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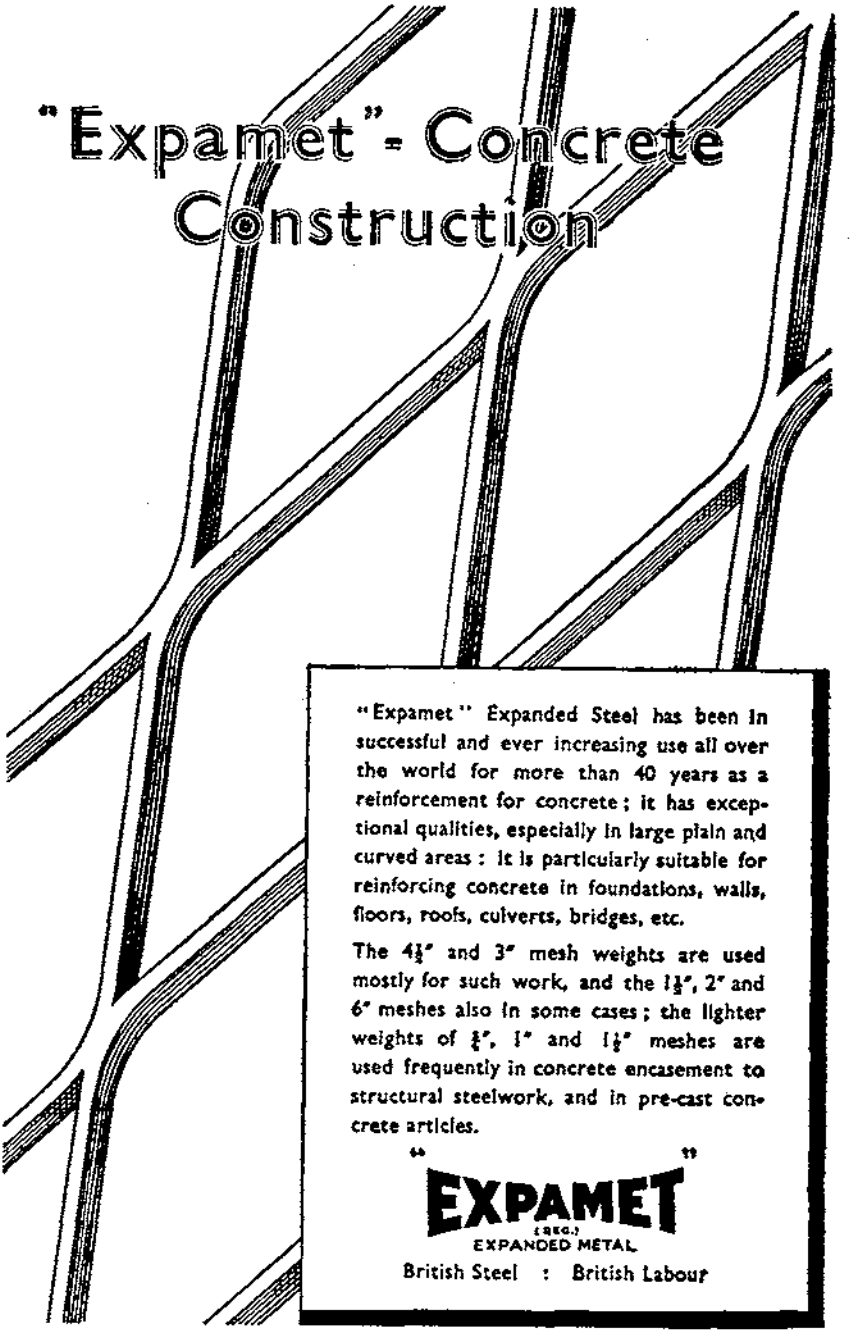

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Bruce Road. 31st May.

The Civil Treasury.

The city wired in. 13th June.

Quetta earthquake, The city wired in

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THE QUETTA EARTHQUAKE, 1935.

By LIEUTENANT B. M. ARCHIBALD, R.E.

I.—QUETTA BEFORE THE EARTHQUAKE.

AT the time of the earthquake, Quetta consisted of three distinct areas: cantonments, the civil lines, and the city. Cantonments could be subdivided into the central area of barracks and residences, the area of depots and installations to the west, the R.A.F. camp still farther west, and the Staff College on the north-east. By road through Quetta from north to south was about six miles. The population in cantonments in May was about 25,000; and that of the city was reckoned about 60,000.

Quetta lies in a long, narrow plain, enclosed by mountain ranges, which include four peaks over 11,000 feet within 15 miles. Down the centre of the plain flows a *lora*, or small sunken stream. On either side the ground slopes up towards the mountains; thus the Staff College is some 500 feet above the civil lines. The soil, which near the *lora* is finely mixed clay and sand, becomes towards the mountains more and more stony. Two large *nullahs* traverse Quetta. One, the Habib, separated cantonments from the city and civil lines. The other, the Durani, lies parallel and half a mile north. South of the Habib, sub-soil water is found within 20 feet of ground-level; while north of it water has not been reached at much greater depths. In the vicinity of the R.A.F. camp and of the *lora*, the water-table approaches the surface.

The normal garrison of Quetta consisted of one division (less one brigade) and ancillary troops; and in May all units were at or near full strength for the summer training season. Engineer units were

the 16th Army Troops Company, Q.V.O. Madras Sappers and Miners; and the 21st Field Company and 42nd Divisional Company, Royal Bombay Sappers and Miners. These units occupied Napier and Kabul Lines, both of which bordered the Durani *nullah*, and which were, except for the cavalry lines and an ordnance barrack, the only barracks within two miles of the centre of Quetta.

Three further details should be mentioned. For water, Quetta depended wholly on a 14-mile pipe-line from Urak, the supply passing through large concrete reservoirs near the Staff College. For supplies and stores, large quantities of food, clothing, tents and stores of every description were held in Quetta Arsenal and the Supply Depot and Engineer Parks. Otherwise all supplies were brought up by the North-Western Railway, *via* Karachi (24 hours by mail train), or *via* Lahore (28 hours).

II.—THE EARTHQUAKE, 31ST MAY.

The first and most severe shock occurred without any warning just after 3 a.m., and lasted less than one minute. Within this brief interval of time the city of Quetta was laid in ruins, a jumbled heap of debris levelled beyond recognition. There were frequent subsequent shocks, but they could do little more damage. Only the broadest streets were not blocked. Fires quickly blazed up from a dozen different directions, illuminating the city with a red glare. Luckily there was no wind. The noise of thousands of buildings rent apart and collapsing was appalling. It was succeeded by extraordinary silence. There was little shouting or wailing. About a third of the inhabitants were buried, or pinned under debris; while those who escaped, injured and choked with acrid dust, were too stunned to take any action.

Most of the civil bungalows collapsed completely; in others walls, roofs, or chimneys fell in. Hence casualties were heavy. The Superintending Civil Engineer and his family were among the killed, and the Agent to the Governor-General had a narrow escape from the Residency. The civil offices were wrecked, the civil hospital razed, and 300 police were buried in their barracks. The North-Western Railway suffered heavily, though some recently-constructed "earthquake-proof" buildings resisted destruction.

In cantonments the intensity of the shock varied. Between the two *nullahs* most of the bungalows collapsed, and there were numerous casualties. Farther from the city, buildings were badly cracked, but remained standing: while at the Staff College the magnitude of the catastrophe was not at first generally realized. The arsenal area was severely shaken; and the worst damage occurred in the R.A.F. camp. Here nearly every barrack block fell in ruins. Many men were killed, and a large number were buried. The long, corrugated-iron roofs fell, in many cases, in one piece; and this hampered the work of rescue. The perimeter walls of the

Parks and Depots, most of which were of brick, fell flat. So, too, did the curtain walls of the steel-framed store-sheds, burying the stores within. For the moment, the road was open to looters; but no one then had heart for looting. Within a few hours adequate measures had made looting practically impossible.

In Kabul Lines the old, sun-dried brick buildings were badly damaged, and one Indian officer and ten Sappers were injured. Much equipment was buried, and valuable time and labour had to be diverted to digging it out. Napier Lines was strangely fortunate, and escaped with a few cracked walls, except for the field-works store, which collapsed. This was annoying, for the picks, shovels, axes, ropes, etc., buried inside were soon in great demand.

In the Engineer Park, the large stocks of peace and of mobilization stores were nearly all buried. Subsequently, weeks were required to dig out and sort them; and an order of priority for salvage work was laid down at once, so that tools, victaulic pipe, etc., would be available early. A number of civilian personnel were killed here, as were others at the Barrackmaster's yard.

Fate was kind in sparing the British, Indian and cantonment hospitals, and also the R.I.A.S.C. garages. The hospitals were expanded immediately, many ladies volunteering to help; and hundreds of lorries were quickly at work conveying the injured to hospital.

III.—Engineer Work, Emergency Period.

Everyone able to do so was soon engaged in rescue or first-aid work. The Sappers and Miners, from their central position, were among the first on the scene in the inter-*nullah* area, the civil lines, city, and by seven o'clock at the R.A.F. camp. Incessant demands poured into each company for parties and for tools. The company M.T. was invaluable.

By eight o'clock, Divisional Headquarters had been established at the Club Lawn, a central point. The work of rescue was co-ordinated and relief measures put in hand. About this time commenced the demands for technical engineer assistance. These very rapidly increased in number, difficulty and variety.

The M.E.S. civilian personnel had suffered heavy casualties, for the majority had lived in the city. The survivors requested leave to take their families to homes in India; and for a few days scarcely any civilian labour was obtainable. However, the M.E.S. at once undertook the repair and maintenance of the water and the electricity services, co-operating as regards the latter with the civilian Supply Company. Sapper fitters and electricians were placed under the G.E. for this work.

Since the M.E.S. were thus handicapped, the greater part of the engineer tasks fell to the Sappers and Miners, who were called upon

to carry out a wide variety of tasks under something like service conditions. Small independent parties were dispatched at short notice in every direction, and for some days their working hours were from dawn till dusk. The few officers present with the companies were occupied principally with reconnaissance, and with organizing subsequent work. They could not attempt to supervise everywhere. The execution of the work was left largely to the Indian officers and N.C.O's, who gained valuable experience in dealing with unforeseen and unusual, but practical jobs, working against time. They had also to "liaise" constantly with other arms.

Two additional field companies were asked for, and arrived from Roorkee: No. 1 Company, K.G.O. Bengal Sappers and Miners, on the 4th June, and No. 2 Company on 7th June. Both had entrained together at a few hours' notice, but counter-orders held up No. 2 Company *en route*.

The Engineer Diary records the tasks carried out during this period, and the entries of the first three days are given here:—

31st May.

0303 hrs. First earthquake shock. Severe shocks continued at frequent intervals.

0330 hrs. Nos. 16, 21 and 42 Companies paraded independently and dispatched parties to south cantonments, city and civil lines. Life-saving and fire-fighting work was carried out by many small parties throughout these areas until 2100 hrs.

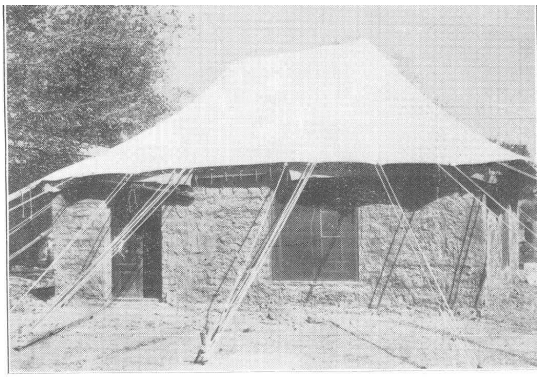
0700 hrs. In response to calls, all three companies sent parties to R.A.F. camp. These, assisted by light tanks, stripped roofs from the debris to assist parties rescuing buried men.

0800 hrs. On the C.R.E.'s instruction, several small detachments were recalled to unit lines, as they completed tasks, and section reserves were formed for major tasks. Sections were no sooner formed than sent out, demands far exceeding resources. Tasks were chiefly assisting other rescue parties by clearing or cutting through obstacles and demolishing dangerous walls and roofs, both by explosives and other means. Much direct rescue work was also performed. District Headquarters, including H.Q.R.E., were established at the Club.

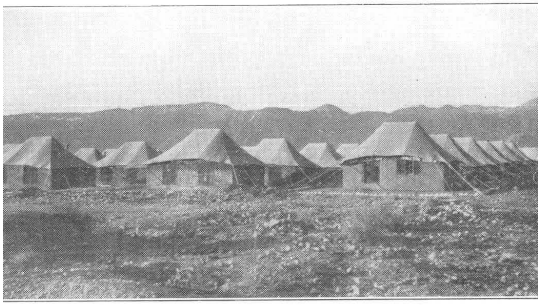
0930 hrs. Four R.E. students from the Staff College reported to the C.R.E. for duty, Brigade Major and Staff Captain were appointed, and pool officers for reconnaissance, liaison duty, carrying urgent instructions, etc.

1000 hrs. Jammed doors of an aeroplane hangar were forced open, with the aid of a tank, releasing five undamaged planes.

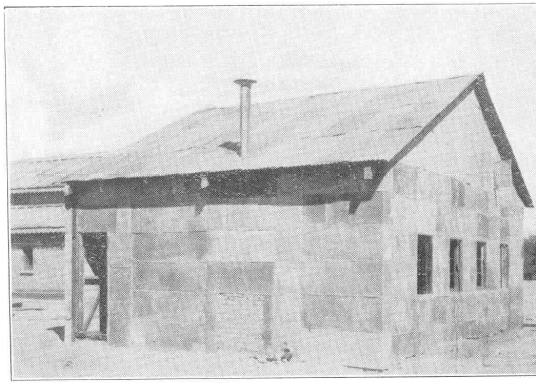
C.R.E. detailed four R.E. officers to areas of the city, to co-ordinate all fire-fighting operations.



A Quetta hut.



Hutted Lines, Royal Signals.



A hospital hut for 9 beds, made from salvaged material.

Quetta earthquaque - hospital hut for 9 beds

Rescue in the city, 31st May.

Quetta earthquaque - Rescue in the city,

No. 21 Company drew and pitched tents for R.A.F. relief camp.

1100 hrs. R.E. officer and party detailed to repair water-mains to N.W. Railway locomotive sheds, on which supply the running of trains depended. This party was withdrawn later the same day.

No. 21 Company commenced to dig out 500 hospital bedsteads from the furniture yard.

1200 hrs. Water-supply pipe-lines from Urak, and reservoirs, were reported intact. All fitters from S. and M. companies were pooled under G.E. to repair bursts in cantonment distribution mains, and to maintain flow to the city for fire-fighting.

1400 hrs. A party from No. 16 Company erected tubular scaffolding in Quetta Electric Supply Company's power-house, to shore up dangerous gable and protect main switchboard.

1600 hrs. No. 42 Company dispatched armed guard to Urak, where the water-supply headworks staff feared attack by Pathans. (*Detachment* relieved after five days by infantry.)

1630 hrs. R.E. officers returned from reconnaissances north, west and south and reported roads to Chaman, Kalat and Sibi passable.

1900 hrs. N.W. Railway line *via* Bolan pass reported intact.

Electricians from S. and M. companies were pooled under M.E.S. to assist in operating plant lighting Ammunition Depot perimeter, and in restoring Company's supply.

N.W. Railway enquired for locomotive drivers from S. and M. C.R.E. regretted that *none* were available.

No. 42 Company supplied light for District Headquarters from E.L. lorry.

2100 hrs. Ceased work.

1st June.

0600–2100 hrs. S. and M. Companies continued previous day's work. City, civil lines and R.A.F. camp were divided into eight battalion areas for rescue and fire-fighting. No. 21 Company detailed detachments of nine Sappers to assist in each area. This arrangement was continued until evening of 3rd June.

No. 21 Company worked on the water supply and incinerators for the Refugee Camp at the Race-course. Two mechanical pumps and 400 yards of victaulic pipe set up, and 16 steel 400-gallon tanks.

No. 16 Company, besides rescue work, sent strong working parties to all hospitals and provided incinerators,

latrines, cook-houses, extended water supply, shoring of vital buildings, quantities of splints, tent-pitching parties, etc.

No. 16 Company, between 1900–2100 hrs., erected two miles of wire fencing to form an enclosure for 1,500 milch cattle.

Electric lighting was distributed to main roads and hospitals.

2nd June.

0700–1900 hrs. S. and M. companies continued previous day's work.

No. 16 Company salvaged two civil lorries, and commenced salvage of civil records and of banks; and sent two fitters to Mastung (35 miles) to repair the water-supply system.

No. 21 Company salvaged 2,000 gallons of petrol from the city (lift and force pumps were used successfully). A party commenced systematic sorting of stores being salvaged in Engineer Park.

No. 42 Company salvaged lorries, and commenced manufacture of large numbers of incinerators.

Continued earthquake shocks caused repeated bursts in water-mains to city. These had to be closed from time to time for repair, but, to meet the requirements of fire-fighting, they were never shut for longer than one hour.

A civilian labour corps was recruited from the surrounding villages. The pensioners of the disbanded Hazara Pioneers were the first to come forward and rendered excellent service.

One section, No. 21 Company, worked for three days on the formation of a railway diversion south of Quetta.

The Political Camp at the Residency was supplied with camp accessories, and with a wire fence around the perimeter.

No. 42 Company salvaged and reassembled the soda-water factory plant.

Constant demands were received for buildings to be shored.

The cumulative effects of earthquake shocks rendered several bridges unsafe and made diversions necessary.

An estimate for the cost of reconstructing the cantonment was called for, and one was prepared and submitted the same day by the C.R.E.

On the 7th, rescue work ceased, and engineer interest shifted to salvage operations. No. 1 Company, with one battalion of Gurkha Rifles and a section of Light Tanks, commenced the systematic

salvage of bungalows, in the area between the *nullahs*. S. and M. parties led, to remove obstructing or dangerous walls and roofs. After the Gurkhas had cleared all kit, furniture, etc., a second salvage party of S. and M. removed all serviceable building materials, *e.g.*, galvanized-iron sheets, doors and windows, wire gauze netting, timber of all sizes, and, later, Labour Corps salved and stacked burnt bricks. The tanks were employed to fell walls and to strip roofs, by pulling on wire rope slings.

After each severe earthquake shock, R.E. officers were summoned to " vet " important buildings which were still in use, *e.g.*, X-ray and operating theatres, petrol-filling stations, many electrical sub-stations; and also road-bridges. Wherever feasible these were strongly shored up, both inside and out.

On the 5th, operations in the city were terminated, the water supply was cut off, and the perimeter piqueted. Demands for new work continued to grow, and engineer tasks took on an ever-widening variety. The following were undertaken in the next three days :—

Salvaging and reassembling Warren cookers, 2-ton refrigerators and soda-water plant.

Erecting flood-lighting in camps and hospitals.

" Earthquake-proofing " generating plant, using tubular scaffolding frame.

Laying a mile of victaulic pipe-line to by-pass the city mains.

Laying " army track " road diversions, using tar-barrel culverts.

Providing the usual requirements for 22 camps for Messes, Banks, etc., and for Indian personnel, and the N.W. Railway.

Making special surgical appliances for the hospitals.

Laying out, fencing, and providing water supply for two large isolation camps—precautions happily never required.

IV.—Engineer Work, 8th June to November.

With the conclusion of the emergency period, the engineer tasks resolved themselves broadly into :—

(i) Salvage. (ii) Miscellaneous. (iii) The provision of accommodation (from salvaged material).

The first two continued on the same lines as previously. It was necessary to train salvage parties to remove timber and other fragile materials carefully, as the wastage, especially in timber, was at first high. By the end of the summer the Sappers had been formed into well-organized squads of specialist " house-breakers." This method of obtaining material, being uncommon in peace, was particularly valuable training.

Under miscellaneous work, the erection of two heavy timber crib

piers to strengthen the Baleli road-bridge, by a detached section of No. 21 Company, was good training for the I.O. and his men. No. 1 Company's work is described later. No. 2 Company erected earthquake-proof shelters over the telephone exchange. No. 16 Company erected tubular scaffolding at Hanna Lake, where the M.E.S. were resuming " guniting " work on the reservoir. Printing presses were moved and reassembled. No. 16 Company installed Merryweather pumps in the Mastung water system. On the 12th and 13th, Nos. 1 and 2 Companies erected 5,000 yards of double-apron fence around the city perimeter. A little later, this perimeter was flood-lit by the M.E.S. The Ammunition Depot chambers had been badly cracked, and the ammunition was removed after the S. and M. had shored up the dangerous walls. As a precaution against a break in the water supply, 20 10,000-gallon sectional steel tanks were brought in from the Engineer Park at Chaman, but they were never required.

Before describing the accommodation work, the organization of the Divisional Engineers should be mentioned. With the arrival of No. 2 Field Company on 7th June, the C.R.E. had at his disposal the full four units of Divisional Engineers, and also an Army Troops Company. They were at once allocated duties as follows :—

Each Field Company, to an area :—
No. 1 to the Civil Lines.
No. 2 to the Cantonment, east.
No. 21 to the Cantonment, west.

The Divisional Headquarters Company, No. 42, to run the central workshop and a central salvage dump.

The Army Troops Company, No. 16, to be in reserve, for employment on special tasks in the Arsenal, etc.

The Field Companies automatically received all tasks in their areas, including salvage. All salvaged materials, except bricks, were to be handed over to No. 42 at the central dump, and were re-issued as required in the shape of sectional huts, etc., by the workshop. This system worked very well, especially as the workshop team were strengthened by about 20 artificers from each of the other companies. Later, No. 1 Company became independent of the divisional organization, being employed with the G.E. Civil on semi-permanent accommodation. In August, this gap was filled by the arrival of No. 17 Field Company, Royal Bombay S. and M., from Kirkee, to take over a share of No. 2 Company's very large area.

There were two distinct stages in the accommodation programme :—

(*a*) Temporary : immediate requirements for protection against
(i) epidemic,
(ii) rains and floods.

(*b*) Semi-permanent: winter accommodation for all personnel in Quetta, for protection against

(iii) cold,
(iv) further earthquake.

The execution of these tasks involved a high degree of organization, large quantities of stores, and of transport, and labour, both skilled and unskilled, military and civilian. Each individual task would afford material for an interesting article. Only a general survey is given here.

(*a*–i) *Anti-epidemic.*

A plague of flies, which followed the earthquake, evoked heavy demands, first for incinerators, then for fly-proof cookhouses and grease-traps, and later for fly-proof latrines. Luckily the newly-finished S. and M. workshops were undamaged, and well equipped to carry out the necessary production, employing nearly 100 tradesmen. Mass-production was organized, the salvaged material arriving at one end of the shops, and the finished products being stacked at the other. Each carpenter, fitter, tinsmith, and blacksmith was put on repetition work, and every man was set a daily task, which was progressively increased during the first two weeks, until the maximum output was reached. Thus the turn-out of cookhouses rose from five per week in the experimental stage to 35. The limiting factor proved to be the supply of sawn timber, which, for interchangeable sections, had to be of uniform size. In addition to the saw-benches of the S. and M. workshops, and of the Engineer Park workshops, the workshop lorry saws of Nos. 16 and 42 Companies were used to capacity. For a long period, day and night shifts were maintained on the shop saws, as the lorry saw-blades were found to be of inferior steel, and new blades had to be ordered from Bombay and Calcutta. To supply enough material, the Field Companies speeded-up salvage work in their respective areas. At the central dump, a party of No. 42 Company, with gangs of coolie labour, sorted, stacked and dispatched requirements to workshops. Mule-drawn A.T. carts were used for the collection of all but the longest timber.

The Field Companies drew and erected the finished products at locations as authorized by District Headquarters. Erection of one cookhouse took a party of ten trained Sappers half a day.

(*a*–ii) *Anti-flood.*

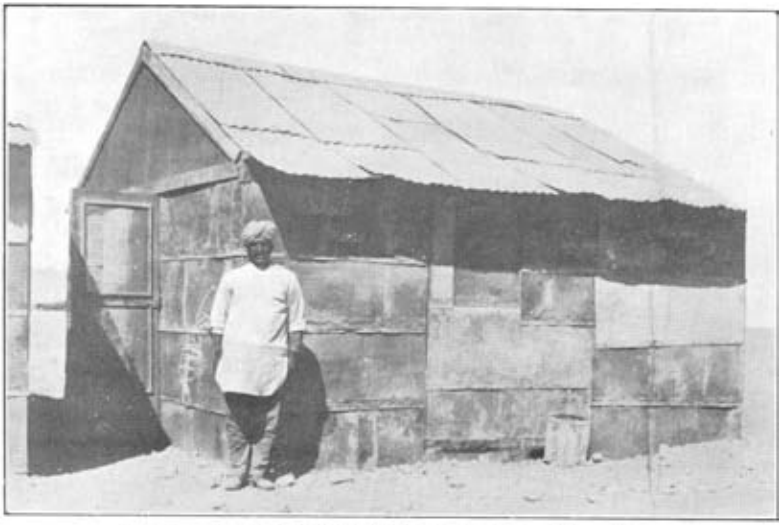
The entire population, military and civilian, were now accommodated in tents. Compound gardens are slightly sunken to facilitate irrigation, and so are liable to floods; while the soil of the larger camp sites becomes greasy mud when wet. Rain is often followed by floods inches deep, and usually falls at the end of July. Hence the next task, concurrent with the cookhouses, was to provide

raised brick floors and low walls for all tents. Units were made responsible for this work in their own lines; but to control the supply of bricks, distribution was centred under O.C., No. 2 Company. At this stage, the demolition of buildings for salvage was confined to the southern area of cantonments; and the average carry for bricks exceeded two miles. The organization of transport therefore needed careful planning. No. 2 Company lent skilled bricklayers to other units, to mark out sites and to supervise the building of walls. They also carried out all work for those units with no men available, for hospitals, and for occupants of bungalows, etc. Altogether about 2,200 E.P. tents, and a similar number of 160-lb. tents, were dealt with. These types required 1,500 and 1,000 bricks respectively, while one A.T. cart carried 150 bricks. Thus the task appeared to be a race against time. As it turned out, the summer was unusually dry, and no rain fell at all; but, had it come at the normal date, the cantonment was prepared.

(*b*–iii *and* iv) *Earthquake-proof Winter Accommodation.*

Meanwhile, winter accommodation problems were studied by the C.R.E., and warning orders were placed for certain essential stores. It was necessary to devise suitable types of accommodation, capable of rapid construction using available material and labour. Samples were prepared of brick-walled huts with double-fly tent roof, on the lines of those used at Wana. These offered the advantages of low walls (5 ft. 6 in.), of short unsupported length (18 ft.), a light roof independently supported, simple construction, and all materials available for a large number. The District Commander and unit commanders approved this pattern, and drew up scales ranging from one senior, or two junior officers, to six troops of followers, per hut. The total number demanded was then found to be 2,200, or several times the figure first estimated. The problem then became, how to get enough bricklayers, their tools and bricks, for completion before the cold weather. No. 2 Company thereupon evolved a substitute, the "converted barrack." The walls of Indian troops' barracks were cut down to the height of the doors, and the existing roofs were lowered in long lengths, and refixed on posts set in concrete, being thus made independent of the walls. Each converted barrack saved from seven to nine Quetta huts; and, in place of bricklayers, carpenters and metal tradesmen were employed. Thus the Field Companies were able to use their tradesmen to greatest advantage, by working at the same time on both Quetta huts and on converted barracks. Another alternative, also proposed by No. 2 Company, lessened the task still more. Analysis showed that the number of huts demanded for servants was very high, owing to the necessity of providing separate huts for the different castes, and for sweepers. The original quarters, being small buildings, had not been

Baleli Bridge. Subsidence of abutments.



A temporary fly-proof cookhouse, made in portable sections.

Quetta earthquaque - temporary fly proof cookhouse

Hospital huts under construction.

Salvage operations in the city. September, 1935.

Quetta earthquaque - salvage ops in the city

badly damaged in the northern half of cantonments. These quarters were strutted inside with a strong timber framework, thus rendering them safe. As a result of these two schemes, the number of Quetta huts to be built was reduced by 740.

No. 2 Company were under orders to leave for Nowshera in October and so another Field Company was asked for. No. 17 Field Company, Royal Bombay S. and M., arrived from Kirkee on 21st August, and took over a part of No. 2's area.

As more unskilled labour was required, normal autumn training was cancelled, and from the end of August, Field Companies were linked with brigades, for finding daily working parties as follows :—

No. 2 Company (centre area)—4th Indian Infantry Brigade ; 850 men. (Less one battalion.*)

No. 17 Company (north area)—5th Indian Infantry Brigade ; 1,050 men. (Three battalions plus one from 4th Brigade.)

No. 21 Company (west area)—24th Mountain Brigade, R.A. ; 300 men.

And also :

No. 16 Company (churches)—2nd Indian Divisional Signals ; 40 men.

Some gangs of local labour had been employed since 1st August. A few more were enrolled now, and additional civilian bricklayers were imported from India.

Special Hospital Accommodation.

For hospitals, steel-framed huts, sheeted with galvanized iron, and about 35 ft. x 25 ft., were constructed. The frames, sheet-iron, doors and windows, and timber for studding and rafters, were to be found from salvage. Walls and ceilings were lined with patent insulating board. The M.E.S. provided concrete floors, brick fireplaces, and electric lighting. As sufficient stanchions and trusses were salved for only 25 huts, the remaining 30 huts (steel frames and sheeting) were purchased in Bombay. Delay in supply, and some damage sustained in shipment, emphasized the advantages of obtaining materials locally.

Three churches and a canteen were built on the same lines as these hospital huts, two of the churches being larger, 75 ft. x 40 ft. No. 16 Company assisted a local cinema by salving roof trusses, and erecting the steel frame of their new building. To avoid dislocating the Field Companies' hutting programmes, all steel-framed work was executed by Nos. 11, 16 and 42 Companies. (No. 11 Army Troops Company arrived in October.)

* As the 5th Brigade battalions shortly afterwards began to leave Quetta, their numbers never exceeded 700.

No. 1 Company's Work in the Civil Area.

After 8th June, No. 1 Company was employed entirely in the civil area. It rendered a fallen girder bridge passable by constructing ramps; and launched a 90-ft. Inglis bridge across the *lora*, under difficult conditions. The badly-"quaked," water-logged steep clay bank "crept" like porridge, and an elaborate platform had to be built on which to swing the bridge. It also operated a large workshop in which a standard type of wood-framed sheet-iron hut was produced, ready for assembly, under mass-production methods. A large hutted camp was constructed near the old brewery. It also assisted the G.E. in the erection of a large number of big steel-framed huts for political and departmental offices. In contrast to the accommodation which was provided in cantonments, civil construction was carried out almost entirely with new material.

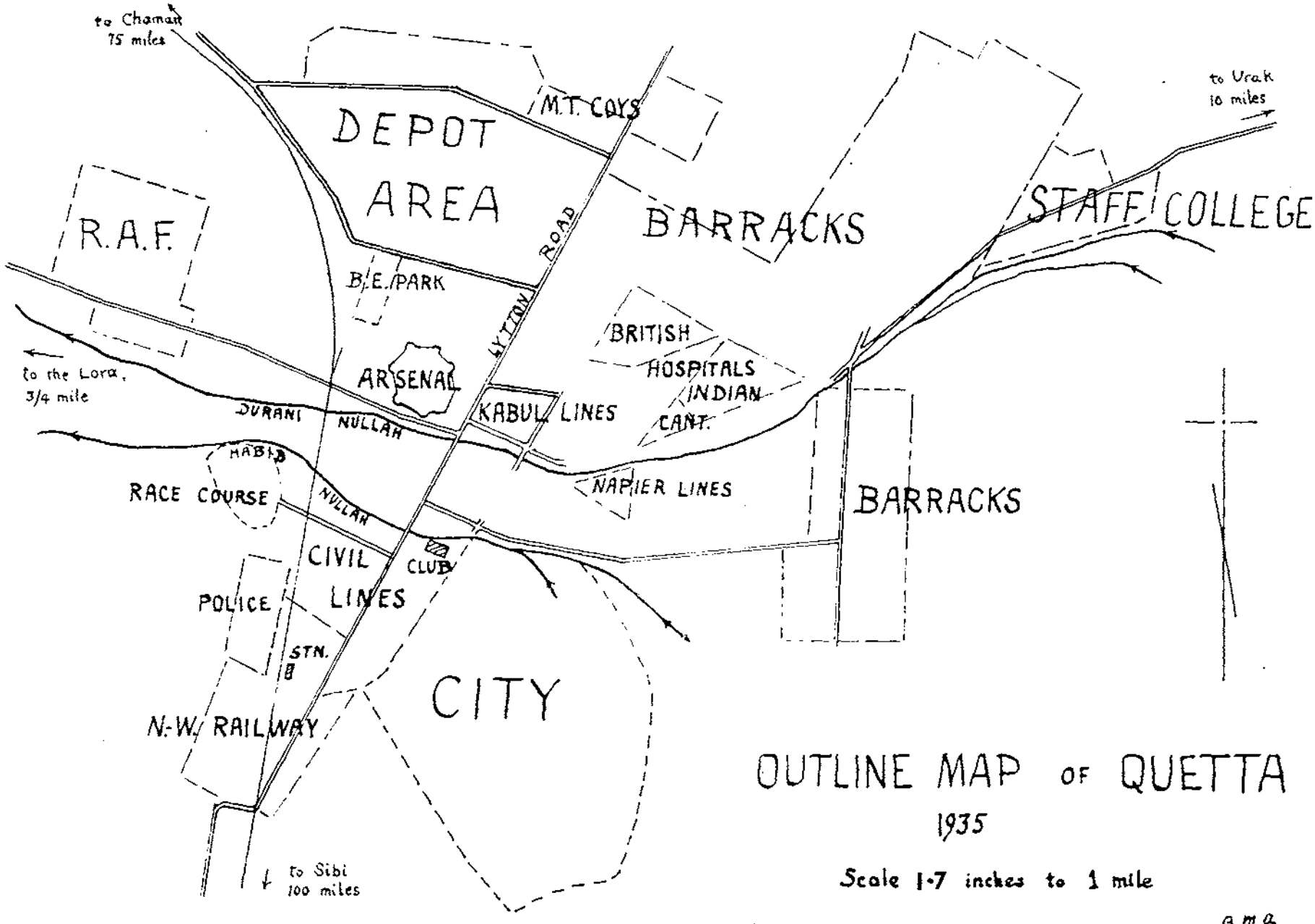
Special Labour Units.

Two labour units were formed specially for post-earthquake work. The civilian Labour Corps has been referred to in the diary for 2nd June. Its strength was quickly raised to 1,500 men, who were organized in platoons of 25, under a jemadar. The pensioned Indian officers of the disbanded Hazara Pioneers, who turned up in their old jackets and wearing their medals, exercised good control over their men and rendered very fine service. Demands for labour were made daily to District Headquarters, who published the distribution each evening. Owing to the requirements of the Arsenal, etc., the allotment for S. and M. was always short of that demanded, and rarely exceeded 300 men. On the grounds of economy, this very useful force was disbanded on the 1st August, but the M.E.S. were able to take on a good many complete platoons as daily labour, for continued work with the S. and M. Companies. The assurance of getting the same parties every day was an improvement on the earlier system.

The second unit was the 8th Road Construction Bn., which was recruited from Sikhs and Musulmans in the Jullundur district, under two R.E. officers. It had also a small nucleus of regular Indian officers and N.C.O's lent from S. and M. and infantry. This unit arrived at the end of July and was employed directly under the civil authorities, chiefly on the salvage operations in the city, which began about 1st September. It was disbanded early in 1936.

Chaman.

Chaman is a small military station on the frontier, on the route to Kandahar, and the terminus of the N.W. Railway. It is 77 miles by road from Quetta and lies at a height of 4,500 feet, beyond the Khojak range. The 1935 earthquake was not felt there, but the presence of a notorious geological fault, and a bad earthquake history,



OUTLINE MAP OF QUETTA

1935

Scale 1·7 inches to 1 mile

B.M.A.
U.S.R.E.
1.4.35

made the authorities as well as the inhabitants anxious. In August, instructions were issued that earthquake-proof sleeping accommodation should be provided there on the same scale as at Quetta. No. 19 Field Company, Royal Bombay S. and M., was ordered up from Kirkee to build the huts, and arrived at the end of August. The Company was assisted by working parties of 650 men, found by the two battalions stationed at Chaman, and by a few civilian bricklayers. Including the small detached post at Shelabagh, guarding the Khojak tunnel, the requirements amounted to 370 Quetta huts, and the equivalent of 150 more in converted barracks. Existing buildings were not demolished, as at Quetta, but the new huts were built of sun-dried bricks made on the site.

Sibi.

Sibi is a small town on the railway, 100 miles south of Quetta. It lies in the plain, at near sea-level, close to the entrance to the Bolan pass, and is the winter station of the Baluchistan administration. The cavalry regiment and the Mountain Brigade R.A. moved into camp there for the cold weather. One section of No. 21 Company provided the requirements for a semi-permanent camp, taking down by train the necessary stores, prepared in Quetta in advance, from salvaged material.

Conclusion.

When the last of the additional companies left Baluchistan in November, the engineer tasks which had been set for 1935 had been successfully completed. Conditions after the earthquake were said to resemble in some respects those of a devastated back area in war. If this were so, the problems dealt with by the engineers will have been very valuable training. Certainly the troops worked practically under service conditions, and for long periods without a rest.

Among the lessons shown up most clearly are: the need for foresight, for thorough organization, and for a proper appreciation of the time factor. These three features, especially the last, are difficult to reproduce to the same extent in normal peace-time training. The Quetta earthquake afforded exceptional opportunities, to the eight Sapper and Miner Companies concerned, to realize the importance of these points, and to put them into practice. Finally the earthquake demonstrated how numerous and varied are the demands which may be made in an emergency on the military engineer.

RECENT DEVELOPMENTS IN VISUAL PLOTTING.

By MAJOR R. P. A. D. LITHGOW, R.E.

PART I.—INTRODUCTORY.

1.—GENERAL.

THE primary function of an anti-aircraft searchlight unit is to illuminate enemy aircraft at night, so as to render possible their destruction either by anti-aircraft artillery or by the fighter-aircraft of the defence.

Such units have, however, a most important subsidiary function. This is the provision of information, of which two kinds are required :

(*a*) Warning of the approach of a raid, including details of its position, direction of flight, height and composition.

(*b*) A record on paper of all raids entering the unit's zone, showing exact times, courses and heights. This is required for subsequent study by the air defence commander and the Intelligence branch, and from it may be deduced enemy methods of navigation, probable lines of attack, and areas where the defences may best be thickened and improved.

Such information is obtained by a method known as "visual plotting."

In permanent defences the plotting system is extended outside the actual searchlight zone by means of a corps of observers, but the present article deals only with one aspect of plotting within the searchlight unit.

2.—OUTLINE OF THE METHOD OF PLOTTING.

Each section of an Anti-Aircraft Searchlight Company, R.E., contains a visual plotting station, commonly known as a V.P. Its equipment consists of a circular table (very like a plane-table) on which is an oriented "trace" or reproduction of the grid of the map on a suitable scale, the pin-point of the position of the V.P. being plotted at the exact centre of the table. Mounted on a pivot at the centre of the table is the V.P. instrument. Briefly, this consists of an adjustable vertical triangle, the hypotenuse of which bears some kind of sight (*vide* Fig. 1). If the sights are trained on an aircraft,

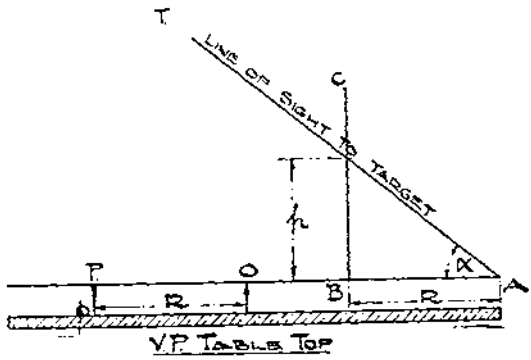


FIG. 1

NOTE.
THE OBSERVERS EYE IS AT A
O - PIVOT OF INSTRUMENT
BC - HEIGHT BAR
AT - SIGHT BAR
P - POINTER. SO ARRANGED
THAT OP - AB - R. (GROUND RANGE)
ϕ - "PLOT" OF TARGET

the angle of elevation of the target from the V.P. is automatically set on the instrument.

It follows that, if the height of the target is known, and is set, on a suitable scale, on the vertical side of the V.P. instrument, the ground range can be read off from the horizontal side. The ground range itself is of no interest, but the instrument has a pointer, which moves along the horizontal arm and indicates the position of the target on the trace.

Once the height of the target is known, " plotting " consists merely of reporting, by telephone, the map-square over which the target is situated at the moment.

Detailed descriptions are given in the *Manual of A.A. Defence*, Vol. I, Part II (Searchlights) and in the *Manual of Anti-Aircraft Searchlight Drills*.

3.—V.P. Methods of Height-Finding.

It will be seen from paragraph 2 above that, to obtain an accurate plot of the target, the height of the aircraft must be known, and it is obvious that information as regards height is in itself of paramount importance.

Various methods of height-finding by the personnel of searchlight units have been evolved and are briefly mentioned here.

(*i*) *Fixed Azimuth System.*

This method does not utilize the V.P. instrument. An imaginary line joining any pair of searchlights is used as a base. When the target crosses this line, both searchlight positions report the angle of elevation to the control room, at which the distance apart of the lights (length of base) is known. Height of target can be found by graphical or mechanical means.

This system suffers from a paucity of suitable bases, requires a telephone at every light position, is rather slow and cumbersome and requires a big control room staff. It is not now in general use.

(*ii*) *Methods using the V.P. Instrument.*

It has been shown (paragraph 2) that, if the height of the target be known, the V.P. instrument automatically solves the vertical triangle and obtains the " plot " of the target.

The converse is also true, for, if the " plot " be known, the V.P. instrument gives the height, by reading off the scale on the height-bar.

It is obvious that the " plot " can be obtained by the solution of a horizontal triangle. At any V.P. station the bearing of the target from itself is set over the trace by the instrument when the sights are aligned on the target. If at a given moment the bearing from another fixed position is known, the plot of the target must be at the intersection of the two bearings. If the pointer is set over this intersection, and the original line of sight (*i.e.*, angle of elevation) re-set on the instrument, the height of the target can be read off.

This is the method employed in the systems mentioned below :—

(*a*) *Single Station Plotting* (*or " Blink " System*).

The " Blink " System is that most widely used up to the present. It is described in detail in the *Manual of Anti-Aircraft Defence*, Vol. I, Part II (Searchlights) and the *Manual of A.A. Searchlight Drills.*

For the purposes of this article it is only necessary to mention that the " plot " is obtained by the use of a pre-determined bearing from a searchlight. Each light is allotted two " blink " bearings or " blink-lines.". At the moment when the target crosses one of these pre-determined bearings a signal is passed from the searchlight to its Section V.P., which is thus able to fix the plot of the target at that moment, and so obtain the height. The signal may be given by telephone or by " blinking " the searchlight beam by dousing for two seconds and then re-exposing.

The telephonic method is more accurate, but is, of course, only suitable for permanent defences.

The visual " blink " introduces a possible risk of losing the target and cannot be truly accurate. Apart from several possible errors

on the part of the lamp attendant, it will not usually be feasible, in a " mobile " layout, to fix all searchlight positions accurately on the trace, and the nature of the visual signal renders it unlikely that the " blink " will be recognized and acted upon at the Section V.P. at the *precise* moment when the target crosses the " blink " bearing.

Further, it is necessary to wait until the target reaches a pre-determined line before a height can be obtained. Since no man can foretell exactly where each target will be illuminated, this may mean a very long delay in the case of a target picked up early, and a more serious, even if shorter, delay if the target has crossed the " outer row " of " blink-lines " before being illuminated.

Records kept in the 1st A.A. Battalion in 1935 showed that the average time to obtain a height reckoned from the moment of first illumination was of the order of 100 seconds, though the procedure once the " blink " is obtained is very quick.

(*b*) *The Master Station System.*

This system was the first attempt to make all questions of plotting and height-finding entirely independent of personnel at the searchlight.

Briefly, the idea is that one V.P. station receives a bearing, by telephone, from another V.P., and so is able to obtain the necessary intersection.

It was found that this system gave more accurate results but, though the actual procedure, with well-trained detachments, was very quick once the two V.P.s were in communication, the time-lag in initiating the plot was very big. The detailing of V.P.s to work together was in the hands of an officer in the control room, who had only telephone reports and the plotting record to go by. Even the brightest officers might (and did) take many precious seconds to determine whereabouts the target was, which way it was flying and, from that, to decide which V.P.s were best situated to work together, and which should be " master " to the other. Then he had to pass an order, by telephone, to the two stations concerned.

Records in the 1st A.A. Battalion showed that the average time to obtain a height, reckoned from the moment of first illumination, was of the order of two minutes, though the procedure, once started by the V.P.s, occupied only some 15 to 20 seconds.

(*c*) *The Central Station System.*

It will have been seen that both Single Station and Master Station Systems were very quick *once the plot had been initiated.* The source of delay in the former was the necessity of waiting for the target to reach a pre-determined line; in the latter it was due to control being based, of necessity, upon plots obtained and passed in by the V.P.s and for the detailing of a master station.

The Central Station System is merely a logical development.

In addition to the four Section V.P.s an extra V.P., known as Central, is provided at Company Headquarters. This is the permanent master station, and in it is vested the control formerly exercised by the "control room," which is now relegated to the position of "plotting room."

The Central V.P. is, in fact, the tactical headquarters of the Company, the function of the plotting room being merely the recording and, if required, relaying of information.

To understand the system it is essential to realize the distinctive functions of Central and Section V.P.s.

The primary function of the Central V.P. is height-finding. It also exercises general supervision over the work of Section V.P.s, demands extra plots or takes check heights as required and, where colours are used to distinguish between different targets, allots a colour to each target as it is reported.

The functions of Section V.P.s are :—

(i) To report the bearing of a target when demanded by Central.

(ii) To report *plots* of targets, using either known or assumed heights.

The details of procedure are given in Part III of this article. Suffice it to say here that the average time required to obtain a height, reckoned from the moment of first illumination, is of the order of 30 seconds. This figure is the result of actual tests in the 1st A.A. Battalion during 1936.

PART II.—LAYOUT OF CENTRAL STATION SYSTEM.

1.—PRINCIPLES AND THEORETICAL REQUIREMENTS.

The main principle governing the layout is that the Central V.P. should be near the centre of the Company Area, in such a position (usually on a cold and windswept hill) that any target, illuminated by the lights of the Company, can be seen.

The plotting room is best sited some two hundred yards from the Central V.P., and it is an advantage if a clear view of the sky can also be obtained from its immediate vicinity. These two positions form the Operations Headquarters of the Company. The main headquarters camp and M.T. lines should be within reasonable distance, sited with a view to cover and easy access to roads.

The four Section V.P.s, also usually on high ground, are so placed as to form four bases radiating from Central, the angle between

adjacent bases being, as nearly as the ground will permit, a right angle.

The ideal practical length of base is about three miles, this being governed partly by consideration of the minimum permissible angle of intersection (30 degrees) and partly by the necessity for limiting telephone cables, which can rarely be laid straight, but must follow roads and tracks as far as possible.

2.—Practical Points Affecting the Layout.

Every V.P. should, if possible, be able to see down to an angle of 5 degrees. The natural tendency is to site them on the tops of hills, but, unfortunately, these are often masked by trees. Low-lying ground will frequently yield better positions, except for a tendency to ground-mist, which may interfere with plotting. The risk of this, however, is not as great as might be expected, since aerial targets are often visible through a shallow layer of mist, even though the ground visibility is very poor. At a Section V.P., a solitary tree, or small clump, does not matter, *if on or near the line joining that V.P. to Central*, since no bearing will be asked for which does not yield a reasonable angle of intersection.

It should be borne in mind that the Section V.P. is part of section headquarters, so that the needs of administration and the accessibility of searchlight positions must not be overlooked.

3.—Sources of Error.

The main sources of error are mentioned here as an introduction to the procedure given in paragraph 4, below, for the reconnaissance and occupation of a plotting system in a new area. They are discussed in greater detail in Appendix 1. Human errors, being incalculable, are not discussed, nor are those which are within the province of instrument design.

Errors latent in the system are :—

(*i*) *Error in Length of Base.*

This may be due to :—

(*a*) Faulty re-section of V.P. position.

(*b*) Error in transfer of map-spotting to V.P. trace, either at Central or Section V.P., or both.

(*c*) Faulty centring of instrument pivot about the pin-point.

(*ii*) *Error in Bearing Reported.*

This may be due to :—

(*a*) Faulty orientation of V.P. table.

(*b*) Faulty centring of instrument pivot (see above).

(*c*) Degree of accuracy possible in a rapid method.

(iii) Error in Levelling V.P. Table.

It is worth noting that this is only of real importance at Central as Section V.P.s only report bearings in connection with height-finding. For the same reason, differences in ground-level between V.P. stations do not matter.

4.—METHOD OF RECONNAISSANCE OF THE PLOTTING LAYOUT IN A NEW COMPANY AREA.

Where accurate heights are required, the fixing of the positions of plotting stations on the V.P. traces must be a priority task for reconnoitring officers on arrival in a new area. The early selection of exact sites is, in any case, essential, to enable the laying of signal communications to be pushed on, and for the establishment of report centres at each headquarters.

A standard method has been evolved and tested in a variety of areas during collective training during 1935 and 1936.

The Company Commander selects the exact sites for Central V.P., plotting room and Company Headquarters camp. While the second-in-command gets the camp and vehicles fixed up, the O.C. resects the position of " Central " on the map.

If the O.C. has to attend a conference or is " no good at survey," the second-in-command does the resection and the C.S.M. does the rest.

The reconnaissance of each section area follows a definite plan. The V.P. (at or very near section headquarters) and six searchlight positions have to be found, and there should be two officers to do the job. Usually one does the V.P. and two searchlight positions; the other takes on four searchlights.

The V.P. is the only concern of this article.

(i) As soon as the exact site has been chosen, the position is fixed on the map. This must be carefully done, and it should, if possible, be properly resected. The officer concerned must satisfy himself that the pin-point is as accurate as circumstances permit.

(ii) The point fixed on the map has now to be transferred to the trace which is on a larger scale (usually 2-in. to 1 mile). This is most easily done either by *measurement* of the horizontal and vertical co-ordinates, or by striking arcs with compasses or dividers from two corners of the grid square concerned, the measured distances being scaled up to the required proportion. The exact position is thus transferred to the trace.

(iii) This point has to be reproduced on the Central V.P. trace. This is done by means of a small piece of tracing cloth, on which is drawn one grid square on the same scale as the V.P. trace. The square is carefully superimposed on the V.P. trace grid square

concerned, and the exact point pricked through. The corners of the square are marked with the relevant grid co-ordinates, the name of the station and the number of the section being marked at the top. The slip of tracing cloth is then sent in, by D.R., to Company Headquarters, where the plot is readily pricked through on the appropriate square on the Central V.P. trace.

(*iv*) To mount the trace on the V.P. table, a small hole must be cut in the centre, to pass over the pivot of the instrument. This means that the actual plot of the V.P. position is cut away. To ensure that the pivot is correctly centred, N. and S., and E. and W. lines are drawn right across the trace through the "plot," before the pivot-hole is cut. These lines are registered with the 0°, 180°, 90° and 270° lines on the bearing scale on the edge of the trace, ensuring that bearings read as from the exact plot.

(*v*) On the Central V.P. trace the plot of each Section V.P. is surrounded by a bearing scale of about 4-in. diameter, to enable the reported bearings to be set off.

If time permits, these bearing scales may be drawn direct on the trace, but it is simpler (and usually more accurate) to use separate scales, either stuck on or fixed in position with drawing-pins.

The reported bearing is best set-off by means of a waxed thread fixed to a pin at the plot of the Section V.P. position.

A celluloid cover for the trace is essential, as the table is almost invariably saturated with dew or mist, and needs continual wiping. Glass is unsuitable, as pins must be put through the cover and trace to take the waxed threads.

(*vi*) As soon as they have been resected, all V.P. positions should be marked by pegs, and bearing piquets or reference points fixed, to facilitate accurate orientation of the table whenever it is subsequently set up.

5.—Equipment and Communications.

No attempt is made in this article to discuss design of equipment or technical matters in the province of the Royal Corps of Signals.

The Central V.P. table must be somewhat larger than the existing standard pattern, to enable the whole Company Area to be covered by the trace. Certain other refinements as regards sights, levelling device, adjustment for height above sea-level and so on, are also desirable.

All V.P.s are equipped with telephones and head-and-breast sets and are connected to an exchange situated in the plotting room.

Reports are received on a loud-speaker. This is far more satisfactory than telephone receivers, as reports must be heard by the switchboard attendant, two separate plotters and the officer in charge. Important visitors are also catered for automatically.

The Central V.P. is permanently switched through to the speaker, so that :—

(i) " Central " can take charge at any moment without having to ring and await the pleasure of the switchboard attendant.
(ii) " Central " hears all reports from Section V.P.s as they are switched on to the speaker.

Section V.P.s must ring to notify that they wish to report—otherwise they frequently all speak at once, usually when " Central " is initiating a plot. " Bunched " lines also introduce considerable line resistance, and the switchboard method has been found to be more reliable.

The switchboard has a buzz-bar by which any selected V.P. is notified that he is through.

One buzz means : " Listen—there is a message for you." On receipt of one buzz the Section V.P. says the name of his station, to indicate that he is " on the line."

Two buzzes (usually given after a station has rung) mean : " Give your message."

PART III.—PROCEDURE.

1.—GENERAL.

A standardized form of message is essential if speed of height-finding and plotting is to be assured. If the standard " plot " message is understood, the height-finding procedure messages are much simpler to follow.

The standard plot message consists of seven distinct parts, as follows :—

(i) Name of V.P. station reporting.
(ii) Identification of target.
(iii) Map-square of target's position. (The " plot.")
(iv) Kind of height (measured, previously fixed or merely assumed).
(v) Height in feet.
(vi) Whether target is illuminated or located by sound.
(vii) Course of target.

Of the above, (i) is of value to the plotters and is essential for " Central," who must know who can see the target and thus be able to supervise. (ii) is done by allotting a distinctive colour to each target. This is a simple way of distinguishing between two or more targets over the area at the same time. In the plotting room, courses are plotted with counters of the appropriate colour.* (iii) A four-

* This is not applicable in R.A.F. operations rooms where colours are used to denote times of arrival of messages.

figure reference is sufficient for plotting messages. A fresh plot should normally be given as the V.P. instrument pointer enters each new square. (iv) One of three words is used: *i.e.*, "Spot," "Height" or "Assumed." "Spot" means that the height has just been measured, and in this system it is used only by the Central V.P. "Height" means that the Section V.P.s plot is based on a spot-height previously obtained by Central. "Assumed" means that the true height is not yet known. (v) Heights are reported to the nearest hundred feet. (vi) "Seen" or "Heard." (vii) Approximate compass point on which the aircraft course is set.

Sample plot messages, for instance, are :—

"*Heath. Red.* 4176. *Assumed.* 6000. *Heard. South-West.*"

and

"*Bridge. Blue.* 3982. *Height.* 7400. *Seen. North-East.*"

Stages of the Raid.	*V.P. Reporting.*	*Procedure Message.*
(1) First warning of raid.	B. V.P. ...	"Beer. Two beams searching North."
(2) Target is heard.	(i) A. V.P. ... (ii) Central ...	"Ale. Target heard North-East." "Colour Blue."
(3) Section V.P. can give an approximate plot on intersection of beams.	B. V.P. ...	"Beer. Blue. 4076. Assumed 6000. Heard. South-West."
(4) The target is picked up by searchlight beams.	(*a*) Central ...	(i) "Central. Blue seen." (ii) "Central. Blue. Beer."
	(*b*) B. V.P. ...	"Beer" (on receipt of 1 buzz).
	(*c*) Central ...	"Central. Blue. 3874. Central Plot."
	B. V.P. ...	"Beer. Ready."
	Central ...	"Read."
	B. V.P. ...	"Two Eight Four." (Bearing.)
	(*d*) Central ...	"Central. Blue. Spot. 6400 3975. South-West."
(5) Central takes a check height using a different V.P. as sub-station.		All messages in same form as in (4) above.
(6) Section V.P.s report plots.	C. V.P. ...	"Cork. Blue. 3673. Height 6400. Seen. South-West."
(7) A fresh target is heard entering area.	(i) A. V.P. ...	"Ale. Fresh target heard North-West."
	(ii) Central ...	"Colour. Yellow."
Followed by procedure (3) to (6).		

The actual procedure is set out above. The left-hand column "paints the picture"; the centre column shows the originator of

the message; the right-hand column gives the actual message. Redundant messages are omitted for simplicity. It is assumed that the four Section V.P.s are known as Ale, Beer, Cork and Drink respectively. Central V.P. is always called "Central."

It is important that Section V.P.s should never hesitate to give reports because they do not know the colour allotted or the spot-height obtained. It is often impossible to broadcast these to all stations owing to the incoming messages. It is the duty of Central to supply information when necessary.

Thus, if in the case quoted above, "Drink" is able to plot, but has not been able to get through in the early stages owing to "traffic," he should report as follows when he does get through :—

"Drink. 3371. Assumed 5000. Seen. South-West."
Central at once says : "Colour Blue. Spot-height 6400."

Section V.P.s must also realize that their reports cannot always be accepted immediately they ring, and must keep on trying to pass in their messages.

PART IV.—POSSIBLE DEVELOPMENTS.

(*a*) It is claimed for the Central Station System that heights of aircraft targets can be obtained in an average time of 30 seconds after first illumination, and that 80% to 85% of such heights are consistent within 300 feet.

Accuracy has not yet been proved, but the conversion of consistency into accuracy is a question of instrument design.

The percentage of bad heights represents those cases where the inherent errors, human and otherwise, are to some extent cumulative. These, when they occur on a first height taken on any target, are soon discovered by the taking of check heights. Practically, in only a small percentage of cases is a bad height not eliminated sufficiently early for the final result to be of some use.

(*b*) The most obvious use of the system is for the passing of information to the A.A. guns. That this can be done has been shown in practice, and it is obvious that the V.P. system is naturally suited to the obtaining of early information, owing to the area which it covers. Any form of monostatic height-finder is at a disadvantage here, and if it is sited at a gun position, the target may well be invisible to it or "below angle" until after the V.P. height has been made available.

There is no question of Sappers ousting Gunners from one of their own jobs. The plotting system in a searchlight unit must in any

case exist (see Part I, para. (1)) and in an aircraft zone the defending R.A.F. must rely on plots and heights from the searchlight units in the sector concerned.

The wise gunner will not take exception to the idea of making use of early and reasonably accurate information.

(*c*) At the moment, the system has been developed solely for use against aircraft illuminated by searchlight beams at night.

It breaks down in daylight, owing to the fact that high-flying targets can usually not be seen from both ends of a three-mile base.

This is due to the fact that a small object, illuminated from above, is very hard to see against a light background. Unless the aircraft banks there is little or no reflected light to reach the eye of a ground observer, and if such light is visible at one end of the base it is usually invisible at a point three miles away.

Further than this, even if both ends of a long base do see a target simultaneously by day, there is nothing to prove that it is the same target, whereas, at night, it is easy to distinguish between the comparatively few targets that can be held simultaneously by the beams of one Searchlight Company, and at least they can all be seen.

By day the monostatic instrument, with high magnification, reigns supreme.

(*d*) The Central Plotting System has, also, not yet been adapted for the height-finding of targets flying above cloud.

The possibility of sound control of A.A. guns is outside the province of the V.P. system of a Searchlight Company, and beyond the scope of this article, but such targets must be taken on by the defending R.A.F. in an aircraft zone.

It is not anticipated that there should be much difficulty in superimposing a sound-height-finding method on to the existing Central System, on the lines of the system at present used with single station plotting, especially as defending aircraft do not require very accurate information as regards height.

(*e*) The vulnerability of the system is fairly high. All the eggs are in one basket at the Central V.P. and plotting room, but so they are in a monostatic system. Besides, it is a small basket, and should be a very unobtrusive one. Given spare equipment and personnel it is quickly replaced.

The weakest link is the cable communications, which are " easy meat " for ill-disposed persons. Alternative routes would help, but sabotage is a very real danger.

The obvious answer is R/T., but existing equipment is not satisfactory.

Two-way speech is essential.

The use of two sets at each V.P. has been tried, but has so far

failed owing to the difficulty of tuning four (Section V.P.) transmitters to one (Central V.P.) receiver.

However, this (thank goodness !) is a Signals' problem, and beyond our scope.

APPENDIX 1.

INACCURACIES INHERENT IN THE SYSTEM.

It has been stated that no long-base method of height-finding can be sufficiently accurate for rapid use in the field, owing to the difficulty of surveying-in the ends of the base. Further, the meticulous work associated with survey is obviously impossible if results are to be produced in a matter of a few seconds.

The Central Station plotting system is a long-base method, based on survey principles, but using crude instruments. In practice it has been found to give remarkably consistent results, and it is suggested that its accuracy is assured by the large number of small inaccuracies inherent in its practical application, on the well-known theory that " inaccuracies tend to cut out."

Practical results are discussed in Appendix 2, but an examination of the theoretical inaccuracies is not out of place.

1.—ERROR IN LENGTH OF BASE.

Three causes of error are enumerated in Part II, para. 3 (*i*). Of these (*b*) and (*c*) are easily kept within the limits of probable error in (*a*), Faulty Resection, by the means described in Part II, para. 4 (*ii*), (*iii*) and (*iv*).

(*a*) *Error due to Faulty Resection.*

It is assumed that a 1-in. map of the area is available. If only smaller-scale or inaccurate maps are available the system obviously breaks down, unless special (survey) steps are taken to fix the V.P. positions, but, if the system is accepted as being capable of delivering the goods, is it too much to expect that such steps would be arranged for ?

It is also assumed that an R.E. officer can fix his position on a 1-in. map to within the size of a *coarse* pencil dot. If this is accepted, the maximum error in resection may be taken as 20 yards. If the errors in fixing both ends of the base are in opposite directions, the maximum error in length of base will thus be 120 feet.

In passing, it is worth noting that this maximum cannot apply to all four bases in one layout.

(*b*) *Error in Plot due to Error in Base.*

The smallest angle of intersection in a properly-arranged layout is 30°, since Central has the choice of four bases to work from.

In Fig. 2, C (Central) and B (Section V.P.) represent the actual ends of the base, and C′ and B′ the ends as plotted, CC′ and BB′ each being the maximum of 60 feet.

T′ is the position of plot obtained when T is the actual plot of the target.

The error in range from Central is given by c′T′, since C′c′ = CT.

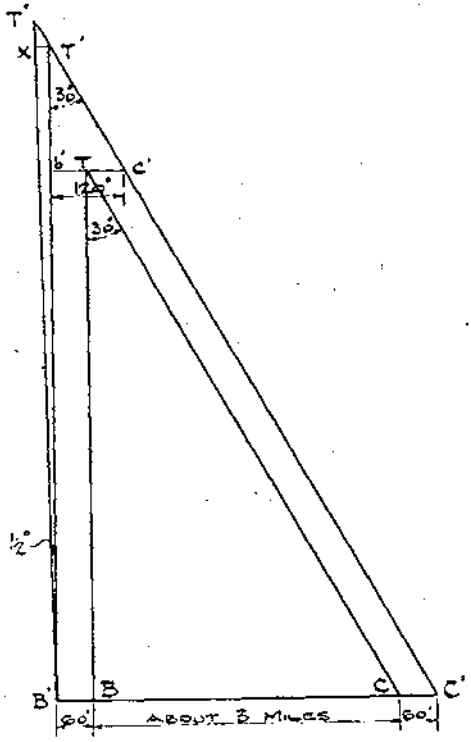


FIG 2.

In any triangle b'T'c',

$$\frac{c'T'}{\text{sin. } b'} = \frac{b'c'}{\text{sin. } T'},$$

which in any particular limiting case is a constant.

Hence c'T' equals Constant × sin. b' and is a maximum when sin. b' = 1 (*i.e.*, when b' = 90°).

c'T', in the case under consideration, is a maximum when b'c' is a maximum (120 feet) and the apex angle is a minimum (30°).

Then, $c'T' = \frac{120}{\text{sin. } 30^\circ} \times 1 = 240$ feet.

2.—Error in Bearing Reported by Section V.P.

Section V.P.s, by means of a scale round the edge of the trace, or table, report the bearing of the target to the nearest degree. The maximum error in the bearing reported is therefore ½°.

The maximum range from any Section V.P. to the outer ring of lights in the sector in which bearings may be called for is 8,000 yards, and it will usually be less.

Taking the worst case, the error in plot, measured at right angles to the V.P. bearing, is given by 8,000 tan. ½° yards, = 24,000 × ·00873 feet = 210 feet.

3.—MAXIMUM ERROR IN PLOT.

(*a*) The maximum plotting error from para. 1 (*b*) occurs when the angle of intersection is small and is represented by c'T' (Fig. 2).

(*b*) The maximum plotting error, from para. 2, also occurs when the angle of intersection is small, and is represented by T'T" (Fig. 2). If T'X = 210 feet (see para. (2)), then T'T" will be 210 cosec. 30°, which = 420 feet.

(*c*) If all errors are taken at their maximum value, and are also considered to be cumulative, the maximum theoretical plotting error (neglecting human error) is :—

240 feet (from para. 1 (*b*)) + 420 feet (from para. 3 (*b*)), which = 660 feet.

4.—MAXIMUM THEORETICAL ERROR IN THE HEIGHTS OBTAINED.

The range from the Central V.P. to the outer ring of lights is approximately 4 miles.

To be engaged effectively by guns before reaching the outer line of bomb release, targets must be illuminated over the outer ring of lights. A target in this position, therefore, will be at the maximum angle of elevation to be expected in finding heights early enough to be of practical value.

If we assume, as appears justifiable, that the minimum useful range from Central is 20,000 feet and that the maximum height of target is also 20,000 feet, the maximum angle of elevation to be expected when taking heights of practical value is 45°.

(If targets are to be expected at greater altitudes than 20,000 feet they should be illuminated at greater range, since the outer line of bomb release will be farther out and the time of flight of a shell will also be greater, if it can get there at all.)

In the worst case, therefore, error in plot will give an equal error in height obtained and, from para. 3 (*c*), the maximum anticipated theoretical error in height is 660 feet.

5.—AVERAGE EXPECTED ERROR.

(*a*) *Error in Length of Base.*

It is considered fair to assume that the *average* error in base length will be one-half of the maximum, since errors in position will tend to cut out as often as to cumulate, and considering the all-round layout (four distinct bases) the average error should be the same as the "permissible" error in fixing one station.

If this is accepted, the average error in range of target from Central (due to error in base) becomes 120 feet.

(*b*) *Error in Bearing Reported.*

It has been shown that, in the worst case, the range error due to inaccurate bearing is 420 feet.

The best case occurs when the angle of intersection is 90° (T'X in Fig. 2) = 210 feet.

The average expected error due to such inaccuracy is :—

$$\frac{420 + 210}{2} = 315 \text{ feet.}$$

(*c*) *Resultant Error in Height.*

At the *maximum* angle of elevation, therefore, the average expected errors, *if cumulative*, will give a height error of 435 feet.

It appears reasonable to expect a normal degree of consistency of the order of two to three hundred feet, which is borne out by the results obtained in practice, but it must be realized that a small percentage of thoroughly bad heights (when errors are maximum and tending to be cumulative) is only to be anticipated.

APPENDIX 2.

PRACTICAL RESULTS OBTAINED.

1.—Accuracy of Heights.

The accuracy of heights obtained is extremely difficult to check. Ordinary altimeter readings reported by the aircraft are not sufficiently accurate to serve as a basis for calculation.

The consistency of results is, however, a useful measure of probable accuracy, especially if several heights are taken on each run, utilizing sub-station bearings from different Section V.P.s.

If the *system* produces consistency, instrument *design* can achieve accuracy.

In the results given below the measure of consistency is taken as being within 250 feet.

A.—1935. *Using Best Available (Experimental) V.P. Table and Instrument.*

(*i*) *Trial Period at Blackdown.*

The figures for the first three nights are quoted only as a matter of interest, from the point of view of the rapid improvement obtained by training and practice.

	Consistent.	*Inconsistent.*
13th May ...	... 33%	66%
14th May ...	... 76%	24%
15th May ...	... 88%	12%

(*ii*) *R.A.F. Sector Training at Hornchurch.*

17th–19th July	... 80–85%	15–20%

(*iii*) *Air Defence Bde. Exercise at Tilbury.*

It should be noted that these results were obtained under conditions approximating to war, and not on regular " runs " during limited periods of nightly co-operation.

	Consistent.	*Inconsistent.*
22nd–25th July	... 78%	22%

B.—1936. *Using a " Mock-Up " Instrument adapted by Local Resources.*

From 4th–16th May, when newly-joined height-finding personnel had had one month's training, it was possible to test results against Kine theodolite readings.

The experimental instrument used in 1935 was languishing somewhere in the Mediterranean, but it was thought that tests with a mock-up instrument would be better than nothing. It was realized that this instrument had an inherent instrumental error.

This constant error was deduced in three different ways, all three results agreeing within 30 feet. The average of these was accepted as correct.

Results given below are for heights corrected for this constant error and for the difference in height above sea-level of the Kine theodolite base and Central V.P.

Average error in height (over 72 readings) ... 194 feet
Of the errors on 72 results :—

76% were under 300 feet.
24% were over 300 feet, only 3% being over 500 feet.

2.—TIME REQUIRED TO OBTAIN HEIGHTS.

(*i*) *Original Procedure*—1935.

Average time from " Target first illuminated " to " Height relayed from plotting room," 45 seconds.

" Record " time as above, 17 seconds.

(*ii*) *Revised Procedure*—1936.

A true average over the whole season cannot, unfortunately, be calculated, as full records are not available. In any case the training of new personnel, with no previous experience of any form of A.A. work, has made it impossible to produce statistical results for trained detachments.

The normal time for reasonably-trained crews is, however, of the order of 25 to 30 seconds.

The " record " for 1936 is believed to be 11 seconds.

HOUSE DEMOLITIONS IN PALESTINE.

By CAPT. A. J. H. DOVE, *p.s.c.*, R.E.

QUALA, a little village in the foothills about ten miles north of Lydda, had been naughty.

During the night 11th/12th July a patrol of the 1st Bn., Royal Scots Fusiliers, and tanks was fired on near the village. Later on four other tanks were fired on. The village was searched and a few arrests were made, but next morning a further search party was again fired on from certain houses as they were leaving the village.

As a result of this the local civil authorities decided to blow up the offending houses in Quala. A small mixed force was therefore dispatched to the village on 13th July.

After a halt at Ramleh, to pick up the District Commissioner, and a truck-load of *mukhtars* (or head men) from neighbouring villages, the column reached Quala about 10.30. The village was surrounded without opposition, and was cleared of its inhabitants by infantry and police. Meanwhile the District Commissioner visited the *mukhtar* and proceeded to hold a court.

Legal proceedings are usually lengthy, and these were no exception. However, before the evidence was completed, it was possible to get a fair idea of what the court's decision was likely to be, and a reconnaissance was carried out, and a tentative plan made.

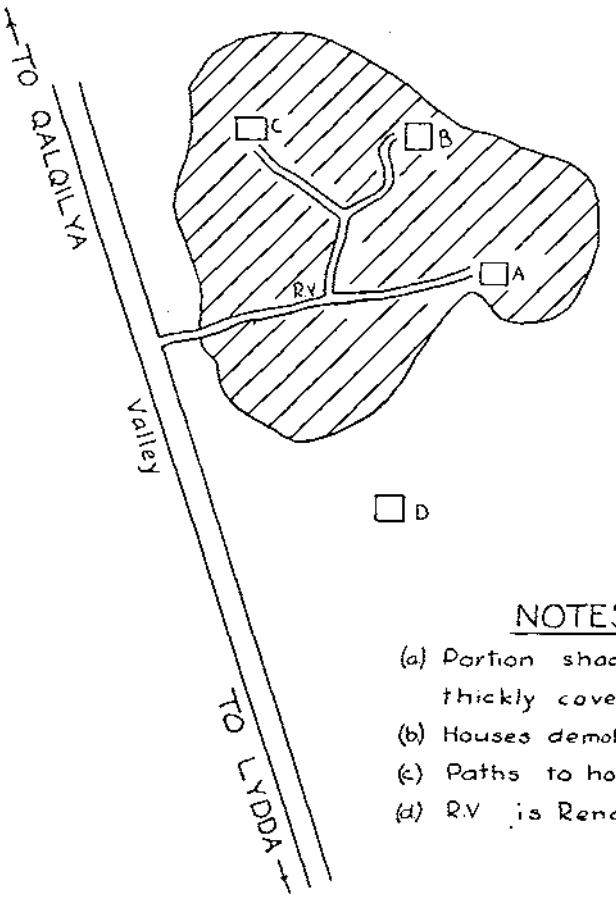
It turned out that four houses were involved. Two were identified by two witnesses each, both of whom had noticed firing coming from them. Two could only be identified by one witness each. The O.C. Force, however, prevailed upon the District Commissioner to visit the doubtful ones. Confirmatory evidence was soon forthcoming. House A, the *mukhtar's*, had obvious marks of a burst of well-aimed machine-gun fire on an interior wall: house B had a nicely-grooved loophole, which looked right along the line of advance of the tanks. So at 12.15 the sentence of the court was pronounced, and the Sappers got to work.

Sketches are attached which show the approximate layout of the village and the placing of the charges in the individual houses.

In house A, orders were to blow down the double-story portion, doing as little damage as possible to surrounding buildings. Two 50-lb. boxes of 40% N.G. dynamite were placed against a central pillar in the ground floor portion, which was used as a store-house for grain. The charge was lightly tamped with grain in sandbags.

House B was rather an awkward one. A charge of 100 lb. was

QUALA VILLAGE



NOTES

(a) Portion shaded fairly thickly covered with houses.
(b) Houses demolished Marked ABC
(c) Paths to houses shown.
(d) R.V is Rendezvous

finally placed against a thick piece of side wall, and tamped with mattresses and other material from the rooms of the house.

House C was perched on top of a granary. Here the District Commissioner was particularly anxious that the next-door house should not be damaged. The charge used was 50 lb., and it was placed in an angle between an exterior and an interior partition wall, and was not tamped.

House D stood by itself. It really consisted of one room, with only a door-opening in it, about 13 feet square. It had a concrete and steel joist roof. A stone staircase ran up one side wall. The room on top was unfinished and had no roof. A charge of 100 lb. was placed against the steps inside the room, and was left untamped.

Each charge was to be set off by two No. 6 Commercial detonators, each with eight feet of safety fuse, timed to burn for four minutes.

A lance-corporal and three men took on houses B and C, and one officer and two men houses A and D. The explosives lorry was run up to the centre of the village, and explosive distributed from there. The quickest route from each charge to this spot was reconnoitred, and all concerned notified that it was to be used as the rendezvous after lighting the fuses. Three infantry buglers were left there, under direct orders of O.C. Fd. Coy.

When all charges were laid, and the lorry had retired to a safe place, the first call was blown—"Short Réveillé." On this, infantry covering parties retired to a safe distance and detonators were inserted in charges. After a short pause and a final look round, the "Infantry Charge" was blown. Fuses were then lit, and the Sapper party retired on the rendezvous. Two minutes later the "Fire Alarm" was blown, as a final warning, and the demolition party was about 150 yards from the village when the first charge went up. The four charges went up in succession quite satisfactorily, and were greeted by faint cheers from the assembled villagers. Perhaps some of the snipers were not too popular.

The double-story portion of house A was satisfactorily destroyed. A small gap was also made in the yard wall. The surrounding buildings were not much damaged.

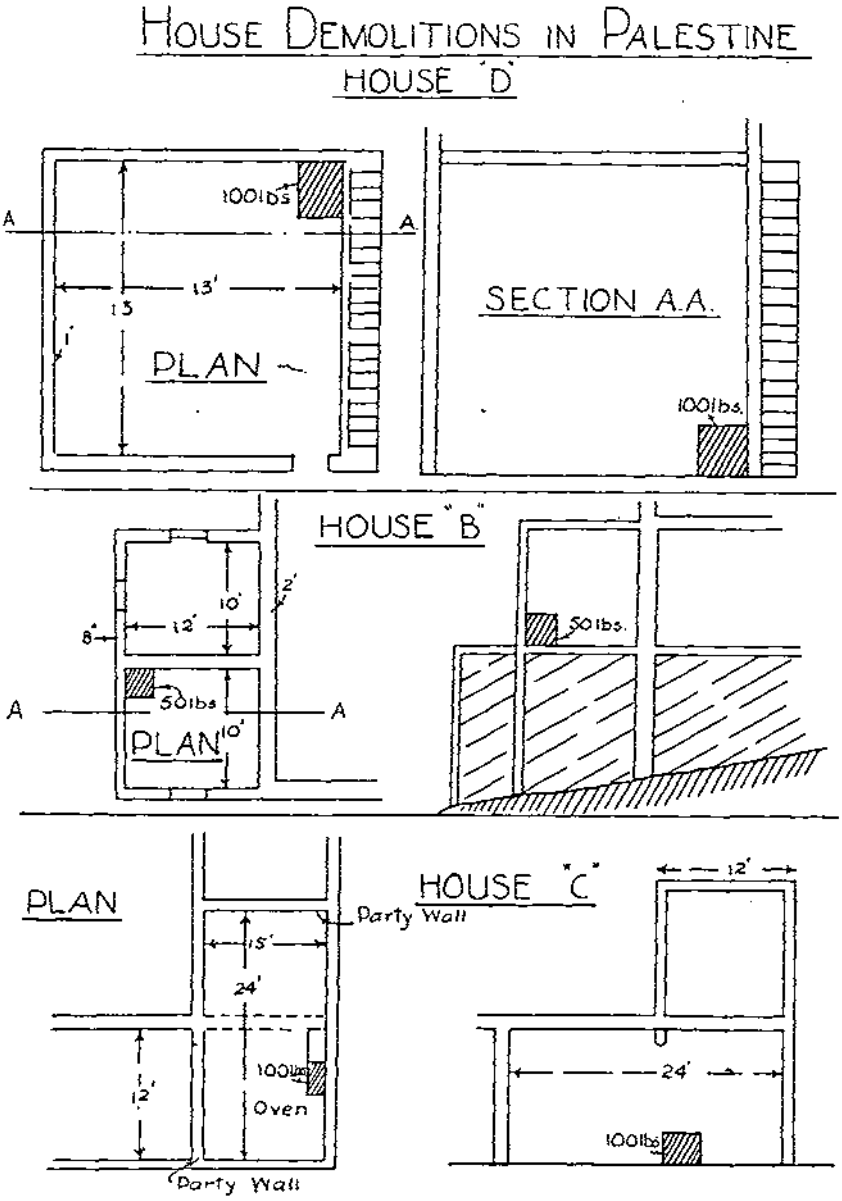
House B, as was expected, was completely destroyed. Unfortunately the houses next door were also nearly flattened, but the Civil Power was in a forgiving mood.

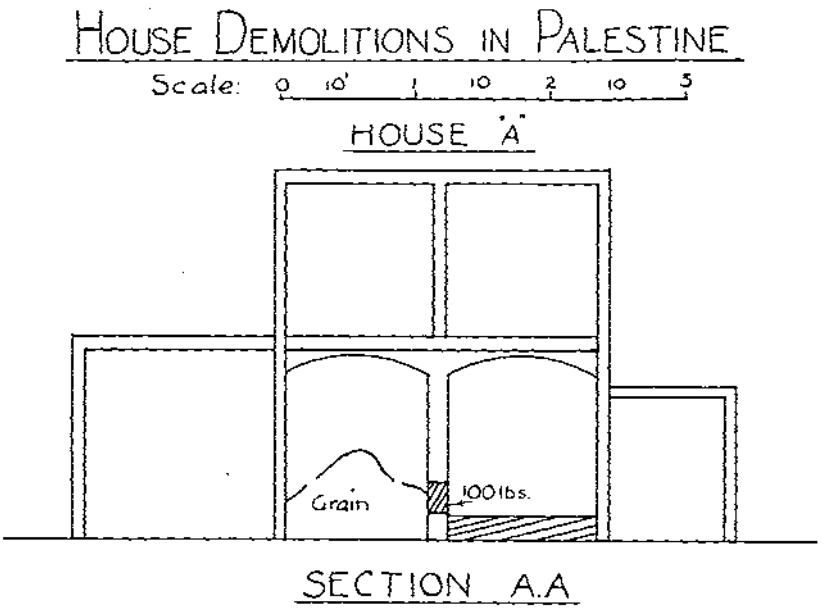
Part of the east wall of house C was left standing, but no undesired damage was done.

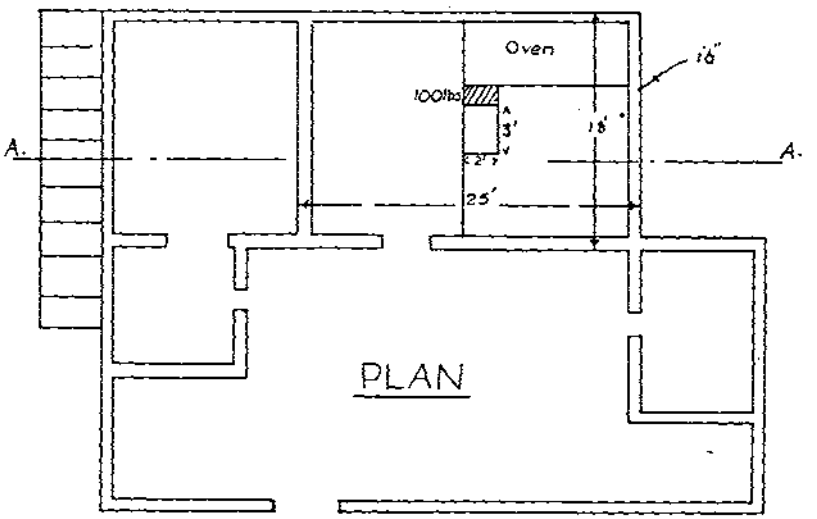
House D was removed completely. The steel girder and concrete floor went about 100 feet up in the air, and crumpled up like a blanket.

The demolition was completed by 12.45, and the column got back home to a late lunch.

Next night there was again sniping from Quala!


HOUSE DEMOLITIONS IN PALESTINE
HOUSE "D"
100lbs
A
A
13'
13
1'
PLAN
SECTION A.A.
100lbs.
HOUSE "B"
10'
2'
12'
8"
50lbs
A
A
PLAN
10'
50lbs.
PLAN
HOUSE "C"
Party Wall
15'
24'
12'
100lbs
Oven
Party Wall
12'
24'
100lbs


HOUSE DEMOLITIONS IN PALESTINE
Scale: 0 10' 1 10 2 10 3
HOUSE "A"
Grain
100 lbs.
SECTION A.A


Oven
16"
100lbs
3'
2'
18'
25'
A.
A.
PLAN

A CROSSING OF THE INDUS.

By LIEUTENANT M. C. PERCEVAL, R.E.

IN February, 1936, the 1st (Risalpur) Cavalry Brigade, with all its transport and some Light Tanks crossed the Indus during the course of Brigade Training. This was done not far from Hund, the site of Alexander the Great's crossing. It is probable that the boats used by him differed but slightly from those used by the Cavalry Brigade. The Indus has, of course, been crossed by troops since that time. From the inevitable *chits* of the boatmen it appears to have been done last in 1907. This is the first time, however, that lorries and light tanks have been ferried across.

The tactical scheme envisaged two main armies engaged in the neighbourhood of Attock. The Cavalry Brigade, part of the army advancing from the east, had been withdrawn and sent round by Haripur to carry out a flanking movement against the enemy's L. of C. at Jehanghira, arriving at Tarbela on the evening of 11th February. The only opposition to be expected on the morning of 12th February were Frontier Guards and some Cavalry. It was decided to get some troops across in the early hours of the 12th February to hold the high ground near Gala and Pihur and protect the crossing. Denied this ground, the enemy could only interfere from the air or by unobserved fire from long range. Local air superiority was assumed and would have been essential for this operation in war.

The O.C. 31st Field Troop, K.G.O. Bengal S. & M. was first warned in November, 1935, that he had to get the Cavalry Brigade across the Indus during the course of Brigade Training. The estimated figures were 1,500 horses and 150 vehicles and guns. Actually 1,330 horses and about 190 raft-loads of vehicles were put across. The number of men is immaterial as they crossed with their horses.

The stores available to do this consisted of a set of 7 folding boats, a set of troop duckboards, country boats and old pontoon superstructure. The details are given in Appendix II. The "troop duckboards" had been made up by Capt. E. W. H. Clarke, R.E., and had already proved invaluable during three training seasons.

To encourage the O.C. Troop he was given the only air photograph available, which depicted a raging torrent, some 600 yds. wide. Investigation, however, quickly showed that this photograph had been taken in August when the river was at its highest.

A modest request was made to do a reconnaissance from the air, but this never took place, presumably on account of petrol economy rules. Instead of this, two ground reconnaissances were carried out in November and December, one from each bank. In most places the Indus runs in several large branches, but two sites were found where the subsidiary branches were fordable. With the limited resources available it was essential to find such a place for the crossing. Details of the sites are given in Appendix VI.

In war this detailed ground reconnaissance could not have been done beforehand and reconnaissance would have had to be done from the air. In some ways this would have been easier as the course of the river could have been easily seen. From the ground the more distant branches of the river always appeared small and easily fordable, whereas in reality they were often bigger than the branch near which one was standing. Detailed reconnaissance would not have been possible until the arrival of the Brigade in the early hours of 12th February. Time spent in this final reconnaissance might have delayed operations slightly, but not much. On manœuvres with the limited time available, it is essential to do this detailed reconnaissance beforehand so as to avoid any risk of undue delay.

The Gala site (150 yds. with a current of 3½ m.p.h.) was selected for the crossing of the horses, as there was ample room for them to form up on the left bank and the approaches and subsidiary branches at this place would have been difficult obstacles for the vehicles. The Pihur ferry site was selected for the vehicles, although it was the obvious place and the approaches here were far from good. Although a track came to this ferry on the right bank, there was a stretch of heavy sand which was very difficult for the Staff cars and four-wheeled ambulances. No better site, however, could be found.

The road on the left bank near Pihur ferry was one of the controlling factors of the whole operation. The Cavalry Brigade camped at Tarbela previous to the crossing, so that everything had to use this road. For a large part of its length it ran along the foot of the steep hills bordering the river, as can be seen in photograph No. 6. Traffic control on this portion had to be worked out very carefully, as no passing was possible. This was complicated by the fact that horses, working parties, etc., had to move in the opposite direction to the Brigade at times. The march table worked out for 12th February is shown in Appendix V. The river was only accessible from the road for a short length and the space here was very cramped. Such horses as crossed at Pihur had to wait on the road because no other flat space was available.

The choice of the Pihur ferry site precluded the possibility of using a flying bridge for the vehicles. Flying bridges could have been used for the horse boats, but each boat would have required

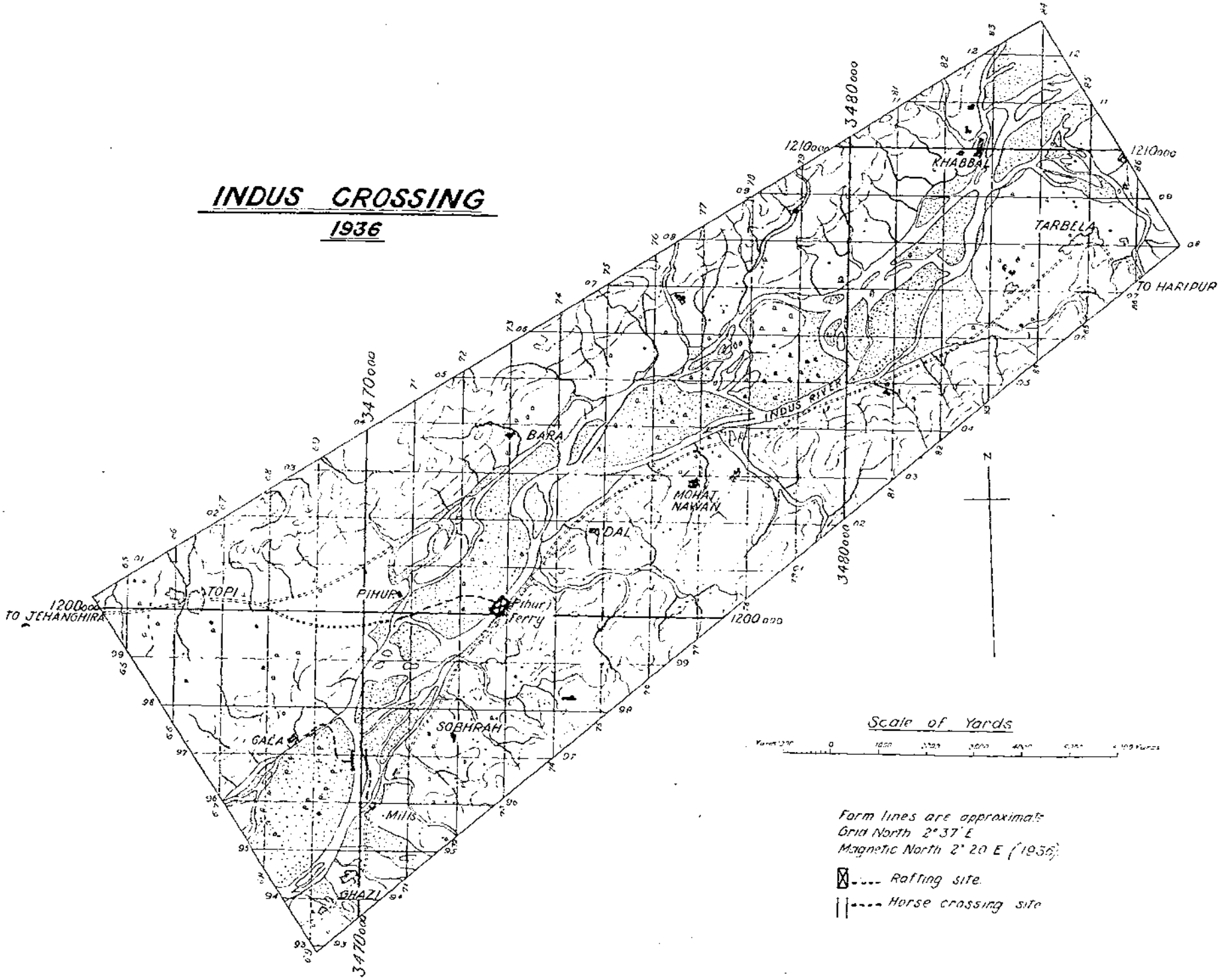
a separate cable and there would have been great difficulty with the cable anchorages on the banks. Below the surface these banks consisted chiefly of soft wet sand. It was decided to row the F.B.E. rafts at Pihur ferry, although this method of propulsion is not recommended in *M.E.*, Vol. III. Actually, under the conditions of this site, it worked very well.

The guns of the horsed Sections of the R.H.A. Battery were put across at Pihur ferry, while the horses had to go round to the Gala crossing. This was a bad arrangement, but was unavoidable. There were not sufficient boats to put the horses of the Battery across at Pihur ferry, and even if there had been, the horses waiting on the road would have completely blocked the traffic.

Swimming of horses was forbidden owing to the risk of losing a few animals, so it was decided to take them across in country boats. Swimming would have been quite feasible and in actual fact some of the horses that showed a marked aversion to entering the country boats were swum across beside the boats. The boats used are of a recognized type in the Indus and are 30′–35′ long, about 12′ broad and 2′–4′ deep. The details of these and the ramps made for them are given in Appendix IV. The slats at the top end of the ramp were found to be ample to prevent slipping, as this only occurred when the horse was stepping down into the boat. On the landing side no ramps were used as the horses jumped out of the boat quite readily. Obstinate horses were pushed into the boat from behind, using ropes if necessary.

The country boats are apt to roll, especially with such a live load as horses. The number of horses loaded into some of the smaller boats had to be reduced for this reason. During the practice one boat rolled so badly that it literally tipped its load of horses into the water. Special precautions had also to be taken to prevent the individual boats of rafts from rolling. All rifles, swords, V.B. guns and ammunition were taken off the horses before they were loaded and about half the horses were loaded without their saddles. The impedimenta crossed at the same site in a separate boat. Four horse boats (20 horses) were used on 12th February, and five (24 horses) on the 13th. The Regiments provided their own working parties. One party collected the impedimenta as the squadrons arrived and took it across in an extra boat. The horses then formed up in parties opposite each boat and were led on singly. The working party provided men to hold led horses, who afterwards returned in the empty boats. On the far bank the boats were pulled upstream to make up for ground lost owing to the current, and then returned to the near bank.

Approximately 3 per cent. of the horses jumped overboard. Nearly all these jumped out while loading was in progress, and moving about, which caused the boat to rock, also occurred at this


INDUS CROSSING
1936
3480000
1210000
RHABBAI
TARBELA
TO HARIPUR
INDUS RIVER
BARA
MOHAT NAWAN
DAL
3470000
1200000
TO JEHANGHIRA
TOPI
PIHUR
(Pihur) Ferry
SOBHRAH
GALA
Mills
GHAZI
N
Scale of Yards
Form lines are approximate
Grid North 2° 37' E
Magnetic North 2° 20 E (1936)
Rafting site
Horse crossing site

stage. Once the boat was well away from the shore 90 per cent. of the horses stood perfectly still. The secrets of successful loading were quietness and keeping the horses' heads away from the shore when once they were loaded. One man per horse was necessary and when they were in the boat, both reins on one side of the bit were undone to prevent any danger of entanglement should the horse jump overboard.

In warfare the horses would have been swum across and, with the space available at Gala, all the horses could have been put across on 12th February. They might have had to go without their rations that night, but in war one does not wait for these things.

For the troop duckboard and old pontoon equipment superstructure rafts, the country boats had to be prepared by lashing three pieces of 8″ x 8″ timber across them, on which the superstructure rested. This meant that all the weight came on the sides of the boat, whereas they are designed to take all the load on the flat bottom. As a result of this the joint between the bottom and side of one boat gave way just as a lorry was leaving the raft. The whole bottom of the boat swung upwards like a trap-door and the boat sank rapidly. Fortunately the lorry was nearly off and the boat was in shallow water so that no damage was done.

One of the light tanks accelerated suddenly just as it was passing from the F.B.E. decked raft to the half-floating bay. The result was that all the roadbearers of the half-floating bay lifted off the shore transom, their ends rising 3′ into the air and then falling again. If many tracked vehicles were being put across it would be worth while anchoring the ribands of the half-floating bay to the ground to prevent this happening.

The drivers of the lorries had been practised, both by day and by night, in driving up or down a slope on to a confined space and halting. Consequently the rafting proceeded very smoothly, and the only safety precaution used on the front of the rafts were chocks, or a chess tied across the ribands. The difference that practice makes was illustrated by the four civilian lorries that went across to take some of the stores back. Had one not seen the obvious terror on their faces, one would have thought that they were doing their best to drive their lorries over the edge of the raft. Some skilful driving was also done by the drivers of the Austin Sevens, as it was found just possible to fit four of these on to one F.B.E. decked raft. Private and contractor's vehicles were not taken across. One tonga driver assured the author that he was carrying all the cakes for the Officer's Mess of the British Cavalry Regt., but even in spite of this he had to use the civilian ferry. His tongas can be seen in photograph No. 6.

Although the first reconnaissance was done in November, the scheme did not take its final shape until very shortly before it was

carried out. Manœuvres are said to be a poor imitation of war owing to the amount of definite information available, but the number of changes that took place must have made this operation quite realistic. The author was told "The 'enemy' will cross and recross on the 12th." "The whole Brigade will cross on the 13th." "The 'enemy' will not cross." "No tanks would accompany the Brigade." "A whole Company of Light Tanks would cross." "Oh, didn't we tell you? There will be an extra Cavalry Regiment attached to the Brigade." "Only a few light tanks will be with the Brigade." "The extra Cavalry Regiment will not cross." Most of these changes entailed fresh schemes, lists of stores and estimates. Arrangements had to be made for hire of boats, hire of lorries, loan of stores from Akora, and boats had to be inspected and bargains struck with their owners. This may be nothing compared to the changes and complications that occur in war, but it seemed quite enough when undertaken in addition to normal peacetime duties.

The boats were floated down to the Gala crossing site during the night before the operation, so that no work was done at this site which could give away the intention of crossing there. It was originally intended to do the same thing at the Pihur ferry site, but there were some bad rapids a short distance upstream where the boats might have been damaged, so that this part of the plan was abandoned.

There was really too much sapper work for a Field Troop to cope with. With more sappers available the rafts could have been prepared in a quarter of the time, even allowing for the fact that congestion on the left bank would have been greater. In war, it is suggested that half a Field Company at least would have been allotted to the operation in addition to the Field Troop. This would have allowed for reliefs and the vehicle crossing could have continued throughout the night of the 12th February. A few lorries might have been lost due to crossing in the dark, but several lorries did cross after dark on the 12th February without difficulty.

In India there are no special trailers for the transport of F.B.E. and this equipment was carried on the long roofs of civilian lorries. Loading tables had been prepared for this by No. 5 Field Coy., K.G.O. Bengal S. & M., but it was found that the lorries provided were of a slightly different type and consequently there was considerable delay in loading. This caused the lorries to arrive at Attock bridge after dark, where further delay occurred as it had to be specially re-opened to allow the lorries to pass. The stores were due to arrive at Tarbela on the afternoon of 11th February, but at half-past nine that night there was still no sign of them. The O.C. Troop looked like having to get all the transport across by some stratagem similar to that employed by Joshua at the crossing of

No. 1.—Horse walking up the ramp into the boat.
Note :—The two men ready to help him on with the rope if necessary.

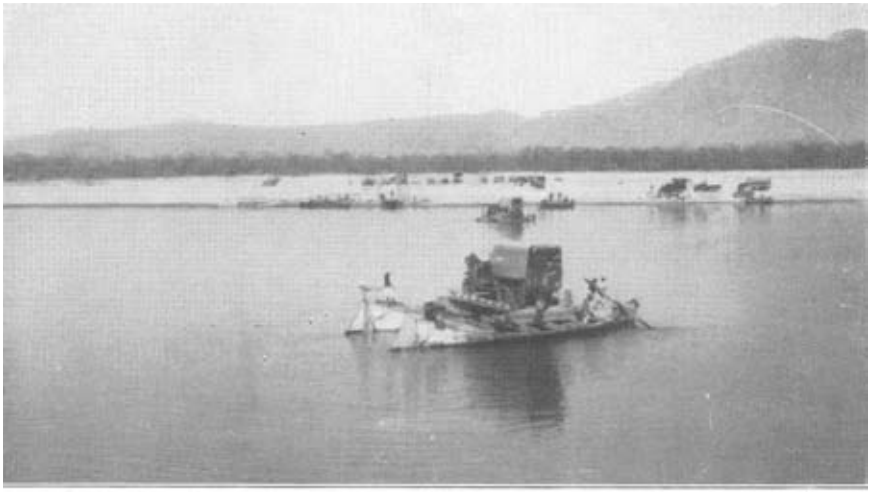
No. 2.—Horse stepping down into boat.
Note :—Horses' heads all away from shore.

Crossing the Indus 1& 2.

No. 3.—Horse boat in mid-stream.
Note :—This boat had an oar post in the middle and only held 4 horses.

No. 4.—Horses landing. One has just jumped out.
Note :—Both reins on one side of the bit undone.

Crossing the Indus 3 & 4.



No. 5.—General view of vehicle crossing-place, old pontoon equipment raft in foreground. In background, left to right :—country boat, broken country boat being repaired, old pontoon equipment landing bay, F.B.E. decked raft and lorry, F.B.E. half-floating bay.

Crossing the Indus 5 & 6

No. 7.—Raft of old pontoon superstructure on country boats.
Note :—8″ x 8″ timbers lashed across the boat also sleepers on end which filled the gap between the landing bay and raft.

No. 8.—General view of right bank. Both rafts are just arriving.

Crossing the Indus 7 & 8

the Jordan. However, the lorries were found at about 11 o'clock that night on their way to camp and arrived at about a quarter to one the next morning. Later that morning they again failed to arrive at the appointed time; on this occasion at the crossing site the O.C. Troop again started thinking of the advantages of Joshua's method of river crossing. The chief boatman evidently had the same idea at the back of his mind. As soon as anything started to go wrong he retired hastily to call on Allah for help. Altogether some 19 tons of stores were required. Figures of loading have not been given as the country boats were used for transport to a certain extent.

It will be noticed from Appendix I that the amount of time required for sorting and checking stores was much greater than had been allowed for. The lorries were arranged as far as possible so that each lorry contained all the stores for one raft or landing bay, and the lorries arrived in the order in which the stores were required. In spite of this, the necessity for clearing the road quickly and the awkward and cramped space between the road and river meant that all the stores had to be shifted again after being unloaded. The working parties making the ramps added another complication; stores conveniently placed for the work were apt to be buried under the spoil. The timings given in *M.E.* Vols. usually start with the stores laid out in a definite order, conveniently spaced, and with the detachment fallen in ready for work. In practice one is often faced with a detachment newly-arrived, who have first to deal with their rifles and equipment. The stores are probably in lorries loaded by someone else and one is lucky if their loading is arranged to fit the work. The site seldom allows of their arrangement according to the book, and although it may appear to cause a delay it is generally necessary to check through all the stores provided.

The principal lessons learnt may be summarized as follows:—

(1) Tracked vehicles must not accelerate suddenly on rafts.

(2) Drivers of M.T. should be practised driving on to and off rafts.

(3) Detailed reconnaissance of approaches is essential.

(4) Allow ample time for sorting and checking stores.

(5) Make ample allowances when dealing with country boats or civilian lorries. In preparing the scheme it was estimated that one country boat raft would be out of action the whole time. This pessimistic estimate proved nearly correct.

(6) Do not stint time spent on working out loading tables and similar time-saving devices beforehand.

(7) Quietness is essential when loading horses into boats.

(8) Slats on horse ramps must be broad and flat; otherwise the wood gets knocked away and a nail is left sticking up.

In conclusion it is the opinion of the author that this operation in war would have required local air superiority and the allotment of half a Field Company. Given these two it would have been possible to put across all the horses, men and tactical vehicles of the Cavalry Brigade by seven o'clock on the 12th February and all the transport could have crossed during that night.

NOTES FOR APPENDIX I.

1.—Strength of 31st Field Troop, K.G.O. Bengal S. & M., on 12th February :—

B.O's.	*B.N.C.O's.*	*I.O's.*	*I.O.R's.*
2	3	3	81

2.—M.T. Drivers are included in the figures. On occasions when they were driving their lorries independently they are not specially mentioned.

3.—The numbers appearing as "spare" give the impression that reliefs would have been possible. Actually the spare men were usually several miles away from the point where work was a maximum. Traffic control prevented their transport to the site of work, even if that had been worth while.

4.—The work of the Camp Party was not accurately estimated. It consisted of M.T. Drs., Qrmr. Hav., etc., who could not have been used at the ferrying sites.

5.—The boatmen are not shown. There were six per boat. The usual crew for a boat was five and, for a raft, six or more. The remainder provided reliefs, cooked their food, etc.

6.—On February 13th one man went sick.

7.—Average time for round trips :—

Gala	13½ mins.
Pihur Ferry :	
F.B.E. and troop duckboard rafts ...	16 ,,
Country boat rafts	20 ,,

APPENDIX I

SERIAL. 12TH FEBRUARY.	Sprs.	Cav.	REMARKS
1 Lieut. Hayes and party move from Tarbela to Gala.	14		"Estimates" shown ▬ "Actual" shown [5]
2 Lieut. Perceval and mounted party move from Tarbela to Pihur.	19		
3 Covering party crosses at Pihur Ferry.	19		
4 Covering party crosses at Gala.	14		
5 Approaches Pihur Ferry, left bank.	15	40	Times for Camp Party were not included in estimate.
6 Approaches at Gala.	10	40	
7 Eleven civilian lorries and three troop lorries move from Tarbela to Pihur Ferry.	30		
8 Horses of 1st Regt. cross at Gala (300 horses).	10	40	
9 Two Squadrons and V.G. Tp. cross at Pihur Ferry (210 horses).		40	
10 Unloading folding boats and putting in water.	38		
11 Manning folding boats as life-boat at Pihur Ferry.	5		
12 Unloading stores.	38		
13 Sorting stores.	38		} Not allowed for.
14 Laying out work on right bank.	3		
15 Camp Party strike tents, dismantle water-point, load lorries, etc.	16		
16 Horses of 1st Regt. (less 2 Squadrons and V.G. Tp.) cross at Gala (110 horses).	10	20	
17 Camp Party move to Ghazi.	16		
18 Approaches on right bank, Pihur Ferry.	4	15	Not allowed for.
19 Approaches on left bank, Pihur Ferry.	5	30	
20 Making up two decked rafts and two half-floating bays, Pihur Ferry, including taking stores across.	13		
21 Making up troop duckboard raft, Pihur Ferry.	9		
22 Making up three country boat rafts and two landing bays, Pihur.	13		
23 Improving ramps on both banks, Pihur Ferry.	13		
24 Horses of Bde. H.Q. and Sig. Tp. cross at Gala (100 horses).	10	20	
25 F.B.E. rafts ferry vehicles at Pihur Ferry. No of trips—each raft 19. Total 38.	10		
26 Troop duckboard rafts ferry vehicles at Pihur Ferry. No. of trips—19.	5		
27 Country boat raft No. 1 ferries vehicles at Pihur Ferry. No. of trips—6.	1		
28 Country boat raft No. 2 ferries vehicles at Pihur Ferry. No. of trips—5.	1		Interrupted for repairs.
29 Country boat raft No. 3 ferries vehicles at Pihur Ferry. No. of trips—4.	1		One C.B. sank 1830.
30 Manning folding boat landing bays, both banks.	4	16	
31 Troop duckboard shore parties.	6	16	
32 Country boat raft shore parties.	8	16	
33 Folding boat for life-boat, transport of officers, etc.	5		
34 Camp Party put up tents and erect water-point, etc.	16		
35 Lieut. Hayes and party move from Gala to Ghazi.	14		
36 Lieut. Perceval and party move from Pihur to Ghazi.	49		
SPARE (including guards on rifles and horses).			
TOTAL.			

APPENDIX I

Serial.	13th February.	Sprs.	Cav.	0600 0700 0800 0900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100	Remarks
1	Lieut. Hayes and party move from Ghazi to Gala.	14		14 14	
2	Lieut. Perceval and party move from Ghazi to Pihur Ferry.	47		47	
3	Horses of 1st Regt., Bty. R.H.A. and Field Troop cross (610 horses).	10		10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10	Original plan was for horses of Bty. R.H.A. to cross at Pihur Ferry.
4	F.B.E. rafts Nos. 1 and 2 and duckboard raft cross vehicles.	15		15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15	
5	Country boat rafts (2) cross vehicles. No. of trips—each raft 20. Total 40.	2		2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	
6	Shore parties for F.B.E. raft, troop duckboard raft and country boat raft.	18	32	18 18 18 18 18 18 18 18 18 18 18 18 18 18 18 18 18 18 18 18 18	
7	Folding boat as life-boat.	5		5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	
8	Camp Party dismantles water-point tents, etc., and loads lorries.	17		17 17 17 17 17 17	
9	Camp Party moves from Ghaza to Topi.	17		17 17 17 17 17 17	
10	Lieut. Hayes and party move from Gala to Topi.	14		14 14	
11	Lieut. Perceval and party move from Pihur Ferry to Topi.	28		28	
12	Dismantle rafts, collect and sort stores, and load 3 lorries.	19		19 19 19 19 19	Estimated to take place on 14th Feb.
13	Ditto . . . Relief.	28		28 28 28 28 28 28 28 28	Estimated to take place on 14th Feb.
	SPARE.			19 19 63 15 13 13 13 13 30 30 30 30 30 30 30 30 30 30 30 30 13 23 9 9 63 63 52 61 61 61 61 61 61 52 52 52 52 52 52 52 52 52	
	TOTALS.			80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80	

REMARKS

"Estimates" shown ▬

"Actual" shown [2 2]

APPENDIX II.

Stores Available.

From Risalpur.

One set of "troop duckboards." These are similar to the tracks of the F.B.E. tracked raft, but are stronger. The short tracks are 12 ft. instead of 9 ft.

Sleepers and timber baulks as required.

Small stores, lashings, etc.

From Akora Bridging Camp.

One set of F.B.E. (7 boats).

Old pontoon superstructure with chesses for 65 ft. of bridge lashings, trestle legs and small stores as required.

From Akora, Jehangira, Attock and Hund.

Country boats of the type shown in Appendix IV. Fourteen were ordered, which were collected with difficulty. More would have been available except for the rivalry of the boat-owners. The *Malik* who failed to get the contract told his friends to refuse to hire their boats and did his best to make difficulties.

APPENDIX. III.

Rafts, Boats and Landing Bays.

I.—*Horse Boats at Gala.*

12th Feb.—4 boats. Total complement: 20 horses.
13th Feb.—5 boats. ,, ,, 24 ,,
1 boat for equipment on each day.

Horse Boats at Pihur Ferry.

12th Feb.—8 boats were used for horses or equipment as required. These were subsequently used for rafts.

II.—*Rafts for Vehicles at Pihur Ferry.*

No. 1—F.B.E. decked raft. Rowed by Sappers.
No. 2— ,, ,, ,, ,, ,, ,,
No. 3—Troop duckboards on country boats. Rowed by boatmen.
No. 4—Old pontoon superstructure on country boats. ,, ,, ,,
No. 5— ,, ,, ,, ,, ,, ,,
No. 6— ,, ,, ,, ,, ,, ,,

Raft No. 6 sank on the evening of 12th Feb. and took no further part in the crossing.

III.—*Landing Bays.*

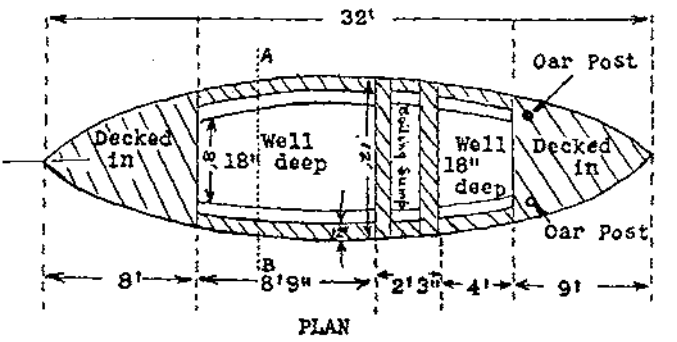
For rafts Nos. 1 and 2—F.B.E. half-floating bays.
For raft No. 3—*Nil.*
For rafts Nos. 4, 5 and 6—A lifting bay of old pontoon superstructure and Weldon trestle legs.

APPENDIX IV.

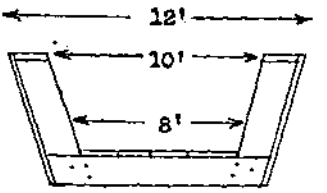
COUNTRY BOATS AND HORSE RAMPS.

Dimensions varied with individual boats.
The boats used for the rafts and the horse boats were similar.

COUNTRY BOATS

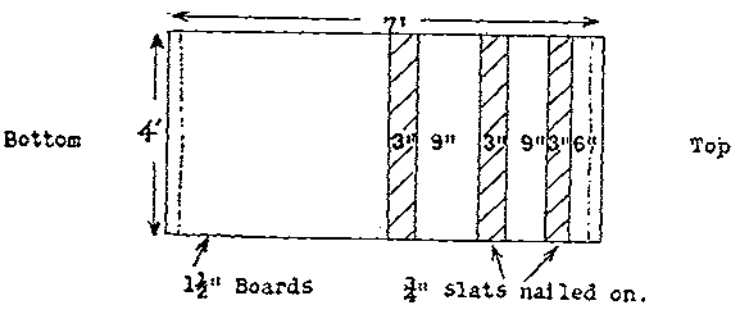


PLAN



SECTION ON A-B

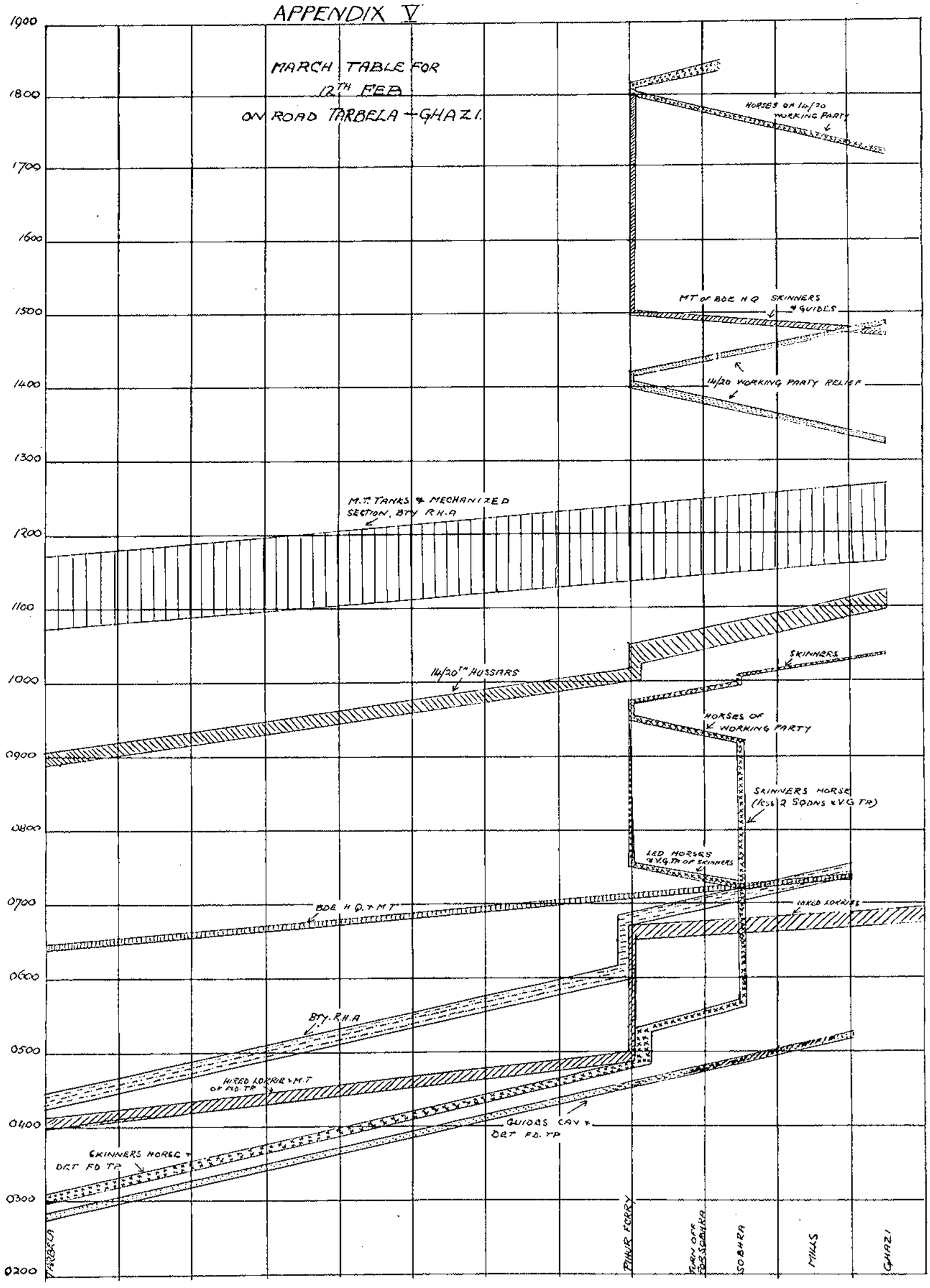
RAMPS



Notes.—Two ramps used for larger well, one for smaller well.
The large well held 4 horses, the small one 2 horses.
Some boats had one oar post on the central cross-pieces. These boats were unsuitable for horses, as the small well could not be used.

APPENDIX V

MARCH TABLE FOR 12TH FEB ON ROAD TARBELA – GHAZI.



APPENDIX VI.

Data of Sites.

	Gala.	*Pihur Ferry.*
Width of main stream ...	150 yd.	200 yd.
Rate of flow	3½ m.p.h.	1–2 m.p.h.
Left bank	A level sandy expanse with a short, steep, stony slope down to the water.	Stones and sand with a steep slope down from the road.
Right bank	Soft sand.	Soft sand.
Depth of water near banks	Deep water close to both banks.	Deep water close to both banks.
Subsidiary streams ...	One on left bank, 9″ deep. One on right bank, 3′ 6″ deep.	One on right bank, 1′ 6″ deep.

THE FUTURE OF SEARCHLIGHTS.

By MAJOR A. M. CAMERON, M.C., R.E.

INTRODUCTION.

THE present expansion of Anti-Aircraft Searchlight Units has caused a severe drain of personnel from other units of the Corps. In consequence of this, there has grown up a school of thought which advocates that the Corps should now cast out searchlights in the same way that it has cast out so many other children. The protagonists of this doctrine speak of the Corps being " swamped " by searchlights, which they feel is undesirable. It must, however, be remembered that at the present moment we are passing through a temporary phase, when the expansion of Anti-Aircraft Units is in advance of the corresponding intake of recruits. This will right itself in time and the establishment of Anti-Aircraft Units should then have little or no effect on the number of men available for other units.

The real basis for the doctrine appears to be contained in the following arguments :—

(*a*) Anti-Aircraft Searchlight Units require the services of a high proportion of our junior officers, but the experience which such an officer acquires in a Searchlight Unit is of little value to him in his future career as an R.E. officer. He can pick up his searchlight duties very quickly, after which he is largely repeating a drill.

(*b*) The training which N.C.O's receive in an Anti-Aircraft Searchlight Unit is of no use to them when they are posted to a Field Company and *vice versa*. With the establishment of Searchlight Units greatly in excess of that of Field Companies, the latter will suffer from a dearth of N.C.O's really experienced in Field Company work.

(*c*) If searchlight officers are correct when they argue that Anti-Aircraft Searchlight work is a whole-time job in which men should remain permanently, then why keep it in the Corps ?

It is the purpose of this article to suggest a few points on the other side of the picture. The question can be looked at from two points of view—that of the Corps and that of the Army as a whole. In the long run, the latter must carry most weight. But, as the arguments set out above are primarily from the Corps' point of view, it is proposed to deal with that outlook before passing on to the broader view.

The R.E. Point of View.

Are we prepared to surrender our motto "Ubique"?

It is logical to assume that all searchlights, whether Anti-Aircraft or Coast Defence, will belong to the same Corps. If we lose Anti-Aircraft Searchlights, we therefore lose Coast Defence Searchlights also. At present Fortress Companies are stationed at Hong Kong, Singapore, Ceylon, Mauritius, Aden, Malta, Gibraltar and Jamaica. The small amount of fieldworks which a Fortress Company may be called upon to execute in time of war would hardly justify the existence of a special Royal Engineer Unit for that purpose alone. If we lose all searchlights, it is reasonable to suppose that we shall lose all the above foreign stations; and the two Field Companies in Egypt will be the only Royal Engineer Units serving overseas. The disadvantages of this from the point of view of the men and from the point of view of the Corps are obvious.

Is it really a waste of an R.E. Officer's time to serve in an Anti-Aircraft Searchlight Unit?

Let it be admitted straightaway that he will not acquire so much engineering experience as he would in Works or even in a Field Company, but he will learn other things. He will learn how to maintain mechanical transport; he will gain a certain amount of electrical experience; but, above all, he will command a section of 64 men in fair weather and in foul, in barracks and in camp. Not many Field Company subalterns have ever really had their own section always up to strength, and always away from company headquarters when in camp for training; and some R.E. officers appear to pass through nearly the whole of their service before being posted to a unit. In an Anti-Aircraft Searchlight Unit every man has his own individual job to perform as a member of a team; companies must therefore be kept up to strength during the training season or they cannot carry out effective training. When the present expansion is completed, it should be possible for every officer to spend a few years in a Searchlight Unit and so learn to command men.

Is it undesirable to interchange non-commissioned officers between Searchlight Units and Field Companies?

Generally speaking, it is. The work of each unit is so different that an N.C.O. trained in one is of little value when first posted to the other. There are, however, two points in favour of interchange. In the first place, the Searchlight N.C.O. is, of necessity, left so much to his own devices that his character and initiative should be more highly developed than they would have been in a Field Company. In the second place, the Field Company N.C.O. acquires breadth of experience and a knowledge of fieldworks which is a definite asset when it comes to " digging-in " a semi-permanent searchlight layout. But, even if it is no longer possible to continue interchanging N.C.O's, it is not necessary to resort to the extreme measure of expelling searchlights from the Corps. A less drastic but equally effective remedy would be the establishment of a separate Corps roster for searchlight personnel; and the Field Companies would then be better off in some ways than they have been in the past, for they would not even have to interchange personnel with Fortress Units. Whether searchlights remain as a separate R.E. roster or are entirely divorced from the Corps is immaterial from the point of view of N.C.O's of other R.E. units.

THE ARMY POINT OF VIEW.

If we do cast off searchlights, what is to become of them?

There appear to be three possible answers to this question. One is that the Royal Air Force should take them over, but this could only happen if the Royal Air Force assumed responsibility for all ground Anti-Aircraft defences and that is a matter of policy outside the scope of this article.

The second possibility is that the Gunners should take them over, but it is doubtful if anything would be gained by this. The strength of the Royal Regiment is already in excess of that of the Corps; any argument that the searchlight expansion makes the Corps too unwieldy would therefore apply with even greater force to the Royal Artillery. There is even less resemblance between searchlight work and gunnery than there is between searchlights and other Royal Engineer work; the Gunners would therefore certainly have to maintain a separate roster. Anti-Aircraft Searchlights do not always work in conjunction with A.A. guns, but sometimes with fighter aircraft alone. The argument which appears most convincing in favour of the change is that closer co-ordination would be obtained between A.A. searchlights and A.A. guns; but actually such close co-ordination is not required in action. When it is decided to allot Anti-Aircraft troops to the protection of a certain place, the layout of

guns and lights is decided from the map by the two commanders in consultation or by their Anti-Aircraft Group Commander; but after that the paths of searchlights and guns diverge. It is the searchlights' primary business to illuminate all aircraft which come within range, and it is the Gunners' primary business to shoot at all aircraft they can see. Either arm can carry out its role adequately without any communications with the other arm, so that the degree of co-ordination required is nothing like as close as that required by Artillery and other arms in a ground battle. If a choice of aircraft presents itself to the searchlights, it is the Detachment Commanders who must decide which they will illuminate, and there is no reason to suppose that Gunner N.C.O's would make any better choice than do Sapper N.C.O's. It is difficult, therefore, to see what advantage the Army would gain by the transfer of searchlights from the Royal Engineers to the Royal Artillery.

The third possibility is the formation of a " Corps of Searchlights " —a Corps consisting of some eight regular and a number of territorial companies at home, with perhaps a depot and a school, and some twelve regular companies abroad. Will such a Corps be able to stand on its own feet? Will it attract officers and men of a sufficiently high standard to maintain the required degree of efficiency? Will its officers be qualified for any of the higher appointments in the Army, other than command of Air Defence formations? And, finally, what of the future? The justification for the formation of such a Corps is the large number of searchlights at present required for the defence of any one point, but this state of affairs may not last indefinitely. Science astounds us every day; some new invention—a form of " Death-Ray "—a super-searchlight, of which one will do the work done by 96 of our present pattern—may reduce the searchlight world to its previous small dimensions and abolish all grounds for a separate " Corps of Searchlights."

Has this searchlight child reached " years of discretion " ?

It has been our lot in the past to foster new ideas, to nurse them through the period of development and, when they have crystallized on definite lines, either to hand them over to some other branch of the Service or to set them on an independent footing. But it is questionable if searchlights have yet reached this stage of development. One aspect of the future of searchlights has been referred to in the previous paragraph; apart from this, the methods at present in use by searchlight companies for picking up aircraft are crude in the extreme; they depend on the human ear assisted by trumpets, the result being conveyed to the projector-controller by telephone. Sound travels slowly and it is obvious that if we are to deal effectively with aircraft travelling at 200 miles per hour at a height of 15,000 feet, some much better means of detection must be perfected.

This is only one of a number of problems which await solutions. So long as Anti-Aircraft Searchlights remain in this elementary state, we, the Engineers of the Army, are surely the most suitable Corps to promote their development.

CONCLUSION.

Briefly, the case is this.

Anti-Aircraft expansion is having an adverse effect on other units of the Corps, but this is a purely temporary phase. When it is over there will probably be a separate roster for searchlight personnel; other R.E. personnel will be in exactly the same position whether the searchlight roster is within or without the Corps. As regards officers, if they suffer "engineering stagnation" for the short period they serve in a searchlight unit, this is offset by the fact that every subaltern will have the opportunity of becoming a "leader." From the broader point of view, we are more suited than any other existing Corps to foster Anti-Aircraft Searchlight development, and the time has not yet come for the formation of a "Corps of Searchlights."

THE NORTHERN BRIGADE: KING'S AFRICAN RIFLES.

By CAPTAIN W. L. ROLLESTON, R.E.

IN January, 1930, the King's African Rifles in East Africa were reorganized from five independent battalions into two brigades, and a policy of gradual mechanization was adopted. The new establishment of the Northern Brigade (Kenya and Uganda) included some officers of the technical Corps, and by the middle of 1930 one subaltern each from the Royal Engineers, Royal Corps of Signals, Royal Tank Corps and Royal Army Service Corps, had been collected and were struggling to learn something of the language and the country. The writer was fortunate enough to be the R.E. representative in this reorganization.

It is proposed in this article to give a short account of the Northern Brigade and the country in which it works. The Southern Brigade (Tanganyika Territory and Nyasaland), which is very similar, and the Somaliland Camel Corps, which is entirely different, will not be described owing to lack of personal knowledge.

Before going into details of the organization and work of the Northern Brigade, a rough description of Kenya and Uganda may be of interest to those who have not seen the countries. A glance at a map of Africa shows that the two territories are right on the equator: consequently height above sea level is the deciding factor in climate, fertility and rainfall. It is roughly true that places above four thousand feet are pleasant for Europeans and those lower in height are not. The climate is hot and unhealthy in the low places, but remarkably pleasant in the highlands, where farmers live as high as nine thousand feet. At about six thousand feet it is cool enough to need fires in the evenings in the cold season, while the midday heat is never much above eighty degrees. Malaria is fairly common in the lower districts and even in the dry sandy northern areas, which is rather surprising. Blackwater, dysentery and typhoid are also still going, but are considerably less general than a few years ago. The white settlers keep very fit on the average, but those who can afford to go home every few years have a big advantage. Whether a country on the equator is really suitable as a permanent home for English people is still a debatable subject.

Uganda is almost all (except the western border) below four thousand feet, and consequently has few European settlers. There is, however, a large number of lakes and rivers, including the

biggest genuine lake in the world, and the evaporation from these produces plenty of rain and a fertile country.

Uganda is a Protectorate and is largely run through native administration under European supervision. It has a prosperous contented native population, while sound financial control has carried the country through the world depression with little hardship. The "Lugard" method of allotting responsibility to native chiefs with their councils of elders is being progressively extended to the less civilized districts with satisfactory results. The various missionary societies are well established and run schools, some quite advanced, in co-operation with the Government education officers.

The main commercial crop is cotton, and a proportion of Government revenue comes from a cotton excise duty, which is only imposed when the average price obtained for the annual crop exceeds a certain sum per pound. Indian traders do well and have small shops in all districts. The ginning of the cotton (preparing the raw product for export) is also entirely in Indian hands. The ginners are supervised by Government inspectors to prevent exploitation of the native; although Indians sometimes make large profits, their standard of living remains surprisingly low.

As indicated above, the climate is on the whole unhealthy for Europeans and malaria is prevalent. The terms of service for Government officials are attractive, with a pension after twenty years for those now serving (new entrants have to stay on till the age of fifty-five). Although the Uganda official has several advantages compared with his opposite number in Kenya, healthy stations are more general in the latter country.

Kenya is a land of contrasts, and far harder than Uganda to describe in general terms. The northern and eastern districts are barren, sandy and hot, with annual rainfall as low as three inches. The coastal belt is also hot, but damp, being very similar to other tropical places near the sea. Inland are the famous Kenya highlands, where much of the land is owned and farmed by Europeans. These highlands culminate in Mount Kenya, which is capped with snow all the year round, and where energetic enthusiasts occasionally try equatorial ski-ing.

The European community is vociferous and rather parochial in its outlook—possibly rather Irish also in the attitude of automatic opposition to everything concerned with the Government. The settlers frequently hold meetings, making violent and personal attacks on Government and its officials, but they possess the happy knack of keeping their politics for certain occasions, and are usually charming and hospitable to people who form the objects of their most severe criticisms. The development of the country and railway was largely financed by loans raised at Home, but the money had to be obtained on long-dated stocks at the high rates of interest,

five and six per cent. then prevailing. The early conversion to lower rates which has been possible elsewhere cannot be carried out, and the high interest charges form an admittedly heavy burden on a small community. On the other hand, the farmers do not pay a large proportion of direct taxation, which comes chiefly from natives and business firms. In spite of poverty publicity, there always seems to be plenty of money for amusements, and the peculiar situation was well expressed by a senior official who remarked on the cost of high living.

The Indian section is prosperous there as everywhere, providing most of the artisan class as well as the small traders. Unfortunately, much of their profit is sent straight back to India instead of being put again into general circulation. Goanese are also well established as clerks and hold down most of the clerical jobs in Government service and private firms. Agitation against their employment is considerable as they are normally Portuguese subjects, but they do their work well and cheaply.

The chief export crops are maize, coffee, sisal, tea and wheat. In spite of the recent general improvement in prices most farmers are still only clearing their running expenses and mortgage payments. The new discovery of gold near Lake Victoria has led to a great influx of capital, with consequent employment for natives and Europeans. It is hoped that the gold industry will eventually prove a big asset to Kenya. Fantastic profits were made in the early stages—one man recently sold two hundred pounds' worth of original shares in the Eldoret Mining Syndicate for forty thousand pounds.

The natives have both gained and suffered from the entry of large numbers of white men into their country. They have lost access to much good land, but can now earn fairly good wages and buy their food instead of chasing their wives into growing it for them. They have to pay about one month's wages annually in direct taxation alone. Security, medical and veterinary aid, and education are provided, but these are rather mixed blessings, as they have upset the balance of nature. Raiding, tribal wars, and sickness among children and animals used to provide against overpopulation. Nowadays, doctors and vets save their children and animals from disease, and the land is going back through overcultivation, while the increasing herds of stock are eating out the grazing (with the assistance of locusts) faster than it can recover. It is hard to see a remedy for these benefits of civilization!

This description gives a ridiculously incomplete picture of Kenya but many good books on the colony exist, notably *White Man's Country*, the life of Lord Delamere, who was easily the outstanding figure in Kenya's short, though interesting, history.

* * * * *

Turning now to the King's African Rifles, the Northern Brigade consists of Headquarters, three Battalions (3rd, 4th and 5th) and the Supply and Transport Corps. Some details of the establishments are given at the end of this article, and stations of units are as follows :—

Brigade Headquarters : Nairobi.
*3rd Bn. Meru, with one Coy. and M.G. Sec. at Wajir.
4th Bn. Bombo (Uganda) with one Coy. and M.G. Sec. at Lokitaung.
*5th Bn. Nairobi.
S. and T. Corps : H.Q. Nairobi. Main depots and workshops Meru and Kitale. First line transport lorries at all stations.

Brigade Headquarters include the Brigade Commander (a Colonel), his staff of three, and a number of clerks. The Staff Officer "G" is a seconded serving officer of the Army, while the Staff Quartermaster and Paymaster are permanent appointments.

The Signal Section is also part of Brigade Headquarters. It consists of a subaltern and two B.N.C.O's from the Royal Signals and approximately sixty African Ranks. This section operates nine wireless and four visual stations in normal use. It also has a mobile wireless set and visual group, which are at present at Wajir with the 3rd Battalion. The wireless stations are run entirely by a detachment of three natives who deal with a fair volume of message traffic. They also carry out minor maintenance and repairs, such as valve replacements, charging of L.T. batteries, testing and changing units of the H.T. battery. All stations work on a common wave-length, and a system of coarse tuning is adopted to avoid "searching" on the receiving side. The operators are not supposed to know any English and consequently do not indulge in guessing when receiving. As messages are audible at most stations and the civil administration also make use of the military wireless, outstation commanders usually have everything that is on the air recorded in a gossip book, which, though illegal, provides an amusing substitute for the daily paper of civilization. Important events such as the Grand National result or the approach of inspecting officers are also broadcast.

The two British wireless mechanics live at the supply bases (Kitale and Meru), which are also the main wireless stations where the change over to Post Office telegraph line is effected. They carry out regular overhauls and make repairs when necessary, going up country by supply convoys or special lorry in cases of urgency. For those interested in these things the sets used are Marconi X.M.C.II with the radio telephony part removed.

The visual groups use helio by day and lamp by night. There

* The 3rd and 5th Battalions have recently changed stations.

are usually two operators with an infantry section in a wired-in blockhouse. In the clear desert air, legs up to about seventy miles are successfully worked by ten-inch helio. Traffic is occasionally interrupted by the use of these magnificent mirrors for a luxurious shave by an officer on patrol.

Battalions of infantry at peace establishment are small units, with only twelve British Officers, one British Warrant Officer and approximately four hundred African Ranks. Battalions are so organized as to admit of rapid expansion on mobilization. There is only one Lewis gun per platoon in a rifle company, and the M.G. platoon has four Vickers guns. The apparent shortage of automatic weapons is partly due to the very open type of warfare expected and also to the difficulties of replenishing S.A.A.

A battalion is commanded by a major, and there are three Company Commanders. The Battalion Second-in-Command is O.C. the Headquarter Company. Bn. H.Q. consist of the C.O. and Adjutant (a subaltern who is also Bn. Quartermaster), two R.S.M's—British and Native—and two Goanese or Indian clerks. Each battalion has its own Drums under the Adjutant and the 4th and 5th also have Bands, with a British Bandmaster, in view of their many ceremonial duties. In war the drummers become runners and the bandsmen stretcher-bearers. Battalions enlist their own recruits independently in batches up to fifty strong, so a recruit depot is usually in action run by a subaltern in the Headquarter Company.

Subalterns are seldom available in peace-time as platoon commanders on account of the low establishment of officers and the requirements of special jobs, leave, sickness, etc. Rifle companies are often reduced to one officer. The African serjeant makes a good platoon commander in peace training, and some of them—particularly Somali and Sudanese tribesmen—become very adequate tacticians. The policy at present is that platoons must be commanded by British officers in war, or at any rate at the beginning of a war, when units are brought up to war establishment. Mainly for this purpose a Reserve of Officers K.A.R. is in being, consisting of volunteers from the settlers and business men of Kenya and Uganda. One month's training in every two years is obligatory, and, during training, pay and some allowances are drawn. As seems to happen everywhere, there is no lack of young men who are willing to give up their year's holiday (and sometimes to mortgage the next also) for training. It is difficult, in spite of their enthusiasm and hard work, to become an efficient platoon leader in one month from a foundation of Certificate A or even less knowledge. The large expansion which would take place in the event of a major war, is another matter, and the K.A.R. are fortunate in having so many ex-soldiers farming in Kenya. The difficulty in this case is likely to be one of *embarras des richesses*, as there are great

numbers of fire-eating officers of the rank of major and upwards, while there were only twenty-two battalions of K.A.R. in 1918!

The K.A.R. are also fortunate in that military service is popular with almost all tribes. A full private is a person of some consequence in his village and recruiting officers can pick the very best. In a recent instance there were eight hundred applicants from one tribe (the Nandi) for thirty vacancies. A recruiting officer usually sets off to a chosen district with the native R.S.M. and one N.C.O. of the tribe. He then chooses the men he wants, with the help of the District Officers and local chiefs. The recruits have to pass a rigorous medical examination and are then taken to battalion headquarters for training. Terms of service are six years with the colours and six with the reserve. Re-engagement for three-yearly periods is allowed for about fifty per cent., and full gratuity is earned after eighteen years' colour service. Three months' leave with free travelling to their homes is given after each period of three years. A C.O. can discharge a man as "unlikely to make an efficient soldier" at any time during the first two years' service, so the final product is definitely the best available.

Recruit training lasts six to eight months and those who pass off the square are then drafted to companies. General development as a soldier is comparatively slow; the good men usually get their chance as Unpaid Lance-Corporal between the fourth and sixth years of service.

Pay is good, as a trained soldier gets twenty-eight shillings monthly with free food and clothing, rising to sixty shillings for a serjeant and one hundred and twenty shillings for a R.S.M. Good conduct and proficiency pay for first-class shots is also available, while specialists such as M.T. drivers, Signallers, or M.G. range takers, are on higher rates. The standard of marksmanship with the various weapons is good and bears comparison with British Army standards. The African possesses remarkable powers of sight.

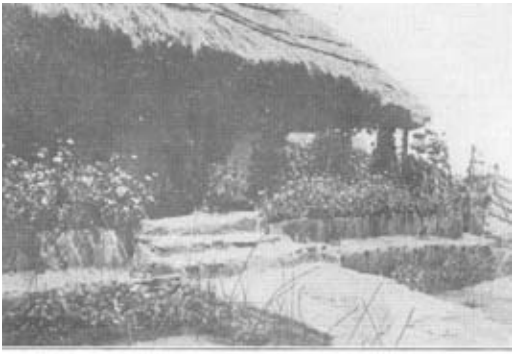
The Supply and Transport unit, although using the impressive title of "Corps," is in reality about the size of a R.A.S.C. company. Commanded by a major, it consists of five officers, seven staff-serjeant mechanics and about one hundred and twenty native ranks. Only two of the subalterns are seconded from the R.A.S.C., the remaining British ranks being locally engaged and permanent. The second-in-command, though recently made a captain in the K.A.R., has just been promoted to the rank of commander in the Royal Naval Reserve, thereby introducing some tricky problems of precedence!

The native drivers are chosen from men in battalions of about six years' service. There are plenty of candidates for selection, as pay is comparatively high; also they are sure of employment as

1.—Fully dressed Karamojong (Uganda) tribesmen.

2.—On patrol near the Kenya-Sudan border.

3.—Typical country near Lake Rudolf.



4.—Officer's house, Moroto (N.E. Uganda).

5.—Starting the Moroto Pass cutting.

drivers when they return to civil life. They go through a training school at Meru, the course lasting about six months, and are then fit to drive lorries in convoy. Some of them develop into remarkably good and resourceful mechanics, and they have a fine *esprit de corps*, which makes a tow home a disgrace to be avoided at all costs. Two typical instances are given. Serjeant Bulassio's lorry ran a big end when about two hundred miles away from his base repair shops. He shot a *kongoni* (which has an unusually tough hide), lined the bearing with a strip of hide, and by careful driving got home without damaging the engine at all. The other case concerned the writer's Chevrolet car, which got caught in a sand river-bed and was submerged by the river, which chose that moment to come down in flood. The water subsided after thirty-six hours, but the car had sunk down also, and only the top of the hood was visible above the sand surface. It was eventually dug out, and after two more days' hand-towing was delivered to Corporal Ibrahim at our small post, which had, of course, no workshops or spares. Thinking of insurance, and displeased at the abrupt ending to a fortnight's local leave, the owner did not much care what he did to it and said so. As the rains had definitely broken there was no chance of getting other assistance or spares, such as gaskets, for three months, so a total write-off seemed probable. Ibrahim, however, dismantled everything down to the bare chassis, removed the fine sand that filled all possible and impossible places, and the car ran for eight months without further attention.

The East African soldier wears much the same kit as his British equivalent, but a useful tool called a *panga* (matchete) is carried by all native ranks, while the gas mask is not used. The *panga* is a long, broad-bladed knife, rather like a meat chopper. It is used for all odd jobs from digging and cutting bush to opening tins.

Boots are a privilege of warrant rank, and serjeants downwards have sandals made of hide or old motor tyres. To preserve the natural hardness of their feet, sandals are only allowed when out on patrol or field training, so all parades such as musketry, ceremonial, or fatigues, are in bare feet. All native ranks have to shave the whole of their heads for reasons of smartness and hygiene. A row of shining bald pates with red tarbushes perched on the top looks remarkably smart, though strange to a new-comer. Razors have recently been introduced as a free issue of kit, but only a few years ago a ration of broken glass was solemnly given out for shaving. In marching order ordinary web equipment is worn, but a second haversack takes the place of the pack on the shoulders. This is big enough to carry the spare clothing needed, and great-coats are always with the transport. Their natural fitness and ability to march long distances without undue fatigue make small units very mobile. Although the British officer carries the minimum of kit

himself, it is hard work moving with the K.A.R. when they are in a hurry. On the march, open or single file is the normal formation, no attempt being made to keep step except on main roads. A steady pace of four miles an hour is normal, with a halt of fifteen to twenty minutes after about three hours. To avoid the midday heat an average day's march of twenty to twenty-five miles starts at five a.m., when it is just beginning to get light, or earlier if the moon is good. If necessary an evening march from about 3.30 p.m. to 6.30 p.m. is sometimes added, but this interferes with cooking of the troops' evening food, which forms their main meal of the day. Incidentally, the sun rises and sets within a few minutes of six o'clock all the year round in Kenya and Uganda.

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Although personal experiences are boring, a few persistent readers may like to know what happened to a solitary sapper in his six years with the infantry. On arrival in 1930 the writer was posted, together with the other technicians, to the Supply and Transport Corps, but finance prevented the formation of the small engineer unit which had been hoped for, and no permanent personnel could be enlisted. Working in various battalion areas entailed posting to any suitable unit; finally an exalted position on the Brigade Staff was reached, with an interesting collection of hat badges.

All engineer work was either carried out by infantry units with sapper advice—very little advice was needed in most cases—or by direct labour engaged as required. Regulations for work with direct labour were non-existent, as P.W.D. rules could not be made to apply without setting up an office, which would have been uneconomical. Consequently, when an estimate for a job had been approved by the Brigade Commander, the money was allotted, and except for normal accounting in monthly statements of expenditure, no restrictions were imposed. Most of the work was concerned with construction and maintenance of patrol roads in the Northern Districts.

The performance and reliability of the modern lorry are so good, that the tendency to spend money on continual improvement of the type of road they are to use seems rather illogical. This is particularly noticeable in the case of patrol or first line lorries. A great proportion of their working life is spent in garages or in a restricted training area, and running and maintenance may total less than overheads and depreciation in a genuine ton-mileage costing. In the case of the Northern Brigade K.A.R., money for road work was scarce, and the policy adopted was to make many miles of bad roads, rather than few miles of good. We certainly succeeded in making them bad enough.

Infantry platoons used to set out in their patrol lorries along

approved routes, making a rough track as they went. When a slightly better road was needed, local labour was taken on, and the original track improved at a cost of about eight to ten pounds per mile.

The biggest task was the construction of the Moroto Pass, where a patrol road had to be made down an escarpment with a drop of twelve hundred feet in two miles. The escarpment is subject to heavy thunder-storms, so side cutting was reduced to a minimum to avoid the wash-outs, which were continually occurring on a P.W.D. road forty miles away down the same escarpment. By using a ridge running out into the lower plain the line could be taken half-way up without much difficulty, and the upper section, although full of bad curves and steep gradients, could be made reasonably secure from wash-aways with a moderate amount of blasting. Unfortunately, the ridge was separated from the upper valley by a steep cliff of about one hundred feet.

Two months were spent in working along the escarpment searching for a better line, but all the trial surveys were disappointing, and it was eventually decided to use the friendly ridge by cutting straight through the cliff. Climbing and braking tests on the six-wheeled lorries were carried out by the S. and T. Corps, and, following the policy of making full use of the performance of a lorry, a ruling gradient of 1 in 6 was allowed with 1 in 5 for not more than two hundred feet. By building up along the ridge and introducing yet another bad corner in the cutting, the greatest depth of cut was reduced to 42 feet; the line ran out into the open at the top of the cliff after 950 feet.

The total length of road was fifty miles, and £3,600 was eventually allotted with the proviso that no more money could be produced. The capability of entirely unskilled naked savages in road work was doubtful, as was the type of rock to be expected in the cutting, and a confident attitude was difficult to maintain. In the end the rock turned out much harder than expected, but so did the native muscles, and the road was completed to time with a small saving in cost.

An old German foreman, who had been a D.C. in Tanganyika, was engaged, and sixteen natives with P.W.D. experience were also taken on for drilling and other difficult jobs. The unskilled labour varied from month to month, as none of them would work for more than two months, while many got tired even sooner. The average strength was about two hundred.

Hand drilling was used throughout to avoid risk of stoppages with mechanical plant (we were entirely cut off from repair shops in the rainy months). A pair of drillers had a daily task of twelve feet, usually in either three- or four-foot holes. A forge was continually in action for sharpening drills, as a fairly soft point was found effective. Black powder was the explosive in small charges of just over half a pound (one and a half cigarette tins!). This

seemed to give about the right breaking-up effect for easy removal of the debris. Charges were fired by safety fuse without caps of any kind, and we had remarkably few failures in the twelve tons expended. Every evening about sixty charges were ready prepared. A small piece of gelignite on the end of a stick provided a torch, and up to fifteen fuses could be lit in one batch. Towards the end of the work safety fuse ran short, and with shallow holes, some rapid moving was needed to get clear before the first lot of rock started coming down. The few charges that failed to go off were damped down with water for removal the following day. There was one serious accident which resulted in the amputation of a driller's hand. A pair, "drilling dry" against orders, cut through a fissure in the rock which contained a few grains of powder blown laterally by an old charge. The man holding the drill had his right hand over the hole.

One disappointing fact which upset calculations was that after a series of three-foot holes had been blown, with apparently correct spacing, the average gain shown by a run of levels seldom exceeded 1 ft. 3 ins. Reducing the space between holes seemed to have no effect on this peculiarity. A flat surface before and after was, of course, impossible, but the average over several months remained persistently round about one foot, though individual holes broke out to their full depth.

The road was completed in ten months, and though the surface was only of ant-hill earth and stones, proved passable for the fully loaded patrol lorries for which it was intended. It was noticeable, however, that most users of the road felt the need for pedestrian exercise during the negotiation of the actual pass!

Other engineer work, besides road construction and improvement, included the making of special lorry bodies, for which a small workshop was started. Plane table amendment of local one-inch maps for training purposes was also done, though only in a small way.

When there was no money available for engineer duties, the writer was posted to a battalion, and was fortunate enough to act as a company commander for a year.

* * * * *

Kenya is perhaps the best country for big game shooting in the world, and officers in the K.A.R. get ample opportunities if they are keen on the sport. The annual licence for a resident is only £7 10s. 0d.; this covers everything except elephant and rhino. With luck the extra cost of an elephant licence (£25) is covered by the value of the ivory. Occasionally the Game Department allow free elephant shooting when particular herds become too destructive, but the ivory in these cases usually becomes Government property. Lion, leopard and buffalo are numerous in places, while

plenty of good heads such as kudu, eland, impala, waterbuck, and the smaller gazelles can be found. The modern fashion is to use the camera rather than the rifle, and there is certainly plenty of excitement and danger in taking close pictures without a telescopic lens. A number of officers from India are coming over to Kenya for their short leave; many of them have had successful *safaris*. Bird shooting is not particularly good except for sand grouse, which come to water at dusk, and provide some fast and difficult minutes. Guinea fowl, bustard and francolin are fairly plentiful in some areas for walking up, and they all provide good eating.

There is plenty of fishing for brown and rainbow trout which sometimes run up to five or six pounds. Unfortunately, Meru and Nairobi are the only K.A.R. stations within easy reach of fishing streams.

Most ordinary games are played at the civilized stations, but only one of the outstations has a squash court, and the life when not on patrol is apt to become rather dull. Cheap polo can be had at Nairobi and Meru. Both kinds of football, hockey, tennis, golf and cricket are sometimes all being played on the same afternoon.

* * * * *

It is a remarkably interesting and varied experience to serve with the K.A.R., and the African native with his keenness and permanent sense of humour is a pleasant individual to work with. The terms of service for seconded officers are good, though not quite so generous as on the West Coast where the climate is worse. Subalterns get £500 a year, with less than seven years' seniority, rising to £550 afterwards. Company commanders get £700, and battalion commanders £900. The pay is inclusive; no allowances are given, except of course free travelling when on duty. After two and a half years, six months' leave at home with free passages is allowed. A second tour of service is optional, but only six years at a time away from one's British Regiment is permitted. Subalterns can do themselves fairly well on the pay, but living is expensive enough to make saving difficult. Company commanders and higher ranks are (or should be) definitely well off.

There is always the prospect of a small "battle" on the frontier in repelling tribal raiders, and if Abyssinia becomes disorganized it is possible that these raids may for a time increase. In the past there has not been much opposition when the K.A.R. have been lucky enough to intercept raiders. The Abyssinians and neighbouring Sudanese tribes, notably the Merille, are stout-hearted, but have suffered from the difficulty of fitting assorted ammunition into rifles of different calibre. They have also been known to saw off the backsights to make their rifles comfortable to carry. More sophisticated methods are probable in the future.

* * * * *

PEACE ESTABLISHMENT—KING'S AFRICAN RIFLES BATTALION.

	Battalion Headquarters.	*2 Rifle Companies.*	*M.G. Platoon.*	*Mortar Section.*	*Depot.*	*Total.*
BRITISH RANKS.						
Officers	3	8	1	–	–	12
Warrant Officers ...	1	–	–	–	–	1
AFRICAN RANKS.						
Warrant Officers ...	1	2	–	–	–	3
Drum-Major	1	–	–	–	–	1
Provost Serjeant ...	1	–	–	–	–	1
Serjeants...	–	16	2	1	1	20
Corporals	–	16	2	1	1	20
L/Corporals	–	16	1	1	1	19
Privates	–	194	24	8	–	226
Batmen	3	8	1	–	–	12
Storemen	2	2	1	–	–	5
Police	6	–	–	–	–	6
Recruits	–	–	–	–	30	30
Buglers	8	–	–	–	–	8
Bugle Boys	12	–	–	–	–	12
Gun Porters	–	16	8	–	–	24
Medical Orderlies ...	4	–	–	–	–	4
African Clerks	2	2	–	–	–	4
Total ...	44	280	40	11	33	408

PEACE ESTABLISHMENT SUPPLY AND TRANSPORT CORPS, K.A.R.

Rank	*European.*	*Asian.*	*Native.*	*Total.*
Major	1	—	—	1
Captain	1	—	—	1
Subalterns	3	—	—	3
Mechanist Serjt.-Major	1	—	—	1
Staff-Serjt. Mechanics	6	—	—	6
Transport Serjt.-Major	—	—	1	1
Sjts.	—	—	4	4
Cpls.	—	—	7	7
L/Cpls.	—	—	11	11
Drivers	—	—	64	64
Batmen	—	—	5	5
Storemen	—	—	28	28
Med. Ord.	—	—	1	1
Clerks & Artisans ...	1	11	—	12
	13	11	121	145

Finally, the peculiar attraction of Equatorial Africa has to be experienced to be understood. It is impossible to analyse, but it brings soldiers and civilians back again to both East and West coasts, often against their better judgment. Major Duff has painted an attractive picture of life on the West Coast in the March, 1936, number of *The R.E. Journal.* Kenya and Uganda are at least as pleasant, and no one who goes to the K.A.R. is likely to regret his choice.

MOUNTED SAPPERS IN THE NEAR EAST, 1916–19.

By LIEUT.-COLONEL F. E. FOWLE, M.C., R.E.

PART I.

IN these days of the decline and fall of the horse, an account of three years' experience with Mounted Sappers in the Great War may be of some interest. It is not the purpose of this article to join in the controversy over the future possibilities of cavalry, or even the smaller one of the proportion of mounted men in a field squadron, but it is an almost established fact that none of the major operations of the formations to which we belonged could have been carried out by mechanized units; the flank march of the 7th Brigade from the Doiran front to the Struma when the Bulgar came over the frontier would have been impossible to anything heavier than a G.S. wagon; the march round to the east of Beersheba, and the hurried dash to meet the Turkish counter-attack in the Judean Hills, in 1917, would have been equally impossible, the former from heavy sand and the difficulty of petrol supply, and the latter owing to the narrowness of the mountain tracks. Finally, it is more than doubtful if a mechanized force could have beaten the 5th Cavalry Division's 65 miles in 22 hours on the 19th of September, 1918, when for a mile or more even the horses had to go in single file between the rocks; whether a mechanized force could have been kept supplied in a roadless country, 450 miles from railhead, is a question which can be left to the specialist; we can only say that horses entirely and men very largely had to live on the country, and got exceedingly hungry in the process.

In so long a period, the variety of tasks which fell to be carried out must necessarily have been considerable, ranging from the rescue of the Divisional Commander's thumb from the breech of an automatic pistol in which he had incautiously shut it (carried out at great personal risk by the commanding officer) to shock-action against the enemy. Equipment also varied considerably, ranging from partial (very partial) mechanization, through wheels and pack to the time when we were hopping about among the thistles of Mudros in bare feet, with everything we possessed at the bottom of the Mediterranean.

Experience started in May, 1916, in Macedonia, when the writer was directed to proceed to Salonica to raise the 8th Field Troop for service with the 7th Mounted Brigade.

For the first two days the Troop consisted of one officer, one horse, one groom, and a G.1098. It cannot have fallen to the lot of many to start every file, ledger and indent in a unit from zero; nor is it easily credible how rapidly they became as involved and erroneous as any other set. A pearl among quartermaster-serjeants (in private life a draughtsman of high degree in Birmingham, with a bald head which was a shining beacon when he led the Troop scrum later on) arrived next day; with a pile of new indent books and an empty ledger, he must have lived the dream of all good quartermaster-serjeants, and he was rewarded by living his dream all over again a year later, after we had been torpedoed.

During the next few days, soldiers innumerable arrived from every Sapper unit in the Force, all nicely equipped with mess-tins, but no one so far had thought of supplying us with "kettles, camp, oval," or "knives butchers," or any helpful things like that. Ordnance placidly declined to issue anything unless we came and fetched it, while remounts equally declined to issue any horses unless we brought our own head-collars, which we could only get from Ordnance if we had the horses. Kind friends, as usual, pulled us out of a difficulty which for some unexplained reason could not be solved by the ordinary method of indenting for transport, and, the head-collars having once been obtained, the Troop began to grow like the house that Jack built.

Only a month was allowed us to shake down, and weld our miscellaneous collection into a unit, and it speaks volumes for the enthusiasm of all ranks that at the end of that time we were able to march 40 miles in two days and arrive complete (in spite of having taken a short cut *en route* and lost ourselves for three hours). If burnished steelwork were next to godliness, we did not score many marks, but we became more godly as time went on.

The only outstanding event of the month was a Zepp raid over Salonica, which ended in the Zepp being shot down in flames. The three officers of the Troop, who shared a hut, were each resolved to show the other two that they were much too accustomed to bombs and things to pay any attention to a few noises off, and in consequence were the only three officers in Salonica who did not see the Zepp crash. A careful reconnaissance of all the Gunner batteries in the area the next morning failed to discover a single officer who did not own the gun which fired the fatal shot; the heaviest claimant was a Monitor armed only with a nine point two.

A quiet month near Lake Doiran followed; the enemy were beyond the Greek frontier, and we were able to some extent to carry on with our training. The discovery that edible frogs inhabited the local ponds and streams, and could be captured by casting to them with a fly rod (or any other form of rod), caused great activity among those addicted to fishing or frogs; we all ate them, but our M.O.

held the record with 25 brace consumed at one sitting. A little mild poker helped to pass the evenings—mild, that is, from the standpoint of Johannesburg or Buenos Aires, whence the two subalterns hailed, but £38 once changed hands on one deal of a quiet three-handed game (fortunately in the right direction).

This idyll was rudely interrupted by the incursion of the Bulgar to Demir Hissar in the Struma valley, and a hurried move across the mountains followed; a nightmare march, taking two nights and most of the intervening day to cover the first 30 miles, limbered wagons requiring eight or ten horses to get them up some of the mile-long hills. At about midnight on the second night, the edge of the road suddenly gave way, and let a loaded double tool-cart over a 15-foot drop; the tool-cart following shied at the mess and joined it. By some miracle of "quick-releasing" no horses or men were hurt, but a pleasant three hours was spent by all unloading every single thing out of those carts and hauling them up again, helped on by the friendly comments of the rest of the Brigade passing by; it happened to be the commanding officer's birthday.

We arrived in the Struma valley three officers and 72 men; we left it, three weeks later, after no war calling for any comment, two officers and 18 men. Nobody knew, or at any rate thought of telling us, that all the streams in the valley were crawling with anopheles mosquitoes, and as there was nice shade along all the streams, and it was very hot, we naturally went and camped there. With great difficulty a weak composite regiment was formed from the Brigade, one squadron from each regiment, and the rest of us took the horses back in relays to a more convenient point for supplies; 10 miles a day meant a 30-mile march for every man. There for a fortnight the remnants of the Brigade converted itself into a remount depot; all watering and stable parades, and exercise, were carried out under the Brigade orderly officer, and all officers below field rank "fell in" in the ranks for duty.

When we returned to the war, the Bulgar had advanced his front to the line of the Struma, and for the next month we were engaged in a series of raids across the river preparatory to the general attack.

The Brigade took part in four of these raids, and the Troop ferried them across on rafts running on cables, at first the familiar "tarpaulin stuffed with straw," and later tarpaulins over collapsible timber frames. After the first two or three raids the Bulgar realized that the raiding parties would retire back over the river at dusk, and very sensibly withdrew his line as soon as we appeared, to avoid trouble; this may well have been the big idea at the back of the raids, for when the general attack came off we were able to cross the river without opposition.

At a Christmas dinner shortly afterwards somebody sang an alphabet song about the Salonica Army ; one couplet ran :

> " N is the Navy, that floats on the Struma,
> Tarpaulins, straw rafts, and a vast sense of humour."

Getting the rafts across the first time was an interesting and exciting, though, as it turned out, harmless enterprise. The Bulgar was known to have posts down on the bank, and careful reconnaissance hoped to have discovered a place where he wasn't ; the river was about 75 yards wide, with thick bush on the far bank, and the problem was to get four cables across during the night ready for the crossing at dawn. The first attempt to get a line over was made in the conventional water-trough boat, carefully painted a nice neutral grey ; when, about ten yards from the bank, we stuck fast on a sunken barbed-wire fence, it became a matter for regret that the Yeomanry officer who had insisted on forming the second member of the crew was wearing a pair of palest cream polo breeches. You can imagine the scene ; in front, the dark sinister line of the enemy shore, concealing who knew what of lurking Bulgars ; beneath, the dark waters of the river, gurgling cheerfully through the holes in the boat ; behind, the ribald soldiery of the covering party, declining *in toto* to take the matter in that serious spirit which was so desirable ; and, gleaming in the moonlight, and visible, one felt, for miles, that shining pair of breeches.

This attempt having ignominiously failed, volunteers were called for to swim over with a line, a feat calling for no mean courage with the imminent prospect of finding a Bulgar patrol on the other side. Six volunteers from the Troop were, however, immediately forthcoming, and Driver Armstrong, primed with the most urgent instructions to swim softly and be as quiet as a mouse, started off towing a light line behind him. He made the crossing in safety, and started gently hauling over the main cable. Suddenly the silence of the night was shattered by a fearful oath from Armstrong, followed by a bellow to the effect that he was coming back to get a —— rope that —— well wouldn't break, and a terrific splashing as he " crawled " back to express himself at greater length on the subject of the Sappers who had supplied him with a line which broke. Nothing under an inch and a half would satisfy him for his second venture (he wouldn't hear of anyone else taking it on) and how he crossed 75 yards in that current with an inch-and-a-half rope behind him passes comprehension. For this very gallant effort he was recommended for an award, but had to be content with a Mention. It was the irony of Fate that, just over a year later, having survived being torpedoed, he was drowned while bathing off the beach near Gaza.

The subsequent ferrying over of the Brigade (dismounted, of

course), and the other crossings later on, do not call for any comment, except the imperative necessity, in any bridging operation, of having a vigilant maintenance party on each bank. On one occasion, while a raid was in progress, the river rose six feet, increasing the width of the crossing by about 15 yards ; at a late hour that night we were called out to go and rescue two squadrons of Chasseurs d'Afrique, who had crossed on our right, and whose bridges had carried away, leaving them marooned on the enemy bank. It was most unfortunate that we were beaten to it by a stray Field Company who had also had the alarm, as their C.O. and three other members received the *Croix de Guerre* from our grateful allies.

It is also necessary to attach a raft firmly to the cable, even though this may cause a little delay ; on the only occasion on which a loaded raft came under fire, this had not been done and, the ferrymen letting go of the cable in the excitement, the raft drifted helplessly downstream, to the considerable discomfort of all concerned.

The general attack resulted in a line being established about five miles from the river, with an open flank which was patrolled by two regiments from the Brigade. The remainder established a permanent camp on the south side of the river, while we kept a half-troop as a rule with each. This situation, with minor alarms and excursions, and varied by repeated attempts to establish a bridge in the shifting sands of the torrent which ran through the camp, lasted till the following spring.

One important event took place as soon as the situation had become normal after the attack, and that was the reorganization of the Troop on a completely pack-transport basis. We marched back the 60 miles to Salonica, handed in all our wheels, and drew 27 of the best (and most cussed) mules I ever saw. With only one man who had ever seen a pack animal before, we spent a pleasant ten days endeavouring to fit our equipment into loads which the mules would condescend to carry. Succeeding admirably in this, we started off in triumph to rejoin the Brigade ; all 27 mules had their loads off in the first half-mile, some of them twice. It was very pleasant, though, next day, to jingle past a former Company Commander at the Shop, who was endeavouring to persuade eight indolent heavy draught-horses to pull a 60-pounder up one of the hills we had struggled up four months earlier.

The soldiers, after a few pointed remarks about donkey-boys, became really attached to their mules, and we very soon reached a very high level of efficiency ; our standard time for watering on the march, including off-loading all loads and reloading, was 20 minutes. The officers' mess, though, was a problem ; only one mule was allowed for the kits of three officers *and* the mess. A wild roach-backed chestnut was selected, and we proceeded merrily, but noticing some weeks later that he was looking a bit hollow in the back

after a longish march, we had the curiosity to weigh his load ; it came out at 351 lbs.

The winter was an unpleasant time ; more often than not we were enjoying a snow blizzard, and at the best snow was always lying on the foothills just above the camp. Only single-fly tents were available, but a providential gift of a large quantity of corrugated iron enabled us to rig up some form of shelter for ourselves and others. Firewood abounded, but the most stringent orders were in force against cutting down trees on any account. This order did not, however, specifically refer to digging up trees, nor, which was even easier, to digging up vines ; vinewood burns most excellently.

The men, too, were rotten with malaria, and a malaria subject (it was very difficult to make the men go sick) on the night of a blizzard had a poor time.

Our chief relaxation was duck-shooting, or, to be more accurate, shooting at duck. Cartridges could be bought in Salonica for about tenpence apiece ; when you pulled the trigger, a hissing noise arose, sometimes louder than at others, after which you lowered the piece to allow those shot which had failed to reach the muzzle to fall out ; occasionally, when the hissing noise was unusually loud, a duck several yards behind the one you were aiming at would come down. Duck and geese there were literally by the million, partridge, snipe and woodcock abounded, only cartridges (and the opportunity) were lacking ; the evening flight of cock from the foothills down to the marshes was a sight to make one dream.

Rations during the winter were also a difficult problem ; the road from Salonica, built through the mountains by the Greeks in the usual Levantine way, failed completely under the stress of the supply columns of three Divisions ; by the most superhuman efforts a road-head was maintained about 25 miles behind us, whence one stage was worked by the pooled wheels of the Divisions, and the final one by pack. Thus our mules had a 12-mile march each way over mountain tracks every day ; luckily there was unlimited grain to be had for the taking from the abandoned granaries of the evacuated inhabitants, and, with as much food as they could eat and 24 miles a day to help it down, the mules were a picture which we thought of sadly in the days around Jerusalem a year later.

The spring of 1917 saw a great recrudescence of military activity. The big idea was to be a sudden mass-attack in the widest part of the Struma Plain, with the object of making a gap through which our Brigade was to pass, and then gallop wildly about charging as many enemy batteries as they could find, accompanied by the Sappers with pockets full of guncotton and detonators to destroy the captured guns. We spent some pleasant days in the mountains overlooking the scene of the attack, spotting enemy batteries through telescopes and making plans accordingly, but it was perhaps as well

for the health of all concerned that the affair was called off at the last moment, when we were actually saddled up waiting orders to move off. By that time we had become pretty well accustomed to having orders cancelled before we could carry them out, but on this particular occasion we got the cancellation before we got the orders themselves.

Just as preparations were in hand for a revised version of the big idea, orders came in for an immediate move to Salonica for embarkation to Egypt. An uneventful three nights' march (in the course of which the stationery box, with all the records, came adrift and disappeared over a precipice in the dark) was followed by immediate embarkation, the Troop going in the *Cestrian*, together with the Sherwood Rangers, the Field Ambulance, and a Company of, I think, the 16th London Regiment. The same afternoon we moved out into the bay and did a very thorough and very providential spell of alarm drill.

The sun was setting as we finished evening stables, the ship's bar was most adequately stocked, we had none of us seen crushed ice for more than a year, and the barman was an ex-trooper of the Sherwood Rangers. . . .

Nine o'clock next morning found the ship sailing over a sunlit and almost calm sea, and all the officers except one reclining on the boat-deck, slowly coming to life and wondering how to get through Rounds at half-past nine. One minute past nine found the boat-deck swamped with several tons of water and coal-dust, the boat which had been hanging close beside us cut neatly in two (half of it was hanging from each davit) and the siren giving as much of an alarm as it could with all the steam-pipes cut. Not that there was any need for an alarm, we had all heard the noise quite easily, including the one officer who was not on the boat-deck at the time; he had been having a bath, and shortly afterwards took command of his squadron clad simply in a life-belt.

The soldiers fell in at their boat-stations with a great deal less hurry than they had at the alarm the day before, although from the angle of the deck it was pretty obvious that something was likely to happen soon, and that anyway none of the starboard boats (ours, of course) could be launched. The port boats were in the water and lying off even before the ship had lost her way (the engine-room had been completely wrecked), and the port detachments were sliding down innumerable ropes and ladders and paddling off to their boats in well under ten minutes. The starboard side, acting under orders from the bridge, had industriously thrown all the rafts overboard very early in the proceedings, but as the bridge had omitted to tell us to make them fast before casting them, they went astern at about ten knots, and were nearly over the horizon by the time they might have been wanted.

The two escorting destroyers meanwhile had been whizzing round the ship at 40 knots, dropping depth-charges and loosing off every gun they possessed to keep the submarine down and prevent her getting in a second shot. One of them now slid alongside, and in an incredibly short space of time had taken on the whole of the starboard detachments, 400 men, as well as all the officers of the port side, who had stayed on board to see how we got on. It was currently reported that every man, with the exception of those of the crew who were standing by the ship, was taken off within 20 minutes, with no casualties beyond two men killed by the explosion—no mean effort. Only one officer actually had to swim, a senior officer who, leaning over the rail to exhort a group of men in the water to swim out to their boat instead of hanging on to the end of a ladder, fell overboard and landed among them like a shell, rendering further exhortation superfluous.

The destroyer went off at once at top speed for Mudros, 90 miles away, continuing to loose off her after four-inch gun at intervals, to the no small discomfort of those of us who happened to be lying on the deck immediately underneath the muzzle, and meeting on the way the rescuing destroyers coming out.

Landing at Mudros, where we were the guests of the Navy and the few Army units left, took on something of the air of the arrival of a victorious army, despite the fact that even the most fastidiously-dressed could only muster a helmet, shirt and shorts, and, of course, the inevitable life-belt. (A subsequent order that all life-belts were to be handed in to Ordnance on the ground that the ship to pick us up would have plenty on board had to be cancelled, as both officers and men refused point-blank to part with them.) The triumphal air with which we marched off, however, soon evaporated in face of half a mile of newly-laid stones, and a forlorn procession hopped and swore over the stones or through the thistles on either side.

At the back of one's mind, though, all the time, was the thought of the horses, tied up below without a chance. A gallant attempt was made by the Navy, with the assistance of some of our boats' crews (the port side, who had got away in their boats, were still sculling about the ocean) to tow the sinking ship to Skyros, which was quite close ; at one time we heard a rumour that she had actually been beached, and those who had shot their horses before we left the ship were in the depths of woe, but she went down four miles from the land.

One man who had a camera with him in a boat secured a photograph of the ship just before she went down ; she was standing on her nose with half her length clear of the water. Not unnaturally he secured an order for several hundred copies, but to everybody's wrath the film, which could have conveyed nothing to anybody, was destroyed by the censor.

A week passed very pleasantly at Mudros, with no cares, since without boots the soldiers could not stray far, neither could they be drilled, and we were quite sorry to see the *Aragon* steaming into the harbour to take us on. The journey on to Alexandria was definitely not pleasant; the nerve-shock of the explosion was coming out, and neither officers nor men would sleep below decks, nor did one ever see a *Cestrian* survivor leaning over the rail.

However, beyond going heavily into action with machine-guns against the minefield buoy off Alexandria, we had no alarms, and landed at Alex with the pleasant job of buying a complete new outfit of everything, with £60 from a benevolent Government to buy it with. Incidentally, this compensation settlement shed a sidelight on the curious mentality of the financial powers; we were allowed to claim for everything laid down as an officer's kit in the *Field Service Pocket Book* except one handkerchief; it was held that, whatever kit a man might have been wearing when he abandoned ship, one handkerchief must have been "on the person."

We had only one night in Alexandria, but that was quite enough for various hilarious spirits to get into trouble for being facetious to the A.P.M. when admonished for not wearing Sam Browne belts.

(*To be continued.*)

THE CARRIAGE OF PONTOON EQUIPMENT BY CIVILIAN TRANSPORT.

By J. A. C.

August, 1936.

Introduction.

In the notes below an account is given of a move of pontoon equipment carried out by means of ordinary civilian motor transport.

This was made necessary as, in the far North, we have pontoon bridging equipment but no transport with which to move it about. It is possible that the use of civilian transport for this purpose may be of interest, not only as an example of improvisation, but because of the wider lessons to be derived from this improvisation.

Theory.

In these days of industrial progress it has been realized that, in war time, armies must rely on normal civilian sources of production for as many of their needs as is practicable. This is an obvious necessity, because recruits will be familiar with articles in everyday use and also dies and jigs, etc., for the manufacture of these articles in large quantities will exist. Thus the use of civilian vehicles, etc., will be a necessity in a great war and an economy in a small war.

This theory is accepted in general by the army as regards its vehicles, but there is always a tendency to produce special vehicles for any special type of equipment. One effect of this is to clog the mobility of formations, as they are inclined to drag about with them a multiplicity of equipment and vehicles "in case" these may be wanted in some emergency. It is a tradition, for example, that the Division should be able to fight an independent action—therefore, in these modern times every conceivable type of equipment must be pressed on it. A result that seems to come from this is that the extra mobility to be expected from the substitution of fast-moving M.T. for horse transport is lost on account of the excessive length of the M.T. columns.

If we could foresee requirements, we could perhaps change over some of the equipment to meet the expected situation and thus reduce the columns. If, for example, maps and air reconnaissance show that operations are to be in a desert country, then water-supply stores will be required with Engineer units. If, on the other hand, a

well-watered country intersected with streams and canals is expected, then bridging materials might be substituted for the water-supply stores, and so on.

Such substitutions would be made very much more easily if Engineer units could be equipped mainly with universal vehicles for the carriage of all forms of equipment or stores. As an example, in 1914 one of the Field Companies of the B.E.F. had occasion to blow up its pontoons in bridge near Mons, on the 23rd of August. The loss of these clumsy articles, then carried by Field Company transport, was of the greatest benefit during the retreat. The vehicles set free were fitted up with planks to transport men and explosives, etc., and used on all sorts of odd jobs. They proved invaluable, and would have been even more useful if they had not been quite such strange skeletons of vehicles.

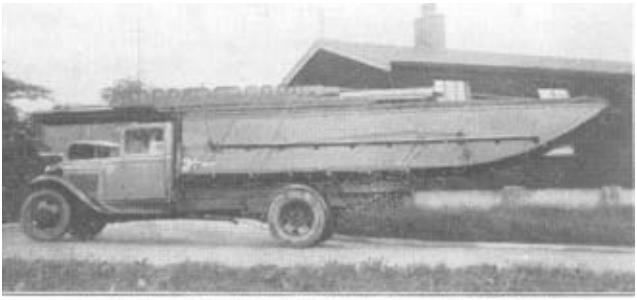
PRACTICE.

Each year it is necessary to dispatch pontoon equipment from Catterick Camp, its normal place of storage in the Northern Command, to various bridging camps. This year the pontoons were sent by road to Halton, a distance of between 60 and 70 miles, and for the move six civilian motor vehicles were ordered, making successive trips until transportation of the gear was complete. When the transport turned up the loading party was a little shaken to find that one of the vehicles was a furniture van. The remainder consisted of normal 3-ton trucks, four being fitted with tipping bodies controlled by a ratchet gear.

The loading party was composed of 20 men, civilians unfamiliar with pontoon equipment, but controlled by an experienced storeman who had superintended the job before. The off-loading party had a few Sappers with it. On the first trip the six vehicles were loaded up in $2\frac{1}{2}$ hours, one pontoon and one bay of superstructure being loaded on to each lorry (except the furniture van), a detail of actual articles being given in Appendix A.

Furniture vans are excellent for transport of Kapok or even folding-boats, but are not ideal for pontoons because loading can only be done from the end. A pontoon was, however, loaded into the van in eight minutes by 14 men with the aid of improvised rollers made from lengths of iron pipes. It was not considered desirable to put heavy road-bearers on top of this pontoon, as loaded, so this vehicle carried a pontoon, chesses and small stores only, instead of the normal complete bay of superstructure. (See Photos 1, 2 and 3.)

The journey of between 60 and 70 miles over the Pennines on narrow and twisting roads took the convoy three hours. Off-loading was slightly quicker than loading and was facilitated by the tipping bodies of the trucks (see Photo No. 4). The small size of the working party can also be appreciated in this photograph.



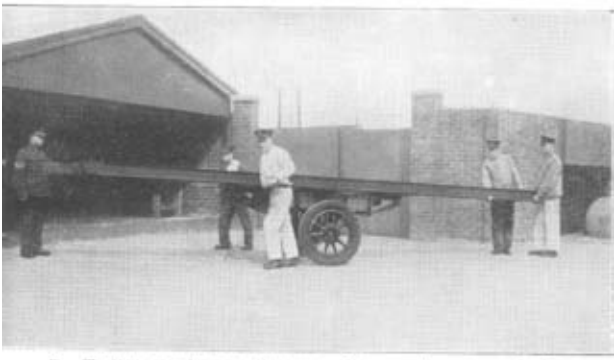
1.—Pontoon and superstructure on 3-ton civilian lorry.

2.—Pontoon in furniture van.

3.—The column ready to move off.

The carriage of pontoon eqpt 1 - 3

4.—Unloading—note the tipping body on the lorry a standard fitting.



5.—Trolley carrying road-bearers. Note small party required.

6.—Trolley loaded with a pontoon.

The carriage of pontoon eqpt 4 - 6

The time taken for loading or off-loading depends largely on the time required to move the road-bearers, so that a large working party would speed up operations. Even so, Field Company commanders may not feel impressed by the times quoted, but the point is that, using a miscellaneous collection of vehicles, the equipment was handled by a small untrained party at a rate rather quicker than half an hour per bay. This should be almost quick enough for normal bridging in war; therefore the necessity for speed of handling does not warrant the introduction of special bridging vehicles.

It may be objected that the civilian lorries would be uneconomical, as additional vehicles will be necessary to carry the extra pontoons required for each pier. A medium pier now consists of a bay of superstructure and two pontoons, not one only, and even if the equipment is redesigned a bi-partite pontoon will almost certainly be required. It is suggested that this difficulty could be met by towing the second pontoon, or half-pontoon, behind the lorry on a two-wheeled, pneumatic-tyred trailer or trolley (see Photos Nos. 5 and 6).

It must be admitted that such a trailer brings us back to a specialized vehicle, but it might be regarded as a necessary adjunct to the pontoon equipment rather than as a form of transport.

The reason is that such trailers or trolleys should be real labour-saving devices for most bridge sites; they could be used to run pontoons down to the water's edge to avoid the laborious carrying of these heavy boats, and then again a further use would be to carry the heavy superstructure, road-bearers, etc., quickly and silently to the head of the bridge, with more saving of labour. This labour-saving of Sapper personnel will be a very important point in a future war and it would seem that there will be few sites where some sort of two-wheeled trolley could not be usefully employed, the chesses being used as a temporary roadway for it if necessary. The photographs show an improvised trolley made up from scrap material and a standard lorry front axle and wheels, which has been built for experiment at Catterick.

Unfortunately, owing to the shortage of personnel, the Sappers of the regular Field Company have not carried out any pontooning this year, and so it has not, as yet, been possible to test this trolley to see whether it has been constructed on really practical lines or not. It is hoped to do this next year, and the photographs are included simply to illustrate the idea.

Conclusion.

The conclusion to be drawn from "experiments" at Catterick is that specialized vehicles for the present pontoon equipment are not necessary, and the introduction of a universal type of M.T. vehicle

for the carriage of Engineer stores seems to be generally practicable. It seems, further, that a type of truck in general use among civilian firms could possibly be found that would be good enough for our purposes, though it might not be the ideal vehicle for all occasions. The elimination of even one specialized vehicle, to wit the pontoon wagon, would, however, be a step in the right direction.

APPENDIX A.

Loading found suitable for a civilian truck, with a 16-foot body, nominal capacity 3 tons.

	Weight.
1 pontoon	1,350 lb.
7 road-bearers	1,820 ,,
26 chesses	2,080 ,,
1 stiffening chess	200 ,,
2 ribands	180 ,,
1 pontoon saddle	214 ,,
8 racking chains	48 ,,
	5,892 ,,
	2 tons 12½ cwt.

ENGINEERS IN ARMOURED FORMATIONS.

Reprinted by permission from the *Militär Wochenblatt* of 10th June, 1936.

[*Note.—The Pioneer Corps in the German Army includes* (*a*) *Infantry Division Pioneer Battalions,* (*b*) *Corps Pioneer Battalions,* (*c*) *Pioneers of an Armoured Division. Each infantry battalion has also three sections* (*one per company*) *trained as Infantry Pioneers. They perform such duties as erection and removal of obstacles, minor bridging, etc.*]

THE erection and removal of obstacles, tasks of the engineers, play an important part in the employment of armoured formations. The operations of armoured formations can thus be seriously affected by the enemy's engineers. On the other hand, engineers are trained in the removal of obstacles. Thereby, in certain circumstances, they can facilitate the combat of armoured formations; and sometimes, in fact, their help is indispensable if the armoured formation is to come into action at all. To avoid the risk of being held up by enemy obstacles, it is essential that armoured formations should be provided with a sufficient number of well-trained and well-equipped engineers.

In considering this question, a few brief remarks on the organization and employment of an armoured formation are necessary. It is true that they are a repetition of what is already known, but they are essential, because the proposed organization of engineers depends largely upon the organization of the armoured formation and on what is expected of the latter.

The basis of the organization will be:—an armoured brigade, consisting of light and medium tanks; a brigade of motorized infantry, carried mainly on lorries, but also having at its disposal light vehicles (motor-cycle scouts); and a specially mobile group (armoured cars and motor-cycle scouts), whose main duty is reconnaissance. The special characteristics of the most important parts of such a formation are:—

(*a*) *Armoured Brigade.*—Not a very high speed, but a fairly even speed over bad roads and across country; capacity for travelling over all kinds of ground, but, at the same time,

of limited use in woods and villages; high fire-power; protected against most arms—an admirable weapon of attack, but not suited to holding a position.

(*b*) *Motorized Brigade.*—Very high speed on roads, but limited in use for cross-country work; capable, without its vehicles, of being employed as infantry, and then limited in mobility; reduced capacity for attack, but able to hold a position.

Such varied components furnish a variety of possibilities of employment. An armoured formation of this composition can be utilized for a frontal attack, as well as for an attack on the flank or rear of the enemy. This was made clear in the *Militär Wochenblatt*, No. 48, 1935 ("Armoured Units in Attack"). The armoured brigade may attack first, and the motorized brigade exploit its success later. Or else, motorized units may be used for clearing the enemy from ground that is not suited to tanks, and the latter can then carry out a decisive attack. It will frequently be the task of parts of the motorized brigade to hold the enemy down in one place by attack or defence, while the tanks drive their attack home elsewhere. The handling of an armoured division cannot therefore be carried out on a definite scheme; its organization demands a flexibility that will admit of a great variety of uses. This has to be taken into account in the organization of the engineers attached to it.

The multifarious possibilities for the employment of engineers can only be roughly indicated here.

On the march it will be their duty to remove barricades, such as may be expected everywhere nowadays. Demolished and damaged bridges will have to be repaired, if a detour cannot be made to other bridges. In many cases, bridges will have to be strengthened to take the loads of a tank division. Barricades will have to be erected across branch roads to guard against flank attacks by motorized and armoured forces.

In halting places and bivouacs protection can be provided or improved by obstacles.

In the course of an attack it will be the main duty of the engineers to clear away obstacles for tanks as well as for the motorized brigade. The rapid crossing of streams plays an important part, as the recent French manœuvres have shown. Incidentally, the attacker will put up obstacles to guard his flank or to enable him to leave gaps in his front.

If an armoured formation is forced on to the defensive, a contingency that only concerns the motorized portions, its capacity for resistance can be increased by obstacles, and flank protection can be provided by barricades. In the case of a pursuit, it will be the duty of the engineers to remove obstacles from the line of advance of an

armoured formation. They may also be able to obstruct the enemy's retirement by the erection of barricades. On the other hand, if the armoured division decided to break off the battle and retire—little has been written so far about such a possibility—the obstacles erected by the engineers will provide an effective method of holding up and shaking off the pursuing force. These brief indications will furnish a reason for providing the armoured division with engineers.

A motorized brigade, with its vehicles more or less tied down to roads, is very easily affected by small obstacles. But the removal of all obstacles must be left to the engineers, as there is always a possibility of having to deal with concealed explosive charges that may cause casualties. The units of the motorized brigades must also have engineers to clear away obstacles. If the engineers were concentrated in one battalion, as in the case of an infantry division, they would always come up too late. This is a result of the extensive areas and the high speeds characteristic of an armoured division. It would not be sufficient to attach engineers to the leading unit only. In the course of deployment there would again be a shortage of engineers in the individual units; additional men brought up at the time to the motorized brigade would arrive too late. Everything depends upon overcoming obstacles rapidly. The importance of attaching engineers to infantry has often been discussed in print lately. The need is far greater in the case of a motorized brigade. It will be impossible to avoid dividing them up amongst battalions, in spite of the serious objection to splitting up units. These engineer detachments are not only required to carry out "current duties," that is, put up or remove smaller obstacles. They must also be in a position to ferry reconnoitring parties of the battalion across minor watercourses with their own materials.

But tanks also require the assistance of engineers far oftener than is generally supposed. Their mobility through woods and villages and across streams, etc., is easily hampered. But, by the timely intervention of engineers, obstacles of all kinds can be deprived of their importance. Clearance work carried out by engineers can be protected by tanks, whose formidable fire-power can overcome the fire of enemy scouts and machine-guns. The possibility of tanks being threatened by hostile anti-tank weapons must be taken into account, together with the necessity for overcoming the latter. But since the object of obstacles is to free the weapons of defence for use elsewhere, these weapons are not likely to be met at every point.

Engineers can render valuable services to tanks on the march. We must become used to having to reckon with obstacles in the most unlikely places. It will often be possible to reach one's destination sooner by removing them than by following side-roads, which may, in their turn, also be found blocked. Similarly, in driving to the

position of assembly, or to the attack, engineers may be able to remove many a natural or artificial obstacle. It will generally be a question of cutting a gap, through which a tank can be driven. Such a procedure is, of course, only possible where there are no formidable anti-tank measures to be encountered. For instance, deep and wide ditches can be overcome by sloping down the sides with explosive charges. Similarly, explosives can be used for cutting gaps quickly in pile stockades, small barricades, and abatis. Tanks will not be used, as in the World War, for breaking through wire entanglements, as they may cause the detonation of specially-laid mines. The correct way of dealing with such obstacles will be, either to blast a passage through them, or else to throw wires with grapnels out of the tank and so tear sections of the entanglement away. Any mines exploded by doing this will not do any serious damage to armoured vehicles.

Incidentally, engineers should be able to recognize mines and render them harmless, or, at least, give warning of their presence. This will often be the case if the enemy, at the sudden threat of tanks, hurriedly lays mines and spring-traps that cannot quickly be camouflaged.

For removing natural obstacles the co-operation of engineers is indispensable. It will only be possible to clear away barricades if they are not under the enemy's observation, or if the enemy's fire can be kept down. In any case an armoured brigade must have engineers permanently attached, so as not to be at the mercy of every obstacle. Mere co-operation with engineers placed at its disposal when required does not offer a practical solution. The engineers employed by the armoured brigade must be able to follow it across every kind of country, that is, they must travel in armoured vehicles with caterpillar tracks. Their numbers can be limited, as they will only be required to cut gaps in weak spots, and, moreover, it would not do to make the units unwieldy. For them the tank is only a means of transport: armament is unnecessary, since they always have the protection of other tanks. Only practical trials can determine what strength is sufficient for armoured engineers. The moderate capacity of a tank unquestionably determines their limits.

Whereas the engineers detailed for the motorized and armoured brigade are only intended for the most urgent work, the armoured division will often find itself faced with tasks for which strong bodies of engineers are required. The division must have a special unit at its disposal for such a purpose. The possibility has already been discussed of protecting the flanks with obstacles during the advance or during the battle. For this class of work the detachments allotted to the separate units cannot be withdrawn. Larger obstacles may

have to be removed that are impossible to circumvent. Many engineers will be required for crossing watercourses. For the construction of obstacles to cover one's own retreat one can never have enough engineers. For such tasks the armoured division requires at least one strong engineer company. In order to be capable of employment in various ways, the company might be organized in four sections, as in the French engineer companies. As it will be employed outside the range of hostile infantry fire, there is no question of transport on caterpillar-track vehicles. A high speed, and facility for moving from place to place, even on narrow roads, are desirable. The most suitable form of transport is a proportion of light lorries and a number of motor-cycles with side-cars. In order to be able to cross small waterways rapidly, a bridging train is to be recommended, but, for normal requirements, it need not have as much equipment as that of an infantry division.

But, in any case, one should guard against having too much material to carry about permanently, so as not to hamper mobility and further complicate the problem of transport. No organization can be laid down to cover every possible contingency. If a study of the map and the indispensable air reconnaissance indicate a probable increased requirement of engineers, bridge parks, etc., and of special equipment, the army reserve should be indented on for such an exceptional case.

This point of view must be taken clearly into account in the organization of individual engineer units. In the motorized brigade they must be specially qualified for the rapid removal and erection of obstacles. For this purpose they will require an ample supply of explosives and mines, for action, above all, against an armoured enemy. Everything must be organized for speed: charges made up in cases, power-driven saws and pulley-blocks must be indented for in quantities. It would be useful to have a ready-made superstructure similar to that in the assault-bridge equipment, to allow of the rapid construction of ferries made of buoyant sacks. The component parts might perhaps be carried on the sides of the lorries. Light machine-guns are necessary for guarding obstacles.

The engineers of the armoured brigade will mainly be required to remove obstacles. They will, above all, require explosives, as well as a number of made-up charges in boxes, and wire ropes for tearing wire entanglements and abatis apart. Some entrenching tools are also required. Light machine-guns can be dispensed with, as the tanks will always provide protection.

The divisional engineer company must be equipped for all contingencies. They must be prepared to fix and remove obstacles, as well as cross rivers. Here rapid execution of work is essential, and, instead of carrying equipment for deliberate work, they should carry

large quantities of explosives. The equipment of this company will resemble, as much as possible, that of any other engineer company. But the commander of the company should on no account be divisional engineer commander. The company commander's place is with his company, and he has quite enough to do in making arrangements for it. On the other hand, there must be an experienced engineer officer with the division, whose business it is to maintain the importance of his arm of the service. This is all the more necessary, as the employment of an armoured division is greatly influenced by the technical services of engineers. For this reason there should be an engineer commander on the divisional staff, who should be heard as often as the artillery commander or intelligence officer. Moreover, it is his duty to control the organization and supply of materials to all engineer units of the armoured division.

ACROSS AMERICA BY CAR.

By CAPTAIN D. V. DEANE, R.E.

To those who have elected—or are condemned—to pass the greater part of their service either in India or the Far East, the normal method of returning to England on leave *via* the Suez Canal very soon becomes monotonous, and is looked on by many as merely a necessary preliminary to, instead of forming an enjoyable period of, the leave.

Alternative methods of reaching England have of recent years become increasingly popular, as these not only enable the traveller to visit new countries, but ensure that the pleasant feeling of being "on leave" commences from the day on which the journey begins.

Anyone who contemplates one of these methods of reaching England from India will find numerous possibilities open to him. He may proceed (1) by air; (2) by the overland route *via* the Persian Gulf and Iraq; (3) *via* South Africa; (4) *via* Australia and the Panama Canal; and (5) *via* China, Japan and Canada or the U.S.A. The two latter alternatives entail a trip round the world and, provided that time is not of major importance, they furnish the two most varied and comprehensive itineraries from the above selection.

The purpose of this article is briefly to describe a journey recently undertaken from India by the writer and his wife, for which No. 5 of the above routes was selected. Although the trip was not carried out with undue necessity for economy, careful observation was kept throughout in order to be able to ascertain the minimum cost of a similar tour in reasonable comfort.

It was decided that the *pièce de résistance* of the tour would be a journey across the United States by car, to include as much sight-seeing as possible. For this purpose one month was allowed, and experience proved that this allowance was all too short.

Leaving Bombay by P. & O. steamer on February 20th, the normal outward route *via* Ceylon, Penang and Singapore was followed as far as Hong-Kong. To many these places will be familiar, but to anyone who visits them for the first time from India the cleanliness of the towns and the beauty and freshness of the scenery will come as a pleasant surprise. Sufficiently long halts are made at each

port to enable through passengers to hire a car and drive to local beauty spots as well as to explore the amenities of the actual ports.

At Hong-Kong the Canadian Pacific liner *Empress of Japan* was boarded, which sets a new standard of comfort in ocean travel to those who, like the writer, have only previously travelled by normal routes to and from India. Spacious, panelled cabins, thickly carpeted, furnished with sofa, armchair, writing-table, wide comfortable beds and such amenities as bedside Thermos jugs containing ice-water, hot and cold running water—all these gave the impression of entering a first-class hotel bedroom. The remainder of the ship is in conformity with this high standard, and amongst its appointments may be mentioned the excellent enclosed swimming-bath and the well-fitted gymnasium. The other ships of the Canadian Pacific Steamship Company's trans-Pacific fleet, though older, all set a similar high standard of comfort, which makes the three weeks' voyage to Vancouver a delightful experience.

The route followed was *via* Shanghai, Kobe, Yokohama and Honolulu. Alternate steamers proceed direct from Yokohama to Vancouver, thereby saving two days in time, but Honolulu is so beautiful an island that the extra time taken by this route is well justified.

From Vancouver the traveller may, if he so desires, proceed by C.P. Railway over the Rocky Mountains *via* Banff to the East Coast, but by doing this he will gain little except time as, once the Rockies are crossed, the scenery is flat and monotonous. Rail travel is expensive, particularly if sight-seeing detours are made, whereas the purchase of a car enables the traveller to go where he likes and to stop where he likes. In addition, many of America's famous beauty spots can only be reached by road, and the majority of them lie near the West Coast.

From Vancouver we proceeded to Seattle—some 200 miles south—where the car which was to transport us over 5,500 miles in 18 days' actual motoring was purchased. (It is cheaper to buy a car in the U.S.A. owing to the high import duty into Canada.) The car selected was a 1932 model eight-cylinder Studebaker; a powerful, heavy and fast car, chosen for its excellent performance and its comfort for long-distance touring. It was purchased for £69 and sold in New York a month later for £25, having given no mechanical trouble whatsoever during this strenuous period. Apart from one puncture, the only repair effected was to have a blocked radiator cleaned, which occupied half a day and cost ten dollars.

Here it should be explained that all car prices on the West Coast are higher than in the East, owing to the freight charges—the large majority of American cars being manufactured on the East side of the continent. Proceeding from West to East, some depreciation is

1.—Part of Hong-Kong Harbour.

2.—Street Scene—Hong-Kong.

3.—Mount Fujiyama, Japan.

Across America by car 1 - 3

6.—San Francisco–Oakland Bridge during construction.

7.—Grand Canyon of the Colorado River, Arizona.

8.—Grand Canyon of the Colorado River, Arizona.

therefore inevitable, but would have been considerably less had one of the cheap popular makes been selected such as Ford, Chevrolet or Plymouth. These cars are in great demand second-hand, being light and comparatively economical to run, and there is no doubt that a perfectly satisfactory car of this type could have been purchased and re-sold in New York for a loss of not more than £20. In the writer's case, the high depreciation was written off against the extra comfort obtained and the pleasure of driving a car of this type.

The route chosen for the tour is indicated on the map at the end of this article, and with certain additions can hardly be bettered by anyone who desires to select an itinerary, which embraces every type of scenery to be found in the continent, including many of the famous beauty spots. Unfortunately, the tour had to be carried out during April, which is one month too early to see the country at its best, except in the more southerly latitudes. Certain famous National Parks, such as the Yellowstone and Sequoia, were still snow-bound and had therefore to be omitted, and others which were visited— such as the Yosemite Valley—were still partially blocked by snow, and could not therefore be fully explored.

It is not the purpose of this article to give a detailed description of the itinerary followed on the tour, and in any case to do justice to the beauty of the scenery would require the pen of a skilled writer. A few general remarks may, however, be found of interest.

The first stretch of the trip—from Seattle to San Francisco—was unquestionably the most beautiful owing to the almost incredible variety of scenery encountered. Magnificent pine forests, stretches of coastal road reminiscent of South Cornwall, sudden ascents into snow-covered mountains, equally sudden descents into green Devonshire valleys, sections of gorse moors, and finally, the redwood groves, where the giant trees make the highway so dark that headlights must be used except in bright sunlight. Many of these trees are over 6,000 years old, 600 ft. in height and 25 ft. to 30 ft. in diameter. In one grove the main highway is tunnelled through the trunk of a living tree—and is wide enough to allow motor-coaches to pass through.

Add to this a newly-constructed and magnificently-engineered road, in perfect condition throughout, and with corners super-elevated to allow a normal cruising speed of 50–55 m.p.h. ; and it will be realized that motoring conditions are ideal.

San Francisco, a large modern sea-port city, is now chiefly famous for the two enormous bridges nearing completion, which will connect the city with the mainland. The clear span of the more spectacular of the two—a suspension bridge—is four-fifths of a mile, and the 90-ft. wide roadway will be 200 ft. above sea-level. The cables used to support the roadway are each one yard in diameter and 11,000 tons in weight. These bridges dominate the harbour and its narrow

entrance at the "Golden Gates" as impressively as does the now well-known bridge at Sydney Harbour.

From San Francisco a detour was made to the Yosemite Valley, a beautiful gorge with vast rock walls covered with flowering shrubs, and containing two spectacular waterfalls, each over 2,000 ft. high. Thence through endless orchards and vineyards to Los Angeles, where a halt was made for five days.

Although chiefly known as the centre of the film industry, Los Angeles has much else to recommend it. The famous Long Beach is within an hour's run, the Mexican border is only 125 miles away, a visit can be paid to one of the numerous adjacent oil-fields, and the beauty of the avenues and residences in the Beverley Hills area must be seen to be appreciated. A tour round one of the film studios is an education in itself, and cannot be described within the limits of this article.

The next major stop was at the Grand Canyon of Arizona, 600 miles from Los Angeles, across the Mojave Desert, an arid scrub-covered expanse, which in the summer becomes as hot as the Sind Desert in India and has little to recommend it apart from the variegated colouring of the rocky outcrops which fill it. By making a detour of not more than 300 miles, Death Valley and the Boulder Dam could both have been visited—the latter being famous as the site of the most gigantic undertaking of its kind in the world—but both these places had to be omitted for lack of time, and 36 hours later we arrived at our hotel on the rim of the Grand Canyon. This vast gorge is over one mile in depth, and of width varying from three to ten miles. No description of it could adequately convey the true sense of its grandeur, and of the rich colours of its sandstone walls, but the traveller should allow a clear day's stop at this point to appreciate it fully.

From there our route lay across the Painted Desert, along nearly 200 miles of good "dirt" roads, over two mountain ranges—where the roads were still deep in snow, crossing the Colorado River by the world's highest bridge, and so to Salt Lake City, beautifully situated under snow-covered mountains, and famous as the headquarters of the Mormons—whose fine temple and tabernacle stood outside our hotel door.

We then set out through the Rocky Mountains on the longest and least interesting section of the journey—the 1,600-mile stretch across the wheat and prairie belt of the mid-west—to Chicago. Due to the magnificent open road and the high touring speed which could be maintained without difficulty, we found that less than four days of easy motoring were sufficient for this distance. The normal day's run of 9–10 hours, including stops, covered a distance of 400–450 miles. Fifty miles could comfortably be covered in the hour—the best hour's run being 57 miles. Towns and villages on this section

Across America by car 4

were few and far between, and the traffic encountered was light, so that average speed and touring speed almost coincided.

Our route then took us *via* Cleveland and Buffalo—an ugly industrial district with sections of road badly damaged by the severe winter frosts—to Niagara, which was reached in a snowstorm. The falls had recently been frozen solid, of which event plenty of evidence still remained. The writer and his wife were both disappointed by this famous spectacle—probably due to over-anticipation—but the scene at night, when the falls are flood-lit in rich colours, amply compensated for the daytime disappointment. Many millions of candle-power are used, picking out the two falls and leaving the walls in darkness, affording a most impressive spectacle when viewed at a suitable distance.

There then remained only 450 miles of pleasantly scenic motoring before New York was reached. A week was spent there, which was found to be ample time in which to visit all the sights, after which brief visits were paid to Kingston and Montreal, whence a Canadian Pacific liner conveyed us across the Atlantic to Southampton.

In all $5\frac{1}{2}$ weeks were spent in America, and as previously stated, this was found to be too short a period. Two months would have enabled a fuller itinerary—as originally planned—to be covered, and would have allowed longer visits to places of special interest. If the time available had been still more limited, a satisfactory solution would have been to cover the West Coast section of the tour by car and then sell it at Los Angeles, completing the journey to New York (*via* the Grand Canyon) by train.

In conclusion, some figures of costs and information of touring interest will be given :—

(1) *Fares.*

A round-the-world ticket (*via* P. & O. and C.P.R.) costs approximately £185 first-class and £125 second-class. Those who are fortunate enough to be in possession of passages under the Lee Commission scheme will realize that, by utilizing the value of one complete return passage from India to England, they can travel round the world second-class without further expense.

Expenditure *en route* naturally depends upon individual tastes and abilities. The female sex will find it difficult to refrain from yielding to the temptations of the silks and china wares in Chinese and Japanese shops—where even a hard-bitten male may excusably weaken. But, apart from such purchases, probably £50 per head should cover the cost of drinks, tips and amusements on board, and shore excursions from the round trip. The total time spent at sea —Bombay to Bombay—is approximately nine weeks.

(2) *Costs in America.*

This, again, is entirely dependent on the tastes and income of the traveller. A perfectly adequate car can be purchased for £40–£50, on which the depreciation should not be more than £15–£20. Petrol is cheap—varying from 6½d. to 11d. per (American) gallon, according to the distance from the oil-fields. For those who wish to economize, tourist camps abound throughout the continent. In these the traveller is provided with a furnished wooden "cabin," in which he can either cook his own meals—having purchased his food from the neighbouring store—or can in many cases obtain a cheap meal in a café run by the camp proprietor. Beds, bath or shower, and linen are provided.

The charges for these are from 4s. to 6s. per head per night. Hotel charges in all but the largest cities are from 6s. per night upwards. Hotel prices do not include breakfast, but there is always a coffee room or cafeteria attached to the hotel, where excellent meals can be obtained at cheap prices.

An allowance of £1 per head per day for board, lodging, drinks and amusements, plus £1 per day for the running cost of the car, should be found quite sufficient for any length of tour. It is always advisable, however, to have an additional sum of money in reserve against an unexpected hold-up or breakdown. This gives a pleasant sense of security when traversing the more deserted regions.

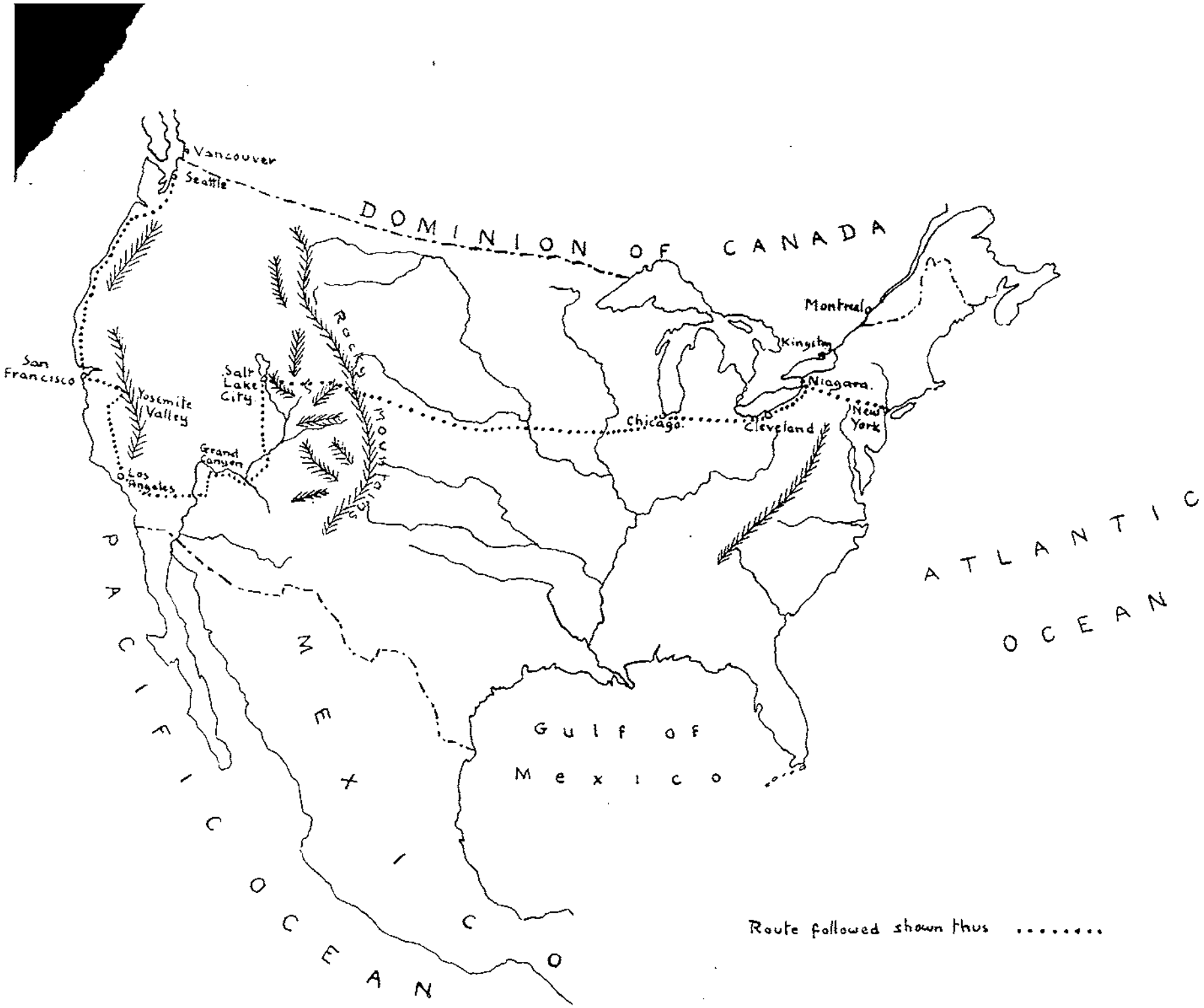
(3) *Touring Information.*

All petrol-filling stations keep a stock of road maps of their State and those adjacent to it, and these are supplied free on demand. In addition, the various branches of the A.A.A. will gladly provide full information on touring conditions, and will attend to such details as insurance, licensing and registration, for a member of any of the recognized English motoring associations, without charge.

Sign-posting on roads, as we know it, is seldom found, but all highways are numbered, and these numbers are found at one-mile intervals on each road, with corresponding numbered direction posts when passing through towns, so that there is no difficulty in following any desired route.

(4) *Roads.*

The National Highways, which form a network of communication throughout the country, were found to be generally beyond reproach. Very large sums of money have been spent on these roads as a relief measure during the recent "depression" years, with the result that it is exceptional to find a bad stretch. Dirt roads should be avoided in wet weather, but normally possess a beaten clay surface along which high speeds can be maintained.


Vancouver
Seattle
DOMINION OF CANADA
Montreal
Kingston
Niagara
San Francisco
Salt Lake City
Yosemite Valley
Grand Canyon
Los Angeles
Chicago
Cleveland
New York
ROCKY MOUNTAINS
ATLANTIC OCEAN
PACIFIC OCEAN
MEXICO
Gulf of Mexico
Route followed shown thus .....
Scale 400 miles = 1 Inch.

The majority of States have no speed limits on the open road, but in certain instances limits of 45 or 50 m.p.h. were encountered. These, however, appear to be generally ignored ; the normal touring speeds throughout the country being 50–65 m.p.h. Most towns and villages impose strict speed limits, and these, together with the universal traffic-light system, should be carefully observed, as the penalties against rash driving are severe, and there is a growing outcry against the enormous annual loss of life through road accidents.

(5) *Driving Conditions.*

Right-hand drive is universal throughout the U.S.A. and Canada, and it is possible that some who have not had previous experience of this sytem may have qualms about attempting it. It will be found that the position of the driving-seat on the left-hand side of the car at once gives a sensation of normality to these conditions, so that the average driver will feel at home at the wheel after the first day's run. It is advisable, however, to drive with considerable caution through large towns till the driver is perfectly accustomed to the position. Road manners are generally poor, and signals are frequently not given. It was found advisable to watch the car ahead carefully, and always to sound the horn before overtaking. A driver will find that he very soon becomes accustomed to the high touring speeds, and is therefore at first liable to forget that he is travelling probably 15 m.p.h. faster than he has been used to elsewhere. This particularly applies when cornering or when overtaking another car against oncoming traffic—the relative speed of the latter to one's own speed being probably 30 m.p.h. greater than in England, thus giving a proportionately shorter time in which to overtake.

(6) *General.*

Apart from the beauty and variety of the scenery, and the excellent condition of the roads, a motor tour on the lines suggested above has the peculiar fascination of travel in a new country, whose inhabitants, though speaking the English language, have evolved many original habits and customs, which cannot fail to be a continual source of interest—and sometimes of amusement—to the visitor. Unusual combinations of food and drink, strange but expressive idioms of speech, original methods of advertisement, the " Welcome " and " Farewell " notices at the entrances and exits of even the smallest hamlets—all these combine to keep one's interest perpetually aroused, and cause the longest day's motoring to pass surprisingly quickly.

Finally, the universal friendliness of this truly democratic country —where, in one city, the writer was introduced by his hostess to a grimy mechanic in stained overalls, who turned out to be an intimate

social friend of the family, and whose children attended the same school—helps greatly in the enjoyment of the tour. An Englishman is at once spotted by his speech, and be it bank manager, lift-boy or waitress to whom he is speaking, it is rarely that he is not plied with questions about the " Old Country " and treated as a welcome and distinguished visitor who must be shown every possible courtesy and assistance. Civility—except perhaps in New York, whose polyglot population proved disappointing in this respect—is encountered everywhere, but servility is totally absent. All men are truly equal ; your waiter is probably a university student earning his college fees during the vacation, and the ten-year-old son of the charming couple you dine with will earn his pocket-money by delivering a round of newspapers once a week, in turn with other of his schoolmates before he goes to morning school.

And—strangest of all, perhaps—in this land of independence and almost frenzied nationalism—it is rare indeed for any chance-met resident not to take the earliest conversational opportunity to inform you of his English ancestry, however remote this may be, and to announce his ambition some day to return to the " Old Country."

WORK THAT IS NOT IN THE TEXT-BOOKS.

By COLONEL W. GARFORTH, D.S.O., M.C.

IN the Great War many Sapper officers must have resorted to expedients in order to deal with unforeseen or unusual conditions or to cope with situations when normal supplies were not available. A record of such experiences would, it is thought, be of interest to the younger generation.

I venture to give, below, an account of a few such experiences which came my way, in the hope that they may prove to be a means of stimulating interest and of producing much more interesting accounts of how unusual situations have been dealt with on active service.

SCREENS.

Behind the front line there was generally a second line of trenches running parallel to it and about 150 to 200 yards behind it. Halfway behind these two lines I erected a canvas screen, during the night, about 40 yards long and 10 feet high. The canvas was supported by wires stretched between wooden uprights about 10 feet apart. Wire stays connecting the tops of the uprights to piquets helped to make them rigid.

The Germans awoke to find this strange, unusual structure just behind our line, and, as we had hoped, proceeded to shell it heavily for days on end. It proved a very simple method of encouraging the enemy to waste his ammunition. After this had been going on for about three weeks, during which time we used to repair the screen where necessary, at night, the enemy got a bit sick of the game. My G.S.O.1 then suggested that I should erect a dummy wireless station, consisting of two uprights and an aerial, just behind the screen. I replied that I did not think we could pull the Germans' legs as easily as all that and I was much against the suggestion. He insisted, however, and I reluctantly erected the aerial. The result was most encouraging and another three weeks' shelling wasted even more ammunition than the amount expended on the plain canvas screen.

PORTABLE BOMBS.

As everybody knows, we used to indulge in many raids into the enemy's trench system during the long years of trench warfare. To help to liven things up, I emptied a field telephone box of all its

normal fittings. A wood partition then divided the box into two chambers, and I took off the bottom of the box and refixed it by means of two pins which, when extracted, allowed the bottom to fall out. A Mills bomb, fitted with instantaneous fuse, with the safety-pin extracted, was then placed in each compartment. The box was taken to the German trenches in the next raid and left on their fire-step. The pins were then extracted, thus making the bottom free to fall out. The Germans, on returning to their front line after the raid, naturally picked up the field telephone box left by the invaders, and I was truthfully able to report the following morning that there was at least one less live German opposite us.

When I first made this box and took it to General Strickland, my Divisional Commander, he looked at me and paused. He then told me that he had thought I was a gentleman, but now he knew I was not.

FLOATING MINES.

In September, 1915, I was in the 69th Field Company, commanded by Major G. S. Knox (the best of C.O's). We were in the line near Armentières, where the River Lys ran from behind the British line, across No Man's Land and through the German line eastwards. It was known that some little distance behind the enemy front line they had a floating footbridge across the river to provide lateral communication. My Major asked whether I could devise a floating mine which we could drop in the river behind our line so that it would float down and, on contact with the German bridge, blow up and destroy it. This presented many interesting problems. The banks of the river were full of weeds and, in the experiments which we carried out about half a mile behind our own front line, we found great difficulty in getting anything to float on the surface of the river without in a very short distance getting entangled in the weeds. After several experiments we solved the problem by fitting to an ordinary barrel (which was intended to contain the necessary explosives) a very light sort of cartwheel, 7 feet in diameter. The periphery of the wheel we found had to have a very broad flange, so that when it came in contact with the weeds the necessary resistance was offered to enable the float to regain midstream. This flange we made of thin wood planking, about ½-in. thick and about 8 in. in depth. The " wheel " was connected to the barrel at its centre by thin struts of wood.

Having now got something which would float down the river fairly easily, we quickly determined its rate of progress and from this we calculated the time it took to reach the site of the German bridge from the point of immersion in the water which, as a matter of fact, was about 50 yards behind our front line. The next problem was to devise something to make the ammonal (with which we filled the

barrel to half its capacity) to explode at the moment of contact with the German bridge. I first tried a time fuse fixed through a candle which burnt, we found, at the rate of about one inch an hour, but this method was not sufficiently accurate. After many experiments we bought an alarm clock and arranged that, at any given time at which we wished to set the alarm, electrical contact was made which fired the detonator. The rest was easy. Having calculated the time it took for the floating mine to reach its objective we set the clock accordingly.

I made ten of these mines and we dropped them in the river at intervals of a few minutes and watched them float down towards their destination.

Our infantry reported that in the dim light, after a series of violent explosions, they saw in the air bits of Germans and boats and timber, etc.

An interesting point was the number of precautions which we had to observe. All our material, barrels, explosives, wheels, etc., had to be carried up and carefully placed under shelter the night before, and numerous other details had to be most carefully attended to, but one point I completely forgot and that was the possibility of rain. If it had not been for the forethought of one of our excellent subalterns (Hart) we might have had a short-circuit in the clocks which would have put an early end to us and our experiments. He, however, erected a tarpaulin over the site of work and it poured in torrents.

Possibly an account of these simple operations may help to stimulate the execution of similar and more important ones by our young officers in future campaigns.

USE OF DYNAMITE IN DEEPENING A STREAM.

(Reprinted by permission from *The Contract Journal*, 2nd September, 1936.)

IN connection with the construction of the Short Route Highway through a section of Athens County, Ohio, it was necessary at three points to deepen the channel of Wolf Creek for a total distance of 1·3 miles. This stream is winding and rocky. The average width is 50 ft., with irregular fluctuations in depth of from 3 ft. to 8 ft. The channel bed is of shale and sandstone composition, too rocky for efficient dredging and too irregular for ordinary ditching.

The specifications called for a uniform channel 8 ft. in depth, and after three different contractors had abandoned the project, the Johnson Co., of Trimble, Ohio, accomplished the task in record time by the use of dynamite bombs. How this work was handled is described in *The Du Pont Magazine.*

The actual excavating was done in 140 working hours, using 1,700 lb. of nitro-glycerine dynamite, 600 electric blasting caps, 6,000 ft. of copper wire and 1,500 ft. of 2-in. iron pipe.

THE BOMBS USED.

The bombs were made in advance, using 30-in. sections of the pipe, the bottom ends of which were welded to a point after cutting out four gores. Next, concrete mortar was poured in to a depth of about 3 in. and permitted to harden.

Then, in each shell was loaded, end to end, the required number of cartridges, and the last one inserted carried an electric blasting cap, with insulated copper connecting wires. To seal the charge, more concrete was poured in, and then a 1-in. reducing plug was screwed into the collar of the pipe. Above that, similarly attached, was the nipple or " handle " extending about 1 ft., and through the hole along the axis of this piece the cap wires referred to were threaded, thus completing the assembly.

STARTING WORK.

When the blasters were ready to start work, a supply of these bombs were stored in a row-boat, which was anchored at the desired

location in the middle of the creek. A bomb was placed in a chuck or holder—a section of 2-in. pipe, 10 ft. to 12 ft. long—through which the leading wires were drawn up and left free. Next, the bomb was secured in the holder by means of a wire between the bomb handle and the top of the chuck.

These preliminaries completed, the outfit was pushed down into the bed of the stream. The holding wire was cut and the chuck used to drive the bomb to the required depth.

Jointing-Up.

The chuck was then carefully withdrawn, leaving the bomb planted in the bed. One of the workmen next attached the free end of the cap wires to a piece of wood floating at the surface, and the planting process was resumed and continued until ten or more bombs were set. This work completed, the cap wires were connected in series, then taped securely and joined to the leading wires which extended from the boat to the terminals of the blasting machine, a safe distance away on the shore. When everything was in readiness, all the charges were shot together.

The Results.

The bombs were spaced 8 ft. to 12 ft. apart, usually in the centre of the channel, and side shots were used only where jutting rock ledges made them necessary. The channel shots loosened the stone and silt so thoroughly that much of the material was quickly carried away by the swift current. Large blocks of broken rock were manœuvred to the shore by man-power, and the remaining burden was removed by scrapers.

The use of bombs eliminated the drilling of holes, at a substantial saving in labour and time. A crew of three men, operating in shifts on the boat, did all the necessary planting, while a fourth man handled the blasting machine. And a crew with barge and scraper completed the job.

AN IMPROVISED WINCH.

By CAPTAIN J. F. HASELDINE, M.C., R.E. (S.R.) *retd.*

THERE are many occasions in Field Works when a winch, if available, would be most useful, such as the removal of large boulders or big tree roots or for the launching of temporary bridges.

Such an article of store is not always available nor is it easily improvised in the form usually supplied.

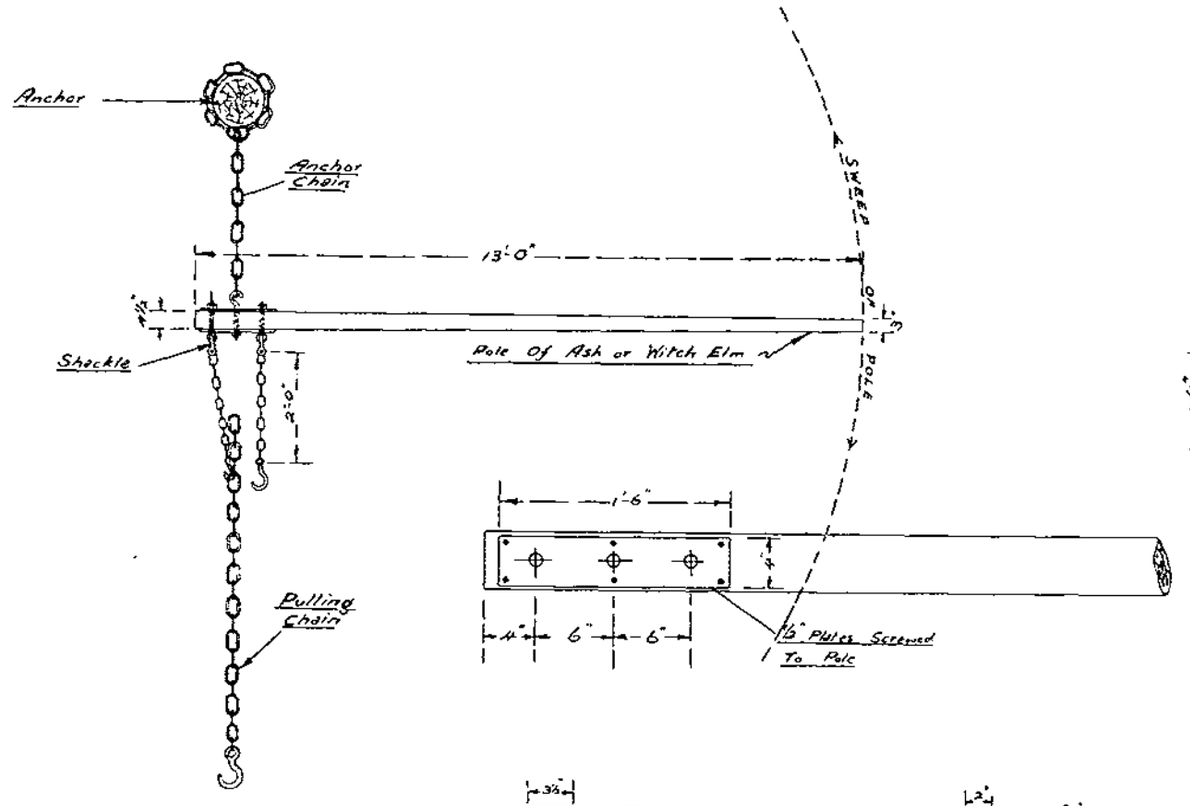
I have recently had occasion to fell a large tree ; the apparatus used by the contractor, and which is, in effect, an improvised winch, appeared to me to be of interest to members of the Institution who have to be prepared to improvise when the usual type of tool or apparatus is not available.

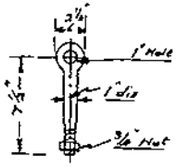
A drawing is shown of the apparatus used ; the dimensions are those of the actual tool used, but these could, of course, be varied according to the material available and the apparatus could easily be made in the field by the usual Field Company tradesmen.

The pull is exerted by rocking the pole backwards and forwards ; at the end of each sweep of the pole the lever hook on the short chain, which has become slack due to the sweep of the pole, is unhooked and re-hooked as far as possible farther up the pulling chain.

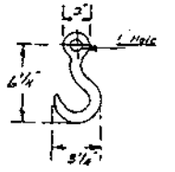
On the opposite sweep of the pole the other short chain will have become slack and that lever hook is then treated in the same manner.

By these means the pulling chain is gradually hauled in towards the anchor and the desired tractive effort is exerted ; this effort may be direct on the object to be moved or, for slower movement of the object or for increased effort, may be exerted through blocks and tackle.

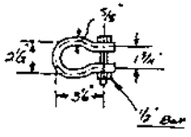




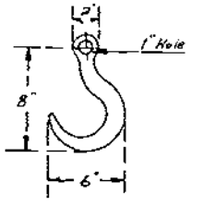
Eye Bolts



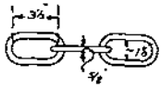
Lever Hook



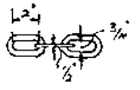
Shackles



Pulling Hook



Links Of Pulling Chain And Anchor Chain



Links Of Lever Chains

TREE FELLING LEVER

Scales ½" & 1½" To 1'-0"

J. F. HASELDINE M. INST. C.E.

THE LAFIA–CHAD ROUTE SELECTION, 1928–1929.

By CAPTAIN R. E. BAGNALL-WILD, R.E.

PART I.—MAINLY DESCRIPTIVE.

Introduction.

IN August, 1928, the Engineer-in-Charge of Surveys, Nigerian Railway (E. i/c S.), ordered a route selection survey to be made for a proposed line from Lafia–Berri Berri on the Nigerian Eastern Railway, towards Bornu.

The survey of railways in Nigeria was divided into five separate operations :—

(1) The Traffic Reconnaissance.
(2) The Engineering Reconnaissance.
(3) The Route Selection Survey.
(4) The Location Survey.
(5) Staking Out.

The E. i/c S. defined the object of the route selection survey as follows :—

" To narrow down the belt investigated by the engineering reconnaissance and to take sufficient detail on one or more possible routes to enable a fairly accurate estimate to be made."

The engineering reconnaissance for the Lafia–Chad line was carried out with compass, perambulator wheel and aneroid, and had been completed a few weeks before the route selection started. The reconnaissance report and map showed the principal tie points of the line and the approximate heights of the cols and river-crossings. Of course, the heights taken by barometer on a rapid traverse, adjusted only by an assumed hourly variation of pressure, were liable to considerable errors, but they were valuable, as they gave the route selection party an idea in advance of the difficulty of each section of the line. The party also used the eight miles to one inch map of the country ; this map showed the main features and larger towns with reasonable accuracy, but the details were unreliable. The engineering reconnaissance was made by one engineer in four months, assisted occasionally by the traffic officer, who was at the same time making the traffic reconnaissance.

The general route followed is shown on the sketch map. The principal tie points were the Namu crossing, the Wase crossing, a

prospective mining area at Zurak, the Kudu crossing, a low col on the Pai–Balanga divide, the Gongola crossing, the Harwal crossing, and the place chosen for climbing out of the Harwal valley. Of these tie points the crossings of the Wase, the Kudu, the Gongola and the Harwal, where there were obvious bridge sites with rock foundations for the abutments, had been closely defined by the reconnaissance.

The Party.

There were three white men in the party. The Survey Engineer in charge, known as the *bom'bature*,* was a civilian. He had two assistant engineers; the "Civil Assistant" and the "Sapper."

The natives in the party varied in numbers, but at times there were as many as seventy on the pay-roll, as well as the personal servants of the white men. From time to time boys left the party for various reasons and were replaced by recruits from the villages passed through. The natives included two survey gangs, which with staff-boys, peg-boys and boys to carry instruments and umbrellas numbered eight each. There were two bush-clearing gangs, each consisting of one sub-headman and up to twenty boys, the numbers varying with the density of the bush. A headman, two interpreters, messengers, night-watchmen, water-boys and police guard completed the party.

Chronology.

On 22nd August, 1928, the Sapper, who had been working with a location survey party in Southern Nigeria, left Ibadan by train to report to Railway Survey Headquarters at Kaduna Junction. Here he spent a few hectic days, buying a pony and a supply of tinned food in the intervals between drinking pink gin and soda and playing tennis, and then left for Lafia on 28th August. After a foul journey, including changing at 5 a.m. into a train with no restaurant car, he reached Lafia on the 29th, and joined the *bom'bature*, who had started work alone a week or two earlier. The civil assistant was at that time on his way back from leave in England and joined the party on 6th September.

By 7th November the survey reached Shendam, 83 miles from Lafia, and stayed there rather longer than usual, partly to finish off plans and partly to send for a doctor for the *bom'bature*, who had fever. The doctor ordered him home by the next boat and he left on 20th November.

Bom'bature II arrived at the next camp on 2nd December to take charge of the party, which had meanwhile worked on happily under a soviet composed of the civil assistant and the Sapper.

* His full title, as given in a letter written to him by a gentleman who wanted a job as messenger, was:—*Babban bature "safia" mai-neman hanyar jirgin kasa, i.e.*, big white man "surveyor" seeker of the path of the land canoe.

Christmas, 1928, was spent at Wase, chiefly memorable as the most highly-smelling town on the route, with the possible exception of Kombo, and for Wase Rock, which stands 900 feet up out of the plain with almost vertical sides and is about half a mile in circumference.

On the 28th February, 1929, the survey reached Zurak. Here *bom'bature II* also had to leave on account of his health, and, as there was a shortage of senior survey engineers, he was not replaced till May. The soviet worked cheerfully through some of the most difficult country yet passed and were sorry when *bom'bature III* arrived to take charge on 8th May.

Kombo, nearly 300 miles from Lafia, was reached on 24th August, and here the party met the engineer who was driving test piles on the site chosen for the Gongola bridge. By October the survey was past Lokwoja, well up the Harwal valley, and then the Sapper left *en route* for England and leave. He met his relief, another civilian assistant, at Kombo, and made his way by a poor track with 25-mile stages to Gombe. The dry-season motorable road from Gombe to Bauchi was not open for motor traffic, which meant six more stages with carriers, but not such long ones. From Bauchi half a day in a lorry over an all-seasons road led to Jos, the railway and iced beer.

The route selection was completed three months later, making a total of nearly 450 miles in 17 months. A location survey of the selected line was then ordered, but the slump and economy caused all work to stop before much progress had been made.

The overall speed of the route selection survey was slow ; this was due to various causes which will be mentioned later ; the two most important ones were (i) the number of alternative routes surveyed, and (ii) the fact, that in order to make reasonably accurate estimates, the amount of detail taken on parts of the route would probably have been considered sufficient on active service for a " preliminary survey." Although the overall speed was not much more than 25 miles a month, the length of traverse lines cut and surveyed averaged about 100 miles a month.

Food and Water.

The feeding and watering of the natives was in most places simple. The white men's camp sites were chosen, if possible, a reasonable distance to windward of a native village, and the boys bought their own food in the village and drew their water from the village stream or wells. On parts of the route, however, the villages were small and the villagers could not reasonably be expected to part with their small reserves of food. For instance, in the Tangale country, which the party entered at the beginning of the rainy season, the inhabitants of the smaller villages were almost without food themselves,

living on the expectation of the *gero* crop, part of which they turn into beer for a grand opening drunk of the season. Whenever the boys found it difficult to get food in the villages, the representative of the local emir was told to arrange for food to be brought from the nearest towns; this food was sold to the boys at a reasonable price, the cost of carriage being paid by the party. Only on one occasion did an emir's representative fail and this will be referred to later. Luckily, in most places where food was short, game was plentiful and a hartebeest made a good meal for many boys.

For the white men chickens and eggs were usually easy to obtain, and from time to time fish, beef, mutton and goat were also available. Guinea fowl, bush fowl and duiker made a pleasant change from the eternal hen, though they were rather tough and not always easy to find. Fresh fruit and vegetables were scarce in the wet season and unobtainable in the dry season, except when the party was near the Mission at Shendam, where there was an orange grove. From time to time, Ibrahim Yola, a messenger with no English but plenty of common sense, was sent off to the nearest store with a list of the tinned chop, flour, whisky, etc., needed to replenish stocks, and two to four weeks later he would roll up again driving a gang of weary, heavily-loaded carriers whom he had picked up in the town.

The party went splash on Christmas Day, 1928. A cow was bought and distributed among the boys, and carriers were sent 100 miles in one direction for a live turkey and 50 miles in the other direction for a case of champagne. Boxing Day was observed as a holiday.

Water was generally plentiful, though in the dry season it came from stagnant pools and was "*highly contaminated.*" All water drunk by the white men was boiled and filtered and made more palatable by dilution with tea, coffee, concentrated ginger beer or whisky according to taste and the time of day.

"*Uninhabited, Waterless Bush.*"

In January, 1929, at the height of the dry season, the party was faced with 40 miles marked on the map as "uninhabited, waterless bush." The engineering reconnaissance had skirted this area; local wiseheads would say nothing but "Much bush—no water." The traverses were worked as far forward as possible and the bush did not appear to be as waterless as the map-makers and local tradition alleged. A new camp site was reconnoitred near a stream with large pools in it, but the emir's representative could not find labour to build a camp, so huts had to be built by boys of the gang. A crowd of carriers was collected, and, after some persuasion, moved off with the loads. On reaching the new camp they put down their loads and beat it for home without waiting for their pay, and the emir's representative went with them. This amazing behaviour gave the

clue to the puzzle; the *bom'bature* appreciated the situation and suggested that the area was uninhabited, not for the lack of water, but because of a *juju*. Luckily, the regular gang were strong believers in white men's magic and only three deserted.

Three camps were made while passing through the area and water was plentiful at two of them; one of these two was noted as a possible locomotive watering station. At the third camp holes had to be dug in a dry stream-bed and the supply was barely adequate; water sentries were posted to prevent the boys using too much and with care the white men were always able to have their daily baths.

While in this area the boys had to be used for building new camps, for fetching food from the neighbouring town of Wase, and as carriers for moving camp; this delayed the survey work slightly.

The E. i/c S. paid his first visit to the party in this area, and, presumably to the surprise of the local population, both he and the whole party emerged safely some weeks later. The Sapper heard on the boat going home that the *juju* was then considered to have been exorcized, and that a few brave souls had moved out of the over-crowded town of Wase and had started to farm the uninhabited area.

Camps.

The distance between camps varied from 8 to 18 miles and averaged 12 miles. It was usually possible to hire carriers locally for the move and so moving day could still be a working day. The party carried altogether from 100 to 120 head loads, so moving at 9d. a carrier-day cost from £3 15s. to £4 10s. in addition to the cost of camp building. The extra cost of short moves was, however, more than compensated by the saving of time in riding to and from work; 14 miles was considered to be the most economical distance between camps.

At the larger towns the white men lived in the rest-house buildings, supplemented by the four double-ridge tents carried by the party, while the boys found quarters in the town. Usually, however, a camp had to be built for the white men and sometimes for the natives also. The white men's camp needed a central office hut, a store hut and a kitchen, and a boys' hut for each white member of the party. These had to be substantial grass huts in the wet season, proof against tornadoes; in the dry season a few mats were enough, except for the office roof which had to be as nearly as possible sunproof.

The emir's representative was expected to find the labour and materials for building the huts, which were paid for at a price suggested by the Political Officer of the district. A wet-season camp for white men and natives cost up to £5. Once, on entering a new district, quite a small pagan emirate, the emir visited the party, complete with mounted band. After the usual salutations had come

to an end, the *bom'bature* tactlessly asked the old gentleman whether the money for hut-building should be paid to him, to his representative, or to the village *sarki*. The old man in his best Hausa replied haughtily: "It is all one; the money comes to me anyhow."

Ponies.

One of the advantages of working in North Nigeria as compared with the South was that the weary surveyor could have a pony. A reasonable pony could be bought for £7 10s. and the best one in the party, an untirable stallion from Bornu, only cost £10, and was sold again for the same amount after the trek back. Food for the ponies was cheap, only costing a few shillings a week, but was sometimes difficult to get. The simplest and most effective method of ensuring that a pony was well fed was to allow the horse-boy a fixed sum every week to keep the pony, with the threat of drastic punishment if it got out of condition. A few pence occasionally for potash was said to be necessary; it may not have done the horse much good, but it kept the horse-boy happy, as he probably made a penny out of the deal.

On either side of most of the large and medium-sized rivers crossed, with the exception of the Wase, the Gongola and the Harwal, there were *tsetse* belts of varying but well-known width. The first one was at the Namu, and here the party tried sending the ponies through in the dark, but evidently the *tsetse* were awake that night as all three ponies sickened and died. After that, whenever a fly belt was reached the ponies were sent on a détour to the other side. Some of these détours were long; for instance, to avoid a narrow belt on the Balanga the ponies had to be sent *via* Kaltungo, Kumo, Gombe, Debbe-Habe and Kombo. To the credit of the horse-boys the ponies always turned up again looking fit.

In addition to the ponies a lorry would have helped slightly during the dry season, but it is doubtful if it would have paid for its upkeep, as there were long stretches far from motorable roads or tracks, and it would have been useless during the wet season.

Pay.

The native gang were paid at the following rates:—labourers, 9d. a day; survey boys, 1s. to 1s. 9d. a day according to length of service and efficiency; messengers and sub-headmen, 1s. 6d. to 2s. a day; interpreters and headmen, 2s. to 2s. 6d. a day. The boys' pay, together with the white men's allowances and the payments for building and moving camp, had to be paid out in coins not larger than one shilling. After the first fifty miles the party was too far from the railway to send to the pay-train for cash, so arrangements were made to draw money from time to time on imprest from the nearest Native Administration Treasury. To guard the cash on the way from the

treasuries, which were often 50 to 60 miles away, an armed police guard of one corporal and three constables was attached to the party. They took a great pride in their turn-out and behaviour, and the *bom'bature* never had to make a complaint about them. They were relieved at intervals of about four months and had a pleasant time while with the party; their ball ammunition was all used shooting game.

Routine.

The daily round of traversing was monotonous for the assistants, as the field work had been reduced to a drill. The usual daily time-table was:—breakfast, 6 a.m.; leave camp, 6.30 a.m.; return to camp, 2.30 p.m.; change, have lunch and go to the office; reducing traverse books and plotting, contouring, etc., from 3.30 p.m. to 5.30 p.m.; stroll after a guinea fowl till 6 or 6.30 p.m., followed by bath, whisky, supper and an early bed.

The only serious difference of opinion between the civil and the military sides cropped up a few days after the start of the survey. The *bom'bature* said Sunday was a working day; the Sapper disagreed, saying that one day of rest and recreation in seven was good for man and beast. The argument became heated, but the Sapper stuck to his opinion and won his day of rest. Sunday became a day for late breakfast, writing letters, reading newspapers, sometimes shooting, and occasionally, as a great concession, an hour's work in the office. The argument broke out again soon after the arrivals of *bom'bature II* and *bom'bature III*, but, with precedent on his side, the Sapper then had an easy task.

The daily routine left little time or energy for serious sport. Game in many districts was scarce and what there was was very wild. In the less inhabited areas it was easier to find and the excuse of killing for the pot justified leaving the traverse line in search of game.

Normally all instrumental work was done by the assistants, leaving the *bom'bature* free to do all the many jobs necessary for the proper direction of the survey. In the field he reconnoitred ahead of the traverse lines, chose sites for new camps and made notes on water supply and bridge openings, etc. In the office he did the more important drawing work, wrote reports, and coped with the office work that cannot be escaped even in the West African bush.

As mentioned before, *bom'bature I* and *bom'bature II* both suffered from bad health, and the assistants had to do some of their work as well as their own. This slowed up the survey, but was very welcome to the assistants, as not only did it vary the monotony of traverse drill, but it gave them experience which was useful during the months that they were without a leader.

The other white members of the party were luckier, only losing a total of about twenty-eight to thirty men-days through sickness.

A daily sick parade was held for the boys, the most common ailments being sores on the legs, guinea worm and constipation. A native dresser would have been a welcome addition to the party. Two boys were bitten by snakes when out in the bush ; drastic first aid with a knife and permanganate crystals, followed by treatment by the local magician (fee five bob, kill or cure) was successful in both cases. They were both very weak for some time afterwards ; whether this was due to the snake or to the cure was never settled.

There were long periods during the survey when no white men were met. The first meeting was at Shendam, where a Political Officer and his wife and an R.C. mission father lived. A doctor visited the party while it was there and the dinner party on Armistice Night of six men and one woman was believed to have broken the local record. Father Sirlinger was generous with fresh vegetables and oranges, and before leaving Shendam some whisky was exchanged for some of his excellent French wine.

At Zurak a miner was prospecting and the party enjoyed dinner in his bungalow. At Kombo an engineer was busy on the bridge site. No other white men were met except for two visits by the E. i/c S., who stayed a few days each time to satisfy himself that the work was proceeding satisfactorily. He was known to the natives as the man who did two days' march in one ; during his journeys to and from the party he rode over the whole of the route in order to get first-hand knowledge of the country traversed, no mean feat for a man within a year of superannuation.

The Inhabitants.

The party passed through the country of a number of pagan tribes, each speaking a different language ; the more important were the Berri Berri, the Ankwe, the Montol, the Yergam, the Tangale, the Kanakura, and the Marghi. As the party approached Bornu the number of Fulani towns increased ; also several tribes of " Cow-fulani " were met, a nomadic, cattle-rearing people who have kept their blood free from intermarriage with the negroes and are pagans, unlike the other Fulani, who are Moslems.

The pagan tribes vary considerably in culture. Some, such as the Montols and the Tangales, are simple, almost nude folk, who file their teeth and use poisoned arrows. The Political Officer at Shendam cheered the party by telling them that the last detected case of cannibalism among the Montols was two years previously and that they had not " chopped " a white man for ten years. The elders of some of these tribes still lived, it was understood, in constant fear of slave raids from the great Mohammedan emirates of northern Nigeria, but the younger men have greater faith in British protection.

A large village in which there was not one man who could speak

Hausa or Fulani was rare, so the language problem was not so difficult as it might have been. Hausa was the official language of the gang and recruits soon picked it up if they did not know it already.

These tribes are given powers of self-government and self-administration, which vary according to their degree of development, but always under the guidance of the Political Officers. The fact that a survey party with magical instruments and flags passed through so primitive a country—erecting pegs and concrete beacons, which were probably magical, demanding carriers, and labour and materials for hut building, and eating up small reserves of food, doing so without any serious friction or bad feeling—is a great credit to the tact and leadership of the hard-worked Political Officers, who are engineers, surveyors, judges, hangmen, cashiers, tax-collectors and friends all rolled into one.

Part II.—Mainly Technical.

The Country.

The country passed through varied considerably, but could be described generally as " undulating orchard bush." In places there were large patches of grass or sand with little or no vegetation, but over most of the country there were small trees of varying thickness. Cultivated ground round the villages was easy to survey except for a few weeks before the *gero* and guinea corn crops. On the banks of most of the streams there was a strip of thick forest country. On some of the stream banks this was nearly two miles wide and almost as dense as the rain forests of Southern Nigeria. There were a few patches of black cotton soil on the route, outcrops of granite and basalt in places, less laterite than was expected, a few limestone ridges and several sandstone ridges.

On the first section as far as Shendam the route was obvious, and it was possible to locate a fairly straight line with easy earthworks, though frequent use had to be made of the maximum grades which had been laid down as 1% against exports and 1·25% against imports. The only thing which delayed the party on this section of the line was choosing the best site for the Namu crossing.

Between Shendam and Zurak there were several isolated hill features and over most of this section at least two and often more routes had to be surveyed, and usually these routes were several miles apart. There were no great difficulties on any of them and estimates had to be worked out in some detail to determine which was the best.

From Zurak nearly as far as the Pai-Balanga divide the country was very broken, with a series of gulleys running approximately at right angles to the route ; these gulleys varied from a hundred yards

to half a mile wide and from 15 to 50 feet deep; they had steep sides and, even using maximum grades and the sharpest permissible curves (8°), some of them were difficult obstacles. There were also a few isolated rocky hills. This sort of country is exasperating to the surveyor, because a railway could be built almost anywhere in a strip several miles wide, but in order to select the best route a topographical plan has to be made of the whole strip and many trial locations plotted.

The last five miles of the climb to the summit was located on a straight continuous maximum grade with negligible earthworks. The fall from there to the Gongola (850 feet in 50 miles) was also simple, as except for one alternative the route was obvious, and by using maximum grades to cross the undulations, little earthwork was necessary. The earthworks from Lafia to Kombo averaged 12,000 cubic yards a mile, of which a small percentage was rock-cutting.

From the obvious bridge site over the Gongola at Kombo the line ran on easy grades up the Harwal valley. Heavy rock-work was necessary on this section, for in places the hills closed down on the river and there was no hope of getting out of the valley for some miles. The Sapper heard later that once the climb out of the Harwal valley had been completed the going was easier once more.

Survey Methods.

The E. i/c S. laid down in detail the methods to be adopted for location surveys. The traverse lines on such surveys were measured tachymetrically, the levels being checked by levelling. The topography was taken by tachymeter, either by rays from stations not more than 900 feet apart in open country or by cross-sections not more than 300 feet apart in wooded country; in broken country the cross-sections were taken closer together. The E. i/c S. did not, however, lay down in detail the methods to be used on route selection surveys, but he strongly advised the engineer in charge of the party to use tachymetric methods. This advice was followed, though one *bom'bature*, who distrusted the accuracy of tachymetric traverses, had part of the line checked by chain and level. The closing difference on 20 miles of traverse between tachymeter and chain and level traverses was about 50 feet in distance, 50 feet in direction and 0·6 of a foot for levels.

Bearing in mind the double object of the route selection survey, which was to narrow down the belt to be covered by the preliminary survey and to make an estimate of the cost of the line, it is obvious that a rough topographical map had to be made of a wide belt or belts. Naturally, methods had to vary with the different types of country, but in general the method followed was to run a number of tachymetric traverses on the leap-frog magnetic principle described in "Notes on Tachymetric Traverses," which appeared in *The R.E.*

Journal in June, 1933. It was normally possible to run the traverses as approximately straight lines between minor tie points, but it was occasionally necessary to run grade line traverses. Grade line traverses were sometimes set out by Abney Level, but the usual method was to use the tachymeter for this purpose.

By running two or more traverses enclosing a strip of country it was possible to sketch in the topography with sufficient accuracy for route selection purposes with a minimum of side shots. The great advantage of running two or more traverses is that gross errors are shown up; this is most important because a single gross error may ruin miles of careful work; small errors are unimportant, particularly on route selection. The traverse lines were tied—in every five miles or so, if possible, and the maximum permissible closing difference of levels was $0{\cdot}4\ \sqrt{M}$ feet, where M was the length in miles of the closed line. If the difference was greater than this the Civil Assistant said the error must be on the Sapper's line and the Sapper said it must be on the Civil Assistant's line, but it was a strict rule of the party that both went out the next day and traversed the other one's line. Gross errors were luckily rare and about evenly divided between the two assistants; sometimes as long as two months would pass without a gross error and with closures averaging less than $0{\cdot}2\ \sqrt{M}$. When the lines were too far apart for frequent checks there was great excitement over the closure, but luckily on these occasions the difference was well within the limit and no long lines had to be run again.

Plotting and Contouring.

Plotting was done by protractor and set-squares; this is much faster than working out co-ordinates and is sufficiently accurate for railway surveys, particularly when using closed traverses which provide a check on the plotting. The scale was varied from time to time according to the difficulty of the country. In easy going a scale of 2,000 feet to the inch was used with contours at 10 feet V.I. This scale is trying to the eyes, but has the advantage that it discourages the drawing of beautiful wavy contours unsupported by spot heights, or the taking of too much detail in the field and thereby wasting time.

In more difficult country, or near major river crossings, or in places where rock-cutting was likely and small errors might have a large effect on the cost, more side shots were taken and the normal scale of 400 feet to the inch was used with contours at 5 feet V.I. A few very tricky bits, where there were alternative routes over large rocky ridges which could not be turned, were plotted at a scale of 200 feet to the inch or even at 100 feet to the inch.

On both location and route selection surveys the E. i/c S. directed that contouring should be done in the office and not in the bush.

The officer on the instrument usually sketched in the direction of the contours roughly in his traverse book and this was a great help when contouring from the spot heights on the plan. On some location surveys E. i/c S. even had the contouring done in the head office and not by the field party. Many surveyors, including A. M. Wellington, whose *Railway Location* is acknowledged to be the standard text-book on railway survey, hold very strongly that contouring must be done in the field ; the reason why the E. i/c S. held the opposite view may therefore be of interest :—

Contouring in the field involves certain practical difficulties : plane-table sheets are liable to expand or contract unless very carefully prepared ; they get dirty and collect dead flies ; in drizzle or light rain the paper gets damp and it is almost impossible to carry on plane-tabling when instrument work is still possible ; a 48-hour week in the Nigerian sun is quite long enough for most men, but an extra 12 hours a week in the office is possible. It is doubtful, however, whether the E. i/c S., who was a clean and accurate worker and untirable, considered these points to be important. His reason was that he believed that drawing of contours in the field led to the sketching of features by eye without taking a sufficient number of spot heights to justify them. He considered that the eye was a most untrustworthy instrument, which sometimes exaggerated and sometimes flattened out the contours, unless checked by spot heights. He therefore insisted on a close control by spot heights for location surveys and advised the use of a scale of 2,000 feet to the inch for route selection surveys.

Mistrust of the human eye is not unreasonable ; the experienced surveyor with the aid of a little common sense can correct the grosser forms of optical illusion, such as streams which appear to run uphill, but there is little doubt that, without some control by spot heights, " contours " sketched in by the eye are of little value. Wellington, in his *Railway Location*, writes : " The natural eyesight is readily deceived even when the apparent differences are so great as to seem clear and positive," and, although he advocates contouring in the field, he says it should not be done without some instrumental control, the amount varying with the skill and reliability of the topographer. Contouring in the office necessitates a denser spot height control than contouring in the field, and is therefore slower, but it is possibly the better method if the topographers are not highly trained.

River Traversing.

The River Namu or Ankwe was in flood when the party crossed it ; it had a wide belt of thick swampy forest on each bank and was about 1,000 feet wide and six to twelve feet deep. In order to avoid aimless cutting in the forest belt the *bom'bature* and the Sapper went on ahead to traverse the banks, take cross-sections and choose a site

for the bridge. By using the leap-frog magnetic method of tachymetric traversing, it was possible to run a zigzag traverse from bank to bank without either the instrument or the staff boys having to cross the river between shots. This method is similar to making a small triangulation along the river, and, although possibly not so accurate, errors are not carried on to successive triangles and the work is done rapidly. The tachymeter was also used for taking cross-sections of the bed. A large canoe and canoe boys were available, but the stream was running too fast in the centre for the boys to paddle upstream. By joining together all the ropes carried, it was just possible to fix a line across the stream, and the canoe worked across on this. One engineer was in the canoe and every time he took a sounding the other one read by a tachymeter shot from the bank the distance of a staff held in the canoe. Several cross-sections were taken, and after some good sites for the bridge had been chosen, traverses were run through the forest belt to them to investigate the approaches. A separate party was sent later to drive test piles and to make the final choice of site.

Azimuths.

As the tachymeters were set up by compass at alternate stations on the traverses, all bearings were magnetic. The party was ordered to make astronomical observations at intervals of not more than 80 miles, in order to determine the magnetic declination. A high degree of accuracy was not necessary, and time was saved by taking the latitude and longitude by dead reckoning on the eight miles to the inch map; slight errors in assumed latitude and longitude do not have a great effect on the reduced azimuth of a line. The normal method was to take a morning and an afternoon sun observation and work them out for time and azimuth; as a check against possible fudging, one of the two sets of readings was reduced by the *bom'bature* and the other by one of the assistants. The instrument used was one of the 5½-inch vernier tachymeters and the morning and evening observations always checked to a few seconds.

The magnetic bearing of the R.O.* from the instrument station was observed and the magnetic declination noted on the plan. There was a slight difference between the compasses of the two instruments used for traversing and this was allowed for at every set up of one of them by clamping the plate a few minutes off zero instead of at zero before letting the compass swing. Traverse angles were only read to the nearest ten minutes, so this adjustment was only roughly made and wasted little time.

Instruments, etc.

The Civil Assistant and the Sapper each had a tachymeter to himself and they stood the rough bush-life well. One of them, which

* Reference Object.

had seen much service before Lafia–Chad, was replaced during the survey by one of a newer pattern in which the screws came easier to hand, but it was still serviceable when it left the party. This system of allotting an instrument to a surveyor to use, adjust and keep clean is the best way of ensuring accurate work and undamaged instruments. A spare tachymeter was carried, but it only left its case on the rare occasions when the *bom'bature* ran a traverse himself.

One of the two levels carried was a small, modern type of instrument, quick to set up and easily adjusted. This was only used for that section of the line on which, as mentioned previously, the tachymeter was checked by levelling. The other level never left its case except for an occasional cleaning.

Most of the tachymeter staves were home-made ones, of wood, 16 feet long, divided into tenths of a foot, but two 20-feet telescopic box staves were also carried. The latter were divided into tenths of a foot with dark-blue markings on a light buff ground, which seemed to be easier to read than black on white when the " shimmer " was bad. They were also useful on account of their height for taking side-shots in orchard bush. The home-made staves occasionally broke because a fool of a boy tried to use them as a bridge over a small stream or for some other equally stupid purpose; the telescopic staves were only given to more reliable staff men.

Traverse pegs were cut in the bush from branches of trees; stocks had to be cut and carried for the few treeless areas. Small concrete beacons were built round selected traverse pegs at intervals of about a mile, and these points were specially marked on the finished plans. The pegs chosen were ones that were near the selected line and ones that would be as easy as possible to locate later; pegs near, but not on, bush paths, or on the tops of ridges, or near some other well-defined feature were considered suitable. This necessitated carrying several bags of cement and sending carriers for more from time to time

Minor Bridges and Water Supply.

The reports made on each section of the line included estimates of minor bridges and culverts and notes on locomotive water supply and several minor points, such as supplies of suitable ballast, sites for stations, depth of soil over rock in cuttings, etc.

The sizes of openings for bridges and culverts were comparatively easy to determine if the streams were, or had recently been, in flood, but the assistants had to search dry stream beds carefully for pieces of debris and other clues to the height of the previous season's flood. The decision on the size of the opening was made by the *bom'bature* who, in addition to noting the assistants' estimates, looked at the streams himself and often made a compass and pace traverse round

the catchment area of streams not shown on the eight miles to the inch map.

Efforts were made to find locomotive watering stations not farther than 20 miles apart, but sometimes it was not possible to find them closer than 40 miles. To make adequate reports on water supply the *bom'bature* needed a wide knowledge, as the points to be considered included the feasibility of getting good supplies by sinking wells in various geological formations, the quality of the water, the rate of evaporation of large pools in the dry season, the possibility of increasing the size of pools by damming and a rough working idea of the cost of well-sinking, pumping, etc.

Even when fully developed the line was only expected to carry a light traffic and in only one place was the locomotive water supply a limiting factor, causing about 20 miles of easy line to be abandoned for a route with heavier earthwork.

Local knowledge of village wiseheads was helpful when estimating openings, if taken with caution, but was useless when considering water supplies. It was disheartening trying to explain in Hausa to a village chief, who thought himself rich because he owned four score cattle, that the white men's land canoe, which he had never seen, drank at one fill as much as a daily supply for several hundred cows.

Finishing Plans.

When a section of about 80 miles had been completed the plans were finished and traced, quantities were roughed out if this had not been done already, and a report on the section was made. The tracing and one copy of the report were then sent by messenger to the Railway Survey H.Q. at Kaduna Junction. The original plan was kept with the party in case of accident to the messenger, and finally went to Kaduna Junction with the tracing of the next section. The traverse books were kept at night in a different tent or hut from the plan, lest one fire should destroy all record of weeks of work.

The finishing off was a pleasant change to traversing, but the tracing was trying work for surveyors. A good draughtsman would have saved much time and temper, though it is doubtful whether he could have been kept fully employed. An indifferent draughtsman would have been of little use, as it is essential that plan work should be done carefully and accurately; slipshod plans simply inspire mistrust of the whole survey.

Summary.

It is difficult to make a summary of an experience lasting many months and covering some hundreds of miles of country, but a few of the points which stand out are :—

(1) The monotony of long periods of traversing in easy country, slightly relieved by pride in good closures.

(2) The interest of finding a good route through more difficult country, particularly when there was no senior engineer in the party.

(3) The varied problems to be solved when maintaining a survey party in thinly-inhabited country.

(4) The number of unexpected and interesting things found when travelling among primitive tribes, as, for instance, when the traverse line passed by a party of natives smelting iron in home-made crucibles in a charcoal fire blown by goat-skin bellows.

(5) The slow overall speed of the survey, about 25 miles a month, compared with the speed of traversing, which averaged about one mile per hour of work in the field. This slowness was due to the time spent getting to and from work, to sickness, to the wide belts and alternative routes surveyed, and to the time spent in finishing plans, estimating, etc.

(6) The reliability of tachymetric methods and the possibility of using this instrument to solve various survey problems.

(7) The possibility of adapting some of the methods used for military railway surveying, although the conditions and objects of the Lafia–Chad route selection are not likely to be closely paralleled on active service.

(8) The paradox that easy country sometimes needs more surveying than difficult country. In easy country there are several good routes and much time can be spent in finding out which is the best. In war there might not be time to survey all these routes and the surveyor would have to choose the best route by eye. When time is not a limiting factor it is probably worth while to survey all possible routes, remembering another quotation from Wellington: "The eye often deceives itself in estimating quantities . . . leading to the abandonment without survey of lines . . . which should have been regarded as the most promising of all."

LAFIA - CHAD RAILWAY RECONNAISSANCE, NIGERIA, 1929.

KANO
MAIDUGARI
DIKWA
L. CHAD
MURGURA
Bornu Plain
ISSAGR
DUMBUK
CHIBBUK
MUSA
NGGHI
BIU
Barbur Plateau
HARMOL
GARKIDA
BUMA
LOKWOJA
Mandara Mts.
HINNA
BAUCHI
Bauchi Plateau
GOMBE
Dukul Hills
DEBBE HABE
SHANI
KUMO
PINDIKA
Balanga
KOMBO
GHORA
PUTTUK
YELO
Tangale Hills
KALTUNGO
SHELLEN
Gongola R.
Benue R.
TOS
BUKURU
KAGORO
DOGO/RIMI
MANSUR
Vigri Hills
PANKSHIN
Mada Hills
Murchison Hills
BASHAR
Uninhabited Waterless Bush
JEBJEB
ZURAK
LAU
YOLA
WASE
GERKAWA
SHENDAM
FESHIEP
PINSHAR
KWANDE
ASSAIKIO
NAMU
ANUGU
ADOJI
LAFIA
IBI
WUKARI
Benue R.
FRENCH TERRITORY

Motorable Roads
Existing Railway
Proposed »

Miles
20 10 0 20 40

A GRID SYSTEM FOR ORDNANCE SURVEY MAPS.

(*Read before Section E of the British Association for the Advancement of Science by* BREVET MAJOR M. HOTINE, R.E.)

THE surveyor has one ruling principle which is applied—or should be applied—to the whole of his operations, from the most precise control surveys executed with the theodolite to the compilation of the roughest of reconnaissance maps. He should work " from the whole to the part," from great to small, and not from small areas to larger ones. Applied to the systematic survey of a whole country, such as Great Britain, this implies the initial provision of a primary triangulation to be used as a sheet anchor for the less accurate secondary and tertiary triangulation or traverses, which may then be rigidly and consistently adjusted to the primary work. Next would come the detail surveys, designed to meet the needs of the largest scale map required and in sympathy with the adjusted secondary and tertiary control. These large-scale maps should then properly provide the material for compiling any smaller-scale maps which may also be required. The primary triangulation is the foundation of the structure ; the less precise control surveys are the steel framework securely attached to the foundation ; the large-scale maps are the walls, and the smaller scales the roof. Unfortunately, most national surveys have in the past started with the roof, and have progressed through a random pile of bricks, which may either be left lying about or may be built into small sections of wall. It is only when the necessity arises for permanently closing the cracks in this crazy structure that the site is cleared in order to put in a foundation.

In defence of this procedure, it may be stated that an undeveloped country cannot afford to bury a large part of its revenues underground and that its immediate necessity is for a tin roof to keep the rain out. This is probably true so long as surveys are financed from revenue and not from capital. It may also be stated that the final type of structure which may be required in, say, a century's time, cannot well be foreseen, and that, even if it could be foreseen, some sort of roof would have to be provided before all the walls had been completed. This also is true, but, without loading the analogy beyond the elastic limit, it may fairly be countered that a suitable compromise would be to put in the foundation at all costs and then to build a framework on it as may be required, first to support a roof and next to hold up such walls as may be immediately necessary to keep out

the prevailing wind. If this were done, we should hear less, for instance, of attempts to compile topographic maps from isolated farm surveys, leading in one memorable case to certain areas on the resulting "map" being shaded and referred to in the table of conventional signs as "non-existent."

The fact remains, however, that in no country has this logical order been consistently followed. Great Britain, which is usually and rightly considered to be the best-surveyed country in the world, is no exception, and we are now beginning to feel the full effect of this neglect of a fundamental principle. The primary triangulation—a magnificent piece of work which, although carried out with primitive instruments in conditions of extreme difficulty, has successfully withstood modern tests of its accuracy—was not completed and adjusted in time to serve its main purpose of controlling the secondary and tertiary systems, and has now fallen too far into disrepair to serve such a purpose. The secondary and tertiary systems have in consequence never been adjusted into the primary and are not therefore consistent between themselves: they are only sufficiently extensive and accurate to serve as a framework for the large-scale detail surveys of independent Counties, or small groups of Counties, with the result that there are indefinite and irregular cracks (amounting in some cases to as much as 50 feet) between the separate County surveys. So long as the triangulation framework had not to be used for any purpose of instrumental extension, and so long as County boundaries remained inviolate, the only disadvantage of this system was that large-scale plans astride a County boundary stood a very good chance of consisting largely of blank paper, which could not easily and accurately be filled with adjoining detail from the adjacent County survey. Various attempts have been made to counter this inconvenience by publishing "filled" plans entirely on one County system, and even in some cases by completely transferring the whole of a County survey to the neighbouring system, but owing to weakness in the County triangulation systems, which were not intended for such extensions, the result has invariably been a deterioration in accuracy of the plans, which has usually been accentuated on subsequent revision. Nowadays, however, changes in County boundaries are frequent and extensive and can no longer be followed up by this system of piecemeal transfer. The original triangulations are, moreover, being called into increasing use for such purposes as the execution and correlation of mine surveys, with resulting confusion whenever the disparate systems meet. Several Counties had been surveyed with sufficiently accurate field measurements for the production of a six-inch map before a general decision was given to map the country on the larger scale of 25 inches to the mile, and in order to meet the pressing needs of the moment these smaller-scale surveys were plotted at the larger scale, whose initial

inaccuracy has (although not in every case) been accentuated at each subsequent revision.

The fabric of our National surveys is, in fact, beginning to crumble and will shortly have to be replaced. This time we hope to follow a due order. A broad backbone of new primary triangulation down the centre of England and Wales has been observed during this year to serve as a firm base for future primary extensions covering the whole of Great Britain, while preparations have been pushed well forward for breaking down this new primary work, in certain areas of special urgency, into secondary triangulation on about four-mile sides. These secondary blocks will be adjusted rigorously to the primary work and are otherwise designed to ensure sympathy with adjacent work which may be taken up much later. Both primary and secondary control will be projected on a single rectangular co-ordinate system covering the whole of Great Britain, regardless of County boundaries, and will then serve as a rigid framework into which the individual " bricks " of the 1/2,500 map of Great Britain can be securely built. It is probable that many of the existing " bricks " can be re-built into the new fabric but many will require renewal by re-survey.

The introduction of a single rectangular projection (actually the Transverse Mercator projection) as a basis for all surveys of the country in replacement of the existing multiplicity of County projections and special projections for the smaller-scale maps, presents an opportunity for modernizing our systems of precise cartography. Since a considerable amount of re-drawing will be inevitable, particularly on the larger scales, there arises an opportunity to recast certain scales and sheet-lines to facilitate mass-production and indexing by adopting sub-multiple scales of the basic 1/2,500 survey covering commensurate areas of country. All surveyed positions can, moreover, be correlated through the medium of this single-projection system, and it is mainly this aspect of the question which I want to discuss in this paper.

Lines ruled parallel to the co-ordinate axes of the projection at fixed intervals form a series of squares, which may or may not be shown on all maps produced from the basic triangulation, and for which it is convenient to share the term " grid " with the Electricity Commissioners. The term " grid " in its cartographic sense was, however, in use before it was applied to modern systems of electric transmission, although the cartographic grid has not yet received an equal publicity.

A co-ordinate grid has been in common use by the surveyor for many years; in fact, his first operation on completing his control survey of an area is to " lay down " such a grid on which he can plot or compile his detail surveys. Certain advantages to the public result if the surveyor does not keep this valuable information to

himself but publishes it on the face of all his maps of the area. In the first place, the estimation of co-ordinates between the printed grid lines provides an unequivocal definition of position which is independent of any particular scale map. The alternative of specifying " the cross-roads 200 yards south of the second 'l' in Nether Wallop," besides being more long-winded, has the disadvantage that both the maker and user of such a reference must have the same map in front of them. It is also impermanent in the sense that the next edition of the map may differ from the last, even if only to the extent of spelling " Wallop " with one " l," or moving the whole name to make room for ribbon development. Such references as " Square B.15," or the local polar co-ordinate system which furnishes the map with a graduated swinging arm which is always in the way, have much the same disadvantages except that they are briefer. The merits of such a pure co-ordinate reference as 632015 have long been recognized by soldiers, and although it is true that soldiers have usually led the way in the construction and use of maps, it is no longer true that soldiers still have a monopoly of intelligent map-reading. Such few gridded maps of this country as have already been published have been used as such by a wide difference of interests ranging from Place Name Societies to the Youth Hostels Association, and there is little doubt that the practice will spread when a permanent National reference system becomes more widely published. Meanwhile, the appearance of an open network of fine hair-lines will hardly inconvenience anyone who does not wish to use it.

To most people, the term " Ordnance map " implies a one-inch map of some holiday area. But for every one-inch sheet published there are some hundreds of sheets on the basic 1/2,500 or " twenty-five-inch " scale, on which the administration and development of the country depends. It is only reasonable that this series of large-scale maps should receive the lion's share of consideration in any proposal affecting *all* Ordnance Survey publications. The proposal to recast the 1/2,500 map as a National rather than as a County series implies that the sheets must be cut along sheet-lines of the National grid. The problem of indexing, or indeed of providing any clue to the position of some 52,000 sheets of this series, would otherwise be almost insoluble. On the other hand, if the sheets are bounded by co-ordinate grid lines, then they may readily be indexed by the co-ordinates of the south-west corners. Any smaller-scale map, on which the grid also appears, then serves automatically as a comprehensive topographic index to the larger scales. The advantage of this will be readily apparent to anyone who has occasion to use the present half-inch County index—that is, to anyone who uses the 1/2,500 scale at all.

Among the principal users of the 1/2,500 map are surveyors, and

to surveyors the publication of a grid is becoming less a convenience than a necessity. This mainly arises from the facility which the grid affords for " grafting " new surveys on to old. A new survey, whether of a housing scheme or of a mine, can, for example, be undertaken on the basis of fresh traverse or minor triangulation based on the co-ordinate values of old work. The results, plotted with reference to the grid lines on a published sheet, will be in sympathy with the old work and will be unaffected by paper distortion of the published plan. Without going too fully into technical details, I may say that this distortion of paper constitutes the main source of inaccuracy in modern surveying and that there is at present no other practicable means of overcoming it. The full force of this argument arises where such surveys cross the sheet-lines of the published plans, and where an accurate instrumental survey would otherwise have to be plotted on a composite mounted map made up of sheets which had expanded by different amounts. It may be argued that accurate surveying in this country is virtually a monopoly of the Ordnance Survey, who could perfectly well be expected to maintain their own gridded originals without publishing the grid on every sheet. To some extent this is still true, but it ignores the requirements of mine surveyors in particular, whose operations receive more attention after every colliery disaster. It has recently been proposed that all mine surveys should be correlated with the Ordnance Survey grid in order that the positions of all underground workings shall be precisely defined in relation not only to neighbouring workings, but also to the surface features shown on published maps and plans. It will be possible to give effect to this sane proposal only when the Ordnance Survey has one unique grid (in place of the present 47) and when that single grid has appeared on all maps of the area.

If a grid co-ordinate system is to be used conveniently and rapidly, whether for reference purposes or for plotting, it must be a decimal system, for the simple enough reason that our ordinary notation is decimal. The fractional interval between grid lines can then be tacked straight on to the co-ordinate number of the last grid line. Suppose, for instance, that a point lies between two grid lines numbered 1205 and 1206 at a distance from the 1205 line measured or estimated at three-tenths of the grid interval. The co-ordinate of the point would then be simply 12053. If, on the other hand, the grid lines were not numbered in a decimal system, but had such odd consecutive numbering as 1205 and 1209, then the required co-ordinate would be $1205 + 3(1209 - 1205)/10$ and it would be necessary to work out this small sum every time, with a fair chance of getting it wrong. On the smaller scales, fewer grid lines must of necessity be shown or the ordinary detail on the map would be obscured. With a decimal system, this is conveniently arranged by

showing every tenth line, in which case exactly the same reference would be obtained in abbreviated form as could be got with greater accuracy from the larger-scale map. Thus, only the 1200 and 1210 lines would be shown on the smaller scale, where they would be numbered 120 and 121, and the same point would be referenced as 1205. A complete reference, the first half consisting of the east co-ordinate and the second half of the north, would be of the form 12051307 or 12050672.

The fact that British arithmetic and metric measures are both decimal at once suggests that the best unit of co-ordinates would be the metre, in which case the grid interval on one-inch maps would be a kilometre and on 1/2,500 maps a hectametre. There are, however, more important considerations affecting the unit of co-ordinates to be adopted than a mere facility in nomenclature. If necessary, we could easily revive the " kiloyard," which was once suggested in an heroic attempt to decimalize British measures of length, and neither would there be any insuperable difficulty in coining a word for 10,000 feet, though to be sure the result might have a distinctly zoological flavour.

One such consideration is the resulting size of grid square, which must be small enough to allow the easy estimation of tenths by eye, or the accurate plotting of surveyed co-ordinates without the introduction of serious error through paper distortion. The square should also be small enough, particularly on the one-colour large-scale maps, for the fact that it *is* an artificial square to be appreciated in one " eyeful " : if the square were too large there would be more danger of part of a side far removed from its fellows being mistaken for a hedge or fence. On the other hand, the grid lines must not be so close as to obscure cartographic detail. There is obviously no unit which would suit all scales equally well, since the common Ordnance Survey scales are more nearly multiples of 4 than of 10. The basic 1/2,500 scale must, however, be given prior consideration, and on this scale a 100-metre square would measure 1·575 inches (which is suitable) ; a 100-yard square would measure 1·44 inches (which is also suitable, although slightly less so) ; a 100-foot square would be 0·480 inches (which is much too small) ; and a 1,000-foot square would be 4·80 inches (which is much too big). On the 6-inch scale, a 1,000-foot grid (1·136 inches) is rather close, whereas a kilometre grid (3·728 inches), and to a less extent a 1,000-yard grid, is quite suitable for a very detailed uncoloured map not primarily intended for the accurate plotting of co-ordinates. Much the same conclusions apply to the smaller topographic scales. From this point of view, the foot (or worse, the link) are unsuitable units, whereas the metre and, to a slightly but definitely less extent, the yard, are suitable.

It may here be mentioned that, for reference purposes, the actual

unit is of no importance whatever, since grid references consist merely of numbers ; anyone concerned solely with the use of the grid for reference purposes need not even know what unit has been adopted. Surveyors will use the grid for plotting and may need to convert their field measures to the unit of the grid, although no competent surveyor would confess to being terrified at the prospect of such a conversion. For this reason, they would prefer the foot or the link, but for cartographic reasons they can be given neither, much less both. Most surveyors in this country use neither the metre nor the yard. Some of them think they will never use the metre, but all of them are agreed they will never use the yard.

A minor point in favour of the metre for surveying purposes is that it is the only unit which provides an unequivocal standard of length to the degree of accuracy attainable in modern primary surveys. In this country we maintain bar standards for both the Imperial Yard and the International Prototype Metre. We occasionally compare the two and publish a different ratio between them, and since this does not lead to enough confusion, with a rare display of over-regulation we define the ratio by statute as well. As a very eminent British surveyor once remarked, there is a " bar " sinister in the family somewhere, but he would be a brave man who, against the experience of the remainder of the civilized world, would impute any lack of virtue to the Prototype Metre, however frail her humbler forebears may or may not have been. In America, they arrange these matters differently. After some early unfortunate experiences with copies of the Imperial Standard Yard, the International Prototype Metre bar, which has now been related to the wave-length of red cadmium radiation to a probable error of one in fifteen million, is now alone referred to as the United States' length standard. If anyone wishes to convert a standardization to feet or yards he is required to do so by means of a simple statutory ratio of 1 metre = 39·37 inches. Otherwise, in the expressive American idiom, " it means that a different kind of foot is used." The difference is not enough to cut into the profits of the drapers, but this simple procedure does allow the wretched surveyor, concerned with measurement to one part in a million or more, to know on which foot he stands. The point is mainly of significance in international surveys, but all major surveys are to some extent international in character. Even the survey of an island, with plenty of sea to sink the errors in, started with a cross-Channel connection between the observatories of Greenwich and Paris. For these reasons the primary bases of the new triangulation of Great Britain will be measured in international metres, leading to co-ordinates in the same units, and it remains to consider whether there is any justification for converting these co-ordinates into yards for the National grid, and if so what ratio to use, bearing in mind that the latest ratio derived from

actual comparison of standards will probably be very dead in 50 years.

A few small-scale maps have been published with a 5,000-yard grid and the confusion that is likely to arise from any change in a grid would, other aspects of the question being equal, favour the retention of a yard grid. The possibility of recasting and gridding the much more extensive 1/2,500 series has, however, completely changed the problem, and there would be small justification for tying *all* Ordnance Survey publications to the existing yard grid, appearing on a few small-scale sheets only, if the yard were found unsuitable for the much more elaborate proposition now being considered.

The French Revolutionaries, who introduced the metre, attempted to make it the ten-millionth part of the earth's quadrant. They did not succeed in doing this very well according to our present knowledge of the dimensions of the earth, but they did succeed in making the metre rather more than a millionth part of the extent in latitude of the mainland of Great Britain. The effect of this fortunate circumstance is that the kilometre references of all points on the mainland can be expressed uniformly in six figures, whereas " kiloyard " references would frequently require eight. Unless *all* " kiloyard " references were expressed in eight figures (with a serious loss in brevity) either by the addition of initial ciphers or by moving the origin of co-ordinates still farther to the south-west, this would imply that certain eight-figure " kiloyard " references could be confused with the 100-yard references to other points. Much the same applies, of course, to references given to the nearest greater or smaller unit.

The strongest point in favour of the metre is that its use is growing rapidly, whereas the yard is being used less and less, and that we have to design a National grid not so much for present as for future use. If this country were ever to adopt international metric measures by statute, then we should have to change any yard grid adopted now. By then, it seems certain that a mass of statistical information would have been compiled on it, and the process would involve a change of sheet-lines of the 1/2,500 map, which, apart from the cost, cannot be effected by any mechanical means without a serious loss of accuracy. Whether the country ever will adopt metric measures compulsorily is problematic, but if there is any way of forecasting the future from the past other than by measurements on the Great Pyramid, it may be noted that the metric system was illegal for any purpose no longer ago than 1878 and illegal for purposes of trade until 1897 ; that resolutions in favour of its adoption were adopted at Colonial and Imperial Conferences in 1902, 1907 and 1911 ; that five Bills for compulsory adoption have been presented and that the 1907 Bill was only rejected on the second reading by a majority of

32. Nowadays, the metric system is used almost exclusively for scientific purposes and at least in the electrical and motor industries. Some of the arguments used in opposition to the 1897 Act make amusing reading in 1936: it is at least possible that our complacent minor prophets, who claim to know that we shall always remain as we are, will provide the next generation or so with a hearty laugh.

It has been represented, or rather misrepresented, by some whose antipathy to metric measures appears to rest on nothing more substantial or up to date than dislike of the French Revolution, that the initiation of a metric grid would compel the adoption of metric measures by a British public which has consistently shown its disinclination to be compelled to do anything at all. Nothing could be farther from the truth. The motorist who orders a tyre size 765 x 105 is not compelled to adopt metric measures because these are actually dimensions in millimetres. The presentation of a bill for electricity, supplied through the "grid," in C.G.S. units does not increase his disinclination to pay it. Neither is he compelled to adopt metric measures by ordering 1/2,500 Plan No. 625/750 (instead of Yorkshire XCIX.16) or by finding a point labelled 649401 in a gazetteer, even though these may be dimensions in kilometres. Far from compelling him to think in metric measures now, this proposal has the merit of making a change less expensive should he at any future time decide through Parliament to introduce it.

The metre grid seems to win on points. Like most new-born babes, it may look a little ugly at birth, but the odds are it will soon develop into quite an attractive child.

TRAVELS IN TSITSIHAR.

By CAPTAIN J. V. DAVIDSON-HOUSTON, R.E.

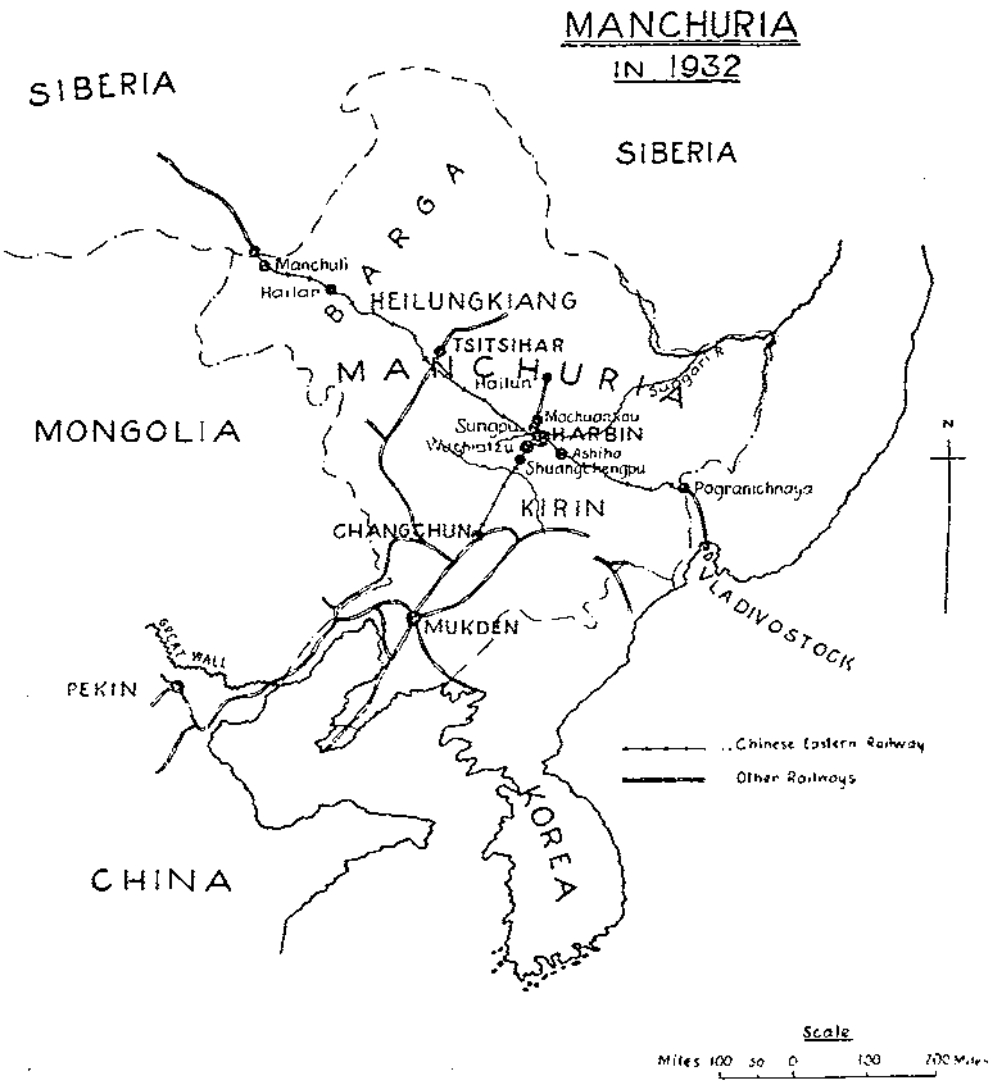
THE Sungari river is peculiar in that its traffic moves along it during the summer, and across it during the winter. As I stood on the quay at Harbin on a February morning in 1932 the scene was sufficiently entertaining to make one forget the fifty degrees of frost which numbed the nose and converted the moustache into a string of tinkling icicles.

The river was about half a mile wide at this point, and frozen to a depth of about six feet; subsidence had caused the ice to assume an undulating character, so that the sledges would appear and disappear over the crests as one watched them cross. Besides horse-drawn sleighs there were *pali*, seating two passengers, which were propelled by fur-clad Chinese with iron-pointed punting poles; the traffic also included motor-cars, and roofed sleighs through whose tops stove-pipes projected. Occasionally an ice-yacht, steered precariously by a young Russian, would sweep past at high speed, while the *pali* men punted madly to get out of the way.

It was on the far bank of the river that my thoughts and gaze were fixed. Harbin had for some time been occupied by Japanese troops, but up till now they had left the other shore severely alone, while they consolidated their position in this Sino-Russian city. Beyond the frozen Sungari, however, lay the vast territory of Heilungkiang, or Tsitsihar, still in the hands of Ma Chan Shan. During the last few months Ma had become a figure of almost legendary heroism, breathing hatred and defiance (at the invading "Dwarf Slaves") from his retreat in the far north. He was applauded by the students and the Press, always ready to take up the pen in defence of their native land, while money contributions reached him in large quantities from the innumerable patriotic societies which had sprung up since the occupation of Mukden. As the Japanese invasion was carried northward, Ma announced his intention of resisting it to the death, and actually offered battle at the Nonni river; his rapid retreat from that action in no way dimmed his glory in the eyes of the Chinese, for whom he now remained their sole hope for the salvation of Manchuria.

Driven from his seat of government in the city of Tsitsihar, Ma had recently established himself at Hailun, a small town on the route which leads from the Sungari to the Amur river, and his army was

now the only organized force opposing the Japanese in Manchuria. While the Tuchun continued to issue the loyal manifestos and "circular telegrams" of which the Chinese nation are so fond, it was noticeable that his troops had taken no part in the resistance which



the garrison of Harbin had offered to the Japanese occupation of that city, but had hovered near the other bank of the river to see how things would turn out. It was characteristic of Far Eastern politics that Ma's agents were at this time negotiating with certain foreign firms for the purchase of arms, while only a few days before Ma himself had secretly dined at the "Moderne" Hotel with

members of the Japanese staff. This last had been discovered by the ingenious representative of a London newspaper, who had induced one of the Russian waiters to lend him his clothes for the evening.

I had made up my mind that I should not leave Manchuria without seeing this legendary hero, and had packed my travelling requirements into a haversack, for in this part of the world a traveller must be prepared to lose or abandon his baggage. I hailed a *pali*, drew the ear-flaps of my fur cap over my ears, and was soon speeding over the ice. On the way we passed close to the large cross built of ice-blocks, which is erected annually at Russian New Year; at this time devout members of the Orthodox Church plunge naked through the hole made in the ice, before a large congregation assembled for the ceremony of blessing the waters. This rigorous ablution is intended to wash away sins, and in many cases is the only cleansing indulged in during the year.

Ten minutes' punting brought us to Sungpu, a collection of huts and hovels inhabited by Chinese and Russians in varying degrees of extreme poverty. The icy, dust-laden wind, and the frozen filth of the narrow alleys, were almost more dreadful than the warm malodours of more southern climes. There was no sign of Ma's troops, and the inhabitants were blissfully existing, as Chinese can, under no government whatever. A curious crowd soon gathered, and I was able to ascertain from it that the Tuchun was lying at a great number of places to the northward, but as no two people could agree as to the actual locality, I decided that there was no alternative to travelling north myself, in the hopes of running my quarry to ground somewhere between the Sungari and the Amur. Looking round for means of transport, I found that the choice lay between a mule cart and a rickshaw, and I selected the man-drawn vehicle as being the more rapid; sitting in any vehicle at twenty degrees below zero is uncomfortable, so that the sooner one's destination is reached the better. My coolie, however, demanded an exorbitant rate, equivalent to about threepence a mile, owing to the hazards and hardships likely to be met with on the journey. The rickshaw is an enterprising vehicle; normally it plies for hire in the winding streets and alleys of every town in China, but is always ready to take a chance in the open country; and I was soon being jolted merrily along over a frozen track which led towards the north.

There was a single line of railway connecting the north bank of the Sungari with Hailun, but no trains were running from Sungpu, as Ma Chan Shan had thoughtfully withdrawn the rolling stock from the vicinity of the Japanese forces. Our progress was slow and painful, and it was getting dark when we reached the village of Hulan, some 15 miles from the river. This village was surrounded by an earthen wall with primitive wooden gates, which were guarded

by a number of ruffians wearing the armlets of Ma's army. The armlet is everything in the Chinese military world; upon it are written the soldier's rank, unit, and other particulars, together with the force to which he belongs; as the uniform worn throughout China is of the same grey colour, opposing sides can readily be made up or changed by varying the armlet. My arrival was regarded with a good deal of suspicion by the sentries, and I was sent under escort to the local commander, a typical bandit of the old school.

As soon as I had established the fact of my British nationality, "Colonel" Wu became most affable, and my condition rapidly altered from close arrest to that of honoured guest. In North Manchuria, the native assumes that any foreigner is a Russian, and is convinced that he is up to no good, whatever his political colour may be; at this time, however, it was hoped that the League of Nations would succeed in forcing the Japanese to withdraw from the country, and nationals of the European Powers were on the whole looked upon with favour. Wu insisted that I should stay the night in his mud-walled *yamen*, and entertained me to a meal consisting chiefly of sea-slugs, bamboo shoots and shrimps, accompanied by neat brandy of Chinese manufacture. Rice was locally unobtainable, while fresh eggs cannot be bought during the Manchurian winter owing to the refusal of any hen to lay during that period.

My host told me that Ma Chan Shan's headquarters were still at Hailun, and that the railway was running from Hulan to that point. Next day I accordingly dismissed my gallant rickshaw coolie, and at 10 a.m. boarded the train, provided with one of the free passes which are so generously distributed by Chinese officials to their friends.

The little train, consisting of a few trucks, and a newly-built and therefore fairly clean carriage, progressed slowly through the dreary landscape of undulating plain covered by patches of thin snow. Stations were few and far between, but we stopped at them all; at some of them I saw the women wearing the flat, embroidered Manchu headdress which has gone out of fashion in China. As we went farther north, I noticed that the towns, unlike those of the south, were not surrounded by walls, for these were Manchu camps long before the tide of immigration swamped the Manchus in Chinese culture. I was an object of curiosity to the many small children in my carriage, who would come up to me, gaze at me for some moments, and mutter: "Is it not a Hairy One (Russian)?" until called off by their parents.

At four o'clock in the afternoon we reached the terminus, where I was amazed to see three motor-cars flying Ma's three-cornered dog-toothed flag. Colonel Wu had apparently informed the Hailun headquarters of my impending arrival, and an officer, accompanied by a retinue of cut-throats, politely conducted me to one of the cars. We drove into the grey town, and stopped at a building belonging to

the Kuang Hsing Trading Company. These unfortunate merchants had evidently been ordered to arrange for my accommodation, for a genial fat man, typical of the Chinese commercial class, welcomed me at the door and lodged me in a large room containing two brick stove-beds and piled sacks of soya beans.

I had hardly stretched myself out on one of the beds, before a small bespectacled man, dressed in a black gown and jacket, entered the room and surprised me by addressing me in English. "How are you, good afternoon," he said, with a bow. "General Ma will see you right now, if you please." I got up, shook hands with my visitor, and exchanged cards with him. His card was inscribed on one side with the names Liu Po Ch'en, in Chinese characters, and on the other side was printed, "Paul C. Lew, graduate of Yenching University, Peiping." As we drove to the *Yamen*, Liu informed me that he had studied English, French, chemistry and physics; his real profession, however, was leather-tanning, while his present occupation was that of Secretary to the Tuchun. He was an interesting specimen of a foreign-educated student recently returned to a completely Chinese environment; one could see that the veneer was already wearing off, and that it was a conscious effort for him to assume Western manners while conversing with me.

The *Yamen* was guarded by two sentries armed with rifles, and better dressed than any I had hitherto seen in this region. They saluted as we entered, and I was shown at once into the presence of Ma Chan Shan.

The Hero of China was reclining on a stove-bed, known as a *k'ang* by the Chinese, dressed in a blue silk gown. He was small but wiry, and his ill-tempered mouth was partly concealed by a drooping black moustache; unlike most of his race, he was sparing of speech and smiled rarely. After we had exchanged compliments, he bade me be seated, while he once more lay down on the *k'ang* and regarded me fixedly for about a minute; he then reached for the little opium lamp by his side, and warmed a small lump of the narcotic over it by holding it on the end of a long pin. Taking up an ivory pipe, he inserted a pinch of opium in the minute bowl, and inhaled deeply two or three times. After this, he leaned back on a pillow and closed his eyes for some seconds. At length he was able to talk, but every few minutes he would have recourse to his pipe, without which he seemed unable to sustain the conversation.

I told the General that foreign nations regarded his struggle against the enemy with interest and admiration, and that I hoped he would give me his valuable opinion on the possible future trend of events. At first Paul C. Lew endeavoured to act as interpreter, but he soon became so confused and involved in English and French that Ma and I decided to struggle along in Chinese. He told me that he had twenty thousand men, but that they were deficient in

ammunition and in any modern weapons such as aircraft or tanks, both of which were being used by the enemy. Since the fall of Harbin he had signed a pact of non-aggression with the Japanese. "Of course," he added naïvely, "they do not trust me, and I do not trust them. As soon as they have established themselves in the Harbin district they will cross the Sungari. In such an event, my duty to China and to the people of this province demands that I should resist them. At the Nonni river, my troops fought fiercely, and the noise of the guns was very great; it became necessary, however, for them to retire, since they were short of ammunition, and we are now concerned solely with the defence of our own homes. Although I am willing to die in order to defeat the Japanese, yet I feel it is my duty to spare my people the horrors of war." After hearing this speech, few could have predicted that, within a few weeks, Ma Chan Shan was to accept an official post from the Japanese, and then suddenly start a guerrilla campaign against them until he was forced to take refuge across the Russian frontier.

Dinner was served at six o'clock, at which a large number of officials, both civil and military, were present. Most of them took the opportunity of impressing upon me the dangers of Japanese imperialism, not only to China, but to the world. "Japan wishes first to conquer China," said one of the guests, "and then she will attack the Philippines, Singapore and Hong Kong. After that she will take India, and is not that a British possession?" "The League of Nations," remarked another, "is, as you say, conducting a full inquiry into the dispute between our humble country and Japan; but if she does not act soon, it may be too late to save the interests of the Great Powers." General Ma leaned over the table and narrowed his eyes to mere slits as he murmured: "What do you think of buying weapons from Soviet Russia?" "I am flattered that you should ask my despicable opinion upon such a matter," I replied, "but it seems to me, that although you may be able to obtain what you want from across the border, there is a risk that you may also obtain what you do not want." Ma made no answer, but pressed me to help myself from a dish of small birds, no bigger than sparrows, which had been placed before us. These birds are found in the mountains north of Hailun, are fried in oil, and are devoured, "with the bones and the beak," in a single mouthful.

In accordance with Chinese custom, all the necessary conversation had taken place before and during the meal, and as soon as we had rinsed out our mouths we retired to our several sleeping-places. Just before I drove back to the Kuang Hsing building, I received an impression of another aspect of the General's character. A telephone rang in a small office off the entrance to the *Yamen*, and Ma was informed that some officer wished to speak with him. In common with most offices in the country, the telephone-room had a

curtain in place of a door, so that it was possible to hear the Tuchun's strident voice replying to the unfortunate speaker at the other end. "It is false; it is not true. Why do you presume to bother me with these ridiculous rumours?" There was a pause, after which the General began again, his voice trembling with fury. "Such messages from you I will not have. If you dare to speak this wild talk again, you will be put to extreme inconvenience." In a country where it is extremely rare to say what one means Ma had shown himself to be unusually direct and outspoken.

At the Kuang Hsing, I had the whole of one *k'ang* to myself, while seven employees of the firm slept on the other. My bed consisted of a mattress covered by a single sheet, upon which I lay, covering myself with a number of quilts full of unspun cotton; the snoring was deafening, and as it was hardly eight o'clock, it was very difficult to sleep. Breakfast was served on the *k'ang*, and was attended by the head of the firm and Paul C. Lew; the bedding was rolled back, and we partook of neat brandy, fermented bean curd, and other dishes with which the Chinaman considers it proper to start the day. The meal was rendered no more appetising by the ablutions of the firm's employees, which took place in the neighbourhood, and consisted largely in rinsing out the mouth and scraping the tongue.

At nine o'clock my friends escorted me to the station, and General Ma politely sent his official entertainer to wish me good-bye on his behalf. As soon as I returned to Harbin I found that city, always the source of the wildest rumours, full of tales about a concentration of Soviet forces opposite Manchuli, where the Chinese Eastern Railway joins the Trans-Siberian system. As developments in that quarter might have some bearing on the movements of the War Lord of Heilungkiang, I boarded a train next morning, and set off for the western frontier.

The line crossed the frozen Sungari and cut straight across the rolling steppes, which were covered with thin snow and completely devoid of trees. The Chinese Eastern Railway is comfortable and fairly clean, although bugs naturally linger in any compartment much occupied by Russians; there was a good restaurant car, where fresh milk was obtainable, but during the winter the traveller may cry in vain for new-laid eggs. Bullet-holes were by this time becoming a common feature in the walls and ceilings of the compartments, and the Russian waiters would describe when and where the train had been subjected to fusillades from bandits or irregulars.

During the night we passed through the small station of Chinghiz Khan, in the foothills of the Khingan Range, and crawled through the dark pass in the mountains which are regarded as the natural barrier to an invasion from the north-west. There was a full moon, and the scene presented a contrast of snowy peaks with black shadows. The highest hills are about 6,000 feet, but their contour is not rugged, and

they do not afford an obstacle comparable to the Hindu Kush or the Alps.

Next morning we passed Khingan station and found ourselves once more in the prairie, upon which were herds of ponies struggling to find sustenance beneath the layer of snow which covered the dead grass. An occasional camel caravan could be seen making its way into the interior from some trading station on the line.

At one o'clock we reached Manchuli, or Manchuria Station, as the Russians call it, and I left the train to explore the border town. It is a small place, consisting mainly of wooden shacks inhabited by chronically unwashed Chinese and Russians; the streets are unmetalled, and badly cut up by the wheels of carts. There were a few miserable shops selling food and household utensils, with signs inscribed in the Russian, Chinese and Mongol languages; there was the ubiquitous Japanese barber's shop and no less than two Russian cabarets, although it was difficult to believe that their custom would be sufficient to support them. I entered the Railway Club, an institution established by the Soviet management for their employees, but available as a restaurant for passing travellers. Here I warmed myself with a glass of tea and lemon, beneath a painting of Voroshilov, the Commissar for War, and a large placard urging the Oppressed Peoples of the World to unite. Upon the opposite wall was a large picture of Lenin, dressed as a workman, brooding over the waters of the Neva. The atmosphere was thick, and the table manners primitive, so I soon left the place and hired a droshky in order to explore the neighbourhood.

Being mistaken, probably, for a Russian, my appearance excited little curiosity, and I was able to move about without drawing crowds of Chinese after me. I intended driving to the frontier, which lay some five miles away, but the *izvoshchik*, after going about three miles, refused to go any farther. He pointed out a low ridge in front of us, along which ran the border; it was, however, so ill-defined that it was impossible to be sure when one had crossed it, and the Soviet patrols had no hesitation in firing upon anyone in their vicinity. Just outside the town was a large barracks of red brick, built originally by the Russians to accommodate their railway protection troops, but now occupied by some two battalions of Chinese soldiers, whose allegiance was as uncertain as their pay.

I carried a letter of introduction from a mutual friend in Harbin to a resident of Manchuli named Mihail Ganin, and later in the afternoon I sought his house, which turned out to be a substantial brick building on the outskirts of the town. Here I was hospitably received by the Ganin family, which consisted of Mihail himself, a black-bearded farmer, his fat, kindly wife, and three young sons between twenty and thirty years of age. We all sat for some time, while I addressed them in halting Russian, and they smiled and

added *Pojaluista* (" Please ") to everything I said. The Ganins were substantial ranchers, owning large herds and vast pastures ; while they kept a number of Russian sires, which they put to the native mares for the purpose of raising the " half-breed " which is seen on many race-courses in China. Like many inhabitants of this region, the Ganins had taken Soviet nationality for convenience, but it was obvious that they had no intention of returning as *Kulaks* to their native land.

At ten o'clock we sat down to a meal reminiscent of the massive appetites of departed centuries. We began with vodka and *zakuski*, those magnified *hors d'œuvres* which in themselves are sufficient for a meal, and then were confronted by several dishes piled high with what resembled pancakes. These were *blini*, reserved for this time of year in the same way as turkeys are reserved for Christmas ; the eating of them is by no means so simple as their appearance leads one to believe. Each one has to be spread out on a plate, covered with caviare, butter and sour cream, folded up, and finally introduced into the mouth. I was dismayed to find that my hosts consumed from seven to ten of these *blini*, while I was compelled to acknowledge defeat at the third, a fact which induced Madame Ganin to inquire whether my lack of appetite were due to ill-health. As with Chinese banquets, it was not easy to foretell how much more was coming, and my embarrassment progressively increased as fish, meats and sticky sweets loaded the board. Towards the end of the dinner, the family rose from the table and surrounded me, while the hostess filled a silver goblet with wine and offered it to me with a song consisting mainly of the words " *Pi do dna* " (" Drink to the bottom "), in which the others joined. We then sang " *Stenka Razin*," a wild Cossack song all about the *ataman* who threw his beautiful captive overboard sooner than make his beloved crew jealous of the attention which he paid to her. At length we moved to another room, where cakes were laid out for anyone who might still be hungry, and talked till after midnight. A fascinating feature of a Russian house is the *ikon*, or sacred picture, which is embellished in gold and silver and hung in a corner of the room, with a silver lamp hanging before it. I was sorry to leave the solid comfort of the house for the icy squalor of Manchuria Station, but I wished to catch the train which left at about 2 a.m.

On my way to the station I looked in at one of the cabarets. It was a wooden shack, with a huge stove in the middle of the floor, and a bar at one end. There was room for three or four tables, at which sat a number of poorly-dressed Russians, amusing themselves with the tawdry ladies of the establishment and drinking vodka ; a depressed-looking pianist played Russian songs on a broken-down instrument, without appearing to entertain any of the company. I drank a bottle of Japanese beer and went to my train.

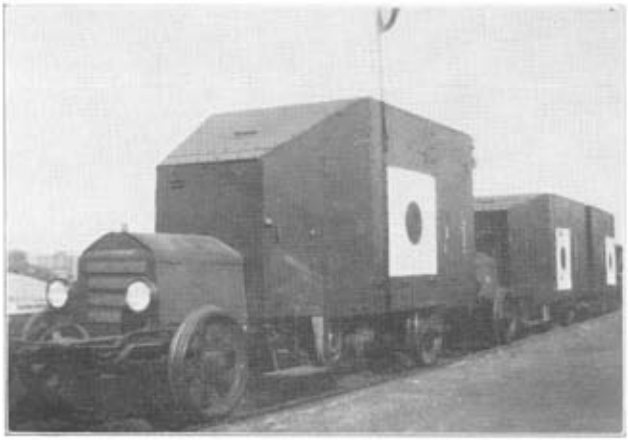
1.—Typical Manchurian Chinese.

2.—A nomad encampment. These round, hive-like tents are the general ty of dwelling.

3.—Manchurian irregulars.

Travels in Tsitsihar 1 - 3.

4.—Japanese armoured car (Harbin).



5.—Japanese armoured cars on railway mountings (Chinese Eastern Railway).

At dawn we stopped at Hailar, the centre of the Barga Mongols, whose antipathy to the Chinese had for some time made the place a potential storm centre. I alighted, and walked into the town, which was larger than Manchuli but consisted of similar wooden shacks and unmetalled roads. The inhabitants were mainly Chinese and Russian, but there was the inevitable Japanese barber's shop, and occasionally a Mongol would gallop down the street, dropping the reins and swinging his arms to warm himself. The traffic comprised sleighs, camels and droshkys; the goods carried mostly seemed to be wolf-skins and hides. Hailar was garrisoned by the troops of Su Ping Wen, who, like Ma Chan Shan, was officially at peace with the Japanese, and charged with the protection of the railway between Harbin and Manchuli.

I called at his headquarters and endeavoured to discover his attitude towards the Japanese. Su was more reserved in his speech than Ma Chan Shan, but I gathered that his attitude was very similar; disliking the invaders, he nevertheless found it politic to make a working agreement with them until such time as he might consider it expedient to violate it. Su Ping Wen was originally one of Ma's subordinates, and later in the year was to follow his Tuchun's example and levy guerrilla warfare against the new régime until he also was forced to flee across the border, taking with him a large number of White Russian prisoners in order to secure the favour of the Moscow Government.

A more interesting visit was that to the Amban of Barga, whose palace lay on the outskirts of Hailar. The old man did not appear in person, but I was received by one of his officers, a Mongol with the reddish moustache and grey-blue eyes which are sometimes met with among Tartars. This official, representing the Mongolian tribes of north-western Manchuria, told me that Prince Kuei, the Amban's eldest son, was now in Mukden taking part in the discussions preparatory to the establishment of a Manchurian-Mongolian state to be known as Manchou Kuo. The natives of Barga had remained loyal at heart to the Manchu House, and twenty years of the so-called "Chinese Republic" had not in any way changed their inclinations; they had heard that the Japanese proposed to set the exiled Emperor of China at the head of the new state, and were prepared to co-operate with the invaders upon this condition. The Mongol cavalry which assisted in the capture of Jehol the following year was doubtless a justification of the Japanese policy. I was interested to learn that the moribund Manchu language was still used officially in Hailar, and took its place on public notices beside Mongolian, Russian and Chinese.

Rumour, which travels in the Far East as quickly as wireless, announced that Ma Chan Shan had returned to his old capital of Tsitsihar, in spite of the fact that a Japanese brigade was in

occupation of the city. I accordingly boarded the afternoon train returning to Harbin, and quitted it at Angangki, the junction for Tsitsihar. It was one o'clock in the morning, but I was not sorry to leave the train, as the temperature outside was 35 degrees below zero Fahrenheit, and it was pleasanter to walk about than to sit in a carriage whose *provodnik* was too sleepy to keep the stove burning. The little platform was deserted except for a figure dressed in the black uniform of the Chinese Railway Police, who walked towards me and revealed in the lamplight a flat Russian face decorated by an enormous pair of flowing moustaches. "*Zdravstvuite*," I said. "*Zravstvuite*," he replied, saluting, "where are you going, please?" I explained who I was, and that I wished to go to Tsitsihar; the old man was most friendly and insisted, as the local train would not leave till eight o'clock next morning, that I should spend the remainder of the night at his house. At the prevailing temperature, such an invitation was extremely welcome, and I followed the policeman out of the station to a small wooden house that stood among some stunted trees. An oil lamp burned in the entrance, by the light of which my host showed me to a divan, poured me out an excessive quantity of vodka, and bade me good night.

Next morning I met the Pushkarev family at breakfast, which consisted of gruel, cold sausage and black bread. The policeman, Nikolai Nikolaievitch, was an ex-serjeant-major of the Imperial Russian cavalry and given to telling tales of horror about the various civil and other wars in which he had apparently taken a conspicuous part. Like most married women of the peasant class, his wife was fat and hospitable, while they had a pretty young daughter whose hobby appeared to be collecting fashion plates from any foreign newspapers or magazines that Fate might waft to Angangki.

The eight o'clock train left at half-past nine, and consisted of a single carriage crowded with Chinese peasants, drawn along a narrow-gauge line which was dangerously unballasted. We must have averaged ten miles an hour, and took an hour and a half to reach Tsitsihar. The capital of Heilungkiang was singularly unimpressive, a grey-walled, dusty town of Chinese merchants dealing largely in beans; the place was occupied by Japanese troops, so I decided to call on the garrison commander. I took a droshky to the building which had been requisitioned as the Japanese headquarters, and spent a difficult half-hour trying to probe the Japanese mind by means of the French, English, Russian and Chinese languages. According to the commander of the Tsitsihar garrison, Ma Chan Shan had just returned to Tsitsihar, and had asked for Japanese support, which had been accorded "under certain conditions." Ma's troops now occupied the northern part of the town, while the Japanese were in possession of the southern half, including the branch railway to Angangki junction. A peculiar feature of the Japanese occupation

of Manchuria was the importation into garrison towns of numbers of geishas, in order to prevent the possibility of the troops associating with the women of the country.

I then called at the Chinese headquarters to hear Ma Chan Shan's version. I was received by his Chief of Staff, who informed me that Ma had been compelled thus to co-operate with the invaders, under the threat of punitive action, and that he was now virtually Governor of Heilungkiang by the grace of Tokyo.

I stayed the night at the Lungkiang Hotel, a small "foreign-style" place under Russian management. I was surprised to observe that one of the waitresses, a black-haired girl of Tartar features, entered the room next to mine, which was already occupied by one of the guests. As the walls were merely wooden partitions, I was considerably embarrassed by being compelled to hear everything which occurred next door. The guest was occupied with a typewriter, the tapping of which ceased shortly after the entry of the girl, and was followed by conversation of the most passionate character. A silence ensued, and again the typewriting began, until at last the clicking ceased and the love-making began again. The guest appeared to be a man with great powers of concentration, and I was kept awake most of the night by alternate periods of typewriting and romance.

I returned to Angangki next morning, and said good-bye to my kind friends the Pushkarevs. Their precarious condition was typical of that of many unfortunate but respectable White Russian families in Manchuria. Disliking and disliked by Chinese officialdom, they enter the lower grades of the public services in order to obtain a livelihood, and because the Chinese realize that they can be useful. Having no government to protect them, they must submit to Chinese law, which is apt to be oppressive to persons of little substance. I often wonder how they have fared in the present turmoil of Manchuria, whether they transferred their allegiance to the new régime or whether their troubled lives were ended in some guerrilla battle on the Chinese Eastern Railway.

The train to Harbin was full of Japanese civilians, who continued to travel unconcernedly about Manchuria, while their troops were engaged in conquering the country. In spite of the dislike of their race by the Chinese, and the fact that the armies of the two countries were engaged in hostilities, a Japanese subject was exposed to no greater perils than those threatening a member of any other nation; the outbreak of disorder due to the operations in Manchuria menaced all alike.

I found Harbin dressed *en fête*, gay with many-coloured bunting and triumphal arches of trellis-work. Posters and banners announced that the birth of the new Manchurian-Mongolian State would be officially celebrated in the open space before the Cathedral

of St. Nikolai. At about mid-day this space began to be filled with crowds of Russians and Chinese; the police, who had gone over in a body to the new authority, were employed to divert pedestrians into the square and to prevent them leaving. In this way a great number of docile but unenthusiastic people were collected for the demonstration, while many were hired to distribute magenta-coloured and yellow flags, bearing Chinese characters to signify that the Millennium had arrived for the people of the Three Eastern Provinces. For the first time I saw the flag of Manchou Kuo, a yellow field for the Imperial Manchu House, with bands of red, blue, black and white in the corner to represent the other races which make up the population of the State.

At about three o'clock a droshky drove through the crowd, and pamphlets were scattered from it by a Chinaman, who stood on the seat; these pamphlets set forth the evils and oppressions of the late Chang régime, and explained how the people of Manchuria, "grinding their teeth and generating the vapour of fury within them," had at last revolted and by universal agreement had established an independent Utopia. A little later bugles were blown to command silence, and a speech was made from a temporary rostrum by a little Chinaman, who had been appointed Mayor of Harbin under the new dispensation. Other speeches followed, and a few paid spectators shouted "*Wan Sui!*" ("Ten thousand years!") at regular intervals, after which the crowd was allowed to disperse. The only signs of Japanese interest in the ceremonies were the faces at the windows of the Special Military Mission, which overlooked the square, and two or three aeroplanes which circled nonchalantly overhead.

That evening the city was brilliantly illuminated, and lanterns were carried about the narrow streets of the Chinese quarter. As I walked along the snow-covered roads, past the droshky drivers sleeping stoically upon their boxes and the groups of fur-covered, chattering Chinese, I met patrols of thick-set, khaki-clad little soldiers stumping about the town in every direction, and realized how Manchuria was to be governed for the future. Paper lanterns and machine-guns were to be the Government, not only in Harbin, but in distant Kirin, Fengtien and Tsitsihar; whatever talk there might be of Constitutional Monarchies, Republics or Protectorates, it was obvious of what the administration of Manchou-Kuo consisted: machine-guns and paper lanterns.

AN OUT-OF-THE-WAY LEAVE.

By LIEUTENANT A. S. T. GODFREY, R.E.

THE idea of a leave of two months' duration, in which one has a very good chance of shooting a polar bear and the possibility of seeing a walrus, may sound to some people fantastic. Polar bears conjure up visions of Arctic expeditions and the long polar winter. And to shoot one in the summer seems only possible to a millionaire who can charter a stout ship to force its way far north into the Arctic Ocean. But the idea is not so fantastic and is perfectly capable of cheap fulfilment.

Based on the ports of Tromsö, Varda and Aalesund in northern Norway, there is the considerable industry of sealing. From these ports over 40,000 tons of shipping make two, and sometimes three, voyages in the spring to the White Sea. Then many ships, their spring programme completed, make their way north to the coasts of Spitzbergen. And of these the more enterprising—perhaps only five or six in each year—go up the Hinlopen Strait, between Spitzbergen and North-East Land, to the edge of the pack-ice which, in July and August, generally lies a few miles off the coast of North-East Land. These five or six ships think themselves extremely unlucky if they do not shoot bear.

The animal mainly hunted in the summer voyages is the great bearded seal or *storkobbe*, which, with the polar bear and ivory gull, form a clear-cut community of the pack-ice. To this community in recent years has been added another member, man, in the guise of the Norwegian sealer—with advantage only to the scavenging ivory gull. The *kobs* are large animals, about eight feet long, a dark greenish grey in colour. They subsist on marine animals such as fish and crustaceans. While digesting this food, they lie out sluggishly on the edges of thick ice-floes, and they are then hunted by bears, which try to creep up behind them and kill them. The *kob* is the chief food of the polar bear in summer, so, in a voyage to a region where the polar bear has not yet been shot out, such as North-East Land, and when hundreds of *storkobbes* are killed, it would be the worst ill-fortune not to catch a glimpse of a bear. The writer had the good fortune to do a tour on the *Vesteris*—55 tons—during which thirty bear and thirteen walrus were killed as well as the full complement of seals.

Sealers start their summer voyage about the end of June. In

1934, the last ship home arrived in Tromsö on September 3rd, but the average voyage is six weeks. From Tromsö to South Spitzbergen takes from two to five days. Then, if the ship is hunting in North-East Land waters, it turns N.E. past Edge Island and Barents Island to the Waiigat Islands in the Hinlopen Strait. Here is a favourite hunting-ground, where, in 1930, one ship, the *Endeavour*, in ten days killed up to three-quarters of her capacity. From here the ships make their way slowly up the Strait and along the coast of North-East Land, branching off north to the pack or into the bays, wherever there are loose floes and a likelihood of seal. The ships return the way they have come or round the north of West Spitzbergen; few go down the east coast to circumnavigate the island. The pack becomes heavier and heavier with the cold polar current running down the east coast.

The actual process of hunting is a pleasant one, for it can only be undertaken in calm weather. In winds over Force 4 the seal finds the water warmer than lying on a floe, and in any case it is difficult in anything of a sea-way to catch sight of their small black heads as they break surface to breathe. The ship steams at an economical speed, with the captain or a mate in the crow's nest, from which he shouts orders to the wheelhouse. He has the dual responsibility of looking out for hidden rocks and shoals in those uncharted waters, and keeping a watch for seals. In the simplest case, when a seal is sighted, the ship turns towards it, shuts off its engines and glides on. Two marksmen crouch in the bows and, at a hundred yards' range, fire together. If the animal is killed outright, the ship anchors to the floes, and one of the crew jumps down to skin the animal. The valuable part is the skin and blubber, which are hauled on board. The carcases are usually left on the floe to be eaten by ivory gulls.

But the hunting is rarely as simple as that. Generally a whale-boat is lowered away. One of the mates crouches in the bows with a rifle, two of the crew row, one in the standard manner, one pushing at a pair of muffled oars from the stern. At a signal from the mate the centre man stops rowing and crouches down while the stern man pushes the boat silently on. At 100 yards he also crouches down. Occasionally with a very somnolent seal the mate gives a low whistle to make it look up and present its neck for a shot. But generally the seal is by this time suspicious and restless.

These men are magnificent marksmen. They use the Norwegian Army rifle which, though less sturdily built and less powerful than the '303, has much finer sights. To kill a *storkobbe* means a 4-in. bull at 100 yards from an open boat. Yet I saw only one miss in over a 150 *kobbe* shot.

As regards the practicability of going on a sealing voyage, the writer knows two captains who, for a small sum, would be willing

M.S. *Polar*, 30 tons.

Shooting from the whale-boat.

[*Photographs by kind permission of Mrs. A. R. Glen.*

An out-of-the-way leave 1 & 2

A fjord seal stalked and caught alive.

On the watch for eider duck.

An out-of-the-way leave 3 & 4

to take an Englishman up north with them on their summer cruise, and he will be only too pleased to give their names and addresses to a "genuine inquirer." It is not every year that these two men go as far as North-East Land, but they would undoubtedly get into touch with other captains equally willing, one of whom would probably be making the voyage outlined.

One is, of course, a passenger on a sealer. Linguistic difficulties alone prevent one taking a very active hand. On practically every sealer there is at least one man who can speak English. A knowledge of German would be very useful, as many of the men have a smattering of that as well. With the study of a tourists' phrase-book on the way to Tromsö one should at the end of three weeks be colloquial in Norwegian. But from the start it should be realized that, apart from pulling at an oar occasionally, there is little enough at which one can genuinely help.

The cruise could be done at a cost of under £50. Below is a list of the items involved, which are explained later.

	£	s.	d.
Return fare, 3rd class, London–Newcastle ..	3	10	6
Return fare, 3rd class, Newcastle–Bergen ..	7	0	0
Two nights in Bergen	2	0	0
Return fare, Bergen–Tromsö	4	0	0
Possible stay in Tromsö of one week	3	10	0
Sum paid to sealer	20	0	0
Incidental expenses	5	0	0
Clothing	4	0	0
	£49	0	6

At the offices of the B. & N. Line, Royal Mail, Ltd., 25, Whitehall, one can get a ticket to Tromsö. Third class on the various boats is somewhat "native," but anyone anxious to go on a sealer will not presumably be fussy about the small amount of discomfort entailed. Two nights in Bergen have been budgeted for, as the packet to Tromsö does not always connect. The possible stay at the Grand Hotel, Tromsö, at which one can stay in great comfort for six crowns a day, is included because sealers do not always sail to time, and in any case it would be advisable to arrive a day or two before the date fixed by the captain.

The sum paid to the sealer is from the writer's experience. I paid £5 for my food for a month and spent roughly £10 in presents to the skipper and crew at the finish of the trip. A careful man could undoubtedly do the trip for less than £50. The journey back, for instance, could be made *via* Stockholm and Gotteburg which, though more complicated, is cheaper than the route outlined. Over and above this there is the question of the possible bear. A ·303, to

shoot it with, cost £7 from Ordnance. Hiring a rifle would presumably be cheaper. Ammunition would be a few extra shillings. One would have to pay the captain the price the skin would fetch in Tromsö, roughly £2. Then, if one wanted to be the only man to shoot, it would be only fair to pay the same sum if the bear got away. It would be an expensive miss; perhaps it would be better to shoot in concert with the ship's marksmen. Admiring friends and relatives viewing the skin later need not be let into the secret!

Finally, the clothing. There appear to be many myths about the Arctic, not the least of which is that it is cold in summer. It is founded on a substratum of truth, but has been magnified to a considerable bogey. Sea-level temperature in the Spitzbergen area in July and August rarely falls below freezing. Nevertheless, one can meet with wind at full gale force at a temperature only a degree or two above freezing. The climate can certainly not be treated with contempt, but no expensive outlay on clothing is necessary. With winter underclothing, a flannel shirt, flannel trousers and two sweaters under some form of windproof covering, one would never be cold, and at times will be sweating profusely. Apart from ordinary winter clothing, one would need sea-boots, a pair of fingerless gloves, a balaclava, trousers of some windproof material, and a leather golfing jacket. A sleeping bag of two blankets sewn together would complete one's outfit.

Life on a sealer is rough. Apart from the men, who, though stout-hearted and wonderfully genial, are respecters neither of persons nor property, the conditions are harsh. The writer has spent a month on a trawler during equinoctial gales, and a month on a sealer. For sheer discomfort, the sealer could at times give the trawler points and a beating. But it is not for this reason that a voyage in polar waters is unlikely to be forgotten in the whole course of a lifetime.

First there is the cruise up the coast of Norway inside the thick flurry of islands that fringe the coastline, when one can see deep gorges, waterfalls innumerable, pine forests, and mountains towering over the tiny and remote farmsteads. Half-way up the coast one crosses the Arctic circle. Then, part psychologically, part sensibly, one begins to feel amazingly fit. The sealing cruise itself is original and novel. Though sealing is an industry and an industry of slaughter, there is a thrill in the stalk of each animal, and each seal caught or lost is a story in itself. It verges on the commonplace to say that the Arctic has a supreme fascination, but, though it cannot be denied it has its periods of harshness, there are, far overweighing these, times when Life has nothing better to offer.

There is always that possible bear. It is worth trying at least once.

Brigadier-General Sir William Danvers Waghorn, Kt., C.B., C.M.G.

Brig Gen Sir William Denvers Waghorn CB CMG

MEMOIR.

BRIG.-GENERAL SIR WILLIAM DANVERS WAGHORN, Kt., C.B., C.M.G.

WILLIAM DANVERS WAGHORN was born on 5th July, 1867, the son of Surgeon-Major A. R. Waghorn, of Redhill. He was commissioned in the Corps from the R.M.A., Woolwich, on 16th February, 1887, and after the usual course at the S.M.E. went in February, 1889, to India, where he spent most of his service. He was first attached to the Q.V.O. Sappers and Miners at Bangalore, but in December of that year went to the Indian Railway Department at Madras, thus commencing a very long and distinguished career with the Indian Railways. He remained at Madras till 1894, when he went to Bombay as Deputy Consulting Engineer for Railways. He was still holding this appointment, when, in the general frontier "flare-up" of 1897, he was sent to the Tochi Field Force, where he served as Assistant Field Engineer and later as Field Engineer for five months, receiving the Indian G.S. Medal and Clasp. After a period of leave, he joined at Chatham in 1899 for the "Wild East" Course, and was there when the South African War broke out. He went to South Africa in October, 1899, and served throughout the war, first as Deputy Assistant Director of Railways and later as Superintendent of Works, Military Railways. He was mentioned in dispatches, won six clasps to the two medals, and also a Brevet Majority. After a short period of leave he returned to Bombay again as Deputy Consulting Engineer, but was transferred to Lucknow in the same capacity in April, 1905, and held that appointment till April, 1907. He then went to Lahore as Deputy Manager of the North-Western Railway, remaining there till 1911, with the exception of a short period at Lucknow. While on leave in 1911 he was sent to West Africa as Inspector of Railways, Northern and Southern Nigeria, a position he only held for a few months, after which he returned to India. He resumed his work as Deputy Manager at Lahore, and in 1913 went to Lucknow as Agent, Oudh and Rohilkund Railway. He was promoted Lieut.-Colonel in March, 1914.

He was on leave in England when the Great War broke out, and

his experience was at once applied to the organization of railway construction personnel, stores and equipment. He was thus appointed Deputy Director of Railway Transport in August, 1914, and, after a brief preparatory period at home, joined the Railway Directorate in France as Chief Railway Construction Engineer; he was appointed successively Deputy Director of Railway Construction in October, 1915, and Director of Railways in November, 1916.

In the early stages of the war the efficiency of the Railway Construction troops was largely attributable to Waghorn's energy, to his previous experiences in South Africa and India, to his practical methods of handling officers and men, and to his relationships with the French and Belgian railway authorities.

On leaving the Railway Directorate in May, 1917, he became Chief Engineer, XVII Corps, with which he remained till the end of the war. He was four times mentioned in dispatches and received, besides the 1914–15 Star, War and Victory Medals, the Brevet of Colonel, C.B., C.M.G., Belgian Order of the Crown, 4th Class, Belgian *Croix de guerre*, and the Legion of Honour, 4th Class.

He returned to India in 1919, and was made a member of the Railway Board, and gave himself unsparingly to transport needs for the Afghan and Frontier campaigns. From 1921 to 1924, he was President of the Board, until its reconstitution under the recommendations of the Acworth Committee, and did what financial stringency permitted to make up the grave deficiencies in equipment and rolling stock on the Indian Railway system, which had resulted from the great demands made on it by the war. If there was latterly some want of flexibility of mind to meet changed conditions, there was no waning of zest and industry. Both in war and peace he had a very high sense of duty. He hated anything underhand or mean. He was a sure friend, an inspiration to his subordinates, and one of the "whitest of white men."

Waghorn was knighted in 1923, and retired in July, 1924, with the rank of Brigadier-General. He subsequently lived in France, and died at Nogent-le-Rotru on 15th September, 1936.

He married in 1890 Emily Isobel, daughter of Mr. F. H. Hodd, and had a son and two daughters. The son, Major R. D. Waghorn, is in the Corps, having, like his father, served for several years with the Indian Railways and being now at the Railway Training Centre, Longmoor.

All Reviews of Books on military subjects are included in the provisions of K.R. 535c (*1935*).

BOOKS.

(Most of the books reviewed may be seen in the R.E. Corps Library, Horse Guards, Whitehall, S.W.1.)

THE WAR MEMOIRS OF DAVID LLOYD GEORGE.

VOL. V.

(Ivor Nicholson & Watson. Price 21s.)

Mr. Lloyd George's fifth volume maintains the standard of its predecessors; brilliant writing, scathing criticism and unfair judgment. Mr. Lloyd George's obsession, in this volume, is an alleged military conspiracy to overthrow his Government, engineered chiefly by Sir William Robertson, who, in particular, is charged with aiming at a Military Dictatorship. Sir Douglas Haig is regarded as another 'conspirator, although Mr. Lloyd George does allow that his loyalty forbade him to go to extremes. No two men were less like dictators than those two Generals, whose whole lives were devoted to loyal service as soldiers, who, by their actions and in their writings, condemned criticism of the Government by soldiers, but who, in their high offices, were bound in duty to give advice which their professional training and experience fully qualified them to give. It was because these men found Mr. Lloyd George forcing his dictation of military strategy that they felt it their duty to oppose him, and in doing so they have incurred his implacable wrath. Nothing resembled dictation more than Mr. Lloyd George's own efforts to take the direction of military affairs out of the hands of soldiers. Long years after the events, he attacks the Generals, accuses them of incompetence, wilful obstinacy, and finally of conspiracy against the Government. The tale would be ludicrous if it were not so bitter.

So Volume V carries on the onslaught against the soldiers, and is chiefly filled with military criticism. The opening chapter describes the outlook for 1918. Sir Douglas Haig is, of course, blamed once more for persisting in the attacks in the Ypres Salient and wearing out the fine British Army "which in June was the most formidable force "on the Allied side." Mr. Lloyd George ignores the other side of the picture, as he always does when "appreciating" a military situation. He forgets that in May, 1917, he had entirely agreed with the soldiers, that in view of the precarious state of the French Armies the British Army must go on fighting, to keep the Germans from attacking the French. "We must go on hitting, and hitting with all our might "until the Germans cracked," he said then, and he did not wish to know the plan or where the attack would take place. Haig went on hitting—not, as Mr. Lloyd George declares, because he obstinately refused to admit a mistake—but because he knew that it was vital to keep the Germans away from the French. Sir Douglas Haig appreciated that danger; Mr. Lloyd George did not. Haig also knew that if he could drive the Germans away from the Belgian coast, he would have gone a long way to defeating the German submarine danger, the gravity of which the

Cabinet had not failed to impress upon him. Why does Mr. Lloyd George so persistently refuse to see any view but his own, or pause to consider that Haig may have had other reasons than those preposterous ones with which he credits him? "For "the massacre of brave men that won just four miles of indefensible mud the Govern- "ment were not prepared by any warning or prediction given us by the military "leaders" (p. 2445).

When viewing alternative campaigns which he favoured from time to time, Mr. Lloyd George always pictures them as overwhelming successes. Complete and instantaneous defeat of the enemy would always have been the result of adopting his own strategy. Here is a typical example of his predictions eighteen years after the events: "One-fifth of the men uselessly sacrificed at Passchendaele could have "achieved that end (Turkish defeat) and put the Turks out of business by the end "of 1917. The large British forces engaged on the two Turkish fronts would have "been available partly to reinforce our Army in France, partly to strengthen our "troops on the Vardar. Bulgaria, with her Turkish flank uncovered, could not have "resisted an attack. Rumania would then have revived her effort and Austria "would thus have been outflanked, and the effect on Russia would have been "incalculable. Nothing but substantial help given by Germany in troops and "equipment could have saved a break-up of the Central Alliance" (p. 2449). This is one of the rosy pictures which Mr. Lloyd George constantly paints for himself, and which only the crass stupidity of the military leaders on the Allied side—for not only British generals opposed his military plans—prevented him from realizing.

But here is a sentence which we wish had been Mr. Lloyd George's guide throughout: "As the years go by, and the realities stand out more clearly, and as personal "prejudices fade or are eliminated, and more impartial conclusions can be derived "from a calmer survey of indisputable facts, it will be easier to reach a decision on "these questions" (p. 2457). This wholesome sentence might well be bracketed with that other axiom of Mr. Lloyd George's in his second volume: "No wise civilian "would ever dream of embarking upon strategy. A man who did that would be "fit for no post in any ministry. He would be a danger" (Vol. II, p. 763).

A chapter is devoted to the Belligerents and their Peace Terms. Towards the end of 1917 Austria was clearly anxious for peace, and the Cabinet sent General Smuts to discuss terms in Switzerland with Count Mensdorff. But Germany was in no mood to make peace—having just been relieved by the Russian Revolution—and Hindenburg and Ludendorff were determined to make one supreme effort to break the Western Front.

In a chapter entitled "Bolshevism Conquers Russia," Mr. Lloyd George gives a good summary of the revolution.

Turning next to Man-Power, he defends himself against the charge that the Cabinet deliberately kept back troops in the spring of 1918 when Haig needed more men to strengthen his line. Having insisted more than once or twice that we should reinforce our army in Palestine in order to crush out the Turks once and for all, he complains on p. 2632 that we "were ridiculously over-insured in our Turkish campaigns." He blames the War Office for delay in bringing troops from Egypt and Palestine to France. He ignores such trifles as shipping, re-equipping, and time required for replacement by Indian troops. We were making great sacrifices in shipping at that time in order to bring American troops to France.

He blames the Army authorities for retaining an unnecessarily large number of men at home, and says that they "had under their hand, already in khaki, a quite "considerable body of troops on which to draw for reinforcing their oversea armies "and all they had to do was to make the best use of them" (p. 2644). Who were the Army authorities who held back the men? Certainly not Sir William Robertson.

Mr. Lloyd George makes out a good case for the Government's efforts at combing out more men in 1918, and no one will deny the great work done by the Man-Power Committee.

Mr. Lloyd George considers any stick good enough to beat the British generals with, and he pounces on them if their estimates of future casualties were wide of the mark.

In his chapter on Clemenceau, he gives a good description of the French Premier, who resembled his British colleague in many respects. He honours Clemenceau with an understanding of his difficulties—an appreciation of his problems which he does not vouchsafe to Haig or Robertson.

Chapter LXXIV, on the Military Position, will be read with special interest by soldiers. In October, 1917, Haig had submitted to the Cabinet a memorandum on the military position resulting from Russia's failure to carry on. At that time Haig considered that the Germans had already transferred the best of their divisions from the Russian front; and that at the most they would have 32 more efficient divisions left to take part on the Western Front, giving Germany a total of 179 divisions there. From the quality of the prisoners captured in the Flanders fighting and from the reports of his Intelligence Department, Haig was justified in considering that the majority of these 179 divisions could be "written down considerably." In October, 1917, he considered that the best policy would be to continue our attacks in the spring of 1918 and so prevent the Germans from launching their great offensive. Had the French supported this view, who is to say whether the result would have cost more than the fighting which actually took place? Clearly it is impossible to foresee so far ahead in war, and at a time when it was known that the Germans must make a mighty final effort to avoid defeat, almost any event was likely to happen.

Mr. Lloyd George writes: "Thus Haig and Pétain could not agree on the appro-" priate strategy for the Allied forces on the Western Front, while the preparations " were being made for the spring campaign of 1918. Repeated conferences took " place; but they could not fix on any plan—defensive or offensive. In the summer " and autumn fighting of 1917 each had gone his own way according to his own " strategical notions. There was no cohesion and not much concert in their plans. " One hammered at the Germans and the other pecked. The hammer was buried " in the sludge. The pecking succeeded in the little it was designed to achieve " On the whole, this arrangement suited the Germans" (p. 2692).

Haig remembered the Allied Conference of May 4th, 1917, at which Mr. Lloyd George came out with the most emphatic declaration that the Allies must go on attacking. "The Conference passed off in the most friendly spirit, and all stated " that they were united in the determination to attack vigorously and carry on the " war *jusqu'au bout*" (*Haig's Diaries*, Vol. II, p. 107). But Mr. Lloyd George forgets. If Haig alone carried out the policy agreed upon by his Government, is there ground there for his condemnation?

Haig's letter of 19th October, 1917, to Pétain stating his views as to the policy to be pursued is given in full by Mr. Lloyd George. It explains concisely what was in Haig's mind at the time. It is unreasonable to take these opinions of Haig's and condemn them outright in the light of events which take place six months later, or in the light of facts which are only disclosed many years afterwards. Mr. Lloyd George habitually refuses to consider the circumstances under which these memoranda were written. Even he thought differently in 1917 and 1935.

The Allied politicians had set up a Supreme War Council at Versailles with a permanent body of military representatives to advise it. They had in effect set up a military body to supplement the advice which their own Chiefs of the General Staff should alone have given. There was nothing but good in the effort made to co-ordinate plans and to combine the military resources of the Allies, but when Mr. Lloyd George wanted to turn the Military Board into an instrument to control a General Reserve, he found himself strongly opposed by the soldiers. All military students will agree that a Board or a Committee cannot exercise the functions of a Command; but Mr. Lloyd George cannot see anything but sheer obstinacy and

hostility to himself in the attitude adopted firstly by Haig and Robertson, and later by Pétain as well, with regard to the Versailles Board and the General Reserve. Even General Foch—almost alone among soldiers to win any favourable opinion from Mr. Lloyd George—when he became Generalissimo, shed all vestiges of Boards and Committees, and worked with a staff consisting principally of General Weygand alone.

In the case of Great Britain, her military representative on the Board was Sir Henry Wilson, and his remarkable independent personality did not make for harmonious working with Sir William Robertson, who, as Chief of the Staff, was the Cabinet's principal military adviser. The political device of setting up a body of military advisers in Paris, which might—and indeed did—give advice which ran counter to that of the Government's adviser in London, was obviously unworkable. It was still worse when Mr. Lloyd George tried to get agreement to place a large number of divisions under the control of the Board. How could either the British or the French Commander-in-Chief willingly agree to placing himself and his armies at the mercy of a Board composed of juniors with no experience of chief command? The appointment of a Generalissimo was undoubtedly the solution which was required, but the outstanding suitability of General Foch, made evident by subsequent events, when, backed by the loyalty of Haig and the determination of the British Army, he controlled the great operations which led to victory, was not so apparent in 1917, and not even the French could agree on his selection then. Moreover, Mr. Lloyd George himself had, in November, 1917, told the House of Commons that he was " utterly opposed " to the appointment of a Generalissimo.

Mr. Lloyd George's present device was very different from that of a Generalissimo in command of the whole, and although he obtained agreement at the meeting of the Supreme War Council on January 30th, 1918, to the formation of an Inter-Allied Reserve to be controlled by " an Inter-Allied body of Generals who constituted the " authority in control of the General Reserve " (p. 2742), it was an agreement forced on the soldiers. Sir William Robertson had already been reprimanded by the Prime Minister for having expressed military views at a Conference which differed from those of Mr. Lloyd George. His silence at Versailles was therefore taken as acquiescence. The responsibility of forcing the position was Mr. Lloyd George's.

The conduct of operations of war by Committees does not commend itself to any soldier; and it soon became apparent that not only our own generals, but also the French and Italian, and even M. Clemenceau himself, realized the futility. The Inter-Allied Board evaporated, but not as the result of Haig's obstinacy or Robertson's jealousy. It was unworkable, and its story, so well described by Mr. Lloyd George, proves once again the dangers of political interference in the conduct of military strategy. Mr. Lloyd George is fond of reminding us of the German strategical successes; but Hindenburg and Ludendorff were not hampered by Calais Conferences or Versailles Boards of Control.

It was the creation of the Versailles Board which led to the resignation of Sir William Robertson. He could not remain the chief military adviser of the Cabinet while a junior adviser might give different advice at Versailles. He was offered the post at Versailles, while Sir Henry Wilson succeeded him as C.I.G.S. Sir William naturally resigned. His fate is now represented by Mr. Lloyd George as the just reward of his part as a military conspirator working for the fall of the Government. The following quotations are typical of this:—

In the House of Commons on February 19th, 1918, Mr. Lloyd George " paid a " warm tribute to his capacity, his character and his attractive personality. I added " that during the whole of the two to three years I had been associated with him " our personal relations had been not merely friendly but cordial, and that even at " the final interview when I did my best to urge Sir William Robertson to take one " or other of the alternatives offered to him, we parted with expressions of great " kindliness " (p. 2828).

But: "No doubt Robertson had been persuaded by the sycophants whom great "power without criticism always breeds, that he could establish a similar dictator- "ship in this country and that this was his opportunity. He made up his mind to "challenge a definite conclusion with the War Cabinet. He was convinced that the "Government had lost whatever popularity it had ever acquired—that the nation "would welcome a change—that there were forces in Parliament, drawn from every "party, strong enough to effect a coup—and that the issue between generals and "politicians was well chosen. Robertson therefore dug in his stubborn toes. He "refused the offer of a position on the Board of Control if it involved the surrender "of the position of C.I.G.S. He insisted that the Chief of the Staff should be *ex-officio* "member with power to appoint a deputy when he was unable to attend" (p. 2813).

Thus the military dilemma forced upon Sir William Robertson by Mr. Lloyd George is interpreted (in 1936) into a conspiracy to overthrow the Government.

A whole chapter is devoted to blaming Sir Douglas Haig for his dispositions before the German attack in March, 1918. Mr. Lloyd George boldly steps forth as a military critic. No credit is given to Haig for any possible alternative views as to the proper strategy to be adopted. Mr. Lloyd George refers to Gough's Army as the "tired Fifth Army" exhausted at Passchendaele and brought down to hold the sector which was about to be attacked; as if it had been bodily transferred after all its struggles. He seems to be unaware that nearly all the divisions of the British Army had been through the mill at Passchendaele and Third Ypres, and that the divisions of all the other armies were also tired for the same reasons. When the Fifth Army was transferred to its new sector on the Somme, there was no certainty as to where the German attack would come.

Mr. Lloyd George makes much capital out of the fact that the Fifth Army line was less densely held than other parts, but he does not consider the situation as it was. The Fifth Army sector included the old Somme battlefield, desolate and stripped of all natural cover. A break-through there would be far less dangerous than one further north where the vital Channel ports were always a target for the Germans. The ground on the British right—albeit the junction of the French and British Armies—presented more manœuvring space than any other part of the line, and, until the event proved otherwise, there was every reason to suppose that French and British reserves, coming up as they would against the flanks of the German break-through, would rapidly restore the situation. The War had often shown that, if the flanks of a gap held firm, the force which had broken through was placed in a very hazardous salient. The break-through on the Fifth Army front was bigger than any which had yet been effected on the Western Front, but the attack which caused it was also the biggest which had been launched.

To write of the "poor abandoned Fifth Army," as Mr. Lloyd George does (p. 2853), is sheer exaggeration. "It was the remnant of the fine Army which had served him "(Haig) with such inexhaustible courage in the greatest trial of endurance and "valour to which any Army had ever been subjected. . . . Constitutionally stubborn "men such as Haig are apt to carry resentment so far into the realm of reluctance as "to thwart and defeat the odious command and to punish with failure those who "issued it." This insinuation against Sir Douglas Haig is too fantastic for further notice.

"There are plenty of historical illustrations in every sphere of responsibility, of "greater men than Haig, who failed to engage their full powers in enterprises of which "they disapproved. In these cases, resignation, or direct refusal, is the only "reputable course and to that extent Sir William Robertson, when he had no faith "in a scheme, played a more honourable part than Sir Douglas Haig" (p. 2854). Would it have been an honourable part if the British Commander-in-Chief had resigned on the eve of the great crisis?

Mr. Lloyd George himself tells us that when the German attack was launched, the French, for some critical days, still thought it only a feint and that the main blow

might yet fall upon them. If that was the case when the attack was actually in progress, how could the politically-devised Board of Control at Versailles have agreed beforehand as to the disposition of thirty Reserve divisions? No wonder that each Commander-in-Chief hesitated to skin his line of divisions to place them at the mercy of such a device. Even Clemenceau backed out of it.

It is no argument against Haig to point to Foch's subsequent success as Generalissimo, when the huge German attack had largely spent itself. As is well known, during the rest of the campaign, Foch left Haig very much to carry out his own plans.

"When the battle was joined and the Fifth Army was fighting a desperate rear-"guard action against forces which were three times as strong as its own, assistance "was sent slowly and grudgingly. It was only late at night on the second day of "the battle that G.H.Q. invited aid from the French. When it is also borne in mind "that the British Commander-in-Chief declined to join in the formation of a General "Reserve that would have averted the whole disaster, it is not difficult to affix the "responsibility for what occurred in the March offensive" (p. 2855).

Every layman can appreciate that one of the assailant's chief desires is that his opponent should engage his reserves at the wrong moment and in the wrong direction. In war, surprise may be guarded against, but it cannot be a perfectly calculable factor. It is true that the forecast of the Intelligence Department was extremely accurate, but this did not make it impossible for the Germans to have some other game up their sleeve. It is perfectly intelligible that both Haig and Pétain should have paused to see what lay behind the German design before committing their reserves. Calmness in a crisis appears to be taken by Mr. Lloyd George to be wilful obstinacy or dreadful incompetence.

Too much is made of the "disaster" to the Fifth Army. A break-through it was; and on a huge scale. But the attack, too, was gigantic. There were tremendous losses; and undoubtedly the withdrawal was forced to dangerous depths, but the junction between the French and British Armies was not broken. There was no panic and no pursuit. The Germans failed in their main purpose. The flanks of the gap held and the enemy found himself in another salient. Haig's Army was not defeated because its right wing was bent back.

The Doullens Conference of March 26th charged Foch with co-ordinating the actions of the Allied Armies, but it did not make him Commander-in-Chief. A further meeting at Beauvais on April 3rd was necessary to equip Foch with full powers as Generalissimo of the Allied Armies in France. Another Conference at Abbeville, on May 1st, was necessary to discuss the application of Foch's powers to the Italian forces. This string of Conferences is a useful reminder that such bodies do not work too quickly.

The last chapter in the volume deals with the American Armies in France. The author's remarks are severely critical. The following sentence seems to be as near dictation as might be: "I concluded by urging Lord Reading to make it his business, "whatever the agreement, to see that as many men as possible were shipped across "without delay, and as many as possible called up in the States in readiness for the "autumn battles" (p. 3055). How Lord Reading could see to this without becoming President of the United States it is difficult to perceive.

Mr. Lloyd George's chapter is itself unsparing in criticism of the American shortcomings; but he quotes a memorandum by Sir William Robertson to the Cabinet in January, 1918, giving his impressions of the falling-short of the American effort at that date. Sir William's views were certainly not more vigorously expressed than Mr. Lloyd George's own remarks on the subject, yet the author writes: "It is almost "amusing to compare this melancholy vaticination with the actual subsequent "history of the American Armies" (p. 3021). And on p. 3011 Mr. Lloyd George himself reminds us that "when the Armistice was signed in November there were "no American field-guns in France, and very few aeroplanes." It is difficult to see

why he has dubbed Sir William Robertson's milder expressions as "melancholy "vaticination" compared "with the actual subsequent history of the American "Armies," when his own remarks in the same chapter go very much further. The irrepressible desire to have yet another hit at Sir William *en passant* is the probable explanation.

The long struggle with General Pershing to get him to agree to the dispatch of infantry reinforcements rather than intact divisions is well described. The event proved that the British Cabinet's representations were right. The chapter furnishes one more proof of the difficulties always to be encountered by Coalitions.

Very few references are given in the book, but the sources of information are clear from the text.

A printer's error occurs on the map facing p. 2760; the British line before the extension of January, 1918, has not been coloured to agree with the legend and appears as French.

W.H.K.

AUSTRO-HUNGARY'S LAST WAR.

Vol. VI.

(Edited by the Austrian Ministry of National Defence and the War Archives. Published by the *Militaerwissenschaftliche Mitteilungen.*)

The fifth volume of this work brought the history of the war up to the end of 1916: the sixth volume covers the period embracing the whole of 1917. The history is illustrated by means of 36 excellent maps and plates, contained in a separate volume. Most of these maps illustrate the operations on the Italian front.

At the end of 1916 the general situation had not come up to the expectations of the Entente powers. The intensification of submarine warfare, the undecided attitude of the United States and of Greece and, above all, the increasing internal difficulties in Russia made it desirable to force an issue during 1917. It was decided by the representatives of the Allied Powers, at a meeting held at Chantilly on the 15th and 16th November, 1916, to deliver a simultaneous attack on all European fronts by all the Allied forces. Various circumstances, however, delayed the delivery of these attacks, originally intended to be carried out in February, 1917.

At the beginning of the year Germany decided upon her campaign of unrestricted submarine warfare. Austria, after demurring to the proposal, eventually fell in with it. The immediate consequence was the rupture of diplomatic relations with the United States. Germany, however, hoped to bring Great Britain to her knees long before the United States' intervention could influence the result of the war.

At the beginning of 1917 Russia appeared to be in a strong position. The Rumanian Army was to be reorganized, and attacks were to be delivered on the Rumanian and Galician fronts. It was expected that Russia would more than make good her expected losses in these projected operations. But the poison of revolution was already at work, and the Russian collapse came sooner than had been expected.

Italy had suffered severely in 1916 and had achieved little success. The war was unpopular, and the outcries against it had a demoralizing effect on the troops. Arrangements were, however, made for stiffening the Italian Army with British and French heavy guns, and an attack on a large scale was planned for the spring of 1917.

In Austria the Italian front had become the most important one, in view of the slackening of the Russian attack, the collapse of Rumania and the expected attack of the Italians. Soon after the accession of the Emperor Carl various changes were made in the Austrian high commands. The most important change was the removal of Field-Marshal Conrad from the post of Chief of the General Staff, which he had held for 2½ years, to that of Army-Group Commander in the Tyrol.

The Tsar abdicated in March, and a state of inactivity continued on the Russian front until June, a state of affairs that was encouraged by the Germans, who were busy with peace propaganda amongst the Russian troops. Pacifist ideas spread rapidly amongst the Russian infantry, who became thoroughly disaffected and could no longer be relied upon for any offensive operations. The cavalry and artillery remained loyal.

Taking the main events in chronological order, the first operations on a large scale occurred on the Italian front, when the Italians delivered their great attack in the tenth battle of the Isonzo, which raged from the 12th May till the 5th June. Though the attack had been anticipated for some time, the Austrians were uncertain at which point the main blow would be struck. The first stage of the battle, which lasted till the 20th May, was the attack delivered by Capello's 2nd Army on a 20-mile front north of Gorizia. The second stage was the attack made by the Duke of Aosta's 3rd Army from the 23rd to the 28th May on the section of the front nearest the coast. These two main attacks were followed by the Austrian counter-attack from the 28th May to the 5th June, in which a portion of the ground gained by the Italians was recovered by the Austrians. In this battle the Italians lost 36,000 killed, 96,000 wounded and 27,000 prisoners. The Austrians admit a loss of 7,300 killed, 45,000 wounded, and 23,400 prisoners.

In June the centre of interest swung northward to the high mountains of the Trentino, and heavy fighting continued round Mount Ortigara from the 9th to the 29th June with varying success.

The account then takes us to the Russian front, where Kerenski, the War Minister, had had a hard struggle to prevent the complete demoralization of the Russian Army. Brussilov, the Commander-in-Chief, determined to deliver a final offensive. The attack was begun on the 29th June, and in the fighting that ensued the German and Austrian forces were driven back. But with the capture of Halicz on the 10th July the Russian impetus was exhausted and demoralization spread all over the army. The Austro-German forces were now able to deliver their counter-stroke, which had originally been upset by Brussilov's offensive. The "break-through" battle of Zborow was fought early in July, and it resulted in the total defeat of the Russian forces and their evacuation of Galicia.

We next come to the operations against the Russo-Rumanian forces in Moldavia, but these ceased to have any great importance, as compared with those in France and Italy.

In August General Cadorna was planning another attack on the Austrian position. The 3rd Italian Army was to try to occupy the Carso, and the 2nd Army to seize the Bainsizza plateau. The battle, the 11th of the Isonzo, opened on the 18th August. This time the Austrians knew where the main attack would be delivered, but the overwhelming Italian attacks broke through the Austrian positions, and the greater part of the Bainsizza plateau was secured and an appreciable advance was made on the Carso. The occupation of the bare, waterless Bainsizza plateau, however, proved of little value to the Italians; it also served to shorten the Austrian line. By the beginning of September both sides were exhausted. Both had lost terribly. The Austrian losses in the 11th Isonzo battle amounted to 110,000, all told; the Italian losses are given as 166,000.

On the 21st September Cadorna informed the Allied powers that he would have to act on the defensive. The Italian Army had lost 720,000 men (including sick) since May, and a further offensive was out of the question.

At this juncture the Central Powers decided upon a great counter-stroke on the Italian position. Although the Emperor Carl had, all along, wished to avoid having German troops on the Italian front, he now felt obliged to call upon the Germans for help. Six German divisions were sent to strengthen the Austrian Army, and a great attack was planned for the end of October.

The twelfth battle of the Isonzo began at 2 a.m. on the 24th October by a terrific

bombardment of the whole Italian line. The main attack was delivered by the 14th German Army on the position east of Karfreit (Caporetto) held by the 2nd Italian Army. Overcome by gas shells, and unable to locate the enemy owing to the dense mist, the Italian artillery was soon put out of action. This was the beginning of one of the most disastrous defeats ever known. The victorious Austro-German Army followed up the retreating Italians, capturing thousands of prisoners and hundreds of guns. By the 31st October, the Italian armies had fallen back to the Tagliamento, and by the 9th November they had reached the Piave. Whole battalions, previously demoralized by peace propaganda, surrendered without fighting. The 3rd Army, to the south, conformed to the retirement of the 2nd Army. The retreat was finally stayed west of the Piave, and the Italians, now supported by British and French divisions, were once more able to hold their own.

The official estimate of the Italian losses in that one disastrous month amounted to 800,000 (including killed, wounded, prisoners, deserters and sick).

After some more fighting on the Trentino front, the end of the year found the Italian Army, with the Allied reinforcements, securely established on the line of the Piave.

The account now takes us back to the Russian front. The revolution had completed the disintegration of the Russian Army, and the treaty of Brest-Litowsk was concluded on the 15th December. A brief sketch is also given of the operations in Albania and Macedonia.

The book will be of great value to students of the war, and much of it, especially the introduction and the conclusions drawn after each of the main operations, will be of considerable interest to the general reader. The compilers have the advantage of having been able to consult accounts and biographies written by belligerents on both sides, and the military and political situations are discussed with an open mind.

A.S.H.

MARLBOROUGH: HIS LIFE AND TIMES.

By The Rt. Hon. Winston Churchill.

Vol. III.

(Harrap. Price 25s.)

This third volume of the life of Marlborough starts in the latter part of 1705 and ends in December, 1708, leaving one more volume to complete this remarkable work. In many ways this is the most interesting of the volumes yet produced; it shows Marlborough at his zenith as strategist, tactician and politician. One begins to get a real picture of the immensity of the man. Militarily, this period includes his classic campaign of Ramillies, the vast strategic conception of the capture of Toulon, the almost modern soldiers' battle of Oudenarde, won mainly by that remarkable personal co-operation between Marlborough and Eugene, and the capture of Lille, consequent upon that move of the gigantic siege train, a move considered by the rest of Europe as the greatest military exploit of the time. These were successes won in the face of fierce intrigues at home and vacillating counsels and actions by allies on the Continent.

The author gives a lively picture, too, of the Spanish campaign, and of that colourful personality Peterborough, sometimes waging wild campaigns, sometimes wandering across Europe, without any authority, pledging the Government at home to all kinds of action; and there are interesting vignettes of the meetings of those two dominating personalities, Marlborough and Charles XII of Sweden, though it is strange to find the author apparently mainly relying on the romantic Voltaire for his facts. Interesting though the military picture may be, it is the political arena which claims most attention. The relentless Whig pressure upon the Queen, and the endless Tory intrigues were gradually undermining the nation's will and the

prestige of Marlborough. It is a most human picture of the Queen which the author paints, forced against her strongest will and inclination to accept men whose personalities and policies she abhorred, losing all those friends in whom she placed her main trust, and finally driven by Marlborough himself, against his will but in the interest of the country and of the Alliance, to lower her Stuart pride. Through it all runs the strange figure of Sarah, with her astonishing sense for political intrigue and equally astonishing lack of understanding of her Mrs. Morley.

The political arena somehow at times seems to resemble only too closely that of another later war period. There is so much in this volume that no reviewer can really cover it. It is written with all the brilliance and clarity that one expects from the author and it is a fascinating study of possibly the most interesting three years of European history.

THE FIRST OF THE LEAGUE WARS.

By MAJOR-GENERAL J. F. C. FULLER, C.B., C.M.G., D.S.O.

(Eyre & Spottiswoode. Price 10s. 6d.)

General Fuller devotes one-third only of this interesting book to the Abyssinian War. The remainder is a philosophic discussion of the fundamental causes of war under modern conditions, the nature of future wars should an outbreak occur, and the prospects of finding a new peace technique. It is impossible in a short review to give an impression of General Fuller's arguments, but the reader will find that he traces an affinity between the League of Nations and Bolshevist internationalism, both of which, he holds, owe their origin to Jewish machinations. His own sympathies are with Fascist nationalism and with the discipline imposed by the Fascist system, though he does not consider that British Fascism should follow Continental models closely.

General Fuller's observations on the Abyssinian War more directly concern soldiers. He maintains that Italy originally planned a political rather than a military campaign, employing large forces to overawe the people while winning them over by conciliation and bribery.

To this policy he ascribes the curious composition of the invading army with its admixture of trained and untrained troops unadapted to military operations in such a terrain.

Sanctions, and especially the threat of oil sanctions, changed the whole character of the war, making the appointment of a soldier to command and rapid military victory imperative.

How to induce the Abyssinians to resort to mass battle became Badoglio's problem and the Abyssinians played into his hand. Perhaps General Fuller hardly stresses sufficiently the extent to which Badoglio's offensive action with ground troops baited the trap, though he brings out the decisive effect of air action once it abandoned attempts to attack Abyssinian concentrations without ground co-operation. He is severe on the defects in Italian tactical training and organization, but is unstinted in his admiration of Badoglio's qualities and the efficiency of Italian staff and engineering work. But for the blunders committed by the Abyssinians, especially the final and fatal blunder of the Ashangi battle, the Italians, even with the assistance of gas, could hardly have hoped to reach Addis Ababa before the rains and, as it was, the final advance was a remarkable feat. One is left wondering how the Italian Army would have fared in the wet season if the capture of Dere Dawa and Addis Ababa had not opened a new line of supply. One might speculate, too, what would have been the course of the campaign if Haile Selassie had trusted less to the support of Geneva and had actively resisted the Italian invasion from the outset, exploiting the possibilities of counter-invasion by guerrilla bands.

C.W.G.

LETTERS OF FIELD-MARSHAL LORD NAPIER OF MAGDALA.

Edited by LIEUT.-COLONEL THE HON. H. D. NAPIER.

(Simpkin, Marshall, Ltd. Price, 10s. 6d.)

This selection of letters is described as an annexe to the same author's life of his father issued for the benefit of the Field-Marshal's grandchildren, but any book about the first Lord Napier of Magdala must be of interest to many R.E. officers besides the two directly concerned. The letters perhaps add little to our knowledge of history; they were mostly written while Lord Napier was Governor of Gibraltar and, later still, when he was no longer actively employed; but they illustrate his opinions on most of the military questions of the day. The lapse of time has made some of the views expressed out of date, though many still seem fresh and cogent. The most definite impressions are unswerving loyalty to the Commander-in-Chief (H.R.H. The Duke of Cambridge), constant anxiety for the welfare of the soldier, and mistrust of politicians, whose lack of definite policy allowed matters to drift to a position needing military effort, for which they had neither the foresight to prepare nor the will to carry through.

E.V.B.

THE ELEMENTS OF IMPERIAL DEFENCE.

By A. G. BOYCOTT.

(Gale & Polden. Price 12s. 6d.)

This is a second edition of the work already published. It is a study of the geographical features, material resources, communications and organization of the British Empire.

The book is essentially one for examination purposes, but its somewhat condensed and statistical form may make assimilation of its contents difficult. It has adequate maps and a valuable set of appendixes giving important extracts from various Government reports and papers.

THE WAR IN OUTLINE.

By CAPTAIN LIDDELL HART.

(Faber & Faber. Price 5s.)

This is a small book in which the guiding principle, according to the author, has been to pick out just those facts which definitely moulded the course of events.

Captain Liddell Hart's views on the conduct of the war and on the professional soldier in general are too well known now to need much comment in this review of what is only an outline of all theatres of war. Joffre, Foch, Haig, all come in for the usual severe criticism, but it is somewhat amazing, in view of the information now available, that the whole credit for the decision to turn at the Marne is given to Gallieni, with Joffre just meekly acquiescing.

The story of the war, as the author sees it, is clearly told and the book is well produced.

The author is still much occupied in emphasizing his views on the powers of higher command of the professional soldier.

"The politician is always 'at war,'" he writes in his preface, "the business man "in competition with others. They have constant practice in conflict and unceasing "experience of its psychological conditions. Soldiering, by contrast, is a sheltered

" occupation, save in war. The higher man rises in the profession the less he is called " on to contend with opposition and the more immune he becomes even from " criticism. The ease with which the will of the superior prevails inside an army " becomes a handicap in preparation for dealing with a hostile army. Always " revolving between the poles of authority and obedience, the soldier gains little or no " psychological experience as a fighter. His training tends to suppress rather than " to develop the combative qualities."

These arguments apparently satisfy the author, but it would almost appear that, in spite of his position in the world of military literature, he must be out of touch and understanding with the modern more senior officer. His outline almost completely ignores what most students of war consider of supreme importance—the power of leadership, of inspiring confidence throughout an extremely complicated organization. Without that power, so well exemplified in many of the professional soldiers he criticizes, his political or business commanders-in-chief are likely to be of little value in National war.

SURVEY OF INDIA.

GEODETIC REPORT, 1935.

Published by order of BRIGADIER H. J. COUCHMAN, D.S.O., M.C., Surveyor-General of India.

During the year under report geodetic triangulation was carried on in Assam, replacing the Assam Valley secondary series, a connection being made with the Naga Hills series. The connection with the Assam Longitudinal series, carried out in 1867–78, did not agree. A re-observation of the old stations showed considerable discrepancies, due most likely to displacements caused by the great earthquake of 1897.

The equivalent of 428 miles of levelling of high precision was undertaken as well as a considerable amount of secondary and tertiary work. A detachment was also engaged in levelling in connection with the Great Bihar earthquake, with a view to connecting the levels in that area with Sironj in the stable part of the peninsula. When this line is completed in 1935–36, it will be possible to determine finally what changes of level have occurred. The question of a rise in levels in Bengal, which was referred to in previous reports, is discussed again by Mr. B. L. Gulatee. His conclusions are that there has been no rise. Some interesting preliminary geophysical work was undertaken in connection with earthquakes in North India. These " are probably due to a continuation of the process which created the Hima- " layan Mountains. This process is a narrowing and buckling up and down of an " ancient broad downwarp marked for long ages by the Tethys Sea." It is, therefore, of great importance to delineate the buried rock features, which lie at great depths up to 6,000 feet below the surface of the mass of alluvium forming the Gangetic plains, and " this is essential for planning of measures for protection against earthquakes." It is the violent thrusting movements of these rocks along faults, due to a horizontal pressure setting up vibrations, which have produced catastrophic earthquakes. " It " is of prime importance that the course of such a feature and other geological features " concealed under the plain should be mapped." This shortly stated is the object of the survey. The instruments used were a magnetometer for declination and horizontal force, and an earth inductor for dip. For gravity determinations a gradiometer, by Oertling and Co., was used. It was only possible to run a single traverse line of stations, from which it was not possible to arrive at positive results, but there was sufficient evidence to show that additional geophysical observations should clear up the situation. No doubt these will be carried out and it is hoped they will indicate the position of the epicentral tract.

The usual tide-tables, published a year in advance predicting the time and height of high and low water for Indian, Persian Gulf and Red Sea ports, were published. The accuracy for which the tables are famed has been well maintained. At the request of the International Association of Physical Oceanography, which is undertaking an investigation into the interesting question of the constancy of sea-level throughout the world, the Tidal Section computed the monthly and yearly values of mean sea-level at Bombay for fifty years from 1880 to 1930. As is well known, mean sea-level has been adopted as the datum of reference for land levels, as it is supposed to be a constant and invariable plain of reference if determined at an open sea-port, not influenced by meteorological conditions which the presence of a river estuary might impose. Mean sea-level having been determined over a sufficiently long period, of, say, five years, can then be transferred to the most permanent bench-mark available which can be used as the origin of a system of levels. Graphs are exhibited showing the annual and average monthly variation in mean sea-level during the period of 50 years. The maximum variation in the former amounts to about 0·35 feet, while in the latter it is less than 0·4 feet. The monthly means seem to be related to barometric pressure over the Arabian Sea. The observations do not show any progressive variation relative to the land level at Bombay. When the Suez Canal was first projected it was urged by the opponents of the scheme, of which there were not a few in England, that the mean level of the sea in the Mediterranean and Red Sea would be different, thus introducing all kinds of engineering difficulties such as the construction of locks. We now know that these fears were unfounded and that there is no appreciable difference in the mean level of the two seas, though the water connection between them was some 14,500 miles long. The remarkable thing about it is that, even if there were a difference in level, the cause which produced it would equally affect the level used in attempting to find it out, so that it would never be apparent. Nevertheless the question of constancy of mean sea-level is an interesting one. The difficulty in arriving at a conclusion arises from the fact that we can never be quite certain that the height of the bench-mark of reference is itself constant.

We look forward with interest to the world-wide investigation being undertaken by the International Association of Physical Oceanography.

A table is given showing the earthquakes recorded on the Omori Seismograph at Dehra Dun. Of a total of sixty-eight records some twenty-four appear, judging by their distance from the Observatory, to have occurred in India.

It is interesting to note a shock recorded as " moderate " was felt at Shikarpur (Sind), not far from Quetta, 16 days before the great earthquake at that place; also " many after-shocks from the Quetta region have been recorded; but no trace has " been obtained of many others which were reported in the daily press to be severe."

The Reports of the Geodetic Branch of the Survey of India are always interesting, and this one does not lag behind its predecessors in this respect.

H. L. C.

THE PROFESSIONAL ENGINEER.

By E. L. Brown.

(Russell Sage Foundation. New York. Price, 3 dollars.)

This book is a general survey of engineering in the United States as a profession, and is one of a series of similar studies of professions being issued by the Russell Sage Foundation. In 86 pages the writer has succeeded in giving a very complete summary of the history, present state and trend of engineering as a profession in the States.

In the historical part it is interesting to note that the first formal education in engineering was given at West Point in 1812, but it was not till 1870 that engineer

educational institutions began to increase rapidly, till now there are 160 colleges granting degrees. The year 1870 also marked the inception of the modern system of a sound general education combined with a good grounding in engineering principles, the practical training in technique being left to industry after graduation.

The achievements of engineers in the U.S.A. have been so impressive that it is surprising to find much criticism of the education and status of the engineer. Education is a state, not a federal, department, and in practice there is very little even of state control over higher education. A fair degree of uniformity exists due to imitation. But, while this freedom has permitted innovations often well justified, it has resulted in the survival of a few weak colleges and the absence of any national system of technical education. It is also affirmed that the standard of education of students entering colleges is unsatisfactory, and it is stated, in explanation, that the standard in secondary schools in the U.S.A. is lower than in Europe, because there is no selective process operating—an interesting view in connection with modern tendencies in England. Another interesting point is that while in Great Britain we have ten technical schools for each college granting engineering degrees, in the U.S.A. there are five such colleges for each school; industry in the U.S.A. considers that it requires 2·7 graduates from technical schools for each college graduate. Finally, dissatisfaction is expressed with the standard of teaching; though this has improved of late, the far higher emoluments of engineering practice deprive the teaching and research sides of the best brains.

An interesting section follows describing the National Engineering Associations. There seem to be an enormous number of these, and only eight very important ones are described. Besides five associations corresponding to our Institution of Civil Engineers, etc., there are mentioned the Society for the Promotion of Engineering Education and the National Council of State Boards of Engineering Examiners; and these seven combine to create an Engineers' Council for Professional Development.

The remainder of the book is largely tabulated statistics, showing the number, distribution (professionally and geographically) and earnings of engineers.

The book is so condensed and so full of "meat" that it is impossible to summarize; but it gives a general impression that in spite of its great achievements, engineers in the U.S.A. are aware of professional difficulties, perhaps most apparent to themselves, and are striving to overcome them.

E.V.B.

EUPHRATES EXILE.

By A. D. MACDONALD.

(G. Bell & Sons, Ltd. Price, 7s. 6d.)

This book deals with Iraq during the two years immediately preceding the birth of its independence. It consists of a series of sketches dealing with that portion of the country known as the Lower and Middle Euphrates.

During the period, Iraq was completing its tutelage in self-government under British advisers and helpers. Whilst this experimental period of partial self-government was proceeding, the Royal Air Force, holding a watching brief, remained in the background, but maintained an intelligence organization throughout the country, in order to keep in touch with the reactions and feelings of the country's several peoples. The author was one of the officers of this intelligence organization.

His position gave him ample opportunities to observe and formulate his views of the country and its inhabitants. Being quite free from all executive or administrative responsibilities connected with the Government of the country, he was able to take a detached view of its officials, their work, the results of their labours and the

populace. At times in his book he shows how far he was removed from the toils, joys and disappointments, apparently inseparable from administrative and executive responsibilities in the East, by being a shade ungenerous to those bearing the brunt of the task.

This position of impartial observer, however, adds interest to his views and conclusions. The fact that he served some years as an instructor to the Iraqi Army should remove any doubts the reader may have regarding his ability to appreciate the magnitude of the task that British officials were faced with in Iraq at this time. Strangely enough he found little of interest in the Kurd or the Bedouin. He appears to scorn the romantic :

" It is a relief that I am to work among the Arabs and not the Kurds." (Page 18.)

" It is a curious and humiliating thing that the life of the Bedouin, a subject " which entrances so many Englishmen, should have so bored and depressed me." (Page 176.)

The book largely deals with the settled tribes of the Euphrates Liwas. Little has been written of these folk compared to their more romantic brethren, the Bedouins. It is full of interest and should be of special interest to those who have served in Iraq, as it gives a very fair and sympathetic picture of the degree of progress achieved by the people of the country under the tutelage of their British advisers and instructors. To others " The personal views of an insignificant observer who had " unusual opportunities of rubbing shoulders with his fellow-nobodies in faded and " remote regions " should prove to be instructive and entertaining.

P.W.C.

MAGAZINES.

RIVISTA DI ARTIGLIERIA E GENIO.

(*June*, 1936.)—1. *La controbatteria nella guerra di movimento.*

Colonel Marras discusses some problems of counter-battery work in mobile warfare.

2. *I tubi elettronici multigriglie ed il loro eventuale impiego nelle stazioni radio per uso campale.*

Lieut.-Colonel Gatta looks forward to a simplification of radio work in the field by the introduction of new types of valves, such as the hexode, octode, etc.

3. *Questioni di addestramento e d'impiego dell' artiglieria alpina.*

Lieut.-Colonel Molinari deals with the technical and tactical training and duties of mountain artillery.

4. *Sul controllo in cantiere dei lavori in conglomerato cementizio semplice od armato.*

Most of the principles laid down in this article by Lieut.-Colonel Del Bello and Lieut. Betocchi for concrete construction are those ordinarily accepted. The writers point out, however, that military conditions are often very different from those in civil work. Much of it is carried out in mountainous country under extremes of temperature. Time is limited, and great strength must be attained in a short time. Workshops are scattered: labour is often unskilled: the concrete is required to resist shells and aerial bombs.

Samples of the cement used must be tested. The purity of the water used is not a matter of great consequence. The aggregate must be suitably graded, but the correct grading of the sand is more important than that of the shingle. With regard to the proportion of water to be added to the cement, the results of Abrams' investigations are well known. There is a natural inclination for workmen to add an excess of water to facilitate mixing. This must be guarded against.

When the concrete is being mixed, whether by hand or mechanically, an occasional "slump" test should be made to ensure that the correct proportion of ingredients is being maintained.

The official regulations prescribe crushing tests with concrete cubes of 16 cm. side after 28 days. As such a period is not always available, tests may be made after three or seven days, and the corresponding strength after 28 days deduced either from a graph for ordinary cement or for high resistance cement respectively, or else from Bolomey's formula.

In the case of numerous small scattered works, the possibility should always be examined of centralizing the production in a central plant.

5. *Le batterie d'accompagnamento dei reggimenti di fanteria.* By Brig.-General Fontana.

Batteries of accompaniment consist of 65/17 guns and model 35 assault mortars. This article deals with their employment and the relation of their sphere of action to that of divisional artillery.

6. *Sul probabile rendimento di tiro.* By Major Morricone and Captain Cavicchioli.

An article on the probability of hitting a given target.

(*July–August*, 1936.)—1. *Artiglieria Anno XIV.* By Brig.-General Balocco.

A treatise on the organization and employment of modern artillery.

2. *Note sulla organizzazione dei moderni materiali d'artiglieria controaerei.* (S.T.A.M.)

Some problems for anti-aircraft artillery. The gun recently adopted in the Italian Army has a bore of 75 mm., the length of the gun is 46 calibres. It fires a projectile weighing 6·5 kg. with an initial velocity of 750 metres per second. Its maximum horizontal range is 13,000 metres.

3. *Distruzioni. Impiego delle unità del Genio.* By Colonel Battista.

In modern warfare, demolitions play a greater part than ever in covering the retirement of an army; and it is probable that a series of accurately studied and prearranged demolitions will hold up an enemy more effectively than a system of permanent fortifications. The bridgeheads at Liège and Namur, which fell, in the Great War, 21 days after the declaration of war, tend to confirm this opinion.

Nowadays, when wars are fought, not by the fighting services alone, but by the energy of the whole nation, it is legitimate to destroy anything that increases the resistance of a nation as well as of its army. Facilities for repair have improved considerably; demolitions should therefore be on such a scale as to exhaust, as soon as possible, all regulation material and all technical troops that the enemy may have at his disposal for carrying out repairs.

At great distances demolitions can be entrusted to the air force, at lesser distance they can be left to long-range artillery, and, during a retirement, they should be carried out, as far as possible, by the rear-guard. Mines with delay action—which may be extended to nearly a month—have proved useful.

The writer then proceeds to deal with different kinds of demolitions.

The destruction of a railway may paralyse the enemy's advance completely. The destruction of a tunnel in slipping ground is very effective. The demolition should be carried out some distance from the mouth of the tunnel, at a point where the crown of the arch is 30 to 40 metres below ground-level. As heavy labour and large charges are involved, it is advisable to make the necessary preparations in peace-time. If there is no time for mining, a tunnel can be temporarily blocked by derailing trucks loaded with large blocks of rock inside the tunnel.

With regard to bridges, a gap of 20 metres used to be considered a sufficient interruption, but, nowadays, a gap of 50 metres can be repaired without a long delay, and it is advisable to wreck the abutments as well as destroy the piers to as low a level as possible. An overcharged mine behind the abutment will produce a crater that will increase the gap considerably. In dealing with girder bridges, the steelwork should always be attacked. If possible, the girders should be made to fall with their ends in water, so that it will be impossible to use jacks to raise them.

The destruction of a railway line in sidelong ground will prove very effective, especially if carried out over a distance of over 50 metres, and on a curve. But such demolitions require a large expenditure of explosives, and are best prepared in peace-time. Embankments, cuttings, or sections of the line on the level require a vast expenditure of explosives and do not give such good results.

The wrecking of the permanent way by the Germans during their strategic retreat of 1917 left the French and British enormous lengths of railway line to repair. Various devices were used for this form of demolition, in which the rails were torn away from the sleepers by a locomotive. The rails were then tied together in bundles and shattered with explosives.

Roads are more important than railways to an army, and the best way of interrupting them is by dealing with bridges or sections of the road in sidelong ground, as in the case of railways. Craters may be formed by exploding mines in culverts, but, to be effective, the demolition must be carried out over a long stretch of road. Obstacles may be created by blowing up houses alongside the road, cutting down trees, or blowing up metal pylons carrying electric wires.

Navigable canals can be rendered useless by wrecking the headworks or cutting through the banks at a suitable spot and letting out the water.

Cables and overhead lines, telegraph, telephone, and radio stations should be put out of action. Buildings can be set on fire and instruments broken up. Electric

power stations can be irreparably damaged by short-circuiting. For this class of work it is as well to employ specialists.

The demolition of a dam, holding up a large body of water, may save the trouble of carrying out any further demolitions.

For each class of demolition there should be a regular programme, the minimum amount necessary to hold up the enemy being carried out first, supplemented later by such extra work as there may be time for.

Finally, there is the question of the responsibility for giving the order for carrying out a demolition. The higher command would decide what demolitions are to be carried out, and would usually leave the method and the time for carrying out each one to the judgment of an officer on the spot. Numerous instances have occurred of demolitions not having been carried out for want of orders, as well as of demolitions having been carried out prematurely by the technical personnel on the spot. Both have had serious consequences.

The method of firing a charge by radio from a distance has not been perfected: there is a risk of the charge being fired by the ordinary radio traffic. Once this difficulty has been overcome, the method should have many advantages.

4. *Studio, in generale, del rifornimento munizioni in montagna.*

Colonel Micheletti works out a concrete case, illustrated by maps, to show the method of keeping up a supply of ammunition in a mountainous country.

5. *Progetti stradali di carattere speditivo.*

Lieut.-Colonel Steiner explains a method of rapidly preparing a project for a hill road. There is nothing new in this method, but, to save time, instead of taking cross-sections at regular short intervals, average cross-sections are assumed to cover long intervals.

6. *L'impiego dell'artiglieria nel bassopiano somalo e sull'altipiano etiopico.* By Major Petroni and Captain Barengo.

Some notes on the employment of the 65/17 gun—with camel transport—in the Somaliland plains and the Abyssinian highlands.

7. *L'impiego del conglomerato cementizio durante i periodi freddi.* Lieut. Betocchi.

Under normal conditions, cement concrete work should be discontinued when the temperature falls below freezing-point, but circumstances may require this class of work to be carried on at extremely low temperatures.

Frost is harmful to cement concrete during the period of setting and the first stage of hardening; that is, the first five or six days in the case of ordinary cement, and three days, or less, in the case of aluminous cement. The effect of frost in the early stages will be to reduce the strength of ordinary cement concrete by 50% to 60% and that of aluminous cement concrete by 15% to 20%.

The action of setting and hardening gives rise to an increase of temperature, amounting to 3°C. to 5°C. in the case of ordinary cement, and 15°C. to 18°C. in the case of aluminous cement. Hence, except on the score of expense, the use of aluminous cement is a distinct advantage. If ordinary cement is used, a richer mixture would help to keep up the temperature.

The precautions that may be taken to counteract the effect of frost (besides restricting the time of work to the least cold hours of the day, and using as dry a mixture as possible) are:—

(*a*) Prevention of the loss of heat, by providing protection from wind and weather, laying the concrete in thick layers, and covering it with sand, straw, or sacks.

(*b*) Providing artificial heat, by heating the ingredients (but not the water), by raising the temperature of the surrounding air (with steam), or by heating the concrete. The latter may be done by passing an electric current through the concrete. (Alternating current should be used: direct current will cause electrolysis of the water.)

(*c*) Lowering the freezing-point of the water by the addition of salts, *e.g.*, sodium chloride, sodium carbonate, and calcium chloride. The two former reduce the strength of the concrete by 20% to 30%; calcium chloride will not weaken the concrete if cement containing magnesia is used. Sodium chloride should not be used in reinforced concrete as it causes rusting of the steelwork.

(*d*) Using special cements or products.

Aluminous cement has great advantages, but, if it is used, great care must be taken not to allow any lime or any other kind of cement to become mixed with it. There are also certain other commercial products, which, if mixed with the concrete, will admit of its setting at a temperature of −10°C., and will, moreover, harden it when set.

It stands to reason that the removal of wedges and of shuttering will need special care; in fact, the supervision of all classes of concrete work during frosty weather is a matter of great importance.

A.S.H.

REVUE DU GÉNIE MILITAIRE.

(*May–June*, 1936.)—*Le Pigeon Voyageur et le monument de Lille*, by General Gamelin. An address by the Chief of the French General Staff on the occasion of the unveiling at Lille of a monument erected to commemorate the Carrier Pigeon Service.

L'École de Transmissions Allemande, by L.M. An article on the development of the Army Signalling Schools in Germany. The present Army Signalling School has recently been transferred from Juterbog to Halle; and the author takes the opportunity of describing the progress of the school from its creation in 1887.

Army telegraphy was first entrusted to the fourth companies of the Pioneer Battalions, but as these were also required to carry out their duties as sappers, it was soon found necessary to create, in 1899, a separate and entirely independent Corps of Military Telegraphists. Three Telegraph Battalions were formed and stationed at Berlin, Frankfort-on-Oder, and Coblentz. The formation of these battalions reduced the functions of the school of telegraphy, and it became merely a school for instructing the cavalry in telegraphy. It was then transferred to Treptow.

Bavaria followed suit, and formed a Telegraph Company in 1901, which was expanded into a Telegraph Battalion in 1910.

The reorganization of the Germany Army in 1913 brought about a large increase in the Signal Service, and four additional German battalions and a second Bavarian battalion were added. The school at Treptow was absorbed, and an enlarged school of telegraphy was established at Spandau.

During the war, additional Signal Schools were established in army areas, with a school for the training of officers at Namur.

By the end of the war there were no less than 28 Signal Schools in the German Army; but the Treaty of Versailles left Germany without any—officially, at least.

In March, 1935, under Hitler's rebuilding of the army, a new school was created. In addition to its functions as a training centre, it is charged with research work of all kinds in connection with signalling and radio-telegraphy.

Recherche et captage des eaux souterraines, by M. Joffet. A lecture delivered to Engineer officers of the Reserve of the 5th Region, by the Chief Engineer of the Municipality of Paris. It is a somewhat elementary outline of the subject. The necessity of a study of geological formations is a *sine qua non* for any engineer who has to search for water, but the military engineer, in civilized countries, usually has so many data already available, that his work is confined to increasing existing supplies and bringing water to points where it is most convenient for use.

Quelques ingénieurs militaires au XVII^e siècle, by Colonel Lazard. This is the concluding instalment of the series. It describes the career of Lieut.-General Louis Lapara, whom the author compares with Vauban.

Lapara was born in 1651 ; he was killed at the siege of Barcelona on 15th April, 1706. At the age of sixteen he entered the service in 1667, as an ensign in the Regiment de Sourches. He was promoted Lieutenant in 1672 in the Regiment de Piémont, and became an Engineer. He took part that year in the campaign in Holland. In 1673, he was present at the sieges of Maestricht and Treves ; in 1674, at the sieges of Besançon, Dole, Fort Saint-André, Salins and Oudenarde. He was wounded at each siege. In 1675–76, he took part as an engineer at the sieges of Dinant, Huy, Limbourg, Condé, Bouchain and Aire. In 1677, he was at the sieges of Valenciennes, Cambrai, St. Omer, took part in the battle of Cassel, and was wounded again at the siege of St. Ghislain. Thus, at the age of twenty-six, he had already had experience of a score of sieges and actions.

And the tale mounted up each year. In 1678, he was at the sieges of Ghent and Ypres, and was again wounded at the latter place. In 1684 he was wounded once more at Luxembourg. In 1688 his experiences included the sieges of Philipsbourg, Mannheim and Frankruther. In 1690, he was with the Army of Piedmont under Catinat. He appears to have aroused the jealousy of Vauban, for in 1692 he was at the siege of Namur as assistant to the latter, but was not employed nor even mentioned in his journal of the siege.

In 1693, he rejoined Catinat in Piedmont, and in 1694 was with Marshal de Noailles in Catalonia, as commander of the Engineers. Next year, he was in Flanders and captured Dixmude. In 1696, he was once more in Piedmont under Catinat. In 1697, he directed the sieges of Barcelona under Vendome. He took part in the campaigns of 1702, 1703 and 1704.

At the age of fifty-three he was promoted Lieut.-General ; but otherwise he was but poorly recompensed for his services. He wished for the Governorship of Landrécies, which carried with it 10,000 livres per annum ; but he did not gain it.

He was mortally wounded in 1706 at the second siege of Barcelona.

His career was remarkable for the number of successful sieges in which he played a part. In two of them, he was in command of the operations. But his valuable services were eclipsed by those of Vauban. Had he lived longer, he might have succeeded to the fame and honours won by Louis XIV's celebrated engineer. He failed to win the King's favour, but he was none the less a distinguished soldier, and few of his contemporaries had anything like his wide experience. He was a plain soldier of the field, and as such he passed through with honour but without great reward.

(*July–August*, 1936.)—*Petit Guide pour les travaux de peinture*, by Capt. Legrand. The article, which is to be continued, gives a detailed description of paints and varnishes, their composition, and suitability for different work.

Projectiles et Fortification, by Lieut.-Colonel Montigny. A theoretical study of the action of projectiles on the various resisting materials used in fortifications. The basis of the article is the data available up to 1914, and it is intended to provide, as the author says, an introduction to the studies made since the war. Of limited interest.

Étude du Calcul des Taux de Travail subis par la Travée du pont de pilots, lourd, by Colonel Girard. A mathematical discussion of the stresses and strains set up in a bay of the regulation heavy-pile trestle bridge of the French Service. The bridge is capable of carrying any vehicle with a maximum axle load not exceeding 9 tonnes 200 kilogrammes.

The calculations are given in full detail.

W.H.K.

REVUE MILITAIRE FRANÇAISE.

(*July*, 1936.)—*Le Commandement en chef des Armées françaises du 15 Mai, 1917, à l'Armistice*, by General Laure. The first instalment of a series of extracts from a new book on the military life of Marshal Pétain. The Marshal has decided not to write his Memoirs, but some of his contemporaries have been at work on his biography; and he is anxious that his experiences in high command during the Great War should be of use in military study.

Pétain succeeded Nivelle on 16th May, 1917, as Commander-in-Chief of the French Armies, and took over his duties at a time of great crisis. The Nivelle disaster brought in its train very serious unrest in the French Army, even amounting to mutiny in some divisions, and Pétain's first task was to restore confidence and obtain a respite for the French troops to enable them to recover their discipline. It was during this period that Sir Douglas Haig realized that the British Armies would have to bear the brunt in 1917, and take the pressure off the French by continual offensives; to allow the Germans no chance of launching any attack on their Allies.

Pétain set himself to the urgent tasks of refreshing the army. He had to increase largely the artillery, the air service, and the munitions, and he had also to put the troops through better training schools. He had to do all this, and at the same time conserve the French effort against the time, now rapidly approaching, when Germany could use her Eastern armies as a huge reservoir of reinforcement for the West. He wanted Haig to relieve more of his troops, even to the extent of relieving two French armies. He did not see, so clearly as Haig did, that to cease attacking the Germans meant that they would attack the French. Fortunately, the Germans did not realize the dangerous state the French were in during that summer.

The article is largely concerned with the political complications which gathered round the French High Command, the alternations of political opinion between the claims of Foch and Pétain, and the vigorous interferences of M. Clemenceau.

Essai de Classification positive des chars de combat, by Lieut.-Colonel Perré. A long article of 54 pages, giving a very complete analysis of the tanks of all the principal powers. It is, in fact, an abridged history of the development of the tank. The multiplicity of types which have sprung up among the powers, and the absence of any clear method of naming the machines, makes classification difficult.

The tendencies in the evolution of the tank are summarized as follows:—

The all-round turret is practically universal, except in the smallest vehicles.

The disappearance of the monster tanks of 20 to 30 tons.

The efforts to attain greater speeds, and greater radius of action without sacrificing armoured protection.

Development of the amphibious tank.

The great activity in other countries besides our own in the research and development of these engines of war is usefully summarized in this article.

Essai sur l'Avancement, by Commandant Loustaunau-Lacau. A lengthy article on the system of promotion in the French Army, with some notes on the systems in other countries.

It is interesting to note that the author considers that the best system in the French Army is that adopted in the Artillery, where there appears to be no block.

The promotion blocks in the British Army are considered to be bound to lead to early reform.

(*August*, 1936.)—*Le Commandement en chef des Armées françaises du 15 Mai, 1917, à l'Armistice*, by General Laure. A further instalment, describing the part played by Pétain in the spring and summer of 1918. The universal prominence given to Foch's success as Generalissimo has overshadowed Pétain's share of the credit; and the author shows how much was due to the Commander-in-Chief of the French Armies, who had been responsible for the rapid moves of the French reserves to stem the German onslaught in March, 1918. Practically the whole of the reserves available, 40 divisions, were hurried northwards towards the Somme.

Le Comte Schlieffen, organisateur et stratège, by Commandant Courbis. The article is concluded in this number. The annual revisions of the German plan are described down to 1905-06, the last year of Schlieffen's term of office. He was succeeded on January 1st, 1906, by von Moltke, the nephew of the greater Moltke. In his retirement Schlieffen continued to influence his fellow-soldiers by articles in the Press. His vision of a second "Cannæ" was continually before his eyes, and he left behind him a nation and an army imbued with a spirit of annihilating victory. Had Schlieffen been in command in 1914, it is possible that his plan might have had more sweeping success. It is certain that Moltke had watered it down.

Continual revision of the plan and constant reiteration of its infallibility had brought the German Staff to believe that their strategy was bound to succeed; and their neglect of the psychology of their opponents may well be explained by the mechanical rigidity of mind which these annual investigations induced. One of the factors which did not enter into the Schlieffen plan was the British Expeditionary Force.

Campagnes d'Outre-Mer et formation des officiers, by Commandant Andriot. After the Franco-German War of 1870, an opinion became prevalent that the colonial experiences of the French Army had not been of any benefit to the nation when opposed to a European foe. The author of this article points out that the Great War showed the contrary. The colonial campaigns since 1870 had produced a large number of officers of wide experience who made their mark in the war of 1914–18. Such men were Joffre, Gallieni, Mangin and Lyautey. As we have proved ourselves, colonial experience provides an excellent school for the formation of character; and it is character which makes leaders of men.

(*September*, 1936.)—*Le Commandement en chef des Armées françaises, du 15 Mai à l'Armistice*, by General Laure, is concluded in this number. The author gives a very rapid review of the operations of the French Armies under Pétain from July, 1918, to the Armistice.

L'Armée Allemande, son histoire, son organisation, sa tactique, by Commandant Carrias. The first instalment of an historical sketch of the German Army from its beginnings in 1655 to the present day. The author covers a good deal of ground and gives many interesting details showing development. He carries his account down to the end of the 1870–71 war.

Fondation de l'École Royale Militaire. Another of Robert Laulan's detailed descriptions of French Military Schools. This one deals with the beginnings of the École Militaire established under Louis XV in 1749. Of historical interest.

W.H.K.

BULLETIN BELGE DES SCIENCES MILITAIRES.

(*July*, 1936.)—*L'Attaque de la Tranchée du Kwaebeek par le 3e régiment de Ligne* (9th September, 1918). By Lieut.-General Baron A. de Callatay. Describes a minor operation by the Belgians preparatory to their further advance in the general offensive of the Allies. The author commanded the regiment which carried out the operation.

Les Opérations Militaires à la Frontière Est de la Province Orientale, pendant la Campagne, 1914–18. A further instalment of the article by Lieut. Bayot. Describes briefly the operation in Belgian Congo during July and August, 1915, in conjunction with the British operations in East Africa.

A propos de Croquis. By Captain Wendelen. A short article emphasizing the use of ground sketches for section leaders, infantry observers, machine-gun N.C.O's, etc. The author, fully aware of the general antipathy to paper-work of all kinds in trench-warfare, urges that in the case of field sketching, much of this could be got over by continuous practice, until familiarity with the subject banishes its difficulties. By careful preparation beforehand, he claims that the rapid production of a sketch from an observation post can become second nature to those likely to have charge

of posts. He has in mind an illustrated range-table rather than a sketch-map; and supplies diagrams to explain his aims. Such aids in the field are invaluable; but they require a good deal of careful and continuous training in peace-time.

Exercice de Franchissement de la Meuse. By Captain Schneider. An illustrated account of a field exercise carried out on the 16th July, 1935, at Marche-les-Dames. The troops taking part were the 2nd Chasseurs à Cheval and the 13th Infantry Regiment, assisted by the 3rd Battalion of the 4th Engineer Regiment. The crossings were made in six places, three of them by rafts built of air-bags and Habert bags stuffed with straw, and three by ferries composed of rafts of ordinary pontoon equipment, working on a cable between shore and landing bays.

The operation was carried out by day, and since all the preparations, rafts, etc., were made up beforehand by the engineers, no special difficulty occurred, nor indeed could reasonably be expected. The conditions were almost too ideal.

There was nothing to call for remark in the formation of the rafts. Each carried a crew of five, and five passengers. Propulsion was by shovel. The horses were taken over by ferry.

(*August*, 1936.)—*La défense du fort de Fléron en Août*, 1914, by Lieut.-General Mozin. Gives a graphic account of the German attacks on one of the chief forts of the defence of Liège. The fort held out until August 14th. The garrison suffered a gruelling which few troops have had to endure. The continual concussion and the asphyxiating fumes became intolerable. It is not generally known how long the Liège forts held out after the actual capture of the city itself.

The account is made all the more interesting by the interpolation of extracts from German versions of the fighting.

Les opérations Militaires à la Frontière Est de la Province Orientale. By Lieut. Bayot. A continuation of the series.

Emploi d'une Compagnie de Mitrailleuses Divisionnaire à l'attaque. By Major-General De Cae. An instructive article by the Infantry Commander of the 1st Division of the Belgian Army, based on the existing regulations for the employment of machine-guns with infantry.

Déploiement rapide de l'artillerie divisionnaire. By Colonel Melen. A short article on rapid artillery deployment in the event of a sudden attack during an approach march.

Le problème de la Direction de la Guerre dans les Coalitions. By Lieut.-Colonel Dendal. The first instalment of a study of military policy as conducted by Coalitions. The author has already written a series of articles in this review (in 1926), on the subject of military direction by various forms of Government. He now writes on the same subject from the point of view of Alliances. It is of considerable interest.

Détermination de la Correction de Convergence. By Lieut.-Colonel Flameng. A mathematical discussion of the artilleryman's problem of calculation of parallaxes, and suggestions for the use of simple tables, given as appendixes.

Considérations sur le mouvement Gyroscopique d'un projectile. By Lieut. Hecq. A long discussion, well put together and clearly illustrated.

Notes sur la balistique intérieure. By Lieut. de Moor. Of artillery interest only.

(*September*, 1936.)—*Pages d'histoire de l'Armée Belge au cours de la Guerre*, 1914–18. This month's articles are *Le 1er Régiment de Grenadiers à la bataille offensive de* 1918, by Lieut.-General Baron de Callatay, and *A propos du Combat de Beerst-Bloote*, by Capt. Velge. The former describes the Belgian attack which began on 28th September, 1918, and continued until 4th October. There are three very clear maps, and it is interesting to note that the 1st Grenadiers advanced over the old British territory from Racecourse and Oblong Farms, near St. Julien, to the Passchendaele-Westroosebeck road. The attack was carefully prepared, and preliminaries were begun on 13th September. Artillery was plentiful, French and British batteries being included in the 344 guns allotted to the Southern Group, with three Belgian.

infantry divisions in line. Twenty-four Belgian infantry regiments took part. The attack began at 5.30 a.m. on the 28th September, and made rapid progress, and in three bounds the infantry had reached the Passchendaele Ridge by 6 p.m. The account is given in full detail, and with the aid of the maps can be clearly followed.

The 1st Grenadiers suffered 453 casualties from September 28th to October 7th, and won for themselves the right to carry Passchendaele on their Colours.

The second article of this series is a short supplement to Capt. Velge's article in the May, 1935, number of the *Bulletin*, correcting his account of a minor operation north of Dixmude on 9th and 10th May, 1915.

Les opérations Militaires à la Frontière Est de la Province Orientale, by Lieut. Bayot. Concludes his series of articles on this subject. The operations, begun on Belgian territory in 1914, ended in the enemy's country at the end of 1915.

Exercice tactique, by Major X. A small demonstration on training ground situated near Beverloo Camp, illustrating a battalion attacking as part of a larger force. The exercise is conducted in a conversational manner, and is well furnished with maps and tracings to superimpose on them. This method of instruction is easy to follow.

Le problème de la Direction de la Guerre dans les Coalitions, by Lieut.-Colonel Dendal. A continuation of last month's article. The author distinguishes between unity of command and co-ordination of operations. The latter function was conferred on Foch at the Doullens Conference on March 26th, 1918, while unity of command was not achieved until the Beauvais Conference of April 3rd.

The difficulties of realization of unity among Allies are enumerated, and the precedents of 1813–15 and the Crimea are discussed. In 1815, while Wellington's personality put him at the head of operations, Schwartzenberg was the titular Commander-in-Chief.

Before the Great War, there was close collaboration between the military staffs of Great Britain and France, but no political engagements. With Russia, on the other hand, France had written agreements. In any European war, our military part will be subject to the same loose co-ordination, and it must be so, if we wish to preserve our independence. Lord Kitchener's general instructions to Sir John French in August, 1914, remained the basis of relationships between the British and French commands, even when the unified command had been achieved. The appointment of Foch in October, 1914, to co-ordinate the operations of the Allies in Northern France is discussed. The King of the Belgians, who had announced his intention of retaining the command of the Belgian Army, however small its numbers, was always deeply impressed with the necessity of unity of action, and he wished Foch to act towards the Belgian Army exactly as towards the British Army; that is to say, to communicate direct with the Commanders-in-Chief. The three nations fought the battles of Yser and Ypres in a common effort, and the experience afforded a good example of co-ordination.

(*October*, 1936.)—*La bataille des drapeaux* (Liège, 1914), by Major Gerard, is the title of this month's chapter of the *Pages d'histoire de l'Armée Belge*. It describes the attack made by the German 34th Brigade during the night of August 5th/6th, 1914—a date at which we in this country had scarcely realized that the war had begun. The 34th Brigade broke through the Belgian defences between the forts of Liers and Pontisse, and between Pontisse and the Meuse. The action is of interest as the first engagement between the Belgian and German troops, and it reads rather strangely to-day that regimental standards played a conspicuous part.

The author describes how a German column of Chasseurs, wearing shakos instead of the spiked helmets, rousing the inhabitants to obtain a guide, was taken to be English, and was led into the town, and announced accordingly to the astonished headquarters of the sector. In the confusion, much damage was done to both sides; and the adventuresome Germans were driven back.

The surprise attack did not find the Belgians unprepared, and their resistance cost the Germans heavy casualties. Out of eight battalion commanders in the 34th

Brigade, seven were killed or wounded, and the 89th Regiment, 1,800 strong to start with, mustered only 600 at the end of the day.

Thèmes tactiques, by Major Wanty. A series of minor tactical studies is begun in this number, the first two of which deal with "Gaining Contact" and "Driving in the Outposts" respectively. These studies are carefully worked out, and tracings showing the dispositions are provided, which can be fitted over the accompanying 1/40,000 maps.

L'Aviation de chasse de nuit, by Colonel Desmet. Night-flying has made such progress that defence in the air by night has become not only practicable, but of considerable value.

The author takes us through a rapid sketch of the air raids by night during the war, and then describes the two aspects of night pursuit under the headings of offensive missions (attacking aeroplanes in the neighbourhood of their aerodromes), and defensive missions (protection of vulnerable points against air bombardment, or reconnaissance work).

Of the offensive missions, he says that they can only be accidental, on account of the great difficulties they must meet with: seeking out objectives which are partially or totally in darkness, waiting at low altitudes in the enemy's territory, aerodromes closely defended by searchlights and automatic weapons. He has more to say on the defensive missions; and examines the subject under seven headings, such as the composition and dimensions of a fighting area, landing grounds, liaison, etc. Searchlight illumination areas, and sound-ranging are included.

The author concludes that "night-hunting" in collaboration with searchlights forms a very redoubtable factor in defence. He emphasizes the importance of surprise, and of frequent shifting of the searchlight area.

Le problème de la Direction de la Guerre dans les Coalitions, by Lieut.-Colonel Dendal. The third instalment of this series. It gives a resumé of the numerous Inter-Allied Conferences beginning with that held at Chantilly on 6th July, 1915, under the Presidency of M. Millerand. This Conference affirmed the necessity of combining the Allied strategy, but it did nothing towards consolidating the command or clearing the responsibilities.

The second Chantilly Conference (5th December, 1915) consolidated Joffre's position. He had already been appointed Commander-in-Chief of all the French Armies, including Sarrail's force at Salonika; and unity of command, so far as the French were concerned, naturally meant the command of General Joffre. The fourth Chantilly Conference (15th November, 1916) represented the peak of Joffre's power: his fall occurred almost immediately after.

The vigorous Allied plans for 1917 ought to have been crowned by the appointment of a Generalissimo, but, instead, a greater change took place. Nivelle succeeded Joffre, and the Russian Revolution broke out. With the relegation of Joffre to post of Technical Adviser to the Government, which amounted to his retirement, the whole plan for 1917 became disordered.

The Conference of Paris (November, 1916) and the Conference of Rome (January, 1917) are briefly described. W.H.K.

MILITÄRWISSENSCHAFTLICHE MITTEILUNGEN.

(*July*, 1936.)—1. *Tegetthoff: An Essay on the Analysis of Success.*

An account of the career of Admiral Tegetthoff, who commanded the Austrian fleet in the battle of Lissa in 1866, when it defeated an Italian fleet of superior numbers and armament. The writer explains how this victory was not a matter of luck, but was due to the excellent training of the Austrian navy and the skilful handling of the fleet by Admiral Tegetthoff.

2. *Limanowa-Lapanow, 1914 and 1936. I.—The Conduct of the War in the Late Autumn of 1914.* By Major-General v. Steinitz.

This account of the introduction to the battle of Limanowa–Lapanow, fought at the beginning of December, 1916, between portions of the Austrian 4th Army and the Russian 3rd Army, is an interesting study of mobile warfare. The battle round Cracow had been raging from the 16th to the 30th November, and a gap of nearly 100 km. had been formed between the army of the Archduke Joseph Ferdinand and Boroevic's army. It was in order to prevent the Russians breaking through this gap that the battle of Limanowa was fought, which resulted in a great Austrian victory. —(*To be continued.*)

3. *New Artillery.* By Major-General Rieder.

The writer describes some new guns turned out by the Bofors factory, viz., the 37-mm. anti-tank gun and the 15-cm. field howitzer. Illustrations are given of the guns in travelling and firing positions. General Rieder considers that the adoption of a forked trail for heavier ordnance (*e.g.*, 15-cm. field howitzer) is of debatable value.

4. *Political Review of the First Half-year of* 1936.

Major-General Paschek discusses questions relating to Central Europe, the Mediterranean and the League of Nations, and the parts taken by Great Britain, France, Germany and Italy in European politics. The Abyssinian conflict was brought to an end, and a word of praise is given to the Italian organization that helped to bring about this result.

The article concludes with the rearmament problem, in connection with which all the great powers are, at this moment, making large increases in their air arm.

(*August*, 1936.)—1. *The Capture of Ofen* (*Buda*), 1686. By Colonel Kiszling.

An account of the siege and capture of Buda, occupied by the Turks under Abdurrahman Pasha, by the Allied armies under Duke Charles V of Lorraine. The town was captured in spite of an attempt to relieve the garrison by an army commanded by the Grand Vizier Suliman Pasha.

2. *Limanowa–Lapanow*, 1914 *and* 1936. By General von Eimannsberger.

The article is concluded in this number with a speculation as to what would have happened in the battle of Limanowa if the armies engaged had been fully mechanized and motorized. The writer considers that the fundamental principles of strategy and tactics remain the same, but that our views of strength, space and time must be constantly changing.

3. *The Offensive Power of Infantry Fire.* By Major Däniker.

A plea for a return to the former offensive power of infantry, by giving it weapons that will enhance its mobility.

4. *Aeroplane and Espionage.* By Lieut.-Field Marshal von Urbanski.

In this article stress is laid on the importance of propaganda and espionage by means of aircraft, also on the value of reconnaissance by aircraft to prevent sabotage by the enemy's air force.

5. *Obstacles and Mines against Tanks.* By General Burstyn.

It is assumed that, owing to natural cover, artificial fog, or bad light, tanks may be able to reach, unseen, a distance of 200 metres from a defensive position. In favourable circumstances tanks could cover these 200 metres in 15 seconds. As it is probable that tanks may outnumber anti-tank guns by 4 or 5 to 1, a gun will have only 3 to 5 seconds to deal with each tank. This is manifestly an impossible task. Hence the necessity for providing obstacles.

Marsh land, whether natural or artificial, is an excellent obstacle. Standing or flowing water must be at least one metre deep to hold up tanks. Woods with trees 25 cm. (10 in.) in diameter are impassable, provided the trunks are so close that tanks cannot pass between them.

Artificial obstacles are described in Part I of Heigl's pocket-book. Trenches have the disadvantage of providing cover to the enemy. A good form of obstacle is a trench so designed that the nose of a tank will drop into it and not be able to get out

again. If such a trench is covered over and supplemented with a parapet on the enemy side, revetted on the near side, it will prove an effective trap.

Another effective obstacle is a fence of solid posts, at varying intervals, with mines laid in the gaps where tanks could pass through.

It must be remembered that swampy ground that is impassable for tanks in ordinary weather is no longer an obstacle when it is frozen over in winter.

(*September*, 1936.)—1. *Twenty Years Ago. The War of* 1914–15 *against Serbia.* By Colonel von Wittich.

An account of the operations carried out by the Austro-Hungarian Army under Potiorek against Serbia in 1914–15. With two maps.—(*Conclusion.*)

That the campaign was a failure does not lessen the writer's admiration of Potiorek as a man.

2. *The French Plan of Operations in the Balkans in the Autumn of* 1918. By Lieut. Diakow.

An account of the Allied plan of operations against the Bulgars in 1918. The first plans for an offensive in Macedonia were prepared by General Guillaumat in the spring of 1918. He was relieved in June by General Franchet d'Esperey, and the latter carried them out, with suitable modifications, in September.

3. *A New Investigation of the Period of Acceleration of Buffer-recoil Guns, With and Without Hydraulic Brakes.* By Dr. Plessing.

4. *Reflections on the Value, Duration and Execution of Telegraph Exercises on a Large Scale.* By Lieut. Werner.

5. *The Cost of Warfare in Former Times and Nowadays.*

Dr. Meier gives an interesting account of the methods of financing wars from time immemorial. It has always been an axiom that war cannot be carried on without money. The methods of raising money, whether by taxes or by war indemnities, or other methods, have been comparatively simple until the World War, when it began to be realized that no estimate could possibly be made of its cost.

The cost of the World War is estimated to have been 782 milliards of marks, the share of the Central Powers being 255 milliards, that of the Allied and Associated Powers 527 milliards; the heaviest charge being borne by Germany and the next heaviest by Great Britain. On an average, the war cost Germany 1,192 marks per second. A.S.H.

WEHRTECHNISCHE MONATSHEFTE.

(*June*, 1936.)—1. *Technics and Organization in a Country's Defence.*

Captain Wesemann discusses the organization of the country for defence under the following heads:—(1) manufacturing plant, (2) out-turn of stores and munitions, (3) experimental and research work, (4) raw materials and their distribution amongst the leading powers, (5) precautionary measures, (6) traffic control, (7) control of manufactories, (8) personal training. His main argument is that the military spirit of the country should be supplemented by the best technical development and organization of industry.

2. *Temperature Conditions in Tanks.*

Major Olbrich concludes his article in this number. Tanks intended for use in the tropics must be lined with a material that is a non-conductor of heat. In a hot climate heat must be excluded: in a cold climate the loss of heat must be guarded against.

3. *New Ideas in Research into Workshop Materials.*

Dr. Karsten dwells on the importance of the use of the microscope in testing metal and alloys. In Germany it is important to be able to substitute alloys of lead, aluminium and zinc, for tin and copper, which are not obtainable in the country. In the construction of arms, not only metallic, but also non-metallic substances, such as wood, have to be tested.

The instrument required for such examinations is the camera-microscope, some types of which are here mentioned and described.

4. *Heligoland and Dunkirk.*

Dr. Köhle describes the construction of the fortifications of Heligoland, from 1891 onwards, and their subsequent destruction, under the supervision of the Allies, under Article 115 of the Versailles Treaty.

Dunkirk went through a similar experience some two centuries previously. It changed hands many times. In 1662 it was purchased by Louis XIV for five million francs. It was fortified at great expense under Vauban's directions. In 1712 it was made over to England, but was returned to France the following year on the condition that all fortifications should be razed to the ground. British policy during the eighteenth century aimed at the prevention of the restoration of Dunkirk as a harbour. Nowadays, however, it is an important naval and commercial port.

5. *Automatic Pistol or Self-loading Rifle.* By W. Brandt.

A plea for continuing the use of the automatic pistol, pending the introduction of a self-loading rifle and a new cartridge.

(*July*, 1936.)—1. *A Psycho-physical Investigation of Aiming at Instructional Target Practice.* By Dr. W. Wirth.

2. *Questions of Military Geological and Technical Organization.* By Major Krantz.

The writer sketches a suitable organization for the practice and development of military geology, based on that adopted in the Russian Army, and elsewhere.

The senior geological officer should be attached to the engineer headquarters of an army, and should be given rank suitable to his qualifications and responsibilities.

There should be a clearly-cut distinction between military geology and geography. The survey officer should have nothing to do with questions of geology.

Engineer officers should receive suitable training and instruction in geology by qualified instructors. A text-book should be got out in which questions of military geology are fully dealt with; such a text-book should also meet with the requirements of civil high schools and public offices.

Hydro-technical formations, working in conjunction with geologists, are essential to a modern army. They would deal with mining, water supply, drainage, dam and road construction, etc.

A very important duty required of military geologists is the preparation of maps, and they will advise the troops in the areas to which they are attached as to the nature of the subsoil. A suitable scale for a geological map is 1 : 25,000. It should show the strata, the height of the water table, and should give information likely to be of military interest, such as sources of raw materials, quarries, etc.

3. *The Risk of Damage to Shelters by Distant Action or Direct Hits by High-explosive Bombs.*

Dr. Heidinger shows how damage can be inflicted on shelters by bombs that burst in close proximity to them, and how protection against direct hits is not sufficient.

4. *Meaning and Limitations of Standardization in War Material.*

Major Mende dwells on the importance of simplicity in the design of all war material, and of standardizing all working parts so as to admit of mass production. It is obvious, however, that standardization must have its limits if the army is to be kept up to date.

(*August*, 1936.)—1. *The Tank Arm of Soviet Russia.* By Heinz Bach.

An account of the development of the Russian Tank Corps. Armoured cars were first introduced in 1914, and increased in numbers during the war. Tanks did not come into use until the Civil War, when they played an important part in the defeat of the White Armies by the Bolsheviks in 1919 and 1920.

In 1930, the whole of the tank equipment (some 3,000 tanks) was scrapped as obsolete. Since then, modern tanks have been turned out on a huge scale in Russian works. Russia now possesses over 12,000 modern tanks.

2. *Industrial Organization for Defence.* By Dr. Meier.

The World War called for an out-turn of armaments utterly out of proportion to anything known before, and requiring the combined efforts of the whole nation to keep pace with it. But it gave us no idea of the demands that a future war may make, especially in the out-turn of aircraft material.

This article shows how countries have endeavoured to shift their manufacturing centres of war-like material to a distance from their most vulnerable frontier. With Russia it has been an easy matter. She has shifted her manufacturing centres to the Urals, which, incidentally, supply her raw materials. Great Britain is about to locate a number of her aeroplane and motor-car manufactories near Glasgow.

3. *The Resistance to Pressure caused by a Projectile in a Gun and its Calculation.* A study of ballistics by C. Spetzler.

4. *War and Industry in England since* 1914. By Captain Ruprecht.

A study of the progress made in Britain since the war in the organization of industry to guard against unpreparedness in a future war. References are made to the "Import Regulation Act" and the "Safeguarding of Industries Act" of 1921, the formation of the "Committee of Imperial Defence" and the "Imperial Defence College," and admiration is expressed for the reorganization of our steel and iron industry.

(*September*, 1936.)—1. *Can War be Carried on Without Money?* and 2. *War Without Money.*

These two articles are criticisms of an article that appeared in the May, 1936, number of this magazine, "War Without Money," by Dr. Tafel. Both writers are agreed that the suggestion is not feasible. War causes quite enough disturbance in the life of a nation without the introduction of such a revolutionary innovation.

3. *Electric Railways in the Defence of the Country.* By Oscar Dost.

The writer discusses the advantages and disadvantages of electric railways as compared with steam, in time of war. When some of the German railways were being converted, experimentally, from steam to electricity, the General Staff insisted that the conversion should only take place on lines of minor strategic importance. But ideas have changed since the war, and electricity offers such obvious advantages to peace-time traffic that it is considered that strategic considerations should take a second place.

Electric railways can be made less vulnerable by adopting a sunk third rail in the place of an overhead conductor. Alternative power stations should be built for use in war-time, concealed from overhead view, on the principle on which modern forts are constructed.

4. *Military Inventions under German Patent Rights.* By Dr. Steinitz.

5. *The Influence of the Temperature of the Air on the Range of Guns.* By Dr. Wehage.

6. *Shells that Fail to Explode.* By Lieut.-Colonel Justrow. A.S.H.

VIERTELJAHRESHEFTE FÜR PIONIERE.

(*August*, 1936.)—1. *Frederick the Great as Master of the Art of Fortification.* By Major Dinter.

The 150th anniversary of the death of Frederick the Great is commemorated this year.

In his book, *Les principes généraux de la guerre*, written after the two Silesian wars, the king rejected the principle of the war of fortification, in opposition to the views of his contemporaries, who often considered the reduction of a fortress as the main object of a campaign. He considered that a war could only be decided by a complete victory over the enemy in the field.

In spite of these views, Frederick regarded fortress warfare as a necessary evil that might have to be undertaken in certain circumstances.

In course of time, however, he realized that no progress had been made in fortress warfare in the fifty years since fortification had reached its prominent position under Vauban. He introduced the study of fortification into the Prussian Army and insisted on infantry officers becoming proficient in it. He superintended their instruction personally.

The Corps of Engineers was founded by his father in 1729, and consisted of 39 officers. By the time of Frederick's death, it had been increased to 72 officers, of whom 17 were foreigners. He usually selected candidates for the corps himself.

By 1757 Frederick had realized that Vauban's principles had, to some extent, become out of date, and he laid down tactical principles to be observed in future construction. Amongst these were the importance of designing fortresses in accordance with the lie of the ground: the necessity for detached works, commanded by the main fortress and incapable of being taken by a *coup de main*. Flank defence and defence against enfilade, and suitable communications were insisted upon. If a fortress were built on a river, safe communication over the river must be ensured.

The fortresses of Neisse, Silberberg and Graudenz are described. They were built under Frederick's orders, and show a masterly attention to detail.

2. *The Fortress of Metz.* By Colonel Heye.

An account of the history of Metz and of its development as a fortress. The town was first fortified in 1231. It was occupied by the French in 1552, and an army under the Duke of Alba failed to wrest it from them. The town remained in the possession of the French until 1870. The introduction of rifled ordnance gave rise to an increased activity in fortress construction in all countries, and in 1867 the French built a number of outlying works, but only a few of these were completed when war broke out in 1870.

During the first period of the German occupation (1870–1885) a ring of outlying forts was completed, and the defences of the town itself were strengthened. Tension between Germany and France in 1887, and the invention of the Brisanz shell, led to an overhaul of the Metz defences between 1887 and the middle 90's. The brick masonry structures were covered with a layer of sand 1 metre thick, upon which a 1·2 metre thick protective layer of concrete was laid. Mass concrete construction was not undertaken until 1893. The first armoured batteries were built about the same time.—(*To be concluded.*)

3. *Electrified Obstacles in the World War.* By Captain Kurhaupt.

Early in 1915 the German High Command made the first experiments with high-tension electricity as a means of defence in the front line. Portions of the line occupied by the 7th Army in the Chemin des Dames were first selected for trial. The current obtained from power stations was conveyed by bare wires up to a distance of 10 km. to 15 km. from the front and then by cable to the front line.

The obstacle line was divided up into self-contained sections of command. It consisted of two rows of wooden posts, three metres apart, the lower ends of which had been dipped twice into hot tar. Each row formed a fence, with three horizontal rows of plain wire; barbed wire was criss-crossed between the fences. At section boundaries the entanglements overlapped for a short distance, but they were kept ten metres apart from one another, so that, in case of damage by artillery fire, the wires of one section should not come into contact with those of the next.

It was laid down as a definite rule that there should be a clear space of ten metres between the electrified obstacle and any other entanglement, and the same distance between the obstacle and the trench or sap.

In the corps sector the entanglements were fed by two transformer stations, in which the current was stepped down from 15,000 to 1,000 volts. Each station supplied four sections. The system is illustrated by means of a sketch. The cable connecting the transformer with the branch switches, and the circuits running from the latter to the entanglements were laid in duplicate, and buried deep in the ground.

If broken wires caused an "earth," it was found by experience that the high-

tension current dried the soil so quickly that the leakage became trifling or disappeared altogether in course of time.

It was found that with a reduction of pressure from 1,000 to 300 volts, due to earthing, contact with the live wires still proved fatal to human beings. Seventy volts were enough to kill a horse. It has now been established as a fact that pressures between 300 and 700 volts are the most dangerous for human beings.

Experience during the war showed that the wires still functioned after a heavy artillery bombardment, and that the simple form of construction adopted by the Germans, consisting of ordinary barbed wire carried on wooden posts, proved more effective than the elaborate form used by the French, with its special insulators and wires.

4. *The Trench Mortar: a Pioneer Weapon.* By Colonel Biermann.

An account of the development of the trench mortar, from its first introduction by the Japanese at the siege of Port Arthur in 1904–05, to the experimental stage with the German engineers in pre-war years, and to its final development during the Great War.

5. *The Construction of Extemporized Weirs.* By Dr. Kraus.

The writer classifies weirs according to their height: low weirs up to a head of water of 1·5 metres, medium weirs with heads of 1·5 to 3 metres, and high weirs with heads of 3 to 5 metres.

The general method of construction is the same in all three cases. Where circumstances permit, a wall of sheet piling is driven into the bed of the stream until the tops of the piles are 0·5 metre above the full water-level. The piles may be of wood or steel. The wall is strengthened on the downstream side by wooden piles, driven into the bed at suitable intervals, and strutted on the downstream side. In the case of medium and high weirs, two rows of supporting piles are driven, carrying a planked roadway on the top.

If no sheet-piling is available, a stronger framework of strutted piles is required. A wall is built up against them, made of thick planks or beams, and this wall is made waterproof with sailcloths or roofing felt, weighted down at the bottom with large stones. An earth or clay dam is piled up against the waterproof sheet, forming, in cross-section, a triangle whose base is $1\frac{1}{4}$ times the height. Great care is required in the construction of such weirs.

The article closes with a few remarks on sluices. It is also pointed out that most railway and road embankments are only moderately watertight, and they should only be used as dams—unless specially strengthened—if their base width is at least ten times the head of water that they hold up.

6. Lieut.-Colonel Winkelmann relates his *Experiences of Mountain Warfare* on the Carpathian front during the Great War. The engineer and labour companies under his orders were mainly employed in the construction of roads, shelters for troops and miscellaneous work on the line of communications, such as magazines, engineer parks, saw-mills, ropeways, etc.

In a poorly-developed country it was necessary for troops to be able to fall back on their own resources as much as possible.

7. *Training for Engineers in Driving and Motor Sports.*

Major von Ahlfen considers that engineers do not, at present, get sufficient training in the handling of motor vehicles under conditions that they might have to experience in war-time, and he propounds a series of schemes for testing drivers over a course in wooded and hilly country, at night, without lights, and in snow or rainy weather. The drivers have to report at various controlling stations: great importance is attached to speed.

8. *Geology in War-Time.* By Prof. Scupin.

The writer dwells on the importance of geology in war-time, in the construction of works, water supply, mining warfare, etc. He considers that:—

(*a*) Every officer, and especially every staff officer, should know on what points geological advice is necessary;

(*b*) Every engineer officer should have some training in war geology;

(*c*) There should be a staff of war geologists and assistants in peace-time, trained in the experience gained in the war.

9. *Alarm.*

In this article Captain Schaette emphasizes the importance of an engineer company being in a constant state of readiness, with its equipment and personnel, to turn out, if required, to deal with a fire, flood, or other calamity.

10. Captain Mennecking gives an account of the assistance given by the Engineers in the preparations for the Olympiad of 1936. A.S.H.

THE INDIAN FORESTER.

(*July*, 1936.)—"The Effect of Forests on Erosion, Floods, Climate and Rainfall and on Irrigation Experiments," is the title of the summary of a lecture by Mr. Warren of the Indian Forest Service, illustrated by photos which show the appalling devastation caused by denudation, erosion, and excessive and uncontrolled grazing. The problem is a terribly serious one, and it is heartening to read of the measure of success obtained by the Forest Department in tackling it. Mr. Warren also contributes an article on the Bihar and Orissa forest stall at the Patna Exhibition.

"A Brief Description of a Forest Fire caused by Falling Stones" concludes with the apt remark by the Director of the Forest Research Institute that this explanation of the origin of forest fires should not be encouraged, as subordinates might find it a too easy way out of difficulty. The cases quoted are, however, undoubtedly true. Quartzite rocks falling down a scree strike together and cause sparks, which ignite adjacent dry grass, which in its turn may set fire to a forest.

The second International Conference on Timber Utilization was held in London in the spring.

(*August*, 1936.)—In this number there is a brief article on Mandi State and its forests. The head-works of Battye's hydro-electric scheme are in this State, and the article thus refers to it: "This great project met with much opposition and criticism in its early stages, particularly when delay and heavy expenditure had to be faced in the tunnelling operations, but it has already more than justified itself by the revenue and power development, for this project is one of the few bright spots in the current provincial budget."

Less than 1% of the plywood consumed in the Empire comes from Empire sources. This is the burden of an extract from the *Timber Trade and Saw-Mill Advertiser*. The manufacture of plywood within the Empire presents no overwhelming difficulty, but capital, cheap and constant labour, and a cheap source of power are the main desiderata.

(*September*, 1936.)—The first article on "Disforestation," a criticism of another on the same subject in the May number, comments on the advisability of some relaxation of forest management efficiency in order to meet real popular grievances. An extract may be interesting. "The change in attitude in the past ten years has been phenomenal. Even those formerly the stoutest opponents now co-operate. I would cite the case of a gentleman who went to prison in one outburst of agitation after preaching the burning of our forests. At the end of his first attendance at a meeting of the committee he agreed to use the paper, of which he was editor, to further the aims of the committee and later, in a very dry and dangerous year, he addressed public meetings in the district, saying that the forests should be protected from fire."

The report on forest administration in the Central Provinces records the shooting of 130 tigers and 108 panthers in forest areas, but adds that these are only a small fraction of the numbers believed to have been killed by poachers and in the protection of crops. There seems to be ample scope for the big-game hunter still.

F.C.M.

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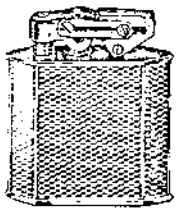

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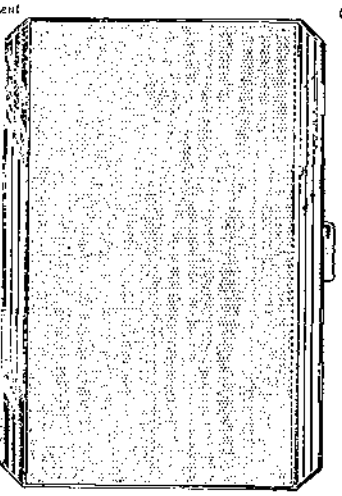

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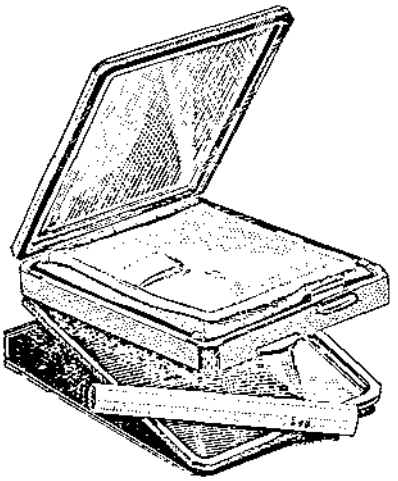

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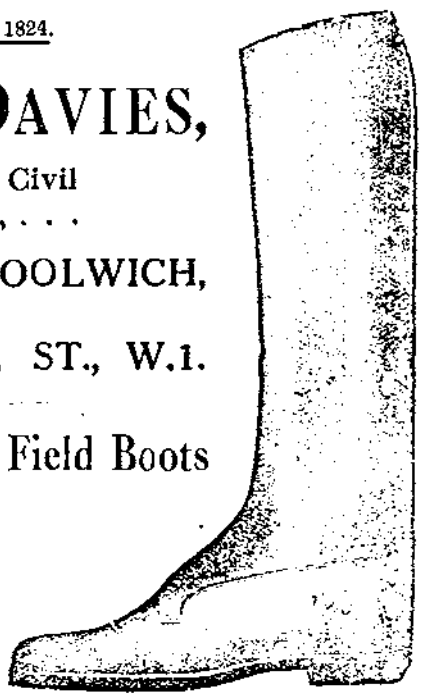

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