shipped away to a large island off the coast where they were to remain until final repatriation. Although it was known that many had deserted to assist the Indonesians, nothing could be done about them. As far as curfew and freedom of movement allowed, life became quite gay in Medan during the evenings. N.A.A.F.I. helped considerably during the occupation and several E.N.S.A. shows paid visits to Medan and Padang.

By contrast with Medan, life in Palembang became increasingly difficult. As the situation deteriorated there was little opportunity to carry out engineer work. Water supply to the R.A.P.W.I. block was always an acute problem. The pre-war mains installation had

suffered severely through lack of supervision and had been tapped in so many places in the native quarter that only a trickle ever reached the Dutch colony. The situation was relieved by a daily water convoy which was operated by the Dutch themselves. The Japanese carried out engineer maintenance in Palembang until they were shipped away, thereafter the Sikh platoon of 28 Coy. did what it could.

During the early summer the situation in Padang showed signs of becoming uncontrollable, "incidents" became daily occurrences and it was clear that reinforcements were badly needed. 23 Ind. Div. which was leaving Java eventually supplied the additional forces. 71 Ind. Fd. Coy. (K.G.V.O.), and a battalion of Gurkhas, arrived in Palembang, whilst Padang received the 5th Madras Fd. Bty., R.I.A. and the 2nd Bn. Kumaon Regt. The Kumaons relieved 28 Coy of the defence of the hospital block. On the day of their arrival their second-in-command was killed and the adjutant wounded whilst travelling in a jeep between the R.A.P.W.I. blocks. A grenade tossed from the ditch exploded in the back of their jeep. An A.O.P. flight was also sent from Batavia and using Padang sports field as a base was able to provide first-hand information of Indonesian concentrations and rendered much assistance to the Gunners. The Auster aircraft also provided a link with the airfield at times when the road was blocked or highly dangerous.

Fresh food and vegetables were very short in Padang owing to the blockade, supplies for the hospital were flown in daily from Batavia to Padang airfield but it was often hazardous to bring the food into town. The R.A.F. staff at Padang staging post had almost daily excitement to contend with. They were initially protected only by a small body of R.A.F. Regt. personnel but later on received a company of the Gurkha battalion from Palembang. The arrival of the Gurkhas necessitated a reconnaissance for additional hutting at the airfield. Major Bewlay carried out this work, and during his return had a narrow escape when his jeep was ambushed, he received a fragment of grenade in his upper arm. Some nights later terrorists felled thirty-nine coco-nut palms across the airfield road. A platoon from 28 Coy. with a covering party of Kumaons had the route cleared by midday, much to the relief of the staff of the staging post. 28 Coy. gained the distinction of being the first troops to dismount from ambushed vehicles to engage and kill one of the ambushers, the company had good cause for doing this since one of their naiks had been killed in another convoy.

On another occasion the commander of Padang Bde. ordered the destruction of the railway line leading into the town, since it was known that hostile Indonesians were using the daily train as transport when they came to town for a night's "nuisance." The orders made

it clear that the demolition was a gesture only and that the line would have to be repaired once promises of good faith and conduct had been given by the local Indonesian leaders. Early one morning a fighting patrol from 28 Coy. left the town through the 8/8 Punjab lines and destroyed the line in several places by means of cutting charges on the rails. This gesture was sufficient to render the town free from trouble for several days until the line was repaired.

Indonesian tactics showed many resemblances to those of the Japanese and it was clear that deserters from the Japanese army were encouraging and training the guerillas. Captured arms and equipment were frequently of Japanese origin and the infiltration tactics used at night were clearly instilled by Japanese and were well carried out. Mohammedan troops were encouraged to desert and promised promotion and good pay if they joined the republican army, these efforts had some occasional success but despite such temptations there was generally no more desertion than in other theatres. Throughout the occupation, the standard of discipline and morale amongst British and Indian troops was of the highest order, although the period of occupation was one during which the feeling of war weariness and longing to return home was prevalent in all theatres.

1946 saw the rapid run down of strength of British and Indian forces in the far east. Release, leave, repatriation and disbandment of units put a continual drain on the strengths of occupational forces. Despite falling strengths, it was imperative that the eventual handover to Dutch forces should be well prepared and smooth in execution. In order that some engineer work should be carried on during the handover and until either Dutch field companies or P.W.D. engineers could take over, the C.R.E. undertook the task of raising a Dutch engineer platoon in Medan. The chief task of this platoon would be the maintenance and operation of the plant from 328 Coy. and the port operation at Belawan. During their forming and equipping phase they were given some pioneer training also.

The success of wireless communication throughout the occupation is worthy of note. The divisional rear link to Batavia and forward links to Padang and Palembang consisted of No. 399 sets operated by Royal Signals personnel. Under normal conditions speech from one's own telephone to another telephone in Padang or Palembang was quite clear and much staff work and organization was carried on in this way. The divisional engineers maintained a separate net throughout, with stations consisting of No. 22 sets at each company headquarters and at H.Q. R.I.E. Although conditions in the far east seem far more suited to long distance R.T. communication than in the European theatre, great credit must be given to the R.I.E. operators who maintained these links. Reception on these No. 22 set links was frequently as good as results obtained on the divisional net.

A large contribution to welfare and social life in Medan was made by the British Works Section in their provision of two clubs, one for other ranks and one for officers. The other ranks' club was opened very quickly in a hall in the centre of the city, preparation of an officers' club was not so simple owing to the lack of accommodation. Eventually the site chosen was beside the main sports ground, in a wooden building erected during the Japanese occupation. This building was beautifully constructed in the traditional willow pattern style and had been used as a shrine. Some of the finest timbers in the east had been used by the Chinese carpenters who carried out the work. The bar, kitchen and cloakroom accommodation installed by the works section were carefully matched with their surroundings. The final result was an enchanting club-house which was a valuable contribution, both to officer welfare and to the welfare of the Dutch forces who would take over.

Events moved swiftly during the late summer and plans were put into operation for the withdrawal of all British and Indian troops during the autumn. Some Dutch units arrived during September and October and a strong force which was known to be sailing from Holland was expected to arrive during November.

Although 26 Ind. Div. had more than completed the tasks allotted to it, conditions on the island were extremely unsettled, the general impression was that much trouble and strife lay in store for the Dutch after the division had withdrawn. During the occupation little production from plantations or oilfields had been achieved, it had not been possible to reopen the large plantations which had been allowed to fall into decay by the Japanese. Every passing month increased the problems of reclaiming land from the encroaching jungle, of restarting neglected machinery, and of recapturing the confidence of the native population.

The divisional engineers returned to India during November and December, some units for disbandment and others for retention in the post-war army. Despite the continuance of domestic problems in Sumatra the divisional engineers felt that their contribution towards the restoration of peace and the revival of the island as a productive colony, had been considerable, and they hoped that these efforts would not have been made in vain. Great problems faced the incoming Dutch and we left with them our wishes for their rapid, peaceful and happy solution.

RECONSTRUCTION OF BOMBAY DOCKS

By BRIGADIER R. GARDINER, C.B.E.

DURING the years 1942, 1943 and 1944, those responsible for Transportation in India Command were successively faced with a series of major disasters. In 1942 and 1943 monsoon floods succeeding in cutting essential rail lines of communication as effectively as any aerial bombing. In 1944 a large part of the Port of Bombay was destroyed by two explosions on a ship. This article describes this disaster, whose magnitude was such as to make the whole project of clearance and reconstruction a responsibility of the Army.

S.S. *Fort Stikine* an 8,000-ton freighter had docked in Victoria Dock on 13th April, 1944. She had arrived from the U.K. via Karachi with a mixed cargo, including baled cotton, taken on at Karachi, and nearly 1,200 tons of mixed explosives.

At about 1230 hrs. on Friday, 14th April, fire was discovered in No. 2 hold in the cotton, and whilst the Port and Bombay Fire Brigades tried to control the fire, prolonged discussion took place as to what further action should be taken. Unfortunately, no effective decision was reached before the first explosion took place at 1430 hrs., when 370 tons of explosives detonated in No. 2 Hold, followed half an hour later by the explosion of 800 tons in No. 4 Hold.

The first explosion caused the immediate destruction of almost the entire fire-fighting force, including many fire-engines. Amongst those killed was Lieut.-Colonel R. Sadler, R.E., who had been loaned by R.E. (Tn.) to the Bombay Port Trust as their General Manager.

The immediate results of these two explosions were so terrific as to stun all concerned for a time. The ship itself had completely disintegrated. S.S. *Jalapadma*, a 4,000 ton d.w. ship berthed next along the quay, was lifted clear of a 30 ft. high shed, dropped on it and turned at right angles to the quay with the bow overhanging the water. (See Plates 1 and 2 and Photo 1).

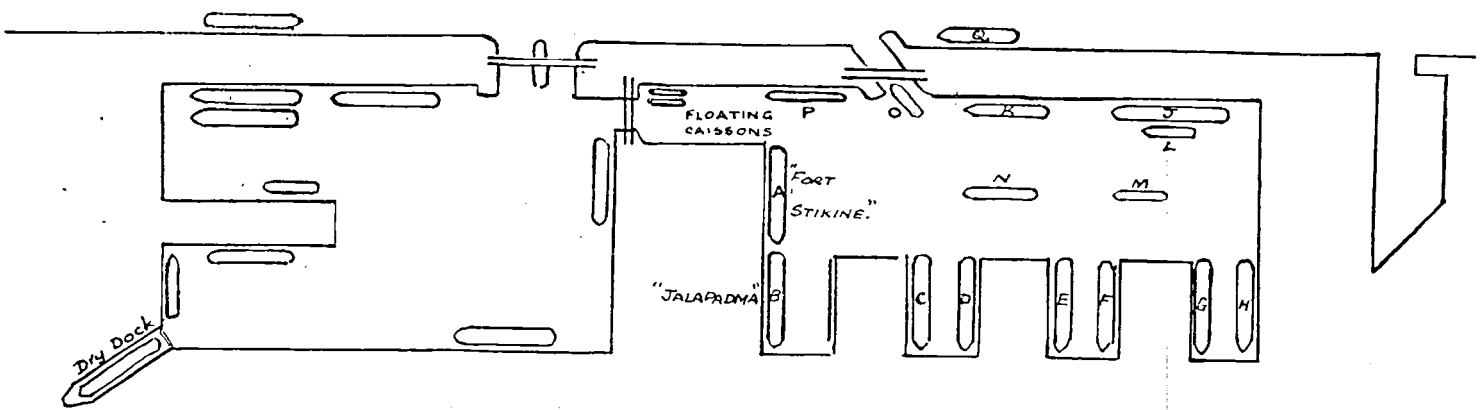
The anti-submarine defence gun of the *Fort Stikine*, complete with its mounting, platform, and magazine chamber, weighing in all about 30 tons was torn from the ship and deposited in the main road outside the docks, 500 ft. away.

All the other twelve ships in Victoria Dock were set on fire and

POSITION OF SHIPS BEFORE EXPLOSIONS.

PLATE 1.

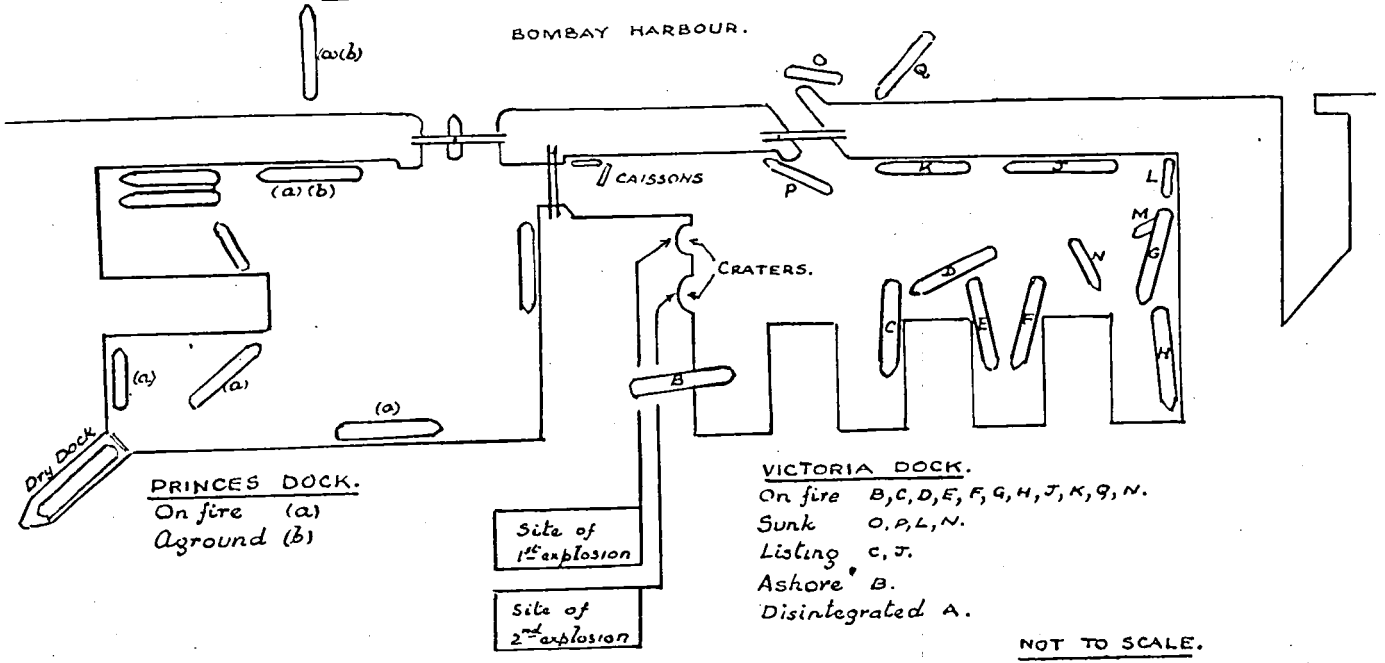
BOMBAY HARBOUR.



N . GRAB DREDGER.
M . SUCTION Do.
O . WATER BOAT.
L . TUG.

POSITION OF SHIPS AFTER EXPLOSIONS.

PLATE 2.



broke adrift unmanageable. Explosions in their magazines continued for several days. Five ships in the near-by Princes Dock were set on fire and severely damaged. Practically every building round Victoria Dock, and many round Princes Dock, was destroyed and the contents set on fire. The dock basins were strewn thickly with smouldering cotton bales and debris of all kinds in which were tangled the remains of many of the casualties.

Outside the dock area incendaries thrown up by the explosions and burning debris spread the fire to the congested warehouse area, up to the main line of the G.I.P. Railway and approach to Victoria terminus was impossible for two days. A number of fires were also started in the residential area across the railway. Debris mostly in the form of jagged pieces of steel was thrown far and wide. The furthest recorded was a piece outside Embarkation H.Q. three-quarters of a mile away

In the residential area north of the docks, an Indian gentleman was sunning himself on a third floor verandah when the explosion occurred. He was somewhat startled by a large metallic " brick " crashing through the roof a few feet from him. This " brick " on examination proved to be an ingot of gold and it was the first intimation of the presence of a consignment on the ill-fated ship.

Two facts relieved some of the gloom ; firstly Alexandra Dock, the most modern of Bombay's docks, escaped undamaged ; and the bulk petrol depot, adjoining Princes Dock, also escaped, miraculously.

The docks themselves were an inferno from Friday afternoon till Monday, with some areas quite inaccessible. The tropical heat made conditions most unpleasant for weeks after, as bodies were found under piles of debris or twisted steelwork of sheds.

So much for the actual disaster. I have tried to paint the picture which was the background of an R.E. project during the following six months.

The strategic value of the Port of Bombay to the India Base and in the war in S.E.A.C. needed no emphasis and immediate efforts were turned to the reconstruction necessary. With this in view a meeting was held on Sunday morning, 16th April, at which, in addition to all local authorities, the D.Q.M.G. and D.Tn. from G.H.Q. India were present. This meeting decided upon the immediate concerted action necessary to control the fires still burning furiously, and on the first steps for clearance. During the meeting it became evident that the clearance and reconstruction could only be successfully undertaken with army resources, both men and materials, and a recommendation to this effect was sent to Delhi. At No. 1 Tn. Trg. Centre the Chief Instructor was Lieut.-Colonel Tydeman, former Chief Engineer Singapore Harbour Board, and this officer was put in over-all charge.

On the 21st April a Joint Transportation Planning Staff was appointed by the P.A.O. India with D. Tn. as Chairman, the terms of reference being to prepare a plan for the clearance and reconstruction of Princes and Victoria Docks. Their report was to be ready for consideration by the Joint Transportation Committee G.H.Q. (I.)* on the 26th April in Delhi.

The J.T.P.S. consisted in this case of the D. Tn., and representatives of Movements, the Port Trust, D.C.E. Bombay District, Ministry of War Transport and the War Transport Department of the Government of India. The report was ready by the 25th April, on which day the Member for War Transport, the Q.M.G., E.-in-C., and D.Q.M.G. (Movements), discussed it in Bombay. It was flown to Delhi on the morning of the 26th and considered by the Joint Transportation Committee that afternoon. The recommendations were agreed to and the project given " XX " priority which ensured availability of both men and materials. Colonel Tydeman was placed in charge with the appointment of Deputy Director of Transportation. In the meantime, of course, clearance had been put in hand and all available men put on to the work.

Although a R.E. (Tn.) project, in which the D.D. Tn. was responsible to the D. Tn. at G.H.Q. (I.), he had under him many units other than R.E. (Tn.) and all engineer resources, including those of the port, were at his disposal. Appendix A is a chart of the organization set up to carry out this project.

Clearance was largely a matter of using mechanical equipment to the maximum advantage, but the work was particularly dangerous in the early stages, owing to fires and unstable walls. Every effort was made from the start to salvage any materials suitable for re-use. Clearance was not limited to the dock area proper, but also included the devastated warehouse area outside. The total debris moved approximated to 800,000 tons. Three hundred and fifty lorries were in use.

Reconstruction of the transit sheds and warehouses was limited to those considered essential for military purposes. As already stated, salvaged materials were used to the maximum extent and any new buildings were temporary structures, many with built up wooden roof trusses which were mass produced on the spot, 1,400 of these trusses were turned out. (See Photo 2.)

Railway work consisted of almost complete re-laying of the track inside Princes and Victoria Docks areas, a remodelling which was long overdue. The removal by this disaster of nearly every building

*The Joint Transportation Committee under the Chairmanship of the Principal Administrative Officer (Lieut.-General Sir Wilfred Lindsell, G.B.E., K.C.B., D.S.O., M.C.) included members from all interests, civil, naval and military. Its function was to provide a truly representative body able to decide and approve the measures necessary to develop the Transportation requirements of the India Base.

gave us the opportunity required. One improvement was the provision of direct railway access to every shed, replacing a series of turntables, too small to handle bogie vehicles. The revised layout included ample facilities for handling M.T. convoys with adequate parking areas.

Many of the other items were major works in themselves. For example, a completely new 12-in. sea-water fire fighting system was installed to serve both Princes and Victoria Docks. More than 16,000 ft. of lead-jointed pipe was used and four specially manufactured pumps, with stainless steel shafts and bronze impellers, installed in submerged pump houses. The following is a complete list of the works making up the project.

Victoria Dock.–Major reconstruction work :—

1. Reconstruction of North Quay wall.
2. Salvage of ship hulks and small craft.
3. Removal of obstructions from dock.

Princes and Victoria Docks.—New work :—

4. Railway lay out. Six miles, fifty turn-outs.
5. Transit sheds. 1,100,000 sq. ft.
6. Paved areas, 28 acres.
7. Fire fighting installation. Three miles 12-in. sea-water mains.
8. Cold storage installation.
9. Small craft landing pier.
10. M.T. water-proofing testing tank and weighbridge.
11. Victoria Dock swing bridge.

Princes and Victoria Docks.—Repairs :—

12. Hydraulic quay cranes.
13. Hydraulic power plant.
14. Electric power supply and lighting.
15. Floating caissons and lock gates.
16. Swing bridges (2).
17. Dry dock pumping plant.
18. Fresh water supply.
19. Telephone service.
20. Drains.

Clearance.—

21. Dock area, 385,000 tons.
22. Warehouse area, 400,000 tons.

A rather more detailed description now follows of the major items under the Port Construction Engineer, namely, the removal of the wreck of the S.S. *Jalapadma*, the clearance of the dock bottom of

Photo. 1.—S.S. *Jalapadma*—it was one of the many spectacular sights in the docks.

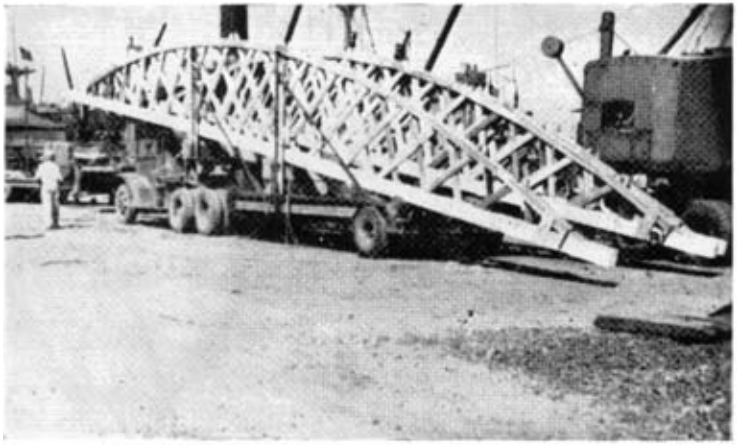


Photo. 2.—1,400 of these trusses were turned out.

Reconstruction Of Bombay Docks 1,2

Photo 3.—Initial clearance of shattered north quay wall.

Photo. 4.—Rebuilding north quay wall.

Reconstruction Of Bombay Docks 3,4

dangerous wreckage, and the reconstruction of the quay wall at No. 1 Berth, Victoria Dock. The last named was the biggest item of the project whilst the others were closely linked with it. It was, of course, upon these three works that the reopening of the Victoria Dock largely depended.

The quay wall was of the gravity type and it was clear from the surface damage that re-building from floor level would be necessary. Such work could only be satisfactorily done in the dry and it was decided to pump out the dock. Since the dock gates were not designed to retain water from entry into the dock, this was made possible by the existence of a floating caisson designed to replace the dock gates should they have to be removed for repairs. By a stroke of good fortune the caisson, although only a few yards from the scene of the explosion, escaped undamaged and likewise the stops against which the caisson fitted were not affected.

Engineering implications had to be examined when de-watering the basin was considered. For instance, the stability of the surrounding quay walls and the bottom of the dock against a hydraulic head of 40 ft. at H.W. springs. There were many subsidiary advantages in de-watering the basin. Hulks were safer in the dock than anchored in the stream and those capable of repairs could be patched up ready for refloating in due course. It was also borne in mind that considerable quantities of ammunition had been jettisoned from ships in the basin when they first caught fire and unless salvaged, they would remain a potential danger when dredgers were used in the future. Location and removal of the dangerous wreckage from the dock bottom were made easier by de-watering and there was some chance of recovering some of the gold bars which had been dispersed by the explosion.

The de-watering involved the removal of 1 million tons of water by pumps. After the maximum amount of sluicing on the tides, a depth of 21 ft. of water over an area of 25 acres had to be pumped. The aim was to pump one inch per hour representing 2,500 tons plus a leakage of 1,500 tons per hour, so a total capacity of 4,000 tons per hour was necessary. Two pumping units were improvised. One was a damaged ship whose boilers were in working order. She was fitted with pumps taken from other ships and had a capacity of 2,000 tons per hour. The second unit consisted of a 500 ton I.W.T. barge on which were mounted a battery of eleven petrol and two steam pumps giving a further 2,000 tons per hour. A stand-by was an obvious necessity and two pumps were installed, one being a 22 in. 750 h.p. electric monster lent by Messrs. Tata & Sons.

Owing to leaks in the caissons, quay walls, and dock bottom, no change in water level occurred until after two days pumping, during which time as many leaks as were visible were closed to the greatest

extent possible. Drainage pumping had, of course, to continue during the whole six months of the project.

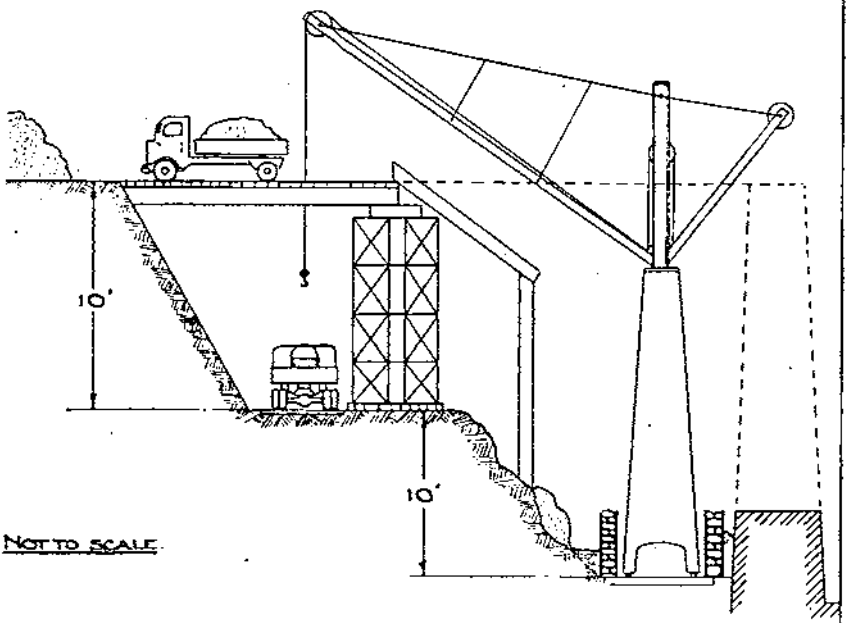
Before de-watering and, of course, before any work on the quay wall could start, it was necessary to remove the wreck of the S.S. *Jalapadma*. This 4,000-ton ship had been lifted and turned 90 degrees and came down on the quay sheds with the bow overhanging the dock basin. It was one of the many spectacular sights in the docks. (See Photo 1.)

A quick examination of the wreck showed that No. 1 Hold could, with very little patching, be sealed off and it was decided to cut off the overhanging portion of the ship from the mass of the wreckage and launch it as a separate unit, thus saving flame cutting of 1,000 tons of steelwork. The job was given to a unit which at that time had just been raised, an Indian Craft Erection Company, R.I.E., commanded by Major Innes, late of the Irrawaddy Flotilla Co. This unit was designed to assemble the prefabricated I.W.T. craft known as " Unicraft," a job far removed from that of cutting up the mangled remains of an ocean going freighter : but their O.C. was one of those individuals who gloried in anything out of the usual and he had trained his unit to a similar frame of mind. Deck hamper on the for'ard portion was cut adrift : masts, winches, ropes and other deck gear removed and the fo'c'sle cut away to 'tween deck level to make it buoyantly stable. Finally this portion of the ship was cut away from the rest and floated away safely to the " graveyard " in the harbour. The whole work of removing this wreck was completed in five weeks, a really remarkable piece of work. A year later the Craft Erection Company was on the banks of the river Chindwin at Kalewa doing its designed task as efficiently as this one in Bombay.

The clearance of the *Jalapadma*, followed by the de-watering of Victoria Dock, cleared the way for the *magnum opus*—the rebuilding of the quay wall at No. 1 Berth. Two large craters had been blown in the wall and 500 ft. of quay wall required rebuilding. The first task was to clear the site and this necessitated excavation of some 30,000 cu. yds. of filling behind the wall, removal of a mass of debris which formed a beach shelving forward into the dock basin and cutting back a large quantity of shattered masonry in the wall itself.

The first six weeks were occupied in clearance of the debris of three-storied masonry and steel transit sheds, quay cranes, railways, ship wreckage, and damaged cargo. The next operation was to cut a service road at a level of 10 ft. below quay level, running parallel to and behind the wall to be rebuilt. This work, carried out initially by three 8-cu. yd. scrapers, was retarded by heavy masonry shed foundations and timber piles and by the arrival of the monsoon

PLATE 3.



SECTION THROUGH N°1 QUAY DURING RECONSTRUCTION.

which finally put the machines out of use. The road itself was 20 ft. wide and surfaced with a double layer of old sleepers and Sommerfeld track. (See Plate 3.)

Following the road the next operation was to form another step, 10 ft. lower, on which to erect five hydraulic quay cranes for use in placing the materials for the new quay wall. This work was carried out by a back-acter working at road level longitudinally behind the line of the wall and dumping beside the road. Small draglines then loaded to tip lorries. The drag buckets had difficulty in picking up and releasing the heavy clay, but spraying with water was found to assist. The five cranes were skidded into place down a specially built 10 ft. gauge track and were erected on ash-concrete bases. They covered the whole length of the service road and the quay wall. Debris from the front of the wall was removed by decauville to four cranes at Nos. 2 and 3 berths which raised and emptied the buckets to tip lorries. The total battery of nine cranes cleared about 1,000 tons of material each 14-hour double shift. (See Photo 3.)

The shattered wall was removed down to a level at which the original foundations were traced and indicated that the wall had either been founded on loose rubble or the lime matrix had dissolved and had been replaced by filling and mud percolating from front and rear. To make certain of the foundations, shallow bore holes, 2 in. in diameter, were put down and these confirmed the nature of the material under the wall as "murram." Into this a new toe was excavated some three feet lower than the old footing and concreted. The wall itself was built up in a series of 4½ ft. lifts, concrete being poured into boxes formed of masonry facing and cross walls. In each lift masonry walls were built in three of the five sections covered by cranes while concreting went on in the other two. Each lift was completed in a three-day turn-round and the whole wall, 40 ft. high and containing 10,000 cu. yds. of concrete, was completed in the scheduled twenty-five days.

Dry materials, such as sand and ballast, were delivered by rail and lorry and then loaded into side-tip decauville trucks and taken to a battery of three 1-yd. horizontal drum mixers mounted so as to chute the mixed concrete direct into tip buckets in lorries standing on the service road. The cranes off-loaded from the lorries to the delivery points.

Filling behind the wall was brought up at the same rate as the masonry. The material was drawn from the dumps at ground level by lorry and dumper, and tipped into position from bridges built over the service road. The cranes were left undisturbed and were boxed in with sand bags until the wall had reached about sea level and the dock basin refilled. They were then removed bodily by a floating crane.

Finally the area was concreted or bitumen paved, railway tracks completed and the C.R.E. Reconstruction erected sheds according to plan.

Whilst reconstruction of the quay was in progress, another job was pressed on within the dock itself. It was known before de-watering that wreckage on the dock bottom was extensive. Large pieces were seen at each low water. Portions of the *Fort Stikine* were everywhere. Some weighing 500 tons. There were the remains of small craft, boilers, quay equipment, trolleys, gangways, vehicles, wire and, everywhere, cotton.

It was essential to remove all this as well as the ammunition dumped from burning ships. The port authorities were also anxious during the de-watering period to remove as much of the accumulated silt as possible so as to relieve subsequent dredging, particularly as two dredgers had been amongst the casualties of the explosion. This was, however, found impossible, owing to the monsoon and lack of suitable equipment.

The only method left in which to locate all the obstacles was to probe the mud. A special gang of men who were nicknamed the " Mudlarks " probed every foot of the dock bottom with the rods. It was a filthy job, the men often working up to their necks in slimy oily mud.

Methods of removal varied according to the nature of the obstacle, but bulldozers, tractors and cranes all did their share, whilst the largest pieces had to be coffer-dammed off and cut into portable sizes.

On the 3rd October, 1944, six months after the explosion, Victoria Dock was reflooded. Damaged ships which had lain on the mud since April had been patched and now refloated. On the 18th April, four days after the disaster and while some parts of the docks were still inaccessible and ships and warehouses still ablaze, Colonel Tydeman had produced what appeared to be a very optimistic graphical programme for each of the main works, with a common completion date of 30th November. One of Colonel Tydeman's provisos was that the project be accorded " XX ", or the highest priority, by the Joint Transportation Committee. Given this priority, sufficient labour, machinery, transport and materials should be assured to saturate each item of the project. It was Colonel Tydeman and his staff who, with this priority behind them and the resources resulting from it, obtained the necessary enthusiasm and spirit of urgency from every man of the labour force to overcome the difficulties of one of the most severe monsoons for many years. The weather was appalling, heavy rain often occurring for days and nights continuously, with one occasion when 6 in. fell in less than twelve hours.

The project was completed according to schedule and will rank as one of the great achievements of the war in the East. In September, 1945, although after V.J. Day, the operation directed against Malaya and known as " Zipper " took place as planned owing to the uncertain attitude of the Japs there. The mounting of this operation required the full capacity of Bombay Port and the success and smoothness of the loading of the ships reflects the successful completion of the project. It also showed that, as so often happens in the case of great disasters, some good resulted. In this case Victoria and Princes Docks were modernized in a way they could never have been in any other circumstances. On the debit side, however, there were over 500 casualties, including several senior officers, and a total loss of seven ships.

APPENDIX "A"

ORGANIZATION FOR BOMBAY PORT RECONSTRUCTION, 1944

DEPUTY DIRECTOR OF TRANSPORTATION

Port Construction Engineer	*C.R.E. Reconstruction*	*C.R.E. Clearance*
Indian River Salvage Company	Indian Field Company	Three Indian Field Companies
Indian Rly. Constn. Company	Indian E. & M. Company	Indian Field Park Company
Indian Port Constn. Company	Indian Workshop and Park Company	Indian Mech. Excavator Company
Indian Craft Erection Company	Indian Mech. Excavator Company	Indian Bridging Section
Four Indian Field Companies	Indian Works Section	Indian Bomb Disposal Section
Four Indian Dock Opg. Coys.	Four African Artisan Works Companies	Indian Engineer Battalion
African Artisan Works Coy.	Military Labour (Indian Infantry and Pioneers)	Indian Pioneer Group
Marine Section		Two Indian G. T. Companies
Hydraulic Section		Two Italian G. T. Companies
Docks Mech. Equipment Section		
Dock Bottom Clearance Section		
Tn. Workshops		
Tn. Stores Section		
Plant Pool		
Bombay Port Trust Facilities		
Indian Pioneers		
Totals at peak periods :—4,000.	2,500.	3,300.

FLYING ROUND FRANCE

By CAPTAIN A. C. JAMES, R.E., and CAPTAIN I. A. P-G. LEIGH, R.E.

IT was Alan's idea in the first place. We had both learnt to fly at Rochester during the spring and summer of 1949, and I believe the thought had been at the back of his mind since then. We had only flown together on two occasions: once on a round trip of London, an experience somewhat enlivened at the last moment when I overshot the airfield, forgot to raise my flaps, and knocked the boundary fence for six with my undercart; and the other time when Alan, an experienced pilot of about one hour's solo, took me to Southend where Flight Control wanted to charge us seven-and-sixpence landing fee, instead of half-a-crown, as they insisted we had landed at least three times—allowing for the two minor bumps before we finally managed to stay down.

Alan wrote and asked me what about it: a flying tour of France, I mean. We were both much more experienced by this time, and had logged about thirty hours flying each, of which perhaps twenty hours was as first pilot. I felt quite confident. I had survived a flight to Cardiff with Jumbo Thomas, and a forced landing in a carrot field with Barry Dempsey. Alan, I believe, would have been just as confident if he had completed his first solo.

The trouble was, it was now 1950 and neither of us had flown for about six months. We were both some distance from Rochester: Alan at Shrivenham and myself at Aldershot, and had not kept our hands in. Not that we were very worried about this. We intended spending a short week-end at the flying club for a brief check flight and cross-country, before setting off. So confident was I, indeed, that I took along a friend from Aldershot intending to drop him back in Aldershot by air. He had been much impressed by my talk in the Mess. Unfortunately, the flying club were not. The short check flight developed into an hour's demonstration of fumbling ineptitude, the result of which was that I was not allowed to go solo. My friend and I went back to Aldershot by car, maintaining a rather awkward silence. I resolved to keep quiet in the Mess in future.

This was rather a bad start. Especially as Alan and I had planned to start off about a month later. I wrote and told him, and was encouraged to hear that he had taken about an hour to get off. Anyway, we went ahead with our plans.

We were working on a basis of about ten days' flying at £5 each per day, the cost suggested by the flying club, but due to unforeseen

engagements we only managed to overlap our leaves by seven days. A previous, and almost forgotten, arrangement to go as scientific observer on a trawler in the North Sea had caught up with Alan. Apparently they pushed him in the fo'c'sle and told him to watch bits of fish to find out how long they took to putrefy. Personally, I have found the channel in a quay punt is all I can manage, without the smell of rotting flesh thrown in.

I was left to make the final arrangements for the flight, and as I am not, rather perversely for a Sapper, very keen on planning, these arrangements were rather sketchy. This was just as well, in the eventuality, because we never kept to them. However, I did write to the air touring department of the Royal Aero Club and asked for I.C.A.O. maps covering our route. I also spoke to the C.F.I. at Rochester, and he gave me some useful tips including how to make cross-wind landings. You have to keep to the runways in France, whatever the wind direction, as there are apt to be crops growing, and cattle grazing, on the rest of the aerodrome. This sounded a little disconcerting at the time, but was really the least of our troubles: I'm sure the cows were much more worried than we were.

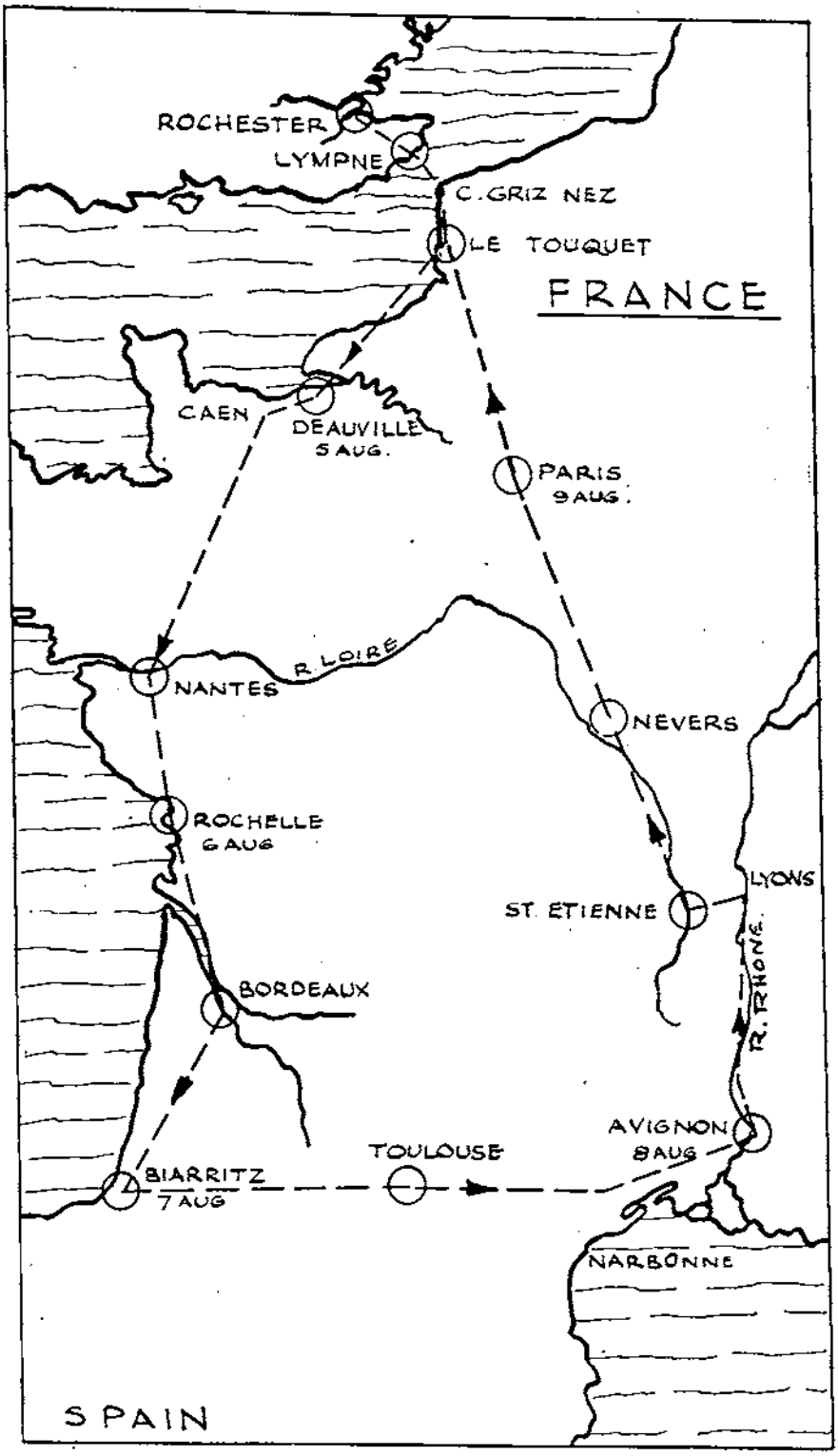
The C.F.I. did not think we should have the slightest trouble though. We were both fairly experienced pilots weren't we? Oh, so we had about twenty hours apiece did we? We weren't by any chance thinking of taking one of the Rochester Flying Club planes were we? That was all right then, and he wished us the very best of luck.

* * * * *

We set off from Rochester at 1119 hrs. on Saturday, 5th August, and landed at Lympne twenty-one minutes later. This was quite straightforward, of course. The sky was overcast, but the clouds were high. We wasted a lot of time at Lympne through inexperience: Customs are quite easy when you get the hang of the business. However, we finally took off at 1324 hrs. and headed out to sea.

We were flying at about 1,500 ft., and took the shortest route to the French coast: Cap Griz Nez, which hove in sight after about five minutes flying. The little ships below seemed hardly to be moving on a sheet of obscured glass. It seemed hard to recall that a few weeks before, I had been clinging to the tiller of *Black Duck* while she bounced around like a cork on that sheet of glass, wondering how long it would be before I threw my still undigested breakfast overboard and myself after it.

This time it was all over in fifteen minutes, and we were flying over the "Grey Nose." We followed the coast down south, and there we were, thirty-one minutes after leaving Lympne.


ROCHESTER
LYMPNE
C. GRIZ NEZ
LE TOUQUET
FRANCE
CAEN
DEAUVILLE
5 AUG.
PARIS
9 AUG.
R. LOIRE
NANTES
NEVERS
ROCHELLE
6 AUG
LYONS
ST. ETIENNE
R. RHONE
BORDEAUX
AVIGNON
8 AUG
TOULOUSE
BIARRITZ
7 AUG
NARBONNE
SPAIN

It is an interesting fact that only in one instance did we have any difficulty in spotting an airfield long before we were flying over it. It is not that you can pick out the hangars, or landing strips, though that is sometimes the way. Usually you see an open space, larger than any other area and, for some reason, of a different colour.

The big thing about flying around the continent is that you pay for fuel in sterling, in this country. On the tour, we carried Shell and BP Carnets, and at every airport just said " Fill her up," and signed for it. The club plane is entered in the log under the name of Major-General McCandlish, President of the Flying Club, and all our petrol bills were made out to Monsieur M. G. McCandlish. I think Monsieur must have paid them : we have not received any yet.

We found the airport charges at Le Touquet were rather steep : 800 francs for an *omelette au champignon* (my weakness) and a bit of cheese, and decided to press on to Deauville. We landed there at 1755 hrs.

There, one of the drawbacks of flying presented itself to us. Landing fields, for safety, are always some distance outside towns. We started by trying to hitch-hike into town, or take a bus, but soon found that this wasted too much time and became resigned to paying about 600 francs for a taxi. We had no trouble at Deauville, however. All the large hotels ran free bus services from the field to the town, and we took one. The conductor was a little put out when, having alighted from the bus, instead of entering the hotel, we did a quick flanker and headed down-town for cheaper lodgings.

Forlorn hope : it was the middle of Deauville's very short season, and everywhere was full. Alan left me with the luggage at a little café, and wandered off to try his appalling French on the inoffensive inhabitants. He returned, depressed, about an hour later to find me carrying on an animated conversation with a snag-toothed waitress. My French is limited to a few expressions which, though of undoubted value in certain circumstances, had given this woman a totally false impression of my integrity. She was enthusiastic about the whole business. We should have no alternative, she considered, but to sleep with her. Suitably shocked, we trailed off and finally found a little place and, although rather tired, pushed off to recce next-door Trouville. Alan remembered a small café where they remembered him, and we drank Calvados and ate peaches and returned to the hotel in the small hours.

The next day, we decided to change our plans and fly to Nantes instead of Tours. Our first day's flying had been easy : just following the coast. But Nantes was a different matter. It was about 150 miles across country, and would require good compass and map work.

We followed the coast to Caen, looking for evidence of the Commando raid, and then took the plunge.

The notes I made at the time tell the rest of the story :

" Caen—Nantes. Fairly long cross-country. Exact location from time to time uncertain (due to errors on map ?), but able to check conclusively every 15–20 mins. 5 k. S.E. wind made periodical correction necessary, and affected relative speed. However, never lost course by more than two miles. Came over Nantes bang on course, and had no difficulty in picking out concrete strips of aerodrome."

So that was that. Visibility and weather were both excellent, and the Loire led us straight on to Nantes. The local gliding club was operating, and I was wearing my " C " badge in my lapel, which is of course an international emblem, and we were welcomed. We only stayed for lunch and then pushed off to La Rochelle, arriving at 1707 hrs. Alan was navigating that leg, and his only comment in the log was : " A piece of cake." The local gliding club again did their stuff, and took us to the bus stop, complete with luggage, on the back of two little two-stroke Peugeot motor-cycles. I exchanged my " C " badge for a French one which is slightly smaller and has an F for France, instead of G for Great Britain, on its face.

We stayed the night in La Rochelle. There were quite a few British yachts in the inner harbour, and the British themselves you can pick out quite easily, irrespective of what they are wearing and before they open their mouths. They seemed decent chaps, but we gave them a wide berth : one does not go to France to meet the British.

By this time, we were resigned to spending most of the morning in unhurried preparations for the next leg, and were seldom airborne before midday. Monday, 7th August, was no exception, and we took off at 1235 hrs. for Bordeaux which we expected to make in fifty-six minutes. Alan was flying, and my part as navigator was very easy. We just had to fly south until we hit the Gironde where it turns west, and then follow south keeping it on our port beam. But just after we had crossed it, clouds loomed up ahead. It became much darker, and visibility was cut down to about three miles. We were rather anxious, and I was very relieved when we sighted the aerodrome about half an hour later. Not a moment too soon, for almost immediately it started to rain heavily, and the airport was blotted out. We flew on in the same direction, and almost bumped a Viking which was already in the landing circuit. So we tagged on and followed in behind it. The runways were wide and long, and Alan had no difficulty in making a good landing. The " Maggie " had no radio or lights, and of course we don't carry parachutes. We are fair weather pilots, perforce, and we fear bad weather more than most aircraft.

We had originally intended turning east to Toulouse, but decided to fly to Biarritz instead, as neither of us had previously been there. The weather cleared up, or rather the bad weather proceeded north, and we pushed on at 1640 hrs. in blazing sunshine. We had the coast in sight most of the way, and navigation was easy. The only qualms we had were where to put her down in the event of engine failure : the ground was just one big forest without a break. In an emergency I should have had to use the beach, but I did not like the look of it : it was covered with dunes, and the sand looked very soft.

Soon the Pyrences loomed up through the haze : surely far more impressive from the air. Nestling at the bottom were the red roofs and white walls of Bayonne, with the Adour winding between, and we touched down on Biarritz airfield at 1741 hrs. feeling very pleased with life. In the club-house was a sweet young m'am'selle who spoke English with a delightful American accent. She was the daughter of a local doctor, and had spent three years at Smith College in the States. She intended to become an air hostess with Air France, but was as yet too young. We arranged to meet her on the beach next morning for a swim, but by the time we idle fellows got down there she was gone. So we took photographs of such edifying records of our trip as : James standing by stone on beach ; James sitting on stone on beach ; James contemplating stone on beach. Quite an ordinary stone.

We left for Toulouse at 1301 hrs. with Alan flying, had lunch, and pushed on to Avignon with Alan navigating, arriving at 1830 hrs. It was all cross-country, and required careful navigation. Later in the day we had to climb to fly over the Cevennes country, and could see the Mediterranean clearly at Narbonne.

Avignon was, I think, the nicest place we visited. We had been warned that the *piste* (runways are termed the same as ski runs : *pistes*) might be rather hard to pick out, and to be careful where we landed. We made a very nice landing on what turned out to be a field which had just been harvested, just by the airfield. It was rather rough, but nobody seemed to mind.

We were taken into town in a little 4 c.v. Renault at a reckless speed, the driver commenting the while adversely on the ability of all other drivers who came near him. He wondered how some of them managed to last so long without a fatal accident. Assuming he had been in the town for any length of time, Alan and I were inclined to agree with him.

We put up at the Crillon, changed and went out for dinner. We found a Club de sans Club restaurant, and regretted we had not brought a copy of their handbook to bang on the table to impress *le maître*. We need not have worried, however ; he waited on us personally and we had wonderful food. At the lunch-time meals, we

usually ate very little and caused no little consternation by drinking lemonade, lest we fell asleep on the afternoon flight : a thing which might have happened quite easily. In the evenings we suffered under no such restraint, and on this occasion left the restaurant feeling very much at peace with the world. In Avignon, in the evenings, the central square is just a mass of tables and chairs put out by all the little cafés, and what little traffic there is at that time of day has to make the best of a bad job. It was difficult to tell which café owned which table and chair, but it did not seem to matter much. We just sat down anywhere, in a bemused stupor, and enjoyed ourselves.

We set out in the morning to find the bridge, but found ourselves straying into a doubtful quarter full of strange smells and notices presumably left over from the liberation (the notices, I mean. I'm not sure about the smells), which said " Off limits—out of bounds to all troops."

The next day, Wednesday 9th, we started what was to be our longest and most difficult leg, and which almost ended in disaster. We survived the journey to the aerodrome with our friend in his 4 c.v., and were airborne at 1229 hrs. Navigation was very easy. We just flew up the Rhone valley, the hills just below our wheels on either side, and the Alps, snow mantled and majestic, striding along beyond our starboard wing. We were up at 3,000 ft., and despite the warm weather were feeling quite cold. We had some qualms about the engine : oil pressure fell considerably, and we had to fly at 21,000 revs. to maintain height. We decided that this was just due to the rarified air, and were relieved when we came down to 1,500 ft. later in the day to find that this was so. At the time, it caused a little anxiety : we had been flying for five days with no maintenance other than filling up with oil and petrol, though we had always supervised this operation ourselves.

Just before Lyons, we turned west up the pass that leads to St. Etienne, a large industrial town, and found the landing field. They took one look at us and charged us 800 francs for a couple of *omelettes* (without *champignons*) and lemonades. It was my turn to fly, and I had some difficulty in getting her unstuck. I thought it was due to the height, about 1,500 ft. above sea level, but found it was because I had not pushed the throttle wide open. (I hope the C.F.I. at Rochester does not see this.) We just flew down the Loire and landed at Nevers at 1732 hrs. Alan was all for pushing on to Paris that day, as it offered better possibilities than Nevers. He looked as fresh as ever, but I was beginning to feel the strain. However, we went to flight control and worked out a rapid *plan de vol.*

We asked the only chap we saw on the airfield if he could produce anything to eat. He said he thought this would be possible, but a powerful voice issuing through the keyhole, reminiscent of some

off-stage Brunnhilde, relieved him of any such illusion. Siegfried shrugged his shoulders and smiled apologetically. So we put in oil and petrol and took off at 1917 hrs.

Alan was flying, and I was not map reading with the care I should have been. I was more interested in the sun, which was very red and not far above the horizon. We were still only half-way to Paris when it went down and we realized, that though we had taken the time of sunset into our calculations, we had not allowed for English summer time. We were an hour later than we had supposed. We had no navigation lights or radio, and so had no business to be flying at that time of day. I was all for putting her down in a field while there was still sufficient light. I had had some experience of that sort of thing. Alan was not so keen as he had not, and so we altered course to bring us over Etampes. After fifteen minutes flying, Etampes perversely refused to show up and we realized we were lost. By this time it was too dark to risk a landing anywhere except on a runway. So we turned north again and hoped for the best. After a few minutes we sighted the Eiffel tower against the night sky, with its beacon flashing. This was small comfort : the ground was almost invisible, and nobody in his right senses would care to make a forced landing over Paris. I had long ago discarded my maps, and we had only a rough idea from which direction we were approaching.

When sailing, I have found that at some time or another, usually when everyone is tired and something goes wrong, somebody starts shouting and swearing : usually at me—I'm a bad sailor. It means nothing later, but is always a little trying at the time. Throughout our whole flight, and particularly at this moment when we were very tired and wondering what to do next, Alan and I had never had a cross word. We had both made many mistakes—more than I have related here. I suppose we felt that in circumstances calling for a cool head, where a mistake could bring a bad accident in a few seconds, swearing would not help.

" What do we do now? " asked Alan. I crossed my fingers, thought for a second and said :

" Turn right." Just a wild guess, you understand. Alan did so. About half a minute later the white concrete runways of a large aerodrome appeared underneath us. The rest of the ground was in complete darkness.

We circled round twice, and they realized we had no lights or radio. One of the runways was lit, and someone started firing green Very lights at us. Alan made a very nice landing. It was Villacoublay, a military aerodrome, and in the normal way we should not have been allowed to land there. We were given a very friendly reception in the bar and some of the staff, who had flown with the R.A.F. during the war, regaled us with their experiences. Later

they ran us into Paris where we put up at a little place Alan knew in St. Michel which catered for students. They remembered him, and we were well looked after. Alan knew the tourists' part of Paris quite well, and showed me around. We must have walked for miles.

The weather had closed in again, and it rained all night and the next morning. But we thought we had better go out to Villacoublay in case there was a chance of getting away. Funds were getting low, and so it was not difficult to tear ourselves away. We got as far as the end of the runway before we were told to come in again : the weather was too bad. We hung around for a short while and a large Humber staff-car with a driver and Staff Major drove up. Shortly afterwards, a Dakota appeared through the clouds and made a beautiful landing. It taxied up to within a few yards of us. The ground crew dashed around frantically, the hatch was opened and steps adjusted beneath. There followed a long pause and then, quite slowly one step at a time, there descended a little man wearing a British warm and a black beret with two badges. He did not look very spritely and in that weather, when we had not been allowed to leave the ground, we sympathized with him. He stayed only a few minutes and then made off in the Humber. We were very disappointed, as we had hoped he would notice " Maggie " with her Sapper colours. Alan took some photos, but they were too small to show anything interesting.

The next morning, the weather had improved considerably, and we took off at 0957 hrs. Time was running out, and we intended to press straight through to Rochester that day : by no means a difficult feat. We arrived at Le Touquet at 1113 hrs. Quite unhurriedly we tanked-up, had lunch, spent our last francs, passed Customs and were airborne at 1338 hrs. There was no need for a map, and we reached Lympne at 1413 hrs. We passed straight through Customs, were airborne at 1502 hrs., and touched down at Rochester at 1525 hrs. Visibility was none too good, but we knew the way blindfold. This was Thursday, 11th August, and we had been away for just over six days.

We looked around vainly for the brass band and red carpet we had expected, with possibly a committee from Chatham to welcome home two intrepid aviators. There was only a mechanic there.

" Well, here we are again," we said, " safe and sound after a week's tour of France."

" I see," he said.

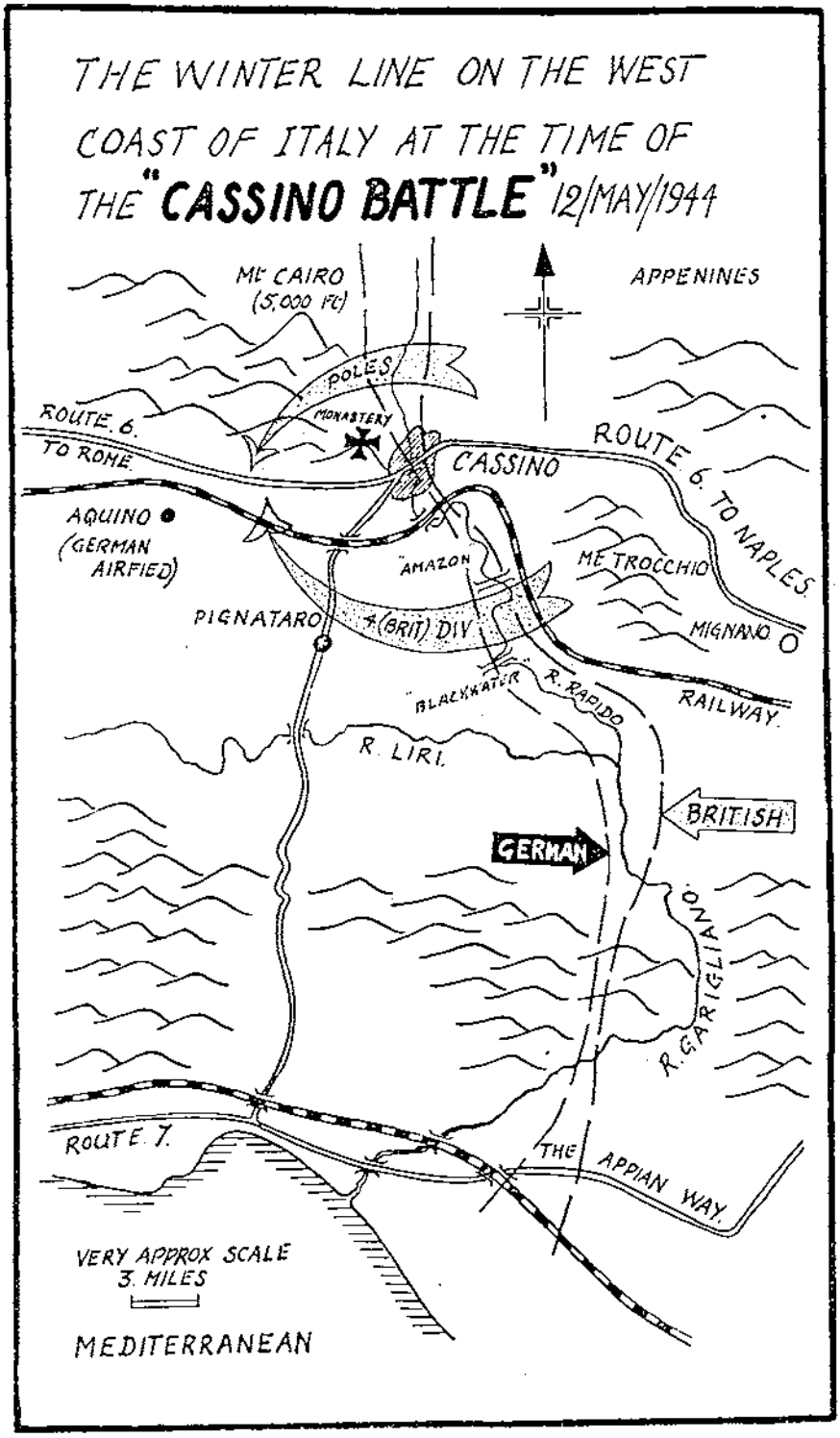

THE WINTER LINE ON THE WEST COAST OF ITALY AT THE TIME OF THE "CASSINO BATTLE" 12/MAY/1944
Mt CAIRO (5,000 Ft)
APPENINES
POLES
MONASTERY
ROUTE 6. TO ROME
CASSINO
ROUTE 6. TO NAPLES
AQUINO (GERMAN AIRFIELD)
AMAZON
ME TROCCHIO
PIGNATARO
4 (BRIT) DIV
MIGNANO
BLACKWATER
R. RAPIDO
RAILWAY
R. LIRI
BRITISH
GERMAN
R. GARIGLIANO
ROUTE 7.
THE APPIAN WAY
VERY APPROX SCALE 3. MILES
MEDITERRANEAN

PLATE 1

THE BATTLE FOR CASSINO MAY, 1944

By LIEUTENANT-COLONEL A. P. DE T. DANIELL, M.C., T.D., R.E.

PART I

THE INITIAL RECONNAISANCE OF THE RIVER RAPIDO

BEFORE I describe the recce that we made of the River Rapido prior to the Battle of Cassino, I must explain briefly the tactical situation appertaining at that time. The Boche had maintained a strong winter defensive line right across Italy since December, 1943. This line was known as the " Gustave " line and on the western side of the Apennines followed approximately the line of the rivers Rapido and Garigliano. The only suitable gateway to Rome was up the wide valley of the River Liri following the famous Route 6, but this valley was completely dominated by Cassino and the monastery above it. Cassino was the key to Rome and had to be taken before any progress could be made. The Boche knew this too. Any assault on Cassino itself necessitated an assault crossing of the little River Rapido, no more than 70–80 ft. wide, but deep and fast flowing (see Plate 1).

The Americans first had a crack at Cassino in January, 1944, but were beaten back with fairly heavy losses. Next the New Zealanders under General Freyburg attacked on the 15th of March, having first pounded the town and monastery with waves of Fortress bombers. A very impressive sight which I watched from nearly twenty miles away. Still the Boche bobbed up from cellars and dug-outs and beat them back. It was therefore decided by General Alexander to mount a really big assault along the entire length of the Gustave Line, each assaulting division backed up with another infantry division and an armoured division. The date chosen was the 12th May, which allowed five weeks from the time the decision was made to train the assaulting divisions and to build up stocks of ammunition for the guns.

Briefly the assault on Cassino was planned as follows: The Polish Corps were to attack over the mountains on the *right* and the 4th British Division on the *left* would cross the River Rapido and swing right-handed to link up with the Poles on Route 6, behind Cassino, thus completely surrounding it. Meanwhile the Guards Brigade would contain the garrison from the front. It was hoped that when the garrison was completely surrounded it would surrender.

4th British Division was to assault the river on a narrow front with two brigades leading, the third brigade in reserve ready to go through, swing right, and link up with the Poles. The two Field Companies, R.E.—7th Company on the left commanded by Major Low, and 225th Company on the right commanded by Major Gabbett—who were affiliated to the assaulting brigades were each to build a Class 40 Bailey Bridge and two ferries in their brigade sectors. The third field company—the 59th Field Company—was to build a Class 9 Bailey bridge as a return route for traffic between the two Class 40 bridges, more or less in the centre of the divisional front. This was the bridge that I was particularly interested in.

On the 26th April the C.R.E.—Lieut.-Colonel Nelson—sent for me and told me the plan. We studied air photographs and decided approximately the site for our Class 9 bridge which was given the code name of "Blackwater" bridge. He told me to carry out a recce on the river line, decide the exact site for the bridge, and produce an outline plan by the morning of the 28th.

On returning to the company I held a council of war and decided that Lieutenant Boston should build the bridge with his platoon, and that Lieutenant Chubb would improve the approach and exit with the remaining half of his platoon. (The other half had been lent for work on the ferries and Lieutenant Drummond's platoon was C.R.E's. reserve, which I could not touch.) We accordingly decided to carry out a recce of the approach and bridge site the following night. At this time the company itself was back at Mignano, some ten or twelve miles south of Cassino on Route 6. The sappers were working at nights on the widening and improving of tracks from Route 6 to the River Rapido, which would eventually be needed as approaches to the bridges. It was, therefore, quite easy to fit in a recce of the river and to work out a plan (see Plate 2).

On the evening of the 27th, Boston, Chubb, I and Sergeant Cox set off in my Jeep at dusk. We had arranged to rendezvous at the Company H.Q. of the Indian battalion who were then holding the river. There we met Major Low, who was also doing a recce of his own Class 40 bridge site farther to our left. We were given the password and told the Indians where we were going and that we intended to be back in about an hour. The river was no-man's-land, but was freely patrolled by both British and Boche alike.

From there we made our way in single file down the approach track to the river. It was rather light with a half moon, very quiet and extremely eerie. The river had a flood bank of shingle which had at some time been dredged out of it. There was still plenty of American equipment lying about and some very unpleasant smells. However, we made our way slowly, keeping below the bank, towards our bend, stopping often to listen. Having reached the bend

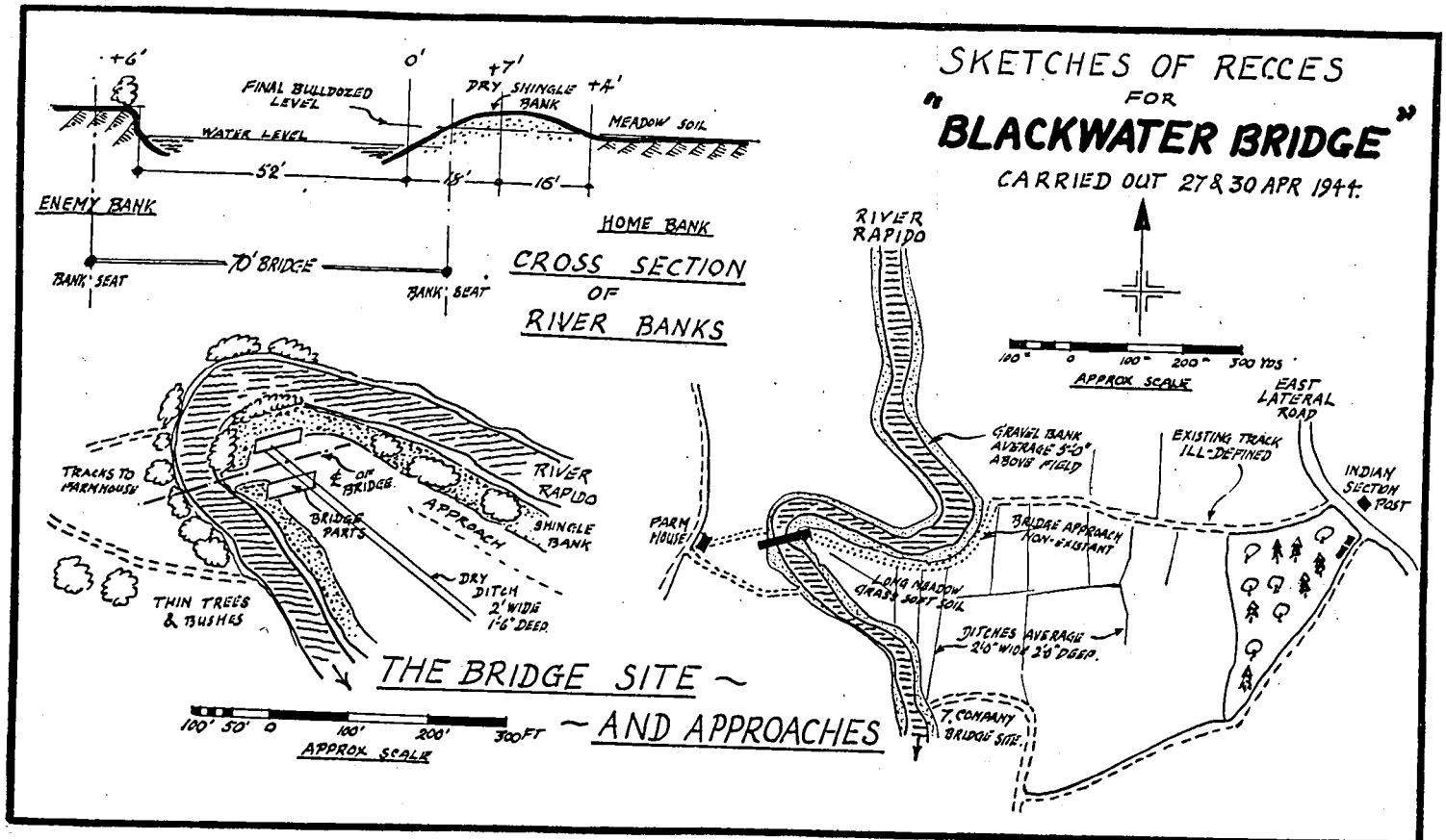

SKETCHES OF RECCES
FOR
"BLACKWATER BRIDGE"
CARRIED OUT 27 & 30 APR 1944.
+6'
0'
+7'
+4'
FINAL BULLDOZED LEVEL
DRY SHINGLE BANK
MEADOW SOIL
WATER LEVEL
52'
15'
16'
ENEMY BANK
HOME BANK
70' BRIDGE
BANK SEAT
BANK SEAT
CROSS SECTION
OF
RIVER BANKS
RIVER RAPIDO
100' 0 100' 200' 300 YDS
APPROX SCALE
EAST LATERAL ROAD
GRAVEL BANK AVERAGE 5'-0" ABOVE FIELD
EXISTING TRACK ILL-DEFINED
INDIAN SECTION POST
TRACKS TO FARMHOUSE
℄ OF BRIDGE
RIVER RAPIDO
BRIDGE PARTS
APPROACH
SHINGLE BANK
DRY DITCH 2' WIDE 1'-6" DEEP
THIN TREES & BUSHES
FARM HOUSE
BRIDGE APPROACH NON-EXISTANT
LONG MEADOW GRASS SOFT SOIL
DITCHES AVERAGE 2'-0" WIDE 2'-0" DEEP.
7 COMPANY BRIDGE SITE.
THE BRIDGE SITE ~
~ AND APPROACHES
100' 50' 0 100' 200' 300 FT
APPROX SCALE

PLATE 2

Sergeant Cox lay on the bank with his Tommy gun cocked as "look-out man" (we all carried Tommy guns). Meanwhile Boston, Chubb and I had a long argument as to who should swim the river. Boston wanted to swim, but I thought it was too light and was against it. At this moment Cox rolled down the bank to say there were four Boche on the other side. So we all had a look and there they were, four of them, quite clear, only about eighty feet away. They must have been sappers too, for each carried a shovel on his shoulder. What an easy shot! I was itching to pull the trigger, but we didn't want to give the show away. However, that finally decided me that no one would swim that night. So instead we quietly measured up the area for space to dump stores and build the bridge. The shingle bank was about four feet high, so we decided it would have to be bulldozed through, also in addition there was an annoying little dry ditch plumb in the middle of the building area. Anyway we took all the measurements we required and decided to clear out back to the road without more ado. On our way back Chubb and I made notes on the amount of work required on the approach tracks, as it was nearly three-quarters of a mile long with a number of little ditches to surmount. Having reached the road, somewhat relieved, we checked in with the Indians and drove home.

We got in about one o'clock and found our cook, Parry, had hot tea ready for us. We then all three got down to prepare the outline plan, working in the office truck. Boston drew a plan of the building area, Chubb worked out his notes on the approach track, while I worked out the design for an 80-ft. Single Truss Bailey bridge, preparing works tables, transport table, etc. At last we finished and got to bed about 3 a.m. I personally felt I had a much clearer picture in my mind of what we were up against and how best to overcome it.

The next morning I took my plan to Colonel Nelson and we discussed it together. The only real comment arising from it was, of course, the fact that we *must* get across the river to measure its width accurately and to have a "look-see" at the far bank. The big question promptly arose as to who should swim across, an officer or a volunteer good swimmer. Well, I decided there being only one officer to sixty-eight men, that I would not risk an officer and so I called for volunteers. There were plenty—morale in the company was very high just then, anything for a bit of excitement. I chose Driver McTighe. He was the best swimmer in the company and was Boston's own driver. I decided we'd do it again the following night, but when the time came it was frightfully light with a very bright moon. So we put it off for a day. Luckily next night, the 30th April, was cloudy and just right, for it was our last chance.

This time the party consisted of Boston, myself, Sergeant Cox and Driver McTighe. Again we set off in my Jeep at dusk and again we

met Major Low, who was working on the approach to his bridge. We again called on the Indians and warned them of our movements —this was very necessary, as they were extremely light on the trigger and delighted in shooting at strangers. Major Gabbett had already had a grenade thrown at him while having a look at his bridge site on our right. This time we all went down Major Low's track, towards his bridge, as far as the river. Again it was extremely eerie, but not quite so light. The plan was for us to crawl right-handed along the bank to our bend and that if we got into trouble and shooting started, Major Low would come along with his sappers to our rescue. We arrived at our bend and all was very quiet.

I lay on the bank to the left with Tommy gun cocked and watched intently the enemy bank. So did Sergeant Cox some forty yards to the right. Boston and McTighe in the centre prepared to measure the water gap. McTighe took off his clothes but wore canvas shoes, dark bathing pants and my brown pullover to hide the white of his body. He tied the end of the measuring tape to his tummy. He waded in and swam quickly across, being carried a few yards down-stream. He was just making his way up-stream under the far bank to get opposite to Boston when two loud explosions went off over his head. He gave a tug on the tape which was the signal for Boston to pull tight the scrap of white tape, through which the measuring line had run, at the water's edge. Either McTighe had set off a trip-wire or a Boche had heard him and lobbed a couple of grenades. At all events he was untouched and swam that sixty-odd feet back twice as fast as he had ever swum in his life. Once they were both over the bank we bundled up our belongings and beat it as fast as we could, up our own track, to the road. For I was afraid that if we delayed, the Boche might bring down a concentration of mortar fire on the bank. However, all was well.

Back on the road McTighe put on his clothes and we had a look at the tape. It measured only 52 ft. This seemed a little short, but I certainly didn't fancy doing it again. At this moment Major Low arrived. Having heard the explosions he came round to see what was up and was delighted to find us all safe and sound. So we all jumped on to the Jeep and drove home again to find Parry had tea ready. We laced it with whisky and drank to the health of "Blackwater" bridge.

Next day, inevitably of course, the C.R.E. would not believe our figure of 52 ft. I was sure it was all right so I asked our Intelligence Officer to try and persuade the Divisional "Tac R" Squadron to fly a special air photo recce. This he did and when the photos came in and were enlarged they showed 55 ft. We were saved and the C.R.E. accepted 55 ft. as the width of the water. This was subsequently found to be correct when the bridge came to be built later on.

The next thing to do was to prepare the company's final plan for the operation. Boston and I went ahead together on this. The bridge was to be 70 ft. of Single Truss construction but Boston devised an unorthodox method of building in order to cut down to the very barest minimum work on the enemy bank. And so began a tussle. I took Boston's side being convinced by the calculations that it would work. But the C.R.E. was adamantly opposed to any divergence from the strictly orthodox method of launching a Bailey Bridge which entailed the removal of a " skeleton nose " on the far bank. Whereas Boston's method employed a counter-weight to cut out any dismantling on the far bank. Well, to cut a long story short, we won our case and Colonel Nelson agreed subject to the actual rehearsals proving successful. As a hard and fast rule Bailey bridges should never be built by unorthodox methods unless there is plenty of time to rehearse, because in training the sappers are taught the orthodox method till they can do it in their sleep.

And so our plan, in all its multiplicity of detail, was accepted and the bridging team assembled. This consisted of Boston with his platoon, Chubb with half his platoon, Lieutenant Williams with the bridging lorries, twenty Northumberland Fusiliers to help unload, and lastly a D7 bulldozer. A total of some seventy-odd men and thirty-two vehicles. The team then went down south to the village of Pietro Variano on the River Volturno, where we set up camp in a pleasant olive grove. I went with them to direct and assist in the training programme. We became, in the ten days of intensive rehearsal, a very happy and confident team. There wasn't a man who doubted for an instant that our Blackwater bridge must succeed.

Personal Message from the Army Commander

" Great events lie ahead of us. All round Hitler's Germany, the Allies are closing in : on the East, the victorious Russians drive on—in the West, the British and American Armies are massed to invade.

" Now in the South, the Eighth and Fifth Armies are about to strike.

" Side by side with our French and American Allies, we will break through the enemy's winter line and start our great advance northwards. Our plan is worked out in every detail—we attack in great strength, with large numbers of tanks and guns, supported by a powerful American Air Force and our own Desert Air Force.

" The peoples of the United Nations will be watching the Eighth Army. Let us live up to our great traditions and give them news of fresh achievements—great news such as they expect from this Army.

" We welcome gladly to our ranks those Divisions whose first

fight this is with the Eighth Army. We send a special message to our Polish Corps, now battling beside us to regain its beloved country.

" I say to you all—Into action, with the light of battle in your eyes. Let every man do his duty throughout the fight and the Day is ours.

" Good Luck and God Speed to each one of you

ITALY,
May, 1944.

OLIVER LEESE,
Lieut.-General."

PART II

THE OPENING PHASE OF THE ASSAULT CROSSING OF THE RAPIDO

The long awaited assault on Cassino and the German " Gustave Line " was to be on 12th May, 1944. The operation was to be known by the code name " Honker "—the cry of homing wild geese. But meanwhile the bridging team for " Blackwater " bridge had been working hard on the River Volturno at Pietro Variano. In all, the bridge had been built seven times under progressively difficult conditions and the training had gone remarkably well. We had good reason to be optimistic.

On 10th May we had a free day which we gave over to washing clothes, letter-writing and chores. It was a lovely day, I remember writing home so well. But the following day was devoted to briefing every member of the team, sappers, fusiliers and drivers all included. This was done with the help of three visual aids. The first was a most excellent model of the River, including our bend and the hinterland behind it, built up by Lieutenant Notley almost entirely from air photos. In addition we had sufficient vertical air photographs for every man to study. And thirdly, perhaps the most useful of all, we had a set of low-angle oblique air photographs of the river line looking towards the Boche.

That night the team moved to a " lying up " area just behind Trocchio, about a mile from the river. The whole area was surrounded by guns and was in fact a part of the " Divisional Gun Area." When I remarked upon this to some gunners while doing a recce for the team they said, " Oh, yes, we usually get plastered about 10 p.m." Just when the team was due to arrive. Time went on and no sign of them. I was getting very anxious. At last they arrived about an hour late to meet myself in a furious temper ordering them to dig in immediately. However luck was with us and no shells came in. I drove back to Company H.Q. at Mignano in the early hours of the morning, tired but relieved.

Next day I came up with the C.R.E. in the afternoon as he wanted to wish the sappers luck. We were sitting on the ground with perhaps

twenty-five sappers sitting round when suddenly shells started arriving. They came roaring in all over the area. All we could do was to lie flat, pressed to the earth, and pray to the Lord, while the ground shook and heaved all round. It was absolutely frightful, I literally bit the dust trying to make myself smaller. In two minutes it was all over. We'd had eighty shells—ten rounds of gunfire from two batteries. And the incredible thing was that not a soul was hurt, except Sapper Hughes who was sitting on the latrine and stopped a small fragment of shrapnel, while kit, motor-cycles and the one or two trucks we had with us were riddled. So we took it as a good omen and said our luck was in.

" H " hour was at 10 p.m. on 12th May. Suddenly the heavens were rent open and every gun fired simultaneously. There were, they say, 900 guns firing in the barrage. The noise was quite indescribable. The flashes made it as light as day but infinitely more lurid, while nearer the river itself one heard the continuous swish of shells passing overhead. The whole effect was to make one, individually, feel extraordinarily small.

Meanwhile the old Boche, cunning fellow that he always was, did not retreat under the barrage, but instead came forward to line the shingle bank of the river with machine-guns. It was, originally, a still night with natural mist hanging over the river. But to add to the general confusion, the Boche thickened up this natural mist with smoke till it was an impenetrable fog some hundred yards or more wide.

Into this thickest of " pea soup " fog the infantry advanced on a wide front carrying their boats in good order straight towards the river. " W " or water hour was three-quarters of an hour after " H " hour. But once in the fog they were lost. Some went right, some went left, and nearly all went round in circles, coming back out of the fog into unfamiliar surroundings. Meanwhile the Boche, who could not see either, fired his Spandau machine-guns intermittently into the fog as well as mortaring spasmodically all along the river. All this fire was of course unobserved and therefore not very dangerous, but in the fog extremely frightening. A few of the boats did get across. But their main intention on landing was to get inland and seize their objectives. Which they did all too easily, there being no Boche anywhere near. But they did *not* clear the enemy off the far bank nor were we able to get anybody to do this vital though invidious task. I did not want to use sappers for this task as we hardly had enough for our engineer tasks as it was.

Half an hour after " W " hour I set up my Bridge H.Q. at the top of the approach track and at the same time the old bulldozer trundled down the track. This seemed to enrage the Boche who directed all his available fire in the direction of the sound. This brought the

The Battle For Cassino

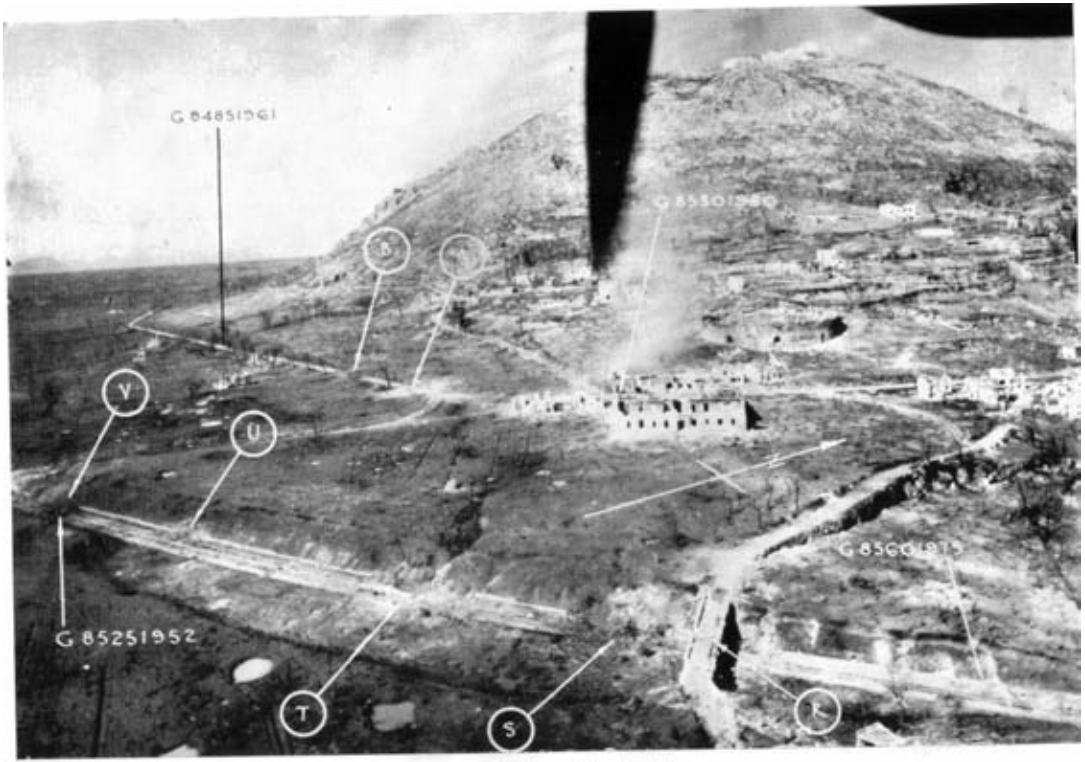


Photo 2.—Cassino during bombing.

The Battle For Cassino 2

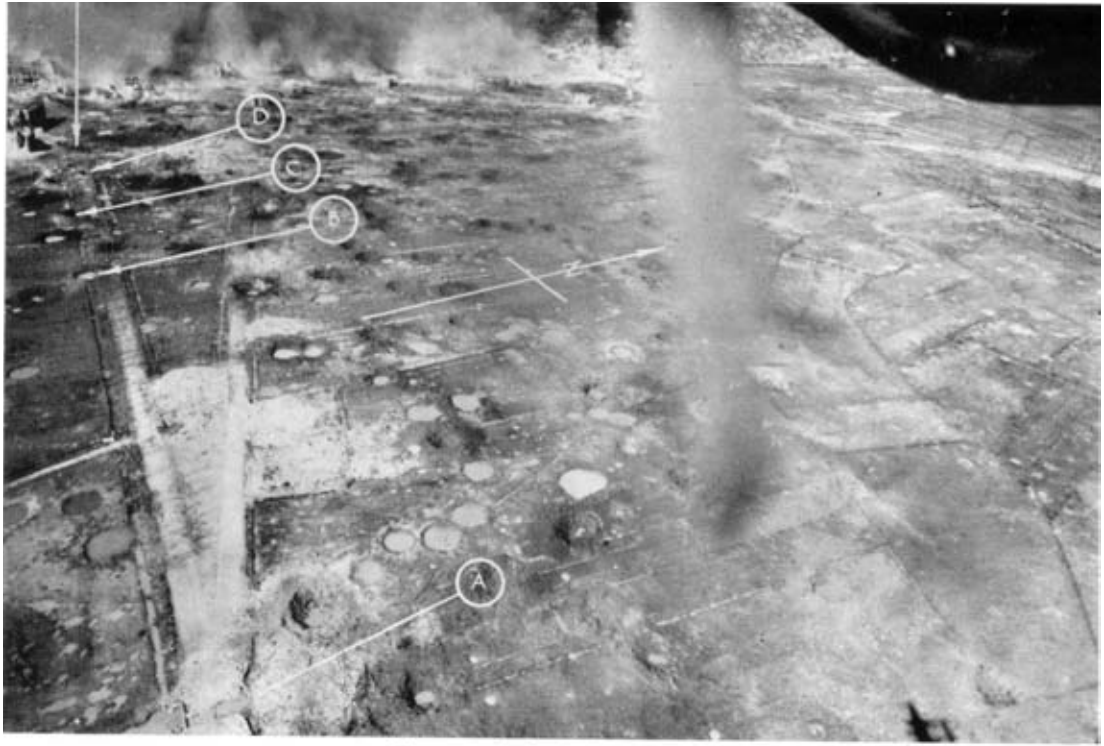


Photo 3.—Cassino during bombing.

The Battle For Cassino 3

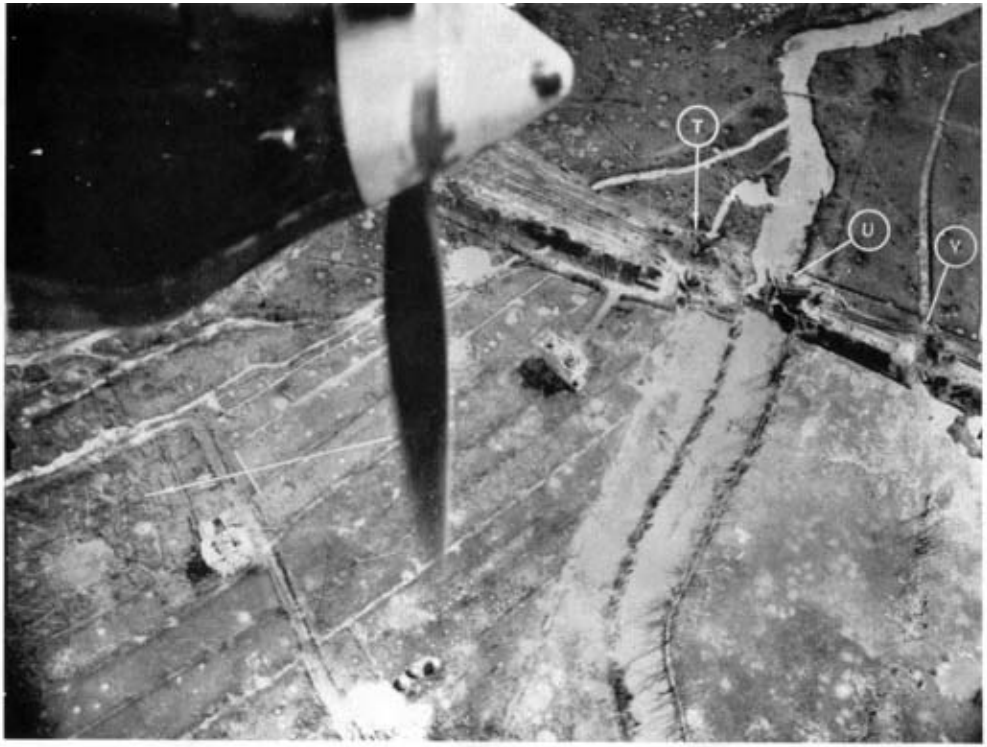


Photo 4.—Railway bridge on Rapido destroyed by bombing. "Blackwater" and "Amazon" bridge sites were below this.

bulldozer to a standstill wounding one driver, but not until he had got almost to the bank. Thereafter every time he started up a hail of bullets arrived. Next the Sappers arrived with the first of the lorries. But nothing could be done in that awful fog with bullets whizzing overhead. We simply must get some chaps across to deal with those " Spandaus."

At this juncture the C.R.E. arrived and together we searched for some officers or warrant officers, but not one could we find, only dejected parties of infantry milling around with their boats. Meanwhile, however, Boston had swum across with a rope and secured both ends to trees and passing it through the bow fairlead of an assault boat, thus making a foolproof ferry. He then found an infantry officer who raised a platoon and promised to clear out the Boche. But they soon came back having got hopelessly lost in the fog.

All this time, of course, the bridging lorries had been arriving, strictly according to time-table, and were merely piling up at the top of the track. I stopped them eventually, but not until at least twenty out of the thirty-two had arrived. During this time Chubb was able to do a bit of improvement on the track, but even that was under difficulties and several track material lorries were hit on the hill down to the river.

As the night wore on this state of chaos increased steadily and to cut a long, exasperating story short, when dawn began to break absolutely nothing had been achieved. The Boche must have seen or sensed our concentration of vehicles at the top of the track, for suddenly he began shelling. Then followed half an hour of the worst, while we tried to turn the trucks round and get them out of it. Lieutenant Williams did magnificent work, finally being seriously wounded. Sergeant Cox was also badly wounded in this jam of struggling vehicles. At this time too, my White Scout car, which was my Bridge H.Q. carrying my wireless links to Company H.Q. and the C.R.E., received a bit of shrapnel the size of my fist through the radiator—much to the consternation of Company Sergeant-Major Tutton inside.

Things looked pretty bad. It was full daylight now and the Boche had started putting over " Minenwerfers " in salvoes of six. The river was clearly in view from the Monastery and so were we. I asked for the C.R.E. on the wireless and, when I'd explained the situation, asked for orders. Imagine my relief when he said get everybody back to the " Lying up area." I sent the Scout car off at once and passed the word round to all the men to return individually to our old field of yesterday. Finally Boston, Chubb and I walked slowly back together. Neither spoke a word, our tails could not have been lower.

PART III

The Final Phase of the Crossing of the Rapido

In the original R.E. plan for operation "Honker" each field company was to build a bridge across the River Rapido on the night of 11th/12th May, immediately after the infantry had crossed in assault boats and secured a bridgehead. Unfortunately this bridgehead was never secured in sufficient strength to allow any of the bridges to be commenced.

Thus all attempts to bridge the River Rapido on the night of 11th/12th May having failed, the C.R.E. decided to make an "all out" Divisional R.E. attempt to bridge the river on the night of 12th/13th, employing each company in turn with the intention of getting a bridge across at all costs, capable of carrying tanks. The site chosen was the original site of 225 Field Company's bridge "Amazon." The plan adopted was also 225 Field Company's own original plan. O.C. 225 Field Company—Major Gabbett—was therefore placed in charge of the operation. The companies were to relieve each other as each became exhausted in the order 225 Company, 7 Company and last, 59 Company. The bridge was to be an 80-ft.—orthodox—Double Single Bailey bridge, Class 40 (see Plate 3).

Work was commenced soon after 1700 hrs. by 225 Field Company on the near bank and near approach. 7 Field Company moved from their "lying up" area to the railway cutting, arriving about 1900 hrs. 59 Field Company moved up next to an area behind the railway cutting, arriving at about 2000 hrs. I went forward with Boston and Chubb to report to Major Gabbett at about 2030 hrs. On the way I met Lieutenant Hobson of 7 Field Company, who was just taking his men down to the bridge site to relieve 225 Field Company who had had a difficult time owing to enemy observation in the fading light. I also met Lieutenant Severn of 225 Field Company on his way back from the bridge site. He told me that he had finished bulldozing and had got the rollers in position. We then went on to report to Major Gabbett at his Bridge H.Q. near the "barracks." It was decided that I should bring my platoons down to the railway cutting as each platoon of 7 Field Company went out, so as to be as near as possible to the job, and at the same time to set up my Tac. H.Q. in the small building opposite the Advanced Dressing Station. On my way back I met the commander of the platoon of 586 Field Company R.E., which was also to be available to finish off construction if necessary and to take over the bridge when complete. They were not in fact used. We then went back to bring up the company.

Going back up the lane we saw the bulldozer grinding slowly

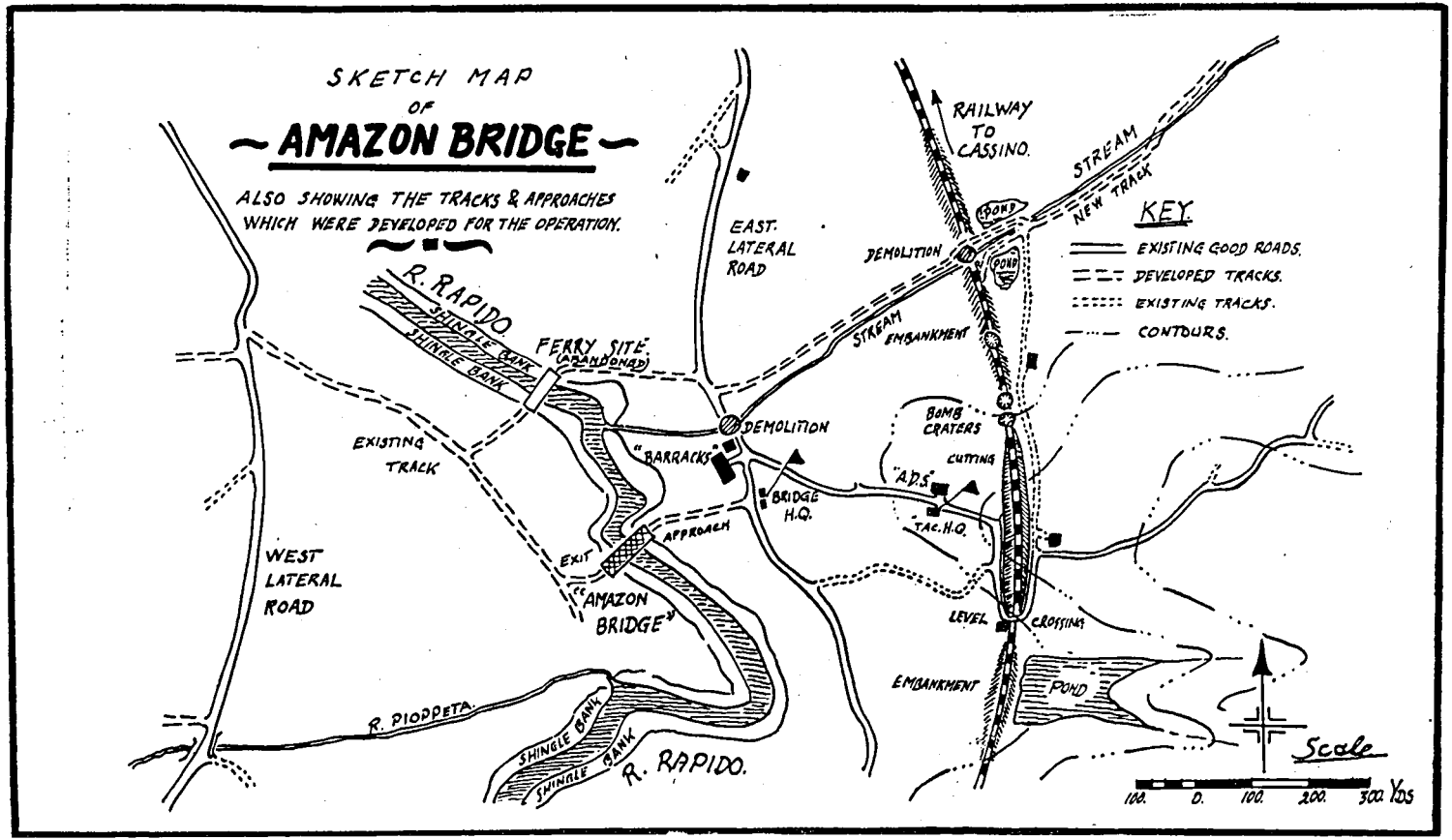

SKETCH MAP
OF
AMAZON BRIDGE
ALSO SHOWING THE TRACKS & APPROACHES
WHICH WERE DEVELOPED FOR THE OPERATION.
R. RAPIDO
SHINGLE BANK
SHINGLE BANK
FERRY SITE
(ABANDONED)
EAST.
LATERAL
ROAD
RAILWAY
TO
CASSINO.
STREAM
NEW TRACK
KEY
EXISTING GOOD ROADS.
DEVELOPED TRACKS.
EXISTING TRACKS.
CONTOURS.
DEMOLITION
POND
STREAM
EMBANKMENT
DEMOLITION
BOMB
CRATERS
CUTTING
"BARRACKS"
"A.D.S."
BRIDGE
H.Q.
TAC. H.Q.
EXISTING
TRACK
APPROACH
EXIT
WEST
LATERAL
ROAD
"AMAZON
BRIDGE"
LEVEL
CROSSING
EMBANKMENT
POND
R. PIODDETA
SHINGLE BANK
SHINGLE BANK
R. RAPIDO.
Scale
100. 0. 100. 200. 300 Yds

PLATE 3

across the fields back towards the railway cutting, with the driver walking crouched in front of the blade. This field was in full view of the opposite bank and was in fact periodically swept by fire from an enemy " Spandau." When he got to the cutting I asked him how he had got on. He told me he had finished the job, but that his blade elevating gear had been hit and put out of action. There was still a smaller D.4 bulldozer on the site which was O.K.

At the Advanced Dressing Station I heard bad news that Major Low—O.C. 7 Field Company—had been hit in the legs by this same " Spandau " on the track just to the south of the one we had come up. Apparently he and the C.R.E. had gone down this track to see how things were getting on. At a rather open stretch the C.R.E. had doubled across and Major Low was following him. Suddenly the " Spandau " opened up and hit Major Low in both legs. Whereupon the C.R.E. carried him back up the track to the railway. From there he was taken to the Advanced Dressing Station on a stretcher. He had just left the Advanced Dressing Station when I arrived.

Having brought the men down to the cutting it was now dark and about 2130 hrs. I left Notley and C.S.M. Tutton at my Tac. H.Q. to collect men and dispatch them down to the bridge site as required. Lieutenant Barnes of 7 Field Company then arrived and asked for a platoon to assist in unloading, as the remainder of the bridging lorries had been sent for. Lieutenant Drummond with No. 3 Platoon of 59 Field Company was detailed and went down to the bridge, this being at about 2145 hrs. Boston and I joined Major Gabbett at Bridge H.Q. It was now quite dark and building had commenced. Bridging lorries were also arriving quite fast, being dispatched by vehicle control. As bridging lorries were required at the bridge site a demand was sent over the air to vehicle control. This channel of communication worked extremely well right through the job.

Throughout the operation Major Gabbett was in charge. He set up his Bridge H.Q. in some slit trenches just off the road behind the " Barracks." There he installed his own wireless set direct to C.R.E. and his company wireless set to vehicle control. He had with him his own personal runner and one or two company runners. Communication with the bridge site was originally by " Walkie Talkie " wireless sets, but later the set at the bridge became damaged and communication was by runner. This chain of communication was maintained without a break throughout the night until after the tanks had gone through, in spite of Bridge H.Qs. quick move to a culvert some fifty yards away. This was when a 3-ton lorry, belonging to the smoke detachment, was hit on the road beside Bridge H.Q. at about 0200 hrs. It immediately caught fire and blazed

furiously for about two hours attracting fire from the enemy. Efforts were made to put it out but failed effectively as it was too hot to get near. At the same time enemy shelling set fire to some hayricks at the top of the field adding to the conflagration.

Shortly after returning to Bridge H.Q. at 2200 hrs. Hobson of 7 Field Company, who was officer in charge of construction, asked me for a party to work on the far bank. Boston went down with two sections of No. 2 Platoon, the remaining two sections followed shortly afterwards. On arrival, several attempts were made to get a ferry across but failed, due to enemy snipers on the far bank. The plan to build a ferry was therefore abandoned for the time being and Boston with his party assisted in the bridge construction. By this time the launching nose was nearly finished and the bridge proper was ready to be commenced on the building rollers. This was actually delayed until all the lorries had been unloaded. There were not enough men to unload and build at the same time, as it was not considered wise to have too many men on the site. Due, however, to the high shingle bank the building site was comparatively immune to small arms fire from the far bank, but the lorries were very vulnerable to mortar fire. It was, therefore, essential to get them away quickly. All bar one got safely back. Meanwhile the bridging lorries were arriving somewhat irregularly due to the traffic regulating system having broken down and empty lorries were meeting full lorries in the narrow lanes. I dispatched Notley to sort it out, which he did, and the remainder of the bridging lorries all arrived and were unloaded by No. 3 Platoon by about midnight. When the last ramp lorry had been unloaded Drummond took part of his platoon back to the " barracks " to rest, while he himself had a very small wound dressed at the Advanced Dressing Station.

A small incident occurred shortly before midnight, which is worthy of note. One of 225 Field Company's lorries stuck in the narrow lane leading down to the " barracks," with broken front wheel steering, completely blocking the lane and preventing the last of the bridging lorries getting to the site. To clear this Boston brought the D4 bulldozer up from the bridge site and coupled it to the front axle. After much straining and slithering the lorry was pulled clear into a field.

By midnight the position at the bridge site was that the skeleton nose was complete, all stores unloaded on site and all was ready to commence building the bridge proper. At this juncture Boston took over complete control of the building from Hobson of 7 Field Company—who still remained at the site to assist, in spite of being very tired. Boston, who already had his own platoon (No. 2) and No. 3 Platoon (who had just finished unloading), asked for Chubb and the two remaining sections of No. 1 Platoon of 59 Field Company. Two sections only of this platoon were available, the other

two being away with infantry battalions. These two sections went down with Chubb to the bridge. Most of 7 Field Company now left the site. I was at Bridge H.Q. at this time and reported probable time of completion as 0200 hrs. However, this was not to be. Enemy shelling and mortaring became rather more intense and inclined to be accurate. The enemy also developed a trick of firing Very Light flares behind the building site, which silhouetted the men against the white mist making an easy target for enemy snipers. I therefore called for counter battery fire, speaking direct to the C.R.E. on the wireless. In a very short while this came over in great strength (from 6th Army Group R.A., consisting of five Medium Regiments and two Field Regiments), but at the same time a number of rounds fell short, sounding terrifyingly near. A call to "pitch them up" was immediately put through to C.R.E. giving the approximate bearing. This had the desired results in a very few minutes and no more fell short. This magnificent counter battery shoot did, in fact, virtually silence the enemy shelling for quite a while.

Meanwhile a mine clearing party of two officers and thirty-nine sappers from 8th Field Squadron of the Armoured Division, which was to follow up, arrived to clear a tank lane on the other side. But as no ferry yet existed and the other side was extremely unhealthy we advised that only a small recce party should go across first and for the remainder to go farther back and wait. This recce party eventually crossed by the bridge and later, unfortunately, the officer stepped on a "Schu" mine and lost his foot.

At about 0100 hrs. Sherman tanks were heard coming down the road presumably expecting to cross the bridge at 0200 hrs. Fearing that the noise would attract fire Major Gabbett asked me to try and stop them. I ran off up the road and stopped the leading tank about 200 yards off, but the damage was done and shelling of the area increased considerably for a short while. It was at this time that the 3-ton lorry, which had stuck in the ditch close to Bridge H.Q., was hit and blazed furiously, causing Bridge H.Q. to move to a culvert some fifty yards away. This blaze started further concentrations and Bridge H.Q. became the centre of quite a "strafe."

Meanwhile building went on steadily but slowly, due to periodical enemy interference. First of all the time of completion was amended to 0300 hrs. and later, out of sheer desperation, to 0500 hrs. Eventually, at about 0300 hrs., the bridge was pushed forward partly by hand and partly with the help of the D4 bulldozer (the D7 having long since left the field with its blade elevating gear out of action). For some time one particular "Spandau" on the left had been causing almost continuous interference and quite a few casualties. So Sergeant Parry of 59 Field Company decided to go across on the launching nose and deal with this man. He lay full length on the

leading transom until it grounded and at once ran a few yards along the bank, throwing himself on the ground to take cover. When the "Spandau" opened fire he got the direction and made a dash towards the spot, firing two magazines of his Tommy gun. The "Spandau" did not fire again. Sergeant Parry returned to organize getting the launching nose on to rollers. When the job of lifting the nose on to rollers was done and the bridge moved forward again more "Spandau" bursts appeared to be coming from directly inland. Again Sergeant Parry, but this time with Sapper Halliday, decided to go after this "Spandau." They were going straight towards the direction of the "Spandau" when they heard cries to the right. On going to investigate they found two wounded men, an officer with his foot blown off by a "Schu" mine and a badly wounded sergeant. Sergeant Parry took the officer back to the bridge on his back, while Sapper Halliday and Sapper Coombs carried back the sergeant. They were the 8th Field Squadron Recce party. Sergeant Parry and Sapper Halliday then returned to shoot up the "Spandau" which they must have succeeded in doing, as the fire ceased. Sergeant Parry was awarded the Military Medal.

The bridge was built by 0400 hrs. with the last four bays decked only and the decking of the other four bays piled on the last bay as counter-weight. Every available man, plus the D4, stood round to push it into position. This required a strong push, as it was an uphill launch. All went well until, with 20 ft. to go, the bulldozer gave out completely, having seized up. Both radiator and sump had been punctured some time before. This was a major disaster, as the bridge could not be pushed by hand alone. However, we suddenly remembered the tanks. Boston went to get the leading tank and I went to the wireless set to report the delay and the action we were taking. When I got back to the site the tank had pulled the bulldozer out of the way and was slowly pushing the bridge forward. The enemy took extreme exception to this and put down a number of well-aimed mortar rounds causing several casualties. It was, therefore, decided not to bother about jacking down, but to push the bridge clean off the rollers on to the ground. It did in fact fall nicely on the base plates. But the far side still had to be jacked up to remove the plain rollers. Once this was done the launching nose was dismantled and the ramps were quickly built. I returned to the wireless set to report this excellent progress.

When the rollers were removed from the far end the bridge rested merely on the shingle bank and in fact only one of the two girders on each side was carrying the load, as it had been impossible to build a proper bank seat. The bridge was, therefore, not strictly a Class 40 bridge. However, as speed was so essential, it was decided to leave it in this condition and trust to luck. It did in fact hold up to a

squadron of tanks and considerable traffic without showing signs of failure. Two days later it was jacked up and correctly finished off.

Meanwhile, there arose a very considerable risk of the enemy staging a local counter-attack and rushing the bridge. For by this time every available sapper was working and unarmed and none were available to form a covering party. Therefore Major Gabbett, who knew the whereabouts of the infantry battalion, went off to get an infantry party as protection for the bridge. At almost exactly 0500 hrs. a runner arrived, rather breathless, from Boston to say the bridge was open. A runner was immediately sent along the road to inform the tanks that the bridge was open, and at the same time, I reported "Amazon" open to traffic to the C.R.E. At approximately 0500 hours the squadron of tanks of 17th/21st Lancers was across.

The bridge was completed, having taken close on twelve hours and the whole resources of the 4th Divisional R.E. to build it. Credit is due to Major Gabbett, for having made the plan, laid on the organization and controlled the operation throughout. Credit is also due to Lieutenant Severn of 225 Field Company, Lieutenant Hobson of 7 Field Company, and Lieutenant Boston of 59 Field Company, for their part in the actual building, which could never have been completed without their fine leadership and complete disregard of personal danger. Finally, great credit is due to a small mixed party of N.C.Os. and men from all three companies who worked unceasingly from the beginning to the end of the operation.

PERSONAL MESSAGE FROM LIEUT.-GENERAL S. C. KIRKMAN, COMMANDER 13TH CORPS, TO MAJOR-GENERAL A. D. WARD, COMMANDER 4TH DIVISION

"H.Q., 13th Corps,
18th May, 44.

"Now that Cassino has fallen to your division I would like to let you know how well I consider they have done. The assault across the Rapido was undoubtedly a most formidable undertaking, as the river, so aptly named, is swift and deep and the defences were well prepared and strong. The overrunning of the enemy's positions was a magnificent effort, the work of your Sappers on the second night was first class, and the building of the bridge which allowed you to pass over your tanks was a turning point in the battle. Each subsequent advance which you were asked to do has been quickly and successfully carried out. What has been achieved will long be remembered as a credit to the 4th Division.

(Sgd.) S. C. KIRKMAN, Lieut.-General,
Commander."

MY EXPERIENCES AS C.R.E. DIEPPE, 1939 AND 1940

By Lieut.-Colonel J. B. H. Doyle, O.B.E., R.E.

Introductory

DESPITE the Munich rehearsal the British Expeditionary Force of September, 1939, was ill prepared for war; and Works Services, though in the forefront of the expedition, held no corresponding position in the planning. Consequently improvisation and extemporization were necessary not only, as always happens in engineering, with labour and materials, but in all the details of organization and administration.

This is a constant factor in the democratic equation. My own problems and their solutions may, then, be of value. It is always easier to correct and improve than to improvise from scratch.

Early Days

The staff of No. 1 Medical Base assembled on mobilization at Crookham on Saturday, 1st September, 1939. Most of us were strangers to each other. An advance party consisting of the Base Commandant, a doctor, Colonel Gordon Wilson; his A.Q.M.G., Lieut.-Colonel Pindar, Leicestershire Regiment; his C.R.E., Lieut.-Colonel Doyle, R.E.; his A.D.M.S., Lieut.-Colonel Flood, R.A.M.C.; an R.A.S.C. captain; four clerks, including one engineer clerk; and three batmen crossed to Cherbourg on the following Monday, and reached Dieppe, by requisitioned taxis, late on Tuesday evening.

Our sealed orders, opened in mid-channel, were to prepare at Dieppe a medical base for five General Hospitals of 1,200 beds each, one of 600 beds, and two convalescent depots of 1,000 beds each. A First Key Plan was enclosed.

On the train from Aldershot to Portsmouth, which carried similar parties for all the bases and departments, the atmosphere had been that of a combined reunion of Camberley and Chatham. "Q" had found the Paymaster-in-Chief and obtained a little French money, and wads of requisition forms. C.R.E. had seen the Director of Works, Major-General Cave-Browne, and obtained general instructions to do all he could by local contract. Our stationery box when opened contained little of value, except an absence of army forms.

We were met at Dieppe by two charming and helpful French liaison officers who, at my request, produced the local head of the Ponts et Chaussées. The latter told me that there was no hope of getting any work done by local contract. All men had been mobilized, all materials requisitioned. It seemed that we must rely mainly on the adaptation of permanent buildings. So we turned hopefully to the First Key Plan.

The "Q" part of this document was excellent: docks and warehouses for the import of stores and the evacuation of wounded. But on the medical side the false assumption had been made that the bulk of the accommodation available could be used for beds. Too small an allowance had been made for staff accommodation and for such essentials as operating theatres, X-ray rooms, laboratories. The plan took no account of the engineering problems involved.

It took time to visit and consider all the hotels, châteaux, barracks, etc., suggested in the plan; and by Wednesday evening I felt badly the need of at least one extra engineer officer. As C.R.E., I had to accompany the Base Commandant and "Q" on their reconnaissance and give them technical advice, and that advice had to be based, not on engineer reconnaissance, nor on engineer intelligence previously gleaned, but tentatively, based on casual glimpses of quarries, sawmills, water towers, seen from the car window.

Luckily we were a happy team. And after the first day, by working treble shift, before and after the daily staff ride, I was able to get some engineer reconnaissance done. My engineer clerk rose to the occasion; and the other officers of the advance party helped after I had told them what to look out for and what questions to ask.

The Pourville Hotel, four miles south of Dieppe, was still full of its summer visitors, which delayed our inspection. The Base Commandant said to us; "This is nonsense, we ought to have done this inspection in peace-time, properly, visiting all the coastal towns and taking, say, six months over the job."

The A.D.M.S. caught my eye, which had wandered to the bathing pool. He added, innocently, "And trying out each bedroom?"

In a few days our Second Key Plan was evolved. No. 1 General Hospital, 1,200 beds, could be housed in permanent buildings in Dieppe; the surgical wing in the casino (the owner was reluctant to close. He had hoped for army custom, and the C.R.E had to "beat the drum" of Hirings and Requisitions), the medical wing in the large Metropole Hotel, and a V.D. section at Pourville Hotel.

Our main effort was in Offranville village, four miles to the south-east of Dieppe, on the inland hills. Here, in their first enthusiasm and relief at the presence of real British troops in France, the French

had offered us a brand new school. Shaped like an arrowhead on two floors, cookhouse and dining-room in the centre, with class-rooms on the wings, it could be made to hold some eighty " treatable beds " very soon with little engineer effort. Around it were open fields with gentle slopes. The rest of the hospital could be built round the school, tented at first, hutted later. Water was available and drainage possible. Here we planned to build two General Hospitals of 1,200 beds each; No. 2 at first, with No. 3 to follow.

Four miles east of Dieppe, in the valley at Arques La Bataille, we were given a similar school. The fields behind it were smaller and steeper. Here we placed No. 10 General Hospital, with 600 beds.

No. 1 Convalescent Depot was sited in a large house on the cliffs to the south of Dieppe. There was flat ground inland on which the tents, and later Nissen huts, for further patients, were erected, largely by the patients themselves.

For the rest we could find nothing near Dieppe. But on the coast twenty miles north, at Le Treport, there was a site which had been used in the 1914 war. A partially developed building site, with roads, water and drains and a good hotel, it had been used in that war for a hospital. After the war the owners had gone bankrupt, the hotel was left derelict, the desirable building plots left to wind and weed. This desirable property formed the nucleus for No. 5 General Hospital of 1,200 beds. This left us No. 6 General Hospital, also 1,200 beds, and No. 2 Convalescent Depot to be found sites later, probably near Le Treport.

It took the three of us, Base Commandant, "Q" and me, some days to evolve this plan. At this time we were expecting the B.E.F. to be heavily bombed during its landing and concentration, and so we planned always to have as many " treatable beds " immediately ready as possible.

Meanwhile the other half of me had to decide how to get going on this plan. I had been a peace-time C.R.E. for three years. But now, and for a fortnight until our main body arrived, I was no longer the conductor of an orchestra, but a one-man band.

It was clear that the first need would be camp structures, to supplement the very inadequate plumbing in the billets obtained by " Q " for the incoming troops. I was able to place a few small orders in the shops for buckets and canvas. But in general the town had been paralysed by the shock of war. An injection was needed.

I therefore went to the local Banque de France, introduced myself to the manager, and asked, as a start, for a credit of a million francs. I suggested that he telephone through to his head office to check my credentials, and that they should check through French G.Q.G. and British G.H.Q. Later that day the Director of

Works got through to me on the telephone. I reported the situation and the action taken, and asked him to hasten the credit.

The next morning as we were about to leave our café on our daily staff ride the bank manager came up in great glee. My credit was through. I promptly went with him to draw a cheque book ; and then drove round the few shops where I had made purchases on credit, and paid by cheque. We then went off on our ride, giving time for the great news, that the British Army were fighting the war on a cash basis, to spread round the town.

That evening I was besieged in our café by a "tender" of contractors. There was, after all, a little unmobilized man-power available, a little unrequisitioned material. I placed orders for my camp structures.

This mention of camp structures brings me to the question of security. To disguise the fact, as long as we could, that it was a medical base we were preparing, we removed our badges. To make such measures understandable and acceptable to all ranks, I had the following suggestion put around. How a good intelligence officer could, from the number of latrine seats ordered, guess the number of troops we were expecting. If he knew that our garrison was that of a medical base he could estimate the number of beds we intended to provide, and from this he could get the expected strength of the B.E.F. I think that this homely example of how intelligence works helped to make all our troops security minded.

With the help of the Dieppe Chamber of Commerce and of the regional head of the Ponts et Chaussées at Rouen I was able to find a contractor willing and able to organize the smaller men, and to act as a Term Contractor. Dieppe had its own Schedule of Prices. I found, and took on my pay roll, an elderly French surveyor who was accustomed to it. Colonel Flood, our A.D.M.S., scouting while I was working, found a local resident, a Canadian engineer. This Mr. Elliott had acted as a kind of local clerk of works to a Parisian architect, supervising the conversion of old farm buildings into luxurious seaside villas. I took him on as a Civilian Garrison Engineer, and his local knowledge, coupled with his ability, proved invaluable.

Material was more difficult. But on the third morning, prowling before breakfast round the docks, I found a yard full of Scandinavian timber. The owner was already there. I asked if all his timber had been requisitioned by the French army. He said that none had been so far, as they were going first for the cheaper local grown timber. We got down to business. The result was that later that morning my clerk took him a requisition valued at some £27,000. Later I paid cash on withdrawal, and altered the amount in the requisition to cover what was left.

Near by I found a rival but derelict timber yard. This also had a saw mill, and as it was well served by water, road and rail, I took it over for my store yard and workshop.

Sand and stone were available in small quantities from the beaches. Rouen gave me an allocation of cement. A start had been made and I could now get on with the adaptation of billets as well as with the provision of camp structures.

There were no maps, and our layout at Offranville was based on a chain survey made by a working party consisting of myself, the Base Commandant, the A.D.M.S. and two French taxi drivers. It stood the test of time. Later I found another elderly Frenchman, a cadastral surveyor, who specialized in the preparation of plans of building sites. I paid him by the job.

The Work Begins

Towards the end of September the remainder of Base H.Q. arrived. We established our H.Q. and mess in a good hotel on the front. My staff consisted at first of two Garrison Engineers, both officers of the Emergency Reserve. Major Mackintosh, M.C., took over Arques and Offranville. Captain Casswell took over Dieppe, assisted by Mr. Elliott. Le Treport had to wait another week or so when a third G.E., whose name I have forgotten, came up from Cherbourg. At that time I also received two sections of 218 Army Troops Coy. from Cherbourg, under its second-in-command, Captain Smith. One section, under Lieutenant Griggs, went to Le Treport. The other got the workshops going and erected camp structures. It served to set a standard and to check the prices of contract work. Captain Smith acted as my stores officer. He roamed over a large area to complete, by purchase, the tools of his unit and, later, of our pioneer units.

The medical units were now arriving, faster than they could be accommodated either in or near their final locations. We tried to get some of them detained in England, but failed. The need to provide temporary billets, especially for the sisters, wasted labour and materials and delayed our main objective, the rapid increase in the number of "treatable beds." All units arrived but partially equipped, with a hope that they would be able to live on the country. To prevent competitive and uncontrolled requisitioning and purchase by unit commanders, "Q" set up a special organization. He picked two good G.Ps. from an idle hospital and appointed them, one Acting Ordnance Officer, one Acting Cashier.

Units were allowed neither to requisition nor to purchase. All demands came to "Q". If Engineer Regulations were not elastic enough to cover, and "Q" approved, Ordnance purchased, Cashier paid and accounted. "Q" now had his own imprest

account. In due course this improvised system of accounting was scrutinized by the authorities, who only started to function some three or four months later, and was passed with very little questioning.

Every morning the Base Commandant, "Q" and C.R.E. had a ten-minute conference. In general we three were delighted to be in the position, so often dreamed of by the self-styled "practical man," of being free of telephones, red tape and army forms, of having a job to do and being left alone to do it. And I do not think we abused the responsibilities that we assumed.

For my part, every order was written in triplicate, in dubious French. It included either a fixed price, or an agreed method of fixing the price. The contractor got one copy, eventually exchanged for his cheque. The G.E. kept one copy till complete. The third copy came to me for vetting, and entry by my Finance Clerk into our accounts. These took the form of a cut-back book, with a vertical column for each order, the legend at the side giving line by line the complete history of each job. From time to time I was threatened with the imposition of some form of peace-time accounting, and cancellation of my imprest account. Luckily the necessary army forms were never forthcoming. Quick payment on completion turned the local wheels of industry. I think that the usual system of long scrutiny of bills before payment, by sundry higher echelons, would have destroyed confidence and delayed the work.

I find it easier to remember the first few weeks at Dieppe than the rest of the six months that we spent there, and I have not had access to my war diary.

A Surveyor of Works, Captain Goddard, came from the D.W. to help me get going on larger local contracts. Later a Lieutenant Cogan came to me full time.

Major Postlethwaite came as my assistant, and took on the detailed planning of our camps, as well as relieving me of office work. Major Lees came as my E. and M. officer, and took on the problems of water supply and drainage.

Other services were also increasing their staffs. I was soon relieved of hiring and requisitioning duties. The R.A.S.C. got transport organized. The first three Pioneer Companies, then A.M.P.S., came directly under my command, and I had to share out their labour with other services, but later they got their own commander.

Looking back, the work seems to have fallen into stages, although in practice these merged into one another. With T.C. work No. 1 General Hospital was soon fully deployed in Dieppe. No. 2 opened with eighty beds in the Offranville school, and set up on a fully tented basis outside it. A local contractor started hutting in the

playground. No. 3 was "grounded," but a scheme for tenting it was prepared, and put into operation later. At Arques, No. 10 opened up in the school. I placed a large local contract for the erection of standard huts in its playground and in the fields behind.

At Le Treport, No. 5 opened in tents, but soon moved into the hotel and the few villas which had been built before 1914. Lieutenant Griggs was the son of Griggs & Son, London contractors, and did great work on the hotel and its services.

At this time there were no Nissen huts. We were working on plans designed by Major-General G. B. O. Taylor for "Standard Huts." In this design the components of the trusses could be steel or timber, and were pin jointed to form trusses of three different spans. Trusses were at 12-ft. centres.

Unfortunately these plans had been used to house the militia in the spring of 1939. The political conditions then ruling had resulted in every plan becoming a special one, none standard. The drawings were liberally sprinkled with W.Cs. and other conveniences inimical to rapid construction.

As Base Headquarters now included a large staff of consultant specialists, we arranged for a local design committee on which they served. The Base Commandant took the chair, and I served as secretary. This committee simplified and finalized these far from standard plans. We worked on the queue system. Each item, operating theatre, X-ray room, laboratory, etc., came up in turn and was considered in all its aspects before approval. But then there could be no afterthoughts or alterations as long as there was anything else in the queue. We worked to the old motto, "The best is the enemy of the good."

Material for the skin and partitions of these huts varied from timber, wall board, bricks, concrete blocks, to hollow tiles, depending on local resources. We soon found that we could economize by reducing bays from 12 to 11 ft., the latter determined by spacing of ward beds.

About this time I was contacted by a Mr. Reid of Rouen. He had stayed there after the 1914 war, and built up a small business designing and manufacturing portable steel hutting for use in the French Colonies. He raised a small gang of British ex-service men and undertook a small contract for the erection of "Reid" huts at Offranville and Arques. I used them to supplement the tented hospitals by basic accommodation such as operating theatres, X-ray rooms and laboratories.

There was an amusing sequel to this contract. Reid escaped to England before I could settle his bill. In the busy summer of 1941 I was asked, through Finance Branch, whether the huts which he had built at Arques were 12-ft. or 11-ft. bays. I replied to the best of

my memory, told where our records had been sent ; and then, the Irish half of me rising over the English, suggested that if that information was insufficient, the question be referred to the Commandos. I was interested, when reading the official account of the raid on Dieppe, to see that the objective had been Arques La Bataille.

Meanwhile it had become clear that the tented hospitals would have to function as such throughout the winter ; and, to our regret, we had to divert engineer effort from our permanent task to making these temporary hospitals snug. I provided floor boards, miles of duckboard, stoves and improvements to cook and ablution shelters. Few electricians were available and so I purchased a large supply of portable gas cylinders and fittings. These gave good light in four to five centres per hospital, and supplied gas rings to each ward annexe. I may add here that the main R.E. Stores organization did not start to function till early 1940 and meanwhile I had to buy locally.

Our greatest difficulty was the disposal of sullage water. The soil at Offranville consisted of some hundred feet of clay on top of chalk. Normally the rain settled through the clay into the chalk, and there were no natural ditches or streams. Despite grease traps sumps soon became watertight and overflowed ; and eventually we had to provide *épuisards*—inverted wells bored and lined with pre-cast concrete rings, down into the chalk.

Supplementing Local Resources

A good start had been made in the first two or three months, but it became clear that with local labour and the military labour then available we could not hope to complete our task for a very long period. It was necessary either to bring in a very large contractor, who could import labour, which was beyond my powers : or to provide more military labour. The latter would have to start by providing its own accommodation.

The Director of Works at first tried solution by contract, and much preliminary work was done. Then one evening I was informed by telephone by a member of his staff that the proposed contract had fallen through. No alternative solution was proposed and so I had to report the impasse to my Base Commandant. He took the matter up strongly with G.H.Q. through the A.G. I do not of course know what happened at that level. But the upshot was that more Engineer and Pioneer units came to Dieppe ; a supply of 24-ft. Nissen huts became available ; and the D.W. placed a large cost plus contract with an important Parisian contractor for the bulk of the work at Offranville.

Looking back on this incident, I think that the trouble was due

to the reluctance of experienced senior officers of the Corps to become responsible for cost plus contracts, with all their potential of high cost and fraud. On the other hand I do not see how, in an emergency, such contracts can be avoided. I believe that the Government would be well advised, if in fact it has not already done so, to appoint a committee to examine the whole question: to obtain details of contracts where waste and fraud did occur: and to see if by improved organization and administration, the risks inherent in such contracts cannot be considerably reduced.

In Edinburgh in 1938–9, in Dieppe in 1940, in North Ireland in 1940–1 I was responsible for many such contracts; I carried them through without, as far as I know, any scandal. In each case I insisted on having a resident engineer on the site, with a considerable clerical staff. He had to keep daily accounts of the labour, materials and plant used, and agree his figures daily with the contractor. Disagreed figures went into a suspense account, which we tried to clear weekly.

The Dieppe situation was now eased, and the situation between late December, 1939, and April, 1940, became as follows:—

Dieppe

H.Q. in hotel.
Many services and troops in billets.
No. 1 General Hospital with 1,200 beds in Casino and Hôtel Metropole.
No. 1 Convalescent Depot with 1,000 beds in billets and 16-ft. Nissens.
Medical stores and medical embarkation at docks.
H.Q. and 1 Section 218 A.T. Coy. R.E.

Arques

No. 10 General Hospital in school. Huts going up to complete to 600 beds by local contract.

Offranville

No. 2 General Hospital in school and tents. Huts going up under main contract. This included roads, water, and sewage for both hospitals.
No. 3 General Hospital in tents. Nissen huts going up with two sections of 685 Artisan Works Coy.
One section of 218 A.T. Coy. on camps and billets.

Le Treport

No. 5 General Hospital with 1,200 beds in hotel. Personnel and many other extras in 16-ft. Nissens.
One section 218 Army Troops Coy.

Floques (4 miles south of Le Treport)

No. 6 General Hospital. 1,200 beds in tents. 24-ft. Nissens going up.

583 Artisan Works Coy. R.E.

No. 2 Convalencent Depot. Hutting just beginning in April. Same unit.

The general plan of the main contract provided a central road with water and drainage, huts on one side, tents on the other. The huts were taken into use as completed and before mains were connected. The D.W. had found in Paris a French-speaking, English quantity surveyor who lived on the site. I also had a G.E. living in Offranville. The work proceeded slowly owing to shortage of material and man-power, but the craftsmanship was good.

The Nissen hospital huts gave us a lot of trouble owing to their large floor area. We had no bulldozers, and wood floors were not allowed. We had a continual struggle to find supplies of brick aggregate and sand, and sometimes had to work small quarries. Also the whole work was delayed by the hard winter of 1939/40. At one time we were erecting hospital marquees over our sites and warming them with stoves in order to concrete. Time and progress reports proved an invaluable aid to our planning and to our pushing on the work.

The sappers were enthusiastic ; and great was the joy of the Press, on a visit to the Medical Base, to find a sapper using ten centime coins from his pocket as washers, rather than lose time searching for those dropped in the mud.

One distraction from our main objective was the need to provide for passive air defence. Much good brick went into marking out red crosses on the ground. A young G.P. was found in one of the "grounded" hospitals who had had some previous training as an engineer, and he was appointed P.A.D. Officer, directly under "Q". This relieved me of the burden of thinking about this work. His schemes were excellent and stood up well to the tests that came later.

My engineer units were doing a little training : one hour every morning, and the whole of Saturday morning. The Mayor of Le Treport took official objection to their arms drill in his square, on the grounds that it was a non-combatant area—shadows of things to come. It occurred to me that air attack might necessitate further intentional demolition and I applied to my Chief Engineer, now interposed between me and the D.W., for the necessary supplies for demolition training. His reply was brusque. What did I think I was playing at? Get on with my job.

My next communication from the Chief Engineer was an order

to prepare certain bridges for demolition. Of course they managed to do it. Perhaps there had been some friendly barter with a near-by Ordnance Depot.

Transition From a Works to a War Footing

When the war really started it took us some time to realize how much we were involved ; that we were not covered by an impregnable front line of trenches ; that we were, in fact, responsible for our own defence. We had no garrison troops, and it soon became clear that the French had none either. All the many rumours from miles around of parachutes, sabotage, sniping, and suspicious characters came to us for action.

The Base Commandant was a doctor. Lieut.-Colonel Pindar, our "Q", had retired shortly before the war and so was my junior. I became "Senior Combatant Officer" and—more important—Pindar continued as "Q" and did amazing work, converting us from a works to a war footing.

Each locality, Dieppe, Offranville, Arques, Le Treport, organized its local defence, and made up a mobile column out of Sappers, R.A.S.C. and Pioneers. Road blocks were constructed and manned. We obtained weapons from Ordnance at Havre, ammunition and explosives from Ordnance at Forges Les Eaux.

Construction work slowed down, and then stopped, as civilian contractors and their workmen vanished. We paid off as many as we could find in time, and here our improvised accounting system was invaluable. I soon handed over my duties as C.R.E. to Major Lees. My position was anomalous, as Dieppe was still, in theory, a non-combatant area, protected by the Hague Convention, and until I left I carried in my pocket orders from the Base Commandant that I was to use such force as might be necessary to protect the sick and wounded in the Base.

The military situation deteriorated. The Germans had broken through to the coast on the Somme, 40 miles to our north. There were some light French troops between us. It is clear now that the Germans contented themselves for a while with bridgeheads over the Somme, until our main B.E.F. had been evacuated. We did our best by converting our mobile columns into active fighting patrols to give an appearance of reality to our hope that there was something more collecting behind us.

These patrols were even more successful in finding our own troops than the enemy. Two T.A. divisions of the second line had been sent to France, untrained and unequipped, to supplement the labour corps. With the front line broken, they were sent up to block the gap, but were bombed out of their trains around Amiens and Abbeville. Our patrols encountered odd units, without ammunition,

boots or food. We used our works transport to bring them into Dieppe and to regroup and equip them. We collected a brigade of three battalions in this way ; and deployed them to hold the Dieppe river crossings as a stop line. The bridges were now ready for demolition. Meanwhile the 51st Division, switched over from the Maginot Line, passed through us to contain, and later attack, the Somme bridgeheads.

Dieppe was bombed, first with magnetic mines to close the harbour, and then with high explosive on the harbour and the town. A hospital ship was hit in its berth. The P.A.D. organization worked well, but we could take little active action against the dive bombers. However, whether the enemy's aim or information was bad, the sheds round the docks which held our stores and supplies were undamaged.

Colonel Gordon Wilson was able to evacuate all his hospitals and medical stores safely to the south. Captain Griggs went with them, from Le Treport, as Works Officer.

The orders regarding demolition followed the usual traffic light system : STOP—WAIT—GO. At the very beginning one of my reconnaissance officers failed to return, and I heard that he had been arrested by the French, for " tampering with dock installations." I then remembered that there was in the town a French major, in charge of two machine-gun posts on the cliffs. As his senior, I sent for him. He produced written orders from his commander that no action whatever was to be taken regarding demolitions. I produced my contradictory orders. We agreed to take copies of each other's orders, and to send them upwards for clarification. Luckily that very afternoon the gallant major heard a rumour that German tanks were immediately advancing on the town ; and, orders or no orders, begged me to destroy all the bridges forthwith. That gave me the controls that I needed. The harbour bridges were swing bridges, controlled from the south bank.

Towards the end of May I was ordered to hand over the brigade I had collected to a newly arrived brigadier and staff with Norwegian experience ; and to go to Rouen to take over C.E., L. of C. North. The C.E. was acting as D.W. as Major-General Cave-Browne had been in Boulogne when the break-through occurred, and his present position was unknown.

ROUEN

Rouen was a district commanded by Major-General Beauman. It contained many reinforcement camps and other base installations. The general was organizing a mock-up division, one brigade of infantry on the left, the brigade which I had collected ; a brigade of pioneers in the centre, and a brigade of miscellaneous reinforce-

ments on the right. He later obtained one battalion of infantry, held in Rouen as a reserve. He had one battery, R.A., and a section of A.A. guns. The services were to all intents and purposes non-existent.

Two works Cs.R.E. met at Rouen, Lieut.-Colonel Alms to the north, Lieut.-Colonel White to the south. Four Artisan Works Companies and one Army Troops Company (218), were spread along 60 miles of river, Dieppe to Forges Les Eaux, then a 2-mile gap, and then along a tributary of the Seine running from near Forges and joining the Seine some six miles up stream of Rouen. The sappers had prepared the bridges, some eighty of them, for demolition, with A.T. mines in the Forges gap, and were standing by to blow. They were backed, more or less, by a skeleton of infantry.

Reorganization was necessary. As the senior I took on C.R.E. to Beauman Division, with 218 A.T. and three Artisan Works Companies. Lieut.-Colonel Alms with the fourth A.W. Company took on responsibility for the ferries which ran across the Seine below the Rouen bridges. He kept them running until the last minute and saw that they did not fall into enemy hands. Lieut.-Colonel White went south to clear up the works situation.

I spent about ten days in Rouen. I kept three A.W. Companies in the line and withdrew 218 A.T. Company to Rouen to make road blocks of pine logs and mines around the town. All the companies made up their transport from depots and from civilian vehicles abandoned on the road-side for lack of petrol. With the Works organization to draw on I was able to build up a strong personal staff. Major Lees became my transport officer. I also had an adjutant, a stores officer, and two liaison officers. We all had cars and drivers and I also had two lorries for office staff and equipment. The principal item in the latter was a sun printing outfit. It proved invaluable as we soon ran off our maps, once we started to retire, and had to take copies of anything we could obtain such as Michelin maps or even guide book maps. Most important, I built up a D.R. service of my own, each company keeping two D.Rs. at my H.Q. and sending reliefs, when their H.Q. changed, to inform me of their new location.

Beauman Division

We were fortunate in having these few days for reorganization, but the end was approaching. A German plane was shot down over the town and in it was a map, marked to show two Panzer and one motorized division heading for the Forges gap. We had the consolation that they seemed to be two days behind their programme. At last about 3 a.m. one day I got the expected order to blow, and to withdraw my companies to R.Vs. south of the Seine.

Divisional H.Q. remained in Rouen till about 2 p.m. the following day, by which time I had received reports from my units that all was well. Only one unimportant bridge had failed to go.

Then our improvised Divisional H.Q. started its trek to the south, through congested refugee traffic. We had about twenty D.Rs. to help with traffic control and to act as connecting files, but it was slow work forcing our way through, and sometimes across, the crowd. We heard later that at the time we were leaving a heavy German tank came down the main Amiens–Rouen road, stepped on a mine in our road block, and neatly corked the bottle. The reserve battalion was able to hold that block for a vital two hours before withdrawing.

We spent the night in woods to the south of the Seine, surrounded by remnants of the 1st Armoured Division. They, and the 51st, had been the only effective part of the great French counter-attack on the Somme bridgeheads. The armour had suffered heavily and from now on our task was to cover its withdrawal. We woke early to the news that the French had failed to carry out their undertaking to destroy the Seine bridges, and the enemy were across. We shifted our line of retreat from southwards to westwards.

The artillery and the engineers, being mobile, were the only troops in hand ; and I was ordered to take up a position with them along a river running south from Evreux, and to hold it as infantry. Other members of our staff went out to try to contact our "real" infantry and to guide it back to these new locations. Divisional H.Q. moved back to a château some six miles from the centre of our new position.

On looking back over the events of the next few days, I believe that the Germans changed their tactics on crossing the Seine. Their previous policy had been to locate enemy strength and to annihilate it. It was now to discover and exploit weakness. Only thus, and thanks to the inherent discipline of the Englishman, however badly trained, can I explain how Beauman Division survived as a coherent force. Public schools try to train all their output as "leaders." The ordinary Englishman is a marvellous "backer up" and, in a crisis, will follow anyone who gives him a common-sense lead.

The infantry had various skirmishes, but in two days were located and led back to take over and extend my line. The sappers reverted to what had become their stock rôle of demolitions, mines, and road blocks. The acting D.W. kept me well informed of sources of supply of defence stores of all kinds, and I never ran short, and I was again able to withdraw one of my four companies into reserve.

I sent one of my liaison officers to discover what troops, if any, there were on my right. There were some French troops on our left. He found the 52nd Lowland Division coming up into position, recently arrived from home, but without their engineers. They

knew me of old as I had been, till September, 1939, C.R.E. Lowland Area, and they appealed for help. I obtained my General's permission to detach to them my reserve company, again 218 Coy.

I heard later that when this unit reported to the front brigade a hostile enveloping attack was imminent. The sappers naturally wanted to join in the battle. But while C.R.E Works I had attended all the divisional T.E.W.T.S. and week-end exercises, and had been given several opportunities to lecture on the proper use of divisional engineers. I had emphasized the time required for engineers to develop their full potentiality. In the event the Brigadier considered that he could handle the situation with his own resources. He sent a very sad company back to me, with his thanks, and quoting my lectures. He said he hoped to find something ready for him at the next stop.

On the night of 17th/18th June we made another sudden withdrawal, to the river running south from Caen. We handed over our previous line to French troops, leaving, to the great regret of my sappers, the bridges unblown. Our task on the new line was again demolition.

About midday on 19th June I was ordered to blow those bridges and to withdraw all my troops to Cherbourg. There I was to ground the sappers and dump the stores ; sending back all my transport to various rendezvous to meet and embus the infantry.

I issued the necessary orders and motored to Cherbourg to arrange these moves.

The narrow and hilly streets of the town were a traffic policeman's nightmare. Remnants of the 1st Armoured Division were making for the docks, the transport of 52nd Division was coming out. At Base H.Q. I found no clear appreciation of the situation. Plans for next week, next month, and not the next few hours seemed to be occupying the minds of the staff. With some difficulty I was able to make the necessary arrangements for traffic control, for housing and feeding my men, and for dumping stores. I then returned first to report on the situation at the Base to my General and then to meet and lead in my companies. My transport, drivers fed and slightly rested, eventually left Cherbourg to pick up the infantry about 2 a.m. on 20th June.

A few hours later I got my sappers working, on plans prepared by the local D.C.R.E., on the defences of Cherbourg. The map production unit set up shop. By noon I reported back to my General at his H.Q., now some forty miles east of the Cotentin isthmus.

He wanted me to prepare another demolition line along that isthmus, but for the first time I was stumped. My men were grounded in Cherbourg, my drivers would require rest. I could not get on to the ground before 9 p.m. that night. At that moment his

telephone rang. I learnt afterwards that he was then informed of Marshal Petain's surrender. He cancelled my orders. Instead, we were all ordered back to Cherbourg. Here one of my companies was put on to the task of blocking roads by smashing up the jammed and abandoned transport of the civilian refugees.

The three G.Os.C., 52nd, 1st Armoured, Beauman and the Base Commandant Cherbourg met for a conference. Beauman was the senior. He got through to the War Office on the telephone, and was ordered to embark that evening.

All the tanks and guns were embarked, and all the personnel except the transport personnel. The latter with a rear party were taken off by destroyer the next day, but the transport had to be driven into the harbour.

On the afternoon of 20th June, the French troops, jubilant at the conclusion of their war, had downed tools and hauled down the barrage balloons. But the French admiral in command got them back to their duty again, until his allies were clear. Our embarkation was undisturbed.

On 21st June, we were sorted out into units in the sheds at Southampton. We were then broken up and sent to various reception depots. The engineer units went to Halifax. I went to London with Divisional H.Q. We wrote up our war diaries and then disbanded.

I sent a note on the "Lessons learnt" to the Engineer-in-Chief. I have no copy, but would now say that these were as follows :—

1. All engineer units must be trained in fieldworks, at least in those required in the defence.
2. The training which a works officer can obtain in peace by attendance at T.E.W.T.S. is of great value.
3. All engineer units should be able to move more quickly than the units they serve. Only thus can they gain the time required for their work.
4. Divisional engineers should be self-contained as regards communication.
5. A division should be able to reproduce its own maps.
6. The C.R.E. requires a large staff.
7. His most important liaison is with Intelligence. He must know the picture, as his General will see it, before he goes in to see his General.

VERTIGO

By "D.W."

IT is for several reasons desirable not to disclose the exact whereabouts of this suspension bridge at present. The reader is asked to accept the photograph accompanying this story as evidence of its veracity.

The gap to be bridged was one of a type not often encountered. A torrent, varying in depth through the year from fifteen to thirty feet, rushed through a gorge at not less than fifteen knots. The sides of the gorge were vertical rock cliffs, nowhere less than 220 feet apart, the near cliff being about twenty feet higher than the far one. At normal water level, the water flowed some sixty feet below the near edge.

On the home bank, a steep hillside rose almost straight from the brink of the cliff, but at one place a flat shelf of rock, 30 ft. wide, offered the only possible site for a bridge abutment. The far bank presented a better proposition. There, at the top of the cliff, was a wide, fairly flat area of rock, running back about sixty feet, before the foot of the hill was reached.

A short way up stream of the gorge a ferry plied as long as the crossing was merely highly dangerous. It stopped working when conditions became worse than this. The locals said that it claimed its toll of drowned travellers every year.

In the territory on the far side of the river there was starvation, while on the near side a record crop was just about to be harvested. The ferry carried refugees in extreme stages of under-nourishment in one direction, and in the other, emaciated porters with bundles of grain on their heads. In a month from the date of the "recce" the water would rise to its maximum level, and the small trickle of grain going across would cease. It was this fact, more than the rather half-hearted strategic requirement for the bridge, which led to its inception and completion.

The nature of the site and the short time available excluded the possibility of building any other type of bridge there but a suspension bridge. The lack of space for anchorages on the near bank suggested the rather unorthodox suspension from a partly loaded cable. So out came the old bridge manual, and there, sure enough, was the whole thing, section so-and-so, page so-and-so and plate so-and-so.

It was necessary first of all to find what shape the cables would take. The book showed clearly how to do this graphically. The relative position of the bank seats (in this case the edges of the cliff) and the two points of support of the cables had to be fixed. One of the latter was chosen on the ground, and the other by juggling with parabolas on a section of levels. It was not until the bridge had been completely designed from a certified accurate section of levels, that a mistake of 50 ft. was discovered in the horizontal measurement. Fortunately, another mistake in the readings for height counterbalanced this, and the designer, Muggins by name (very busy just then), stuck to his parabola.

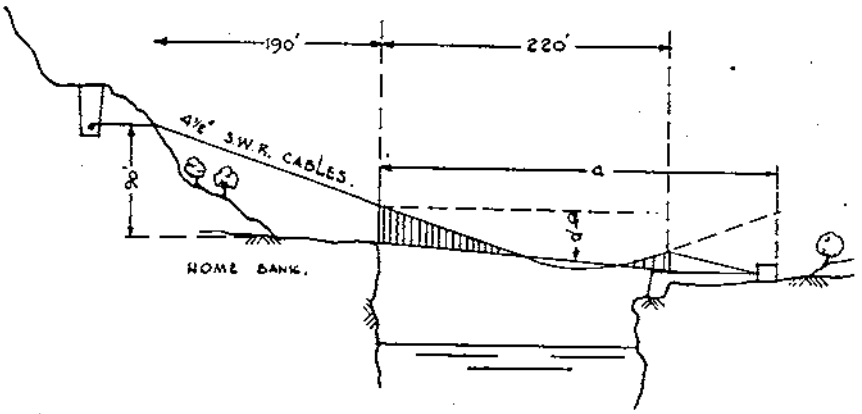
At this point, in order to explain things which the reader may otherwise find inexcusable, it is worth mentioning that the bridge was at a very remote place. True, a road was slowly creeping towards it, but during all the preliminaries, the final four miles of approach had to be made on foot with a descent of about a thousand feet intervening. Moreover, officers were few, and a visit by an officer once a week was all that could be expected. Of necessity, therefore, almost all the work was supervised by the J.C.Os. (Junior Commissioned Officers), direct descendants in the line N.O. (Native Officer), I.O. (Indian Officer) and V.C.O. (Viceroy's Commissioned Officer), and the measurements were made by them.

The ferry was a poor way of getting stores across for work on the far bank. The gap provided a classic opportunity for the use of a light field ropeway. So Jemadar "X" was sent off with a coil of steel wire rope, and his finger marking the relevant plate in the manual, with instructions to make what was depicted thereon. Very soon news came back that the "traveller" (as the ropeway was always subsequently called) was ready for inspection.

Now the designer, who was a man of poor nerve where heights are concerned, had never contemplated crossing by the "traveller" himself. But when he arrived at the site of the work, he was told that the ferry had been sunk while crossing during a flood a few days before. Fourteen refugees had been drowned, and a sapper Naik who had been in the boat, had climbed out of the water about half a mile down stream. Government had only lost one shovel, with which the Naik had reluctantly parted company during his involuntary immersion.

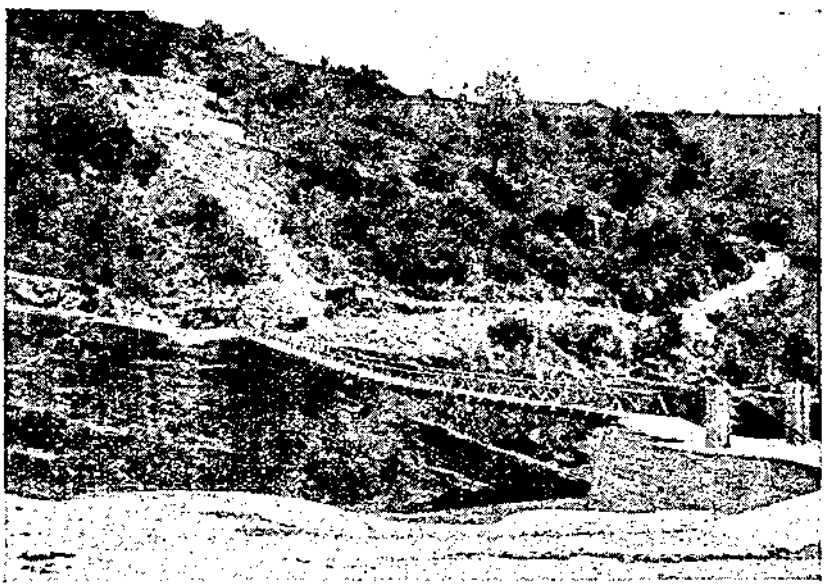
This news disturbed Muggins greatly. The sight of Jemadar "X" crossing the fearsome gap from the far bank on the "traveller" did not improve matters. It consisted at the time of a few pick helves lashed together hanging from a single block. On being invited to go across, therefore, with the assurance that the contraption was quite safe, he demurred, but further entangled himself by undertaking to cross when the proper cradle, then under construction, had replaced the pick helves.

AS PLANNED.



a (EQUIVALENT SPAN) = 320'
d (DIP) = 30'

AS MADE.



He was indeed well and truly trapped, "hoist with his own petard," and faced, he imagined, with a premature descent from a cradle of his own design, to a grave for which as yet he had made no plans. He could not build the bridge by shouting directions across the river, nor could he now honourably withdraw from the project. A second ferry in operation about three miles down stream offered the only faint ray of hope.

On his next visit after a restless night spent shuddering on the edge of a precipice, or tight rope-walking across Regent Street, he walked down towards the work with sinking heart and lagging steps. When just about to dart off towards the distant ferry, he was intercepted by Jemadar "X."

"Salaam Sahib! the 'traveller' is ready and the cradle fixed. Now only the old women are afraid to cross."

There was no hope left!

On the way down to the cliff edge it became apparent that all was not well with the home bank anchorage. When the would-be bridge builder was confronted with his own sketch, he saw why. This anchorage was to be the buried type with the cables well spread, the sketch was that of the far bank which was a masonry block with the cables fairly close together. A "major nonsense" had occurred as the excavation was fairly far advanced. The force of the mental and verbal explosion which followed the discovery drove away vertigo, and only subsided when the inspecting officer stepped out of the cradle on to the far bank.

As he mopped his brow and wiped his damp hands on the seat of his shorts, his place in the cradle was eagerly taken by two old crones with a small child, a goat and a chicken.

The import of the "traveller" was soon realized by the locals. The refugees and grain porters from then on made good use of it. Jemadar "X," who had his bright moments, used to charge them toll for crossing. Before being eligible for a seat in the cradle, each man had to bring either a sandbag full of sand, or twenty boulders to the site of the work. It was a small charge as both stone and sand were quite near. A check on passengers showed that about a hundred men and women (apart from troops), and about eighty maunds of grain passed over in a day. Eighty maunds of grain: enough to keep about 10,000 people alive for a day! The "traveller" was in constant use for about six weeks. It must have carried a major part of the food of all the starving thousands in the valley across the river.

As for the vertigo, it never returned. A trip across the "traveller" became a matter of routine, albeit always carrying with it a twinge of excitement.

The bridge itself, the designer hoped, was but to be the embryo

of something bigger and better to come. He had just been faced with the problem of making another, existing, suspension bridge stronger and stronger to take ever-increasing load classes. So the " partially-loaded cable " bridge was given anchorages capable of taking five times the load to be placed upon them presently. The towers on the far bank were placed far enough apart to allow the widest known military vehicle to pass. Unfortunately fate and Jemadar " X " intervened again in the design. This time it was the cables. They were of 4½-in. steel wire rope, and with the proposed parabola it would have been possible to make a Class 5 bridge using a single steel wire rope on each side.

One day a drum with the cable on it arrived at Jemadar " X's " camp. He took it off the lorry, but then found he wanted to move it from point A to point B. He had not many men available to manhandle it, so he started to nose it along with an angledozer. The drum collapsed under this treatment, and the freed coils broke loose and sportively tied themselves into knots.

As Jemadar " X " put it " Sab out of control hogia."

The knots would not respond to gentle treatment, so he found the two ends of the cable and attached each to a truck. Then he ordered the drivers to drive away from each other in bottom gear. When Muggins next came he took a look at the maltreated steel wire rope and sadly carried his sketches home and changed the design to the " one jeep and trailer, one loaded camel, four bullocks or cows and twenty donkeys " class.

In order to give this story a technical flavour the following suggestions are, with diffidence, put forward.

It saves time and trouble to fix the slings to the cables before pulling them across. In Muggins's bridge this was done by first placing a length of 3-in. cordage between the anchorages, and marking on it the position of the first sling. Incidentally, this also gave an approximate check for the length of this sling which had previously been calculated. The position of the remaining slings was then marked off on the cable and the slings, of calculated length, were fixed in safety, on the bank.

At least one of the books says that a suspension bridge should be cambered in its length. Surely the arch effect of camber in a long suspension bridge is negligible? Besides, is it not of prime importance to have the dip in the cables as great as possible, so as to reduce as far as possible the strain imposed on them, by the weight of the bridge? In fact, at the lowest point of the cable, should it not always be below the transoms? Camber in a bridge shows that the cables have been raised above the lowest level at which they could have been, and so are a little more strained than is absolutely necessary.

Handrails are usually relied upon to stiffen the bridge. In fact the manual again makes a point of this. In practice, in a timber suspension bridge, after a few weeks of use wooden handrails always loosen up. Their stiffening effect is very soon lost. It is suggested that a better way of stiffening the bridge (which is not advocated in the book) is to stagger the road bearers at half their length, so that all in one cross section do not have their ends on the same transom. If the bridge is stiffened this way, then the handrails can be made very light. This helps to ease the main problem of a suspension bridge, which is that of making the bridge parts themselves as light as possible.

These suggestions are, of course, only meant to apply to semi-permanent suspension bridges, made in the field mainly out of timber, and the sag apparent in the bridge in the photograph is not an aggressive attempt to demonstrate them. That was only Jemadar "X."

A MODERN STEELWORK DESIGN

By MAJOR B. S. JARVIS, M.C., R.E.

INTRODUCTION

ONE of the largest tasks set to the Works Services this year is the building of numerous storage depots to hold the vehicles and stores being produced under the rearmament programme. Whereas stores were turned over quickly during the war they must now be kept under cover for an indefinite time. The bulk of the work consequently takes the form of vast, lightly-clad sheds of two standard shapes, one 48 ft. between columns and 12 ft. 6 in. high (for vehicles) and the other 60 ft. between columns and 18 ft. 6 in. high (for stores). Appreciating the coming steel shortage and the trend of all engineering design to pass from empirical to scientific methods, the D.F.W. directed that the best brains in the country be engaged on producing the most economical design for the steelwork and the aim of this article is to tell, without going too far into technical detail, how the design was evolved.

Approach

The two standard "conventional" designs (truss and column), now already committed to the first contracts, had been very carefully worked out at the War Office, to the extent of obtaining a 15 per cent saving in steel over all other known truss designs, and it was realized that some entirely new approach would be necessary if any greater economy were to be achieved. Two courses were considered: first, to erect a section of the shedding to the War Office design and set the engineers of the Building Research Station to work on load tests, to see if any members could be pared down and whether any "latent" strength were developed in practice: second, to submit the requirement to Professor J. F. Baker, professor of mechanical sciences at Cambridge University and an eminent consultant and structural engineer, who, after some twenty years' work, presented his paper on "plastic" designs and tests to the Institution of Structural Engineers only last year.

On further considering the B.R.S. practical test method, it soon became evident that the contractual negotiations and labour difficulties would be so lengthy that the revised design, if any, would not be ready in time for any but the last few of the depots. It was, therefore, decided to drop this investigation and concentrate on the Cambridge method as far as steelwork was concerned, but to investigate independently alternative methods of construction, such as pre-stressed concrete or barrel vaulting, in case the supply of steel sections dried up completely. It is well known, however, that steel framing is the quickest and cheapest way of providing covered storage in this country.

The Cambridge Design

It has long been appreciated that the assumptions made in normal framework designs are erroneous, and that if a mild steel member is stressed beyond the elastic limit re-distribution of stress occurs so that other parts of the frame take up a fairer share of the load. The "plastic" design takes into account this property of steel, and extensive miniature and full-size tests on rectangular portal frames over the last few years have verified beyond all doubt the calculations used. As the relation between stress and load is non-linear, safety is obtained by working to a "load-factor," or fraction of the load which would cause collapse. Needless to say, the calculations are at present beyond the powers of workaday drawing offices, but in time the method will simplify some of the more complex analyses based on the elastic theory and the process is certainly more rational.

The first investigations by Professor Baker's team on the War Office shed design were made into a simple pitched roof portal

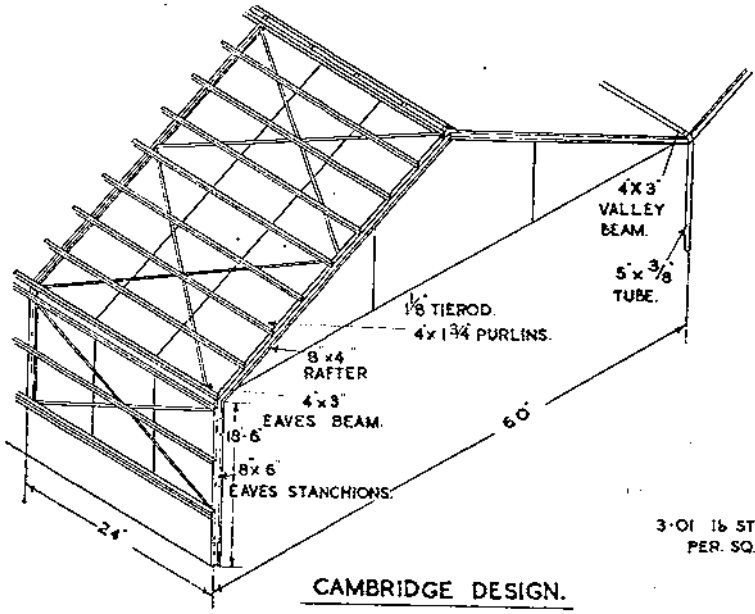
frame of 48 ft. span. Calculations based on a load-factor of 1.75 produced frames of 9 × 4 in. R.S.J's. at the optimum spacing of 26 ft. The saving in steel over the War Office design was not great, after amendments had been made to the purlin designs on account of lateral deflection, being of the order of 10 per cent and further investigations revealed certain disadvantages in this type of structure. The limiting factor was the resistance of the end bays to collapse and it was felt that if a shed were subsequently enlarged beyond the normal seven to eight bays, trouble might be encountered at the end stanchions due to the spread of the eaves. A more satisfactory solution was obtained by introducing a light tie at eaves level, as shown in the sketch. This produced a marked reduction in the rafter spread and, as the bays would now reach their limits simultaneously, considerable economy was achieved. The rafter joists were reduced to 6 × 3 in. R.S.Js. with only a 2-ft. reduction in the frame spacing. As this form of structure had not been previously designed by the plastic method, calculations were made for every possible form of failure under all the accepted combinations of loading (including snow) and in no case did the load-factor fall below the permissible value. The final saving in steel on the 48-ft. span shed, excluding doors and end bracing, which are common to both designs, was 28 per cent (2.46 as opposed to 3.43 lb. per sq. ft. of floor area).

The design of the 60-ft. bay was now tackled on the same lines and the even more spectacular saving of 34 per cent was obtained, chiefly because the heavy valley beams essential to the War Office arrangement were unnecessary in the Cambridge design. The table on page 327 gives the comparative weights of steel used and the sketch shows the arrangements of the two designs. To get an idea of the extent of the saving, it should be appreciated that even a good reinforced concrete design would require about 3–4½ lb. of steel per sq. ft. Only pre-stressing would produce a figure below this amount and the constructional and haulage difficulties involved are only too well known.

Practical Considerations

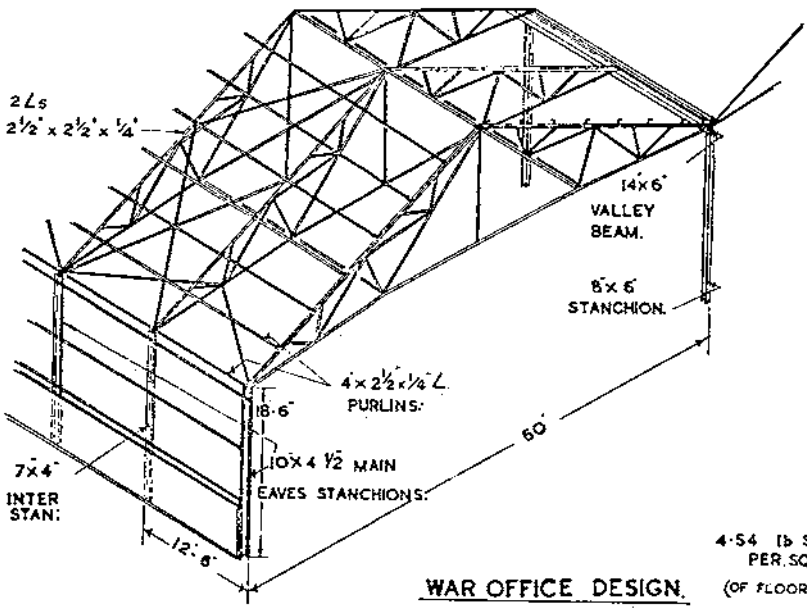
No one can doubt that Professor Baker's work is an epic, but other considerations apart from the basic design are very important.

The preparation of detailed drawings for contract purposes was no mean task and the sequence of erection, ease of welding, fitting of roof-lights and doors and, above all, the ensurance of full continuity at all joints had to be considered throughout. The credit for this part of the work goes to the D.F.W's. Chief Designer, Mr. R. P. Haines who, incidentally, designed the Marston Shed during the war.



3·01 lb STEEL
PER. SQ. FT.

CAMBRIDGE DESIGN.



4·54 lb STEEL
PER. SQ. FT.
(OF FLOOR AREA)

WAR OFFICE DESIGN.

The attitude of the contractors had to be considered and although the reaction of the steelwork industry to any change from the traditional bolted or riveted connections is being overcome, the possibility of the Cambridge design being more expensive than the truss and column design, though very improbable, could not be entirely ruled out, and as a trial the two designs must now be used in competition with each other.

As in all design, the three factors of satisfaction, cost and economy in scarce materials must be balanced before definite conclusions can be formed, but at least the notion that peace-time Works Services must follow accepted civilian practice has not been allowed to stand in the way of steel economy. This time we lead; and may well set the standard for future practice.

TABLE I (60 ft. SPANS)

Conventional Truss and Column design (420 × 212.5 ft.)			Plastic Design (420 × 208 ft.)		
Component	Section	Wt. (tons)	Component	Section	Wt. (tons)
Trusses		68.99	Rafters	8 × 4 in. at 18 lb. R.S.J.	32.88
Longitudinal Ties	3 × 2 × ¼ in. L at 4.04 lb.	5.37	Horizontal Ties with Sag rods	1⅛ in. dia. at 338 lb. ⅜ in. dia. at 0.376 lb.	6.04
Purlins	4 × 2½ × ¼ in. L at 5.32 lb. 3½ × 2½ × ¼ in. L at 4.89 lb.	14.13 38.97	Purlins	4 × 1¾ in. at 5 lb. R.S.J. 4¾ × 1¾ in. at 6.5 lb. R.S.J.	39.00 16.90
Sheeting Rails	3 × 2½ × ¼ in. L at 4.46 lb.	2.54	Sheeting Rails	4 × 1¾ in. at 5 lb. R.S.J.	1.86
Eaves Stanchions	10 × 4⅛ in. at 25 lb. R.S.J.	7.43	Eaves Stanchions	8 × 6 in. at 35 lb. R.S.J.	5.20
Internal Stanchions	8 × 6 in. at 35 lb. R.S.J.	17.34	Internal Stanchions	5 × ⅜ in. at 18 lb. Tubes	8.25
Valley Beams	14 × 6 in. at 46 lb. R.S.J.	26.18	Eaves and Valley Beams	4 × 3 in. at 10 lb. R.S.J.	7.43
Total weight : 181.0 tons			Total weight : 117.6 tons		
Weight per sq. ft. of Plan : 4.543 lb.			Weight per sq. ft. of Plan : 3.015 lb.		

MEMOIR

COLONEL G. R. PRIDHAM, C.B.E., D.S.O.

COLONEL Geoffrey Robert Pridham, C.B.E., D.S.O., who died on 22nd March, 1951, was the elder son of Colonel F. Pridham of Instow, North Devon. He was born on 4th October, 1872, and educated at Marlborough and the R. M. Academy, and commissioned in the R.E. on 12th December, 1892. After completing the S.M.E. course he was posted to the 7th Field Company at Chatham, but went to India in the next year 1895, where he had a varied career on the Attock Defences and in Madras and Rangoon on Military Works. In June, 1898 he was posted to No. 4 Company, Bombay Sappers and Miners, serving with it in the Khyber, during the Tirah Expedition, and receiving the medal and clasp. In August, 1898 he was employed on Military Works at Mhow, but returned to the Bombay Sappers and Miners three months later to " A " Company at Kirkee.

In February, 1899, he was promoted to be Company Commander No. 2 Company Bombay Sappers and Miners, and he served with this company in Tientsin from August, 1900, for one year, receiving the China medal and clasp for the campaign. Returning to England on leave in 1901, he was posted again to No. 2 Company Bombay Sappers and Miners in August, 1902, and remained with that company until 1904, when he returned to England and was given the command of the 59th Field Company, first at Bulford, and in 1906 at the Curragh. In June, 1908, he was posted to the Depot at Chatham, and the next month to the 29th (Fortress) Company at the S.M.E., being transferred to the 20th (Fortress) Company at Plymouth in September, 1910. In November, 1913 he went abroad to Egypt, as D.O. Abbassia and when war broke out later on served as C.R.E. Anzac Expeditionary Force in Gallipoli and France, until posted to the Depot at Newark in April, 1918. He was Mentioned in Despatches four times and received the D.S.O. in 1917. He was referred to most honourably in the *History of the New Zealand Engineers* for his professional attainments and his personal characteristics.

In October, 1919 he was C.R.E. Dover and six months later went to Gibraltar in the same capacity, returning to Chatham in July 1924 and going on half pay in October.

In March 1925 he went to Egypt as C.E. until his appointment as President R.E. Board in May 1927. In 1929 he received the C.B.E. for his services and retired under the age limit on 10th October, 1929. He married in 1917 Mignonne Muriel Maude, daughter of C.L.B. Cummings, I.C.S. and widow of Major J. Chrystie, R.G.A.

In physique Pridham was a short well-built man, and in temperament cool and deliberate with plenty of character.

H.B.

BOOK REVIEWS

THE FOURTH DIVISION 1939 TO 1945

By HUGH WILLIAMSON

(Published by Newman Neame, 39 Percy St., London, W.1. Price 15s.)

In the Preface to *The Fourth Division 1939 to 1945* the author, Hugh Williamson, gives the aim of his book. "This," he writes, "is the unofficial history of an infantry division during the second World War. It has been written for those who served in the division, as a record of their service and as a description of events whose course and purpose may not have been clear to all who took part in them. The book has been published in order to provide a complete and reasonably detailed account of the division's part in its four campaigns."

The four campaigns in which 4th British Division fought were France and Belgium, North Africa, Italy and Greece in 1944 and 1945.

The division went to France as part of the B.E.F. in 1939. At first it was in II Corps reserve near Lens, building defences on the Canale de la Haute Deule, which runs from Douai to Beauvin near Lille, but later it moved up into a forward sector north-east of Lille. Here the division took over from a French division and discovered that while the French staff had worked out on paper a wonderful *projet* for defence, nothing on the ground had actually been done. So the division set to work to build pill boxes on the Belgian frontier, sending one brigade at a time down to the Maginot Line to be in actual contact with the Germans.

When the real war started, the 4th Division moved up to Brussels and fought a series of defensive operations in the withdrawal to Dunkirk. Sappers will be interested to read how in the course of this "the C.R.E., Lieutenant-Colonel Coxwell-Rogers, placed 7th and 59th Field Companies under command of the Black Watch ; the sappers took up their rifles, and with the infantry put in a spirited counter-attack. The commanders of both companies, Majors Gillespie and Macdonald, were wounded . . . The attack was successful and the Germans were driven away from their threatening position in the division's left rear."

At La Panne the division, less its equipment, was mostly embarked by the evening of 1st June and returned to England.

There followed the period of preparation against a German invasion ; and then the embarkation for the North African Campaign which, in great secrecy, the division joined in March, 1943. Here they found themselves fighting under General Anderson who had started the war commanding one of the brigades of the division (the 11th).

The division fought in the many gruelling battles from Béjà to the end, where it had the enviable experience of "swanning" round Cape Bon, putting Germans in the bag by the thousand.

It was not till February, 1944, that the division was again in action ; this time in Italy. Here it fought in many battles ; though, as Field-Marshal Lord Alexander of Tunis points out in a Foreword, the reader's attention is drawn particularly to "the assault on the Gustav Line and the capture of Monte Scalari, together with the capture of Incontro Monastry and that of the airfield at Forli."

Considerable dash on the part of the infantry characterized the work of the division on more occasions than one ; and the reader will not be surprised to see how one battalion waded across the Savio chest deep in icy water without any bridging equipment at all.

In December, 1944, the division was hurriedly transhipped to Greece where it helped to subdue the E.L.A S ; and remained there till the end of the war in Europe

Such then is the ground covered. It has been done in a workmanlike and readable manner. It seems likely that all past members of this famous division will join the reviewer in congratulating the author on an excellent volume.

M.C.A.H.

THIS WAR BUSINESS

By ARTHUR GUY ENOCK

(Published by The Bodley Head, London. Price 18s.)

Mr. Enock, a Member of the Society of Friends and also of the Institution of Mechanical Engineers, has at the age of eighty produced this considerable book of 375 pages on the evils of war. In 1923 he published *The Problem of Armaments*, dedicated to the citizens of many countries whose sacrifices in 1914–18 to put an end to war "are still ineffectual." The two works taken together are a striking testimony to the determination of the writer, in the leisure snatched from a busy life, to demonstrate to the world the appalling waste entailed by war and by the security measures intended to prevent it. Although few people alive to-day have any doubts about the folly of it all, there may be many who do not fully realize what war has actually cost the nations of this planet during the last fifty years. They will find it, converted where necessary into pounds sterling, comprehensively set out in this book. Of the three forewords by Dr. L. P. Jacks, Professor Kathleen Lonsdale and Major-General J. F. C. Fuller, the General's is the most thoughtful and constructive. The author's style is laboured and discursive, but the earnestness of his purpose carries the reader along fairly steadily to the rather inconclusive end. Now and then he strikes a rich vein of thought but does not develop it, as, for example, in his reference to the history and fate of Germany as the world's greatest tragedy. He might also have hazarded some reflections on how long the peoples of the U.S.S.R. will stand the Communist tyranny, which is the root cause of the world's unrest to-day. A most interesting chapter describes his personal attempt, at the eleventh hour, in September, 1899, to prevent the outbreak of the Boer War, about which his sympathies lay with the Boers. But our author makes a bad mistake in thinking that the promulgation of a sentence of death is the actual execution. The rather sensational frontispiece of the book, therefore, gives a wrong and bad impression to a reader ignorant of legal terms, and the remarks about it on page 206 require correction. Another slip on page 158 refers to Joseph Chamberlain as Chancellor of the Exchequer in 1937. In the welter of statistics about *This War Business*, illustrated with copious, well-chosen photographs, actual suggestions for the prevention of further world conflict are distressingly few. Mr. Enock outlines the vast problem and challenges all concerned to do their utmost for peace. He then, like the good Christian he is, leaves the matter in the hands of God, which is, I fancy, what most of us do.

B.T.W.

A SHORT HISTORY OF WORLD WAR I

Compiled by BRIGADIER-GENERAL SIR JAMES E. EDMONDS, C.B., C.M.G., HON. D. LITT., p.s.c., R.E. (Retd.)

(Published by the Oxford University Press. Price 30s.)

In compiling this book, *A Short History of World War I*, Sir James Edmonds has brought to the task immense knowledge, based on the experience of thirty years as head of the Military Branch of the Historical Section of the Committee of Imperial Defence (later of the Cabinet Office). He was also largely responsible for the compilation of the *Official History of World War I*; though he explains that in *this* book he alone remains responsible for the selection of the facts. And, of course, in a history of this sort, even in 500 pages, many facts from so wide a field of knowledge must be omitted.

The author begins with "How the War Came About" and then follows it in every theatre, by sea, land and air, to "The Final Advance 1918." Throughout, he hinges his narrative on the land war on the Western Front, contending that the other fronts were side-shows.

To-day few will question this contention as far as land warfare was concerned; the feuds between Easterners and Westerners are dead. People are agreed that France was the vital land theatre. They will not quibble with the place, but the mind is stunned at the methods adopted. Even our subservience to French leadership will not excuse the squandering of British lives.

How was it that, until 1917, no one in high authority saw (as the author foresaw in 1905) that the war in France had become "siege operations in the field" and that different methods were required? Throughout the early years Haig had to relieve the pressure on the French. He "fought at the Somme in 1916 at the desire of Joffre; at Arras in 1917 at the desire of Nivelle; and he had to persist in the Ypres offensive in 1917, ending in Passchendaele, on the repeated requests of Petain." At this time we had not the preponderance to make a break-through possible. Why did not G.H.Q. perceive, or practice if it did perceive, some more ingenious methods than those which cost us 50,000 casualties in a day? Perhaps some explanation is to be found in the fact that so many of our senior generals belonged to one arm of the service only, and that they had not a free hand in the selection of their staffs in order to get a "composite brain" as our opponents preached. Even Haig could not have as Chief of Staff the man he wanted; for at 45 he was too young. Perhaps with the right man beside him (and this is no personal reflection on the men he did have), Haig, with his great powers of inspiring confidence in his soldiers, his loyalty, his courage, and his determination, might have drawn off German forces from the French with lighter losses to himself.

The author shows us all these grave events with a masterly economy of words; and his commentary is shrewd but kind. If sailors feel that the war on land has too many pages and the war at sea too few, landsmen at any rate will be grateful for the account of the Battle of Jutland. In four and a half pages the battle becomes easily comprehensible.

The maps are numerous and clear and the whole work eminently readable. Soldiers who want to study World War I will find this book in a class by itself for accuracy, conciseness, fairness and clarity.

M.C.A.H.

MILITARY SCIENCE TODAY

By COLONEL DONALD PORTWAY T.D., J.P., M.A., D.L., A.M.I.C.E.

(Published by Geoffrey Cumberlege. Oxford University Press. Price 7s. 6d.)

Many Sapper officers, past and present, will remember Donald Portway as a Cambridge don. Some, including the present reviewer, will have memories of him in his official capacity as a proctor. Others will remember him as the commanding officer of an O.C.T.U. in Aldershot during the 1939–45 war. Again, others will remember him as an ardent supporter of the Cambridge University O.T.C. during the League of Nations era, when intellectuals were wont to sneer at soldiers and their trade. All will remember with affection the extraordinary enthusiasm for things military displayed by the Master of St. Catharine's College.

It is, therefore, both a privilege and a pleasure to review this third edition of his book on *Military Science Today*. It starts with a chapter relating science to the art of war from the earliest times. There follows a chapter showing how modern tactical ideas have grown. The author continually emphasizes in these two chapters this: the honourable character of military service, and the fact that all depends in the end on the man behind the machine and not the machine itself.

Thereafter follow chapters on mechanization, artillery, signalling, field engineering, mining, coast defence works, chemical warfare, radar and the atom bomb. In all these chapters the reader is shown how the various instruments and techniques have been evolved from primitive beginnings to their present forms. Illustrations, photographs and plain English take the place of all the bewildering scientific symbols and jargon that reduce schoolroom science to an incomprehensible mumbo-jumbo. Even radar and nuclear fission are described in terms which the ordinary mortal can understand.

There is a "donish" air about this book no doubt; but if one has an inquisitive mind (or a schoolboy son with one) this is the book to read to find the answers to many of the questions.

There are fascinating glimpses of biography too. For instance, we are told that M. Maginot was "a tremendous eater, particularly of oysters" and that he ultimately died of typhoid contracted from "his beloved oysters."

All this makes the lessons more like those we learn in the Science Museum than in Scroop House. And not being a B.A., I prefer it like that.

M.C.A.H.

THE OTHER SIDE OF THE HILL

By B. H. LIDDELL HART

(Published by Cassell & Co. Price 17s. 6d.)

A notice of the first edition of *The Other Side of the Hill* appeared in the *R.E. Journal* in June, 1949.

The second edition appears to contain most of the original material: the story of World War II as told by German commanders since the war. It has, however, been considerably extended and enlarged, with much new evidence included, which shows that the German General Staff cannot place all the blame for mistakes on Hitler.

It is one of the best books of its kind, and shows many of the difficulties under which the enemy, unknown to us, laboured and many of the mistakes that he made.

M.C.A.H.

190 IN PERSIA

By MICHAEL ROBBINS

The author gives an account of the work done by 190 Railway Operating Company, Royal Engineers, on the Persian L. of C. from December, 1941, until January, 1943, when the hand-over to the Americans began.

Persia is a country of extremes. Its climate may be tropical or arctic ; its countryside searing desert or bleak mountain crags ; its people wealthy or destitute. The Iranian State Railway, too, has its extremes. Many sections are among the most heavily engineered in the world : the line traversing two mountain ranges at elevations nearing 8,000 ft., with numerous tunnels and bridges. The main flow of military traffic was from the Persian Gulf ports of Bandar Shahpur and Khorramshahr through Ahwaz to Bandar Shah on the Caspian Sea—a distance of over 800 miles. Equipment and staff were quite inadequate for the traffic called for by the " Aid to Russia " programme, let alone for normal Persian traffic in addition. Capacity had to be raised from 200 to 2,000 tons a day. This was done by importing British W.D. locomotives and wagons, by increasing the Persian railway staff and by raising the standard of operation.

At first, the " 190 " was spread in detachments from the Persian Gulf to the Caspian Sea. In January, 1942, the Russians took over the lines north of Teheran, and by June, 1942, 153 and 192 Railway Operating Companies had taken over the Andimeshk and Teheran divisions respectively, leaving the " 190 " concentrated on the Ahwaz division, which included the ports of Bandar Shahpur and Khorramshahr. It was then that the peak rail lift tonnages were realized.

This informative, well-written, illustrated booklet of forty pages (obtainable only from the author, 64a Longridge Road, London, S.W.5, price 5s., post free) should be read by everyone interested in war-time railway operation.

C.R.L.R.

THE STORY OF ALDERSHOT

By LIEUT.-COLONEL HOWARD N. COLE, O.B.E., T.D.

(Gale & Polden, Aldershot. Price 30s. net)

A great many officers will be glad to read this complete and attractive account of Aldershot, its military and its civil story. The author has given the history of the Camp " in parallel," so to speak, with that of the town, with remarkable success.

He has built up the story of the growth of the original hutted camp (1854–9) with sufficient detail to interest any member of the Corps. The construction occupied about five years, but the first troops marched into occupation on 7th May, 1854. Austerity was the keynote of the whole project. Even the Royal Pavilion, built for Queen Victoria's use on her annual visits to the camp, was built entirely of wood, with its walls and ceilings covered with canvas stretched on frames and papered over. The Prince Consort took a keen interest in the camp from its start, and made many useful suggestions.

The whole camp cost £476,892. The work was not scamped ; when the huts were replaced by brick buildings some forty years later, the woodwork was for the most part still strong and sound.

Life in the Camp was grim for the first thirty years; but not more so than in the average garrison town of that period, and a great deal healthier. There was little for the soldier off duty to do except to drink in the numerous beer-houses which sprang up in the village of Aldershot. But it is remarkable how quickly efforts were made to provide better entertainment. As early as 1856 a Garrison Theatre had been built in South Camp, and in 1859 the Officers' Club in the Farnborough Road was built by private subscription. Speculative builders soon began putting up houses and Aldershot started to compete with Farnham in attracting the troops.

The development of the town proceeded apace, and if it owes its existence to the military camp, the Camp owes a great deal to the generosity and public spirit of the townspeople. Institution after institution, financed and staffed by voluntary helpers in the town, arose to provide amenities for the soldier.

The author has given accounts of the principal Royal Reviews, naming the regiments which took part; those by-gone pageants whose passing may well be regretted by many of us who served there during the early years of this century.

Aldershot has indeed changed. The disappearance of horses has altered the whole scene. Yet the traditions will not die. Aldershot is still the most important military centre in the kingdom, and to judge from the most recent of the photographs in this book, it is creating new standards with the new materials.

The book is packed with information, and illustrated with four plates in colour and 158 photographs.

W.H.K.

ELEMENTARY ELECTRICAL ENGINEERING

By A. E. CLAYTON and H. J. SHELLEY

(Third Edition, published by Longmans, Green & Co. Ltd. Price 14s.)

It is always an agreeable experience to meet an old friend who has gone up in the world. In the case of this well-known little book the improvement in the appearance of the third edition gives much pleasure. The type, the paper, and size and clarity of the diagrams now do justice to the subject matter which has always been excellent.

The timid reader, and there will always be some to whom this subject brings a constriction of the throat and symptoms of anguish, is encouraged to find that it remains true to its title: it is still elementary. There have, it is true, been additions and they are designed to help the reader towards an understanding of radio circuits and electric power distribution networks. These extensions of the ground covered are rightly placed at the end of the book and serve their purpose admirably.

As a concession towards rationalization of units some mention is made of the M.K.S. system. There is also an appendix giving the M.K.S. values related to the c.g.s. That, however, is as far as it goes.

"Clayton and Shelley" is thus re-equipped to retain its position as an excellent introduction to Electrical Engineering. There are many Sapper officers who will feel, when they have reached the end, that this introduction meets all their needs and that they need seek no further.

H.H-B.

TECHNICAL NOTES

THE MILITARY ENGINEER

(Published by the Society of American Military Engineers, May–June 1951.)

Engineer Bridging by Air

A brief description of the value of the Fairchild C-119 for the air transport of bridging stores in the Korean campaign.

The pontoon bridge provided for the Han River at Seoul could not be unloaded in Inchon harbour because of low water. Another 250-ton pontoon bridge, in 2,500-lb. sections, was flown to Kimpo airfield in seventy sorties from Japan. Later a 600-ton bridge in 4,000-lb. sections was flown to the same airfield.

During the withdrawal from Northern Korea in December the Marine Divisions were cut off by bridge demolition on their only available road. The 314th Combat Cargo Wing dropped, by means of 100-ft. parachutes, the 2,000-lb. spans of a complete steel treadway bridge direct to the bridge site. All loads landed safely and the resulting bridge carried tanks and troops.

An electrically-operated monorail in the C-119 permits also twenty, ¼-ton, parachute-fitted packages of supplies to be dropped in ten seconds.

Water Supply

For water supply in the Arctic, a steam generator type of ice and snow melter, skid mounted and capable of being transported in standard vehicles, is under development. Rated at 200 gallons per hour, technical tests reveal that the equipment has many other potential uses, including jetting in ice and frozen soil.

The Distillation Test Section had by the end of the last war designed equipment capable of producing 250 lb. of distilled water per lb. of fuel. Unfortunately scaling of the tubes caused too frequent shut-downs. As a result of further basic research, it was found that if ample surface could be provided exteriorly to the evaporator, the amount of scale formed in the evaporator would be greatly reduced. An experimental thermo-compression distillation unit, electrically powered and incorporating the scale prevention principle, is now under service tests. Rated at 1,250 gallons per hour this unit might support a sizeable force in an area devoid of fresh water sources. The unit weighs 80,000 lb. and can be broken down for transport into loads not exceeding 15,000 lb. It is expected to operate six months without requiring scale removal. No reference is made to its performance with radio-actively contaminated water supplies.

Petrol Storage in the Field

The conventional bolted steel tanks for petrol storage in the field are good, but take too long to erect. Floating petrol ashore in drums is successful, but requires too much man-power to handle. At the Engineer Research and Development Laboratories at Fort Belvoir a 10,000-gallon collapsible container has recently been developed for use in forward areas, along pipe-lines or for landing operations. Various shapes were tried

but, with the exception of the spheroidal container, all had to be supported by wood panels or earth banks. The spheroidal container was self-supporting, but it creased in storage, proved difficult to manufacture, and its shape did not lend itself to autoclaves so that it could be vulcanized into single units. The developed container, which is shaped like a large mattress, is simple to make, is capable of being vulcanized into a single unit, is easy to carry, is not damaged in storage by creasing, and is capable of being installed by troops in the field with a minimum of training.

FESTIVAL ENGINEERING WORKS

(*Civil Engineering*, dated May, 1951)

To coincide with the opening of the Festival of Britain the May edition of this periodical contains a supplement dealing with the outstanding engineering features of the South Bank Exhibition. One of the most outstanding features of the exhibition is that the organizers have brought together a number of most unusual structures and many of these are described from the engineering standpoint in the supplement. They include the Dome of Discovery, the Skylon, the Royal Festival Hall and the South Bank River Wall. The latter is one of the less elaborate works and might easily pass unnoticed, yet the success of the whole exhibition depended on it being completed to schedule. There is also a section on footbridges, which features the Bailey bridge, built by R.E. personnel, and a prestressed concrete footbridge. Amongst other comparatively new developments described are laminated timber arches used in the Waterloo Station entrance building, a design which has its counterpart in laminated timber girder construction for military bridging.

In addition to the *Festival Supplement* there is an interesting article on a visit to sewage purification plants in the U.S.A. These are compared with those in the U.K.

PUBLIC HEALTH ENGINEERING

(*Civil Engineering*, dated June, 1951)

This issue includes the first of a series of articles on public health engineering. These articles draw attention to recent developments in water treatment, sewage treatment, composting of urban wastes, river pollution and district heating, all of which fall within the scope of public health engineering.

There is also the first of a series of articles on a rural water supply scheme which is at present being carried out in Gloucestershire.

ALUMINIUM STRUCTURES

(*Civil Engineering*, dated July, 1951)

This edition has an important article on the design of long span aluminium hangars at London Airport. A feature of this type of construction is, of course, its lightness—in fact it is possible to do the bulk of the assembly of the framework at ground level and to hoist frames into position afterwards with consequent saving of effort. With a clear span of 125 ft. this type of construction has obvious attractions for the military engineer.

The series started in the June issue, on rural water supply schemes and on public health engineering, are continued in this number. The former gives an interesting account of the structural design of a reservoir.

During June, 1951, a joint engineering conference was held in London in connexion with the Festival of Britain and was organized by the three main Engineering Institutions. Summaries of the various papers presented to this conference are included in this Journal.

MAINTAINING ENGINEER SERVICES UNDER BOMBING

(*The Engineering Journal of Canada*, dated May, 1951.)

The May number of *The Engineering Journal* contains an interesting article entitled " Maintaining Engineer Services under Bombing." It is essential before making a plan to counteract the effects of bombing to appreciate the effects of various types of raids and various types of bombs ; the data required for this appreciation is tabulated in a clear and concise manner in two tables—the one is headed " Bombing raids and their effects," and the other " Types of bombs and their effects." The article then goes on to consider the vital services which are affected by bombing and the degree of priority which should be attached to their repair. The sources from which engineer and other labour can be drawn is gone into at length ; under the category of special assistance when the civilian organizations are unable to cope with the situation, the writer has a word of praise for the Royal Engineer General Construction Companies of World War II ; a useful table shows the additional tools and plant normally required by these companies on such occasions. The repair work completed by one particular general construction company in a six-month period is described in some detail ; the work covered the repair of sewers, water and gas mains, flood control devices, craters, sewage plant, power and pumping stations, etc. ; the cost of the repairs was valued at over £150,000. The article contains much useful information on several subjects ; communications for one—reliance could not be placed on the telephone system ; the blackout for another—the blackout precludes night work and, therefore, intensive shifts had to be worked by day ; the marshalling of men for work required careful organization, since jobs change from night to night and, furthermore, a job half completed one day may be completely abandoned on the next. The article has two appendices which are of both value and interest ; the one describes in detail the engineer work required to restore the situation in the case of three specific incidents in the London area ; the other contains statistics in respect of the damage suffered during the London " blitz." The writer concludes with a note on the attitude of mind which must be observed under bombing ; in addition to a sense of urgency and a sense of proportion, all the planning, preparation and organization put into force for maintaining vital services will be of no avail without a philosophical outlook and a sense of humour.

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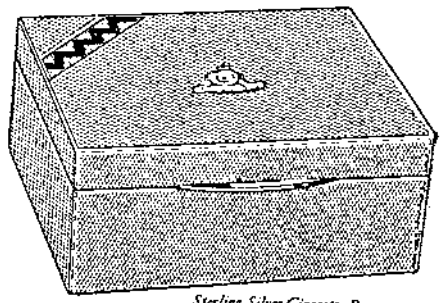

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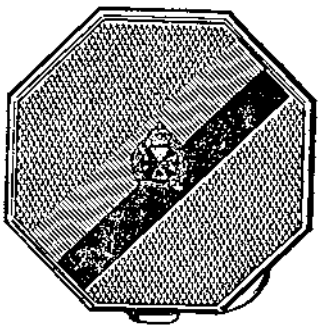

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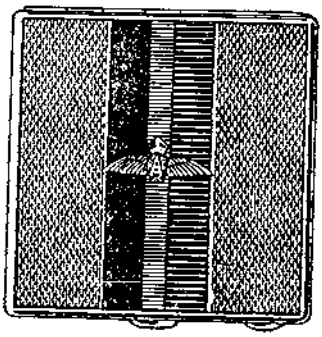

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