THE ROYAL ENGINEERS JOURNAL

VOL. LXV.

No.



THE ROYAL ENGINEERS JOURNAL

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Cinema for 2nd Battalion, New Zealand Regiment.



Part of Quonset Hut accommodation, Base Headquarters, Kure. (Dock where *Tamat* was built is shown on left.)

Engineers In The British Commonwealth Occupation Force-Japan 2,3

ENGINEERS IN THE BRITISH COMMONWEALTH OCCUPATION FORCE—JAPAN

By LIEUT.-COLONEL A. T. J. BELL, O.B.E. Royal Australian Engineers

INTRODUCTION

THIS article deals with the work in Japan of the Royal Engineers of the Commonwealth, principally between mid-1947 and early 1949. The writer is not competent to describe the earlier days from the commencement of the Occupation in December, 1945. Briefly, this first period was one which included the inevitable improvisation, shortages of stores and all the other problems usual in an Engineer organization designed for one set of conditions, and finding itself in another completely different set. By mid-1947 the necessary organization for the task in hand was evolving, Japanese industry was recovering, hence stores were becoming easier to obtain, procedures generally were being more firmly, but happily not too firmly established, and a large number of major projects was well under way or approaching completion.

Now if we may digress for a moment about Japan itself. Pre-war, at any rate to many Australians, Japan was the land of the Mikado and Madam Butterfly. Perhaps during the war it came as rather a shock to find them a highly industrialized race, with fanatical soldiers enduring it seemed beyond normal limits, to such an extent that in the early days they appeared nearly superhuman. Their immaturity in strategical thought, and lack of sustained industrial effort came as a considerable anti-climax, and it was with a curious expectancy that many sappers must have approached service in Japan.

The complete obedience of the Japanese to the Imperial ceasefire order is well known. By mid-1947, the Japanese had lost their awe of their conquerors, and had regained their natural dignity in relations with the Occupation Forces. Of course contractors are a people apart in any eastern country, and are no different in Japan. The worst of the devastation caused by Allied bombing had been removed, if not repaired, and the country was beginning again its own internal life. In the cities, the cherry-blossom, geisha girl atmosphere had vanished completely, probably forever. In its place had come dirt and squalor, in hastily-built shanty type houses covering the devastated areas of Tokyo, Hiroshima and similar cities.

Japanese industry in the big nerve centre of Tokyo-Yokohama had been very severely damaged. Outside these cities, Japanese industry had been relatively decentralized, and it was in these less badly damaged areas that recovery was taking place. This decentralization of Japanese industry had been possible, because of the extensive electrical grid which covered the country. Even little fishing villages, such as those which abound along the Inland Sea, had their own one or two factories, in some ways giving them a more stable economy than we can hope to achieve in Australia for a decade at least.

In the country or rural areas the charm of old Japan lingered. There the ever-changing scene varied rapidly as a result of the two crops a year, from brown through green to gold according to the season. In the green times, the countryside was wonderfully picturesque, the little collections of thatched unpainted wooden houses nestled unobtrusively in the bamboo thickets, and terrace after terrace of green crops flowed over the foothills and up the lower slopes of slender and unreal mountain peaks. These mountains showed to their best in the rainy season, when straying clouds hung around mountain tops, and little streams cascaded down steep valleys and between terraced crops. The peasants retained the courtesy, which is usual amongst their class in most parts of the world.

The British Commonwealth Occupation Force was fortunate indeed, to be allotted Western Honshu and the island of Shikoku surrounding the Inland Sea. The Sea is justly famed, with its hundreds of islands big and small, some with little fishing villages or temples on them, and some with just a few spreading pine trees leaning out from the rock at impossible angles.

Perhaps it is the beauty of Japan itself that makes the strongest impression on any foreigner; however we must return to the practical outlook of a sapper article.

Organization

The organization of the British Commonwealth Occupation Force (B.C.O.F.) has been described very amply in the October, 1948, issue of the Army Quarterly. To summarize, the force was commanded by an Australian C.-in-C. with an integrated headquarters, and consisted of a Royal, and later Royal Australian, Naval shore party, the British-Indian Division, the 34th Australian Infantry Brigade Group, the 2nd New Zealand Expeditionary Force (Brigade Group), the British Commonwealth Air Group and the British Commonwealth Base. At its peak the force numbered almost 40,000 all ranks. Unkind blows of fate caused the withdrawal, in late 1947, of first the United Kingdom component of the B.C.O.F. and then the Indian component. With their going, B.C.O.F. lost a great deal of its colourfulness and many of its intriguing contrasts. During 1948, no major change occurred until late in the year when the New Zealanders left us, resulting in the standard of rugby football taking a definite turn for the worse. About the same time, the Australian component commenced running down to its present strength of about 2,500 all ranks.

Throughout these changes until December, 1948, the area controlled by the B.C.O.F. remained the same. Consequently the Engineer organization underwent constant change, with the units remaining throwing off other units and taking control of Engineer works in additional territory. Projects never seemed to decrease at the same rate as did the troops, this being partly due to our responsibility for construction for Allied Military Government units located in the B.C.O.F. area. The Engineer organization shown in Appendix A existed at about December, 1947, and the principal units which had withdrawn prior to that date were the 5th Field Company Royal Engineers, the 429th and 363rd Field Companies and the 653rd Mechanical Equipment Company of the Royal Indian Engineers. The territorial distribution of the Engineer organization is given in Plate I at the end of this article.

Almost from the outset, when field units were asked to perform Works tasks, office and draughting staffs were augmented with Japanese nationals. Later as unit strengths decreased, and the security of the force became no longer a major factor, Japanese were increasingly employed as tradesmen, drivers and the like.

PROJECT AND CONTRACT PROCEDURE

In the early days of the Occupation, formations placed demands for construction through the Regional Allied Military Government on the local Japanese Prefectural Government. By 1947, General MacArthur's Headquarters (Supreme Commander of the Allied Powers, i.e., S.C.A.P., also known as G.H.Q.) had centralized authority to approve new Work projects, and the Japanese Government had commenced the establishment of the Special Procurement Board, equivalent in British Commonwealth ideas to a special Department of Works and Supply, to deal with all Occupation Force requirements.

Under this arrangement, B.C.O.F. had authority to approve new Works projects of not more than \$5,000 each, up to a set monthly total. Projects over that size were forwarded to G.H.Q. through H.Q. Eighth U.S. Army, which headquarters controlled Japan for G.H.Q. Seven copies of a project with a vast amount of detail were required. If approved, G.H.Q. issued a "Construction Directive," including approved plans and specifications to the C.-in-C., B.C.O.F. H.Q. Eighth U.S. Army then issued a "Procurement Demand" on the Japanese Special Procurement Board, which after some delay, instructed its local representatives to let the contract to a Japanese contractor. Normally it took about four months from the time a major project was submitted to H.Q. Eighth U.S. Army until work could commence. This time lag is comparable with Australian peacetime standards, but in Japan where commanders held almost unlimited powers, and resources generally were not governed by priorities, units found this delay very irksome.

The Japanese contract system is curious. When say, the local branch of the Japanese Special Procurement Board was to let a major contract, it submitted the names of three or four major contractors to the Chief Engineer, B.C.O.F., who normally added a few more names to keep the party as clean as possible. Tenders were then called from the contractors on the approved list, and the lowest tender accepted subject to C.E's. approval. Efforts were made by the C.E., B.C.O.F., to introduce the Western system of open bidding, but these were turned down flatly by the contractors themselves. Apparently in Oriental eyes, chance should not decide important events.

Maintenance generally speaking was performed by Japanese contractors, under the nominal supervision of the Special Procurement Board. Initially there was no limit on maintenance expenditure, an arrangement which gave great scope, but later G.H.Q. made quarterly allocations with a \$5,000 limit on individual jobs. The supply of utilities, i.e. water, electricity and disposal of sewage, was performed by various Japanese Utility organizations. Originally the Procurement Demand requiring the Japanese to carry out these services, included a construction clause authorizing the Japanese to carry out any work necessary for the supply of these utilities. In one part of the B.C.O.F. area, a massive concrete gravity dam was constructed, allegedly to supply water to a small number of married quarters. It was understood that the cost of all construction by the Japanese for the Occupation Forces, was to be offset later against Reparations Payments. Hence G.H.Q. gradually tightened up control of all work, which only goes to show that no good thing lasts for ever.

Two terms were in use in Japan which really should be incorporated into our own Works procedure. They were "Rehabilitation" and "Pre-emption." To "rehabilitate" a building meant to reconstruct it in any way, provided the original foundations were not altered. "Pre-emption" was a polite term for unauthorized construction.

SUPERVISION OF CONSTRUCTION

Under the Procurement Demands served on the Japanese, the Japanese Government agency, normally the Special Procurement Board, was responsible for supervising construction. In practice, to ensure adherence to Occupation Force standards and our desired type of construction, supervision by B.C.O.F. Engineer units was very close and direct, although of course all official dealings with contractors were through the Japanese Government agency. In the early days, the Field Engineer units of the B.C.O.F. supervised the widespread construction programme to the best of their ability, but by late 1947 sufficient Works units (Cs.R.E. Works and D.C.s R.E.) were available, to perform this supervision with easier results.

In the first year or so of the Occupation it was believed by some, that Japanese contractors deliberately sabotaged work for the Occupation Forces. It is probable that some sabotage did occur, but in the later days faulty construction was normally caused by the language bar, or by lack of knowledge on the part of the Japanese tradesman and his supervisor. Since most of their own construction had been in timber, Japanese contractors had a large supply of carpenters skilled in the Japanese type of construction, but there was a grave shortage of other tradesmen, particularly in the rural areas of southern Honshu. The complex electrical, plumbing and steam heating installations required by B.C.O.F. were quite beyond the smaller Japanese contractors. In a General Hospital in the New Zealand area, the Matron swore that when one of her nursing sisters crept in rather late one night to new quarters occupied only that day, she turned on the electric light switch, and in so doing also set off the fire alarm. In the Kure area, numbers of tradesmen from the heavy engineering shops were available, but their foremen had apparently disappeared to places unknown when the war ended.

In addition to construction specifically for the B.C.O.F., G.H.Q. required B.C.O.F. to supervise certain national works with strategic implications, such as concrete highways, to ensure that construction standards were maintained, and that the materials released for the job by G.H.Q., did not disappear on to the Black Market.

ESTIMATING AND COSTING

G.H.Q. introduced the American system of estimating construction. Under this system, an average dollar cost per unit area was fixed for each type of installation or construction such as roads, airfields, storehouses, houses, pipelines etc. To these unit area costs, was added the cost of all principal fittings and extras. These dollar costs were not directly related to actual costs, but were taken from American estimating data. In effect then, the system was a measure of the amount of construction in each project, the unit of construction being the dollar. It was not practicable to estimate in Japanese currency (yen) because of the constant inflation, under which the yen jumped from forty-eight yen to the pound sterling in 1946, to 1,400 yen to one pound sterling in 1949. All contractors' accounts for progress or other payments were in yen, and H.Q. Eighth U.S. Army maintained a very large accounting staff which kept all construction accounts. Apparently it was possible on the higher level, to relate dollar estimates in the aggregate to yen costs.

Since approval for projects was in dollars, i.e. units of construction, there could be no firm control over expenditure, and enterprising Engineer officers were able to construct buildings and installations which must be a hallmark in Army construction. Later, as the need passed for simultaneous commencement of widespread construction, G.H.Q. was able to send back approved plans which left less freedom for the individual stylist.

The following dollar costs are of interest when considered on the basis of four dollars to the pound sterling :—

- (a) Cost per head for semi-permanent construction of a new troop housing area, including roads, water supply, electric power, steam heating and all facilities based on a total gross area of 185 sq. ft. per man, = \$1,500
 (25 per cent costs were external utilities, i.e., water supply, roads, sewer mains etc.)
- (b) Average cost per sq. ft. for semi-permanent construction (lath and plaster walls, tiled roof) for troop housing, = 55-56.
- (c) Cost per individual married quarter of semi-permanent construction as for (b) above, all electric throughout, steam heated, including all external facilities, = \$11,000.
 (Cost less all external facilities = \$8,000).

It might also be mentioned that the above costs, when converted at three dollars to the pound Australian, fairly closely represent Australian costs at 1st January, 1950.

STORES SUPPLY

By 1947, with very minor exceptions all construction stores were supplied by the Japanese. Early in the Occupation, the supply of stores had not been adequate, but by the end of 1947, Japanese industry was well able to meet all requirements, except for a few critical items which were directly dependent on the limited Japanese coal production, such as glass and steel in all forms. For all construction other than married quarters, supply of stores was arranged by H.Q. Eighth U.S. Army direct from manufacturers to the B.C.O.F. Engincer Store Base Depot. Stores were then issued

through formation Park Squadrons or C's.R.E depots to Japanese contractors. In principle, therefore, these contractors were not required to purchase their own materials on the Black Market.

By a very satisfactory system of accountancy, presumably because married quarters would be of infinitely greater use to the Japanese than troops' barracks, after the departure of the Occupation Forces, not the capital cost of married quarters, but only an agreed rental was debited against Reparations. On this basis, supply of stores was through Japanese Government channels. Both stores systems had their defects.

The B.C.O.F. Engineer Store Base Depot was established by the 14th Australian Workshop and Park Squadron. With the run down in unit strengths, a Japanese combine, known as the "International Warehousing Company," took over the operation of the depot. Later employing altogether some 800 Japanese, this combine took over and greatly expanded the Park's workshops, and operated the C.E's. pool of earth-moving plant, the majority of which had been left behind by 643rd Indian Mechanical Equipment Company. Despite initial misgivings, this arrangement proved satisfactory. It was not a popular arrangement with some officials, because it smacked of a monopoly, and was therefore undemocratic. During its three years' operation, the depot handled some 500,000 tons measurement of stores, including 100,000 tons of cement.

CONSTRUCTION

The B.C.O.F. construction programme might be stated in outline as :--Semi-permanent accommodation for 30-40,000 troops :---

Barracks and all facilities, including steam heating

Theatres

Swimming pools

Clubs-Y.M.C.As., Y.W.C.As., etc.

Churches

Leave hostels (10)

H.Q. accommodation

Base facilities (semi-permanent or permanent construction) :---Depots and warehouses

Workshops

Oil storage

Hospitals (1/600, 2/300 bed)

Bulk refrigeration

Air operational facilities :---

Two 5,000 ft. \times 150 ft. concrete airstrips with related installations Rehabilitation of transport, satellite and emergency strips Auster strips

Radar warning stations

Married quarters :---

600 new houses in eight community centres with the following facilities :--

Schools Theatres Churches Canteen (or domestic shop) Recreational facilities and playgrounds Fire station Servants' dormitories Boiler house and electrical substations Maintenance office and workshop Maintenance office and workshop

Rehabilitation of 200 Japanese/European houses for diplomatic missions in Tokyo and Kobe.

In Japan, flat areas suitable for building construction are very scarce, some 80 per cent of the country being mountainous. Most of these flat areas are along the coast, and often partly on reclaimed land and are intensely cultivated. As G.H.Q's. policy was to disturb Japanese agriculture as little as possible, fortunately the Japanese Armed Services had done themselves proud, and in Western Honshu and Shikoku it was possible to take over many former Japanese barracks. The principal exceptions to this were in places such as Kure, where the B.C.O.F. Base Area was concentrated. Since Kure had been the main arsenal of the Japanese Navy, it had been systematically bombed and burnt by the American Air Force, right from the main dry dock, in which the mighty 70,000-ton battleship Yamamoto had been built, to the outskirts of the former Japanese security area. Therefore in Kure, derelict industrial areas had to be taken over by B.C.O.F. which, because they were covered with burnt and twisted steel frame buildings, frequently presented quite a project in their clearance alone.

Most Japanese barrack areas were fairly spaciously laid out, the buildings were usually stoutly built wood framed structures, with the conventional Japanese grey tiled roof, and much superior to Japanese civilian construction. It was somewhat surprising to an Australian, to find that Japanese Air Force accommodation was sometimes of a lower standard than that of their other Services. Where decent buildings existed, these were "rehabilitated" by stripping and altering internal layouts, and lining structures inside and out with lime plaster to reduce the fire risk. Western style latrines, ablutions and kitchens were added. In about half of the areas occupied, completely new unit accommodation was built to the B.C.O.F. standard of timber frame, lath and plaster walls and tiled roofs. In 1946, C.E., B.C.O.F., had laid down this standard in drawings for the accommodation for an Infantry Battalion, which then formed



Morshead Barracks--Hiro--Occupied by 65th Aust. Infantry Battalion, showing Company Barrack Blocks, Cinema, and Officers' Quarters (*left.*)



Accommodation for an Infantry Battalion under construction. Company Barrack Blocks in foreground.

Engineers In The British Commonwealth Occupation Force-Japan



Married Quarter Settlement. Naval Academy, Etajima. (130th Aust. General Hospital occupied large white building in right rear.)



A four unit Other Ranks' Married Quarter, Iwakuni.

Engineers In The British Commonwealth Occupation Force-Japan 4,5

the basis for all troop accommodation. The design was based on a two-storied company barrack block dormitory style, with external latrines and ablutions. Had the supply of Japanese plumbing fittings etc., been assured, then internal plumbing might have been substituted. All the amenities which regular battalions would like were provided, including recreation centres, canteens, cinemas, chapels, swimming pools, sports fields, tennis courts and the like. Since the ban on fraternization with the Japanese meant that troops had nowhere to go in off duty hours, these facilities were essential. Similarly in areas of concentration of units, Y.M.C.A., Y.W.C.A., clubs and so on were built. Also a really good chain of leave hostels was acquired or converted throughout Western Japan, a matter in which the C.-in-C., B.C.O.F., took a very special interest.

Strangely enough, in American eyes, we often required unnecessarily elaborate facilities, but the C.-in-C., B.C.O.F., was determined that our accommodation would reflect truly the life of our national Services. For instance as is well known, Officers' and Sergeants' messes do not feature in the American Armed Services, and therefore were an additional requirement for us over the American scale. Even after the provision of such messes, we still needed "clubs" for Officers, Sergeants and rank and file, although we used them for a slightly different purpose from that in the American Army. Again there was the need to provide specially for the quartering of Indian troops, and for Christian denominations which would not share the same places of worship. In this latter connexion, the Americans had a very practical solution, using altars which were wheeled out and replaced according to the denomination which was to use the chapel.

Japan being a land of typhoons, carthquakes and other disasters, the fire risk was ever present. Quite apart from disasters, the low standard of Japanese electrical installations was the cause of a large number of fires. The addition of lime and plaster coating to wooden buildings was found to act as a fire deterrent, and also made the fire easier to control. Latterly, fire walls preferably of concrete or brick, were included every 60 ft. in large structures or in multiple unit buildings. If a fire started in a good class Japanese house, it was reckoned to be only ten minutes before the tiles crashed to the ground, a fact which sometimes had amusing consequences. In most cases, although ample external and internal hydrants were provided, often the main was being repaired or was not in working order for some reason when a fire started, consequently below-ground concrete pools or tanks were standard.

The function of sewage in Japanese agriculture is common knowledge, so that except in some parts of the larger cities, Japan has no water-borne disposal systems. Septic tanks were almost universal for the Occupation Forces. In some low-lying areas, especially for married quarters, it was necessary to use small septic tanks serving groups of, say, six to sixteen houses. Thereby effluent mains could be laid at flatter grades to a central collecting chamber, which was pumped out at low tide. The mains also carried the stormwater and quite interesting pump systems resulted.

Japanese water supply came from storage reservoirs in the mountains, from ground wells and from collection chambers in the beds of large rivers. Full filtration and occasionally chlorination were normal. Owing to the relative high consumption per head in Occupation Forces areas, it was often necessary to enlarge existing Japanese systems.

Japan's nation-wide electrical grid connects the hydro-electric stations with thermal stations which boost the supply in dry times. Final distribution is at 100 volts. Before the war, most Japanese farmhouses had at least one point in the house. Now that, even in Japan, discipline is not what it used to be, the Japanese householders have overloaded the national system by means of adapters. Fortunately, Occupation Force requirements were paramount, and Japan was one country in which enough transformers could be acquired, in this case by removing them from derelict munition plants of one sort or another.

The Japanese climate results from two major influences, the Pacific winds and currents in the summer and the Siberian winds in the winter, producing a wet hot summer and a dry cold winter. Japanese and Occupation Force buildings were best suited for summer, since in a Japanese house all the walls and internal partitions were simply removed, and in an Occupation Force house as many windows as possible were provided. In the winter, a Japanese house made use of its sliding glass exterior walls as a suntrap, supplemented to an extent by charcoal braziers. For the Occupation Forces, heating was provided from central steam plants, and a battalion would require two or three boilers, preferably of the Lancashire type, each of about 200 h.p. capacity. Steam was distributed at medium pressure in the mains, reduced to low pressure for radiators. Using condensate returns, hot wells, economizers etc., coal consumption including that for hot water supply, averaged half a ton per head annually. Close supervision of Japanese contractors installing steam heating was necessary or there were most unexpected results. For example on testing one new installation, high pressure steam entered a radiator and wrecked the owner's sitting-room. As it was the local Garrison Engineer's house, nonsappers affected to see humour in this. Reinforced concrete chimneys for boiler houses were commonly used, and a small team of Japanese would run up a chimney 100 ft, high on a lightly piled foundation

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in about six weeks, without fuss or bother. In Australia, it would be a matter for considerable investigation and consultation, for quite a while before and during such a project. Although typhoons occasionally blew pieces off the top, there were few, if any, cases of these concrete chimneys falling during earthquakes.

Two major concrete airstrips, each 5,000 ft. by 150 ft., were constructed by B.C.O.F. on the site of former Japanese naval airstrips at Bofu and Iwakuni. Japanese planes being very light, required only about four inches of lightly reinforced concrete often laid on the natural surface, but Allied planes quickly broke up these strips. The Lancaster strip at Iwakuni was of some technical interest. It was constructed in approximately six months, partly by the 5th Airfield Construction Squadron, Royal Australian Air Force, assisted by a Royal Australian Engineer Plant Detachment, and partly by a Japanese contractor under very forceful supervision. The site had been reclaimed by the Japanese, and at high tide the natural surface was 3 ft. below sea level. It was protected by dykes which every selfrespecting typhoon breached as a matter of course. Eighty per cent of the proposed runway site consisted of 3 ft. of sand over the original sea bed, the other 20 per cent being the untouched reclaimed sea bed, which had every appearance of a bottomless swamp. It was assumed that 3 ft. of well consolidated river gravel would give an equivalent bearing value on this section, to that on the other 80 per cent. California Bearing Ratio tests were taken along the runway site, and from the U.S. Aviation Engineers' Manual gave a combined thickness of surface and base course of 15-16 in. Modulus of sub-grade reaction tests required a concrete thickness of 7 in. Particular attention was paid to the concrete box side drains, which had perforated sides to drain the sub-grade. Some 160,000 cu. yds. of river gravel were "won" and carted over a 12-mile lead. What the Australian costs would have been, it is best not to contemplate. A minor panic occurred during placing of the concrete slabs, when the compression strength of check cubes only averaged about half the designed strength, which was expected after earlier trial mixes. The chemists of the Ube Cement Works quickly explained that the early strength of their cement fell off very rapidly up to three months after manufacture, but that the strength of the concrete would pick up again to normal expectations after about a further three months. To the relief of everybody, this proved to be the case.

A rare opportunity presented itself in the construction of the married quarter settlements. It was possible to start completely new areas from scratch, or in some cases behind scratch, as certain areas had to be made good by suction dredge. A town planning specialist was given his head with good results. B.C.O.F. married quarter settlements ranged in size from twenty units, or houses, to 200 odd units, with an average density of about ten units per acre. G.H.Q. had produced standard designs for two, three and four bedroom houses in single, double and four unit blocks. Houses were all electric except for steam heating. Rectangular road patterns were avoided and easy curves were the aim, road systems dividing the areas into large blocks with houses around the perimeter, and "At Home" play areas in the centre. Main traffic routes were kept out of the married quarter settlements. The community facilities provided have been listed earlier. All services, steam, telephone and electric power were placed underground, and as far as current economy restrictions permitted, Japanese style landscaping was incorporated. Subdivision fences were added later at the rear of houses. Manpower constants were not easy to derive under the Japanese contract system, but the following other figures provide some indication of construction rates :—

- (a) Complete housing settlement of 157 houses and all facilities -8 months to construct.
- (b) One four unit block—5,500 man-days.
- (c) Reconstruct on existing foundations after a fire, a four unit block—23 days (a record set under considerable pressure).

Some Reflections

Over such a period in a Commonwealth Force, it is with some trepidation that one sets down reflections. However, it is believed that the following are not necessarily original by any means :--

- (a) The Army Engineers of each of our Commonwealth nations appeared to attack a technical problem differently in method and speed, but presumably by virtue of our common training and organization seemed to reach a surprisingly uniform standard. On the other hand, it was easier for the Army Engineers of different Commonwealth nations to arrive at a common solution, than for the Engineers of different services of one nation to do so. Surely a case exists for a common organization and basic training for the Engineer units of our armies and our air forces.
- (b) Co-operation with the American Corps of Engineers in Japan was always very good, by reason of the similar basic outlook of one Engineer to another. However it was found that even on technical matters, because of the vast administrative differences in our systems, letter writing was not an adequate means of communication, unless supplemented by very good liaison and frequent personal visits.
- (c) With the large and widespread construction programme which was required, an adequate Works organization alone could control the work, and it was not until this was introduced that the programme really progressed smoothly.

- (d) The problem of control of expenditure, and thus standards of construction, in an area where the currency is inflating rapidly, is a very real one. Perhaps it could be done without fixing any financial limits, by the issue of comprehensive standard plans and specifications, but in a foreign country under new conditions this all takes time. Anyway, this standardization is necessary as soon as possible, to relieve subordinate commanders of the design commitment, and to guard against personal requirements of changing occupants of installations.
- (e) It is suggested that our Works procedure is slightly more elastic than the American equivalent. This elasticity is vital, as with frequent changes in procedure, a junior officer's task is made very hard.
- (f) Prior to the late war, Great Britain alone maintained a Works and Engineer store organization of any size. Now that this is no longer the case, it is believed that shortly it will be necessary for inter-Commonwealth exchange of ideas in this matter. At present this exchange of knowledge is limited very largely to the field or operational side of our respective organizations.
- (g) On a widespread construction programme, it was found essential for all Engineer officers to have a knowledge of store accountancy.
- (h) Service in a Commonwealth Force, as in B.C.O.F., is a most refreshing experience. The Commonwealth idea of its member nations serving together equally in a truly integrated force, pervaded every aspect of B.C.O.F. life and right from the C.-in-C. down to the children of the private soldier. Few will forget their impressions quickly—may they remember them for a very long while.

APPENDIX A.

ENGINEER ORGANIZATION



Notes : Above represents an average organization in December, 1947-February, 1948.

*On withdrawal of Brit. and Ind. Div., C.R.E. Okayama was replaced by an Aust. D.C.R.E.

[†]Located at Iwakuni.

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TERRITORIAL DISTRIBUTION OF ENGINEER ORGANISATION

PLATE I



"OVER THE ELBE AT ARTLENBURG"

By COLONEL R. N. FOSTER, D.S.O., O.B.E.

LITTLE publicity has been given to the crossing of the River Elbe in April, 1945, since at the time we faced a beaten and disorganized enemy and events followed swiftly to the final disintegration of the Wehrmacht. Also, the limelight had been stolen by the previous major river crossing operation over the River Rhine. The Elbe, however, was a formidable obstacle, enemy resistance was well sited and still determined and the crossing was certainly not without incident. The field of battle imposed a number of difficulties on the assaulting troops and these merit record.

The following account describes the action of the Engineer Formations in VIII Corps supporting the assault by 15th Scottish Division.

On 11th April the Commander of Eleventh Army Group R.E. reported to the Chief Engineer VIII Corps and was given the outline of the plan for VIII Corps crossing of the River Elbe. The exact sector of the river for crossing was not firm. The crossing might be in the nature of a scramble to take advantage of the disorganization of the enemy or might be more deliberate. Owing to the rate of advance of VIII Corps the available bridging equipment was limited if success was to be exploited forward of the Elbe. Forward troops had not yet closed the line of the river.

On 12th April, H.Q. 11 A.G.R.E. was placed under command VIII Corps and arrived complete on 14th April from the River Rhine to find VIII Corps H.Q. still moving. Meanwhile Commander 11 A.G.R.E. had visited H.Q. Second Army to inquire as to the availability of experienced R.E. formations and ferrying forward of essential equipment and plant. Bottlenecks appeared likely to be the provision of motor-tugs and armoured bulldozers. Air cover of the river was out of date and very limited, and the weather was unsuitable for photo recce. At this stage, planning could only be made from maps.

Topography

The River Elbe near Lauenburg and Artlenburg was about goo ft. wide, navigable to barge traffic, with water level high, since the peak level is normally reached in March with a steady drop until the autumn. The banks are dyked to ensure a constantly navigable channel, and on the north bank at Artlenburg stone groynes project out into the river. At Lauenburg there is a double tracked steel railway bridge and a good ferry site with paved ramps. Another ferry site exists at Artlenburg.

A 5-mile wide belt of alluvial clay borders the river on the south side, partly wet uncultivated meadow land, and partly "strip" farmland cultivated with numerous small parallel drainage ditches. The villages are closely grouped on the small areas of dry land. Cover is negligible. On the north bank the ground rises steeply to 140 ft. with wooded slopes, giving excellent observation over 10 miles of the flat southern border. A few roads and tracks lead down defiles to the water edge and the steep approaches through Lauenburg are narrow and twisted.

The Elbe-Trave Canal, between deep banks, joins the Elbe east of Lauenburg and restricts expansion of a bridgehead to the east.

Planning and Recce

By 17th April it was firm that the Corps would cross on the Artlenburg site to take Lauenburg from the rear, and that one Class 40 Bailey Pontoon Bridge would be built at the ferry site at Artlenburg and one Class 9 Folding Boat Bridge at Lauenburg.

The assault would be by L.Vs.T.; Stormboats to be provided as a reserve ferry and that three Class 40 Rafts and three Class 9 Rafts would be operated as ferries, each with one spare.

On 19th April 15th Scottish Division were selected to make the crossing, and 11 A.G.R.E. moved to their Divisional H.Q. at Barum. The possibility of crossing on the nights 19th-20th April or 20th-21st April by stormboats only was considered, and caused considerable readjustments to the R.E. plan, but this scheme was rejected after a discussion between Commander 15th (S) Division and the Corps Commander. On the morning of 20th April the date was settled to be NOT before 27th April. H.Q. 15th (S) Division moved to Scharnbeck and the Divisional Commander held his first planning conference at 1430 hrs.

Good photo cover now began to arrive.

15th (S) Division moved to the river on 20th April and recces for bridging and rafting sites were ordered from 21st April. Recce forward of the Neetze Canal could only be carried out by night since the enemy had observation over our side of the river.

Recce disclosed that the ground between roads was very soft and was unlikely to be suitable for L.Vs.T., also that the few tracks existing would not carry much traffic except in very dry weather. Sites for bridging were possible, though the approaches to the Class 40 bridge were steep and would require considerable work. North bank approaches were steep and restricted, but could not be recced since the enemy held close to the water's edge and bright moonlight prevented recce parties from crossing the river. Information was required on possible L.V.T. crossing sites, but L.V.T. recce officers were only available by 22nd-23rd April and, when they had completed their first recce, the whole regiment was moved to XXX Corps. Little but negative information on L.V.T. approach routes had been gained. The Sappers continued recces for L.V.T. approaches and crossing places. Cs.R.E. of 15th (S) Division, VIII Corps and Sixth Army Troop Engineers were all at hand and were briefed generally on their tasks and it was known that Seventh Army Troops Engineers would be available for the operation.

On 25th April, C.R.E. Seventh Army Tps. Engrs. arrived and also representatives of another L.V.T. Regiment. They were briefed and recces then went ahead.

It was found that the L.Vs.T would have to use the main roads for a considerable part of their approach and that little R.E. work was required, other than cutting the flood-bank in two places on the right brigade sector.

Despite a sudden alarm that the operation might take place on the night of 26th-27th April involving a modification to the plan, all Cs.R.E. were finally briefed at a R.E. co-ordinating conference held on the plan for a full scale crossing.

Seventh Army Tps. Engrs. came into concentration area on 27th April. Commander 15th (S) Division held a final conference on 27th April and 11 A.G.R.E. held a final conference on 28th April at 1100 hours.

Special recces had been ordered and R.M. Commandos had attempted to obtain the information required. Owing to the bright moon and some interference by the enemy, our swimmers could not obtain the full information required, but they did give valuable information as to the strength of the current $(1\frac{1}{2}-2 \text{ knots})$, nature of banks and bottoms on the south bank and general information as to the nature of banks, depth of water and slope of bottom on north bank, though they could not reach the exact north bank exits of bridge sites. Enemy swimmers were in the water at the same time.

In the hopes that unnecessary fighting might be avoided by the Boche surrendering, a German speaking young Marine Commando Officer was chosen to put the question to the Lauenburg garrison commander. He was briefed to explain their hopeless position, to tell them how soon the dreaded Russians might be expected, and to paint a vivid picture of the pretty river resort of Lauenburg under a rain of H.E. bombs if the Boche proved intractable. He was duly pushed off with a white flag in a motor boat one morning. The engine failed. The affable or curious enemy sent over a far more efficient craft and collected him. He was well received and given lunch, during which time he had a good look at the type of defending troops and endured a tale of woe from a German Officer who was a

naturalized American but had had the misfortune to be visiting Germany in 1939. The garrison commander assured him that their personal inclinations were all in favour of surrender, but that they must first obtain permission from their Corps Commander. Since our R.A.F. had so disrupted their communications, it took them two days to get a message to their Corps and back. He would let us know. He was too late.

Tactical Plan

To enable VIII Corps to secure a bridgehead over the River Elbe and advance to the capture of Lubeck, 15th Scottish Division were charged with the assault crossing and establishment of the close bridgehead. They were given the 1st Commando Brigade, the Royals and the 4th Armoured Coldstream Guards, an R.A. Group of two Heavy, four Medium, one Mountain and ten Field Regiments, and supported by a regiment and a squadron of Buffaloes (the latter an R.E. formation) and a squadron of D.D. Tanks.

Their plan was a night crossing by two brigades in Buffaloes at 0200 hours on "D" day after bombing of Lauenburg. On the left 44th Infantry Brigade were to cross on either side of Artlenburg and secure the high ground up to Schnakenbek. On the right the 1st Commando Brigade were to cross west of Hohnstorf to capture the dominating hill opposite, thence to swing right to the 70 m. hill north of Lauenburg, clearing the town from the rear to the river and attempting to capture the Elbe-Trave Canal bridge intact.

These bridgeheads were to be linked and then expanded by 227th Infantry Brigade crossing and passing through 44th Brigade, while 46th Infantry Brigade on the right were to cross and pass through 1st Commando Brigade.

Subsequent moves do not concern us but the bridgehead was to be further expanded with 15th Scottish Division spreading to the north-west and 6th Airborne Division to the north-east, while 11th Armoured Division made for Lubeck.

Engineer Plan

The Engineer plan for the operation was to provide the following crossings (see sketch):—

L.V.T. and D.D. crossing places including preparation of tracks, entries into and exits from the river.

A Dukw crossing at Lauenburg ferry site.

Two Stormboat Ferries, each of 12 boats, at Hohnstorf and west of Artlenburg.

A Class 9 Close support Raft Ferry of 3 rafts operating, and one spare, west of Hohnstorf.

A Class 9 F.B.E. bridge at Lauenburg.



A Class 40 Raft Ferry of 3 rafts operating, and one spare, at Artlenburg.

A Class 40 Bailey Pontoon Bridge at Artlenburg.

Boom Protection, firstly by thickening up the demolished bridge upstream, secondly, assisting the Naval Boom Party to provide a naval net downstream of all crossings when tactically possible. Site approximately 1,000 yds. downstream of Class 40 bridge site. Mine clearance of and construction of exits on the north bank up to the first lateral.

Maintenance of main axes south of the river in order to free 15th (S) Division Engineers for any task required within the bridgehead.

The plan involved the allotment of the following engineer troops:---

For preparatory work on routes and tracks on the south bank For mine clearance and preparation of exits on north bank.	2 Fd. Coys.	15th (S) Division
For two stormboat ferries For Class 9 Ferry and approaches	1 Fd. Coy. 1 Fd. Coy. + 1 Pl.	Sixth Army Tps. Engrs. with u/c
For Class 40 Ferry and approaches	1 Fd. Coy. $+$ 2 Pls.	257th Fd. Coy.
For Class 9 F.B.E. bridge and ap proaches and maint. of Dukw. Ferry	2 Fd. Coys. + 1 Pl. R.E. 1 Pl. Pnrs.	VIII Corps Tps. R.E.
Boom Protection	2 Pls. R.E.	-
Class 40 Bridge	3 Fd. Coys.	Seventh Army Tps. Engrs.
Maint. of main axes south of river	I Fd. Coy.	245th Fd. • Coy. of 5th Inf. Div.
R.E. reserve (at call)	1 Fd. Coy.	6th A/B Div.
This totals	13 Fd. Coys.	+ 6 Pis. R.E.

79th Armoured Division also made available 81st Armoured Squadron R.E. for the maintenance of L.V.T. tracks and exits. This served to free a Field Company of 15th (S) Division when it was required for any Engineer task in the expansion of the bridgehead. 81st Armoured Squadron was put in support C.R.E. 15th (S) Division.

Timings

Stormboats were to be dumped in selected hides on night D_{-2}/D_{-1} and ready to operate from " D " Day of oo hrs. if required. Infantry carrying parties were to be provided at each site.

Final preparations for L.V.T. and D.D. Tanks, i.e., cutting through flood-banks by explosives and bulldozers, were to be completed on D-1/D night before "H" hour.

On the Right

Class 9 Rafts were to operate 4 hours and the Class 9 F.B.E. bridge to be completed 15 hours after the capture of Lauenburg.

On the Left

From the time the building site was reasonably free from shell and mortar fire—

Class 40 Rafts were to be operating in 4 hours.

Class 40 Bailey bridge was to be completed in 30 hours.

Equipment

The Chief Engineer of VIII Corps had carried out a masterly operation of ferrying up bridging equipment from dumps stretching back to the banks of the Rhine, and a Bridge Company R.A.S.C. was available for transport.

Bombing

The planned bombing of Lauenburg had to be cancelled owing to adverse weather conditions.

Narrative of the Battle

Dumping of stormboats in forward hides had been successfully completed during the hours of darkness on the night of 27th-28th April by 70th Field Company of Sixth Army Tps., R.E.

Owing to the bombing programme being cancelled it was necessary to lay on an Artillery substitute to cover the blowing of the flood-banks and the approach of the bulldozers on 1st Commando Brigade front. The banks were blown and bulldozers commenced work. C.R.E. 15th (S) Division was at the site of work during this operation and, though a few anxious moments were experienced, the L.V.T. tracks through the flood-banks were completed and L.Vs.T. from all sites entered the water dead on time, "H" hour o200 hrs. 29th April.

The first call for Engineer troops and equipment came from C.R.E. Sixth Army Tps. Engrs. at 0415 hrs. asking for approximately half the Class 40 Raft equipment and main bodies of 69th Field Company. Commander 44th (L) Brigade was extremely keen that R.E. work should commence and "G" authority at Division was obtained to move off the column as requested at 0445 hrs. At 0420 hrs. C.R.E. Sixth Army Tps. Engrs. was instructed to call forward the column to move at 0445 hrs. Unfortunately the code-word passed by the C.R.E. was misunderstood and the column did not in fact cross the Start Point until o600 hrs. and did not arrive on site until 0715 hrs. The delay was most unfortunate, as it was hoped that this column would be free of the Artlenburg roads before the arrival of the first bridge serial for the Class 40 bridge. However, it was appreciated from the very start that traffic in the town would be extremely congested and in fact it reached saturation point. This was accepted as unavoidable, since there were two L.V.T. ferries operating and Class 40 Rafts and bridge in construction practically on the same site with only one approach route.

It was now clear that, in the course of the next few hours, calls would come in from all Engineer Commanders for troops and equipment. At 0530 hrs. O.C. 257th Field Company reported he was on site with recce party and as far as he could see things were going well in the Lauenburg sector but that he had not yet made contact with 1st Commando Brigade. At 0600 hrs. C.R.E. VIII Corps Tps. reported from right crossing control that the situation appeared favourable and he was proceeding to H.Q. 1st Commando Brigade. At about the same time C.R.E. Seventh Army Tps. Engrs. asked for the main bodies of his three Field Companies and the first bridging serial of 70 vehicles for the Class 40 bridge to be dispatched to arrive at 0800 hrs.

The situation was appreciated at H.Q. 11 A.G.R.E. that a bid for timings must now be made with "G" at Division and at 0615 hrs. the following provisional timings were agreed.

	Unit	Task	Column	Time to cross S.P.
(a)	Sixth Army Tps. Engrs.	Class 40 Rafts	Balance of Class	0645
(-7		•	40 Raft equipment	t
(6)	257th Fd. Coy.	Class 9 Rafts	Troops	0710
(c)	257th Fd. Coy.	Class 9 Rafts	Equipment	0715
(d)	Seventh Army Tps. Engrs.	Class 40	Troops	0700
1	, i B	Bridge		
(1)	Seventh Army Tps, Engrs.	Class 40	Equipment (First	0715
		Bridge	Column)	
(f)	VIII Corps Tps. Engrs.	Class 9	Troops	0730
	1 1 0	F.B.E.		
(2)	VIII Corps Tps. Engrs.	Class 9	Equipment	0740
107		F.B.E.		

By o630 hrs. all units were informed of the timings, which were confirmed by them with the exception of VIII Corps Tps. Engrs. The C.R.E. with 1st Commando Brigade was unable to obtain a decision regarding commencement of bridging operations and reported at 0715 hrs. that there would be at least two hours' delay on the timings for start of his columns as given. However, at 0830 hrs. C.R.E. VIII Corps Tps. asked if his columns could be dispatched forthwith. The O.K. for the columns to pass S.P. was passed to the Adjutant at 0840 hrs.

At 0830 hrs. C.R.E. Seventh Army Tps. reported that the head of the first bridging serial for the Class 40 bridge was arriving at Artlenburg but that congestion in the town would impose delay in moving the vehicles on to the bridge marshalling harbour. At the same time the C.R.E. asked if the Artlenburg right L.V.T. ferry as previously arranged with Division could be closed down, as any progress on the Class 40 bridge was entirely dependent on the closing of this ferry. Commander 11 A.G.R.E. immediately asked Commander 15th (S) Division for permission to close the L.V.T. ferry. This was granted and orders were given by 15th (S) Division to that effect.

257th Field Company reported at 0850 hrs. that troops and equipment were being deployed on site and the O.C. was proceeding to the far bank on recce. At 0945 hrs. a similar report was received from VIII Corps Tps. Engrs.

At this time the situation was reasonably quiet, with spasmodic shelling on the Artlenburg bridge and Class 40 Raft sites, all Engineer troops were deployed on their respective sites with all necessary equipment to complete their tasks, with the exception of Class 40 bridge. Two further bridging serials were required to complete the bridge. The detail of progress at each site is given in the Appendices.

Peaceful bridging operations, however, were not the order of the day. At 1100 hrs. the accuracy of the shelling on the Class 40 bridge site improved and casualties to men and equipment were suffered by Seventh Army Tps. Engrs. Bridging operations continued in spite of further shelling. It is worth mentioning that cranes and plant are most vulnerable under these conditions. Two Coles cranes were hit, one on the bridge site and one on the raft site and put out of commission for considerable periods. A bulldozer waiting shipment on the Class 40 Raft was also hit and damaged beyond immediate repair.

At 1315 hrs. a most determined effort was made by the enemy air force to damage the bridges and rafts under construction. A force of eight to twelve planes made a very low flying attack with bombs and cannon. VIII Corps Tps. Engrs. suffered heavy casualties to personnel—eight killed and twenty-two wounded. The bombing was extremely accurate and though the parts under construction were not actually hit, the damage to the immediate approaches caused the estimated time of completion to be retarded four hours. In fact, this timing was very much cut down and the bridge was finally opened to traffic at 2015 hrs. on "D" day.

Several more attacks were made before nightfall and at 1500 hrs. Sixth Army Tps. Engineers from the Class 40 Raft site reported casualties. Shelling at intervals carried on throughout the remainder of the day. In spite of this, however, at 2200 hrs. "D" day the

Sapper picture was reasonably bright—progress on the Class 40 bridge was continuing with completion time for 1200 hrs. 30th April. Two Class 40 Rafts were operating and by this time a total of thirtyfive tanks had been ferried over the river. The Class 9 ferry had opened for traffic at 1400 hrs. and by 2200 hrs. ninety-three vehicles had been put across. The Stormboating Company of Sixth Army Tps. Engineers had experienced a most disappointing day—the right stormboat ferry had not been used while the left had little employment. Permission was obtained to close both ferries at 1600 hrs. 20th April.

We had expected "swimmer" attacks on the bridges, since at Lubeck was the training school for the frogmen.

After completion of the folding boat bridge, the bridge guard spotted a man in the water, who made signs of surrender when aimed at. He proved to be a frogman who stated he was on a recce to find the exact sites of our bridges and that he had been forced to give up a long swim through our bridgehead, since his clothing had been torn on the barbed wire of one of our booms. Meanwhile, a Sapper sergeant found a cylindrical object tied to the F.B.E. bridge, but it slipped from his hands while he untied it, and sank.

The frogman's recce story was very thin in view of the number of enemy aircraft which had flown over our bridges, and it is probable that he had fixed a demolition charge.

At 1200 hrs. the following day the Class 40 bridge at Artlenburg was open to traffic in spite of occasional shelling, the fighter cover over the bridge was greatly improved and it was not until the evening that the enemy air force again approached. No damage or casualties however were suffered. By 1800 hrs. the majority of 15th (S) Division were across the Elbe and 11 A.G.R.E. reverted to command of VIII Corps. The build-up phase was now in progress and the battle to secure the crossing of the Elbe over.

COMMENTS

Selection of Formations

The advantage of having the same team as in a previous river crossing cannot be overstressed. 11 A.G.R.E. had supported 15th (S) Division in the XII Corps crossing of the River Rhine, and their staffs knew each other well. The L.V.T. Regiment, 11th Royal Tanks, was the same. Three of the four R.E. formations had taken part together in the XII Corps crossings, on the Rhine, and the fourth had been in the adjoining sector on the XXX Corps front.

As a result, endless discussions were obviated. C.Os. of each arm knew the other's requirements and were prepared to adjust their plans to effect the best compromise in cases of conflicting requirements.
Pre-Dumping of Equipment

If it is at all possible, without prejudicing surprise, Class 9 Rafts should be dumped forward on their sledges the night before the operation. Though this involves provision of towing vehicles the time saved in off-loading on "D" day is considerable. A raft section on a sledge is not too big to camouflage.

Congestion on Sites

Where the ground is not exceptionally dry, sites for L.V.T. vehicle ferries, raft ferries and bridge construction are usually very limited. As in this operation, the same site may have to be used for ferrying and then bridging. Clear priorities must be laid down by the commander, as to who may use the marshalling harbours and sites and when they must be handed over. Delay in construction must be accepted if sites are thus restricted.

Movement of Personnel and Bridging Columns to the Site

It is better for the C.R.E. having seen the situation and "G" approval having been obtained, to call his personnel column to the site. He should not have to worry about the Bridging Column other than to tell H.Q., A.G.R.E., when he wants them and send guides to the Bridge Company.

Bridging Columns should be held by the Bridge Company and dispatched to sites on the orders of the A.G.R.E.

Bridge Marshalling Harbours

The siting of Bridge Marshalling Harbours close to the river bank was exceptional in this operation and was only justified by the disorganization of the enemy.

CONCLUSION

Astonishing sights were revealed at the conclusion of the operation. The folding boat bridge had to be closed against forward traffic frequently to relieve the streets of Lauenburg which were choked with German prisoners walking into captivity. Beside the roads to Lubeck were thousands more, herded into fields with equipment of all sorts, waiting for orders for the next move. The Sappers left to maintain the bridges they had built over the lest major river in the North-West Europe Campaign, could justly feel that their efforts had speeded the end of the war.

APPENDIX "A"

CLASS 40 RAFT FERRY

29th April				
0715	Stores arriving on site			
0800	Construction started on first raft			
0800	Work started on approaches			
0900	70 per cent stores on site			
	Off-loading 50 per cent			
1000	Construction of two rafts 25 per cent			
1048-1103	Heavy shelling on site impeded work and caused			
	temporary damage to Coles crane			
1200	Construction 60 per cent			
	Approaches 90 per cent			
1300	Stores on site 80 per cent			
	Off-loading 70 per cent			
	Approaches 100 per cent			
1410	Two raft ferry operating			
1600	Complete ferry in operation			

NOTE: Work on this site was at times considerably delayed by enemy action, shelling and air attack and by L.Vs.T. concentrated in the area.

2000	Two rafts operating, one in reserve. No. of trips 29
2200	Two rafts operating, one temporarily u/s. No. of trips
	35
2359	Two rafts operating, one temporarily u/s. No. of trips
	41
30th April	
0200	Two rafts operating, one temporarily u/s. No of trips
	47
0400	Two rafts operating, one temporarily u/s. No. of trips
	53
0600	Three rafts operating, nil in reserve. No of trips 59
	U/s raft repaired and in service shortly before of oo hrs.
0800	Three rafts operating, nil in reserve. No of trips 82
1000	Three rafts operating, nil in reserve. No of trips 94
1400	Three rafts operating, nil in reserve. No of trips 121

After this time ferry was used occasionally as required, bringing back return traffic and casualties; the main traffic being carried by the Class 40 Bailey Pontoon Bridge opened at 1200 hrs.

N.B. At no time was a steady flow of traffic waiting shipment on the Class 40 ferry, hence any average turn round figures would give a false impression.

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APPENDIX "B"

CLASS 40 BAILEY PONTOON BRIDGE

Artlenburg

29th April Stores arriving on site and off-loading commenced 0830 1200 Survey of site and centre line of bridge laid Intermittent shelling on site, two panel lorries knocked out and Coles crane damaged. Casualties O.Rs. 2 killed and 3 wounded. Work on bankseats and west approaches started Construction of Floating Bays started 1500 Bankseats 75 per cent Off-loading 25 per cent 1530 Construction of south Landing Bay started 1700 Bankseats 100 per cent Off-loading 35 per cent South Landing Bay 40 per cent Construction of north Landing Bay started 1830 Stores off-loading 45 per cent 2100 South Landing Bay 95 per cent North Landing Bay 50 per cent South Landing Bay complete 2200 30th April 0600 North Landing Bay 70 per cent Construction of floating bays 40 per cent 0000 North Landing Bay 100 per cent Construction off-loading bays 80 per cent Floating Bays in position 60 per cent Bridge open to traffic. Improvements to approaches still in 1200 progress, but not restricting flow of traffic Traffic Using Bridge 30th April 1200-2000 1156 30th April-1st May 0200-0800 2095 (including 212 tanks) 1st May 0800-1200 2179 1st-2nd May 1200-0800 1985 Total for first 44 hours 7,415 vehicles including tanks Design;— South to North Landing Bay 80 ft. 0 in. EFB 41 ft. 6 in. 15 Floating Bays 42 ft. o in. each 1 Floating Bay 32 ft. 0 in. EFB 41 ft. 6 in. Landing Bay

> Total length 925 ft. o in.

100 ft. 0 in.

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APPENDIX "C"

CLASS 9 RAFT FERRY

29th April

- 0200 "H" hour
- 0430 Recce parties arrive. Routes, debussing points and advance park for equipment vehicles signed Confirming recce of building and ferry sites and taping of approaches completed
- o655 Order given by W/T for personnel vehicles to move up
- 0735 Order given for equipment vehicles to move up to advance park behind flood-bank
- o850 Equipment vehicles arriving Lauenburg reported clear. Orders given for building to start
- 0900 O.C. 3rd Platoon, 183rd Field Company, crossed in stormboat to recce far bank Platoons and equipment deploying on to sites 1st Platoon near bank approaches, 3rd Platoon 183rd, Field Company far bank approaches, 2nd and 3rd Platoons raft construction
- 0920 O.C. crosses to far bank selects ferry site and exit route L.V.T. exit found on far bank
- 0940 Herd of Buffaloes tramples far bank exit road
- 1000 Approx. Far bank Platoon starts reloading track material into L.Vs.T.
- First raft complete and ready for operation2nd Platoon switched to helping with stores for track on far bank
- 1130 Second raft complete but grounded
- 1200 Second raft ready for operation Near bank approach completed Far bank 75 per cent complete
- 1300 Far approaches complete, FERRYING STARTED; but first vehicle breaks surface of slipway which proves to have only a thin skin of cement Service suspended to 1315 hrs.
- 1315 2nd Platoon providing two raft crews 1st and 3rd Platoon construction third and fourth rafts 3rd Platoon, 183rd Field Company developing second exit on far bank
- 1320 Severe bombing attack. Two men slightly injured Raft crews dispatched to prevent fire from spreading to fuel store
- 1400 Ferrying re-started
- 1630 Third and fourth rafts completed and three rafts operating Second exits far and near bank complete

APPENDIX "D"

CLASS 9 F.B.E. BRIDGE

29th April

0945	Stores arriving on site				
1100	Survey and laying of centre line complete				
	Construction of south bankseats 40 per cent				
	Off-loading of stores in progress				
1300	South bankseats 100 per cent				
-	South Landing Bay System 50 per cent				
	Stores off-loaded 40 per cent				
	Construction of Floating Bays 30 per cent				
1500	Stores off-loaded 70 per cent				
-	South Landing Bay System 90 per cent				
	Floating Bay 45 per cent				
Not	E: Between 1300-1500 considerable delay and damage				
incurr	ed from bombing and air strafing.				
1700 Stores off-loaded 90 per cent					
	South Landing Bay System 90 per cent				
	Floating Bay 90 per cent				
	Approaches 40 per cent				
1900	North bankseat 50 per cent				
	Stores off-loaded 100 per cent				
	South Landing Bay System 100 per cent				
	Floating Bay 100 per cent				
	Approaches 70 per cent				
2015	Bridge open to traffic				
Traffic	Using Bridge				
	29th–30th April 2015–0800 840 vehicles 20th April–1st May 0800–0800 2 120 vehicles				

29th–30th April	2015-0800	840 vehicles
30th April-1st May	0800-0800	2,130 vehicles
ist May	0800-2000	1,308 vehicles

Total for 48 hours

4,278 vehicles

Design: ----

Shore Bay

Half Floating Bay to bi-partite pontoon pier

Landing Bay from bi-partite pontoon pier to two folding boats

45 Floating Bays

Landing Bay with two folding boats to bi-partite pontoon pier

Half Floating Bay from bi-partite pier to shore

Shore Bay

Total length of Bridge

980 ft. o in.



ARCTIC HITCH-HIKE

ARCTIC HITCH-HIKE

By "GREMLIN"

(See folding map at end of article for place names.)

The Start

 \mathbf{F} OUR Sapper Officers faced with long leaves and short purses decided during the summer of 1949 to visit Lapland. It was financial considerations, not the dictates of Imperial Strategy, that sent us to the north. Lapland however covers the northern provinces of Norway, Finland and western Russia, so I feel that the experiences of four Arctic tourists may be of some interest to the rest of the Corps.

The main objects of our holiday were fishing and mountaineering, but as we wanted to see as much of the country as we could we took our bicycles.

A Hull Fishing Company was kind enough to give us a lift, and so at a very early hour on the morning of Sunday, 17th July, our two trawlers nosed their way into the Norwegian harbour of Vardø.

The watery sun was high in the sky and rain squalls were sweeping across the sea. Immediately in front of us a towering sheet of misty rain was turned to a golden haze by the sun and reflected shimmering upon the sea. In the distance the low dark coast was bare and desolate, broken here by a patch of dirty snow and there by the deeper blackness of more distant squalls of rain.

On the point of a small island, emerald green with salmon-berries, a white wooden lighthouse showed us the way towards the haven. As we got nearer the wireless masts rising high above the wooden houses of the water-front came more clearly into view. Soon the unmistakable smell of fish drying on the wooden platforms around the harbour told us that our sea voyage was almost over. Captain "Coastwise," my travelling companion, was not sorry to set foot upon dry land. He had been horribly ill throughout the voyage and had lain in his sleeping-bag looking like death.

The trawlermen helped us ashore. The Norwegian harbour officials were just finishing a party on Aquavit which looked, smelt and tasted like petrol. We brewed up in a hut and waited for the Customs. The Customs Officer who spoke good English arrived about 6 a.m. We were the first tourists that he had ever had and our presence rather surprised him. He gave our luggage a cursory inspection and passed us on to the police. The police were even more helpful and we were soon equipped with ration-cards, sweet-coupons, and all the other concomitants of civilization. Then, going into the town we sought accommodation for what remained of the night.

Vardo to Vadso

Vardø was a town of about 2,000 inhabitants. It had been completely destroyed by the Germans when they abandoned north Norway in 1944, and was being steadily rebuilt. The houses were mostly wooden huts of various sizes, some of them large and comfortable. There was a fair shopping-centre, a big school and a wellequipped hospital. There was however only one hotel, a Salvation Army Rest-house converted from a German barrack-hut. Here we got one room. Coastwise was all in so he was put to bed, while the rest of us dealt with the baggage.

At nine o'clock we had our first taste of Norwegian food when we breakfasted at our hotel—boiled eggs and coffee, smørbrod and creamy milk. Smorbrod was a Norwegian institution which we were soon to know well. It was an hors d'œuvre of cheese and fish dishes eaten with several varieties of bread and real butter. It often included smoked salmon and nearly always a dark honey-coloured cheese with a strong flavour all its own. When in Norway, doubtful and hungry, order smørbrod, you can't go wrong.

Vardø is on a small island and the next boat to the mainland did not sail until evening, so the rest of the day was spent in exploration. We climbed the rocky hill above the town and inspected the ruined remains of the German defences and radar post. From the summit we could look castwards across the town of shacks and rising concrete buildings to the barren mainland flecked with drifts of snow. Eastwards far across the grey sea we could see the darker shadow of the Ribachi Peninsula, our first glimpse of Soviet Russia.

After lunch, we caught the afternoon ferry. This turned out to be a small "Puffer" with a fair turn of speed. A couple of passengers had to jump into a row boat off one of the mainland settlements where the water was too shallow to get alongside, but we were landed safely on the wooden quay at Svartnes.

Captain "McHaggis" and Major "Panda," who had come on the other trawler, bicycled north to try the fishing in the streams running into Persfjord. Coastwise and I pushed southwards.

Coastwise had taken a new lease on life after his day in bed, and I must admit to being a poor cyclist. Anyway for me the rest of this day was a chapter of disasters. First my three-speed gear gave up. Then the weight of my kit buckled the carrier of my bicycle so that it acted as a brake. The road was of rough gravel and our machines had thin British tyres which sank in deeply. (Later we learnt that the locals use broad low-pressure tyres which are easier to pedal and more comfortable to ride.)

Continual showers of rain swept down from the hills and soaked us to the skin. At first the road climbed steeply over the shoulder

of the Varanger Halvøen, but beyond Kiberg it hugged the edge of the fjord and ran for miles along the almost level strip of coastal plain. It was a dead and eerie land with the midnight sun shedding a ruddy and unreal light on a scene reminiscent of H. G. Wells' *End of the World*. On our right the bare treeless hills sloped down to the marshy plain, where mosses, lichen and dwarf alder struggled to survive. On our left clumps of reeds bordered the flat lifeless waters of the fjord and across this glassy surface, roscate with the reflections from the clouds, we could see the stark barren cliff of the southern shore dull red in the glare of the sun. Only the gravel road across the tundra seemed to show that life existed still.

From time to time we did pass isolated farmsteads where a pocket of fertile ground permitted the raising of hardy crops and the keeping of animals. Eventually, wet and weary, we sought shelter at one of these farms. It was a big cluster of buildings on the water's edge, some half-mile from the road. The farmer spoke no English, my Norwegian is rudimentary, but friendly relations were soon established and we were shown into the best room. Here amid a welter of Victorian bric-à-brac I unpacked our kit and prepared to sleep.

In the kitchen where the farmer's wife continued unconcernedly to suckle her babe we asked permission to cook upon the stove, and Coastwise discussed the transport situation with the farmer. This conversation can only be mimicked not described, for neither spoke a word of the other's language. The results however were electrifying. A bus was coming. It would be here in a moment. It was in sight now at the turn of the road. We wanted to catch it. The old farmer leapt on to his bicycle and pedalled down to the road junction. The bus-driver, happy to help, turned off his route and drove up to the farm. Our kit was still scattered all over the best room.

While Coastwise superintended the loading of our bicycles on to the roof of the bus, I piled all our kit into my unrolled sleeping-bag and hurried from the house, the whole paraphernalia flung across my back, like Santa Claus without the beard.

The rest of our journey was uneventful. The bus was filled with a selection of the racial types to be found in Norwegian Lapland. Broad flat-faced Finns rubbed shoulders with tall Norwegians whose tanned faces were darker than their blond hair. Lapps in black clothes edged with red and orange cloth talked quietly in their strange tongue, which like Finnish is related to Hungarian and nothing else. The bus-driver wore the red insignia of the Norwegian Communist Party.

In spite of the rough nature of the road and the frequent bridges, many of them improvised since the departure of the Germans, we travelled fast. At about one o'clock in the morning we reached Vadsø and the bus obligingly dropped us outside the best hotel.

Vadsø to Kirkenes

The hotel proved to be a fine two-storied wooden building with concrete foundations. Several large modern cars were drawn up outside. While Coastwise marshalled our luggage I rang the bell. After some time an attractive young lady in a night-dress who spoke a little English came to the door.

Yes, we could have a room, but as the hotel was not yet fully furnished there was no linen on the beds, did we mind? "No," said I, pointing to our sleeping-bags, "we did not mind."

We gathered our bags and followed her up the clean pine-scented staircase to a comfortable little room complete with hot and cold running water. Two hundred and fifty miles north of the Arctic Circle one could ask no more.

Next morning we rose late and after another excellent egg and smørbrod breakfast we looked at the town.

Vadsø is the capital of Finmark, the northern province of Norway. It was about the same size as Vardø and had been knocked about by the Germans in much the same way. Reconstruction had been quicker here and already a fine new reinforced-concrete shoppingcentre had sprung up. There was a fair-sized harbour well protected by a string of small islands, and there was the inevitable wireless station, school, and hospital. A large bank near the harbour cashed our travellers cheques.

About midday we set off on our bicycles along the coast road which ran westwards to the head of Varanger Fjord. We determined to try the streams for trout and return to our hotel for supper.

As we cycled out of the town it was obvious that the countryside had undergone a significant change. The hills above the road were still naked and boulder-strewn, but in the hollows and along the sides of the streams there were straggling copses of silver birch and dwarf willow. In places there were lush green meadows and fields of hay and potatoes. At Jakobselv there was a large village, perhaps half the size of Vadsø. Here we stopped for lunch. I tried to get permission to cook in one of the houses, but had considerable difficulty with the language. Jakobselv is a Finn settlement, and although my Norwegian is execrable, my Finnish is non-existent. At last we were rescued by the school-teacher, who took us to his flat above the school-house. Here, he and his wife shared their meal with us. They turned out to be on their honeymoon, and as I inadvertently broke one of their wedding presents, while helping with the washingup, we must have been a grave imposition.

Thanks to this diversion the start of our fishing was delayed, but we got a bus back to Vadsø all right in the evening, our bicycles balanced on the top as usual.

The next day we caught the morning bus down to Varangerbotn

at the head of the fjord, where the Vardø road joins the Arctic Highway from Narvik to Kirkenes. It was a dull grey day and drizzled most of the time. Varangerbotn proved to be a single café with a petrol station at the road junction. We had to spend most of the day waiting for our connexion, so to kill time we cycled up the road a little way towards Skipagurra. Here we ran into real tundra country—miles of marsh with rocky outcrops and scrubby bushes. The only thing that seemed to thrive on it were the mosquitoes. We returned to the café.

In the evening, promptly to time, the Polarbil arrived. These vehicles, running six days a week, cover the distance from Narvik to Kirkenes in three days. They are big luxury coaches, diesel-driven, carrying thirty-four passengers and their luggage. Our bicycles were hung nonchalantly on the radiator and we were soon on our way.

Áround the head of the fjord the birch woods were taller and more prominent, and the water meadows were strewn with golden buttercups. Then as we started to climb into the hills bordering the southern shore of Varanger Fjord the country changed again. Here on the north slopes there were great flat surfaces of smooth stone with only an occasional spray of lichen clinging to the vertical face.

We emerged on a plateau overlooking the fjord at Karlbotn, then dived into a maze of misty crags and island-studded lakes. From time to time we would pass the head of some lesser fjord stretching deep into the heart of the mountains. At Neiden Kla we crossed a great salmon river tumbling in a broad foaming torrent between birch covered banks.

It was here that we were joined by that funny little man that we came to call Arthur Askey. He spoke fairly good English and we were soon in deep conversation. He was a Lapp although his blond hair bespoke a mixed parentage. He had learnt his English as a salmon ghillie on the Pasvik River in the days when Petsamo province had been a part of Finland. Now he was living at Ivalo and had just walked across the frontier to do business in Norway.

We were keen to fish in Finland and had obtained visas before leaving London. "A.A." was returning in a day or two, so he agreed to guide us back across the frontier. He gave us an address in Elvenes, where we agreed to contact him when our plans were settled. Soon afterwards he left the bus at the cross-roads above Kirkenes.

Kirkenes and the Russian Frontier

Kirkenes is an iron-mining town which is being rapidly developed. It is hoped by 1951 to be turning out a million tons of ore a year. This gave the town a "Dawson City" aspect that we found nowhere else in Lapland. Here there were more people than houses, and the efforts of the population were directed towards improving the mine rather than improving their streets, so that horses and long low carts dragged through the mud between ramshackle wooden buildings. The hotel was a series of small two-room huts rather like overgrown packing-cases, with a single large hut housing the restaurant and the staff. The restaurant itself was hung with synthetic glass chandeliers and illuminated with garish strip-lighting which added to the "Dawson City" effect.

Next morning after breakfast we went down to the harbour where we met Panda and McHaggis. Their bicycles had proved even less reliable than ours, and they had crossed Varanger Fjord the previous night in a small fishing boat from Vadsø.

We took them back to the hotel, and lunched in the restaurant. Thick salmon steaks swimming in butter were placed before us. The more we ate, the more we were given, until we could eat no more.

When we had recovered, Panda and I hitch-hiked out to Langfjord where we fished in the tidal waters of the fjord at its narrowest point. Here it was only 50 yds. wide, with high precipitous banks covered with birch and small boulders. An improvised pile bridge crosses close to the derelict remains of the old stone bridge destroyed by the Germans.

We caught several sea-trout with wet fly, but the fishing was not good, so we hitched across to Elvenes to look for "A.A." Our destination turned out to be a low log cabin on a small hill. A quaint old man with a gnarled, weather-beaten face and half-moon spectacles, who looked like the wood-carver in *Pinocchio*, opened the door. He told us that "A.A." had gone on to another house near the Russian frontier, and he drew a small sketch map to show us the way.

We walked on down the road towards Boris Gleb. Boris Gleb is a monastery of the Orthodox Church situated on the west bank of the Pasvik River. In the days when Petsamo province belonged to Finland, Norway had permitted this small community to become a part of Finland. Now it forms a Russian bridge-head over the Pasvik.

Ever since we landed in Norway we had heard terrible tales about this frontier. The further that we were from the border the more exaggerated were the tales of Russian brutality. A great swath was cut through the forest we were told. "Anyone who steps into it is shot, even on Norwegian soil. Animals that stray across this frontier are never heard of again. Fishermen driven ashore on the Ribachi Peninsula never return to their families."

At the frontier, when we arrived, there was nothing special. The gravelled road running down to Boris Gleb was disused and overgrown. A triple concertina fence stretched through the forest down to the Pasvik and climbed over the rocky shoulder out of sight. On one

side stood the Russian frontier pillars and on the other the Norwegian. Across the road ran a single coil of dannert, partly trampled down, and a few strands of barbed wire. There was no Norwegian frontier post, there were no Norwegian frontier guards. The road beyond the frontier ran straight down through the forest until it disappeared behind the edge of the hill. There was not a Russian in sight. There was not a Customs post in sight. In the distance, half hidden by the foliage, there was something that might have been a pillbox, but it was apparently unmanned. If animals do stray across, the Russians return them via the Norwegian Army. So much for this *terrible* frontier.

While we were still looking for signs of Russian patrols "A.A." arrived in a decrepit car, driven by the "Wood-carver." We discussed the proposed journey.

Broadly speaking there are four routes into Finland from the north. The first is by the good gravelled road running south from Banak, via Karasjok to Inari. The second is up the Tana River from Skipagurra and thence by road from Utsjoki or Outakoski. The third is the way by which "A.A." himself had come, over the winter roads from Neiden Kla to Lake Inari, a cross-country journey of thirty-five miles. Finally there is the route down the Kirkenes Appendix to Vogterboliger and across-country to Lake Inari, a journey of thirty miles but less well marked.

"A.A." was keen for us to go by the Neiden route which he knew best. We wanted to go in by the Kirkenes Appendix and out via the Tana as we thought that the round trip would be more amusing. "A.A." reluctantly agreed and promised to come to our hotel to collect us in two days' time.

Panda and I, well satisfied, now tried to get a lift back to Kirkenes, but ended up by walking most of the way.

The next day, leaving Panda to fish, McHaggis, Coastwise and I took a bus to Jarfjord. We crossed the Pasvik River on the improvised bridge at Elvenes, where a fine looking suspension bridge was in the course of construction. Skirting the Russian frontier, we drove through miles of birch forest with occasional glimpses of mountain and fjord. The journey was uneventful and we still saw no Russians.

That evening Panda had the courage to take a Norwegian public bath. He sat in a steam-filled room in which benches rose in tiers towards the roof. The higher he climbed the hotter it got. When he was thoroughly steamed, he had a cold shower and came out. He was lucky. He went for his bath at night just as it was closing down. If he had bathed at a more conventional Norwegian hour, the brawny female bath attendant would have got to work on him with birch twigs to make sure that he perspired sufficiently.

On 22nd we packed up in Kirkenes, sent our bicycles by bus to meet us at Skipagurra, and our heavier kit by mail steamer to Hammerfest. While at Kirkenes we had had our dirtiest clothes laundered. The good people who did it refused all payment.

In the late afternoon we caught the bus to Vogterboliger. "A.A." was with us but suffering from a terrible hangover.

As we drove south the forests thickened before our eyes. Birch and poplar became interspersed with fir, spruce and pine, stunted at first but soon towering above the birch forests and ultimately displacing them entirely. Here and there among the trees were rich green meadows with cows grazing. From Svanvik we could see the new Russian mining settlement of Mikkelstad, and beyond Svanvik the road ran close to the Pasvik River which here formed the boundary.

From every hill top on the Russian side wooden block-houses with cleared fields of fire covered the frontier, but they were too far off to tell whether or not they were manned. Of border patrols we saw no signs.

At Skogfoss we got out of our bus to look at the beautiful falls tumbling over the rocks in a torrent of yellow foam. At Vagatem our passports were checked by the Norwegians, and soon afterwards at Elli Lompoli just north of Vogterboliger we finally debussed.

Into Finland

At Elli Lompoli, "A.A." tried to hire pack horses to carry our rucksacks to the frontier, but he was unsuccessful as the route was much too bad for horses at this time of year. We therefore shouldered our rucksacks and set out westwards.

After about two miles we came to a lumber camp on the edge of a lake. The lumber-jacks were friendly and hospitable. They allowed us to cook our evening meal in their workshop, and offered to allow us to sleep in their cabin. Having seen the interior of their cabin, we politely refused, and laid out our sleeping bags on the pine covered hill behind the camp.

We slept well under our mosquito nets and next morning arose at six-fifteen to make breakfast. "A.A." who had spent the night in the lumber-jacks' hut, had borrowed a boat so that we were able to row the first mile and a half down the lake, instead of having to scramble along the shore. The boat leaked badly so that we were glad to reach the other end in safety, for in spite of our baling the floor boards were soon under half an inch of water.

From the landing stage a corduroy road led across the marshy ground towards the forest, but once within the woods we soon left it and took a track down to the Føleven River. After we had crossed on a narrow bridge of logs we lost the track and had to pick our route up craggy ridges, through forests of birch and pine, then down into marshes and boulder-strewn river beds. Eventually we found another track which brought us down to Tørfurutj, a couple of deserted cabins beside a lake.

Here "A.A." had hoped to find a boat to help us on our way, but we were unlucky. We brewed up and ate lunch of sardines and biscuits. Then we began a tedious journey round the lake, crossing streams by balancing precariously on boulders, and marshes with less success by stepping on tufts of grass. Once we saw a reindeer swimming in the lake. A big beast with wide antlers and a shaggy coat which streamed water as he pulled himself out on to one of the innumerable islands.

It soon became evident that our guide did not really know where he was and his rather humourous turns of phrase began to pall as we imagined ourselves walking round for ever amid trackless forests and mosquito infested lakes. Panda and McHaggis took over the map-reading, but this was now complicated by the fact that no one knew where we were, and the compass was totally inaccurate owing to our closeness to the iron ore deposits.

"A.A.'s" brilliant remark, "We are here!" as he pointed to the ground at his feet, was not appreciated. His later remark, "For the first time to-day, we are on the right road," would have been better received if he had not set off due north, when our course lay to the south-west.

Eventually after several false starts we decided to dump our kit and search about until a suitable track was found. On his first cast "A.A." discovered the winter road from Kirkenes into Finland, and we followed it hopefully.

These winter roads are a feature of the European Arctic. They are broad tracks cut through the forest from lake to lake so that in winter a sledge can travel fast across the smooth ice and beaten snow. In summer they form convenient land marks and can be followed on foot. They are unsurfaced, however, and drive straight over marshes and boulder fields which in winter will be frozen or deep in snow. The lakes provide easy travel so long as a boat can be found, but where there is no boat the journey through the thick forest that borders it can be most arduous. On this occasion we were lucky and the road led straight to the frontier. The frontier was marked by a fire-break through the forest, and there were no frontier guards for miles.

About three miles beyond the frontier we came to the Finnish settlement of Piilola. This was a cluster of cabins set in the midst of green meadows on the edge of another lake. The men were away felling trees, but as "A.A." was a friend of one of them, we were taken into the clean warm cabin, full of dogs and children. We were given fresh milk and raw dried fish, the latter was nourishing but unappetizing. We brewed tea, and after unsuccessfully trying to look bright and cheerful, we fell asleep on the floor.

At eight-fifteen we started off again, this time in two small boats paddled by the Finns. They took us four miles on our way down the lake. The water was smooth and dark and covered with fir clad islands. On either shore as far as the eye could see there was nothing but endless forests of pine and fir.

At the far end of the lake we picked up the winter road again and "A.A." set off down it at a tremendous pace. Tired as we were and heavy laden, we had considerable difficulty in keeping up. We were therefore doubly angry when "A.A." in an excess of zeal overshot the road and could not find it again.

For hours we wandered in the twilight of the forest. It rained. We stumbled knee deep through morasses. Panda was the only one who really kept us going. It was he and "A.A." who found the settlement of Kassevono for which we were searching. He cooked our dinner so that when we arrived it was almost ready. We ate it in the shelter of our sleeping bags and fell asleep. It was three in the morning.

Kassevono to Inari

When we awoke next morning we had time to look around. Our sleeping bags were spread under a clump of pines. Below us the ground dropped steeply away to the water's edge. The hamlet of Kassevono consisted of some half-dozen houses, and a low wooden jetty. It was built on the shore of a narrow bay running in from Lake Inari, and across the bay the trees climbed the hillside in rank on rank.

After breakfast Panda borrowed a boat and went fishing in the bay. He caught several large grayling by trolling for them. Meanwhile "A.A." had got a passage for us on the post boat to Nellimø.

"The post does not go until to-morrow," he explained, "but as we are here to-day, it will go to-day !" And it did.

The Finns had not much idea of time, however, and it was not until three hours after we had been told to be ready that we finally pushed off. The post boat was a large motor boat which wound its way in and out among the settlements along the coast, collecting packages and bundles of letters. At one place an old gentleman came out in his pyjamas and balanced on a rock to pass his mail to the boat. At another, we went ashore and were surprised to find copies of *Punch* and the *Illustrated London News* in one of the cabins. The owner was away, but after a brief search among the surrounding islands we found him fishing. He was a cultured Hungarian with a bristling red moustache who was acting as ghillie to a Dutch business man and his wife.

We reached Nellimø after a cold journey, for the sky was overcast and there was a bitter wind. As we entered the bay we were just in time to see the bus that we had hoped to catch disappearing round the corner. The next bus was not until the carly hours of the morning, so we went to a café and, after a supper of hard boiled eggs and weak Finnish beer, we slept on the floor.

The bus on which we finally travelled to Ivalo had just come from the Russian occupied town of Virtaniemi, five miles away. Here the Finns were constructing a big hydro-electric plant as part of their reparations to Russia.

We arrived in the early hours after a fast ride over a bumpy road. The two biggest hotels were full, but we got a room in a clean little hostel outside the town.

Ivalo is an important road junction on the tourist route from Sweden to Nordkap. It is about the same size as Vardø and lies on the flat cultivated land at the mouth of the Ivalo River. There were several shops and a bank. It was interesting to note that postcards of Marshal Mannerheim were still on sale, and nowhere was there any sign of the police state. Indeed, having entered the country without passing a frontier post, we felt that we ought to report to someone in authority as soon as possible, but people in authority were hard to find.

After a prolonged search we discovered the police station, a pleasant pinewood chalet, behind the post office. I walked in and wandered round. At last I found a dark haired girl in a flowered frock, who appeared to be the only inhabitant. Conversation was limited as she spoke neither English nor Norwegian. I showed her our visas, pointed out to her on the map the route by which we had come, and she stamped our passports. No one else appeared.

We had lunch at the four-story tourist hotel in the centre of the town—beef steaks and Finnish beer.

As the next bus did not leave until the following morning, we told "A.A." to arrange transport for us to Inari. Shortly after lunch he arrived back, breathlessly.

"Hurry ! Hurry !" he said, "Car ready now !" And off he went to collect his own kit.

The old road bridge over the Ivalo River had been demolished so we crossed on a rickety wooden foot bridge. All motor vehicles were still being ferried over. On the other bank we found an aged 15-cwt. truck with plywood top and sides. There were already more than a dozen people crowded into it on piles of baggage. We could hardly believe that this was meant to be our transport, but soon "A.A." came bustling along and told us to get in quickly as they were waiting for us. Our rucksacks were tied insecurely on the roof, and we all bundled in. Immediately the truck drove off in a cloud of dust and our companions started to sing.

Now that we had time to take stock of the situation, we found that we were sharing the truck with a Finnish girls' choir. The Finnish girls' choir appeared to be nearly as intrigued by us as we were by them. "A.A.," the only person who could understand what each party was saying about the other, spent most of the journey convulsed with hysterical laughter. The girls came from a small village in the mountains near the juncture of the Finn, Swedish and Norwegian frontiers, 120 miles from the nearest motor road. Each year the choir makes a tour of Lapland singing from church to church. They carried their belongings in rucksacks on their backs, and the walk which they must have made before even starting their motor-tour made our little trek from Elli Lompoli look pretty silly.

As we bounced along the rough roads they sang song after songfolk songs, hymns, marching songs, and once what appeared to be a bawdy drinking song, which they stopped in the middle as it was not quite suitable.

About half-way to Inari the truck pulled up on a rocky ridge beside a small lake. On our right was a steep, pine covered hill with a rough foot-path leading upwards among the boulders. Soon our travelling companions were scrambling up like mountain goats, and we followed them wondering what it was all about. Near the top three huge rocks had fallen together to make a diminutive cave, and here in the winter the bears hibernate.

Each person in turn climbed into the bears' cave and out through one of the side crevices. Panda disgraced the party by setting up the most horrible hullabaloo as soon as he was inside—whether in imitation of the bear or from claustrophobia, we were left in doubt. There was a Bear's Visitors' Book, which we were expected to sign, and when McHaggis wrote "Scotland," Panda had to cap it by adding "English bear—First Class."

When we got back to the truck the girls asked us to sing our National songs. Unfortunately none of us had a musical ear, so we had to disappoint them. I did my best to atone by giving a performing flea circus in mime. This was a great success, but only, I think, because every time the truck went over a bump my head hit the roof with a sharp and painful thwack.

Inari, Karasjok, and Outakoski.

It was evening before we reached Inari, where we found a small tourist hotel by the lakeside.

The village was little more than a scattered farming community with a few shops and a petrol station. It was also a stage on the Finnish Airmail route, for we saw a seaplane land to deliver the post.

In the hotel we held a conference to consider our finances, which were now becoming a serious problem. This was because we had only been able to get a few Finnish travellers' cheques. In the end, we decided that we would have to keep "A.A." until we got back to Norway where we could cash the money to pay him his wage.

Next morning we caught the bus for Outakoski. We crossed the Inari river on a footbridge over the reconstructed piers of the



Photo 1.- The Russian frontier near Elvenes.



Photo 2 .- Insignia on the Russian frontier pillars.

Arctic Hitch-Hike 1,2



Photo 3.-Suspension bridge over the Tana below Skipagurra.



Photo 4.- The Outakoski road beside the River Tana.

Arctic Hitch-Hike 3,4



Photo 5.-Our bus crossing the Inari river.



Photo 6.-Crossing the Finnish frontier.

Arctic Hitch-Hike 5,6



Photo 7 .- "The " Hotel " at Kirkenes.



Photo 8 .- Aboard the trawler homeward bound. Last view of Honningsvaag.

Arctic Hitch-Hike 7,8

demolished bridge. The bus crossed by ferry. At first we drove northwards through flat country with marshes and lakes bordering the road on either side. At Kaamanen the road forked, the righthand branch leading to the Tana near Utsjoki, while our route swung westerly and climbed over the shoulder of Peldoaivi. Soon we left the firs and pines behind and as we neared the limit of the tree line only dwarf birch and stunted alder groves broke the barrenness of the hills.

Then dropping into the Tana valley at Karingasniemi we were stopped by frontier officials for the first time. Here the tourist road to Nordkap crossed the Tana into Norway and there was a small Finnish Army Post. The young lad who asked us to report to the Passport Control Office looked cold and pinched in his thin grey uniform.

From Karingasniemi our bus followed the Finnish bank of the river north to Outakoski. Here "A.A." arranged for us to sleep in the attic of the big tourist hotel, no other rooms being available. Soon a tourist bus full of Swedes and Frenchmen arrived. They had an enormous dinner in the hotel restaurant, which we shared. There were five large courses including salmon steaks again.

Karasjok was the centre of the Norwegian Lapp Reservation and only fifteen miles from Karingasniemi across the frontier, so when the organizer of the Swedish party offered us a lift, we gladly accepted. "A.A." who was conducting a spirited affair with the cook volunteered to remain behind.

This bus was even larger than the Polarbils, and was equipped with a radio-gramophone for use on the move. The woman in charge spoke four or five languages with apparent ease, certainly her English was flawless.

Karasjok was a disappointment. It was a straggly northern township with wooden huts clustered on either side of the Karasjok river. A German equipment bridge spanned the river and a stone war memorial commemorated Partisan activity in the spring of '45. There were a sprinkling of Lapps in their traditional costume, but no more than in other parts of Lapland.

Returning to Outakoski proved difficult. Both motor boats and taxis could be hired, but neither were immediately available. We got a hitch on a lorry for four miles but had to walk the rest of the way to the Norwegian Customs House. From here we were able to get a Finnish taxi back to our hotel, arriving about midnight. "A.A." and the cook had a meal ready for us.

"A.A." had intended to sleep with us in the attic but when he discovered that we were going to open the windows, he warned us that it would give us terrible headaches, and departed hastily to sleep elsewhere, presumably with the cook.

Down the Tana

Shortly after midday we left the hotel for Onnela in a Finnish post boat. This was a 24-ft. wooden canoe with a 20-h.p. outboard motor. Such vessels are common in Finland, almost every family possessing one or more. We five were huddled together forward. Amidships there was a high pile of mail The postman and another passenger were aft. We only had a couple of inches free board, but this did not seem to worry the Finns.

The river here was 100 yds. across with a swift current sweeping over a sandy bottom. At that time of year the snow had all melted from the hills and the river was low. In places where the channel was deep and clearly defined the canoe would drive forward at full speed throwing up a cloud of spray from its sharp bow. Often however we had to nose our way slowly over sandbanks or drift down the rapids with our engine cut. Sometimes we scraped the shingle, and sometimes we grazed past rocks where the water bubbled and foamed. On either side the banks rose steeply to several hundred feet, covered with birch forests, so that we were reminded of a Burmese river with its bamboo jungles.

About seven-thirty we stopped for a meal at a small log cabin. Here we had the finest smørbrod that we found anywhere in Lapland, smoked salmon, dried reindeer, eggs, fish, bacon, cheese, and thick country butter. It was followed by delicious fish cakes made from finely ground fish and quite different from their British counterpart. Vegetables being scarce in the north, potatoes and macaroni were served instead. The meal ended with curds and whey washed down with excellent coffee and glasses of fresh milk.

We settled back into the canoe to sleep but were out of luck, because a few miles further on we came to the first really dangerous rapids. Here we had to get out and make a $2\frac{1}{2}$ -mile detour on foot, while the postman poled his canoe down through the turbulent water. In spite of a good road McHaggis and I managed to get lost and were not popular with the rest of the party.

We reached Onnela half an hour after midnight and "A.A." got accommodation for us in the wooded hut that served as a tourist hotel. It was an attractive spot among the birch trees on a cliff overlooking the junction of the Tana and Utsjoki rivers. Unfortunately it was alive with mosquitoes who were remarkably clever at penetrating our nets.

As no post boat was going south next day, we set off after lunch in another motor canoe hired for us by "A.A." This took us to the next big rapids in a swift two-hour journey. Here we were shown into a clean little house where we had tea.

"A.A." organized the next stage of our journey by telephone. There was no transport available on the Finnish side of the river to

take us the six-mile detour round the rapids, and no Finnish boats were leaving the foot of the rapids before morning. However, it was possible for a Norwegian lorry to collect us on the opposite shore and take us round that way to the next village where a Norwegian motor canoe would await us.

Panda stayed behind to fish the Tana with "A.A." as his ghillie. The rest of us pressed on as McHaggis and I still hoped to get some mountaineering on the west coast. A young Finn ferried the three of us across the river and in due course our lorry arrived.

It was extremely ancient and in grave need of an overhaul. Indeed it broke down twice during our short journey. The road itself was being repaired. At last we reached the village safely and found our canoe waiting.

The Tana was deeper and wider here and the canoe was able to run at full throttle all the way to Skipagurra, except where it slowed down to cross the shallows at Polmack.

At Skipagurra we lodged in the tourist hotel. This was also a Norwegian Army Headquarters and I shared a room with two Norwegian officers both of whom had served with the British Army during the war.

Next morning with the help of the Norwegian Army we were able to cash the last of our travellers cheques. This put an end to our financial difficulties. Our bicycles and baggage also arrived safely from Kirkenes.

Coastwise decided that he could not face another five days aboard a North Sea trawler and left on the midday Polarbil to catch a mail boat through the fjords to Bergen.

McHaggis and I left the heavy baggage for Panda and set off on our bicycles for Hammerfest.

Hammerfest, Honningsvaag and Home

It was a beautiful sunny afternoon and the Tana, now 250 yds. wide, sparkled as it danced over a rocky bed. We crossed at Seide by a new suspension bridge and followed the estuary northwards past prosperous farms and rich pastures. Beyond Bonakas the road climbed steeply over a rocky saddle to Smalfjord, where there was a fishing wharf with a deep water jetty.

Here we found a good camping site along the road at the head of the fjord. The turf was soft and springy and a tumbling mountain stream danced among the rocks. We cooked our supper and crawled into our sleeping bags.

The sky was clear and cloudless, the still fjord mirrored the tints of the sky. At the mouth of the fjord a tall island like the fin of a gigantic shark was silhouetted against the pale yellow of the horizon. I fell asleep watching it. In the morning we were up at 5.30 and cooking our breakfast. It was dull now and somewhat overcast but we were soon on the road again, pedalling westwards. We passed Tarnfjord and Vestertana, then started another steep climb over the mountains which would take us to the next group of fjords.

Since early morning there had been no traffic on the roads, so that we were lucky to get a three-mile uphill lift in a workman's lorry at about midday. This brought us on to a desolate undulating plateau well above the tree line and dotted with drifts of still unmelted snow. All afternoon we struggled across this dead land, stopping for lunch at a derelict workman's hut, which at least gave us shelter from the biting wind.

McHaggis was map reading and kept promising that there would be a big lake on the right just over the next ridge, but as each succeeding ridge only showed a small lake on the left and another ridge, I began to lose faith. Eventually our road led us down through a tangle of birch forests to Ifjord, without ever finding the big lake on the right at all.

We pushed our bicycles up the next crest and coasted down to the next fjord. Half way up the crest beyond, we were picked up by a lorry full of cheerful brown skinned Lapps, dressed in all their finery and evidently off to a party. They took us through wild and rugged country, where bulldozers were labouring to improve the road, to the head of Laksfjord, and six miles beyond into the grey stony wastes of Svaerholt Halvøen.

Here the road was only half completed and very rough. Hardly any of the damaged bridges in this area had yet been repaired. We were nearing the tree line again and there were only a few stunted birches sheltering in the hollows. As soon as we had been dropped by the Lapps, we brewed up, but we had scarcely finished before another lorry came bumping past, and gave us a lift the whole way to Banak at the head of Porsanger Fjord.-

On the way the driver stopped to show us the Børselv Gorge. Here we were able to look down almost 1,000 ft. of sheer cliff to the tumbling waters of the Børselv river below.

We reached Banak at ten in the evening, but learnt that tomorrow being Sunday, 31st July, no buses would be running. We were just wondering what to do when a Norwegian military truck went past and gave us a further lift to Skaidi. We arrived there at 2 a.m. and camped out in the birch forest by a chattering brook.

Next morning we got up late and did not start till noon, only to find that the ring holding the valve into one of the tyres of my bicycle had come out. I was immobilized.

I went back to Skaidi which is the junction of the Hammerfest Road and the Arctic Highway, but there was only a tourist hotel and no shops. A Norwegian business man gave me the address of a friend of his at Kvalsund whom, he said, would be able to help, but Kvalsund was fifteen miles away.

There was nothing for it but to walk, pushing our bicycles and carrying our loads. About half-way a lorry passed us, giving me and my useless bicycle a lift, but there was no room for McHaggis who had to start pedalling again.

In Kvalsund I explained to all and sundry with a wealth of gesture and a paucity of Norwegian exactly what was wrong with my bicycle. Everyone was sympathetic, but no one seemed able to help. I went to the address that the business man had given me. Here a pretty blonde girl speaking good English let me in, and I explained the situation again. I was shown into the kitchen and made polite conversation while her mother telephoned the local storekeeper, arranging for me to collect a new valve from him.

Outside the house, I picked up my bicycle and walked it round to the store. As I got there McHaggis arrived, hot and panting. The shopkeeper brought out the new valve ring. He looked at the machine and asked what was wrong. I looked at the machine and for a moment thought that I must have gone crazy. The valve and valve ring were back in place. Only the fact that the old valve was still in my pocket made me realize that the whole thing was not a dream. What must have happened was that the Norwegians to whom I had explained my plight had repaired the bicycle while I was in the kitchen waiting for the telephoning to finish. I apologised profusely and we pedalled on.

From Kvalsund we crossed to Kvaløy by motor ferry. This is the island upon which the port of Hammerfest is built. It was rocky steep and barren with a few farmsteads scattered along the roadsides on the flatter ground. After a time we stopped to brew up.

A fairly constant stream of traffic passed us, mostly salmon fishermen returning from their Sunday's sport on the mainland. Just as I finished tea a most convenient lorry came along. I stopped it and asked for a lift in my best Norwegian.

"If you'd speak your own language, old boy," said one of the occupants, "We might understand you." This was a bit damping, but I climbed aboard, bicycle and all. McHaggis was not as grateful for this hitch as might be imagined. In the first place he had not finished drinking his tea. In the second place he had not had time to put away the primus stove, which was still hot. Being last into the truck he had to nurse the two bicycles for the rest of the journey. And finally, as he sat on the tail of the lorry he got covered in dust from head to foot. He had not been keen to hitch-hike the last stage of the trip anyway, so he had quite a lot to say by the time that we got to Hammerfest. Hammerfest is north of the tree line. At present it can claim to be the most northerly town in Europe, although this year Honningsvaag will be raised to the status of a town and will rob Hammerfest of this honour. The town had about 2,000 inhabitants. It had a good natural harbour protected by high cliffs. In a small subsidiary haven further south there were oil storage tanks. The whole place had been thoroughly demolished and was recovering more slowly than the other Arctic towns. This was partly due to the fact that its two main industries, catering for tourist cruises and North Sea trawlers, were now carried on in a much smaller way than before the war, while much of what remained was now being diverted to Honningsvaag. In spite of this there were quite a number of shops, a cinema in a wooden hut, a bank and a wireless station.

There was no tourist hotel in the town, and we had to put up at one of the three pensionats. This was a long wooden building divided into cubicles with hot and cold running water in every room, but with no food served on the premises. We had to have our small supper in a flashy dance hall down by the waterfront.

Next morning we learnt that a trawler would be calling at Honningsvaag on Wednesday, 3rd August. This was our only way home, so reluctantly we had to abandon our plans for climbing the glaciers on Seiland Island.

We lunched in the big communal feeding establishment of the British Restaurant type, as this was the only place where a hot meal could be obtained. Food was short in Hammerfest as it had a poor hinterland and everything had to be fetched by ship from Tromsø.

In the afternoon Panda arrived. He had caught two big salmon in the rapids, one of them nearly 20 lb. He had descended the Tana by canoe with "A.A." and, after paying him off with the money that we had left, he caught the midday Polarbil.

Next morning we were up at five and got ourselves, our bicycles and our baggage aboard the mail steamer. It was a dull morning with fog hanging low over the water, so that we missed the splendid views that we might have had as we sailed through the fjords to Honningsvaag. Several times we passed through deep narrow channels so close to the sheer rock face that it was almost possible to touch it. We spent most of our time sleeping and eating. In the intervals we consumed quantities of synthetic Norwegian beer.

We docked after midday and reported to our trawler agent, who was also the harbour-master. He was a large jovial Norwegian in a smart blue uniform, who had served with the British Navy throughout the war. He welcomed us in and gave us more beer.

He rang up the tourist hut to arrange our accommodation, and warned us that the food was not good and recommended Folvansens' restaurant, where we booked an evening meal. He put through a telephone call to the skipper of our trawler, who was fishing off the Murmansk coast. This call was relayed by wireless from Vardø so that we were able to speak to the skipper direct and agree our rendezvous.

By this time we were so full of beer that we were glad to spend the afternoon sleeping. The tourist hut was a big barracks on the hill overlooking the township. It was primitive but quite comfortable, although the meals that we did have there were unappetizing and poorly served.

The supper at Folvansens however was a very different thing. It was prepared for us in a private room at the back of the house. The owner's daughter, a charming young Norwegian, looked after us. She had been educated in Oslo and spoke a most attractive English. The meal itself was a delicious series of egg and fish dishes, ending up with really good coffee. Apparently, although most foods have to be imported into Finmark, the rations are better there than elsewhere as an encouragement to settle in that difficult country.

Honningsvaag lay at the southern extremity of Nordkap Island. Although slightly smaller than the towns of Vardø, Vadsø, and Hammerfest, it had recovered far more quickly. It was a long straggling village built on the low rocky foreshore around a natural harbour well protected from the Arctic gales. Behind it great grey cliffs towered into the mist and disappeared. Apart from being a convenient port for the trawlers fishing the prolific banks off Nova Zembla and Murmansk, it was the landing place for tourists *en route* from Nordkaphorn, the most northerly point of the Norwegian archipelago.

We wanted to go to Nordkap ourselves, but the harbour-master's beer and the magnificent supper, combined with heavy fog that enenshrouded the island, deterred us. Some French tourists tried to walk there but were forced to return, saying that it was too thick to see a thing. The only alternative route was by small boat and reckoned too dangerous in view of the weather.

Next morning we did our shopping, buying smoked salmon, and other delicacies to bring home with us. At midday we lunched at Folvansens, and half-way through the meal one of the harbourmaster's men ran in to say that our trawler was alongside. Hastily we bundled our kit aboard, bicycles and all. The trawler took on extra rations and refilled with water. Soon we were sailing out of the harbour and dipping our flag to the gunboat at the entrance.

It was six o'clock as we rounded Nordkap. The mist had cleared and the dark cliffs rose sheer from the white surf. On the furthest promontory the triangular rock of Nordkaphorn broke the waves like the snout of some prehistoric beast. The wind from the north freshened and we butted out into the grey wastes of the Arctic Ocean —Homewards bound.

SUMMARY

The most striking thing about Lapland was the degree of civilization that existed there. We had expected to find Lapps with reindeer, a few rough carts and villages of reindeer hide. Instead we found towns with all the normal amenities of civilized life. We found a well organized road system with fair gravelled roads connecting all important centres, and alternative routes for winter use. Bus services operated six days a week and daily mail boats linked the fjords and the islands. An airmail service flew twice weekly from Tromsø to Kirkenes. Although completely devastated in the German withdrawal, the towns were being reconstructed rapidly. Vadsø and Honningsvaag reverberated ceaselessly to the explosions of demolition gangs and the rattle of concrete mixers.

The inhabitants were not only more friendly, but also better educated than we had expected. During the whole time that we were in Lapland everybody went out of their way to assist us. Lapps, Finns and Norwegians were all most kindly and helpful.

The percentage that spoke English was equally surprising. Apparently all town schools in Norway make English a compulsory language, and although it is not taught in the village schools, many of the villagers are educated in towns.

We were told that Communist influence was strong in the north, but there was no evidence of it in the treatment that we received at anyone's hands. Indeed, we were surprised and gratified to find how much faith the Norwegians placed in Western Union and the Atlantic Pact.

The frontiers were much less closely guarded than in the south. We entered Finland and re-entered Norway without anyone attempting to stop us. The only time that a customs official came near was at Vardø. Even the Russian frontier appeared practically unmanned.

The weather was generally mild, though at times the wind could chill to the very marrow. Everyone we met apologized for the appalling summer, saying that it was the worst for fifty years. Yet in spite of living out of doors a good deal we were seldom really wet, and with twenty-four hours of daylight we got more than our share of sun.

Finally the mosquitoes must be mentioned. They are the curse of the Arctic summer. They rise in swarms from the lakes and the marshes. They sting unremittingly by day and by night. They are not malarial however, and their sting is less irritating than that of their British relatives. All the same Lapland would be pleasanter without them.

I realize that only the most superficial impressions can be gained from a three weeks' holiday. Here, for what they are worth, are my impressions of the European Arctic. If anyone finds them of interest my literary efforts have not been entirely wasted.



FACTORS IN THE DEFENCE OF THE WEST

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

1. Two Political Advantages

THE democracies of the West may be slow beyond reason to arm themselves against aggression but they are quick to form political groups against the possible aggressors. This point was well brought out by Mr. Churchill in a conversation in 1937 with Herr von Ribbentrop, the German Ambassador. The story is told in *The Gathering Storm* (p. 175) and an extract is quoted below :--

And I [Mr. Churchill] repeated "Do not underrate England. She is very clever. If you plunge us all into another war, she will bring the whole world against you like last time." So then the Ambassador rose in heat and said "Ah England may be very clever, but this time she will not bring the world against Germany."

Ribbentrop no doubt "rose in heat" because he had an uneasy feeling, which was not misplaced, that the prediction might prove to be true.

The Western World of 1950 is faced with a problem in power politics which bears a general resemblance to that which faced Great Britain and France at the time of this notable conversation, i.e., how to mobilize the world against possible aggression and at the same time to make military provision for defence in event of war. But the conditions affecting the problem are in curious contrast to those of 1937.

This time the U.S.S.R. and its satellites have evolved a system of political infiltration which has made good a greater extent of territory and secured far more adherents than ever rewarded Nazi blustering and brute force. As territory is won over, it disappears behind the Iron Curtain and "the rest is silence." The infiltration process never stops. Eastern Germany, for instance, is already in the toils, whilst Western Germany is being worked on, happily so far without much visible result.

The Soviets have at the same time created armed forces out of all proportion to their needs for defence, not only on land and in the air but also, most significantly at sea, so much so that any intelligent observer cannot but believe that their ultimate object is to dominate the world. In both Europe and Asia, where infiltration is in operation, the various peoples concerned are either just beginning to recover from the crippling effects of World War II, or are still distracted with other conflicts. In Western Europe Germany is completely disarmed and other nations except Great Britain have only a fraction of the armed forces which they possessed in 1939.

But there are, fortunately, important new factors which are favourable to the Western Powers. World War II started as a European war and only gradually spread over the whole world. If there is to be a third World War it will start as a world conflict from the word "go" and most of the nations of the world will probably be involved in it from the very beginning on the side of the West. There will therefore be fewer complications and hindrances in drafting the plans for the defence of the West.

In addition to this great advantage, the United States of America will be in general control of the Western Powers and, situated between the Atlantic and Pacific Oceans in North America, will be far better placed to direct a world war than Great Britain, whose proximity to Europe is a disadvantage in these days of ever more powerful aircraft, the atom bomb and guided missiles.

The U.S.A., which has grown, quite within recent memory, to be the greatest industrial power ever known to mankind, has fortunately for Western civilization, some great statesmen who have not hesitated to abandon the traditional isolationist policy of the New World and to take over from Great Britain the political leadership of the world. They show signs, moreover, of being able to use their powerful resources quickly, boldly and wisely. Leadership of this kind is a signal advantage for the West.

2. Armed Force only one requirement of Total War

It is against this roughly sketched background that European statesmen have recently been considering the defence of Europe and have been discussing the existing weaknesses with ultra democratic frankness. Although nothing has been revealed which will have come as a surprise to the absolutists of the East, they may be naively apt to conclude that the peoples of the West now realize the full weakness of their military position and that therefore they will be the more ready to absorb the gospel of Communism.

For this excellent reason alone, it is high time that active steps were taken to create effective armed forces. It is not enough merely to be very clever at politics.

The creation of these armed forces is a complex problem, at once political, military and technical, which is already being tackled. Provided that time permits, there is hope that something good enough to make a promising start will be produced. But in these days of total war, the creation of regular armed force is only part of the problem of defence. There are many other activities to be attended to before the effective strength of the whole world can be brought against the possible aggressors "like last time."

3. The Importance of Ideas

First of all there is the realm of ideas: as a man thinks and believes so he will act.

Have effective steps been taken to persuade the vast majority of the peoples of the West that the Western idea of democracy is tolerable and that the Eastern one is not? Unless great statesmen with sound governments at their backs are able to do this, there will only be apathy in the defence of the West.

Faction, that fatal sign of decay in ability to govern that ruined Rome, is a curse in many Western European democracies. In a world standing on the very threshold of a third world war, statesmen must somehow get rid of faction and unite their peoples.

4. Home Guards for the West ?

In Great Britain there is happily neither any widespread belief in Communism or much faction. It is probable for instance that if there was a call for the reconstitution of the Home Guard, hundreds of thousands of men would enrol within a few weeks. They would all be free from any taint of faction or Communism or any other 'ism: their only thought would be the defence of their country.

Few statesmen on the Continent could venture at the present day to arm their people in such a fashion—" 'Tis true 'tis pity: and pity 'tis 'tis true ! " The Latin countries could do it readily enough if they were not such a prey to faction that the weapons issued might start firing by themselves like Bismarck's guns.

Curiously enough Germany, in her long history of warfare, has record of genuine Home Guards. On the Luneberge Heide (heath), not far from where Lord Montgomery signed the Armistice of 1945, lies the grave of a German poet who wrote of the beauties of the Heide and of the defence of the countryside by local volunteers in the Thirty Years War. The long struggles of that interminable war bore hardly on those who lived in the isolated villages of Northern Germany. Marauding armies, seeking food and plunder, roved the country like wolves and like wolves sheered off in the face of organized resistance.

Local volunteers of this kind, as opposed to the private armies of unreliable political or military adventurers, would be most useful to a defending Army of the West. Indeed nothing would cure the modern military disease of "infiltration" better than a reliable system of Home Guards. In good days they would be a security against sabotage and in bad days they could hold local "hedgehogs" and be organized as partisans. It is therefore perhaps worth considering the idea of establishing Home Guards throughout Western Europe as a basis of security.

5. Two Important Economic Advantages

It is a matter for regret that the statesmen at Strasbourg spoke almost entirely of the inadequacy of the existing defence measures and neglected to draw attention to some of the long term, but overwhelming, advantages which the West will enjoy, if a third world war is thrust upon it.

Although the Western democracies have commonly to be galvanized into ordering their defences by brutally frank revelation of their deficiency, it is surely unwise not to point out to the world some of the brighter features of the military picture as well. Such an omission is not only discouraging to the West, but may also mislead the East, which might judge its success in a third world war to be certain, when actually nothing could be surer than its eventual defeat.

The overwhelming advantages of the West lie of course in the economic field.

Apart from a multitude of well-trained and well-disciplined men, the creation of armed force depends on steel, oil fuel, chemicals and many other raw materials. Of these steel is perhaps the most important, as it can only be stepped up very slowly. A glance at the table below is revealing.

Country	Steel production in millions of tons ber annum				
U.S.A.	100				
G.B.	16 but increasing steadily				
Western Europe	40 (the Ruhr, the Saar, Belgium,				
_	Luxembourg etc.)				
Eastern Block	40 (includes Czechoslovakia, Silesia,				
	Manchuria etc.)				

Even if the Eastern Block was able to possess itself of the steel production of the whole of Western Europe as a going concern, which is most improbable, its steel potential even then would be less than that of the West by an amount equal to more than twice the huge steel capacity of Great Britain.

If to this staggering advantage is added the better mass production technique of the West and the well proved superiority of sea transport over rail transport for long and heavy lifts, the steel position of the East is an unenviable one.

If the Soviets unhappily decide on war, one of their immediate

objectives will obviously be to secure the coal and steel of the Ruhr and the Saar, which will become as important to them as they were to the Germans in World War II. Any Western plan of defence must therefore include effective arrangements for the denial of this steel production to the East. It will also be necessary to prevent the arrival of the considerable amount of iron ore which is normally required from outside sources.

Although, in view of their weakness on the steel front, the Soviets are busy stock piling immense quantities of tanks, trucks and other M.T. vchicles, they have also to find the fuel oil to drive them, not to mention the ever-increasing amount of aviation spirit required to cover movement from air attack.

This brings into view another big advantage of the West which is apparent from the table below.

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Production of	Oil Fuel in 1948—Chief	countries only	
West	million tons	East mi	llion tons
U.S.A.	277	U.S.S.R.	30
Venezuela	70	Roumania	1 4 1
Mexico	8		14
Trinidad	3		
Columbia	3		
Argentine	3		
Persia	25		
Arabia	19		
Kuwait	6		
Iraq	3		
Brit. Borneo	312		
	4201 million tons		$34\frac{1}{2}$ million tons

Proved reserves in barrels 1947 Eastern Powers 14 per cent do.

These figures show that the West has an oil production more than twelve times as great as that of the East and that it is in the habit of holding reserves of oil which are six times as great as those of the East.

Now during the German campaigns in Russia of 1941-5 both sides disposed of hundreds of divisions, but a large proportion of these divisions had only horse-drawn transport. It is extremely doubtful whether either Army could have produced the petrol to move all these divisions with mechanical transport even if they had had the necessary mechanism. As it was, the Armoured and Motorized Divisions were in a chronic state of petrol shortage. The long periods of inaction during the Russian final advance westwards
were for the most part due to the supreme difficulty of moving stores forward from rail heads.

Three to four hundred modern divisions with the increasing air support which is essential require an amount of petrol which for the East will prove more and more difficult to supply and transport.

To work out the measures required not only to preserve the favourable steel and oil advantages enjoyed by the West, but also to add to them, is a task of the first magnitude which gives scope for genius. If they can be even maintained, their influence is bound to be decisive.

6. A Plan for the Future of the U.S.S.R.

Behind the Iron Curtain there are probably frictions, discords and human miscries before which those of the West pale into insignificance. If, in spite of their fervent protestation in favour of peace, the rulers of the U.S.S.R. were to order their armies to march into Western Europe, it is by no means certain that the Soviet soldiers would do so with great enthusiasm, especially at the beginning when the Russian soldier, judging by past wars, seems to be slow to perceive the essentials of combat and takes time to develop his great powers of fighting.

It is therefore important, at an early stage, to possess moral weapons to work on the minds of the Soviet troops, as well as those which act more immediately and directly on their bodies. In any event trial and tribulation come to all soldiers and would come in aggravated form to those of the Soviets, because in the end they would be totally defeated.

This being so, it is essential to have, from the very beginning of the struggle, some rough but clear plan for the future of the U.S.S.R. and its satellites to which all action can be related and on which assaults on the morale of the Soviet soldiery and peoples can be based. Furthermore, it is not in reason to contemplate destroying the machinery of government of a whole continent without at least having a rough idea of what is to be set up in its place.

When the Germans marched into Russia in 1941, they had at first very great successes, but they had no clear idea of what they were going to offer the Soviet peoples, although they could have bestowed most compelling benefits. They had been taught by Hitler that all Eastern peoples were "sub-human" and fit only to be slaves. This attitude and the lack of a plan for the future of the U.S.S.R. may have gone a long way towards their loss of the Russian war, because the Soviets reacted fiercely against the first and in the absence of the second gradually became as Imperial in their outlook as the Russia of the Czars and far more formidable.

The Western world must for once in a way profit by the lessons of the past and not make such colossal mistakes a second time. The future of the U.S.S.R. is of course an Eastern problem and can only be solved by the East with the aid of the West. There is no quarrel with the Russian people who are as helpless to decide whether it is to be peace or war as the West itself is. In the present welter of events the world would welcome with joy the emergence in Russia of a great Russian capable of evolving and putting into execution a plan for putting Communism on to a better road than it is following at present. But whether such a leader appears or not, some sort of plan for the future of the U.S.S.R. there must be, if the West is to enter a possible conflict with the best chance of saving humanity from ruin.

No thoughtful person can but be appalled that the world situation has deteriorated so quickly and so profoundly as to require serious consideration in peace-time of plans for radical changes in the government of a former great Ally, without whose long enduring heroism World War II might have continued for another decade. Only five years ago the civilized world, though shattered, was full of hope that the Allies having won the war would get together and win the peace. It might have been done and could still be done, for a change of heart works quickly. Until signs of it show themselves, the West has no possible course of action but to take all possible steps to defend itself.

THE WEIGH-BATCHING OF CONCRETE

By MAJOR E. H. JENKINS, R.E.

THE object of this paper is to describe the weigh-batching of materials for concrete mixes, to set forth its advantages over the more commonly used method of volume batching, and to show that it may, with advantage, be used on small works.

Methods of Batching

The measuring out of the constituent materials for a concrete mix is known as batching. Two main methods are in general use.

- (a) By volume. Materials are measured in gauge boxes or other containers or, in the case of continuous mixers, by worm feeds passing through hoppers containing the constituent materials. Since this paper deals only with batch mixing further reference to continuous mixers is omitted.
- (b) By weight. All materials, with the possible exception of water, are weighed.

Necessity for Accurate Batching

Since concrete is not a homogenous material and is usually made on site, under possibly unfavourable conditions, from materials which may vary in quality between deliveries, it follows that the quality of the concrete as produced at the mixer will vary. As no concrete structure can be stronger than the weakest batch incorporated the structural engineer must use, as the basis of his calculations, the minimum strength likely to be developed by the concrete.

To allow for variation in quality the concrete mixes must be designed to produce an average strength greater than that used in design calculations. It is apparent that the greater the variation in concrete quality the higher will designed concrete strengths have to be in order to produce a required minimum.

Consider two examples. Expressing total variation as a percentage of minimum strength:—

- (a) If variation is 10 per cent and required minimum crushing strength 3,000 lb. per sq. in., then average strength to which concrete must be designed is 3,150 lb. per sq. in.
- (b) If variation is 100 per cent then, for same minimum strength, average strength will require to be 4,500 lb. per sq. in.

It is obvious that where variation is likely to be large (and a range of 100 per cent is not uncommon), any reduction in range by the exercise of control will permit a more economical use of materials without a decrease in minimum strength.

The extent of variation depends, *inter alia*, upon the accuracy of batching.

Possible Errors with Volume Batching

In the following paragraphs volume batching by the use of gauge boxes only is discussed. The points raised are, however, generally applicable to other methods.

Cement. The quantity of cement that can be placed in a container of given size depends upon the fineness of the cement and the degee of compaction applied. Tests have shown that the weight of 1 cu. ft. of normal Portland cement measured volumetrically may vary between 80 and 100 lb. It has, therefore, long been accepted that cement should always be measured by weight. Where volume batching is in use it is common practice to

- (a) assume that 1 cu. ft. of normal Portland cement weighs 90 lb. or that a 1 cwt. bag contains 1½ cu. ft., and
- (b) to obviate volumetric measurement of cement by using mixes of such size as permit the use of whole bags of cement. Thus, for example, a 1:2:4 mix would comprise a multiple of 1 bag of cement, 2½ cu. ft. sand and 5 cu. ft., coarse aggregate.

This practice, while obviating errors in measurement of cement, precludes mixers being used to full capacity; this point is expanded later.

Sand bulking. The volume of a given quantity of sand will vary with its moisture content. Saturated sand occupies the same volume as dry sand while maximum bulking occurs at about 7 per cent moisture content and may be as much as 30 per cent dry volume.

In many cases where volume batching is in use the bulking of sand is ignored or the assumption is made that sand, being damp, has bulked 25 per cent and capacity of gauge boxes is adjusted accordingly. It will be apparent that, while the latter practice is better than making no allowance, both practices may be productive of considerable error.

Filling of gauge boxes. Gauge boxes may be designed for filling to a mark inside the box or for complete filling. If the first method is used the material cannot be struck off level with the mark and while the second method enables this to be done, it is seldom carried out.

The average gauge box is usually designed for easy filling and is therefore wide in relation to its height. It will be seen that with a measure of such proportions any irregularities of the upper surface of the aggregate may lead to serious errors. These are reduced if boxes are made narrow in relation to their height, but they then become more difficult to fill and workmen tend to count the number of shovelfuls required to fill the box and thereafter to dispense with the box except when under an eagle eye. Such practice requires no comment.

If measurement in gauge boxes is to be anything like accurate the boxes must be fitted with bottoms, but as this involves the frequent lifting of a heavy boxful of material it is common practice to use a bottomless box and to stand it on material already placed on the banker or in the mixer skip. Unless the upper surface of the material already placed is level, and it seldom is, serious errors will again occur.

Even given properly designed and filled gauge boxes the amount of aggregate placed therein may vary with each filling unless boxes are filled in a standard manner, and it is most difficult to ensure this being done.

It is apparent that the use of gauge boxes imparts an air of accuracy which, in actual fact, is not justified.

Water. Most concrete mixers are fitted with water tanks from which a pre-determined volume of water is discharged through a siphon into the mixing drum. Provided that the mixer is level, the

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water tank and siphon are well designed, and gauges are accurately calibrated, a reasonable degree of accuracy may be achieved, but if the mixer is out of level, gauge readings will, in most cases, be completely fictitious.

Elimination of Batching Errors by Weigh-Batching

Cement. The weighing of the cement for a concrete mix enables a mixer to be used to its full capacity and entirely eliminates errors due to "fluffing up" or overcompaction of cement in volumetric measure. It must be admitted that, with some of the smaller weighbatching plant, the weighing of cement is often dispensed with and recourse had to the practice of using whole bag mixes. This however is merely a matter of choice and with any form of weigh-batching plant the cement can, if desired, be weighed.

Sand. The bulking of sand, which with volume batching is often the probable cause of the greatest errors, may be ignored. The weight of moisture content must be added to the prescribed weight of sand but this involves no extra calculation since, whatever the mode of batching, the surface moisture content must be found and deducted from the water to be added to the mix. Moreover it is an easy matter to use a different scale reading on a weighing machine, but a much more annoying and difficult problem to have continually to vary the size of sand gauge boxes to allow for different degrees of bulking.

Aggregates generally. Errors due to varying methods of loading and incorrect use of gauge boxes are eliminated. There is no inducement to use substitute methods of measurement. With volume batching by gauge boxes several fillings of the boxes are usually necessary with each size of aggregate. Errors thus become cumulative. With weigh-batching the whole amount of each material is placed in the weigh hopper in a single charge; there can be no accumulative error.

Water. The measurement by weight of the mixing water eliminates errors due to faulty or out of level tanks and measuring devices. With smaller plants where water is not weighed the same errors as described under volume batching are of course possible, but the mere fact that materials are being carefully weighed out will usually have a psychological effect on workmen who will then take greater care.

Other Advantages of Weigh-Batching

Output of Mixers. It has been stated that the practice of using whole bag mixes precludes mixers being used to their rated capacity.

Consider a 1:2:4 mix by volume. The quantities of material in each batch, using a single bag of cement, will be:---

Cement, one bag	<u>д, ог,</u>	1 1 f.c.
Sand		2 ¹ / ₂ f.c.
Coarse aggregate	3,	5 f.c.
		—
	Total	8≩ f.c.

This represents approximately 87.5 per cent and 62 per cent of the rated dry capacity of a 10/7 and 14/10 mixer respectively. It will be seen that a two-bag mix cannot be used in the larger mixer and that the only way of using mixers to capacity is to either measure the cement by volume—a practice already condemned even by the proponents of volume batching—or to weigh out the requisite quantity.

Mixing times should be related to the number of drum revolutions and since a 14/10 mixer usually has a lower drum speed than a 10/7 the number of batches produced per hour by the larger machine will be less than that of the smaller. Assuming a production rate of seventeen batches per hour for the 10/7 and fifteen for the 14/10, hourly production figures for the two machines using whole bag mixes are approximately $3\frac{3}{4}$ yds. cu., and $3\frac{1}{4}$ yds. cu. respectively. An interesting paradox, the larger the machine, the less the output ! Comparable figures using the machines to capacity by weighbatching are $4\frac{1}{3}$ yds. cu. and $5\frac{1}{2}$ yds. cu. per hour. The larger machine comes into its own and production goes up by 16 per cent in the case of the 10/7 and 69 per cent in the case of the 14/10.

Further investigation will show that:---

- (a) it is impossible to adhere to the whole-bag rule when making mixes weaker than 1:2:4 with a 10/7 machine unless it is overloaded, and
- (b) that weigh-batching affords the only means of using machines to capacity.

Large works. On large works weigh-batching offers the only satisfactory means of rapidly and accurately measuring the large quantities of material involved and is now normal practice.

Small works. On smaller works much time and labour may be saved by the introduction of weigh-batching and the consequent elimination of the tedious business of filling boxes the size of which is perforce restricted by the weight of the filled box, which must be such as can be handled by two men. This point will perhaps be better appreciated after a study of the descriptions of small weighbatching plant given below.

Weigh Batching Plant

It is unfortunate that while the majority of engineers agree that weigh-batching is most desirable, many of them have the impression that it is only suitable for use on large works; to them the word weigh-batching conjures up a mind-picture of a vast plant with possibly a battery of two or more 1-yd. or even larger mixers producing a vast amount of mixed concrete in a very short time. This, however, is only one side of the canvas. Much plant is available which is eminently suitable for small works and it is representative items of such plant and not the larger installations which are described in this paper.

Use of wheelbarrow scale. An ordinary platform weighing machine can be used as shown in Fig. 1. In this case cement is not normally weighed and mixes are based on the use of whole bags of cement. Where, however, it is desired to use the mixer up to capacity the cement may of course be weighed.

Portable weigh-batchers. The machine illustrated in Fig. 2 comprises a weigh hopper which is suspended from a dial weighing machine, set at a suitable height for hand filling, and fitted with a manually operated outlet door through which materials are discharged into the mixer skip. It is available in two sizes, one for use with either a 14/10 or 10/7 mixer and the other with a 7/5. In both cases the machine is mounted on a short length of rail track running between stock-piles and mixer. The weigh hopper is charged with materials placed one upon the other, the machine is pushed up to the mixer skip and discharged and immediately returned for filling while the preceding batch is being hoisted into the mixing drum. A considerable saving of time is thus effected and the manhandling of materials between stock-piles and mixer is eliminated.

The scale dial of this machine and the others described below may be fitted with indicators which are set to indicate the requisite quantities of cement, sand and aggregate which are loaded successively in any desired order until the appropriate cumulative total is reached. The task of the loading numbers is thereby much simplified since they are merely told to load until the needle reaches a given mark.

Concrete mixer with integral weigh-batcher. In this case the loading skip of an otherwise standard mixer is carried in a cradle connected to a spring balance mounted on the mixer. The arrangement is readily available with mixers of 10/7 or 14/10 capacity and may casily be fitted to the makers' standard machines without cutting, drilling or welding (see Fig. 3). The cradle of the weighing device hinges on the same axis as the skip to which it may be locked; it may thus be elevated for travel.



Fig. 1.-Weigh-batching with platform scale.



Fig. 2 .- Portable weigh-batcher.

The Weigh-Batching Of Concrete 1,2



Fig. 3.-Concrete mixer with integral weigh-batcher.



Fig. 4.-Small weigh-batching plant.

The Weigh-Batching Of Concrete 3,4

The saving of time and labour that may be achieved by the use of such a machine is self-evident and needs no further comment.

Small weigh-batching plant. The plant illustrated in Fig. 4, is suitable for use with from 18/12 to 40/28 mixers. It comprises a two or three compartment storage hopper set above the weighhopper. Both hoppers are fitted with manually operated doors and the weigh-hopper has a sub-chute through which materials are discharged into the mixer skip. All controls are grouped so that the machine may be operated by one man. The storage hoppers which may be loaded by elevator, clam-shell or similar equipment have, in the case of the two compartment set-up, a capacity of 7 cu. yds. for coarse aggregate and 6 cu. yds. for sand, while the weigh hopper has a capacity of 26 cu. ft. The plant, which is mounted on a sprung axle, fitted with pneumatic tyred road wheels, is so designed as to enable it to be partially dismantled and towed behind a lorry.

SUMMARY

1. Volume Batching

- (a) Can produce reasonably accurate results, but only if properly designed gauge boxes are used and a constant and high degree of supervision is exercised.
- (b) When whole bag mixes are used mixing plant cannot normally be used to capacity.

2. Weigh-batching

- (a) Can, with advantage, be used on small works where accurate batching is required.
- (b) Is more accurate than volume batching and thus enables a saving of cement and a better concrete to be made.
- (c) Enables mixing plant to be used to capacity and is productive of a saving in time and labour.

ACKNOWLEDGEMENTS

The author wishes to express his gratitude to the undermentioned association and firms for permission to reproduce photographs of, and data regarding, plant.

Cement and Concrete Association.	Fig. 1.
Messrs. Stothert & Pitt Ltd.	Fig. 2.
Messrs, Blaw-Knox Ltd.	Figs. 3 and 4.

" OPERATION PLAINFARE "

THE ROYAL ENGINEERS' CONTRIBUTION TO THE BERLIN AIRLIFT. 1948-1949

By COLONEL A. MACG. STEWART

The object

The object of this paper is to help Royal Engineer Officers who may be involved in a similar operation, by stating the scope of the work required, showing difficulties which arose in its execution, and suggesting means of overcoming these difficulties.

Limitation of Report

This report has been compiled in the office of the Chief Engineer, 7th Armoured Division, and only covers work done in that divisional area.

Abbreviations Used

A.A.T.O.	Army Air Transport Organization
B.A.F.O.	British Air Forces of Occupation
B.A.O.R.	British Army of the Rhine
B.S.E.	British Supervisory Element
C.A.A.T.O.	Commander Army Air Transport Organization
C.C.G.	Control Commission for Germany
C.F.A.S.O.	Commander Forward Airfield Supply Organiza-
	tion
C.M.L.O.	Civil Mixed Labour Organization
C.M.W.S.	Civil Mixed Watchmen's Service
C.R.A.S.O.	Commander Rear Airfield Supply Organization
D.E.L.	Directly Employed Labour
D.E.S.D.	District Engineer Stores Depot
E.B.W.	Engineer Base Workshop
E.F.	Expeditionary Force
F.A.S.O.	Forward Airfield Supply Organization
G.C.L.O.	German Civil Labour Organization
P.O.L.	Petrol, Oil and Lubricants
P.S.P.	Pierced Steel Planking
P.X.	Post Exchange (American Services cross between
	the N.A.A.F.I. and a departmental store)
R.A.S.O.	Rear Airfield Supply Organization

How it Began

"There is a scheme starting at Wunstorf to supply Berlin by air. The Sappers are sure to be involved. I am just off to see what goes on, you'd better come too." At Wunstorf we found the D.Q.M.G., B.A.O.R., installed as C.A.A.T.O. Together we sought out the R.A.F. Station Commander who was busy trying to decide where to park forty York and sixty Dakota aircraft, which were due to arrive in forty-eight hours on a field housing a couple of dozen fighters. He displayed longer sight than most of us for he was already thinking how to keep the wings of parked aircraft free from snow in winter.

The aircraft really did begin to arrive within forty-eight hours, flying to Berlin started at once, and the Sappers were faced with the following rush jobs:---

- (i) Hard standings along a railway siding to enable food and coal to be loaded direct from trains to lorries.
- (ii) Adequate lighting to enable trains to be unloaded by night. As the airfield barrack supply was already fully loaded this entailed the installation of a generating set.
- (iii) A road from the railway sidings to the tracks made by_the... R.A.F. across the grass to the aircraft parking areas.
- (iv) Camp structures at Expeditionary Force scales for 1,000 British Troops, employed on handling and checking stores for Berlin.
- (v) Assisting the R.A.F. in uncrating generating sets for transport in Yorks to Berlin, and in providing load spreaders for floors of aircraft, lashing chains and hooks, as well as various loading ramps etc.
- (vi) Rehabilitation of Poggenhagen Camp for G.C.L.O.

The main difficulty in this part of the work was to lay hard standings and make roads, impeded by heavy rain, mud, and hundreds of airlift lorries which started work before we did. The roadway was made possible by the use of flexible duck-boards of which an adequate supply was available in the D.E.S.D. The hard standings were only made possible by the fact that the R.A.F. had a huge stock-pile of gravel on the airfield for another job, and allowed us to use 2,000 tons of it. We put it down on the mud and the vehicles consolidated it; unorthodox but highly successful.

How the Airlift Worked-As the Sapper saw it

C.R.A.S.O. is the pivot of the airlift. The Air Force place an aircraft ready to fly at a convenient spot, fly it to Berlin, fly it back and put it back in its parking place. C.R.A.S.O. unloads trains and keeps a fleet of lorries under load in his area. If he is getting more in by train than he can fly out, he builds up a stock, against an extra good day, when the aircraft can move more than the trains bring him. The Air Force make out their flying programme and C.R.A.S.O. has to ensure that aircraft are loaded up from his fleet of lorries, with whatever Berlin has asked for. The Skymasters are doing six trips a day to Berlin and back. They are scheduled for a 20 min. stop to unload there and take off again, and for a 30 min. stop at our end to refuel, and for C.R.A.S.O. to reload them. C.R.A.S.O. has little time to spare. The Army and Air Force on the ground endeavour to have a petrol bowser and a stores lorry backed up alongside each aircraft before the pilot has switched off his engines. They usually succeed.

The R.A.S.O. area as we have christened it covers railway sidings, checkers' office, shelters for labour, N.A.A.F.I., and the road past the check point on to the aircraft parking area. It must be carefully laid out to enable C.R.A.S.O. to keep his loading programme up to time.

This side of the operation is most impressive to watch, and is an example of very high personal discipline. An announcement on a loud speaker that such and such an aircraft will arrive in so many minutes brings the requisite Americans, British and Germans out of their canteen or rest room to do their job. There is no shouting, falling in or numbering off. The job is done, lorries and bowsers reloaded and the men quietly wait the next call without any further orders.

The First Extension

"If you ever want this done again you will try to give us a bit more notice, won't you, Sir? We should do much better for you, if we could get the Sappers on to the site before the airlift started."

"My dear chap, I told you the very moment H.Q., B.A.O.R., knew anything about it."

A few days later came the call, "Come on, we must go to Fassberg. All the Dakotas are going there from Wunstorf, and we've got to help the R.A.F. to open up a new airfield."

At Fassberg we met the R.A.F. Station Commander and his staff, and some representatives from H.Q., B.A.F.O., and the D.Q.M.G. who arrived by air from Wunstorf. The R.A.F. officers on the Station were delighted to see us, because the Airlift meant an influx of aircraft in large numbers, whereas there was then only one on the airfield. The Squadron Leader commanding said "There is only one fly in the ointment, I'll start it all off and then some senior chap will come and relieve me." And it was so.

Here there was a large almost empty barracks on the airfield, and it was agreed that no R.E. help was wanted. As an afterthought the R.A.F. asked for one 72 in. cooking range and a new clutch for a D8 angledozer. These were sent up next day in a 15 cwt. truck.

Within a few days the 72 in. range and the clutch had grown into a project costing $\pounds 300,000$ as it had been decided to use the field for U.S.A.F. Skymasters on a large scale. This project consisted of:-

- (i) Camp structures for a tented camp to be replaced as quickly as possible by:---
- (ii) A hutted camp for 3,500 G.C.L.O. men, complete with water-borne sewage system, roads, paths and lighting.
- (iii) Bringing in the standard gauge railway and laying sidings.
- (iv) Making hard standings at the railway sidings.
- (v) Erection of forty-eight huts in the R.A.S.O. area, and a small group for each squadron opposite its aircraft for maintenance along the side of the aircraft parking area.
- (vi) Erection of first a tented N.A.A.F.I. canteen with camp structures, and later a hutted canteen, in the R.A.S.O. area.
- (vii) Erection of lights at the railway siding and along the aircraft parking area.
 Erection of 2 km. of 20 kv., overhead 2-phase, A.C. line and the installation of a 200 kva. Sub-Station and 150 kw., Generating Station.
- (ix) Provision of two Bore Holes and water towers in the R.A.S.O. area and at the locomotive watering point.

Our first trouble was that the quarries could not get stone fast enough to enable the first half of the hard standings to be completed by the date flying was due to start. So a sandwich of two layers of Sommerfeld track was laid with chespale between and some stone poured on top of it. This carried 10-ton lorries until the second half of the hard standings was complete, and the sandwich was then overlaid with 4 in. of stone, and finally tarred and blinded. The aircraft build-up only necessitated the use of half the vehicle hard standing being used at a time for the first few weeks, which enabled us to tackle the job half at a time.

C.A.A.T.O.

When the second airfield began to operate the H.Q., A.A.T.O., separated itself from H.Q., R.A.S.O.; C.A.A.T.O.'s business being to control all the C.R.A.S.Os.'; each C.R.A.S.O. became responsible for local working and worked direct with the R.A.F. Station Commander.

Winterization

It was by now clear, that "Operation Plainfare" would continue into the winter, and the replacement, at Wunstorf, of tents by huts and various improvements, were put in hand.

The Third Airfield

To make the best use of the big Skymasters it paid to use them from an airfield as near Berlin as possible, to increase the number of sorties which each machine could make daily. It was therefore decided to move forty of them from their base in the American Zone to Celle. The R.A.F. undertook to make a new runway, 2,000 yds. long in tarmac, in place of an unserviceable one from which all the P.S.P. had been removed, in ten weeks. The Royal Engineers, with a little trepidation, said they would have their side of the task done in order that flying might begin as soon as the runway was ready.

The work required of us was:-

- (i) Recondition the barracks, which had just been vacated by the R.A.F. and were in process of being handed over to the Army, and hand them back to the R.A.F.
- (ii) Extend the standard gauge railway to provide necessary sidings, including a temporary siding to take stone along the new runway.
- (iii) Erect camp structures for a tented camp for 2,500 G.C.L.O. This camp had to be tented because it was needed urgently to house the labour required on the more permanent R.E. work, and on the R.A.F. works. U.S. Army pyramid tents were provided by the U.S.A.F., each complete with its own stove and stove pipe. These tents lasted out the winter. Consideration was then given to replacing them by huts.
- (iv) Provide a hutted camp for 1,200 Enlisted Men of the U.S.A.F., without dining and cooking accommodation.

This work was completed in seven weeks, except for the permanent drainage system for the G.C.L.O. camp. The chief difficulty was caused by people arriving to live in camps before the camps were ready for them, and the tendency for civilian labour to burn floor joists and purlins in their stoves.

Before this work was complete, the Military Governor visited the airfield, accompanied by the A.O.C.-in-C., B.A.F.O. The latter pulled a piece of paper from his pocket and said:—

"We are going to increase the number of aircraft on this field by ten Skymasters. That will mean 500 more Officers and 1,500 more Enlisted Men. You will be able to put up another camp for them and finish it by the same date as the camp you are already building, won't you?" There was a chorus of "No, Sir," to this. It was satisfactory to hear the Director of Works, B.A.F.O., agree firmly with the C.E.

The Americans had originally accepted 45 sq. ft. per man in barracks and living huts. They now asked for 100 sq. ft. per officer and 60 sq. ft. per man. The R.A.F. Station Commander said very reasonably that he could not have two different scales for Americans and British on the same airfield and that the R.A.F. should have increased scales too. This necessitated thinning out in barracks and in the first camp, and reproviding for the men who could not be fitted into them at the new scale, as well as providing for the in-

creased numbers. After discussion between R.A.F., U.S.A.F., and British Army Staff the further demand resolved itself into:---

- (v) Provision of a hutted camp, complete with dining, cooking, bathing facilities for 250 Officers, and 1,250 Enlisted Men, and a large detention camp.
- (vi) Provision of a hutted camp for 100 C.M.W.S., largely Yugo-Slavs, but as the name implies "mixed allies."

Another American requirement to which the British Army was unused was for a car park for 200 private cars "because so many of the boys bring their cars over from the States with them." The cars were there, and they must stand somewhere, so a car park was of necessity provided, synopsis entitlement or no synopsis entitlement.

The R.A.F. Work

Practically everything connected with flying was tackled by R.A.F. Works Flights. Acres of P.S.P. were laid. They did a lot of concrete roadwork at Fassberg, because they had just made a new concrete runway and had all the necessary plant already on the airfield. Wooden platforms, named "nose-docks" were built; an aircraft is run up to this and fitters work on a platform at engine height. The Skymasters' tails were too high to go through the hangar doors, so small ramps were made to raise the tricycle nose wheel, and lower the tail fin while passing under the door opening; the wheel then runs down off the ramp and the aircraft stands level with its nose in the dock inside the hangar.

Runways

The runways at Wunstorf and Fassberg had been completed by the R.A.F. before "Operation Plainfare" started, as a normal project. That at Celle was completed in ten weeks from the day work started. In those ten weeks the aircraft hard standing area was also completed in P.S.P. on stone bottoming.

Co-operation

All concerned realized that there was only one common object, to get the aircraft flying, and although at times we made rude criticisms of each other's work and of the time it took to get decisions from distant headquarters, those on the sites worked absolutely hand in glove. They lent each other plant and stores and the difficulty, not a very grave one, was that both sides were inclined to say "I'll do that." No one ever said "That is not my business," except the Chief Engineer who once or twice had to say "Stick to your own job, for if you try to do the R.A.F.'s as well, you will not complete your own job on time." Doubtless the Director of Works B.A.F.O. said the same to his Works Flight Commander.

The height of co-operation was reached when one of the R.A.F. Stations had an American Commanding Officer.

Planning

(a) This was mainly done in the C.E.'s office. M.E. Volume VII, Part VII "Expeditionary Force Camps" was used as a basis for work, necessary adjustments being made later. Without this basis stores calculations, and release and issue procedure, would have taken much longer.

There is no doubt whatsoever, that attempts by commanders and staffs to get some men on the ground digging holes must be firmly resisted until layouts have been planned. That much overworked expression "a sense of urgency" causes eventual delay when it leads some over-enthusiastic men on the spot to set up a huge tar macadam plant just where all the railway sidings are to go. Any time which may be gained by an early start is more than counterbalanced by the drop in output resulting from having to abandon or change work once started. All concerned just lean on their shovels until they are quite sure that their labours will not be wasted, and the Engineer Officer in charge of the job does not feel inclined to exhort them to work until he is fully satisfied that those above him will not change their minds again.

(b) WUNSTORF was not planned, because no one knew what was required, and there was no time to think anything out before the airlift started. The summer camp project just grew as requirements manifested themselves. The winter camp was designed to E.F. scales, except that 100 f.s. per officer and 60 f.s. per man was allowed. We had an idea that "Operation Plainfare" would last a week or two, and when building the tented camp had no thought that it would be replaced by a hutted camp. We therefore fell into the old error of putting the temporary camp on the best site available, which was a great nuisance when later on we had to put a hutted camp on the same site.

(c) FASSBERG was planned entirely in the C.E.'s office. Here we knew before starting that tents were to be replaced by huts, and we planned accordingly. There was not quite the same hurry as at the other two airfields, and planning got three days' start of building, and managed to maintain its lead; as a result the work went with a real swing from start to finish.

It was here that we first met the Americans, but our paths only crossed on the R.A.S.O. area, and their demands were small. In any case of argument about scales we stuck to normal British scales and they were accepted by the Americans as adequate, even if not all they would have liked.

The sewage problem for the camps for G.C.L.O. at Trauen at first looked difficult, but scouting around we discovered an unfinished sewage purification plant, a relic of a German research establishment. A specialist contractor easily and quickly expanded and completed the plant.

(d) CELLE. This was first discussed at a large conference. There were many senior officers present, who rightly did not dabble in detail, but the conference broke up without adequate discussion of detail by those of us charged with carrying out the decisions of the conference, and we lost several valuable days catching the people concerned, from those who fly to those who run the P.X. As a result planning was hurried, and work on the site got ahead of work on the drawing board.

The lack of detailed decisions at this conference caused temporary, but serious, consternation. After the conference the Army and the Air Force Headquarters both produced plans to cover the general layout of airfield and camps, and issued them to their own people. By chance it was noticed, several days later, that the Station Commander's plan differed in several essential details—to describe them at their lowest value—from what we were working to.

It is disconcerting to a D.C.R.E. who is working to beat the onset of winter to find when he has concrete floors down for a couple of dozen Nissen huts in accordance with the orders given to him, that the user of the huts wants them somewhere else. This confusion was also quickly and satisfactorily settled, but it bears out the contention that it is bad policy and bad practice to start work before plans are agreed and signed by all concerned, including the actual user.

The airfield was 5 miles from the C.E.'s office. The C.R.E. was 30 miles away and there was a constant temptation to short circuit him. On the whole it was resisted, although the C.R.E. will probably not agree.

The Americans showed an embarrassing trust in us. Having said what they wanted in general terms at the first conference, they went back to their own zone, and were no more seen for several weeks. It is to be hoped that they did not feel later that their trust was misplaced. The presence of an American Liaison Officer from the beginning would have saved us a lot of worry. One knows what a British Commanding Officer will want; one is not sure what an American may want.

By the time the final camp came to be planned, the U.S.A.F. was already operating from the airfield. Then we were beginning to think of the winter 1949-50 and our ideas had grown since the operation started. There was no time to provide central heating in living huts the first winter, much as the American would have liked us to do so, but it might be installed before the following winter.

We had already agreed on 100 f.s. per Officer and 60 f.s. per

Enlisted Man. To satisfy their requirements we increased other scales as follows:----

	Officers	Enlisted Men
Ablutions	25 per cent	13 per cent
Latrines	16 per cent	5 per cent
Showers	11 per cent	12 per cent

We put up some " cockshies " and invited the Americans to come over and vet them before we made final drawings. There was one hilarious morning in the C.E.'s drawing office, when the American Commander and his Catering Adviser got to work with coloured pencils on our cookhouse and dining hall layout. Their commendable object was to get a man into the dining hall, served from the hot plate, seated at a dining table, and out at the other end without crossing the path of waiters who had to collect dirty crockery, carry it to the wash up, and back to the entrance door for the next hungry man. The blue and red paths of men and waiters all over the plan were like a map of the wanderings of the children of Israel. It may take faith to remove mountains, but goodwill can move most obstacles and so a compromise between British and American ideas was reached. American signatures were swiftly obtained on the drawings.

The necessity of this was proved by the arrival of the officer who was to run the messing and who reckoned we had laid out the cookhouse and dining rooms all wrong. He first arrived in the incomplete camp on a morning when the C.E., two S.Os. R.E. and G.E. were going round together. We overpowered him with the help of a drawing approved by the U.S.A.F. Commander and his Messing Adviser, but he left us shaking his head and saying sadly "I don't go much on that Catering Adviser's ideas and he doesn't have to operate the goddam show anyhow."

Flying Requirements

Details of control towers, runway lighting, etc., if they have to be erected by Sappers must be agreed by those who fly. It is not sufficient to ask an R.A.F. Works Officer what is required. The only item over which there was anything remotely approaching a squabble was when we undertook to build an extra story on a control tower. In the rush, someone said to a D.C.R.E. "Oh, you know more or less what is wanted. We'll leave the details to you." The tower was completed before a flying man saw it and when he did he would have nothing to do with it because there was too much woodwork in the windows. It took several days to correct what could have been avoided had we insisted on a drawing signed by the Station Commander or his representative before starting work.

Difference Between Airfields

At Wunstorf the R.A.F. provided either in barracks or in huts all the accommodation required for themselves, and the railway siding lighting. The Army only had to provide for its own people and the civil labour which it employed, roads, and hard standing. The Americans were not involved. Most of local dealings here were with the Army Camp Commandant.

At Fassberg the G.C.L.O. camp was on the far side of the airfield from barracks and hangars, and the Army had no work in connexion with housing either R.A.F. or U.S.A.F. The R.A.S.O. area huts and hard standing were done partly by the D.C.R.E. and partly by the Works Flight. Here we dealt chiefly with C.R.A.S.O.

At Celle everyone was much more intimately tied up, and we were working for and alongside the R.A.F. and U.S.A.F., and we dealt exclusively with the R.A.F. Station Commander. He was a great strength to us. Not only did he interpret American airman's requirements into British Army language, but he stood up for the D.C.R.E. against unreasonable criticism by H.Q., B.A.F.O. and the U.S.A.F., for he was on the spot and knew the D.C.R.E.'s difficulties.

Scales of Accommodation

"Plainfare" started as a minor operation and we thought it might last a fortnight or so. It grew into a huge concern and became at least semi-permanent. We started off with Expeditionary Force Scales. The Americans rightly said "Hell, the war has been over for four years. You can't expect our boys to live as if they were on a battlefield. The folks at Home wouldn't stand for it." They seemed to be far more worried about what Washington would say, than we were about what London would say. Nevertheless they were most reasonable and easy to work with. They knew we had been doing a rush job, and looked upon our efforts to meet their requirements as a favour, and not as a right. We tried to provide what they asked for, because the aircrews deserved it, and also because we did not want them to think the British were prepared to live in slum conditions if they could avoid doing so.

Drawings

The mixing on one airfield of British Army, R.A.F., U.S.A.F., and the use of D.E.L., G.C.L.O. and several specialist contractors on one project caused an abnormal demand for drawings. No less than eleven prints of most drawings were required at Celle airfield. Before the clamorous requests of D.Cs. R.E. had been met, the following numbers of prints had been issued by the C.E.'s office:---

Wunstorf	1,400
Fassberg	2,500
Celle	2,000

Even so one D.C.R.E. in his report on his share of the work complains of the niggardly supply of drawings by the Chief Engineer's office.

Approximate Costs

The approximate costs of the work carried out by the Royal Engineers were:---

Airfield	Works	Tn.	Total
Wunstorf	D.M. 1,408,000	D.M. 75,300	D.M. 1.482.200
Celle	D.M. 4,455,000	D.M. 1,027,000	D.M. 5.482.000
Fassberg	D.M. 3,645,000	D.M. 850,000	D.M. 4,495,000
Total	D.M. 9,508,000	D.M. 1,952,300	D.M. 11,460,300

A total at the official rate of exchange of D.M. 13 $\frac{1}{3}$ to £1 of £860,000.

Outstanding Requirements

When the airlift came to an end the following additional works had been planned. The R.A.F. Works Directorate were arranging with the local authorities to increase the town water and sewage plants at Celle, to enable them to deal with a "Plainfare" population of 8,000. One thousand seven hundred married quarters were to be built by the German Land (Province) Authorities for the U.S. A.F. at Celle and near Fassberg. The design was American, modified to suit German post-occupation requirements. The plans included churches, schools, shops, cinemas and the requirements of a small town.

Organization of Work

An airfield covers a very large area. The ideal is to start a project with a plan agreed by all concerned. The resident Engineer can then start at one end of the airfield, divide his labour into gangs each doing one particular job, and work through to the other end. First goes a setting-out gang. Then comes a gang digging foundations, followed by a gang of concreters. Behind comes a succession of gangs which

- (a) build dwarf walls to carry floor bearers.
- (b) fix wall plates.
- (c) erect ribs of huts.
- (d) fix purlins.
- (e) fix sheeting.
- (f) put in wooden floors.
- (g) install stoves.
- (h) install electrical wiring and fittings.

A fearful waste of time occurs when this orderly procedure is upset because someone suddenly thinks of an extra couple of huts required at X X priority at the far side of the aerodrome, and every gang has to be pulled off its task and sent back a mile to start again at the beginning, dragging its plant with it.

Roads and hard standings at Fassberg were similarly organized in a series of jobs for different gangs:-

- (a) Formation was graded by mechanical plant to required levels and falls.
- (b) 3-ton tippers were loaded by grabs direct from trainloads of stone.
- (c) Tippers spilled 40/60 mm. stone on to the formation.
- (d) Gallion graders followed the tippers and spread the stone spilled by the tippers.
- (e) The 40/60 mm. stone was rolled by heavy rollers.
- (f) 20/40 mm. stone was similarly spilled, spread and rolled.
- (g) 5/40 mm. stone was spread, tarred and rolled.

Contractors

There is a great difference between British and German contracting. In Britain it is possible to employ a contractor who will undertake a complete building project. In Germany work is much more specialized and the contractor who will lay concrete roads will not erect huts; the man who will erect huts will not install the electric wiring in them; the man who will do the drainage will do nothing else. This necessitates drawing up several contracts for one project. This entails more paper work in the R.E. office, but it does mean that the contractor is an expert in his own line, and one is well advised to accept his guidance on a rush job, and allow him to arrange details in accordance with the trade customs of the country, rather than try to compel him to adopt British methods and ideas.

Contractors provided an agent who was present at site throughout working hours. They provided foremen and skilled men for supervision, setting out, and construction. Tradesmen and labourers were provided by the D.C.R.E. as required by the contractor each day from D.E.L. or G.C.L.O. groups.

Each afternoon the officer in charge of the work held a meeting of contractors' agents and noted the contractors' requirements of men, transport and stores for the next day. These notes were most important for they are the official documents from which the German Landrat (Chief Magistrate or Sheriff according to the dictionary) decides the amount due to the contractor. The Landrat is responsible both for measuring up work and for actual payment to the contractor.

Road work at Celle was all done very well by a contractor who used labour provided by the D.C.R.E. but who supplied all his own plant and materials including stone. He also replaced a derelict wooden bridge by one of R.S.Js. on concrete piles, designed by his own engineers, and approved by the D.C.R.E.

Painting was ordered through the "Malerinnung" or painters guild who farmed the work out to individual firms which provided their own materials.

British Staff was found with some difficulty, as "Plainfare" had to be done without any avoidable interference with the D.C.R.E.'s normal work. A typical arrangement was:---

One G.E. at an airfield,

One W.O. I. i/c stores at an airfield.

One M.T., N.C.O. at an airfield.

One Clerk of Works for each camp area or R.A.S.O. area.

One Assistant M.F.W. (Corporal) with each C.W.

German Staff

German staff was drawn from the D.C.R.E.'s normal staff and each airfield required:----

One German Clerk of Works.

Three interpreters.

One mechanist.

This staff was reinforced on the E. & M. side by German engineers from the C.E.'s staff.

Labour

Labour in B.A.O.R. is a complicated business. Civil labour is all paid by the German authorities. There are innumerable ration scales according to the type of worker. The G.C.L.O. is a civilian organization as the name implies, but its members live as a unit under control of a B.S.E., commanded by a Major with a very small British staff. They are housed and fed as a unit.

Directly employed labour is like D.E.L. anywhere else and lives at home. The men are given a midshift meal on the work. This must be eaten on the site and not taken home to supplement the family's rations. Contractors' labour was not at first entitled to a midshift meal. So on one project men worked side by side on different quantities of food.

Long hours were worked; at Wunstorf from 0700-2000 hrs. with an hour's break at midday; at Fassberg fourteen hours a day to begin with; at Celle all daylight hours including Saturdays and Sundays. These hours were reduced in each case as soon as it became clear to the D.C.R.E. that he could finish the various phases of his project without so much overtime.

A change in ration scales at Wunstorf resulted in a deputation which informed the D.C.R.E. that they would only work eight hours

a day, five days a week. The D.C.R.E. persuaded them to continue from 0700-2000 hrs. six days a week, while half the labour worked each alternate Sunday for twelve hours.

At Celle a C.M.L.O. Transport Group was used to carry German workmen who complained to the D.C.R.E. that the C.M.L.O. drivers deliberately stopped and started jerkily, and swung round corners too fast, so that the passengers were thrown about and bruised. The C.M.L.O. men when remonstrated with, feigned complete lack of knowledge of both English and German. They were in the end made to behave properly but very nearly caused a strike.

Some D.E.L. had to be transported several miles to and from work daily. Contractors were easy to find and proved competent, but housing their labour was quite a little problem on its own.

The labour force naturally varied as work went on, but average figures were:---

Wunstorf	360 men for 2 months	20,000 man days.
Fassberg	550 men for 5 months	82,500 man days.
Celle	730 men for 3 months	65,700 man days.

Transport had to be provided to take civil labour into a town once a week from Fassberg, which was away in the country far from any amenities.

Force of Example

One day on Wunstorf airfield a jet fighter was practising dives over the airfield. The D.C.R.E. and the G.E. who was with him were both enthralled by the exhibition. When their attention returned to earth they found that their complete labour force had also stopped work to watch the aerial display.

Engineer Field Units

As Celle airfield grew larger and larger people kept thinking out new traffic circuits. Each time a new circuit was thought of, we made a signal to 23rd Field Engineer Regiment who came up no less than five times to erect Bailey bridges over a small canal which ran between the airfield and R.A.S.O. area and the new camps. The bridges were D/S constructions and were all 80 ft. span. There were no abnormalities worthy of report. The Sappers worked so fast that they had on each occasion been and gone again before the C.E. got out to see how they were getting on.

Plant

Cranes always seem difficult to get in adequate quantities, sufficient slings and spreaders must be provided with them. Coles cranes were satisfactory, but a small 1-ton crane sank into the ground as soon as it got off a road or hard standing because its wheels were so small.

At Celle we used a battery of bulldozers to push an aircraft graveyard a couple of hundred yards. This left a camp site covered with bits of wire, broken glass, soaked with oil and generally unpleasant, so we pushed the top 9 in. or so of earth after the aircraft wreckage and thus achieved an area fit to build on. Three or four days sufficed to do what would have been an impossible job by hand; without the plant we should have been forced to put the camps several hundred yards further from the airfield, with resultant waste of the time of those operating the airlift.

The total amount of Army plant used is given in Appendix "A." Contractors brought some machines of their own.

Plant was lent to the R.A.F. on demand. They repaid the loan with interest when we wanted help. Some items of plant were also lent to the Reichsbahn (German Railway) engineers to help them handle ballast.

Transport

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One only had to breath the word "Plainfare" to get any transport asked for, if it could possibly be found anywhere. The 3-ton tipper is an invaluable vehicle, but is rarely discoverable in the numbers desired.

Wunstorf	3-tonners	20
	3-ton tippers	9
	dumpers	6
Fassberg	3-tonners	20
	3-ton tippers	40
Celle	3-ton tippers	45
	3-tonners	30
	10-tonners	6

The mileage covered, which best shows the magnitude of the transport work, is given in Appendix "B."

(To be continued)

APPENDIX "A"

ARMY PLANT USED

Machine		Wunstorf	Fassberg	Celle
Crawler Tractors	D 8		·	I
do,	D7 .	I	2	3
do.	D ₄	I	2	I
Excavators	<u></u> ∦ yd.	I	I	I
do.	$\frac{1}{2}$ yd.	I	I	T
do.	ξyd.	_	4	2
do.	³ ₄ yd.		I	2
Motor Grader		I	2	I
Trencher	<u> </u>		I	I
Dumpers	2 cu. yds.	4		
do.	3 cu. yds.	3		—
Road Rollers	10 tons	1	3	I
do.	8 tons	—	ī	I
do.	6 tons	I	I	1
Tar sprayers	1,000 gal.		I	
do.	300 gal.		4	2
Concrete mixers	13/10	2	·	
do.	10/6	2	6	8
Wheeled cranes	1 ton			I
Compressors	105 cu. ft.		1	

This Appendix does not include plant provided by contractors.

APPENDIX "B"

VEHICLE MILEAGE "OPERATION PLAINFARE"

This table covers journeys solely on Works services at Wunstorf, Fassberg and Celle.

Period	15 cwt. miles	3 ton miles	T.C.Vs. miles	10 ton miles	3-ton Tippers miles
From start to					
31st August	36,389	403,209	39,734	22,322	
September	72,829	517,221	77,985	44,992	
October	34,244	268,576	48,307	23,302	
November	18,269	105,232		15,373	155,634
December	6,907	71,508		96	43,068
January	8,695	125,603	•	22,838	224,133
February	6,140	89,900		20,830	189,620
March	1,642	35,105		2,185	25,919
	185,115	1,616,354	166,027	151,938	638,374

Total mileage of all vehicles 2,757,808.

IT NEVER RAINS BUT IT POURS

A Play in Two Acts to Illustrate the Problems which may Arise in Connexion with the Demolition of a Bridge

By Lieut.-Colonel M. C. A. Henniker, D.S.O., O.B.E., M.C., R.E.

and

MAJOR H. R. D. HART, R.E.

PLAYERS

(in order of appearance)

FIFI, A French young lady, the daughter of the house: PRIVATE ATKINS, Batman to Major Forrester. MAJOR FORRESTER, Close Bridge Garrison Commander. LT.-COL. WARREN, R.A., Rep. of G.O.C. at the Bridge. CAPTAIN METHOD, R.E., Troop Comd. i/c Demolition Party. CPL. PICKANE, Corporal R.E. in Demolition Party. PROFESSEUR DE CRUCIBAL, A French Professor. CAPT. THE EARL OF TOLOLLER, An Officer of the R.A.C. GENERAL BULLDOG, Divisional Commander. SOLDIERS, ORDERLIES and SIGNALLERS.

SCENE: An Inn at Mantes-Gassicourt on the East Bank of R. Seine. TIME: Evening.

Editor's Note:—This play has been performed at the S.M.E., and elsewhere at exercises and is being published by special request. It illustrates some of the problems involved in the demolition of a bridge, though it does not claim to offer the solution. Reprints can be obtained from the Secretary, Institution of Royal Engineers, Chatham, at a cost of 3s. 6d. for a set of twelve copies, if required for the production of the play.

IT NEVER RAINS BUT IT POURS

Act One

SCENE: The parlour of an Inn on the East Bank of the R. Seine at Mantes-Gassicourt. There are two windows at the back of the stage, and two doors, one at each side. There is a deal table in the middle of the room, some chairs, a sofa, etc.

The rising curtain discloses Fifi dusting the room with a feather mop.

Fifi: (Hums a tune.)

(Enter Private Atkins)

- Atkins: 'Ullo missie ! D'you 'appen ter parlez Anglais at all ?
 Fifi: (In attractive broken English) But yes. In ze Hitler war we had ze British soldiers here. (Sighs) Oh . . . zay was so charming : so brave, so strong ; and ah ! (Sighs again) Oh so beautiful ! An then ze Boches, zay come ! Ah ! Sales cochons ! (Her face clouds) Enfin, they will come again to-day, no ? (Continues dusting and humming as she does so)
- Atkins: Not yet missie. They ain't Jerries this time anyway. They're Fantasians. Rum chaps Fantasians, I can tell you. Well look 'ere, missie. I'm Major Forrester's batman. And 'e's out in the rain and 'e'll be coming in 'ere presently.
- Fifi: A major? But why a major?

Alkins: Well I ain't go no colonels about me just now, see ! You'll 'ave to put up with a major.

(There is a clatter of feet and a procession of soldiery enters. First Major Forrester; he is young and good-looking. He is followed by a soldier with a wireless set.)

- Atkins: (Salutes) 'Ow's this, sir? Sergeant-Major told me ter commandeer this 'ere 'ouse for H.Q. (He points at Fifi) And she's a nice little thing. Talks English too. (Exit)
- Major: (Salutes her). Well, mademoiselle. I'm afraid we'll have to take your parlour for our H.Q. What's your name?
- Fifi: I'm Fifi. Are you a major?

Major: Yes: I have that honour. Why?

- Fifi: In ze last war the majors were so fat and so old. But you . . . (She gives him a bewitching smile) you are like Monty.
- Major: That's nice of you to say so. But I'm afraid you must be off now.
- Fif: (On the way to the door) If you say so I go. But give a call and I come running back.
- Major: Ta ta Fifi ! Be a good girl. (Exit Fifi) (There is a clatter of footsteps and a tall thin Lieut.-Colonel enters. Major Forrester salutes.)
- Major: Good afternoon, sir. What can I do for you?

- Lt.-Col.: I am Colonel Warren, commanding the Div. A.A. Regiment—118 Light A.A. Regiment. I have been sent by the G.I. as the personal representative of General Bulldog, G.O.C. 2 Infantry Division. I am empowered to advise you when to give the order to blow up the bridge here at Mantes-Gassicourt. Later on, of course.
- Major: Well I'm new to the division and I've never seen you before. I don't want to be personal, but how do I know you're not bogus ?
- Lt.-Col.: Well first, I have a message of introduction here. It refers to me by name and is signed by the G.I. I expect someone here will recognize his signature. Secondly, I can prove I am Colonel Warren by the name-tape on my socks; and finally if I talk on my wireless, which is now being installed (a signaller is installing it as he speaks) you will see that the G.I. actually knows my voice.
- Major: Hum ! That all sounds all right. But I suppose the whole thing might be a plant. You and your message and the wireless, the chap the other end and your socks. You see, sir, one can't be too careful. This is a really important bridge. In fact I'm told it's the only one left for the division. I think I must make quite sure.
- Lt.-Col.: I see your point. In fact I foresaw it. Your colonel knows me quite well and I spoke to him on the way down. If I talk to him on your blower the recognition would be complete.
- Major: I'll just verify that, sir. As I say, I don't want to be rude or personal. But I'd like to be sure. (He picks up the headphones and speaks) Peter Three, Fetch Sunray, Peter Three, Over. (Pause 8-10 seconds)

Peter Three, I've got a chap here who claims to be an important person. He says you will be able to recognize his voice. Over.

(Pause 8-10 seconds)

Peter Three, Roger, Wait ... (Turns to Lt.-Col.) Here you are Sir, my C.O.'s at the other end.

- Lt.-Col.: (Takes Handset) Hullo Peter Three, Sunray, Able Baker Charlie speaking. Do you recognize my voice? Over. (Pause 10 seconds)
- Major Peter Three, Yes if you say so, I am satisfied, Over. (Pause 10 seconds) Peter Three, Yes we are all right so far. Out. (Turns to Lt.-Col.) That's O.K. Sir.
- Lt.-Col.: Good. Now what about this demolition. Is the Sapper around?
- Major: Yes. He's in the next room. I'll call him. (Calls) Atkins !

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Atkins: Major: Atkins:	(Outside) Sir ! Just ask the R.E. Captain to come in please. Sir !
	(Enter Fifi)
Fifi:	You called ?
Major:	Yes. But not you, Fifi. You trot along and be a good girl. (Exit Fifi)
	(Enter Captain Method R.E.)
Capt. R.E.:	(Salutes) Good afternoon, sir. The demolitions are all ready. State of Readiness "B."
LtCol.:	What the hell does that mean?
Capt. R.E.:	(As though reciting a manual). It means that the charges
	are in place, the primers and detonators removed, the cordtex
LtCol.:	To hell with all that technical stuff! What I want to
	know is two things. First, How long will it take you to
	poop it all off from the time I say "Go"? And
	secondly, is there any danger of its going off by accident
	if it's shelled or mortared ?
Capt R E ·	It will take me an hour and a half from the time you say
	"Go" Sir: and there's not the least danger of a nre-
	mature before that
It-Cal.	Ob I see (Paula) Do you think they know the second at
LiCui	On 1 sec. (1 ause) Do you think they know the score at D_{in} H O_{in} 2. I don't think they may include the Dentities
	Div. 11.Q.: 1 don't think they realized all this Keadi-
C. LL D. F.	ness D. Dusiness.
Capt. R.E.:	1 expect they do, sir. I've told the G.R.E. He was on
	the air just now and he will have told the General or
	the G.I. or someone.
LtCol.:	Well, I think I'll just make sure on the blower. In the
	meantime you hop off and put it all at Readiness " C "
	or "A" or whatever comes after "B." I want it so
	that you can fire it off as soon as I say so.
Capt. R.E.:	Very good, Sir. (To Major) Do you mind signing this.
	(Produces A.F.G. 4012).
Major:	Good God! I thought we'd got away from Army
•	Forms. In peace-time one walks perpetually in a snow-
	storm of paper. I thought in war-time one would get
	shot of it. And anyway why doesn't the Colonel here
	sign it ?
Cabl. R.E.	Well sin as I understand it it works out like this T_{a}
Super Habit	Majar) You are in command of the party have and in
	the end we are reporsible that the builder is
	me end you are responsible that the bridge is properly
	guarded and blown up on time. The Colonel here is
	responsible for tening you when to do it. I am responsible
	for seeing that it really does go up when you (to Major)
	order it.

Well let's have a look at the paper. (Takes it* from Lt.-Col.: Captain R.E. and reads) "Instructions to Commander of Engineer Firing Party. Para 1. You are responsible for the following demolition: Bridge Mantes-Gassicourt Map Ref. 6061. Signed G. S. Shovel, O.C. Demolition Serial 60. 24 Fd. Sqn., R.E." (Ceases reading) He's your O.C. eh? Yes sir. He ordered me to prepare this bridge for Capt. R.E.: demolition and he initiated this A.F.B.4012. I see. (Continues reading) Lt.-Col.: "Para 2. The close bridge garrison will be provided by 'A.' Coy. 1 North Staffs." (looking at Major) That's you. That's me. Major: (Continues reading) Lt.-Col.:

"The demolition will be prepared to a state of readiness shown below. This will be completed by the officer authorizing firing." (*Ceases reading*)

Then it gives a definition of state of readiness "A." and "B." (To Captain R.E.) You say it is now at "B."

Capt. R.E.: Yes sir. No detonators in place and one and a half hours needed to put them in.

Lt.-Col.: Well now, (Reading again)

"This state of readiness may be changed by the officer authorizing firing." (Looks up)

Who is that I wonder?

Capt. R.E.: Read on, sir, and you'll find the Major is.

Lt.-Col.: (Reading)

" Para 4. If a close bridge garrison is provided, you will not fire until the following order is given by its commander."

That is you. (Points at the Major. He continues reading and pointing at the Major)

"As commander of the close bridge garrison I order you to fire the demolition of the bridge NOW." (*Ceases* reading)

That seems clear enough. (Indicates Major). You authorize the firing by signing this paper, so you only may alter the state of readiness from "B." to "A." You'd better sign quickly to get it changed at once.

O.K. I submit. (Signs)

While we're at it, shall we read the rest of this form? "Para 5. If there is no close bridge garrison . . ." (*Ceases reading*)

* Current army form available with units.

Major: Lt.-Col.: But there is a close bridge garrison so Para. 5 is crossed out.

(*Reads again*) "Para. 6. This para. will be obeyed when signed by the officer issuing the card or an officer signing for him. (*With emphasis*) 'This bridge must NOT fall into enemy hands intact. You will fire the bridge on your own initiative if you are unable to prevent its capture. Signed G. S. Shovel, O.C. 24 Fd. Sqn., R.E."

- Capt. R.E.: Yes, sir; if the worst comes to the worst the Sapper carries the can home.
- Lt.-Col.: (Having read some more) Para. 7. refers to what happens if the Sappers make a nonsense of it and it fails to go up; Para. 8. says what to do when it has gone up. (Pause) Sufficient unto the day . . . We'll read that later. (Looks up) There seems no doubt about it, Forrester. You are head-boy here. I am merely the mouthpiece of the General.
- Major: A tinkling brass or sounding cymbal.
- Lt.-Col.: That's about it. If one could be sure the telephone would work there'd be no need for me. The Sapper here is merely the rude mechanic who does as he is bidden by you. Are we all agreed now?

All: Yes, sir.

Lt.-Col.: I think I'll just have a word with Division on the blower. (He goes to W/T set and the curtain falls)

Act Two

(One and a half hours later)

Lt.-Col.: Hullo operator put me on the air . . . Thank you. Hullo Love Queen Charlie, One, Message for you, Love Queen Charlie, One, Over. (Mild Whistles) Hullo Love Queen Charlie, One, Report my Signals, I say again, Report my Signals, Love Queen Charlie, One. Over. (Whistles) Hullo Love Queen Charlie, One, Report my Signals, I say again, Report my Signals, Love Queen Charlie, One, Over. (Heterodyning)

Hullo Love Queen Charlie, One, Report my Signals, I say again, Report my Signals, Love Queen Charlie, One, Over.

..... (Violent heterodyning)

- Lt.-Col.: (Shaking his microphone) God damn it all ! This bloody thing's gone wrong. Hullo. Love Queen Charlie. Report my signals. Over. (There is a roar of heterodyning. Lt.-Col. throws it down in a rage. Then in a controlled voice) In any case Damn !
- Major: It looks as though you are left to use your mother wit. The brass must tinkle and the cymbal sound.

(Enter Capt. Method R.E. and Cpl. Pickaxe)

- Capt. R.E.: I've just had my O.C. on the blower, sir. I've got to withdraw with my troop to prepare another bridge further back. I'm leaving Cpl. Pickaxe. He'll actually push the handle when you tell him. (Turns to Pickaxe) That's the officer who gives the word to blow. (Indicates Major)
- Cpl.: (Speaking in a way that leaves no doubt that he comes from north of the Tweed) What happens if he gets bumped off? (Indicating Major)
- Lt.-Col.: What happens if he gets bumped off? (Indicating Pickaze)
- Capt. R.E.: If my corporal gets bumped off he has two men with him. One of them ought to survive. There are two methods of firing the charges. One is to press the exploder which you can see out of the window there (*He points*) The other method is to press the other one in that slit trench fifty yards away. I think we are as nearly foolproof on our side of the house as possible.
- LL-Col.: I see. And before you go you want to be quite sure that your corporal will get the orders correctly. Eh?
- Capt. R.E.: That's it. He's like the hangman who erects the scaffold and springs the bolt. He's not the judge and jury or the prison governor. The hangman has to have the Death Warrant before he pulls the plug. My corporal must have the Major's signature on that A.F.B. 4012 before he fires. And if he's killed, whose thumb mark should he take?
- Lt.-Col.: Ahem ! Well now. (Pause) If he's killed it will be the O.C. "A" Company whoever that may be; probably the C.S.M. That clear ?

Capt. R.E. and Cpl. Pickaxe: (In unison) Yes, sir. (They withdraw)

Lt.-Col.: (To Major) There seems to be quite a bit in this business. The wireless going wrong has rather upset the apple cart. I wonder how the withdrawal is getting on.

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Major:	I'll ask the platoon officer on the road block. He's only just outside. I'll shout to him. (<i>Leans out of the</i> window and shouts) Hi ! Bobbie ! Who's come back over the bridge ?
Voice:	(<i>Outside</i>) I've seen the rest of the battalion back, sir. There have been a lot of gunners and a few armoured cars. There's the hell of a lot of civilians; and there's a French professor just arrived. I've sent him up to you. He'll be along at any minute. (<i>Enter a French Professor voluble and bearded</i>)
Professor:	(Very agitated) Je suis Monsicur Le Professeur Pai (Torrent of French)
LtCol.:	Can you understand all this?
Major:	No, but I know who can. (Shouts) Fifi ! Fifi ! (Enter Fifi not very combletely dressed)
Fifi:	Hullo, mon commandant. Here is your little Fifi.
Maior:	Look Fifi. Can you tell us what this "Johnnie" is
<u>j</u> +	saving.
Professor:	Je suis Monsieur Le Professeur de Crucibal. J'ai (Torrent of French)
Fifi:	He says he is Professor de Crucibal from ze Institute Atomique of Fontainbleau. He say he have three trailers painted red, steel lined, triple locked and weigh nine tons. United Nations will lose ze Number One Top Secret Device Atomique if zese trailers cannot pass ze bridge. You must not blow without he say so.
LtCol.:	Well Fifi tell him
Fifi:	But you are a Colonel. Yes? You are young. But I prefer Majors. (She makes eyes at Major Forrester). (There is a sudden burst of rifle fire, and some terriffic explosions. They all duck and dive for cover under the table. Fift is thrown into the Major's arms)
Major:	What the Hell is that?
Fifi:	It's only Fifi.
Major:	No, I mean the noise.
	(The noise dies down and the Major peers out of the window)
Major:	What's all the shindy about, Bobbie?
A voice:	 (Outside). There's a parachute landing going on about a mile away to the west, sir, and bombing on the bridge. It's the Greys engaging them I think. (The Major withdraws his head and by now all are again on feet. Fifi again entwines herself round the Major. The Major addresses the LtCol. Exit Professor muttering in French)
Major:	What do we do about parachutists landing?
LtCol.:	Let's get that Sapper with his blasted Army Form.

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Major: A Voice:	(Shouting out of the window) Corporal Pickaxe. Coming sir.
	(Enter Cpl. Pickaze)
LtCol.:	Now what happens if these parachutists capture the bridge? Do you blow it before they do or not?
Cpl.:	(Looking at his A.F.B.4012) Well it says here, sir, (Reads) "Para. 6. This bridge must NOT fall into enemy hands intact. You will fire the bridge on your own initiative if you are unable to prevent its capture."
LtCol.:	Oh yes. The Sappers carry home the can. I forgot. Thank you corporal. (Corporal salutes and Exit)
Voice:	(From outside) You there, sir?
Maior:	(Looking out of the window) Yes. What's up Bobbie?
Voice:	There's an officer here from the Greys. Captain The Earl of Tololler, hunts with the Grafton. Says the parachutists are a false alarm.
Major:	Ask him to come in, will you please. (Enter Tololler. He is dressed in corduroy trousers, a yellow scarf black heret and desert boots)
Tololler:	(Saluting in a somewhat unorthodox way. He cannot pronounce his R's.) Evening, Colonel. I'm Tololler, Corps Armoured Car Regiment. You all seem to be very
	military here. (Looks at Fifi) She yours?
Major:	Well not exactly.
LtCol.:	Look here, Tololler. What's all this about parachutists?
Major: Tololler:	Run along Fifi, will you; there's a good girl. (<i>Exit Fifi</i>) It was a scare Colonel started by the locals. But it
1 0000007.	put the wind up my C.O. <i>He</i> thought you'd blow the bridge with us on the wrong side. So he sent me back to make sure you don't.
LtCol.:	Everyone wants to keep that bridge open. There's a Froggie Professor here. Says he's got an Atomic Device on the far bank too. Did you see it?
Tololler:	Yes. Going like bats from Hell. I should think it's back at the base by now. I shouldn't take the professor too seriously, Colonel.
LtCol.:	I wish I could make that blasted wireless work.
Tololler:	What's the trouble? Who do you want to speak to?
LtCol.:	The Divisional Commander or the G.I. I want to
Tololler:	My C.O. will be here presently. (Looks out of the window) Here he comes. You could stop him and speak on his blower if you like, Colonel. Our signals work, you know. Strange isn't it?
LtCol.:	(Shouting out of the window) Hi ! Johnnie ! Where are you off to ? Can you stop a minute ?
Johnnie's voice:

-	Yes I'm stopping anyway. I'm meeting the G.O.C.
	here. He's due in a minute or two.
LtCol.:	Are all your chaps back ?
J's voice:	Yes.
-	(There is another burst of shell or mortar fire. They all take
	cover. It eases up and Cpl. Pickaxe enters).
Cpl.:	Excuse me, sir, but I think you'd better give the order
-	to blow. This mortar fire will cut the cables and then
	it won't go up when we want it.
LtCol.:	Can vou test it?
Chl.:	Yes, sir. I've just tested it. It's still O.K. but it won't
1	be good for long with this mortaring.
	(Another burst of mortar fire)
LtCol.:	I think we'd better risk cutting off this French Pro-
	fessor. But it's a tricky one. I wish to God the General
	would come !
	(Outside a voice is heard)
Voice:	The General, sir, coming down the road in his armoured
	car.
LtCol.:	Thank God he's come. Generally I don't want him
*	much. To-day seems different.
	(Enter General Bulldog. He wears a black beret with two
	badges. They all salute)
General:	Well now Forrester. How is it all? Everything quite
	all right? Quite all right ch? Morale good?
Major:	We're all right, sir. It's the Colonel here in a bit of a jam.
General:	Why what's the trouble Warren?
LtCol.:	Well sir. Everyone is back now, and the sappers say
	that if they don't blow the bridge soon it will not go at
	all as the mortaring will cut the cables. So I want to
	blow it at once. But there is a French professor in
	the next room says he has an Atomic Device on the
_	far bank and we must wait.
General:	It never rains but it pours. What do the Greys say
	about these Frenchmen?
Tololler:	We saw them cut and run two hours ago, General.
	They weren't even on this road. I think the French
	Professor is off net.
General:	So do I. Blow the bridge !
Pickaxe:	Would you please sign this A.F.B.4012, Sir. (The
.	General signs)
LL-Col.:	(To General). Well, sir. Thank God you came !
General:	You may do that; but it's the art of command to turn
	up when you are wanted. I've studied it.

Curtain

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From:—Brigadier J. Mann, D.S.O. E.-in-C., Australian Military Forces, Melbourne, Australia.

To:---

Colonel A. Crichton Mitchell, O.B.E.

October, 1950.

DEAR COLONEL,

I, and many other Sappers in Australia, have read your two articles in the R. E. Journal* with deep interest. They have shed much light on happenings that hitherto have been unknown to us or only dimly guessed at. Also, the experiences of yourself and your units paralleled our own in many respects. Perhaps it may be of interest to you to hear our side of the story, mostly from memory, now rather hazy as we, like yourself, burnt all our records in the "Benghazi Handicap."

What was eventually to become 9 Aust. Div. Engineers started off as follows. On the threat of the invasion of England, certain Australian forces, *en route* to the Middle East, were diverted to England, included in which were 3 Fd. Coy., under Major Risson and 13 Fd. Coy., under Major Gehrmann. A party, including myself, was sent from Palestine to England to meet them. 7 Fd. Coy. continued on its way to Palestine and 24 Fd. Coy. was mostly still in Australia. Our time in England was spent in trying to get equipment and transport, and prior to embarking again for the Middle East, training and constructing defences in the Yellow Line and in the Colchester Box. When we got back to Egypt we found that operations were going so successfully that we thought that we might be missing the bus.

o Div. was being built up in Palestine, but I, like you, plagued H.Q., B.T.E., to get as many of my units forward as I could. My experiences with that H.Q. were very similar to yours, although the engineer portion of the staff helped as far as it was possible. After more or less taking the matter into our own hands, we moved up with what transport we could muster-3 and 13 Fd. Coys., 7 following up and the Fd. Park Coy. to come up from Palestine when and how it could. Eventually we got somewhat informal recognition as Corps Troops under the direction of Lieut.-Colonel Boddington, R.E., and for a period the companies were strung along from Tobruk to Bardia repairing roads, bridges, water supply, and utilities in Tobruk, Derna, etc. The elements of 9 Div. were still in Palestine. When the Italians finally met their fate at Beda Fomm, I was made C.R.E. Southern Cyrenaica, Lieut.-Colonel Secombe of 7 Aust. Div. Engrs., C.R.E. Benghazi itself, and Lieut.-Colonel Boddington, C.R.E. Central and East Cyrenaica, all under Brigadier Kisch at Barce. I set up my H.Q. at Agedabia and had 3 Fd. Coy. supporting the forward Brigade of the 6 Aust. Div., 7 Fd. Coy. north of Agedabia and 13 Fd. Coy. in the Tocra area repairing the airfield and building a bridge at Maddalena on the Wadi Cuff route. 6 Aust. Div. was withdrawn and went to Greece and was replaced by 9 Aust. Div. Many accounts of this period refer to 2 Armd. Div. as if it were a proper Armoured Division. Few people have ever realized that its actual strength was as you stated. Our own plight was nearly as bad. 9 Aust. Div. was one weak brigade forward and another weak brigade between Benghazi and Derna. No transport, practically no artillery or supporting arms, and about one Bren gun per battalion.

*R. E. Journal for June and September, 1950.

We, the engineers, had been in the desert a bit longer so had scrounged quite a few Italian weapons and vehicles, but we were still practically without transport and many essential items of unit engineer equipment. Mines and explosives were practically non-existent at that time, and it was only by the unremitting efforts of Brigadier Kisch and his staff that a few supplies of assorted mines were got forward. I think that the only one who took a realistic view of the situation at that time was Brigadier Kisch himself. Although 3 Fd. Coy. had sent patrols up with the K.Ds. to the west and south of Agheila and had reported tanks and other vehicles, nobody seemed to take much notice. It was about that time that elements of your command made their welcome appearance but I recollect the hot reception from bombers given to them on the road leading through Agedabia, to which you refer in your articles. About that time a British officer (I cannot remember his name) was made C.R.E. Benghazi, and about a third of my Fd. Park Coy. had now turned up, and was placed under him. I was made C.R.E. Southern and Central Cyrcnaica and Lieut.-Colonel Boddington was made C.R.E. (I think) of East Cyrenaica.

2/1 Aust. Pioneer Bn. was placed under my command and was employed on an anti-tank ditch in the vicinity of Tocra and on restoring the Wadi Cuff route. Just prior to the commencement of the retreat, I was given orders to prepare the line Er Regima-Tocra for defence. 9 Aust. Div. (what there was of it) were ordered to fall back on the main Benghazi Road, and 2 Armd. Div. would protect our left flank on the Msus axis. We were to try to delay the enemy on our axis by demolitions (including wells) as far as we could. I told 3 Fd. Coy. to try and keep touch with you as far as possible and to send a section to assist C.R.E. Benghazi in his demolition scheme. 7 Fd. Coy. were to destroy Benina and Tocra airfields and all water supplies in the Benghazi plain, and to try and do something about the Er Regima Pass. 13 Fd. Coy. were to prepare to blow the bridge they had just built at Maddalena and to try and block the Tocra Pass. 2/1 Pnr. Bn. were to prepare demolitions on the Wadi Cuff route. The fog of war seemed to be very thick at the time. Units and sub-units were all over the landscape and one trusted to luck that they would turn up at the R.Vs. named from time to time. One seemed to use up every M.C. and truck despatch riders and thus be quite without means of communication.

My Headquarters and myself made our way back to carry out our orders to prepare the Tocra-Er Regima position and, if I remember rightly, I did send my Intelligence Officer to try and contact you at Sceleidima, but as I didn't see him for some considerable time afterwards, I never found out if he did. He went on to Msus to have a look at it and then made his way up to El Abiar. I don't think anyone was too happy about the Tocra-Er Regima position (approximately 40 miles to be held by one weak brigade), particularly the left flank overlooking the Wadi Garidla.

We had a bit of bad luck with our block on the Er Regima pass as, due to some unknown course, quite a length of the minefield blew up, and we did not have the mines or time to properly replace it. I understand the German tanks found (or were led to it by Arabs) the gap and went through it. However, we did not worry over much about the left flank, owing to the broken country and our belief that 2 Armd. Div. was somewere south in the desert guarding us. By this time, orders were given to set fire to Benghazi and Benina which was done. We were given orders to blow the Er Regima Pass, but although at the time we seemed pretty certain that there were none of our troops still to come through, I withheld the order. Later on, word came through that a large number of men and vehicles were trying to get across the Wadi Garidla, ours or theirs we did not know. It amazed us to find out that it was part of the Armd. Div. who we all (including Div. H.Q.) imagined were away in the desert. Aided by a few field and anti-tank guns at the Pass, some small delay on the enemy was effected. The Aust. 13 Bn. lost quite a few men, killed and missing. The incident of the water tower at El Abiar might be explained, if it was the water tower alongside the railway just outside Abiar where H.Q. 2 Armd. Div. were at the time.

I remember one of the officers of this H.Q. being very irate at the time, but I explained to him that this was a preliminary demolition only and that there was a full underground concrete water tank just below it. I don't know if he ever passed this information on. We did finally blow this second tank and another tank in El Abiar itself and in doing so a sub-section of 7 Fd. Coy. became either killed or missing. After that I received a message to R.V. with C.R.E. Benghazi at the railway gates at Barce, but after waiting some time gave the orders to set fire to the place including the Corps R.E. stores depot there. It afterwards transpired that the C.R.E. had been killed in a car accident in proceeding to the R.V.

After careful checking of units by a staff officer from Corps H.Q., the bridge at the Barce Pass was blown and again we hoped there were no troops left behind.

When I arrived at 9 Div. H.Q. at Technis the opinion was current that, although very thin on the ground with an extended line of some to miles from incl. Barce to Maddalina, we could hold on there. However, at a conference with Generals Neame, O'Connor, Morshead and Brigadier Kisch (later, I think, repeated at Marawa with General Gambier Parry in regard to his rôle on the flank), it was decided that owing to the obscure position in the desert on the flank and the nearly total lack of motor transport, it would be wiser for 9 Aust. Div. to go back as fast as they could—as you say, non-stop to Tobruk. I think I remember that radio at Marawa you mentioned.

General O'Connor told me to try and delay the enemy by demolitions. Brigadier Kisch told me were to R.V. with Lieut.-Colonel Boddington who would go with me and who knew where all the demolitions had been prepared in rear back to Derna by the British engineer units which had been under his (Colonel Boddington's) command. Time had not permitted, however, to prepare the very large ammunition dump at Ain Mara for demolition, so a section of 3 Fd. Coy. was sent back to do this. This section, having done the job of preparation, set off on the desert road and were captured by the Germans. Our rear demolition party was given a company of infantry (R.N.F. I think) for protection. The extrication of 9 Div. that night was something of a nightmare and your experience as acting as a traffic cop was repeated by us. We met Colonel Boddington as arranged and found the British engineer units had done a grand job. As we passed each we touched them off-a lot of loud bangs with Ain Mara a most spectacular one that went on for hours, as we could see from the smoke mushrooms in the distance.

Among the cross-roads at Giovanni Berta we paused awhile, and it was just as well we did as a number of cruiser tanks—battered and short of petrol—came through. They were, I think, the remnants of 3 Armd. Bde. Arriving at Derna, we cleared out the heterogeneous lot of soldiery and set off the demolitions and fires at that place. When we arrived at the top of the Pass, after blowing it, we found the road cut and a lively little battle taking place. Apparantly the Germans had pushed up a light mixed force from Mecheli with the idea of cutting the main Derna road.

After a council of war, it was decided to try and by-pass the opposition. The few tanks which were there were on the inside and the soft-skinned vehicles on the outside of the periphery. It must have been very much like that show of yours at Mecheli. Quite a lot of vehicles got through, but I don't think many or any of the tanks did. Unfortunately, we ourselves came to grief in a wadi and when deciding what to do, were joined by Colonel Boddington and one of his officers who were in the same predicament. We decided to try and make for Tobruk by land and after burning all our papers, etc., did so eventually. Licut.-Colonel Boddington and his officers elected to make for the coast with the hope of being picked up by the Navy. Unfortunately he was picked up by the Germans instead and during his recent visit to Australia I heard all about his adventures. At the end I think we were about all in, as you were. Ever since the 30th we were practically without sleep, shave, and for about a week without food and practically without water. We counted ourselves fortunate and often wondered about you. We were amazed and delighted when Bill Loring and Peter Moore walked into Tobruk. We wanted to keep them, but Cairo ruled otherwise. We were also very sorry when we heard the news that Brigadier Kisch had been killed, as we all respected and admired him. Risson, by the way, did very well subsequently in Syria, at El Alamein (where he was wounded) and in New Guinea and rose to the rank of Brigadier.

I hope that this account, although rather dimmed by the passage of years, may supply some of the necessary links, as did your articles in the *Journal* for us.

Kind regards, Yours sincerely,

J. MANN.

From:-Colonel A. Crichton Mitchell, O.B.E.

To:---

Brigadier J. Mann, D.S.O.

Switzerland. 23rd October, 1950.

DEAR BRIGADIER,

It was very good of you to send me that long and interesting account of your adventures in the desert in 1941, and I was most glad to have it. The two accounts—yours and my earlier article—between them give as good a résumé of the Sapper side of that unfortunate time as I have seen. Mine, of course, was a very compressed version.

As you say, the fog of war was pretty bad, but you seem to have been luckier than I was as you actually managed to have some contacts with Brigadier Kisch, Boddington and others. The 2nd Armoured Division was, for most of the time, too far out in the blue to the south. I saw General Neame once and Kisch once in all that time, and none of my daily sitreps ever got to Kisch at Barce. Between your chaps and mine, too, there was a fair-sized fog of war. Neither knew—or could learn—a thing about the other. As to any co-ordination of engineer policy, such as the good books talk about, it was impossible in the circumstances because of distances and the almost complete lack of communications. I hoped daily to get some idea from Kisch as to what was to happen on the Sapper side. He, I suppose, equally hoped to hear from me. Within my own division, my General was a grand chap but he had not learnt how to play with the strange and newly-arrived Sappers which had been lent to him. When I asked him for his broad policy as far as engineer work went all he said was: "Do what you like, old chap, and I'm sure it will be grand." In the circumstances it was natural that mistakes and misunderstandings should arise. You had hoped that we would be swanning around Msus to watch your left flank at Regima. We hoped to find you as a firm foot through which we might pass near Scheledima or Solluch. We had originally been told to send part of the 2nd Armoured Division by Msus but this was changed and we all came tumbling and crashing through that damnable Wadi Garidla—I shall never forget that night there—right on to your left flank on top of the Regima scarp.

Well, all history shows war to be like that and, for all our aircraft and wireless, I sometimes wonder if we are much better off than Wellington was when he said he'd give his last pair of pants—or an Army Corps—to know what was happening on the other side of the hill. Of course, in 1941 in the desert, we Sappers had no wireless and we saw damned few of our own aeroplanes. I was my own D.R. most of the time.

I hope you will not take any of my remarks in my article in any way personally. In fact, I feel you have not done so from the tone of your letter. Although I burnt most of my papers I managed to keep a small diary which came unscathed through many a search during my two and a half years in Italian prison camps. In that I had written as I felt at the time and from that I reproduced my article. My remarks were the feelings of a much harried man.

As to the water tower of Abiar of which I made mention. It was in the middle of the big open space in the village, about 150-200 yds. south of the railway. There was another tower closer to the railway, but farther west about half-way between Abiar and where your chaps were on the top of the Regima scarp. That had been reported to me as empty and we had not time to blow it up. As you can imagine, however, Bill Loring and I got a bit of a fright when the Abiar tower suddenly blew up in our faces, so to speak. But let it pass.

I was in two of the same prison camps as Boddington and knew his story. The officer with him near Derna when you all tried to burst through the Boche was Ted Oliver, a Territorial Field Company Commander who had also done good work and who was in the bag with me. In one prison camp, too, I met Bob Marlan, one of your Staff Corps who had been in command of a battalion in these operations, and we discussed the whole business. He confirmed much of what you say about the fog of war being "pea soup thick " at the time. I was interested to hear about Risson going on to do such good work.

Again, many thanks for your most interesting letter. My best wishes and all good luck.

Yours sincerely, A. CRICHTON MITCHELL.

MEMOIRS

MAJOR-GENERAL G. E. GRIMSDALE

GENERAL GRIMSDALE, who died on 30th, October, 1950, at ability very much above the average. He would have made a greater mark in the Army had the right opportunity come his way, and had not the closing stages of his career been gravely prejudiced by unusual and improbable circumstances that he was powerless to control.

Gordon Edward Grimsdale was the son of the late D. H. Grimsdale, Esq., J.P., of Uxbridge, and was born on 26th September, 1893. He went to Cheltenham at the age of 14 and passed tenth into Woolwich four years later, together with twelve other Cheltonians. He was commissioned in the Royal Engineers twelve months before the outbreak of the First World War, having risen to fifth in his batch. Serving with the 1st and 3rd Field Squadrons (a word with a very different meaning to-day) he also had some months' experience as an A.D.C., and became a Captain at the end of 1917. In the last year of the war he was Staff Officer to the Chief Engineer of the Second Army, accompanying Lord Plumer's Headquarters to Cologne. He was twice Mentioned in Despatches, was wounded, and in addition to the 1914 Star, War and Victory medals, received the French croix de guerre.

After the war Grimsdale spent a few years on the Staff in Ireland, and as Adjutant to the 47th Divisional Engineers of the Territorial Army; this was followed by success in the entrance examination to the Staff College, where he joined in 1925. His contemporaries at Camberley speak of him as a quiet, studious officer, not taking much part in games or sport except a little mild golf and riding, but commonly reported to work very hard in his spare time, and with a reputation for brains.

In the summer of 1927 he joined the Department of Military Operations and Intelligence at the War Office, and found himself in the Far Eastern sub-section, a part of the world about which he knew nothing. This appointment proved to be the crisis and turning-point of his career.

At that time the writer of this Memoir was the head of the Section which included the Far East among the various parts of the world for which it was responsible, and frankly viewed with some misgiving the arrival of an officer with no local knowledge of China or Japan. He need not have been anxious. Grimsdale fully realized the position, and mobilized all his considerable powers of industry, determination and intellect with the happiest results. So much so, indeed, that when he was detailed for service in India a few years later, in the normal course of regimental duty abroad, the writer (with the support of higher authority) prevailed upon A.G.7 to post Grimsdale to Hong Kong instead. He was thus able to see something of that distant region about which he had learnt so much at his desk in Whitehall.

During the 'thirties he gradually built up a reputation at home and abroad as an expert on the Far East, returning to his old Section as G.S.O.2 for three years ; awarded a brevet Lieutenant-Colonelcy in 1934 he was promoted substantive Colonel in 1937. He went east a second time in 1939, as G.S.O.1, China, his work including the supervision of the Intelligence Bureaux at Hong Kong and Singapore ; this was followed by his appointment as Military Attaché at Chungking, and shortly afterwards head of the Military Mission there as well—first as a Brigadier, and from the end of 1942 as Major-General. The following notes by a colleague who was with him for about eighteen months throw a vivid light on Grimsdale's work in that medieval city on the Yangtse, with its indescribable dirt and thin veneer of modernization, and a climate varying from humid heat to damp cold.

"Grimsdale was a tower of strength to the British Community in China. His accumulated knowledge of the Far East made his opinions and judgment, which were always shrewd, much sought after and listened to both by our Ambassador and the Americans, who were responsible for the main military aid to China, and with whom he was on excellent terms. His house was never without some distinguished visitor—American or British—and was the centre of informal discussions on the situation in China. He was never under any illusions about the rottenness of the Kuomingtang régime, and their war effort, which was negligible. His views on the subject were not always popular, but they have been proved right by events."

The arrival in Chungking of an officer with a European reputation and legendary prowess on many battlefields, considerably senior to himself and with extremely wide powers, but no previous acquaintance with China, made Grimsdale's position very difficult. His outspoken and firm conviction that his views on China were correct led to sharp clashes with the new arrival, and at the end of 1944 Grimsdale was replaced. Nothing further need be said about the paralysing handicaps under which he had worked. But his opinion of our Ally is reflected in Lord Wavell's Despatches dealing with joint operations with the Chinese : they contain more than once the pithy sentence " The Chinese did not move." (*The Times*, 23rd April, 1948.)

A further extract from the notes of the colleague mentioned above may be given here :

"Grimsdale was involved in a serious accident when a truck in which he was travelling to Pihu (site of a training-school) overturned. His knee-joint was badly damaged and he was brought back to Chungking on a stretcher and evacuated to Calcutta for treatment; he was in plaster in bed for weeks and became permanently a bit lame as a result. He accepted this misfortune quite philosophically and patiently. His quiet but charming personality was well loved by the whole Mission (fifty officers and thirty other ranks), who all had the greatest confidence in him. He always struck me as a man of great gentleness and thought for others. There was no personal problem of any of his staff to which he was not prepared to give his sympathy and active help. In all the trying circumstances of Chungking I never knew him flurried, irritable, or out of temper. Through it all he preserved a remarkable equanimity, which was, I think, a reflection of his inner pcace."

So Grimsdale came home and retired, having tasted frustration more bitter than can have fallen to the lot of many men; but he had a clear conscience and never complained. He received no honours or rewards, and even his rank of Major-General was not made substantive. After the war he busied himself in various ways and spent three years at Minden in the Control Commission; but he was not in a position which offered scope to his abilities, and had not enough work or responsibility. He also did some broadcasting and writing, an article over his own name in *The Observer* of 15th February, 1948, entitled "Germany's Fifth Eleven" attracting considerable attention.

He married, in 1923, Miss Breta Merrylees (sister of Colonel K. W. Merrylees in the Corps) by whom he is survived, with two adopted sons, both of whom are now at their father's old School. Greatly to his misfortune his wife could not be with him at Chung-king, the time of all others when he most wanted her support and comfort. To the end of his life he preserved his youthful appearance and slight, boyish figure ; those who knew him well will remember a rather shy, thoughtful man, with a sense of humour that hid a determined but gentle character. Perhaps these qualities stood him in better stead than those of a robust, forceful and "tough" personality, in the strange conditions and highly-charged atmosphere where he passed his last months in the Army.

F.S.G.P.



Major-General GE Grimsdale



Brigadier-General F Rainsford-Hannay, CB,CMG

BRIG.-GENERAL F. RAINSFORD-HANNAY, C.B., C.M.G.

TREDERICK RAINSFORD-HANNAY was born on 7th F September, 1854, the youngest son of Major Rainsford-Hannay of Kirkdale, Creetown, in the Stewartry of Kirkcudbright. He was educated at Windermere and passed straight into the Shop, obtaining a commission as Lieutenant R.E. on 11th September, 1873. He took up Submarine Mining at the end of his training and served in Cevlon Pembroke Dock, Plymouth and Harwich.

His first spell of duty at the War Office was from 1885-9 in the I.G.F's. office and from there was sent to Australia on special duty. It was during his service in Australia that he met and married, in 1891, Emily Louisa Wilkie.

On returning to England in 1894 he was posted to Chester and in 1898 went to the War Office as Inspector of Submarine defences. He served continuously at the War Office for eight years, holding appointments as Asst. I.G.F. and A.D.F.W. and being promoted Colonel in 1904.

In 1906 he was made Chief Engineer of the Irish Command, but but only remained there for a few months, being posted as Commandant S.M.E. in January, 1907. The following year he returned once more to the War Office, this time as D.F.W. with the rank of Brigadier-General. He held this appointment until he retired on reaching the age limit in September, 1911, and was awarded the C.B.

He was not idle very long, as he was appointed Bursar of Charterhouse School and remained there for twenty years, except for a break from 1914-17 when he was recalled for service as Commandant S.M.E. For his war-time service he was awarded the C.M.G.

A junior officer serving at the War Office when Rainsford-Hannay was Commandant at the S.M.E. says : "I had often to discuss problems of organization with the Commandant, who always made a difficult task lighter by his courtesy, and a memory remains of kindness and wise counsel given to a younger officer."

Rainsford-Hannay settled down at Godalming and built himself a house and laid out a very charming landscape garden. He was much loved and respected by the school during the long tenure of his Bursarship. After the 1914-18 war a memorial to old Carthusians was built under his care and supervision and this will also be a lasting record of his fine technical knowledge of building and architecture.

He was very much crippled for the last two years of his life, as he broke a thigh slipping on the pavement, but his fine constitution, even at the age of 94, pulled him through and he lived until 23rd December, 1950, when the oldest sapper officer passed to his rest.

He is survived by his wife and daughter, now Mrs. Fisher-Rowe.

A. G. R-H.

COLONEL R. E. M. RUSSELL, C.V.O., C.B.E., D.S.O.

REGINALD EDMUND MAGHLIN RUSSELL was born on 2nd September, 1879, the son of E. M. Russell of Limerick. He was educated at Cheltenham College and passed into the Royal Engineers from Woolwich in June, 1898. During his time at Woolwich the Cadets paraded outside Buckingham Palace for Queen Victoria's Diamond Jubilee celebrations.

On completing the usual course at the S.M.E. he was posted in 1900 to the 46th Field Company who were employed on building Tidworth camp on Salisbury Plain. He went with this company to South Africa the following year. In May, 1902, he contracted enteric fever and was sent home on sick leave. For his services in the Boer War he was Mentioned in Despatches and received the Queen's Medal with five Clasps.

On completion of sick leave he was posted to the 1st Field Company at Cork, but within a few months he returned to South Africa to join the 38th Field Company, where he remained for the next three years.

In 1905 he was posted to the Sudan Government Railways. Here he was employed on the construction of the new line linking Port Sudan with Khartoum and after the line was opened he played an important part in building the railway H.Q. at Atbara. With S. F. Newcombe he later surveyed the line to Kassala.

In 1903 Russell was sent to Alexandria as the Sudan Railway Agent and A. P. Rolland, who had joined the Sudan Civil Service in 1905 at the same time as Russell joined the Railway Department, says he was a very popular member of the community there, his special hobby being sailing, and he won many races in his little boat *Dik-dik*.

In 1910 he was appointed Assistant Director of Intelligence under Sir Lee Stack, when Kitchener was Agent-General at the Residency. Rolland was then Commercial Secretary at the Sudan Agency and he says "Russell endeared himself to everyone with his delightful personality. He and his dog 'Guts ' were amongst the best known personalities in Cairo in those days. There was a simplicity and charm in his character which made him loved by everyone with whom he came in contact. In the East he was loved by all the natives, who, better perhaps than most Europeans, judge the true worth of a man."

In 1912 he went on the Anuak Expedition in the Sudan. For his services in this expedition he received the Sudan General Service Medal and the Order of the Medjidieh 4th Class.

In 1913 he was appointed Assistant Director of Intelligence at Khartoum, where he was serving on the outbreak of the First World War. Shortly afterwards he was promoted Major and appointed as a G.S.O.II of the Egyptian Expeditionary Force.

He served in Egypt and Palestine throughout the war and held appointments successively as C.R.E. Canal Defences, G.S.O.I Western Frontier Force, C.R.E. 52nd Lowland Division, Chief Engineer Desert Column, with the temporary rank of Brigadier-General, and C.R.E. Cavalry Corps in Palestine. He was awarded the D.S.O. in 1915, was six times Mentioned in Despatches, promoted Brevet Lieut.-Colonel and, in 1919, was made a C.B.E. He was also awarded the Order of the Nile (4th Class) and the Italian Order of St. Maurice and St. Lazarus.

In April, 1918, he was given a temporary Commission with the R.A.F., with the rank of Lieut.-Colonel, and qualified as a pilot. He served as G.S.O.I. at R.A.F. H.Q. Middle East, under Major-General (later Chief-Marshal) Sir Geoffrey Salmond, who was in the same batch as Russell at the Shop. In July, 1919, he was appointed G.S.O.I. R.A.F. H.Q. at South-Eastern Area, U.K., with rank of Wing-Commander.

Towards the end of 1919 he was appointed to command the new R.A.F. Depot which was then formed at Uxbridge. J. E. Baldwin (later Air Marshal Sir John Baldwin), an ex-cavalry officer, was his second-in-command. He writes that "Russell was a delightful man to serve with and his knowledge of Regimental soldiering and his Army experience were of the utmost value to the R.A.F. and we were a very happy team. His quiet efficient methods in that difficult post-war period, and particularly in a new service which was starting from scratch, were just what were wanted for laying the foundations of the R.A.F. Depot. I (ex-cavalry), Parkin (ex-guardee ranker) and my drill adjutant Wombwell (who had been C.S.M. at Sandhurst) all enjoyed working with him and found him a tower of strength against which to lean, but at the same time quite willing and anxious to give us our head and encourage us to make a show of our own commands."

In 1920 he resigned from the R.A.F. and returned to the Army and attended the Senior Officers School at Woking, after which he was posted as D.O.R.E., South Dublin in 1921. Later the same year he was sent to Chili for special duty with the Chilian Army, where he remained till August, 1922, when he was posted to M.I.2 at the War Office.

In December, 1922, he was posted as Second-in-Command of the Training Battalion at Chatham and took command of the battalion on 1st January, 1925, having been promoted Lieut.-Colonel the previous June. It was here, perhaps, that he became best known to a large number of officers of the Corps.

I.S.O.P., who was his adjutant, writes of him as follows :-

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"He was an outdoor man and a keen shot and was a firm believer in the importance of character, self-reliance and general "savvy" in the make-up of an officer. He thought a broad-minded Sapper was far more use than an intense one. He attached great importance to the encouragement of outside interests including the use of leisure —the time when character and experience are developed more than they are on parade or in the office.

"He based his policy of training in the Training Battalion on these lines and insisted that Officers and N.C.O's. required training as much as recruits, and if they were to gain in experience they must be given responsibility. To carry out this principle he made the Company Officers and N.C.O's. take much more responsibility for the training than they had done previously, when the training had been left largely to specialised cadres.

"Russell did not think that the Commanding Officer should make his appearances and interventions too deep, and Russell was essentially a Commander rather than a General Manager. He had the strength of mind to stand back and let his subordinates do their own work and profit by their mistakes, but when necessary he made the influence of the Commanding Officer felt.

"His appearance and bearing were greatly in his favour; he was a charming friend and a splendid host."

At the Corps Dinner last year Russell collected as many as possible of the officers who served with him in the Training Battalion to form a table and it was a most successful reunion, to which he referred afterwards with delight and with pride of the many distinctions this group had gained.

On completion of his tour of duty with the Training Battalion Russell returned to Chili in 1927, this time as Military Attaché at Santiago and also at Rio de Janeiro. This double appointment lasted for four years and during the last few weeks of his tour of duty he accompanied the Prince of Wales on his South American tour.

On completion in 1931 he asked to be allowed to retire. He was then appointed a Member of H.M. Body Guard and made a C.V.O.

On the outbreak of war in 1939 he was re-employed as Military Attaché in Buenos Aires, which appointment he held till 1943. He then volunteered for service with the Admiralty in the Yachtsmen's Emergency Service as a deck-hand on a motor fishing vessel No. 124 stationed at Cowes in attendance on the invasion fleet in May and June, 1944, and subsequently as deck-hand, stoker, bosun and mate on several coastward voyages until October, 1944.

In 1918 he married Dorothy, the twin daughter of the late Major R. B. Clarke of the Rifle Brigade, who survives him with one daughter. Their only son was killed in action in North Africa in 1943.

C.C.P.



Colonel REM Russell CVO CBE DSO



Brigadier Sir Edward A Tandy, Kt

BRIGADIER SIR EDWARD A. TANDY, KT.

SIR EDWARD ALDBOROUGH TANDY died in Oxford on 30th November, 1950, in his seventy-ninth year. Almost the whole of his service was spent in the Survey of India, from which he retired in 1928 as Surveyor General. He was created a Knight Bachelor in 1929.

Soon after leaving the S.M.E. in 1891 Tandy was posted to India and for five years had a varied experience in "Works", including the water supply of Agra Cantonment, road prospecting in the Chin Hills, and famine duty in the United Provinces. He also served as Assistant Field Engineer with the Kurram Mobile Column in the Tirah Campaign of 1897, receiving the Medal and two clasps.

He joined the Survey of India in January, 1898. His first two years in this Department were spent in the "Latitude" Party, when he found time to investigate and make a valuable report on the calibration of levels. From 1901 to 1903 he was placed on special duty to reorganize the Mathematical Instrument Office, the work of which had increased enormously. Drastic reforms were necessary without upsetting the flow of current work. Since that time the office developed steadily and at the opening of the Second World War it was responsible for the repairs and a great deal of the initial supply of most of the instrument-using departments and services in India, including the Army which was by far its largest customer.

During this period of "deputation" Captain Tandy served for short periods in most of the headquarter offices and formed the strong conviction that the most urgent need of the Department was reorganization on a regional basis, by the creation of a few large Survey Circles to administer all Survey work in their areas, instead of the existing system under which topographical, revenue and forest surveys were grouped under separate administrative officers on an All-India basis. Tandy devoted himself to bringing about this great reform and his efforts were rewarded by seeing it gradually established during his service, with great benefit to all branches of the work.

From 1903 to 1909 Captain Tandy was in charge of No 18 Party, at the time perhaps the most difficult charge in the Department, being responsible for a great variety of special surveys in the Punjab plains and hills. The principal work of the unit comprised riverain boundary surveys and the rectangulation surveys of desert areas about to be brought under irrigation, both of which were initiated by Tandy in consultation with the Government of the Punjab. He solved the difficult problem of locating fixed boundaries along the banks of the ever-changing Punjab rivers, where formerly there had been a succession of violent disputes, not infrequently accompanied by bloodshed, and endless litigation, which in the absence of reliable maps was largely infructuous. The rectangulation surveys, for which new methods were devised, saved vast tracts from the confusion and waste which had arisen from inferior rectangulation, carried out without professional assistance. The Department is still carrying out this beneficial work in large areas which are being prepared for irrigation and colonization.

In 1911 Major Tandy was posted to the "Pendulum" Party at a time when the work of Sir Sidney Burrard in India, and Hayford and others in America, was stimulating world-wide interest in the problem of isostasy and the earth's crust; Tandy devoted his attention to various aspects of this investigation with characteristic enthusiasm and read a paper on the subject to the Royal Geographical Society in 1921.

In 1914 he received the thanks of the Government of the United Provinces for the resurvey of the Nepal boundary in the Pilibhit district.

On the outbreak of World War I, Major Tandy, with other senior officers of the Survey of India, was retained in India, but in 1916 he succeeded in being posted to Iraq as Assistant Director of Works, R.E. Parks. The heavy work of evolving order out of the existing chaos in the trying climate of Basra eventually told on his health and after a brief period as officiating Brigade Major R.E. at Baghdad, he was reposted to the Survey of India in September, 1917, when he carried out the difficult survey of the Khewra Salt Mines.

From 1921 Colonel Tandy was posted as Director successively of the Geodetic Branch, the Map Publication Branch, and the Northern Circle. He succeeded to the post of Surveyor General in 1924, at the age of 52, and was granted an extension of two years up to December, 1928. This tenure of office was marked by the gradual expansion of the activities of the Department which had been curtailed by the war and the period of financial stringency which followed the re-establishment of the Survey on a peace footing. A very notable improvement was effected solely on Brigadier Tandy's initiative, in the formation of the Frontier Circle. The formation of this Circle, with headquarters in touch with the Army and of Survey Companies recessing with Command H.Q., led to great improvements in mobilization arrangements and to the recognition of the important rôle of the Survey of India in peace and war. The Circle included a Survey Party devoted exclusively to the development of Air Survey. The war had put a stop to the comparatively easy access to tribal territory, which has never since been regained, and, short of mobilizing a brigade or more as escort for ground surveys, the only method of mapping these areas is from the air.

Tandy possessed a very vigorous personality and an active and versatile imagination. His critical habit of mind took nothing for granted, and he was constantly searching for, and putting into effect, improvements in a wide range of subjects, both professional and administrative. He stimulated discussion with his juniors, and thought the more of those who stood up to him in argument. His varied interests in a long retirement included the active support of Basic English as an international language.

For the last four years of his life he suffered from arterial contraction of the legs and was unable to take any form of exercise. This must have been a great deprivation to a man of his energy and he showed the fineness of his character in the indomitable courage and cheerfulness with which he bore this disability.

During the critical years of 1940 he evolved an emblem based on an ancient design, to represent the unity of the freedom loving nations of the world and this appeared on the cover of the *Studio Magazine* in the month of the Battle of Britain. It was his constant hope during the past years that this should be adopted as the insignia of the Atlantic Powers in the present critical epoch.

He was a son of the late Colonel E. O. Tandy, I.M.S., was educated at Tonbridge School and married, in 1909, Mary, daughter of the late George Eaglesome, who survives him. There was one son of this marriage.

C.G.L.

NOTICE

A memoir on Major-General Sir Ernest D. Swinton, K.B.E., C.B., D.S.O. has been unavoidably delayed and will be published in the June, 1951, *Journal*.

BOOK REVIEWS

A SHORT HISTORY OF THE BRITISH ARMY By MAJOR E. W. SHEPPARD

(Published by Constable & Co., Ltd., London, W.C.2. Price 30s.

It would not be difficult to say unkind things about the latest edition of Major Sheppard's book A Short History of the British Army; so perhaps, because it is a splendid book, it were well to say these things first.

To start with it is not short : it is nearly 500 pages. The original edition was short. It was about 300 pages which, compared with the long history of the British Army is short ; but another thirty-five years of history has almost doubled its length. Of course, to us, who have lived the last thirty-five years, the epoch seems momentous indeed ; but compared with what has gone before, 200 pages seem to be out of balance.

Next, it is misleading to call it a history of the British Army. It is more a history of British campaigns. You will not find in this book the regiments which fought at Blenheim and Waterloo, or charged at Omdurman and Balaclava. The author acknowledges this defect, and offers instead a chapter at the end. In this he deals with The British Soldier, The British Officer, The British General and The British Military Machine. If this chapter does not retrieve the position it certainly makes good reading ; and it presents an excellent picture of a fighting machine that has lost innumerable battles, but only lost two wars in a thousand years. These two wars, it is interesting to read, are the only two which began well. Indeed, if we were defeated by Joan of Arc and George Washington the only reason that one can see is because the British Army did not start off with a staggering defeat. That is what the British Army seems to need to put it on its mettle.

Right through this history we see the army's reliance on sea power. Sea power covered its early defeats and launched it to its final victories. Without supremacy at sea it would have been a very different tale. This tempts one to wonder whether the large numbers of men in khaki to-day (by no stretch of the imagination can they all be called soldiers) can really bring victory without a dominant air force. In the light of history it seems too much to hope to fight a Waterloo or an Alamein in the first clash; but by itself the British Army could not have fought a Corunna nor a Dunkirk. A larger army at either place might merely have swelled the casualty lists.

Until the massive armies of Haig appeared on the battlefields, every British commander has always been handling the only existing British Army, the single, priceless jewel of the land. This fact—that he cannot afford to lose men—has, until the Somme of 1916, always coloured British generalship. The author traces this in his biographical studies of British Generals. Some of these are excellently done, though readers of Philip Guedalla's biography of *The Duke* will not always agree with Major Sheppard's appraisement of Wellington.

Another factor that has coloured British Army history is its association with allies. It has never fought a major war alone, and now is not the only occasion when allies of one war have become enemics within a few years. The beating down of France in 1940 was not the first time a British Army has been left to work out its own salvation—always of course with the Royal Navy behind it. It has sometimes achieved results out of all proportion to its size by applying itself at the proper place—as for instance when Pitt resolved to "conquer Canada on the Rhine" and six regiments of British Infantry, fighting in a German army, earned immortal fame at Minden.

There is no end to what one could write in reviewing this book. Suffice it to say that it tells a tale of which we all know a few glittering episodes. But we should all be the better for knowing how they fit together; and this excellent book gives us a chance to read the story as a whole. And how easy it is to read !

M.C.A.H.

HISTORICAL RECORDS OF THE SURVEY OF INDIA VOLUME II. 1800 to 1815

Collected and Compiled by COLONEL R. H. PHILLIMORE, C.I.E., D.S.O. (Late Royal Engineers and Survey of India)

(Published by Order of the Surveyor General of India. Price Rs. 20 or £1 115. od.)

The second volume of this series has just been published. It covers the years from 1800 to 1815. It is an interesting period, for it starts with each of the three Presidencies controlling its own surveys and ends with the appointment of Mackenzie as the first Surveyor General of India.

They were big men in those days and not the least of them was Lambton, to whose courage and foresight the Survey of India owes the establishment of its Trigonometrical Survey. Head and shoulders above his contemporaries, his figure strides through the pages of this volume following the trail laid by the Ordnance Survey of Great Britain, the work of which he read with the closest attention.

The fact that General Roy was a member of the Board of Fortifications and so had direct access to the Duke of Richmond may have been partly responsible for the setting up of the Ordnance Survey. The accident that Lambton served as Brigade Major to Wellesley, whose recommendations received great attention from the Government, may have led to his proposals for a Trigonometrical Survey being approved. Thus are big affairs often settled.

During the sixteen years covered in this volume Lambton measured ten bases, observed the latitude of a number of stations with the Zenith Sector and covered the peninsula south of 15 deg. north with triangulation.

The full account of his work has been published elsewhere, but it is a pity that the details of his results are treated somewhat sketchily in this volume for it would have been interesting to know how he determined his longitudes.

© Little is written of the accordance of his bases with lengths carried through his triangulation, but we read that the Bangalore base differed from the length carried through from Madras by just under four inches in a distance of about 140 miles. Another base differed by rather more than seven inches in about the same distance. Nothing is said about his methods of calculation and adjustment.

In the Madras Presidency we find that surveys were being more and more based on triangulation and less on traverse. Elsewhere the military route was still the main source of information, although these were being adjusted to a control of astronomical latitudes in many cases. Little attention was paid to levelling in this period but the heights of some of the Himalayan peaks were obtained by theodolite observations with surprising accuracy considering the little that was known about refraction at that time.

Although work was pushed ahead on Colebrooke's and Reynolds's maps of India, their completion was long drawn out since new surveys were continually being received, which added to, or corrected, the meagre knowledge of the country.

During this period the three Survey Departments continued their work along separate paths with little or no liaison. In fact, there was much duplication of effort in the preparation of maps and some refusal to exchange information. Eventually, in 1814, the Directors ordered the appointment of a Surveyor General for India and abolished the posts of Surveyor General in each of the Presidencies. Although Mackenzie was nominated for the new post in 1815 he did not leave Madras to take up his new appointment until 1817.

This volume tells of the vast amount of work carried out in the period, often in conditions of great difficulty and disappointment. Surveyors were spread from Java in the East to Persia in the West and were often removed from their work to serve as Engineers in the many campaigns of the time. The tale of their work is told in great detail, perhaps in too great detail. The importance of the period lies in the transition of survey work from the haphazard to the precise. There is so much in this volume that the thread of the change is difficult to follow. But, as an account of the day to day work of the surveyors, this volume is excellent and there are interesting chapters on the pay, conditions and administration of the period.

We congratulate Colonel Phillimore on the production of this second volume and we hope that the third, which will tell of the organization of the new Department of the Surveyor General, will not be long delayed.

K.M.P.

ROADS

By R. G. Batson

(Published by Longmans, Green & Co., Ltd. Price 215.)

In the preface to this book the author makes it quite clear that the information given in it is intended as a guide to the young engineer commencing his training. The young engineer in this case being one who is intending to take up a civilian appointment.

Consequently a large portion of the book deals with the purely civilian aspect of road engineering, such as transition curves, cloverleaf junctions, the aesthetics of design etc., which do not concern the military engineer to the same extent.

The book, however, covers the whole field of road engineering from the preparation of schemes and road surveys, through working drawings, junctions and layout, to the construction of roads from the subgrade to the wearing surface, whether it be by concrete or bituminous construction. It ends with two chapters, one on private street works, contracts and specifications, and a very short one on road bridges.

The main criticism of the book is that the subject is not put simply enough for the young engineer, nor is the book technical enough for use as a reference.

D.R.H.

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STAR ALMANAC FOR LAND SURVEYORS

(Published by H.M.S.O. Price 3s.)

There has for some time existed a need for a Star Almanac specifically devoted to the requirements of the surveyor. The Nautical Almanac contains much that he never uses, yet too little of what he does. "Apparent Places of Fundamental Stars" gives data for a large number of stars to a precision required by the geodetic but not normally by the topographical surveyor; while it gives no information on the sun. The scope of the new Almanac was discussed at the Conference of

Commonwealth Surveyors in 1947, and following further consideration by a Committee set up by the Colonial Office, and by interested authorities, the new Almanac has been prepared by H.M. Nautical Almanac Office for 1951. The form of tabulation is particularly suitable for surveyors, and is more compact than the equivalent portions of the "N.Á." Contents include the Ephemeris of the Sun for intervals of six hours of Universal Time (G.M.T.), tables of sunrise and sunset, Apparent Places of 650 Stars of brightness greater than magnitude 4.0, Circumpolar Stars (Northern and Southern), a Star Index, a Pole Star Table giving quick values of latitude and azimuth to 0'.2 from values of LST and altitude, and Refraction and Interpolation Tables. The precision of tabulation is appropriate to ordinary survey work, and removes the temptation to compute results to an apparent accuracy which the original observations frequently will not support. Interpolation is linear, and avoids the need for Besselian Coefficients. Mean time intervals may be converted readily and accurately to Sidereal time, though provision is not made for the reverse process, and resort must be had to Chambers. This is a weakness which could be remedied at the cost of only a half page more of tables. There is room for minor improvements in detail which will no doubt be included in subsequent issues, but in general this is an excellent publication and gives the Surveyor precisely what he wants in compact form. The type is clear and easy to read.

For navigators the *Abridged Nautical Almanac* is more suitable and, from 1952, is being published in a form yet more appropriate to the navigator's needs.

A.H.D.

PROJECTION TABLES FOR THE TRANSVERSE MERCATOR PROJECTION OF GREAT BRITAIN

(Produced by the Ordnance Survey, Published by H.M.S.O. Price 4s.)

These tables provide the information necessary for geodetic computation of Azimuth, Reverse Azimuth, True Distance on the Spheroid, and conversion from Geographical to National Grid Co-ordinates and vice versa.

They are designed for machine computation throughout and are clear, quick and simple to use. Values are tabulated for every minute of Latitude from 49-61 deg. N. An excellent feature of the tables is the provision of all relevant formulae at the head of each page.

No derivation of formulae or examples of the use of the tables are given; for these, the reader is referred to the Ordnance Survey pamphlet entitled Constants, Formulae and Methods used in the Transverse Mercator Projection, obtainable from H.M.S.O. price 18.

J.K.

CONCRETE PRACTICE IN BUILDING CONSTRUCTION (Published by the Cement and Concrete Association)

This little book is the answer to a long-felt need, a book which tells exactly how and why.

In the foreword it states "Concrete Practice is intended for the use of Clerks of Works, Contractors' Agents and others responsible for supervising the construction of concrete buildings. The object of the booklet is to give the reasons underlying the various clauses of specifications in order that they may be clearly understood and intelligently followed" (the italics are mine), and that is exactly what it does.

It covers the whole range from materials and mixes to formwork and finishing and makes general comments on the later developments of non-traditional methods, including air entrainment and prestressed concrete. The tables, examples and illustrations are very much to the point and materially assist in the explanations and do not confuse the reader, a not infrequent fault in booklets of this type, this is probably due to the fact that the Cement and Concrete Association is a nonprofit-making body which is concerned only with the promotion of better concrete practice.

The "Memoranda" at the end of the book is a useful mine of information for the practical engineer dealing with weights, average costs and quantities of the various ingredients and accessories required in the production of a concrete building; it also gives, with their prices, a formidable list of British Standard Specifications dealing with concrete materials, testing of materials, test apparatus and concrete practice.

A definite *must* for all engineers, second only to the *Concrete Manual* published by the United States Department of the Interior Bureau of Reclamation, which is much longer, much more detailed and quite expensive.

E.E.P.

ELEMENTARY THEORY OF STRUCTURES

By JAMES C. GRASSIE

(Published by Longmans, Green & Co. Price 25s.)

Mr. Grassie has here made a noble attempt to produce a "Theory of Structures" textbook which is elementary, without being useless; commendably avoiding the example of some of his predecessors, whose object would appear to have been to analyse a more unusual structure by a more complicated method than anyone else. He starts at the definition of a force, and slowly cuts a wide swath through the field of statics, gently passing into what we usually call the "Theory of Structures" at about Chapter V. It is made quite clear that the book is concerned only with the solution of determinate structures, but we are shown clearly how to recognize redundancies, and we have a look at such methods as Area-Moments and Strain Energy, so that our way ahead is clear if we wish to tread it.

This is a good textbook for the slow and thorough student, and for the man whose misfortune it is to work alone, unaided, but the class who wish to, or have to, cover a big syllabus quickly will find Mr. Grassie a triffe leisurely. There is a good selection of examples, but these for the most part are confined to the analysis of the force system into thrust, shearing force and bending moment : questions of practical design are not introduced until three-quarters of the way through the volume. This position is defended by the author in his introduction, but it will not commend the work to the Sapper who is interested above all in elementary practical design.

The printing and presentation are without reproach. Although a table of Highway Loading is included, Steel Section tables are not, and prospective purchasers are warned that they need at least a nodding acquaintance with the Calculus.

D.A.S.

TEN TON TRAVEL By E. E. Nott-Bower

(Published by John Murray, London, W.1. Price 12s. 6d.)

Many books on long cruises and races in small yachts have been written since the war: some of them are good, and nearly all are of interest to the amateur sailor, who can learn a good deal from others' experiences. Pilotage to little-known harbours, useful advice on gear or sails, and advice on the handling of yachts in bad weather are among the points which are often covered in these books.

Ten Ton Travel is different: it is certainly not a textbook in any sense, but a pleasantly and modestly written story of an enterprising cruise; it is entertainment for both landsman and yachtsman alike, but does not set out to teach.

Brigadier Nott-Bower retired from the Corps in 1946 and bought the old clinker-built 10-ton gaff cutter *Smew*. He had done very little sailing in anything larger than a dinghy and set out to learn. His first effort was a cruise down Channel from the Thames to Exmouth and another to St. Malo and back. During most of the time his wife was the only other member of the crew. In 1947 he set forth for Gibraltar with his wife and another lady as crew. Generally it was a coasting trip, putting into ports every two or three days, with a longer leg between Belle IIe and the north coast of Spain. He left the ship in Gibraltar and returned later in the year with his wife. Together they sailed to the south coast of France and thence by canal to the Gironde, arriving there in December, 1947, and laying up.

In June, 1948, Brigadier Nott-Bower returned to Smew with his wife and daughter and sailed her back to England, cutting across the Brittany peninsula by canal and river.

The cruise was a great achievement, and there is no doubt that the Brigadier and his wife are thoroughly competent sailors, though he tends to conceal this in his modest writing. Slow to windward and a bit of a brute to steer with the wind on the quarter, *Smew* must have been a tiring boat to sail, but there were no serious mishaps.

The book is excellent light reading and the descriptions of life on board evoke a flood of memories in any yachtsman. In particular, the story of doings at the Spanish town of Cedeira, and of frayed tempers off Cape St. Vincent are a joy and should not be missed. Any officer on an E. & M. Course, or anyone owning a yacht with an auxiliary, should moreover read the technical description of "Henry" the auxiliary, in Chapter VII.

L.R.E.F.

THE MILITARY ENGINEER

(Published by the Society of American Military Engineers) September-October, 1950, "The Atomic Battlefield", LIEUT.-COLONEL DAVID B. PARKER, Corps of Engineers.

From the Civil Defence angle much has been written on the effects of atom bombs on cities, but not much has yet been said about the effects of such bombs on the battlefield in direct support of troops. The author remedies this in an interesting article which analyses the individual chances of survival of men and machines at various ranges from atom bombs of varying power, exploded at various heights, including underground and underwater.

The analysis is carried out for each of the three characteristics of the atom bomb-Blast, Heat Radiation, and Nuclear Radiation-and is illustrated by sketches and simple calculations showing the chances of survival of the individual in slit trenches and vertical foxholes at various ranges. In designing fieldworks of the future against gamma rays a knowledge of the "half-thickness" of the material used will be required (the "half-thickness" of a shielding material is that thickness required to reduce the radiation dose by a factor of $\frac{1}{2}$). The thickness of earth is given by the author as about 5 in. At 2,500 ft. from the burst the gamma dosage is some 5,500 roentgens. (700R is 100 per cent lethal, 400R about 50 per cent lethal and 100R safe.) With 20 in. of earth, i.e., 4 half-thicknesses 5,500R divided by 2 to 4th gives a dosage of 350R or about an even chance of survival. After various calculations of this type the author concludes that a good solution of the protection problem is given by a standing foxhole as small in diameter as possible and deep enough to give 3 ft. or more of earth above the head of the occupant. Better still is a cut-and-cover shelter which with 2 or 3 ft. of earth cover will give almost complete protection from blast, heat, and gamma rays even when close to ground zero.

Under his analysis of effects on tanks, the author records that at 1,000 ft. from an air burst a tank may be lifted and thrown some 25 to 100 ft. even though the blast wave does not itself crush the tank. This would appear however to be of somewhat academic interest to the occupants who with a shielding value of tank wall equivalent to 4 in. of iron will receive a medium lethal dose of 400R even at 3,000 ft. from the burst. Tank crews are in danger if closer than 4,000 ft. to the explosion.

Fortunately with the high air burst there is no significant residual radioactivity on the ground and troops can assault over such an area without danger immediately after the bombing.

Effects of ground or undersurface bursts are then dealt with. Where the burst is low enough for the ball of fire to touch the ground, contamination of the area results partly from condensation of fission products on contact with the ground and partly from radioactivity induced in soil constituents by neutrons. A vehicle travelling moderately fast might cross the area as early as 15 minutes after the explosion, or within 6 hours of the burst the area might safely be walked over. In the event of an underground burst at a depth of say 50 ft., the 800 ft. diameter crater, 100 ft. deep, would be highly contaminated and unsafe to cross for much longer periods. The author sums up with the following conclusions :---

- 1. Residual radioactivity from a high air burst—1,000 ft. or more above the ground—is insignificant compared to other bomb effects, and an area so blasted can be entered immediately without risk.
- 2. Contamination from a low air burst, or contact burst, will prevent occupation of a limited area for some time, but passage through the contaminated area is possible within a few minutes or few hours.
- 3. The thermal radiation from an air burst can produce casualties at a greater range than either blast or gamma rays, if there is no shielding from the flash heat.
- 4. Blast is generally more effective against structures and material than against persons, because of the human body's resistance to overpressure. Nearly all the blast casualties in Japan were indirect, resulting from flying debris, collapsing buildings, etc.
- 5. Single shelters for troops in the field can cut down casualties drastically if personnel are in them at the time of attack. On the atomic battlefield, tactical surprise is of the highest importance.

November-December, 1950, "Engineer Field Notes-Korea-Delaying the Advance in the First Few Days", COLONEL HENRY BERBERT, Corps of Engineers.

The author was the engineer officer in the small group of fifteen G.H.Q. Far Eastern Command Officers sent to Korea on the third day of the war to advise the Republic of Korea Forces. He soon found himself involved in the war, with Korean engineers engaged on delaying actions in the early retreat.

He describes how South Korean depots in Seoul were immediately overrun and supplies, including explosives, lost to the enemy. Alternative supplies of explosives for demolition were collected from police stations and mines. These consisted largely of deteriorated stocks of exuding dynamite considered quite unsafe to handle, but it was with this stock of questionable explosives that all demolitions of bridges and roads were carried out in the initial days.

The morale of South Korean engineers was remarkably high and in the absence of an adequate supply of anti-tank mines individual South Korean engineers resorted to placing a charge on an enemy tank and tamping it with his own body before detonation.

He describes how one group of fifty South Korean engineers carrying 5,000 lb. of explosive travelled to the west coast and were just in time to blow up four railway bridges in the vicinity of Taechon, an important factor in delaying the North Koreans on that flank. The party returned with its explosives intact having fortunately found alternative supplies in a mine near the site. Had it not been for these fortuitous supplies of explosives from commercial mines throughout the retreat the author infers that a different story might have been told.

In the absence of South Korean anti-tank mines, bazookas, and artillery the enemy used their tanks boldly and pressed on with them well ahead of their infantry. Later when anti-tank mines were available the enemy changed his tactics and used his tanks more cautiously. The desperate situations which periodically developed necessitated the use of South Korean divisional engineers as infantry. In spite of this the author remarks on frequent instances of South Korean engineer operators' devotion to their equipment and the risks they ran to save even slowmoving D-7 tractors from falling into enemy hands.

WINTER CONCRETING

(The Engineering Journal, dated October, 1950)

It is generally accepted that construction should be so planned that concrete work is carried out in temperatures above $32^{\circ}F$. This was not possible, however, in the case of the dams required in connexion with the Ottawa Hydro-Electric Power Project, due to the magnitude and urgency of the work. Provision had therefore to be made for concreting throughout the winter in temperatures ranging from $10-32^{\circ}F$.

The medium used was heat—heat for the various buildings used for concreting purposes, heat for the aggregate and the water, heating for thawing out forms, heat for protecting the concrete after placing and for numerous other purposes. The heat was provided from a central boiler house in the form of steam—100 h.p. approximately of boiler capacity was required for every yard of mixer capacity. The boilers operated at a steam pressure of 100 lb. per sq. in. It was found that with steam at 15 lb. per sq. in. pressure nothing but cold water resulted at the end of exposed lines. Lines were constantly being changed and therefore could not be provided with insulation.

Materials. The sand and water only were heated, the coarse aggregate contained little moisture and heating the sand and water provided sufficient heat to produce concrete at the desired temperature. The sand was heated by inserting steam jets at the top of the pile and spreading tarpaulins over the pile to maintain a more uniform distribution of heat. The water was heated in an enclosed wood-stave tank of 10,000 gal. capacity built adjacent to the mixer plant; the heat was applied by means of steam coils and jets; the operating temperature ranges were from $100^{\circ}-140^{\circ}F$.

Distribution of concrete. The freshly-mixed concrete was distributed by belt conveyor. The conveyor was housed in a heated building for its entire length.

Forms. The forms used for the construction of the dam were 50 ft. in height. A wooden working platform was built at the top of the form and covered with tarpaulins which draped over and were fastened to the sides of the form. The platform was built approximately six feet above the ultimate working level of the concrete in the form in order to provide adequate working space when the concrete reached its full height. Unit heaters were then used for heating inside the forms. The heaters, six to twelve in number depending on their size, were connected by steam hose both at inlet and discharge. The heaters were hung with light block and tackle from supports above the form in the housing. The heaters were raised as the level of the concrete in the form rose until finally they were in a position to protect the surface of the concrete.

Curing and protection. Concrete requires moisture for its curing whether in winter or summer and, with dry heat used for frost precautions, surfaces exposed to it must be left moist. This is done by watering, a layer of sand being spread over the surface to prevent too rapid evaporation. The tops of lifts are protected for at least seventy-two hours and side forms are left on as long as possible, usually from three to four weeks.

Costs. Mass concrete placed in winter costs approximately 8 per cent more than similar concrete placed in summer. This percentage includes the cost of the installation and operation of the boiler plant and steam lines, heating of the sand and water and the protection and heating of forms and buildings used for concreting purposes.

ALUMINIUM FOOTBRIDGE AT PITLOCHRY

(The Engineer, dated 13th October, 1950)

The use of aluminium alloy for bridge structures is not yet extensive, but reference to two cases where this metal has been used was made in the *R.E. Journals* for September, 1948, March, 1949, June, 1949, and March, 1950.

An arched aluminium highway bridge of 290 ft. span has recently been built at Arvida in Canada, and the material has also been used for the construction of a footbridge near Pitlochry to take the place of an old stone bridge, the site of which has been submerged by the raising of the level of the River Tummel by about forty feet, in connexion with the Pitlochry Reservoir of the North of Scotland hydro-electric scheme.

No particular problems were encountered in the erection and assembly of the bridge, and a gantry, made up of tubular steel, with a 2-ton derrick, was utilized to handle the shore span girders weighing approximately 32 cwt. each, which were fabricated in the workshop. The centre span was built out in panels from each side ; all joints being riveted and bracings and floor plates added before the next panel was commenced. A 10-cwt. short-legged hand crane was used for reaching out to place the panels.

The floor plates were formed of aluminium sheeting with an asphaltic covering, and designed for a loading of 84 lb. per sq. ft. over all.

Considerable difficulties were, however, experienced in finding a suitable method for closing the rivets. The use of steel bolts covered with cadmium was considered, but it was felt that aluminium rivets should be used if satisfactory heads could be formed.

A detailed description is given of the various experiments that were carried out with closing the rivets cold and hot, and although the latter method would have been satisfactory, it was found impracticable to control the temperature within the necessary close limits. Slight overheating made the rivets useless, and any delay in driving resulted in too much heat being lost and the rivets becoming work-hardened before they properly closed and filled the holes.

Eventually, all the \S in. diameter rivets, both in the shop and on the site, were made with pneumatic hammers (Boyer 60 and Cleveland 50). A flat tool was first used in line with the rivet to stave it and fill the hole, then rolled until the head was nearly formed. The job was completed by the use of a 1 in. deep concave snap, which was also rolled slightly to finish the head. It was necessary to finish driving the rivet completely once it had been started. No difficulty was found in driving cold the $\frac{1}{2}$ in. rivets in the bridge deck, but heads about $\frac{1}{26}$ in. less than the standard heights were used.

The complete structure has a centre span of 172 ft., and two shore spans each of 69 ft.; it is supported on concrete piers specially designed on slender lines to be in keeping with the airy appearance of the bridge structure.

The bridge has not been painted as it is considered that it will resist atmospheric corrosion without such protection.



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Pluvex Pure Bitumen Dampcourses provide an efficient and permanent damp-proof course which is resistant to damp under all climatic conditions and which will not squeeze out under pressure. All Pluvex Dampcourses are supplied in rolls of 24 lineal feet, and in all widths up to 36 in. Made in four grades :---

No. I. Hessian Base. In addition to its widespread use for buildings of all kinds, this dampcourse is specially recommended for lining tunnels, bridge decks, reservoirs and tanks.

Average weight-7 lb. per sq. yd.

No. 2 Fibre Base. Of the same high quality as the No. 1 Grade but manufactured with a fibre base. It is of proved efficiency and reliability for all types of buildings.

Average weight-6 lb. per sq. yd.

No. 3. Lead-Lined Hessian Base. No. 4. Lead-Lined Fibre Base.

Produced especially to meet the demand for lead-lined dampcourses, these grades incorporate a membrane of lead weighing 4 oz, per sq. ft.

Average weight-8 lb. per sq. yd.

ASTOS

100% MINERAL DAMPCOURSE

DC.89

Made from two of the most permanent building materials known—Bitumen and Asbestos —Astos is virtually imperishable and retains its waterproof properties unimpaired indefinitely in any climate. Being flexible it is easy to lay and will withstand normal foundation settlement without risk of failure. Every roll is branded across its width every 8 ft. with a goid band bearing the trade mark "Astos."

Astos Dampcourse more than complies with B.S.S. 743-1941. Available in all wall widths up to 36 in., and in rolls of 24 lineal feet.

Standard. Average weight---7 lb. per sq. yd.

Lead-Lined. Incorporating a membrane of lead weighing 4 oz. per sq. ft.

Average weight-92 lb. per sq. yd.

Manufacturers of P.B.S. (Prefabricated Bitumen Sheeting)

THE RUBEROID COMPANY LTD.,

171 COMMONWEALTH HOUSE, NEW OXFORD STREET, LONDON, W.C.I



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