The Royal Engineers Journal



VOL. LIX

JUNE, 1945

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GORDON MEMORIAL, KHARTOUM.

Trumpeters sounding the Last Post on 26th January, 1945, the 6oth anniversary of General Gorpon's death.

The Gordon National Memorial 1

THE GORDON NATIONAL MEMORIAL (The Gordon Boys' Home)



The Gordon National Memorial 2

THE GORDON NATIONAL MEMORIAL

(THE GORDON BOYS' HOME)

BY LT.-COL. GRAHAM SETON HUTCHISON, D.S.O., M.C.

THE 26th January, 1945, was memorable in that on this date, 60 years ago, Gordon gave his life for the same cause which again has summoned millions of his fellow countrymen at home and overseas to obey the high call of Duty and Sacrifice. The sons of Empire fight for the same Freedom for which Gordon lived and fought and died. They strive also that the unkindness which a cruel Fate deals out to the poor, the sick, and the forgotten in the byeways of life, shall at last become a charge upon the National conscience. Even as Gordon gave his genius for friendship and all his leisure hours to lifting the destitute from the ditches of degradation and to setting their feet firmly upon the highways of opportunity, so today, in the midst of tragedy and trial, in what may be called the Jubilee of his memory, the public conscience has been profoundly stirred to plan on a national scale from the blue-print provided by this engineer skilled in shaping mankind to the Good Life.

The greatest soldier of the last half-century, Lord Kitchener of Khartoum, who as a young officer had known Charles George Gordon and followed in his footsteps, avenged his death 12 years later. The first act of the hardest taskmaster the British Army has known, after his victory at Omdurman, was to issue an Appeal for £100,000 with which to found a College for Sudanese boys to the memory of the man who had devoted so much of his life to their welfare. The National Memorial at home also took the form of a School for boys, thus perpetuating that part of Gordon's life work from which he obtained the greatest happiness. Gordon's name as a courageous, daring, and resourceful soldier would certainly have lived in history, for his achievements in China, in Equatorial Africa, in Abyssinia and Basutoland, and in the Sudan were outstanding. But so unorthodox were his methods and so picturesque was his manner, although he was quite unconscious of either, that his name would assuredly have lived forever among the stories of the heroes. The man, who when scarcely thirty years of age had commanded the " Ever-Victorious Army," who, armed only with a cane, had led the storming parties against breaches in the defences of the Taiping rebels, and with power in China little less than that of its august Emperor, declined all rewards for his great services is one of peculiar fascination for all time. "Chinese Gordon" would always have been secure on his pedestal in the Hall of Fame.

His appointment as Governor of the Equatorial Provinces of the Egyptian Khedive's domain displayed Gordon's unusual character and qualities under the most severe tests. Surrounded by enemics, frustrated by intrigue and corruption, his health undermined by an immensely inhospitable climate with its fierce sunshine alternating with drenching rain, he succeeded, nevertheless, in forcing his way through swamps and jungle and across the treacherous cataracts, so that, penetrating to the source of the Nile, he brought his steamers to the Lakes of Central Africa. While he completed this almost super-human engineering task, his duties included the establishment of the Khedive's authority in the Sudan Provinces of Darfur and the Kordofan, the riches of whose Arab rulers were vested in "black" and white ivory. His amazing personal ascendancy over great numbers of varied inhabitants of the Sudan became a portent perhaps without parallel in African history. With neither railways nor telegraphs, he covered immense distances, riding a camel of such speed that it became a legend in the land. Gordon would fly from one post to another, opening communications through turbulent tribes; freeing slaves and drilling them as soldiers; establishing posts at the water holes as the basis of his strategy; marching by day and night through terrifying sandstorms, and the deluge of torrential rain, until men marvelled that he never seemed to feel the pangs of hunger or the need of sleep.

He read his Bible with the zeal of a Covenanter. In the last message which ever came to us, he wrote : "The Almighty God will help me." The story of his death on the Palace steps at Khartoum in the midst of his famished garrison after eleven months of bitter siege is enough to have ensured Gordon's memory being deeply cherished by the peoples of the British Empire. But, granted his skill as an engineer and ability as a soldier, bringing to professional prowess all the alluring charms of a vivid and most unusual personality, and to these attributes adding also the drama of his death; vet Gordon's character and life made their most deep impression upon the subconscious mind of his fellow countrymen because wealth, rank, social distinction, the comforts and pleasures of life, counted with him as little as obscurity, danger or death from the other quarter. His triumph was that, like few men before or since, his life showed that Faith is not weakness, but strength ; that service is its own reward ; that courage and humility, strength and mercy, should march hand in hand together; that the Providence of God is not an incalculable chance but a power which gives strength to overcome every obstacle and to meet every danger. He destroyed for ever the illusion that " God is on the side of the big battalions "; that wealth is worthy of respect, or that poverty is to be despised. He challenged the convention that the exalted must stoop in patronage to the humble, and that dignity suffers a decline by lifting those born in humble circumstances to the high pedestal of Friendship. Of all his achievements none was greater, and none has borne richer fruit, than the work he initiated among destitute and necessitous boys while stationed in the futile fort at Gravesend.

Gordon's death summoned the whole Nation both at home and abroad, and many foreigners also, to found in his memory an institution worthy of his great example and attuned to those interests in which a gay personality, albeit doomed to march with ever-deepening tragedy, had found its greatest delights in life. Gordon had already discussed with Lord Tennyson a project upon which he had set his heart. It was to found a Home for poor boys. Queen Victoria contributed all the energy of her wonderful personality to initiating the scheme, and was the first of the Sovereign Patrons who have always taken a lively interest in the School. The Home was built on an estate of 58 acres at West End, near Woking, Surrey; and over 5,400 boys have already been trained in this institution, of whom more than 1,500 have become regularly enlisted soldiers. The outstanding feature of the foundation was the wise combination of a military system of discipline and management with vocational technical training in various crafts. The object in view was to give a course of instruction such as would qualify boys for a good start in life as civilians, soldiers, or sailors. The conditions for entry were that the boys be necessitous, of sound physique, and of good character. No financial, social, geographical or religious bar was set. The age of entry was fixed at "about fourteen" and the leaving age "about seventeen to eighteen," demonstrating that the founders were fully alive to the advantages of continued education during the adolescent period, especially for lads who had known little or no home discipline. Uniquely, therefore, sixty years ago, the Gordon

Boys' Home initiated what the nation is now only about to begin to realize through the Education Act of 1944.

To the School's foundation, donations of truly munificent proportions were included among those which came also from children with their pennies and from the poor of many lands. Corps and Regiments of the Army, Mayors, and Corporations, Banks and Firms of all kinds contributed generously. Churches all over the country gave their offertories on the Sunday nearest to Gordon's death, a practice continued for many years. Boys from the great Public Schools organized their own collections. But no community has been more eager to refresh the memory of their great comrade-in-arms than has the Corps of Royal Engineers.

The first Chairman of the Executive Committee was Field-Marshal Lord Napier of Magdala, to the memory of whom his fellow officers subscribed funds from which the present Dining Hall, Kitchens, and Bakery were built. The School of Physical Training, to which there are few superior in the country today, was erected by the liberality of a relative in memory of Major-General W. Hitchens, C.B., R.E., a personal friend of Gordon. The Library building was presented in 1908 by the Corps as their Memorial to Field-Marshal Sir Lintorn Simmons, G.C.B., R.E., the Chairman of the Home. Indeed, although many others have contributed to this National Memorial, the School has in a very special sense been a shrine in which "the Corps" for many years has been accustomed to record the services of some of its most distinguished members.

The buildings consist of four blocks of dormitories, named Woolwich, China, Gravesend, Khartoum, and administered on the "House system," accommodating in all 250 boys. For the majority of boys whom the School maintains, skill as craftsmen, in addition to a high sense of citizen duties, has always been the first and essential objective. The Workshops provide a vocational training for every lad, and consist of carpentering, bootmaking, engineering, motor mechanics and tailoring establishments, under a technical staff, while market gardening is learned in the grounds. The shops radiate round the classroom instruction, and they provide very largely also for the School maintenance. The laundry, bakery, boiler house, are all serviced by the boys themselves, and their working uniforms are made in the tailors' shop. Thus, instruction and practical work go hand in hand. But, beyond all else. character training has been the paramount aim. That the development of qualities of self-discipline, of a communal sense, of initiative and self-reliance, of physical and moral courage, is particularly desirable in the lives of boys who through poverty or misfortune have lacked a good home influence requires no emphasis.

Gordon was so luminous a personality that boys rallied round him in hero worship, to discover a man of unique inspiration and with close affinities with themselves, who could make them laugh, and what was so much more important make them laugh at themselves.

It would be difficult to discover any man—who has played a lead in the public life of this or any other country—who was so saintly and so selfeffacing, who so disdained wealth and honours, and yet who, in planning a campaign or battle, could be more coldly purposeful, and in carrying out his plan could show greater violence and ruthlessness. His character secmed to be a mass of contradictions; he had his faults, of which, like few, he was very conscious. Had Gordon been without faults, he would not have built himself so securely into the hearts of men. Others go down to posterity as great statesmen and soldiers, but none will ever rival Gordon as a great legendary figure, clothed alike in mystery and majesty.

The record of Gordon Boys' achievements, the many testimonics from

senior officers and employers, and not least the fact that Old Boys return year after year to the institution to which they owe so much, are all proof that the "sealed pattern" of Gordon's dreams has been in production for sixty years. The time comes in the life of every institution when new social and economic conditions have to be faced. The School has been running at a loss for the past dozen years, owing to the greatly increased cost of living coupled with some falling-off in subscriptions. The latter was to be expected since new generations have arisen to whom the name of Gordon is a glorious though vague memory, and the National Memorial, which since foundation has been maintained by voluntary subscriptions, has seemed to lose the first magic of its appeal.

But the year 1945—the Diamond Jubilec of the School's foundation—is now one of appeal to National institutions and to the public everywhere to refresh and to make possible the extension of the work perpetuated in Gordon's name. The claims upon this foundation increase as the result of war casualties; and, no matter what social reforms be introduced, no State system can ever supersede this unique institution. Memorials of stone are subject to decay as the years pass by and to forgetfulness as memories of former generations fade. But a Memorial such as this School remains for all time a constant and living instrument for Youth, a haven and a home for boys for just so long as Love and Charity abide in the hearts of men. Great Wars breed a comradeship which oversteps the boundaries of ordinary life. To some, perhaps, in their bereavement, consolation may best be found by helping others less fortunate in worldly blessings, making of them living memorials to those who have made the supreme sacrifice.

Field-Marshal Sir Bernard Montgomery writing to me from the grim battlefield in Holland has sent this message--

"No work is finer than the kind which cares for our British boys and gives them training and opportunities for usefulness; it is they who will have to play the major part in rebuilding the post-war world, and they must be well trained for the task. The Gordon Boys' School does such work, and is therefore worthy of our help and prayers."

I suggest that this commendation of work, with which during many years the Corps of the Royal Engineers has been particularly closely associated, is one which will encourage a lively revival during 1945.

Sixty years ago, Gordon perished at Khartoum in the dark hour of defeat, alone, because the most powerful Empire on earth, whose wealth was as the sands of the desert, showed its inability to reach him even with one message of regret for past forgetfulness. His fellow countrymen were too late. The Gordon Boys' School is now besieged by its needs. Surely it should be the object of all those in any way associated with Gordon's old Corps to ensure that the siege is raised.

TIDDIM WATER SUPPLY SCHEME

By MAJ. J. V. CORBET, R.E.

INTRODUCTORY

TIDDIM, the administrative centre of the Northern Chin Hills, is situated on the top of a ridge 5,500 ft. above sea level, and 2,500 ft. above the valley floors of the Manipur River and its tributaries which almost surround the base of the ridge. In peace, a large village, Tiddim was content with a gravity water supply (1" main) from hilltop springs, whose output dropped low during the dry period, December to May.

In Autumn, 1943, the plan of operations called for the concentration of 17 Ind. Lt. Div. forward of and based on Tiddim. A water supply of 69,000 gallons per day, independent of seasonal variation, was required to maintain this force. Such a supply could only be obtained from sources on the valley floor.

It fell; therefore, to the C.R.E. 17 Ind. Lt. Div. (Lt.-Col. R. S. B. Ward, R.E.) to prepare the scheme for water supply, while its execution was entrusted to a (Q.V.O. Madras), Fd. Coy.

The source of water decided on was the Za Lui, a tributary of the Manipur River. This necessitated pumping from a point N.E. of Tiddim to the ridge 2,500 ft. above.

PLANNING

At the time of planning, the Imphal-Tiddim Road was still in process of construction, and in its Southern stages (i.e.—nearest Tiddim) was "Jeepable" only, but it was to be passable for 15 cwt. trucks by the time the water supply stores would be required.

This meant that the pumps would have to be capable of being broken down to 15 cwt. loads, and the only suitable pumps available were ten 50 h.p. Waukesha-Hesselmans. These were semi-diesel engine driven pumps, having a duty of 10,000 galls./hour at 350 ft. head. This of course entailed pumping by stages, and it was decided to reduce the number of stages if possible, by grouping the pumps in sets of two coupled together in series. This was considered desirable for two reasons :--

- (a) The pipe alignment lay along a convex slope close to an old mule track. The gradient in places was extremely steep, and, whereas it was possible to find 4 or 5 comparatively flat sites for pumps and staging reservoirs, if 8 single stage pumps and reservoirs were installed some would have to be located on steep slopes involving a great deal of excavation.
- (b) The personnel available to run the pumps were few. If pumps were coupled in series one man could easily run two pumps.

Enquiries were, therefore, made as to the suitability of the pumps for coupling in series, and as far as could be ascertained, the proposal was quite feasible. It was decided to operate the line in five stages, one pump only at the first stage, then four stages each with two pumps in series (see Fig. 1. This left one pump as a spare. At the time the pumps were still back at the base, and no instruction book or other literature had been received.

The source of water, the Za Lui, was known to be liable to spates, and to rise about 8 feet. Its flow at the driest period of the year was unknown and could only be estimated. It was decided, therefore, to build a small dam, 20 ft. long and 6 ft. high, at a narrow part of the river, so as to impound at least a day's supply of water (60,000 galls.). This necessitated constructing the first pump house on the side of a steep bluff, with attendant heavy excavation.

It was decided to use 4" Victualic pipe for the rising main, and to construct the staging reservoirs from $40' \times 40'$ tarpaulins, supported by timber frames of locally cut pine. The capacity of each staging reservoir was to be 10,000 galls. and that of the main storage reservoirs at the highest point 50,000 galls.

The distribution layout is shown in the attached plan (Fig. 2). It is gravity fed from the main storage reservoirs, except for the truck and mule tank water filling points in the F.S.D. area. These are fed from the rising main from No. 5 Stage Pump.

EXECUTION

-Fd. Coy. (O.C. Major Partap Narain and later Major J. V. Corbett), were moved to Tiddim in October, 1943. On arrival, the O.C. and Lt. R. S. Jepson, R.E., with a party of 4 Sappers went down the hill for a preliminary Recce; going down and having a bathe and a sandwich lunch at the bottom was a picnic. On the way back they decided to measure the length of the pipe required, but cutting a straight path through the thick undergrowth and measuring with a tracing tape was a different matter.

Half way up, it started to grow dark and the attempt had to be abandoned. for the day. However, at the top, a drink of water with a handful of salt was more than welcome.

Preliminary work was started, with the help of Chin Labour, on the marking of the pipe line and the improvement of the mule track to make it "Jeepable." Up to Stage 4 a Jeep track was successfully made, but beyond that point it was a name; only one Jeep out of seven with the company could be trusted to travel up it. The system for getting round the corners involved considerable use of hand brake and chocks, and the passengers preferred to jump out and place the chocks rather than trust themselves to the driver. Visiting officers, of whom there were not very many in those days, were taken as far as Stage 4 in a Jeep. From there, they looked over the hillside at the river far below but invariably declined the offer of a walk down with the words "Oh, thanks ! I can get a good idea of the scheme from here !"

The marking and lay-out of the scheme was completed by the end of November. It was all plain sailing except that the last tank had to be sited where the Supply Officer's *bashas* and mess were. As he controlled the supply of rum to the officers' mess it required a great deal of tact to get his *bashas* moved.

Work was then started on the construction of the dam, and excavation of the pump site.

The track was later made passable for 15 cwts. to the site of the Stage 4 pumps; it was made just passable for Jeeps (reversing on hairpin bends) to Stage 3, and later to Stage 2. From Stage 2 downwards the track was made fit to take a specially constructed trolley to carry the pumps. The gradient was as steep as 1 in 2 on hairpin bends.

During this stage the 4" pipes were being brought to site. They were taken from Imphal to mile 109 in 3 ton lorries, thence to the Stage 4 site in specially adapted 15 cwt. trucks. Above Stage 4 the pipes were dumped at intervals along the track close to the proposed alignment. Below Stage 4 they were strung along the line by hand.

Shortly before Christmas Lieut. P. A. Longley, R.E., a pump expert in civil life, was sent up by the C.E. 4 Corps to render any assistance and technical advice required. His knowledge and experience proved invaluable, and on his advice certain changes were made. The first of these was the abandonment of the site for the Stage 1 pump. The drop in level of the Za Lui during the month had shown that on the original site, if the pump were placed so that the suction head during the dry months was reasonably low, it would be in danger of damage by spates during the monsoon. The new site selected was 400 yds. up stream. Here the wet weather rise in level was not nearly so great, and there was a flatter site for the pump house, while by the construction of a small boulder dam, the entire dry weather flow could be canalized to the suction pipe.

TESTING

It had all along been realized that the crucial point of the scheme was whether or not the pumps would stand up to being coupled together in series. Water would enter the second pump at a pressure of 150 lbs. sq. in. (350 ft. head), and leave it at a pressure of 300 lbs. sq. in. (700 ft. head). Would the pump casing stand this pressure ? Though, as already stated, inspection had revealed that it probably would, this could only be finally determined by actual test. Arrangements were therefore made to carry out the test as soon as possible.

Previous to the test, however, it was obvious that alteration would have to be made to the heat exchanger layout of the second series pump. In this type of pump the engine cooling water passes through a heat exchanger, in which it is cooled by water circulating from the delivery to the suction side of the pump. In the second series pump this cooling water would be circulating at a pressure of 300 lbs. sq. in., and it was immediately apparent that the heat exchanger and the circulating pipes would not be robust enough. The pipe layout had therefore to be altered so that the cooling water was taken from the suction instead of the delivery side of the pump. This alteration proved exceptionally troublesome owing to the fact that all fittings were American thread, and the only available dies for pipe screwing were British Standard thread. It was, however, achieved by means of improvised reducer and borrowed nipples from the spare pump.

The alterations having been effected, and Stage 1 (single pump) and Stage 2 (two pumps in series) installed, a test was carried out. The initial test was satisfactory, but fortunately it was continued for three days. On the third day leaks started to develop through hair cracks in the casing of the second series pump.

ALTERATION TO THE SCHEME

There was now no alternative but to resort to single stage pumping, and the system was revised as shown in Fig. 3. At Stage 2 the new location for the pump had perforce to be on a very steep slope and worse still, the pump had to be dragged up hill from Stage 2 instead of being lowered into position.

New staging reservoirs were of course necessary at each new stage. These were made of the same tarpaulin and timber frame construction as before, but they were reduced to a capacity of 5,000 gallons each, and each was placed above its pump so that the pump would run with flooded suction.

DISTRIBUTION

The distribution (see Fig. 2) was straightforward and calls for no comment. The only difficulty encountered was in laying the 4" main between the northern F.S.D. water truck filling points and the main storage reservoirs. For approximately half the distance the line ran across the air dropping ground. To protect the pipe against the assaults of bags of flour, jam tins and 25 pounder shells arriving from the skies, the pipe had to be buried. This meant nightwork, as the arrival of Dakota supply planes could not be delayed. The trench was not completely filled in until test, and in consequence four joints fell casualty to air action and had to be replaced.

The demand from the northern and southern distribution areas was expected to be about equal. By-pass arrangements were, therefore, made at Stage 5 so that either engine could pump singly to the F.S.D. area, while both in series would pump to the main storage reservoir. When it was decided to abandon the series pumping, one pump from Stage 5 was moved up above the higher F.S.D. reservoirs, and these were used as staging reservoirs for pumping on to the main storage reservoirs in addition to being the reservoirs for gravity feed to the F.S.D. area.

LESSONS

- (a) Vertical bends were found to be more of an obstacle to quick pipe laying than horizontal ones. A supply of setting pieces, which were not available, would have been useful.
- (b) The advantages of flooded suction for pumps are not always fully appreciated. Pumps should be given flooded suction wherever possible. Sufficient valves must be included to allow. for this.
- (c) Instructional literature about all plant held in E.S.D.'s should be available on a far wider scale so that copies are obtainable in the planning stage.
- (d) The sets when received were already connected pump to engine by the makers. These had to be broken down to make suitable loads for carriage to site, and to make up complete sets when either the pump or engine had become damaged in shipment. This entailed a lot of unforeseen work in fitting pumps to engines on site.

POSTSCRIPT

While the scheme was under way there were several "flaps" before the main scheme came into operation, Bde. Comds. threatening that they would have to withdraw unless water was available. But no such disasters befell us. All we had to do was to go a little further down the hill and look for fresh sources of supply.

The infantry wanted the water from the taps !

The system when completed was taken over and operated by (K.G.V's.O. Bengal) Lt. Fd. Pk. Coy., until the Japanese attack on the Tiddim Road in March, 1944. The enemy did slight damage to the pipeline. The installation was finally demolished by 17 Ind. Lt. Div. Engineers before the withdrawal from Tiddim.





LIFE IN INDIA LONG AGO

By Lt.-Col. E. W. C. SANDES, D.S.O., M.C., R.E. (retd.)

LURED by prospects of wealth and adventure, many young Englishmen sailed eastwards round the Cape during the latter half of the 17th Century, braving Atlantic gales in little ships and running the gauntlet of European enemics and Asiatic pirates. Some came as servants of the East India Company, others as prospective "Interlopers" to challenge the Company's trade; but all were fired with ambition fostered by the tales of returned "Nabobs of the East" and were prepared to undergo long years of exile in the pursuit of riches. A few survived to return to England, their pockets full and their health ruined; the remainder found early graves in the Ganges Delta, on the Coromandel Coast, or in the swamps of Bombay. Of the Company's men it may be said that although they amassed their wealth mostly by surreptitious private trade in a land where ostentatious display, intrigue, bickering, and licence of every sort were rampant, they were not wholly to blame; their way of life was thrust upon them by a directorate unique in the parsimonious treatment of its employees.

Into the monotonous existence of the hundreds of men scattered in small factories up and down the coasts of India came, from time to time, a few Englishwomen. The lack of female companionship was one of the greatest evils which the Merchants, Factors, and Writers had to endure, and the Directors in England were well aware of the fact. Early in 1668 they undertook to send out some of "the civillest Englishwomen" they could procure in order to found a colony on Bombay Island, and in the same year they wrote "And for such Single women or maides as shall now come unto you, we order that if they desire it or do not otherwise dispose of themselves by marriage to Englishmen, that then for one year after their arrival they shall have victuals at our charge, with one suit of wearing Apparel, during which time they are to be employed in our service as you shall think fit, but not to be employed in planting : and we do not consent that the said English women or maides be permitted to marry any other people but those of our Nation or such others as are Protestants." Twenty young women " of sober and civil lives " arrived in Bombay, but they behaved so badly that they were warned in 1675 that if they did not reform they would be placed on a diet of bread and water till embarked for England. This threat seems to have been effective, for almost all married forthwith and proceeded to increase the population. In 1678 the Directors made a further matrimonial experiment in giving free passage to Madras to three friendless maidens. These young women landed in a destitute condition and could give no explanation of their arrival except that they had been sent out by the Company which, they said, was accordingly bound to maintain them. The Madras Council therefore agreed to give them free board and lodging and to pay them each 10/- a month until they married, which they did within the next five years.

These women, and others of their class, found husbands from among the higher officials, but there were no Englishwomen for the rank and file who were consequently encouraged to marry natives because, as the Directors wrote, it was impossible to get "ordinary young women " to pay their passages although some gentlewomen were prepared to do so. Many officials who drew

a blank in the matrimonial lottery of imported gentlewomen also proceeded to marry natives, but still more took native mistresses and installed them in bibi khanas or small detached bungalows in their gardens. These men rapidly "went native," and native habits at length became so prevalent that the Directors had to issue stringent orders that on Sundays, or while on duty, their employees should wear European dress. They had already supplied their soldiers with uniforms, though their main object in doing so was to encourage the local native potentates to clothe their own soldiers in woollen material of the Company's make and thus to increase profits. Among the civilians and sailors, the umbrella came to be recognized as a mark of rank and the privilege of carrying one was strictly guarded. "Rundells shall not be wome by any man without the Governor's permission, except by Members of this Councell, Chiefs of Factorys, Commanders of Shipps and the Chaplaine and by no women below the degree of Factors Wives and Ensignes Wives." Thus wrote the Madras Council in 1678. Writers' wives had to share with all soldiers, and most civilians and sailors, the discomforts caused by vagaries of the climate.

Life in the very early settlements was monotonous, and liberty was restricted because the surroundings were dangerous. The factory gates were opened at dawn and most people took some exercise before work started at 9 a.m. At noon the bachelors dined formally at the Company's Table, where the seats were arranged in order of seniority, and afterwards everyone worked till 4 p.m. A couple of hours later, the men reassembled for supper, and in the cool of the evening they rode or drove to neighbouring gardens or beaches or were carried thither in palanquins. Some amused themselves on the musketry range, others hunted game in the adjacent jungles with an adequate bodyguard, but all had to return to the factory before 9 p.m., when the gates were shut and bolted. At meals there was much hard drinking, the favourite beverages being Shiraz wine and punch, the latter so called because of its five (panch) ingredients, arrack, water, sugar, lemon-juice and spice. On formal or festive occasions, the fashionable wear was a cloth coat adorned with silver lace. The Agent and the Chaplain sweltered under full wigs, and the juniors were supposed to wear perukes, but those who put comfort first had their hair cut short. Servants were cheap and plentiful, so the Company's officers lived in some luxury and were waited on hand and foot; and the fact that many of the servants were devoted and faithful shows that the morals of their masters were not so dark as sometimes painted.

In their communications with powerful native dignitaries the Company's officials of the 17th Century adopted the fashion of the country and, with their tongues in their cheeks, wrote in a most grovelling manner. For instance, the opening paragraph of an appeal from Sir John Child, Governor of Bombay, to the Emperor Aurangzeb ran as follows :---" The petition of the least of your servants, Sir John Child, like a grain of sand and with the greatest regard to your Majesty's Person, Amber-like Influence, Lord of Benificence and Liberality, Solomon-like Throne, Epitome of Priesthood, Heavenly Judgement, Potentate of the World, Center of Security, Emperor of the Earth and of the Age, Object of all sub-lunary thinges, the Divine Shadow of the Holy Prophet Mahomet, Orangzeeb, whose Person and Kingdom the Divine Powers long prosper that his righteousness and justice may spread over the whole world and everlastingly continue for the benefit of its inhabitants, Representeth after due recommendation of servitude and vassalage, with humility and lowness of mind, kissing the floor of all servile offices with lips of respect and obsequiousness, and with a head bowed down to your Fame and Greatness, etc., etc." No doubt the Emperor was flattered, though not deceived, by this adulation ; but it is deplorable that men of British

birth could so far demean themselves as to pen such nonsense, with its consequent loss of prestige.

The settlement at Bombay, ravaged by a recent Mughal invasion, was at that time moribund. Immorality was rife among the native population, and the Directors attributed it partly to the bad example set by the Company's soldiers whom they described as "debauched broken tradesmen and renegade seamen." Men died like flies on the wooded islands separated at low water by pestilential swamps. Many tried to drown their sorrows in country liquor. Some were content with the local arrack : others preferred superior brands from Goa or Bengal. The strongest arrack was distilled from molasses and heated by inserting a hot iron or a wedge of gold before being drunk. The more abstemious British emulated their Dutch neighbours as great tea-drinkers, usually adding spices, small lemons and sugar-candy to the beverage in place of milk and sugar. Meat was so scarce that there were two meatless days a week when *dal bhat* was served.

The Directors tried to reform their employees in Bombay by drawing special attention to religious matters. They issued strict orders that Sunday should be properly observed and prayers regularly offered, and they enclosed a form of prayer which began by asking the Divine favour for themselves and secondly their own favour towards the supplicants. Services were to be held twice daily in a room set apart for the purpose, and all Merchants, Factors and Writers were required to attend. A similar decorum was maintained in Madras. Writing of St. Mary's Church in 1700, Charles Lockyer remarks "Prayers are read twice a Day, but on Sundays religious worship is most strictly observed. On the Governor's approach the Organs strike up and continue a Welcome till he is seated." Thomas Salmon adds "The Church is floored with black and white marble, the seats regular and convenient, and altogether it is the most airy lightsome temple to be found anywhere, for the windows are large and unglazed to admit the cooling breezes. If it were otherwise the people must sweat intolerably at their devotions; for though in their own houses they are as thinly clothed as possible, yet when they come to church it is always in the European dress." A few years after this was written it was noticed that the young Writers were not attending regularly, so a fine of half a crown was instituted for each absence from a Sunday service. In the register of marriages is an entry "Adrian Playmer and Anne Daccur, June 5th, 1703," which records the conclusion of a curious episode, for Anne Daccur, with whom Playmer had cohabited during the voyage from England, had posed as a soldier, and Playmer had been ordered to refund £23 for her passage expenses as a female.

The opening years of the 18th Century saw a general improvement in social conditions in Madras and some advance in Calcutta. Describing the regal state maintained by the Governor of Madras, Thomas Salmon remarks : "He has as much respect paid him at his going abroad as a sovereign Prince. The guards are drawn out, the drums beat as he passes by : and fifty or sixty armed blacks run before him, and some of the likeliest young fellows he can pick out of the European soldiers run by the side of the palanquin he is carried in, armed with blunderbusses. A numerous train of servants also, and the country musick, attend him, and with their harsh untuneable trumpets give notice of his march. In the Black Town stand several Indian temples, and to them belong abundance of female choristers or singing women who seem designed to serve the public in another capacity and make up part of the equipage of a great man when he goes abroad ; for every man of figure in the country, I observed, had a number of these singing women run before him."

The Company's civil servants of this period were accorded free board and lodging, but so little pay that any who could raise money or goods for private

trade lost no time in doing so. Even the chaplains joined in the scramble for wealth. "The Company allow the two ministers £100 per annum each and a house," writes Salmon. "How they manage it is a mystery, for they are not suffered to trade openly and yet frequently they lay up several thousand pounds; one of them particularly I knew who hoarded up money enough to purchase a Bishoprick and sit in the House of Lords at his return." The Governor's official salary was £300 a year. Members of Council received from £40 to £100, Merchants from £30 to £40, Factors £15, and Writers only $\pounds 5$ a year, for which they had to work very hard. Clive himself drew only \pounds 5 annually until he was given a commission for showing outstanding military capacity ; yet by 1759 he was adding £29,000 yearly to his enormous fortune by a royalty secured on the Company's lands. Soldiers were paid at higher rates than civilians, perhaps because their opportunities for private trade were limited. A Lieutenant drew £75 a year, an Ensign £60, a Sergeant £27 and a Private f.14, on which, with free quarters and rations they are said to have lived very comfortably. Each Private had, as a "batman," a small native boy who wished to learn English, and he paid the child the equivalent of only a few annas a month for his services.

Soldiers were punished with extreme severity for the smallest fault. "Scarce a day passes," remarks Salmon, "but one or other of them are tyed to a post and whipped unmercifully. This makes them mortal enemies to the Government they should defend, and piques them more than any soldier-like punishment would, such as riding the wooden horse, running the gauntiet and the like. Another hardship the soldiers complain of is that though they have served forty years they shall not be released or suffered to return to their native country; and if they are so hardy as to petition for it, a dungeon probably will be their portion." Cruelty persisted throughout most of the 18th Century in the punishment of the Company's soldiers. In 1775, for example, four British soldiers were court-martialled for desertion. Two were sentenced to be shot and the others to receive one thousand lashes each. Then the Madras Military Board, being willing, as they said, to show mercy, directed that those condemned to death should be marched to the place of execution and there throw dice for their lives, the one who threw lowest being shot forthwith and the other reprieved and flogged. This barbarous sentence was actually carried out in public to deter other soldiers from deserting.

The civilian officials in Fort St. George at the beginning of the 18th Century lived sumptuously. "Provisions are at a cheaper rate than in Europe," writes Lockyer, "especially Beef, Pork and Poultry, with Fish of all sorts. Venison is often brought to Market, with several kinds of wild Fowl, as Teel and green Plover; three of the former and twenty of the latter are sold for a Fanam (3d.). Hence everyone has it in his power to cat well tho' he can afford no other Liquor at Meals than Punch, which is the common drink among Europeans. Wine and Beer also may be had. The Governor keeps a generous Table, not is that where the Factors and Writers dine less regarded, differing only in this that here you have a great deal of Punch and little wine, there what wine you please and as little Punch. As to Diversions, some are for a Collation at Marmalong or a jaunt to St. Thomas's Mount. Others think riding, shooting or coursing more agreeable Exercises ; but those that love a Punch-house prefer Billiards and Back-gammon to them all. Thus a Man seldom fails of Company to his own liking; clse let him search the curtains and noted walks and 'tis much but he'll find enough to entertain him with something new and diverting The better sort of people travel in Palankeens carry'd by six or eight Cooleys, whose Hire is three Pence a Day each; but they are paid more on long journeys. They have of

late Chariots and Chaises to take the air in. The Governor has four score *Peons* armed. Two Union Jacks are carried before him and two *Dubashes* attend to cool him with Fans and drive away the flies that would otherwise molest him." Lockyer's statement that punch was the common drink among Europeans may be amplified by remarking that in 1710 it was consumed in such quantities at the General Table that it became necessary to have armed soldiers in the diningroom to keep order among the junior Factors and Writers when the senior Merchants were absent.

Drink and boredom led to so much gambling for high stakes that in 1721 the Directors protested strongly. "It is with great Concern," they wrote, "that we hear the Itch of Gaming hath spread itself over Madrass, that even the Gentiewomen play for great Summs, and that Capt. Seaton makes a Trade of it to the stripping severall Young Men there. Wee earnestly recommend you to check this mischievous evill." Gambling was popular also in Bombay and Calcutta. The arrival in Bombay of a Royal squadron under Commodore Matthews, R.N., gave a fillip to it and to duelling; for it is recorded of the naval officers that "they looked as much superior as the greatness of their ambition could possibly lead them and challenged all and sundry to a duel on the least provocation."

In 1728 The Directors wrote to the Bengal Council :---" Wee do hereby peremptorily forbid all manner of Gaming whatsoever in any of our Settlements to the Amount of Ten Pounds or upwards and do direct that if any of our Covenant Servants or others in our employ shall be discover'd to have plaid at any Sort of Game for the value of Ten Pounds sterling or upwards at a Time, such Offender be *ipso facto* dismist the Company's Service and sent home by the first Shipping, as likewise all Free Merchants and all Women, Marry'd or Unmarry'd." These stringent orders produced some effect in checking open gambling for high stakes, but there is little doubt that the practice continued in secret and resulted in much misery and many suicides.

Life in Calcutta during the first decade of the 18th Century seems to have been pleasant and not too strenuous. The forenoons were dedicated to business, and after the noonday dinner everyone retired for a siesta. Punctually at nine o'clock each Monday morning, the Bengal Council met in muslin shirts, pyjamas, and starched white caps to write their petitions and protests and sip their punch. There was always a show of religion and decorum. The chaplain read prayers morning and evening; and on Sundays a solemn procession, headed by the Governor, wound its way to Church. If there were no chaplain, the prayers were read and a sermon preached by a Member of Council who received Rs. 100/- annually for these duties and to defray the expense of a black suit. He might be required to officiate often at a funeral, for the death rate from malaria and dysentery was prodigious. Until 1705 there was only one doctor in Calcutta, and no hospital till 1707; and in one year, out of 1,200 Europeans, no less than 460 died during the autumn and winter.

In Bombay, many years later, life was even more indolent. "In 1750," writes James Douglas, "the hours of business were from sunrise to 1 p.m. when its cares and troubles were laid aside and our breeched and wigged citizens, and our patched dames and demoiselles, spent their time, like little children in France, in eating, drinking and sleeping. The hour of universal satisfaction was 1 p.m. when dinner was served. After this came the *hookah*, the gurgling noise of which had a wonderfully soothing effect and sent the guests to sleep. They rose like giants refreshed and sallied out to walk, ride or drive on such oxen-drawn vehicles as were available near Bombay Green. Fortified with the fresh sea-breeze along the Back Bay sands, or a lounge at Mendham's Point, our diners returned at eight o'clock to attack the ghost of the midday feast, and if they could not eat, they could drink the strong wines of Portugal, the consumption of which contributed to swell the mortuary returns. Grose tells us of three other drinks which now burst upon the bibulous world of Bombay with astonishing effect. These were the spirit of deer, the spirit of mutton and the spirit of goat, animal spirits introduced from China. Flesh was thrown into a vat in which arrack was being distilled and imparted a distinctive flavour ! All the ladies of the period wore patches, at least Mrs. King, the Chief's wife of Anjengo did, for Grose records that at a reception some leading natives condoled with Mr. King on his wife's ' distemper' and hoped that there would be no more breaking out of boils and blains."

By 1765, Madras, Calcutta, and Bombay were cities of some pretensions. "Madras is without exception the prettiest place I ever saw," writes Mrs. Jemima Kindersley. " The town is laid out in streets and squares ; the houses neat and pretty and many of them large ; the rooms large and lofty. Verandars give a handsome appearance to the houses and in the evenings are cool and pleasant to sit in. But what gives the greatest elegance to the houses is a material peculiar to the place : it is a cement or plaster called channam made of the shells of a large species of oyster found on the coast : these shells, when burnt, pounded and mixed with water, form the strongest cement imaginable : if it is to be used as plaster they mix it with whites of eggs, milk and some other ingredients; when dry it is as hard and very nearly as beautiful, as marble : the rooms, stair-cases, etc., are covered with it. But let not what I have said lead you to suppose that anything here is equal to the noble edifices in England. I only mean that there is a neatness and uniform simplicity throughout the whole which cannot fail of being universally pleasing. The mode of living, from the religion of their servants, the heat of the climate and other circumstances, is so extraordinary that I can scarcely believe myself among English people. I can only say they are expensive in horses, carriages, palanqueens and number of servants, are fond of entertainments, dress and pleasure, sociable with each other, hospitable and civil to strangers. The heat is excessive; but the climate, for India, is esteemed healthy and people frequently come here from Bengal for the recovery of their health."

From Madras, Mrs. Kindersley went to Calcutta, which seems to have offended her artistic taste. " After Madras it does not appear much worthy describing," she records, " for although it is large, with a great many good houses in it, it is as awkward a place as can be conceived, and so irregular that it looks as if all the houses had been thrown up in the air and fallen down again by accident as they now stand. The appearance of the best houses is spoiled by the little straw huts which are built up by the servants for themselves to sleep in, so that the English part of the town is a confusion of very superb and very shoddy houses, dead walls, warehouses and I know not what. Here is not, as at Madras, a black town near for the servants to reside in; therefore, Calcutta is partly environed by their habitations which makes the roads rather unpleasant; for the huts they live in, having no chimnies, the smoke of their fires comes all out at the doors. The town is daily increasing in size, but houses are extremely scarce. A little out of the town is a clear airy spot, free from smoke, called the corse because it is a road the length of a corse (kos) or two miles, made on purpose to take the air, which the company frequent in their carriages about sunset or in the morning before the sun is up."

Native servants were plentiful in Calcutta when Mrs. Kindersley was there, and their wages were remarkably low. A *khansamah* was paid Rs. 5/- a month, a bearer or *khitmagar* Rs. 3/-, and a *dhobi* Rs. 3/- for the laundry of an entire

household or Rs. 1/8/0/ for that of a bachelor. A masalchi, who was then chiefly a torch-bearer, received Rs. 2/- a month, a wig-barber Rs. 1/8/0, and a durzi Rs. 3/- per household. The durzi was required to attend punctually in the early morning " on pain of corporal punishment if complaint is made," and any servant who refused to accept the specified rates of pay was liable to imprisonment or confiscation of his property. Thirty years later the rates had risen enormously, for khansamahs were then drawing Rs. 25/- a month and bearers or khitmagars Rs. 10/-; yet the wealthy still maintained dozens of servants and it is recorded that one family of four persons had no less than 110 Indian retainers and a number of negro slaves. Writing of Madras in 1780, Captain Innes Munro, 73rd Highlanders, gives some interesting details of a typical bachelor establishment :--" The numerous band of servants that a gentleman is obliged to keep occasions an immense expense. No person considers himself comfortably accommodated without maintaining a Dubash (steward) at four pagodas (Rs. '15/-) a month, a Butler at three, a Peon at two, a Cook at three, a Compradore at two and a kitchen boy at one pagoda each : and as in India no man will put his hand to any business but his own, an Hairdresser and a Barber at half a pagoda each with a Tailor occasionally at three pagodas : to which add nine Palanquin boys at one and a half pagodas each and a Horsekeeper and Grasscutter at two pagodas, and the amount for servants alone will be thirty-six pagodas or $f_{14}/8/0$ sterling per month without including the expenses of a horse or a zenana." As Munro's British service pay was only £15 a month it is evident that he had some excuse for bitterness.

Innes Munro is very critical of female society in Fort St. George. "When a young lady arrives in Madras," he writes, "she must, in a few days afterwards, sit up to receive company, attended by some beau as master of the ceremonies, which perhaps continues for a week or until she has seen all the fair sex and gentlemen of the settlement. This is a favourable opportunity for the display of folly and extravagance, the ladies vying with each other who shall put their husbands or parents to the most expense, and who shall cut the most ridiculous figure, with high heads, flying feathers, jewels and silken robes. They are seldom seen before, and never visit until the candles are lighted up in the evening; and then four or five are quite sufficient at one time to fill up all the couches and chairs in any house, being obliged from the extravagant width of their bell-hoops to sit three or four yards asunder. Many of them have the weakness to affect such airs of pomp and ceremony as to render their company extremely disgusting in any public place. But I should be sorry not to make a wide distinction between these and many whom I have the honour of knowing. I have often wished that the newly imported ladies might be initiated into the fashion of Madras by such virtuous examples ; but chance too often directs it otherwise, and unfortunately the ridiculous party most prevail. I apprehend that few ladies would remain so long in the Indian market did they display more of their abilities in the economy and management of a family than in adjusting the etiquette of extravagant decoration; for, according to the present mode of life, none but the most opulent can venture upon the luxury of a wife."

Ladies never came to India by the overland route, the record for which stood at 79 days, and during the normal six months' voyage round the Cape, in a ship of about 750 tons, they got to know each other only too well. A letter in 1780 from the Madras correspondent of the scurrilous *Hicky's Bengal Gazette* runs as follows :—" In my last I sent you an account of the number of Ladies which has arrived in the late Ships. There came Eleven in one vessel : too great a number for the peace and good order of a Round House. Milinary must rise at least 25 per cent, for the above Ladies, when they left England, were well stocked with Head Dresses of different kinds formed to the highest Ton. But from the unfortunate disputes which daily arose during the space of the Three last Months of the passage, they had scarcely a Cap left when they arrived." The anonymous correspondent was obviously trying to spread scandal but it is probable that his allegations had a substratum of truth. The more recent experiences of a young Army doctor who was placed in charge of twenty "intended wives" for the voyage to Bombay tend to confirm the story.

The outfit recommended for any young man sailing for India was elaborate and comprehensive. Innes Munro gives some details. "When an European arrives at Madras he is obliged to get a fresh supply of cotton shirts, waistcoats and breeches, not only because they are better adapted to the climate, but because the washermen seem to have come under an engagement to the cotton-vendors and tailors to destroy the Europe habiliments as soon as possible ; which indeed they do effectually and make no secret of their purpose; for while they thump your linen upon the washing stones, at every blow they call out ' Europe !' and strike with ten times the force they would do the produce of their own country. And this leads me to make you acquainted with the articles which seem most necessary for a gentleman to purchase in England before he embarks for the East Indies. All that is necessary for a young adventurer to carry out with him is as much light cloth and other furnishings as will be sufficient for three or four coats ; a few fashionable thin waistcoats ; three hats, two black and one white; four pairs of boots; twelve or eighteen pair of neat shoes; with only a few pairs of silk stockings, as those of the country are for the most part worn ; a neat saddle and bridle with a strong bit, and spare girths and straps. A fowling-piece and a few books are to be added to the list.

The scale on which a small ship was sometimes provisioned for a voyage to England is shown by the articles put aboard the Fortitude in 1783 when Major-General James Stewart, Commander-in-Chief of India, was sent home from Madras under arrest. Here are a few of the items :--Claret and Madeira, 60 dozen each; Arrack, ½ barrel; Brandy, 18 dozen; Hock, 12 dozen; Porter, 24 dozen; Hams, 15; Tongues, 5 casks; Bullocks, 12; Sheep, 60; Fowls 30 dozen; Ducks, 12; Turkeys, 2; Geese, 2; Pigs, 30; Sows with young, 2; Milch Goats, 6. No doubt the General was known to be a hard drinker and a hearty feeder, but as he was being deported for misconduct and disobedience of orders, it is difficult to understand the necessity for entertaining him and his fellow passengers so lavishly and shipping a complete farmyard with them. This, however, was typical of the times. Life was made ultra-luxurious for the highly placed, and spartan for the humble. In Calcutta where a " Bread and Cheese Bungalow " had to satisfy the juniors, there was a pretentious emporium for the wealthy which advertised that " turtle were dressed, gentlemen boarded, and families supplied with pastry." Over-indulgence by the rich was pilloried by the Calcutta Gazette in 1788 in a jesting article purporting to give advice on health in the hot weather. "Gentle-" it ran, " are particularly requested not to eat above four pounds of men, solids at a meal, or drink above six bottles of claret, and to refrain from ridin ; between the hours of ten and four in the day. Dancing will be extremely fatal to ladies if taken more than three times a week." An exaggeration, no doubt, but with a foundation of truth for Calcutta was unhealthy and the inhabitants had neither ice nor punkahs. Of Madras in the hot weather, Innes Munro writes :-- "Providence surely never intended that Europeans should carry their conquests thus far from their native shores, for their emigration hither is certainly meant as a punishment and a scourge. No one, in my opinion, that could exist in his native country would ever wish to spend

the best part of his life in this. Here, patriotism evaporates through the stream of perspiration." Many who have experienced an Indian summer in the plains will agree with him.

The observations of Captain Innes Munro are particularly valuable because they were made from the point of view of an outsider, a man who had no connection with India and was unaccustomed to its ways. He gives some amusing details of a typical banquet in Madras in 1780. "An entertainment given by the Governor, or by any other gentleman of consequence, is really a curious spectacle. It is the custom for each guest to go thither attended by all his retinue of servants, who wait upon him at table in great pomp, the head dubash taking post directly behind his master that he may convey his orders to the rest, who are all arranged in rear as far back as the diningroom walls. This ridiculous fashion, together with the smell of the meat, renders the room intolerably suffocating and disagreeable during dinner. It is reckoned ungenteel upon such occasions to be attended by any domestics but your own : yet a foreigner at first feels quite in pain when he is obliged to ask for anything at table, for the sign is no sooner made than twenty servants get into rapid motion, all darting at one object, and frequently running against each other in the simple act of handing a glass of beer. Every liquor that is brought to a great man's table, even the water, is cooled with saltpetre, for the art of wine-cooling is a distinct profession of itself. When the cloth is removed, all the servants, except the hookerbedar, retire and make way for the sea breeze to circulate, which is very refreshing to the company whilst they drink their wine and smoke their hookers. This instrument is trimmed and set in order by the hookerbedar, who has no other profession and who sits upon his hams at a distance in the rear of his master adjusting the chillum, as they call the different ingredients, whilst he conveys the coral pipe to his mouth which at every whiff sounds like boiling water; so that, when ten or twelve gentlemen smoke at the same time, they make a noise as if they were all snoring together." The habit of smoking hookahs was not confined only to men. Ladies also indulged in it and sometimes borrowed a man's hookah if they wished to pay him a compliment. In this case he was expected to substitute a new mouthpiece before handing it to the lady, who took a few pulls and then returned it to the gratified owner. After 1840, hookaks went gradually out of fashion, being ousted by cheroots, which had been in favour with both sexes in Calcutta for many years.

Military life in India in the latter half of the 17th Century, and the equipment and uniform of the Company's soldiers, deserve some mention. "A soldier should be as attached to, and careful of, his musket as his mistress" ran a General Order of 1770, and the proverbially licentious soldiery probably appreciated the metaphor. In 1777, however, the soldier's attachment to his musket was challenged by the appearance of the first rifles, a batch of twenty having been sent to India on approval. They were handed over to Captain Manoury, Commissary of Stores in Madras, for trial and proved to be shorter and lighter than the musket and to require less than half as much powder. " The Point blank range of both Pieces are nearly equal," reported Manoury, "but the rifle barrel carries much truer than the musket, for at 200 Yards distance we generally struck within a few inches of the mark, but with the musket not within as many feet." 'This report induced the Commander-in-Chief in Madras to advise that two or three men in each company should be armed with rifles and the Government indented for 1500 of them, but nothing came of it, and the musket, or its modification the lighter fusil, held the field in India till replaced by the Brunswick rifle in 1844. So the Company's soldiers of the latter part of the 18th Century continued to use the old smoothbore whose recoil was almost as shattering as its wayward spherical bullet.

In 1778 the uniform of the Madras native infantry was picturesque, if hardly suited to campaigning in a hot climate. "Their uniforms have a very military appearance," writes Munro, " consisting of a red light-infantry jacket, a white waistcoat, and a blue turban placed in soldier-like manner on the head, edged round with tape of the same colour with the facings, and having a tassel at the lower corner. The sepoy has a long blue sash lightly girded round his loins, the end of which, passing between his legs, is fastened behind. He wears a pair of white drawers, tightly fitted, which come only half down his thighs, and, being coloured at the lower end with a blue dye, appear as if scalloped all round. A pair of sandals upon his feet, white cross belts, a firelock and bayonet, complete the sepoy's dress. The native officers rise according to their merit from private sepoys, and before the most of them arrive at the rank of subidars they become quite bald and grey and their hoary beards and whiskers cut a venerable appearance at the head of the regiment. Their dress is much the same as described above : with this difference only, that their coats are made of scarlet cloth, with tinsel epaulettes, light drawers all the way down to their ankles, and a large crooked scimitar by their sides." The full dress of a British officer of the Madras Pioneers was a dark blue, cut-away, tailed coat with black facings and gold epaulettes, white waistcoat, a frilled cravat and shirt, tightly fitting white trousers above black spats, a red silk sash round the waist, white cross-belt, and a black hat with a plume .. How the Madras Pioneer must have suffered on a ceremonial parade in June 1

The conditions under which the Madras troops marched against Haidar Ali of Mysore in 1780 are so extraordinary that they warrant more than passing notice. "The preparations for war carry nothing hostile in their appearance writes Innes Munro, "ease and comfort being far more studied upon these occasions than dispatch. It would be absurd for a Captain to think of taking the field without being attended by the following enormous retinue, viz., a dubash, cook and boy; and, as in these times bullocks are not to be had. he must assemble fifteen or twenty coolies to carry his baggage, who, with an horsekeeper and grasscutter, and sometimes a dulcinea and her servants, complete his traine, having occasionally the assistance of a barber, washerman and ironer in common with the other officers of his regiment. It might be found improper, on such occasions as taking the field, to allow a Captain a palanguin, although I have known many of them permitted to enjoy this luxury at very improper seasons, which of course must add nine bearers to his suite. His tent is furnished with a good large bed, mattress, pillows, etc. a few camp stools and chairs, a folding table, a pair of shades for his candles, six or seven trunks with table equipage; his stock of linens (at least twentyfour suits); some dozens of wine, brandy and gin; tea, sugar and biscuit; an hamper of live poultry, and his milch goat. A private's tent for holding the overplus of his baggage is also requisite. Thus every officer in the line equips himself according to his abilities and rank. When an officer has company to dine with him in camp he never provides plates, knives and forks, glasses or chairs for them; it being the invariable custom for each guest to send his servant thither with these articles, who lays them down upon the table wherever he sees a vacant place. In place of messing together, as in Europe, each officer keeps a cook, and in this manner entertains half a dozen friends in his turn. . . . Should it happen to rain during the night, every servant thinks himself fully entitled to take shelter in his master's tent. You may easily imagine then how much their disgusting habits must blast all the enjoyment of life; the Captain being obliged, in the midst of all his luxuries, to repose in a close tent, surrounded by twenty or thirty of these black miscreants lying compactly upon the floor in order to keep each other warm."

It is not surprising that, a few years later, Ensign George Rowley, of the Madras Engineers wrote : "The marches of an Indian army are so impeded by the cumbrous train of baggage that it will find more difficulty in making a march of ten miles than a light European army in performing one of twenty."

In conclusion a few words on the subject of leave may be of interest. It was difficult for an officer to get leave to England in the olden days, and almost impossible for the rank and file. A certain Captain Thomas Fenwick, applying for sick-leave, added that he had served the Company for no less than 34 years without any absence from duty. A medical certificate of 1779 indicates also that leave was rarely granted. It runs as follows :-- " This is to certify that Lieut.-Colonel Horne, from uninterupted duty during the course of twenty years in the field and in Garrison, is becoming subject to Stifnesses in his Joints, Rheumatick complaints, and a Scorbutick Disposition of his Juices. As they may be effectually removed by a course of Bath Waters he is advised to proceed to Europe for that purpose." The invalid was allowed to go home and it is hoped that his juices benefited by the treatment. The expense, however, of a passage to England at this period was so great that only the wealthy could afford to take leave on private affairs. Passage money varied according to the rank of the traveller and the nature of the accommodation provided. Factors or Captains were charged Rs. 2,000 (£225) for the homeward journey, and Writers or Subalterns Rs. 1,500 (£170). As the fares for the outward journey were only £150 for Factors, £125 for Captains and £105 for Writers or Subalterns it appears that leave to England was discouraged. Generals were required to pay £250 for an outward passage, Councillors or Colonels £200, and Lieut.-Colonels or Majors £150. Voyages were risky owing to prowling French privateers and were often greatly prolonged by alterations of course to avoid capture. Most of the ships carried mails. In 1798, communication by letter was accelerated by the establishment of a regular monthly postal service up the Persian Gulf to Basra and thence overland through Aleppo or Baghdad, but the charge for a letter was enormous and very little could be written. No envelope could exceed four inches in length and two inches in width and the postal rate was 27/- for 1/8th oz. A letter by either overland route took about one month to reach England, and any important despatch was usually sent in duplicate, one copy by Aleppo and the other by Baghdad. Thus it will be seen that the poorer classes of the British community in India were isolated, both in person and in correspondence, from their friends in England.

Modern India, with its electric lights and fans, wireless broadcasts, and air transport, bears little outward resemblance to the India of the 17th and 18th Centuries in which small gatherings of Europeans struggled for life and wealth among the teeming millions of the native inhabitants. Yet the soul of India never changes. 'To many, the country is a land of regrets; but the majesty of its mountains, the mystery of its dark jungles, the melancholy of its distant horizons, and the fascination of its varied peoples and customs will appeal always to men and women of the British race and there will be no lack of volunteers for service within its boundaries.

THE KILA SAFED ROAD

Anonymous

KILA SAFED is a small mud fort on the Indo-Persian frontier, some 350 miles West of Quetta and 270 miles North of the Arabian Sea. Why has it given its name to 582 of the 1,642 miles of the Karachi-Jacobabad-Zahidan-Meshed highway, one of the important supply routes to Russia?

To answer this question it is necessary to go back to the autumn of 1941, when, so far as World War II was concerned, it was still a matter of "Delhi dur ast." (Delhi is far away.) Certainly, until the Japanese entry into the war, the retreat of the Russians to the Caucasus and the Eighth Army to El Alamein, the war, to India, seemed very remote. India, in spite of her politicians, was ready to raise, train and, to some extent, equip an army, provided that army was paid for by the British Taxpayer as soon as it left India's shore. But to develop her land communications, either to East or West, was another matter.

In World War I, owing to the disintegration of Russian troops in Persia, who had previously barred the way to Turkish and German Agents, it was found necessary to build up the East Persian Cordon to serve the same purpose. The E.P.C. was based on Duzdab, a small village in East Persia near the point where India, Persia and Afghanistan meet. A railway was constructed South of the Afghan frontier, from its terminus in Baluchistan to Duzdab.

When Reza Shah came to power in Persia a few years after the end of World War I, one of his objects was to combat British and Russian influence. An Indian railway with its terminus in Persia was looked upon as a slur upon Persian sovereignty and at the request of the Persian Government the service to Duzdab was discontinued and part of the line taken up. Duzdab— "Thieves' water "—was thought to be an inappropriate name for a Persian frontier town, so it was rechristened Zahidan—" Priests' place "— after an ancient Seistan site.

So things remained until World War II. The German attack on Russia, followed later by the Russian retreat, rendered it necessary to develop supply routes to Russia, East of the Caspian. The possibility had to be faced that the Persian Gulf ports might fall, and that India might have to defend herself against a German invasion from Persia. A big programme of airfield construction and a road from Karachi to the Russian frontier at Bajgiran, N.W. of Meshed, were planned and the order went forth to relay the Zahidan railway.

All agreed that the road from Zahidan to Meshed, which had been constructed during World War I, should be reconditioned and form part of any L. of C. plan to send supplies to Russia. The question was whether a road from India to Zahidan was necessary, or, could the relaid railway cope with the traffic? The two factors which decided the matter were the shortage of rolling stock in India, which limited the capacity of the railway, and the fact that we might have to fight a battle in East Persia—and even in Baluchistan—when road, as well as rail L. of C., would be essential.

Having decided to build a road, the next question was where? If the object of the road was to supply Russia via Zahidan and Meshed, the logical route was straight North from Chahbar on the Persian Gulf. This would have meant the development of port facilities at Chahbar. This project was vetoed for the reason stated above and because our L. of C. would have been

at right angles to the line of enemy advance, a practice which, as has been proved in Manipur, is dangerous. It was decided, therefore, to use the existing port facilities at Karachi.

The next problem was to decide the route from Karachi to Zahidan. Some favoured going straight North through Las Bela, Khuzdar and Kalat to Nushki, others by the longer but already partially developed route via the Indus valley, Jacobabad and the Bolan Pass. The latter was adopted, as portions, such as Karachi to Hyderabad, and Sibi to Quetta already existed, work was in progress in other sections as part of the Indian Strategic Road Programme, and the route followed the railway line which facilitated supply.



So much for the planning. Let us now consider the problem with which the D.C.E. Quetta, who is also Secretary, P.W.D. Baluchistan, was faced. He had to build or improve some 582 miles of the Karachi-Meshed highway from the Sind border near Jacobabad to the Persian frontier at Kila Safed, He decided to omit any reference to places outside his area, such as Zahidan, or to places not actually on the route, such as Quetta, and call the road, as is usual in the case of new roads, after its furthest point, the "Kila Safed Road."

From the Sind frontier, $5\frac{1}{2}$ miles North of Jacobabad, to Sibi (93 miles) and for some 21 miles beyond, the road crosses a flat, almost waterless desert. During the summer Sibi and Jacobabad record some of the hottest temperatures in the world. Although normally waterless, the desert is subject to occasional floods, which descend with little or no warning from the Baluchistan highlands, washing all before them. The soil is mainly clay, often containing saltpetre and there is a complete absence of stone.

From mile 21 from Sibi (Pir Chauki) to mile 77 (Kolpur) we have the "Bolan Pass." This consists of a gradually narrowing valley through which the road rises from the level of the Sibi plain, about 500 feet, to the level of the Quetta plateau, about 5,800 feet.

From Kolpur to the boundary between Kalat State and the Chagai Agency of Baluchistan (63¹/₂ miles from Quetta), a total distance of 75 miles, the road crosses the Quetta-Kalat plateau. The height of this plateau varies from 5,800 feet at Kolpur to about 5,000 feet at Sheikh Wasil. From it mountains rise to some ten or eleven thousand feet. Here temperatures as low as zero fahrenheit have been recorded in winter and the ground is sometimes under snow.

From Chagai boundary the road winds down through the Galangur Gorge and Nushki Pass to the Rakhshani and Sinjrani deserts. These alluvial deserts, which begin at mile 90 from Quetta, near Nushki, lie at a height of just over 3,000 feet. They are bounded on the North by the Chagai hills (7,000 to 8,000 feet) and the Koh-i-Sultan (7,600 feet), and on the South by the Ras Koh (almost 10,000) and a vast saltpetre waste called the Hamun-i-Mashkel which takes the drainage of Western Chagai. While this desert is not so hot as the Sibi plain, it is well above normal hot plains in summer, almost completely waterless but, like other waterless tracts of Baluchistan, subject to occasional severe floods and cursed with strong winds and almost daily sandstorms.

At mile 399 from Quetta, the road comes to the Persian frontier at Kila Safed. Just across the frontier is Mirjawa, a station on the Zahidan railway with a good water supply. To the West can be seen the cone of Koh-i-Tuftan, an active volcano some 13,000 feet high.

So much for the ground. Next for the factors affecting the problem. First and most essential—water. As the Chief Engineer remarked in a letter apropos of siting airfields: "To site a work in Baluchistan before finding out about the water supply is putting the cart before the horse on a steep, uphill grade." Unfortunately the road had to cross long, waterless, stoneless tracts and for work in these areas, all water and road metal had to be transported by road or rail.

The supply problem therefore resolved itself into one of transport. The palmy days of smoothly flowing lease-lend were yet to come. A certain amount of very part-worn civil transport was hired but the position was greatly aggravated by various local Governments placing a ban on the export of vehicles from their domains.

Road rollers had to be requisitioned from all over India. This naturally took time as Provincial P.W.D.s, District Boards, etc., had their own road problems and were reluctant to part with them. Human nature being what it is, the oldest and most decrepit rollers were sent. The rail journey was often long and complicated, treatment not of the gentlest. "Sirkari mal, darya men dal" (Government property--throw it in the river). When the rollers finally did arrive they had to be repaired and overhauled before they could be used.

At the very start of the work an event occurred which was to have very f. r reaching results—the outbreak of war with Japan. The immediate effect, so far as Baluchistan was concerned, was to divert men, machinery and materials intended for the supply route to Russia to the more urgent task of stopping the Japanese invasion of India. From this time onwards the Kila Safed road had to fight a losing battle for men and materials with the strategic roads on the Eastern front and the numerous new airfields required for the defence of India. On 30th January, 1942, the Defence Department of the Government of India sanctioned the construction of a "motor road" from Karachi to Zahidan at a cost of Rs. 2.75 crores (£2 millions) and committed the project to the Q.M.G. From this date, therefore, the project ceased (in theory) to be civil and became military, under the Q.M.G. The Q.M.G., however, asked the External Affairs Department and the Communications Department to carry out the work through the P.W.D. Baluchistan, for which, in fact, the M.E.S. were the agents.

Work on the portion Sind border-Quetta (190 miles) was carried out under an existing organization (C.R.E. L. of C., Quetta), and a C.R.E. Kila Safed Road, with two additional Garrison Engineers, was appointed to build the road from Quetta to Kila Safed (399 miles).

The Secretary P.W.D. soon found out that his principal difficulties were lack of transport, and the competition of other urgent works, defences and airfields. As soon as the railway to Zahidan was relaid, it was used to full capacity for the transport of stores for Russia and work on the road was interrupted for want of materials. On 17th March, 1942, the Secretary P.W.D. wrote to the External Affairs Department: "It would appear necessary for a decision to be made by the Government of India whether the carriage of goods to Persia or the supply of water and delivery of materials for the construction of the Quetta-Kila Safed Section of the Karachi-Kila Safed road is to be given priority."

Early in April, 1942, urgent demands were being made by various authorities for early completion of Defence Works and R.A.F. Works. As the available plant, materials and transport were insufficient to meet all demands, W (I) District signalled G.H.Q.: "Is road to be given priority over landing grounds?" The reply was that "Landing grounds and defence works will be given priority over the Kila Safed Road." On 27th April, 1942, G.H.Q. followed this up by saying that the road was "equal with defence works, next in priority after aerodromes."

Undue emphasis is perhaps being laid on these teething troubles, but, as there was undoubtedly delay in starting physical work on the ground and in maintaining reasonable progress, they must in fairness be recorded.

During April, 1942, a major reorganization of the India Command took place—the old Northern, Southern and Eastern Commands and Western (Independent) District were abolished, and replaced by North Western, which absorbed Western (I) Dist., Southern and Eastern Armies and Central Command. The effect on Baluchistan was to abolish the Chief Engineer W. (I) Dist. and replace him by a Deputy Chief Engineer under the Chief Engineer, N.W. Army. The D.C.E. in his capacity of Secretary P.W.D. could still write to the External Affairs Department, but he could no longer write to the Engineer-in-Chief.

From the point of view of the C.R.E. Kila Safed Road it was, possibly, unfortunate. Knotty problems could no longer be settled by a friendly chat with his Chief Engineer in Quetta—they had to be set down on paper and sent, through the D.C.E., to distant Rawalpindi.

The specification to be adopted led to some argument. Because of the scarcity of water a penetration grout was agreed to. The all-India shortage of bitumen, and the road and airfield programme already referred to, limited the amount available for the Kila Safed Road. On 25th May, 1942, the E.-in-C. wrote to the C.E., N.W.A., saying "a grout is far too costly in regard to consumption of bitumen and in spite of the consequent difficulties the specification for the entire road must be based on water bound macadam with one coat of surface dressing at 50 lbs. per 100 sq. ft.

The E.-in-C.'s letter having reached the D.C.E., Quetta, via the C.E.,

N.W.A., Murree, the D.C.E., replied on 15th June, 1942. In this he said, "Since except in rare places, there is barely enough water on the alignment for drinking purposes and even that has for the most part to be transported in railway tank wagons, ordinary water bound macadam is out of the question." He added : "Up to date not more than one-third of the rollers asked for have been supplied, and these are now being withdrawn for work on aerodromes which rank above the road in order of priority."

The D.C.E. won his point, and a specification was adopted using a semigrout of 70 lbs. per 100 ft. super, followed by a surface coat of 20 lbs.

The great rush of work in the spring of 1942 led to a state of affairs in Baluchistan where there was more work to be done than labour and materials with which to do it. When supply exceeds demand, competition lowers prices, but when demand exceeds supply, competition raises them. Consequently the normal method of putting out work to competitive tender had to be temporarily abandoned. Instead, the principal contractors in Baluchistan were divided into five groups and each of the five C's.R.E. at that time was allotted a group. The C.R.E. had then to distribute his work to the best advantage among the contractors in his group. Rates and prices were negotiated.

For such a system to be satisfactory it is necessary to have rigid price control. Unfortunately rationing and price control was not introduced in Baluchistan until a later date. Consequently prices rose steeply, wages rose in an attempt to keep pace, and the contracts made in 1942 cost much more than they would have done pre-war.

The difficulties and misfortunes experienced during the spring of 1942 with regard to materials for the work and food for the labour were as nothing compared with those experienced during the summer when an event occurred which had a most disastrous effect on the Kila Safed Road. This was the breaching of its protective bunds by the River Indus, the flooding of a large part of upper Sind and the severance of all road and rail communications between India and Baluchistan.

Baluchistan is a province which in normal times is almost self supporting for food, as any deficit in the highlands can be made good by a surplus from the plains. Prices, however, had risen more quickly in Sind than in Baluchistan, and the spring wheat crop of 1942 had been largely sold to Sind. Coupled with this was the fact that there had been a large influx of foreign labour to work on the defences, airfields and roads. So when the floods came, they caught Baluchistan dangerously short of food. The prompt and energetic measures taken by the Civil Authorities to ration and control all existing supplies and arrange for the import of food by boat, prevented a famine such as later, under somewhat similar conditions, occurred in Bengal. For months, however, the Province was very short of food, a good deal of our existing labour departed and no fresh labour could arrive. Further, the shortage of petrol and coal made road and rail transport extremely difficult and even had there been food in Quetta it would have been impossible to maintain large gangs out on the road. Some petrol was obtained from Persia, where, thanks to the Anglo-Iranian Oil Company, it is cheap and plentiful. Due to international and possibly inter-oil combine complications, the supply took some time to arrrange and was always hedged about with irritating restrictions.

The road and railway between Baluchistan and India remained breached until December, 1942. Progress on the Kila Safed Road was therefore, depressingly slow. There was little to show for the first year's work other than a cross country track, improved in the worst places, and a few bitumen grouted miles near Quetta ! Just before the floods stopped all traffic, some excavating machinery had been sent from Lahore to work on the road. This was a very welcome addition to our strength and gave valuable help. The operators had, however, only done a 6 weeks' elementary course, and the O.C. was anxious to derive the greatest training benefit from the work. In consequence there were sometimes arguments as to what was or was not good training, and naturally a fully trained unit under the sole command of the C.R.E. would have been far more useful.

Some two months before railway communications were re-opened the D.C.E. Quetta again raised the question of priorities and of water supply for the road. It was again pointed out that in the waterless sections of the desert we depended entirely on the railway for water, which was brought in railway tank wagons. If on the reopening of traffic the line was to be used to full capacity for replenishing the exhausted reserves of Baluchistan, especially coal, and for sending aid to Russia, then water could not be carted, and work could not be done on the waterless parts of the road.

In October, 1942, instructions were issued by N.W. Army that the road from Nushki to Kila Safed would be a 35 ft. shingled road. The change to shingle was due to bitumen shortage and the necessity to conserve engineer resources in India.

In January, 1943, orders were received for the detachment of the Excavating Machinery Group to return to Lahore immediately. This was a great blow as the operators were now trained and had the detachment remained with the C.R.E. it could have done most useful work.

In the same month another important administrative change took place the Operational and Administrative boundary between the India Command and the Persian and Iraq Command was moved from the Indian frontier to a line which just excluded Kerman, but included the Zahidan-Kerman and Zahidan-Meshed roads. This placed the C.R.E. East Persia (also known at that time as C.R.E. Works) under the D.C.E. Quetta and his title changed to C.R.E. East Persia and Western Baluchistan. He moved his headquarters from Kerman to Zahidan, to be in closer touch with Quetta, and in February took over the portion of the Kila Safed Road west of mile 63.

It was an advantage to have the whole route from the Sind border near Jacobabad to Meshed (where the Russians took over) under the D.C.E. Quetta. It was, however, rather awkward for the C.R.E. E.P. and W.B. to control the road back almost to Quetta. The reason for this was that communications along the road were bad, and a letter often took several days to get from Quetta to Zahidan.

With the coming of summer, the work on the road entered a new phase. The railway was working again, rollers and bitumen had arrived and it was now possible to feed large numbers in the desert. We still had to contend with a shortage of motor transport which delayed metal collection. We also had the greatest difficulty in getting good work from the untrained gangs of the contractors. The railway breaches and other difficulties had so delayed progress that it was now felt that speed was paramount and the contractors were constantly urged to go faster and try to make up some of the lost time. The two operations where we found it most difficult to maintain quality were earthwork and soling. Unless organized teams of road machinery are available (tractors, elevating graders, sheeps' foot rollers and motor graders), it is extremely difficult to make a bank which does not settle. Long stretches of soling were condemned, and the contractor was made to do them again. Sometimes the work was condemned twice and three times and in the end we had to accept something not as good as we could have wished.

Our supervising staff was also a problem. There were of course, loyal and

willing workers but our better men were mostly promoted and transferred or posted to an area where the necessity for staff appeared to be greater and some of our new recruits left very much to be desired. There is an unfortunate conviction in India that the passing of examinations qualifies a man to take charge of practical work. We had some reliable men with practical experience, but we could only promote those who could read and write English and record measurements.

In spite of the intolerable climate, the scarcity of food and at times the almost entire lack of water, as well as the complete absence of amenities for the staff and the labour, it is most creditable that some 200 miles of road were metalled, grouted and surfaced during the summer and autumn of 1943. In addition, a big programme of bridges, culverts, causeways, retaining walls, and huts for the staff and permanent gangs, who up to then had been living in great discomfort in small tents, had been also carried out.

Nothing further of interest occurred until the end of November, when it became too cold to do successful work with bitumen. Where water was available the specification was changed to water bound macadam which was surfaced in the spring with two coats of bitumen. In the waterless stretches, the road was only soled at soft spots, and the soling was "hogged," covered with shingle, and opened to traffic. Later it was thoroughly cleaned and given two coats of bitumen surfacing.

In February, 1944, the C.R.E. E.P. and W.B. and the C.R.E. Quetta were abolished. Work in Baluchistan and East Persia was divided between two organizations, C.R.E. North, and C.R.E. South. C.R.E. South now has the whole road from the Sind frontier to Meshed in his charge.

The work which remained to be done in 1944 was 168 miles of shingled road from the end of the tarmac at Dalbandin to Kila Safed, and the few unfinished portions between Quetta and mile 231. This work went forward smoothly and without incident. The floods had gone, the necessary men, plant and materials were on the job.

The road was completed in May; the longest single stretch of road ever made in India under M.E.S. Agency. No Military labour except an Exc. Machinery Section was ever engaged on it. The section, from the Sind-Baluchistan boundary up through the Bolan Pass to Sariab, about 8 miles from Quetta, then on to Nushki and a few miles beyond Dalbandin, is entirely tarred-macadam, varying in width from 12 feet in hill sections to 16 feet in plains sections, on a formation width of 20 feet to 35 feet. From mile 231 from Quetta, just beyond Dalbandin, to Kila Safed, a distance of 168 miles, the formation averages 30 to 35 feet, with 18 feet wide shingled surface. The total length of road as stated at the beginning of this article is 582 miles. It is capable of taking the heaviest traffic which it is ever likely to be called upon to carry for many years to come.

If there are any who find it necessary to put up a mild grouse at the occasional undulations they should remember the work entailed and that the road was constructed entirely under the war conditions and, in the desert portions, under deplorable climatic conditions, not to mention the difficulties and disappointments with labour, plant and materials.

" And the end of the fight is a tombstone white,

with the name of the late deceased.

And the epitaph drear ; ' A fool lies here,

who tried to hustle the East,' "

In a corner of the compound of the G.E.'s bungalow at Dalbandin there is

a little British cemetery, with the graves of a number of officers who died during World War I and in the years that followed.

Mercifully in this war, so far none of us have joined them there, and the only monument to our efforts is the KILA SAFED ROAD.

We here in the N.W. Army are thoroughly satisfied with the road. It reflects the greatest credit on all who took part in its construction and the General Officer Commanding the North Western Army who recently went over the road up to Zahidan, stated that in his opinion the road was excellent.

When the Highlands were pacified after the '45, General Wade made some steep and tortuous roads which came in for some criticism. (Many roads made since suffer in the same manner.) The reply was usually the same.

" If you'd seen these roads before they were made

You'd have blessed the name of General Wade."

India is now busy planning a very extensive Post-War Road Development programme and it is interesting to note that this road has been classified in the Programme as a National Highway and it is hoped that in the next few years the last 168 miles to the Persian border will be soled, metalled and surface treated like the remainder. Beyond that point the improvement of the existing good shingled roads *West* to Kerman and *North* to Meshed will become the responsibility of the Persian Government.

There are many who see in the Kila Safed road the first link in a chain from India to Europe which will become the Great Western Highway where the milestones will truly state " $6,0\infty$ odd miles to London."

SNAGS

By K. S. VERDAD

CENERAL BANGS was, amongst other things, a very keen fisherman. CAs the district he commanded included several good salmon and sea-trout rivers, it is not surprising that his official car usually carried, discreetly hidden in the ledge behind the back seat, a very workmanlike collection of fishing tackle.

One fine day in June, the General was touring his district, and as he crossed a bridge over one of the best rivers, he noticed a figure at the water's edge several hundred yards downstream. It was obvious the man was fishing, so the General stopped the car, and got out his field glasses.

" By Gad I He's in a fish," he said excitedly to his driver.

"Oh yes, sir?" said the man with the maximum of politeness and the minimum of intelligent interest. This driver was newly posted, and it was clear that the ways of fishermen (and of fishing Generals in particular) were a closed book to him.

The General lowered his glasses and glanced at the speaker, or rather' at the back of his neck, as he sat stolidly looking straight to his front down the road.

"Looks as if he's snagged—or the fish is sulking," muttered the General after another long look through the glasses. Although the fisherman's. rod was well bent, nothing much seemed to be happening. The exact locality of
the fish was partly hidden from an observer on the bridge by the low branches of trees, but then the General saw a splash, and this moved him to instant action. Leaping out of his car almost as nimbly as if we were diving for a slit trench under enemy air attack, he strode off the bridge, clambered over the fence, down the embankment, and walked briskly down the river bank. Low bushes then hid the fisherman and the pool from him, and it was not until he got round a bend and within fifty yards of the pool that he got a good view of what was happening. He then stopped dead in his tracks, feeling no longer like a brother fisherman, but rather, a vulgar intruder on a charming riverside idyll. The fish, splashing about in waist-deep water, was a sprightly damsel in a gaily coloured bathing-dress. The fisherman he at once recognized as his own C.R.E., clad in battledress and waders, his rod still taking strain on the line, which was fast to some object deep in the water near the bather.

Retreat was impossible, as both the fisherman and the bather had now seen him, so he walked up to them and said good-morning.

"Nasty snags in this pool, sir," said his C.R.E. putting a brave face on the matter. "We were just trying to save my tackle by a spot of diving."

The General said nothing. There are moments when even Generals are lost for a word.

At last--" You'd better introduce me to the lady." The said lady was at that moment picking her way shorewards as quickly as slippery boulders and bare feet would let her.

"Oh yes, sir. This is my driver, *Private* Smith. She volunteered to do a little salvage work for me."

Pte. Smith was probably not long from the Training Establishment, where the rudiments of drill and nice military conduct are imparted to young ladies of the A.T.S. At any rate on seeing the General, she attempted to spring to attention—an evolution said to be performed by bringing the heels smartly together. As at that moment one heel was poised on the sharp but slimy summit of a rock lying in a foot of water, the evolution was not successful : Pte. Smith lost her balance and fell with a splash almost at the General's feet.

The General turned tactfully away, and made hasty conversation about the state of the river, the run of salmon, and other similar mysteries about which fishermen are seldom at a loss for words.

Back in his car, the General thought over the whole incident—the blushing damsel, the unblushing C.R.E. and the providential possession by the lady of a bathing dress at the right time and the right place, the latter very many miles from their Headquarters.

"Recreational Training," he suddenly said half aloud, and chuckled.

Then he caught the eye of his driver in the driving mirror, and hastily straightened his face to its normal dignified severity.

. There is no moral to this story, but if ever you find yourself in a district "somewhere in England" where the District Commander, known to be a keen fisherman, is now driven by an unusually attractive A.T.S. driver, also said to be interested in fishing, whilst the C.R.E. is driven about the country by a dour soldier, whose only interest in sport is a weekly wager on the "dogs," you will know with some certainty that you have hit upon the district in which these happenings may (or may not) have occurred.

PERMANENT GUN SITES IN MINING DISTRICTS

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MAJOR R. D. FORRESTER, F.I.Q., R.E. (T)

and

H. V. A. HATELY (late R.E.) Mine Surveyor

THE selection of permanent gun sites comes normally within the scope of officers of the Royal Artillery, Royal Engineers and the W.D. Land Agent Branch. It is thought, therefore, that an account of the work done in considering the location of these sites in a mining area may be of some interest, and perhaps guidance, to Royal Engineer Officers who may be faced with the problem.

The type of gun envisaged is the heavy coast defence or the heavy antiaircraft pattern, and which, in certain localities, must be sited on ground immediately above or adjacent to underground coal seams. The position of these guns is naturally dependent upon the object to be defended, and also the location of individual guns relative to each other. This allows a certain degree of latitude, generally governed by a radial distance from the given vulnerable point. It is just as well that this is permitted as generally the object to be protected is a town or community, which also has proposals for Post-War Development Schemes on its periphery, and the available space is inclined to become congested.

Assuming that some, if not all, of the gun sites are found to lie within the coal-bearing areas, the guns may have to be placed on one of the following three underground conditions :--

- (a) Virgin Coal.
- (b) Worked out areas.
- (c) Semi-worked out (or supported) areas.

In the case of (a), it is necessary to estimate the quantity of coal which will be sterilized by the support left for the gun emplacements, bearing in mind that, at some future date, compensation will have to be accepted by the W.D.

In the case of (b), consideration has to be given to the effect of the land movement which may have taken place in the area or is likely to be expected in the near future. This is governed chiefly by the time-lag since working the coal, the type of methods used to mine the coal and the nature and depth of the intervening strata.

In the case of (c), it is often found that the coal has been worked in such a way that the surface will not be damaged. This would be due to "incomplete extraction" leaving a honeycomb structure of pillars and only removing a portion of the coal seam. This is called the "Stoop and Room" method, and the quantity of the extraction is expressed as a percentage of the whole. It is not unusual to extract 40 per cent of the seam and leave 60 per cent for support.

Mining engineers have studied the problem of land subsidence to a very full extent, as it is of vital importance to protect their vertical mine-shafts as well as ancillary buildings at the pit-head. Generally mining operations are started away from built-up areas, but of course with the extension of both

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the mine's underground workings and the growth of town-planning the question of support receives a lot of attention in the mining industry.

Text books show no less than nine different formulæ evolved by eminent Mining Authorities, and as these opinions can be tabulated into figures varying from 22 per cent up to 100 per cent, the Engineer is perhaps at a loss to know which can be acceptable to his particular problem. However, in modern practice a figure of 333 per cent can be accepted as a recognized safe one. Naturally it will be appreciated that the nearer the surface the greater the percentage support required.

The derivation of these percentages is based on the fact that surface damage and subsidence takes place within the lines of the vertical sides of a truncated cone, having the object to be protected as the top horizontal side, the bottom horizontal side the scam of coal under consideration and the vertical height of the cone the depth below the surface of the coal seam. A pillar is left in the coal equal to a percentage of the depth round the perimeter of the point to be protected. Section No. 1 illustrates this point.

For the purpose of this article it is assumed that Plan No. 1 indicates a theoretical position of the guns on site. Each gun is to be mounted on a solid block of reinforced concrete. Having studied the Geological Survey maps of the area, if the R.E. Officer finds that coal is expected to lie below the proposed site, he should then approach the nearest colliery. From the Management will be obtained the name of the Mineral Lessee, who will be in a position to supply plans and information about the mineral position. It should be appreciated that the British Government have purchased all the coal royalties from the original owners. It being a custom of long standing that the Company mining the coal pay to the owner of the surface a sum (generally 3 to 6 pence per ton) for each ton of coal taken from under the property, the Government compensated these land owners, but anticipate the recovery of this expenditure by still charging the Mining Company a royalty for extracting the coal.

Royalties may or may not exist in other parts of the world, and it is as well for the R.E. Officer abroad to have the position clarified by the local Civil Authorities before proceeding to site gun positions.

The Colliery Company can supply the following data, and the R.E. Officer is well advised to obtain as much of it as possible :---

- 1. Name and number of seams known to be existing in the area.
- 2. Name and number of seams already worked from under proposed site.
- 3. Thickness of seams, if known, otherwise local information from nearest point where working has taken place.
- 4. Actual (or theoretical) depth below gun site of each seam already worked out.
- 5. Date when seams were mined, and whether, if obtainable from old plans, the whole seam was extracted. (By certain methods of working some coal may have been left in for support.)
- 6. Anticipated depth from surface of seams which are still to be worked in the future.
- 7. By consulting the Colliery Company's Development Plans, it will be possible to form an estimate of the probable date at which they propose to extract the remaining coal seams from under the gun site.

So that the subject can be clearly explained, a typical instance may be quoted from a British coal field, where it is recorded that two of the coal seams have been totally extracted prior to twenty years ago, and that all the



SECTION Nº1 ON LINE A.B



PLAN Nº2 SHOWING AREA SUPPORTED IN PLESSEY SEAM.



PLAN Nº3 SHOWING PILLAR OF COAL LEFT FOR SUPPORT other seams are virgin. The worked seams are the Yard Seam, at a depth of 430 feet below the surface and having a thickness of coal of 3 feet, and the Low Main Seam at a depth of 630 feet with 4 feet thickness of coal.

As indicated under heading (b) at the beginning of this article, land which has been mined gradually subsides, and after a number of years it can be accepted that full subsidence has taken place. Therefore, for the present purpose, it can be treated as being without the coal seam already extracted. A period of 25 years generally may be accepted as being sufficiently long to permit this settlement on the surface to have taken place.

So that, as no further subsidence will take place in regard to these two seams, it is only necessary to consider the future workings in the remaining seams, and the necessary amount of support required to protect the gun positions from movement due to the void which would be created if the coal was removed.

From Section No. 1 and Plan No. 1 it will be seen that the workable scams remaining are as follows :---

FIVE QUARTER,	having	a	thickness	of	coal	of	2'	6″	at	a	depth	of	520	ft.
PLESSEY,	,,	,,	**	**	• •	"	3'.	6″	,,	*1	11	"	690	ft.
Beaumont,	,,	,,		,,	39	"	3	6″	"	,,	"	"	825	tt.
TOP BUSTY,	"	"	**	,,	"	> ,	2	<u>6</u> ″	**	,,	**	,,	880	n.
BOTTOM BUSTY,	· ,,	,,	31	"	**	,,	2	°,	"	,,	**	"	925	II.
Brockwell,	33	,,	.,	**	"	*7	2	0″	,,	,,	**	*1	1015	π.

The amount of lateral support required will be calculated at one-third of the vertical depth from the outside of each foundation, and is shown by dotted lines on Plan No. 1.

Section No. 1 is taken through line A-B on Plan No. 1, and shows the vertical depth of each seam of coal, the assumed gun mountings to be protected, the broken lines indicating the depths from the surface and, the length (in section) of the part of the individual coal seams forming the required support.

The percentage of coal to be left for support is to be 60 per cent in every seam, and Plan No. 2 shows the method of excavating sufficient coal to leave the support required in the Plessey seam to provide safe support to the reserved area shown on Plan No. 1.

Although the R.E. Officer will not be required to evolve the method by which the Colliery Company extract the agreed quantity of coal from the reserved area, it is as well for him to appreciate the manner in which this is done.

From Plan No. 3 it can be seen that the sizes of the pillars of coal to be left (leaving 60%) will be 27 yds. by 16 yds. with the "Rooms " worked out at 6 yds. wide, and the working places having 33 yds. by 22 yds. centres.

Taking the specific gravity of coal as 1.24 and the weight of a cu. ft. of water as 62.4 lbs., we get the weight of a seam of coal, one acre in extent and one foot thick, as

$$\frac{4840 \times 3 \times 62.4 \times 1.24}{2240} = 1,504 \text{ tons.}$$

It is usual to allow 10% wastage and in consequence the weight of this seam would be calculated as 1,350 tons.

To explain the method of showing the calculations required for the valuation, the Five Quarter Seam is taken as an example.

Suppose this seam of coal was going to be worked immediately and the amount of profit to the Colliery Company is accepted at 2s. od. per ton (which is assumed to be 8% of capital involved). From the valuation

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Table (see page 109), the area of support in the coal seam is 6.88 acres. and using the accepted figure of 1,350 tons per foot per acre, and the seam being 2' 6" in thickness a tonnage of 23,220 is recorded. If it is agreed that 60% of this coal is to be left unworked, then the amount of sterilized coal becomes 13,932 tons.

If 2s. od. per ton profit represents 8%, the actual value of 13,932 tons at production price, if mined immediately, would be :---

13,932 ×
$$\left(\frac{2}{1} \times \frac{100}{8}\right)$$
 shillings=£17,405.

To calculate the present capital value of seams which are not to be worked immediately a book of tables has been prepared giving the proportion of the immediate capital value to be used, based on the number of years' deferment and enjoyment, the interest on capital at 8%, and Income Tax calculated at an average figure of 5s. in the pound.

In this particular case allowing for 2 years of deferment and 1 year of enjoyment (this area would be worked off in one year) then the present value of £1 capital is £0.633.

The loss to the Company allowing 8% profit and leaving 60% coal in the Five Quarter Seam, is £17,405 × 0.633 × $\frac{8}{100}$ = £882, as shown in the Valua-

tion Table.

In addition to the Colliery Loss of Profit, there is the Royalty Rent of 6d. per ton. The Coal Commission has to be recompensed separately on the same hasis as the Colliery Company. Therefore, if 2s. od. per ton profit is equal to 8% on capital, then 6d. is equal to 2%. The total amount of compensation due will now be 2% of (£17,405 × 0'633) or £220, plus £882, equals £1,102. This is the present value of the Five Quarter.

Calculations shown in the Valuation Table for all other seams have been worked out in a similar manner.

It is probable that the R.E. Officer will not always find so many seams lying under the proposed site, but it is only right to emphasize the charges that will be brought, through his responsibility, against public funds.

Although 162,370 tons are perhaps only a very small proportion of the nation's coal reserves, it must be stressed that considerable development and a lot of planning has been carried out by the Colliery Company with the anticipation of winning this coal.

When the day comes for this gun site to be put into service, it is possible that the importance of this coal sterilization may be of greater significance than its actual monetary cost to the country.

Name of Coal Seam	Worked or Unworked	T'hickness of Seam	Extent of area left for support in acres	to be left in support area	Total tons left in Support area	No. of yrs. elapsing before wkg. commences in support area	rresent value of £1 at No. of deferred years in previous column	Value at 2/- ton profit	Royalty rent at 6d. per ton	Total present value of coal left for support
Yard	. Wkd. out									
Five-Quarter	Unworked	2′6″	6.88	60,4	13,932	r1	Lo'633	£882	£220	£1,102
Low Main	. Wkd. out									
Plessey	. Unworked	3′ 6″	18.0	60°,	27,811	61	£0.633	£1,760	£440	£2,200
Beaumont .	Unworked	3, 6"	12.48	60 ^{0,}	35,380	6	£0.514	£1,818	£454	£2,272
Top Busty	. Unworked	2, 6"	13.65	60 ⁷⁶	27,640	8	£0.466	£1,288	£322	£1,610
Bottom Busty -	. Unworked	2, 0,	14.86	60 ⁰⁷ 0	24,073	01	£0.424	£1,021	£255	£1,276
Brockwell .	Unworked	2,6"	16-56	60%	33.534	01	tzt.03	61,422	£355	£1,777
					162,370			£8,191	£2,046	£10,237

VALUATION TABLE

DEFERRED ANNUITY-REDEMPTION OF CAPITAL AT 3% AND INTEREST OF PURCHASER AT 8%

FOR COAL SEAMS

PERMANENT

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DISTRICTS

A FIELD COMPANY IN THE EARLY STAGES OF THE INVASION OF NORMANDY

BY A SUBALTERN OF THE 246TH FIELD COY., R.E.

"To looks peaceful enough now, doesn't it," said someone over my shoulder as I looked out towards the Normandy coast from the rail of L.S.I. "Battle-axe" early on D day. Everyone appeared casual, almost unconcerned, in those last few minutes before going to our L.C.A.; even the sinking of a minesweeper off our port beam aroused little comment. As we were lowered away, cast off and commenced our run-in no word was passed between those still on the ship and the first flight in the tossing L.C.A. The moment was too big perhaps, maybe they too wondered what it would be like when we touched down. This was to be my first action, in which there would be a sudden transition from comparative peace to war. In front of us the beach was hardly distinguishable in the smoke and dust, but before we could study it we were crouched in the bottom of the craft for the last lap.

A Tellermine fixed to a post appeared to glide past, then another, nearer this time and almost touching the gunwales. Suddenly a slight jar and it was "Ramps down." Milling bodies tumbled out into three feet of water. I picked a submerged shell hole and promptly disappeared from view and had the greatest difficulty in regaining my feet, owing to the now terrific weight of water logged equipment. Now, free of the boat, we could see the houses in front of us, and hear mysterious whistles of missiles hissing through the air and in the front, the crump of mortar bombs landing on the water's edge. On my right, just a few yards distant, a group of infantrymen disintegrated, on my left was a burning tank and as I moved forward I glanced back. The water was now crammed with craft, some were hit and aground, but the L.C.A. were beginning to pull off.

A few tank crews, their tanks "drowned," joined the infantry as they moved doggedly across the sand, through the thin belt of wire, to the safety of a low bank in front of the houses. Here the C.O. was killed as he looked over the bank. Snipers were plentiful and difficult to spot. We halted for a moment to take stock, our numbers were depleted and I could place only twelve or fifteen of the thirty-five who disembarked.

Having come ashore some distance to the left of the Bn. axis we made off to the right, passing *en route* an assault Coy. clearing the houses, ably assisted by the attached Demolition and Mine Clearance teams, under Cpl. Field, who had by now abandoned their special equipment and were acting as infantry. They seemed happy enough as I waved and passed on. The Bn. 2 i/c joined us as we picked our way through the houses and moved inland. The F.O.O. was now carrying his own No.18 Set, after his signaller had been hit, and the party pushed on through the deserted streets of Hermanville as far as the crossroads, where we came under sniper fire again. We dug in. The Bren carried by my runner was the only automatic weapon left and in the forward position where we were we did not seem very strong. Without W/T communication to the Companies we could only wait for them to contact us. Our feelings were not improved by the Mortar Platoon Officer, who arrived alone with the news that none of his mortars had got off the beach. Gradually the companies reported in and the position became stronger.

The days following brought us many varied tasks, including mine clearance along roads, checking of marked enemy minefields, many of which proved to be dummy, and the construction by night of a Class 40 Bailey Raft over the R. Orne. In this last task the filling of the Pontoons, back in England, with empty petrol tins, proved its value. Every pontoon was badly holed by shrapnel, and the task would have been impossible without the added buoyancy. Without our transport, we marched everywhere in those early days. In a short time we were once again at the river constructing a track between the Pontoon Bridges being built over the Canal and Orne. This job included a 50 ft. S.S. Bailey, a short span, improvised, timber bridge and Armco culverting, and was completed without interference by the enemy. Everyone was by now exceedingly tired, having worked at high pressure since D day, and it was now D + 5.

The Platoon's next encounter with the enemy was provided by an attack on the night of June 22/23 by the Bn. of the S. Lancs. on the Chateau My platoon provided two Sappers per Infantry Platoon de la Londe. to give assistance in dealing with mines or booby traps, and a further section had the task of clearing mines to allow S.P. A/Tk guns to move up. The Bn. had a bad start, the enemy brought down heavy shellfire on our positions an hour before zero, and casualties were caused.

The enemy positions in the "Chateau" were about 150 yards ahead of us, across a cornfield, and just after dark the Assault Coys. moved forward, silently at first, but soon firing came from all directions and shelling started again. I judged that the enemy shells were about 60 to 80 lbs. with a pretty heavy blast effect. Many burst in the trees and showered shrapnel down into our slit trenches. By daylight fighting was very confused. The Bn. held about three-quarters of the objective, but the Germans popped up from many odd corners and after firing a few bursts disappeared again. The A/Tk Officer and I went round the positions to make a report to the Bn. Comd. and were promptly fired on by a M.G. Fortunately it missed, and before a second burst came we were flat. As we made our way back across the cornfield we were grounded again by mortar fire. On our return we were informed that an enemy counter-attack had been put in with six tanks, three of which were knocked out, but we lost all but one corner of the objective and suffered. Of my two sections, three men were missing and two heavy casualties. wounded. Later we returned to the unit very tired but wiser men.

We could not get away from the "Chatcau," soon we were back again laying mines. How I came to hate the place. One never knew what to expect next, always an uneasy silence to be shattered at any minute by M.G. or mortar fire. We worked by night, the enemy were about 100 yards to 150 yards in front and often we could hear their movement, digging and talking. On the second night a patrol approached, probably from another sector, but they made off rapidly. The enemy seldom bothered us ; now and again a little hate, but nothing to hold up our work. The last of the four nights, however, seemed to me more eerie than the others, and I had a feeling that something was brewing. The men too must have sensed something because we finished early and the Platoon was clear of the field by 0345 hrs. I remained behind with L/Cpl. Starling, my bodyguard, to complete the recording. As we made our way back, the air became suddenly alive with red and green tracers. Some were a bit too close for my liking

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and a ditch was indicated. A string of mortar bombs fell on the forward edge of our minefield. We were glad to see the back of the "Chateau."

A short break, spent mainly in road repair, and on again to Caen. We harboured at Blainville, watching a terrific attack by the R.A.F. on the city during the evening prior to the push, and the Platoon moved forward at first light. Our task was the construction of a tank route across a partly finished by-pass. We had a rough start that morning. From the very beginning, mortar bombs, and at times shells, fell regularly and accurately in the area in which we were working. It was short range stuff and the only warning was the bursting of the first bomb. I prayed many times that morning. The broken nature of the ground blanketed the effect of the bombs and we received no casualties, until suddenly, almost on the completion of the task. a dumper, working with us, blew up; a British Mk V. A/Tk mine, left behind by someone, was the cause. I lost all that remained of No. 2 Section, five men wounded in all. To make matters worse, whilst dressing their wounds, we received another basketful of mortars. Then the battle as far as we were concerned quietened down as we swept routes up to the Bn. ahead of us, and later returned to the Company harbour area. On the following evening we formed recce. parties to find routes into Caen. The devastation was terrific-streets had disappeared-and in parts nothing remained but piles of rubble and tremendous craters. The people of Caen gave us much assistance and two usable routes were found. The following day found us buildozing our way through, and roads again began to take shape.

Soon afterwards we were across the River Orne in readiness for another push; this time along the East side of the river. Again, in the early morning, the attack was preceded by a terrific bombing programme by the R.A.F., and as the bombers finished, the infantry moved up to the grounds of the Chateau d'Escoville. All went quietly for a time until the infantry moved in on the enemy positions. Here we came into contact with the "Moaning Minnie" with which the Boche plastered, from time to time, the roads from the Chateau forward. I did not hear the first one until it landed some ten yards away; before the second came I was down. I sent Sgt. Halls and a Sapper forward up the Avenue to see if we could work, and they disappeared from view amidst a hail of mortar bombs and I wondered if I would see them again.

Meanwhile, my Platoon Sgt. and I were disarming a tank one minute and the next diving headiong into a shell crater. While we were in the bottom we were joined rather hurriedly by Lt. Trench. He started to move out, but just as he reached the top of the crater and stood up another mortar landed just 3 or 4 yards from him, and he was flung back on top of us-miraculously unhurt. These German mortar bombs have a welded seam, down which they split when bursting, leaving an end like a peeled banana.

As the mortar barrage lifted for a moment we moved up, sweeping the road and verges as we went. Periodically a cluster of shells or mortar bombs came our way; their ranging was good and each salvo straddled the road. Later the Platoon Sgt. and the other two sections followed the Bn. to Sannerville with the bulldozer well to the fore. Sannerville was taken with little opposition from the "bomb happy" Germans, but enemy mortar fire again was heavy. Immediately on arrival the bulldozer was put to work clearing a route up to Bn. H.Q.

While reconnoitring routes forward to meet the Troarn road, Sgt. Halls and I came into an area under tank fire, which foxed us for a while, until we were told that an orchard some 50 yards from us contained 8 enemy tanks, which later were engaged by our Shermans. An 88mm., firing down the railway line, had a crack at the bulldozer once or twice. The range must have been fairly long because no hits were registered, though later a stray shot hit Spr. Bland in the leg.

The Platoon concentrated later in Sannerville, in preparation for the construction of a water point, but no water supply could be found. Throughout the night shells and mortar bombs came thick and fast, and few of us got any sleep. Just before first light shelling became very heavy. Spr. Pugh was hit in the head with shrapnel. No other casualties were suffered, due to all ranks being dug in ; we had become proficient at this and the men needed no encouragement.

Throughout the following days rain fell, and we battled with mud and water in the devastated village. A Sommerfeld by-pass was constructed with little interference from the enemy except for spasmodic shell and mortar fire, to which we were getting accustomed by now.

When we left this area there were no regrets—few of us were sorry to see the end of that close country and we moved on to new fields—this time, south of Bayeaux.

NOTES FROM THE CONTINENT

BY CAPT. J. L. IREMONGER (The Lincolnshire Regt.)

I HAVE now been on the continent for some three months and have come to the conclusion that some impressions of the people and countries might perhaps hold some interest for those who have not had a similar opportunity.

The course of my military daties have fortunately enabled me to meet and talk to many civilians in France, Belgium, and Holland. I have thus been able to understand, to a certain degree, what is going on in the civil world as well as in the military. In Belgium and Holland I have, on occasions, been billetted with families, which undoubtedly helped me in getting to know something about the people.

In France, the average soldier did not see very much of the country or the people, apart from Normandy and a narrow strip of land on either side of the road, up which he chased the Germans. Consequently there have been many unfair conclusions drawn as to the French attitude to the liberating armics.

Normandy, a part of France which had been untouched by war until our Armies landed, had to endure a period of war at its worst. The greater part of Normandy is agricultural, and consequently the people have never been short of food. The Germans behaved well and bought produce from the farms at good prices, either for Army consumption or for sending back to the Fatherland, thus the farming population were satisfied. The only people to suffer were of course those who lived in big towns or industrial districts and who had previously obtained their food from this area.

The people of Normandy had apparently very little to thank us for and although the majority were pleased to see us it is possible to understand the feelings of the minority.

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Unfortunately the soldier in France had very little opportunity of really meeting the French population. In most cases they had been evacuated and did not return for some time after the areas had been liberated.

It has always been a difficult matter to get to know the French, they do not throw open their houses to all and sundry in the same way as the Belgians and the Dutch. I do not think this is due to lack of enthusiasm or friendship towards us, but more a matter of custom; the reason probably is the very rigid and close family circle into which strangers are seldom admitted.

That there was sufficient food in Normandy was evident in many ways; butter, eggs, and checse were in abundance and could be obtained at most farms; chickens and even geese or ducks could be obtained in a number of districts. One point of interest was that money almost ceased to have any value, no farmer would accept it in payment for anything supplied, barter was the order of the day, cigarettes and soap wielded an unnatural power. For example, on one occasion a goose was exchanged for 200 cigarettes and 2 tablets of soap, both parties feeling they had achieved a considerable bargain.

Another indication of the state of affairs was given to anyone fortunate enough to be invited to a farmhouse for a meal. It was more of a prolonged and very excellent feast than a meal, the menu would be something like this:—

> Fresh Tomatoes. Veal (by itself). Two Vegetables. Chicken (by itself). Cakes. Coffee.

If desired it was possible to have an unlimited number of helpings of each course. I do not suggest that this was the normal fare of the family, but it certainly could not have been provided if there was any shortage.

Much has been heard of looting in France by the Germans, and I can confirm that when the time and opportunity were present it was carried out with typical German thoroughness. It not only consisted of stripping a house of all goods of any value but, in addition, damage and destruction were carried out, apparently out of sheer childish spite.

I happened to enter a village in France a very few hours after the Germans had departed and saw the condition in which it had been left. It had not received any damage from shot or shell, but had been very thoroughly looted. The houses appeared as if they had had a whirlwind pass through them. In every room the contents of the cupboards and drawers were strewn all over the floor, mattresses had been slashed, and in one case the grandfather clock in the hail had been riddled with bullets. Dirt and filth were present everywhere and the sanitary conditions were unbelievable.

An interesting sidelight on the calm and resignation, with which these people faced the frightful conditions of war in their country was witnessed in this village. When it was first occupied there were no civilians present as they had not yet time to return. Within 24 hours they began returning on bicycles, carts and on foot. One particular family whom I knew well, showed no apparent surprise or dismay at the condition in which they found their house. I think the fact that it was standing at all, coupled with such a relief at being liberated, and at home, after several weeks, was sufficient for them to overlook the appalling state of the inside of their house.

This family like many others had been turned out of their home at the pistol point to make room for the German Army. All of them, men, women and children had to live in neighbouring barns, very often in sight of their own homes. Paris and the interior of France were very different from Normandy, and the supply of food was undoubtedly restricted, due to transportation difficulties. A great welcome was given in Paris to the British Army, to those who were lucky enough to pay the capital a visit. Luxury goods were by no means short and the women were still extremely smart, even after the four years of enemy occupation. In fact, apart from food and certain necessities like soap, Paris is in a very much better condition than London, as of course it has received very little damage from shelling or air-raids.

I have asked a number of people about the activities of the Black Market, and I find that it differed very greatly from its counterpart in England and was on a bigger scale. In Belgium particularly, and to a certain degree in France, the luxury goods, which afford the opportunities to the English Black Market, were in ample supply and could be bought at reasonable prices, thus there was no demand for them. Certain necessities were either unobtainable except on the Black Market, or at the best rationed to such a degree that the people were forced to turn to it to obtain sufficient quantities. In England this has never arisen, the system of rationing and price control ensuring a sufficient and equal distribution of necessities.

A further reason for the success of the Market was that popular opinion did not consider it dishonourable to have dealings with it. They felt that if they did not buy, the Germans undoubtedly would, or perhaps in a number of cases, take the goods back to Germany without payment which they prevented by their own purchases. The Government knew of the existence of the Black Market and of course prohibited it, but did not ensure that their orders were complied with. The Germans themselves used to deal with it, as well they might, in view of the very favourable rate of exchange they had arranged for themselves.

The fantastic prices which were paid for some goods can be explained by the fact that, as a general rule, the really poor excluded, the people had money and very little opportunity of spending it, which even at this moment is very much the case in Holland.

Some of these prices which were actually given to me in Holland but are very similar elsewhere, are as follows :—a pair of shoes of not good quality cost $\pounds 20$; a complete suit anything between $\pounds 100$ and $\pounds 150$, cigarettes of varying qualities would cost up to $\pounds 2$ for 20, real coffee, which is looked upon as a necessity here on the continent in the same way as tea is in England, would cost up to $\pounds 20$ for about 1 lb., and people were paying these huge prices as it was the only means they had of obtaining the articles.

In Belgium, particularly in Brussels, even recently, real coffee is sold at 3s. 6d. per cup and the maître would apologize for the price, and tell you that it was Black Market coffee and consequently very expensive. On one occasion in Belgium I was given some "waffles" at the house of a very charming and respectable family, and they told me quite unconcernedly that they had been bought in the Black Market.

The Belgians I found wholly delightful and extremely pleased to see us. They have indubitably a strong dislike for the Germans, engendered during 8 years of German occupation over the last 30 years. Their reaction was in a way surprising, as, of the three countries, they had probably received the fairest treatment from the Germans. They had a Military Governor who did not interfere with the civilians to any great extent.

Food and necessities were extremely scarce and everything was rationed, more strictly than in England.

In the towns there were many luxury goods on sale, at fairly reasonable prices, e.g., watches, fountain pens, propelling pencils, scent from Paris, cosmetics and wines. In Brussels the prices were something like this :---

Watches—£5 to $\pounds 7$. Pencils and Fountain Pens—5/- up to 30/- according to quality.

Scent, of course, varied, but the best Paris produced, probably without its equal anywhere, i.e., Chenel or Worths, would cost something over 10/- for a small bottle and up to any amount according to the size of the bottle. Silk stockings could also be bought in limited quantities at a price, first class quality costing up to $\pounds 2$.

As regards wines and spirits, liqueurs were in great evidence, and a bottle would cost probably about f_3 . It would, however, be of a very fine quality and compare favourably with English prices.

Fruit, particularly peaches and pears, were in abundance and incredibly cheap when compared with prices in England to-day. At a small town, in which I stayed, there were at least a dozen fruit shops simply stacked with peaches, pears, and even grapes.

Brussels gave a good example of a truly friendly spirit, shown in many ways. A few examples are given as an illustration; all English speaking Belgians wore a white star in the lapel of their coats so that it was possible to distinguish them. If one had the luck to have a street map of the city and opened it in view of any Belgians, there would be an immediate rush to help and one would be surrounded in a very few minutes by a crowd of friendly people. There were many vendors on the streets selling copies of "Tipperary" the song which everyone over here connects, above all, with the British Army. Shop windows had been most elaborately decorated with the United Nations colours and embellished with expressions of gratitude for the liberation of Belgium.

One characteristic, which is very noticeable among the Belgians and the Dutch, is the extreme cleanliness of the people, their houses, towns and villages. This was the case whatever the size of the houses or the circumstances of the people. Stone floors scrubbed to an incredible degree, or if wood, highly polished. Even the earth in front of small houses in villages is often swept. If one penetrates into the back quarters of a small café or house, again everything is absolutely spotless.

The children are kept in an amazingly clean condition, one very seldom sees a really grubby child playing in the street, an all too frequent sight in England. There are, I think, a number of reasons which contribute to this state of affairs; a good system of education for all, new and very clean houses, a high standard set by the older people, all of which produces a real sense of self pride. I have not seen anywhere in either Belgium or Holland any houses or districts which in any way compare with our frightful slum districts. The task of their Governments is of course much easier as the population of both nations is only about 8 millions each and the largest towns have under 1 million inhabitants.

The Dutch people have been the worst treated of the three nations. Their country has been very largely stripped by the Germans, they had neither sufficient necessities nor an abundance of luxury goods. The comparison between Belgium and Holland in this respect is very obvious when one crosses the border.

They have a great dislike for the Germans engendered by the harsh treatment they have received at their hands. They are a very delightful people, very much more reserved than the Belgians. Whereas a Belgian family will all at once almost overwhelm one with kindness and generosity, the Dutch family will, from day to day as they get to know one better, gradually increase their hospitality until it becomes almost embarrassing, nothing they can do to help is too much trouble. To give an idea of what some of these people have had to endure I will recount the adventures of the inhabitants of one small Dutch village as told to me at first hand by a village schoolmaster.

Just before our troops arrived the Germans pulled out of the village and eventually a motor-cyclist from the British Army arrived and the liberation celebrations commenced. All the long hidden national flags were hung out, the girls put on their national dresses, collaborators were rounded up, and some of the women collaborators had their heads shaved, and were then locked up. All this took place during the morning. One can imagine the horror and panic which resulted when during the late afternoon a number of German tanks suddenly entered the village, flags and dresses were hurriedly hidden away again, the Germans released all the collaborators and then of course went after the people responsible. Everyone who had taken part in the rounding up of the collaborators had to get clear and hide as they would have undoubtedly been shot if they had been caught.

This went on until the evening of the next day, when the Germans were driven out of the village and those in hiding were then able to return to their homes.

I would like to conclude this article with a few thoughts on the future, even under the trying conditions of war I am certain a great deal of good has been done by the visit to these countries of which I have been writing of many thousands of our young men.

Many of the inhabitants had practically never even met an Englishman, and certainly many of our soldiers had never been out of England before.

A Belgian said to me that before he had the opportunity to meet us he had always thought that the English were much more reserved and very difficult to get to know and to get on with, he now thought very differently.

I am convinced that one thing that would help to dispel misunderstandings and the likelihood of further wars would be a frequent interchange of young men and women between the various European nations. In this way different people exchange ideas, and above all get to know, understand and like each other.

I do not include the casual holidaymaker under this heading, because from my own experience, visiting a country for a few weeks staying in hotels, in large towns and speaking English all the time does not produce anything like the results.

I suggest that a great deal of good would come from the interchange of girls and boys of a school and university age and those who are about to embark on a career no matter what it may be. There is always a great deal to be learnt from other people. This should be organized and arranged by the respective Governments who should do all in their power to encourage and help the idea, and thus go some way to prevent another terrible war.

THE POWER RESOURCES OF GREAT BRITAIN A BRIEF GENERAL SURVEY

BY COL. T. W. R. HAYCRAFT

(Note.--This article was written before the publication of the report on the Severn Barrage Scheme)

OF all our national resources power is by far the most important. Without power we can have no industry, no transport, no warmth in our homes, we cannot even cook our food. The possible sources of power are petroleum, coal and water—let us consider them in that order.

I. PETROLEUM

Petroleum, which, of course, includes Diesel oil, is at present the only. suitable fuel for road transport; crude oil is the most efficient, though not the only fuel for ships; the intermediate grades are required for medium and low powered stationary engines. The vast majority of lubricating oils, road bitumens and a host of other products are derived from petroleum.

No petroleum to speak of is obtainable in the British Isles; we must import it from one of the three main world sources—the Near East, the Far East or America. Three important considerations must be borne in mind :—

- (i) Supplies are not inexhaustible. They may last another 50 years, another 250 years; during the cycle of civilization in which we live the petroleum resources of the world, if not actually exhausted, will cease to meet the world's demand.
- (ii) During this present war, we have been fortunate in losing only one of the main sources of supply, though we nearly lost another. Had we lost the Middle East, America would have had to meet the whole demands of the Allies. This might have been impossible and certainly would be in the next war.
- (iii) After explosives, oil is the most vulnerable cargo to carry. The scale of air and under water attack in the next war may take an even greater toll of tank shipping than we have had to suffer in this.

But oil, not only fuel oil in all its grades but lubricating oils, bitumen and the whole range of oil products can be obtained from coal. That may be disputed in some cases, e.g., lubricating oils derived from coal are not so good as those derived from petroleum, but it was said that 100 octane petrol could not be obtained from coal; now the Germans are getting 110; research will do the same for other products.

II. COAL

Both in quality and quantity the coal seams in Great Britain are among the best in the world. They are our most valuable national heritage. The following are the principal uses to which our coal has been put :--

- (i) Except for very small units using petroleum, and a somewhat larger but still very small amount of fresh water power generated in Scotland and Wales, coal has been our only source of power for industry.
- (ii) Our railways, whether electrified or not, run entirely on coal.
- (iii) With the exception in (i) above, the whole of our electric power and light is generated from coal.
- (iv) Coal is used in coking plants all over the country for the production of coke, gas and tar.
- (v) Coal is burnt in millions of open fires and ranges for heating and cooking.
- (vi) Coal has been supplied for bunkering ships both at home and all over the world. The last has much diminished in latter years owing to the development of coal resources abroad, while both have been considerably reduced due to the change over of the navies and of fast passenger and freight shipping to oil.
- (vii) Steam coal and anthracite have been valuable exports to countries that do not possess them.
- (viii) Last, but by no means least, the mining, transport by rail and sea, and distribution of coal have provided occupation for a very large part of our population.
- Let me now make a few remarks about these uses of coal :---

 - (ii) Only in coking ovens do we get any of the very valuable byproducts of coal. I have not mentioned the small amount of plant already installed for the extraction of petrol from coal by the hydrogenation process because this represents a fraction only of the whole output.
 - (iii) Even in coke ovens all we get is gas, tar and a very small amount of benzol. However the gas replaces much coal which would otherwise be wastefully burnt in cooking ranges and the output of tar is probably no more than the country can usefully absorb.
 - (iv) All coal burnt in this country pollutes the atmosphere. In our big towns and in industrial districts this is a serious matter.
 - (v) For various reasons the output of coal is diminishing and the costs of mining and transport are rising. Unless a solution of the problem is found we shall be faced with a shortage of power and heat and we shall lose our coal export trade. The high price of coal will also be reflected in high production costs of goods for export, which require a large amount of power in their manufacture. Our heavy industries will be the first to suffer.
 - (vi) Lastly, but most important of all, our coal resources are strictly limited. We cannot afford a situation where petroleum has run out and we have no more-coal from which we can derive petrol and lubricants.

III. WATER

On Tuesday, 12th December, 1944, a question was put to the Brains Trust regarding the future use of the tides for the production of power. The ensuing discussion turned entirely on the financial aspect— \dot{a} return of 1% or $\frac{1}{2}$ % only on invested capital could be expected; it is cheaper to burn coal—and there the matter was left.

Years ago the Severn Barrage scheme was shown to be uneconomical. In view of the rise in price of coal the scheme has been reconsidered; no doubt, due to a corresponding rise in labour costs, it is still not a financial proposition; it will never be a financial proposition. Since this particular scheme has alone been seriously considered all other schemes for using the tides and/or the fresh water flow of our big rivers are possibly still more unfavourable.

Let us, however, consider some other aspects of the case :---

- (i) The rivers and tides will not cease to flow during our civilization. Even if it takes a hundred years to harness all the water power we need we shall be on a better wicket than with either coal or oil.
- (ii) The replacement of black coal by white will make our seams last longer. We can reserve our hard coal for bunkers and export and leave our soft coal in the ground against the day when petroleum runs out or is denicd to us.
- (iii) The grid already exists and only need be thickened to serve industry and expanded to reach the new water power stations. As I shall point out later some power will always have to come from steam, but it is only a matter of adjustment of grates for steam to be raised on a mixture of coke and low grade coal.
- (iv) For our size we have a very long coast line with a number of places suitable for generating power—tidal basins like the Wash, estuaries like the Severn, very big tides as in many places on the Channel. Being an island the tides flow round the North and South and times of high water are fairly evenly spaced throughout the 12 hours.
- (v) We can avoid making an already poor climate worse by smoke pollution.
- (vi) On the other side we have the problem of finding employment for our mining population. I will deal with this later.

IV. CONCLUSIONS

If I have been successful in setting out the considerations governing the supply and uses of the three main sources of power in a clear and ordered sequence, the following conclusions suggest themselves :----

- (i) The major proportion of power, heat and light should be obtained from water—fresh water as far as it will go and then salt.
- (ii) Since this is a scheme which will conserve our national resources and improve the health of our people the economic aspect should not be a governing consideration. The majority of the money may have to come out of taxation.
- (iii) Since this is a scheme which will benefit future generations and as we must find employment for the labour in mines to be closed down, the scheme should be phased over a period—say 25 years.
- (iv) The whole field of coal resources, requirements and costs of mining should be reviewed from the national aspect and phased programmes prepared for those mines that are to be developed for bunkers and export and those that are to be sealed as reserves.

(v) Since the supply of coal is also a national question the cost of mining should not be a major consideration. This will be dealt with in more detail later.

V. THE COAL MINES

Without touching on the controversial subject of the present failure of the mines to produce coal in the quantities that they used to do and that are now urgently required, I think it is fair to say that :---

- (i) Certain pits would benefit by mechanization and modernization, whilst others are unsuitable and the use of machines would have little advantage.
- (ii) Even the best pits have been so long worked by hand methods that the installation of machinery would not now bring a financial return on capital expended, but if this expenditure could be substantially reduced mechanization would enable higher wages to be paid as well as reducing the cost of coal at the pit head.
- (iii) The increased efficiency would put new blood into the industry from top to bottom. I believe I am right in saying that in America miners get higher wages and work harder than they do in England and coal costs less at the pit head. This may be due mostly to mechanization, but I submit it is also due to the enthusiasm that goes with efficiency and good wages.

I have shown earlier in this article that our coal is a national asset and I have advocated the development of certain mines for the export trade and the sealing of others as reserves against the day when petroleum is no longer available. I suggest therefore that those mines which would benefit by mechanization should be brought right up to date, the cost being shared at each pit between the Company and the Government in such proportions as will make the installation a financial proposition for the Company.

The programme of improvements would be drawn up by the Company, phased over a number of years, costed, apportioned and agreed with the Government. The Ministry of Supply would arrange the supply of machinery from Home or abroad. Each year the Government would provide their share of expenditure out of revenue and the company theirs by raising new capital. The Government must protect the taxpayer by exercising such control as is required to ensure that his money is spent to the best advantage but there should be no other control by way of price fixing or subsidy.

The basic principle is that the Government should recognize the responsibility of the nation for ensuring that its natural resources are exploited to the national benefit, and at the same time the Government should not interfere with free competition and enterprise. To my mind such a scheme would have the advantages of both nationalization and the present system of control without their disadvantages.

I think we are all agreed that we cannot go back to the conditions prevailing between the two wars.

The uneconomical pits will still have to work for some years before they can be closed. In their case the present or some other system of control will have to continue. Nationalization might be tried as an experiment with those pits that will be the first to go. Such a limited experiment would in fact, be very useful.

VI. THE LABOUR ASPECT

There will be no surplus labour from the mines for some time. The small number released every year by closing mines will be required to replace those called up during the war and ordered into the mines and who do not elect to remain in the industry. Labour for water power schemes will therefore have to come from demobilized soldiers awaiting absorption in their pre-war occupations or in those of their choice.

As water power becomes available and when the total supply from both black and white coal reaches the demand, the most uneconomical pits can be closed. The labour thus released will be available for further water power projects.

VII. PLANNING

This article indicates the broad outlines of a scheme which might be successfully carried through. It cannot however be a success without the willing co-operation of all parties—the coal companies, the miners, the trades unions, industry and the General Public. For the efficient co-ordination of all aspects it would be essential to concentrate all planning under one authority.

To take one example for instance—the Grid. It will always be necessary to keep a reserve of power on coal to make up deficiencies due to peak loads and synchronization of tides. The decision as to which coal generating stations are to be retained would be based on various considerations; they would be the most efficient modern stations situated at concentrations of load, far from water power and near to coal. Obvious examples are London and Birmingham.

Other aspects have already been discussed—mining efficiency, conservation of coal, labour. The authority charged with this planning would, I suggest, be a committee composed of the best brains in the country, experts in the various aspects of the problem. The committee should have direct access to all the Ministries concerned. The plan would include :—

(i) An outline for the whole scheme covering say the next 25 years.

(ii) The scheme in detail covering the first 5 years.

ROAD BRIDGING IN EASTERN INDIA

Βy

LT.-COL. G. MORGAN, I.E., B.Sc., Assoc. M.Inst.C.E., M.Inst.W.E.

and

CAPT. A. H. W. POLLICUTT, R.E., P.A.S.I.

A T the end of September, 1943, G.H.Q. India decided to accelerate the construction of a single way, all weather, road route in Eastern India connecting the broad gauge railway system with the military road system. The work involved, *inter alia*, the construction of eight major bridges, varying in total spans from 230 feet to 750 feet, and up to a minimum load classification of class 12, in a remote undeveloped area. Work was ordered to commence as soon as the necessary staff, plant, materials, and labour could be assembled, and to complete before the onset of the flood season in May, 1944.

The country traversed by the road is, when measured in geological time, new. The larger rivers, which are crossed at distances of from 20 to 40 miles from the foothills of the Himalayas, are subject to frequent changes of course, resulting from their habit of building up their shingle beds in the reaches just below the points of debouchment from the foothills on to the plain. This habit is emphasized by the present-day local names of the rivers. Over a distance of 25 miles four distinct rivers now bear the same local name, each having in fairly recent times carried water from a common mountain source.

Preliminary plans for the work were based on information acquired during a rapid reconnaissance by an engineer staff officer. This information was somewhat meagre; borings of doubtful reliability had been taken previously on four of the bridge sites; velocities during floods were reported to reach 10 feet per second, and scour at piers up to depths of 20 feet was considered to be probable. The borings indicated that beds varied from coarse shingle up to 3 inch gauge down to fine sand.

The foundation problem had to be solved with the very limited equipment available in India at the time, such obviously possible solutions as wells. being ruled out by the lack of grabbing equipment required for the purpose. Two Simplex piling plants were known to be available and were ordered to move to two of the sites. The Vibro Piling Company (India), Ltd. (in liquidation) were also known to have one or more plants of uncertain condition. It was decided to base foundation plans for the largest bridges on the use of these "in situ" piling machines. Provisional arrangements were thereupon made with Messrs. Simplex Concrete Piles (India), Ltd. for construction, using their machines, and with Messrs. J. C. Gammon, Ltd., who were to use available Vibro machines. Of the latter, three were located at distances up to 2,000 miles from the work and, of these, two eventually reached the bridge sites in workable condition.

Deck design was also limited by available resources. The alternatives considered were :--

(a) A simple reinforced concrete beam and slab construction freely supported on reinforced concrete piers.

(b) A timber deck on steel girders.

Alternative (b) was adopted for the following reasons :---

- (i) An adequate quantity of steel plate girders and R.S.J.'s was available at Army depots.
- (ii) Suitable timber was available from local forest depots.
- (iii) The design would be appropriate for use with either concrete piers or timber piled trestles.
- (iv) Assuming that foundations would normally be built to withstand loading much in excess of class 12, decks could be conveniently strengthened by adding more girders.
- (v) M.S. rods for main R.C. beam reinforcement were not readily available in lengths over 18 feet.

In view of the danger of scour, piers were designed to give the minimum resistance to flow consistent with adequate rigidity. For concrete piers a type design was adopted allowing 3 feet width with half-round battered ends. Piles were staggered as far as possible within a 3 feet 6 inches wide reinforced pile cap, 2 feet 6 inches deep, also having half round ends. Piers were suitably reinforced on all faces with a mesh of M.S. rods.

The type design is shown on Plate I and was adopted for five bridges. A double timber piled trestle bent design, prepared by the first named writer, and suitable for construction by local hand piling machines, was adopted for the remaining three bridges, where conditions were somewhat easier, and for which heavier plant was not made available in time.

PILING PLANTS

A brief description of the plants used may be of interest. Both Simplex and Vibro plants use a 16" external diameter steel tube and produce a 16" round "in situ" pile, reinforced or unreinforced, but their methods of achieving this result are somewhat different in detail.

The Simplex plants comprise heavy steel frames 38' 8" high (extensible if desired), 12 H.P. Spencer Hopwood boilers, British Steel Piling steam winches, and clutch controlled drop hammers of $2\frac{1}{4}$ to $2\frac{1}{2}$ tons each. The pile tube, which rests on a hollow conical shaped pile shoe, is driven in the normal way, using 4 feet to 4 feet 6 inches drops, and is withdrawn, as concrete is poured into its upper end, by a direct pull of the winch exerted through 2×5 sheave blocks and tackle. During withdrawal the tube is "vibrated" by striking it with a heavy steel rod, after the fashion of a battering ram. Tubes 30 feet 'long and upwards are available and follower tubes are provided for extensions as necessary.

Vibro plants comprise timber lattice frames, 60 feet high and upwards, similar boilers and winches, and single acting 2 tons steam hammers. Extraction is done by attaching side links to lugs on the hammer and tube, and, using the steam hammer applying an upward jerking blow to the pile tube, at the same time maintaining a slight tension on the hammer rope. Concrete is poured into the upper end of the tube, in which reinforcement cages have already been hung. The jerking motion serves to vibrate the concrete and leaves a series of horizontal ridges around the pile, which increase its frictional value.

When using Simplex piles in wet river channels it is necessary to construct islands to carry the piling plant and to provide earth forms for the piles. The construction of such islands in running water over 5 feet deep calls for considerable effort. The fact that islands increase the velocity of the water inversely as the waterway is restricted must also be remembered.



PLATE I.

With the Vibro plants a method of driving piles from staging erected in water has been evolved. This not only saves the construction of islands but gives a larger pile between water level and bed level where erosion is likely to be greatest. The process is described in detail later in this article.

CONSTRUCTION

It is now proposed to give a detailed description of the construction of one typical bridge, of 703 feet total span, divided into 16 equal bays.

The bridge site was some 24 miles by (at that time) indifferent track from the nearest railway station on the metre gauge system. All imported plant, girders, cement, steel, coal, etc., after having survived the broad gauge metre gauge rail transhipment points, which were serving an active theatre of military operations, had to be transported along this track to the site, mainly by 3 ton trucks which, in the early stages, were the only transport of any sort available.

The site, which was surveyed with a theodolite and level, kindly loaned by the Indian engineer of a nearby native state, had a seasonably eroding right bank 8 feet high of clay overlying a sand clay mixture, with a channel 5 to 6 feet deep fairly close in. The left bank was sandy and ill defined with a bank of finely divided mica sand stretching some 200 feet to low water. Bed conditions were extremely unstable and soon after the first profile was taken it was noted that the main channel was moving across the bed from right to left. It was, however, observed that the depth of this channel remained fairly constant which gave rise to the comforting theory, since borne out during the first floods, that the heavier gravel underlying the very unstable sand would not scour unduly.

Early days were spent in finding local supplies of materials, following up bulk timber demands on local forest depots, enquiries regarding flood levels, and making contacts with local private interests whose very limited resources were to no small extent offset by their unfailing desire to help.

Meanwhile the first Vibro plant had arrived at the railway station, after travelling roughly 2,000 miles from the North West Frontier, and was towed to the site by one, sometimes two, 3 ton trucks attached to the two pairs of detachable steel wheels supplied with the frame. The piling tube, 43 feet long and weighing $2\frac{1}{2}$ tons, and the base frame, 25 feet \times 8 feet weighing 2 tons, were difficult movement problems over the indifferent track. For transporting the tube and later some of the girders, a trolley was improvised from the two pairs of detachable wheels and two Sal timber poles bolted on.

Transport of the plant and erection on site occupied 2 weeks, all being ready for driving the first pile on 16th January, 1944. Piling was commenced from the left bank in order to make full use of the dry portion of the river bed and, meanwhile, successful efforts were made by means of groynes, consisting of double rows of bamboos, 4 feet apart with cross walls at 4 to 5 feet distances, all filled with sand and grass, to check the water velocity and cause silting. By this means the width of the dry bed was extended approximately 45 feet.

The piling plant had been out of operation for some considerable time, the crew were out of practice or new, and it was not surprising that considerable adjustments had to be made in driving the first pile. During the withdrawal, however, two major accidents occurred, the first being the fracture of a side cheek of the front winch drum, which necessitated the transfer of the front rope to the rear drum, and the second being the fracture of one of the side withdrawing links on the tube. Night having fallen by this time and the tube containing only 3 feet of concrete after having been drawn 3' 3", work was abandoned till the following day. The tube was then successfully withdrawn by means of sheer legs with heavy hand winch and 2 No. 3 sheave blocks, assisted with jacks and direct pulls by the steam winch.

Immediate steps were taken to obtain replacement parts from an old plant in Calcutta, but these were lost by the Railway for 2 weeks and piling was not restarted until 3rd February. Subsequently this plant ran perfectly and piling was continued, almost uninterruptedly, until completion on 21st March, 1944.

The pouring of concrete in pier caps was commenced on 10th February, followed by piers on 28th February, these being completed on 26th March and 3rd April respectively. Piers were 10 ft. high and were poured in one operation on alternate days using one set of shuttering. Concrete was conveyed from mixer to shutters in steel pans passed hands over head by a string of coolies sitting one above the other on a wide bamboo ladder, empty pans being returned similarly. This method of handling was smooth, rapid, and effective. Tamping in forms was done by coolies working inside, directed by a foreman. Steel forms, distanced by $12^* \times 2^* \times 2^*$ precast concrete strut pieces and held by §" dia. bolts passing through the latter, were used for side forms, and flattened corrugated iron sheets on wooden runners and blocking pieces for the ends. The appearance of the completed work is excellent and required no touching up.

The first $44' \times 24'' \times 72'' \times 95$ lbs. R.S. girders were transported from the station on the improvised trolley mentioned above. Later, two "Dolly converter" trollies, with heavy duty tyres and swivelling top carriages, became available. These were used in conjunction with a 6×6 G.M.C. truck for towing and a Holmes "Wrecker" for loading and unloading. This equipment, driven by two "borrowed" infantry B.O.R.'s, incidentally travelled more than 7,000 miles over indifferent roads moving heavy bridging materials without accident of any sort.

Hoisting of girders across the dry bed was commenced on roth April, using a gin pole with block and tackle. Decking of land spans followed immediately behind each pair of girders and was later ready to receive the girders for the water spans, which had to be launched forward as each span was decked.

Gear for launching was made up entirely from materials available on site and the following drill was evolved to enable two girders (one span) per day to be launched. Employing the cantilever principle, the launching " carriage " consisted of one of the 44 ft. girders with cross frames fixed at each end. The front frame was carried on hardwood rollers and the back frame on small wheels. The girder to be launched was attached to the front end of this "carriage" by means of a channel piece bolted to the top flanges of each girder. Sufficient sandbags were added to the near end of the "carriage" girder to keep the front girder horizontal. The whole assembly was moved forward by means of a block and tackle worked by a crab winch, set up at the near end, and the girder gradually took its position over the span. Both ends of the girder were now attached to blocks and tackle from dwarf sheer legs fixed over the piers, enabling the "carriage" to be disconnected and the launched girder to be lowered into position. The drill provided for the launching of two girders and the completion of one span of main decking in one day. Girder launching and lifting was completed on May 7th, and the completed bridge opened for traffic on May 18th, 31 months after the recommencement of piling.

Some notes on pile sets and calculated loadings, driving times, coal consumption, aggregates and reinforcement are given in Appendix I. Safe loads calculated on the Hiley formula are probably on the conservative side as Vibro piles may be expected to develop higher friction values than precast piles for which the formula factors were taken.

DRIVING CASINGS

The steel casings are made up in three sections; the lower one, to which a casing ring is rivetted, is $\frac{1}{4}$ thick; the other two remaining sections are $\frac{1}{16}$ thick. The overall length of casing and ring, used on this work was 12 feet.

A short Vibro tube is used for casing driving, being easier to handle, and the normal tube is afterwards' used for completing the pile. The assembly is illustrated in Plate II.

The following are the operations in driving the steel casings :----

- 1. The casing is first of all stood on sleepers in its approximate position leaving the inside of the casing ring clear to receive the driving ring and shoe.
- 2. Driving ring and shoe are lowered into the casing and the driving ring registers in the casing ring.
- 3. One short Vibro tube and wooden lining are lowered into the casing.
- 4. The steel casing is held up by wire secured to ears on the casing and to a clamp fixed to the top of the tube. 'The driving ring and shoe supporting the tube and wooden lining are held in position by ³ S.W.R. passed through the mouth of the tube and lashed on.
- 3" S.W.R. passed through the mouth of the tube and lashed on.
 5. The whole assembly thus secured to the Vibro tube is in turn held by the side links in the normal manner. The assembly, after being raised slightly and after removing the supporting sleeper, is correctly aligned whilst in suspension between wire profiles and then lowered into the water.
- 6. The casing is now driven by a series of light blows on the tube with the steam hammer. Heavy blows are likely to result in shearing of casing rivets. The tube, wooden lining and special shoe assembly are then withdrawn leaving the casing and ring in their final position.
- 7. When all the casings for one pier have been driven, and the additional casing reinforcement placed, the short tube is exchanged for a long one, which is lowered through the casing until the pile shoe rests in the river bed. During lowering the shoe is attached to the base of the tube with wire, which is cut as soon as the shoe comes to rest.
- 8. The tube is now driven and the concrete poured in the normal manner. During its withdrawal through the casing the tube acts after the manner of a tremie pipe for pouring underwater concrete.

It was found that, in driving subsequent adjacent piles, sand rose into the driven casing making it difficult to insert the main tube. This was cured by making up concrete plugs (see top centre of Plate II) on site to fit the casing ring. These were lowered into the casing ring, a joint being formed with a rope ring nailed to the wooden bottom of the plug. This expedient was entirely successful in preventing any influx of sand from below.

PLANT ACCIDENTS

Mention has been made above of two accidents which occurred on one bridge. A similar and more serious accident occurred on another bridge with a similar plant and the subsequent experiences are worthy of record,

In this case again the plant had been out of use for a considerable time and one of the first piles of a bridge was being driven.

The action of the steam hammer in withdrawing and vibrating the pile tube results in a light tap being given to the tube by the hammer descending



PLATE II.

under its own weight. This is followed by an upward blow on the side links which withdraws the tube from one to two inches per blow. A heavy coiled spring at the base of the piling frame is connected through pulleys to the side link ropes and prevents undue shock to the latter during the downward blow. The steam control valve on the hammer works automatically, admitting steam when the hammer reaches its desired lowest limit and causing the hammer to reverse for its pulling stroke, which is again limited by the automatic exhaust of steam at the upper position. Meanwhile the link ropes are kept in a state of tension by the winch drum. At the beginning of withdrawal this tension must be maintained at a minimum, leaving all the pulling to be done by the hammer.

Failure to observe the above rule resulted in an undue strain being put on the piling frame by the link ropes. This caused the frame leaders to buckle and left a tube containing 23 feet of newly poured concrete in the ground, and a concreted tube in the ground may be a total loss.

Sheer legs were immediately rigged and the combined efforts of steam winch, hand winch, and jacks raised the tube a few feet only. This method was then abandoned. A second frame was fortunately available from a nearby bridge at which piling had just been completed. This was moved and erected and the tube withdrawn in the normal manner after several days.

A "post-mortem" on the occurrence suggested that the following immediate measures might have saved much subsequent trouble in clearing the tube :—

- (i) The reinforcement cage could have been withdrawn as soon as the concrete had reached initial set. This would have given a honeycombed concrete and simplified subsequent clearing.
- (ii) Kerosene oil could then have been poured down the tube to prevent the concrete setting hard.

Clearing the tube proved to be a difficult undertaking. Pneumatic rock drills were first tried without success, and then a paving breaker. The latter was fairly successful up to 8 feet distance, using ropes attached to the breaker handle to hold the tool against the work, the tube being in the horizontal position. At 8 feet visibility became so bad that it was decided to cut the tube at 15 feet, leaving approximately 7 feet remaining to be cleared in each portion. This was done, the tube subsequently cleared, and the two portions welded together. Progress on clearing was only 4 inches per day after the first 3 feet and the concrete was so dense and the disposition of the reinforcement so satisfactory as to settle any doubts as to the quality of this type of pile.

BEHAVIOUR DURING FIRST FLOODS

Having regard to the particularly changeable reputation enjoyed by the river, the bridging of which has been described above at some length, its behaviour during the first 3 months of the 1944 flood season has been carefully watched. The river rose to its previously highest recorded maximum level in June and scour and velocity during the flood were much less than we had been led to believe. Scour has reached a maximum of 5 feet below previous lowest bed level at pier No. 4 and between piers Nos. 15 and 16 and has subsequently decreased. Velocity reached a maximum of 8 feet per second approximately.

An indication of what can happen in such a river if obstructions near bridges are not immediately removed has been provided by a large jungle tree which has come to rest some distance upstream. This tree has caused scour to 14 feet below previous lowest bed level and it is evident that such an obstruction or obstructions, near the bridge, might well cause the collapse of a pier unless dealt with immediately.

CONCLUSION

The bridges have, at the time of writing, been carrying convoys and other traffic for over 3 months. Although nominally Class 12 all have occasionally taken Class 18 loads and five have passed one vehicle of Class 30 without apparent damage to the girders. Despite the limitation of information, time and resources, imposed by wartime conditions, there is good reason to hope that the structures will serve all wartime demands and will still remain to meet the civil needs of peace.

Appendix I

- I. LOADINGS, SETS AND PENETRATION OF PILES.
 - (a) Safe loads on piles calculated on Hiley formula were as follows:—
 (i) Minimum 39.4 tons.
 - (ii) Maximum 57.45 tons.
 - (iii) Average 43 tons.
 - (b) Average set per ten blows of 2 ton hammer with drop of 50" 2.3 inches.
 - (c) Average penetration 39 feet.
 - (d) Average times for piling were as follows : \rightarrow

Driving piles 70 minutes actual driving.

Driving casings 90 minutes including aligning and fixing wooden linings.

Withdrawing 80 minutes actual withdrawing and concreting.

- (e) Average consumption of coal per pile was 13 cwts.
- 2. CONCRETING AND REINFORCEMENT.
 - (a) The average amount of concrete per pile was 15 mixes of the following :---

I cwt. bag cement.

1 cu. ft. sand.

3 cu. ft. shingle maximum size of aggregate 11".

This quantity was placed in three operations :---

1st batch 6 mixes.

and batch 6 mixes.

3rd batch 3 mixes.

The proportion of mixes was very effective in keeping down the head of water in the pile tube and the top of the pile in almost every case was of concrete with a satisfactory slump.

(b) Mix of concrete for piers :--

r cwt. bag cement. .
2½ cu. ft. sand.
5 cu. ft. shingle maximum size of aggregate 2^{*}.
Pile caps cast in one operation.
Pier cast in one operation.

 (c) Piles 6 No. ³/₄" dia. M.S. rods with ¹/₄" spiral at 6" c.c. Casings 8 No. 1" dia. M.S. rods with ¹/₄" spiral at 6" c.c. Piers. Main reinforcement ³/₄" dia. M.S. rods. Stirrups ³/₄" dia. M.S. rods. Links ³/₄" dia. M.S. rods.

MEMOIRS

BRIGADIER-GENERAL ALEXANDER GRANT

A LEXANDER GRANT who died on 20th December, 1943, was born on A the 20th August, 1861, at Eltham Manor, Weymouth, the son of Major T. J. Grant, 58th Regt; he was educated at Cheltenham and the R.M.A., and commissioned, as Lieut. R.E., on the 30th July, 1879. After a year at the Curragh, Grant returned to the S.M.E. and joined the Submarine Mining Service, serving continuously in this until 1892, at Gosport, Malta, and Harwich.

In 1889 he was promoted Capt., and three years later appointed Instructor in Fortification at the "Shop," a post he held for six years. On attaining his majority in 1898, he served in Canada and commanded the garrison at Esquimault, where he was able to indulge in his hobby of sailing, and won several prizes in the one design class. On returning home in 1903 he took over the command of the M.(S.M.).Coy. at Chatham. Whilst there, he commanded the Service Battalion on the parade held on the occasion of the visit of H.M. King Edward VII to Chatham on October 21st, 1904. In 1905, being promoted to Lt.-Colonel, Grant joined the M.W.S. at Rawalpindi.

In India he held a variety of jobs, viz., Staff Officer to the Chief Engineer, Northern Command, Asst. C.R.E. at Lahore and Meerut, Offg. C.R.E. to the 5th and 7th Divisions, and finally, after promotion to Brevet-Colonel in 1908, C.R.E. of the 8th Division at Lucknow.

Grant received his first appointment as a Chief Engineer in 1911 when he was posted to Gibraltar, and became a keen follower of the Calpé hounds.

Early in 1915 he came back to England to become the first Chief Engineer "Third Army at Home." Through the troublous years 1916-1918 he held the post of Chief Engineer, Irish Command, with the rank of Brig.-Gen. and at the end of 1918, after 39 years service, was placed on the retired list.

Alexander Grant had the charm of manner usual to Irishmen, but there was nothing mercurial or inconsistent about his nature. On the contrary, he had one of the most steadfast and reliable characters to be met anywhere and his face was the mirror of his integrity. He stood well over six foot and would have been noticed in any company for his good looks and because he looked (and was) good. He was a man of deep religious conviction, and wrote several essays on man's relationship with God (which were printed and were of great help to a wide circle of friends) and two small books, *A Modern Layman's Faith*, and *Religion and Church for To-day*. In 1897 he married Chris Lindsay-Crawford, daughter of J. A. Crawford, I.C.S., of Annan, who survives him. There were no children of the marriage. Of him can truly be said "He nothing little did, or mean," and with his death passes a great gentleman.

E.St.G.K.

BRIGADIER-GENERAL G. E. SMITH, C.M.G., D.S.O.

W^E have had many versatile men in the Corps, but few to equal "Uganda" Smith. He was that rare combination—classicist, mathematician, and expert player of games. Those of us who knew him will not readily forget his keen zest in life, his well-trained and well-stored mind, and that short wiry figure with the eye and the hand that worked so well together. As young officers we used to marvel at his card tricks; he was an army champion with the foils; his tennis and golf were really good; and he was an expert fly-fisher and keen sailor. To all this he added the rare accomplishment of being a curler of international fame. He "curled" for England against Scotland and won the Royal Caledonian gold medal in 1923, and was a noted chess player. Horses, shot guns, and "works" (for he was, by choice and by turns, submarine miner and surveyor) were not matters of interest to him, and yet, in later days, he was to show his metal as Director of Works in Italy during the last war.

Smith, the son of a Fellow of the Royal Society, was a Wykehamist, and, in a day when the classics still counted for something in the entrance examination. passed well into Woolwich in 1886. At Chatham he chose submarine mining (the choice was much more varied in those days 1) and served at Gosport and Sheerness. Then fate and a brother-Consul C. S. Smith, a retired naval officer chosen as boundary Commissioner between German and British East Africa-conspired to introduce him to a surveyor's life. On that commission, between Vanga and Kilimanjaro, Smith's work was mainly concerned with the trigonometrical framework; but included the management of porters and stores. The next six years were spent in submarine mining at Halifax (Nova Scotia) and again, at special duty in Mombasa. 1897-8 saw him in St. Mary's barracks, once more submarine mining. Then after a short spell of field company duty Smith saw service in the South African War (Queen's Medal and 5 clasps), but in 1904 he returned to East Africa as Commissioner for the still undemarcated portion of the boundary with German Tanganvika. He went by the then finished Uganda railway to Kisumu, and from Karungu on Lake Victoria Nyanza completed the boundary to the camp, north of Kilimanjaro, which he had reached from the East in 1893. Before this boundary had been completed, and ratified, Smith was asked to report upon the surveys of British East Africa. The problem was no easy one for it included the property surveys for settlement, the topographical survey of a vast area, and, of course, a framework of triangulation upon which to base them both. His report (1905) was accepted and acted upon, and he had but a few months at home before he was appointed Surveyor General. The next five years were indeed busy. Smith had an excellent staff and worked them hard, and to their ability and thorough training many of us could bear witness to in after years. In 1907 he received the Murchison award from the Royal Geographical Society. In 1913-14 Smith was S.O.R.E. to the Chief Engineer Western Command. Then in the last war he was C.R.E. Boulogne till 1917 and then Director of Works Italy. In 1919 he was made Brevet Colonel. After the war he was C.R.E. Bristol and retired in 1922. He died on the 7th November, 1944. Smith was an Officer of the "Legion d'honneur" and a Commendatore of the order of St. Maurice and St. Lazarus.

H.S.L.W.

BRIGADIER-GENERAL R. H. H. BOYS, C.B., D.S.O.

REGINALD HARVEY HENDERSON BOYS, who died on the 15th on the 17th October, 1867. Educated at Wellington College and Woolwich he was commissioned in the Royal Engineers on the 24th July, 1886. After . completing the usual course at the S.M.E. he was posted to the 1st Div. Telegraph Bn. at Aldershot. He thus started on his long career on the signals side of the Corps. Altogether he served on this side for nearly 21 years and finally as A.A.G. at the War Office from 1919 to 1923, was responsible for organizing the new Corps of Signals, which was then separated from the Royal Engineers.

In 1892 he was posted to the 25th Fortress Coy. at Hong Kong, where he remained till 1895. This was his only break from work in connection with signals between 1888 and 1908. During his service in Hong Kong he was presented with a special set of plate and received the thanks of the Community for his services rendered during the outbreak of plague in 1894.

He served with the 1st Div. Telegraph Bn. in South Africa from 1898 to 1901 and was appointed Asst. Director, Army Telegraphs, in Cape Colony in 1901. He was three times mentioned in despatches and received the D.S.O., Queen's Medal with 5 clasps and the King's Medal with 2 clasps.

After a spell of service at home from 1902 till 1908, still on the Telegraph side, he was ordered to Mauritius as D.O. Port Louis. On the voyage out, in March, 1908, the ship was wrecked off the South East coast of South Africa. Boys was saved, but his wife was unfortunately drowned.

On returning to England in 1910 he was appointed Staff Captain under the D.F.W. at the War Office. In 1913 he was promoted Lieut.-Colonel and appointed C.R.E. and Div. at Aldershot and proceeded to France in that capacity on the outbreak of the Great War. He was wounded and was awarded the C.B., returned to the U.K. and in 1916 was appointed Commandant of the Signal Service Training Centre, at Woburn, Beds., and was granted the temporary rank of Brig.-General. He was promoted Brevet-Colonel on 3rd June, 1917.

After serving as D.D.A.S., Forces in Great Britain, and as Deputy Chief Engineer, Eastern Command, he was specially selected at the end of 1919 for the appointment of A.A.G.R.E. at the War Office, on account of his great experience on the signal side, at a time when this branch of the Corps was being separated from the Royal Engineers and being created into a new Corps of Signals. He remained in this appointment until he retired on the 16th September, 1923. During recent years he studied Braille and transcribed several books for the blind.

In 1912 he married, as his second wife, Dorothy Conyers, the daughter of Conyers Baker, and had two sons and a daughter.

C.C.P.

BOOK REVIEWS

(Most of the books reviewed may be seen in the R.E. Corps Library at Brompton Barracks, Chatham.)

BRITAIN AND MALAYA

BY SIR R. WINSTEDT

(79 pp. in paper cover, with illustrations. Published by Longmans, Green & Co. Price 1/-)

So many R.E. have served in Malaya during the 20 years between the Wars that this pamphlet should have a busy time when it is admitted to the Corps Library. It is the first of a series dealing with Britain and her Colonies and it sets a high standard for the rest.

No one is better qualified than Sir Richard Winstedt to write about Malaya and here he has written with all the clearness, conciseness, accuracy and, so far as limits of space permit, completeness which we have learnt to expect from his pen. He begins with a sketch of Malaya's history from pre-historic times down to the year 1874, when order had been completely evolved from chaos and chaos ended. Seven years before, however, the country's administration had been transferred from India to the Colonial Office. It was that transfer which launched Malaya upon the marvellous voyage of development which made it, in 70 years, by far the richest and most prosperous of all our colonies. There can be no more eloquent tribute to the beneficence of a firm, sympathetic and liberal government.

The chapters on the "Constitution of Malaya" and on its "British Administration" will appeal specially to Administrators; but those dealing with its "Economic Development" and its "Social life and Services" must be of interest to every imperially-minded Briton.

The author does justice to the quality of the oft-maligned British element in the population in such sentences as—" The average Briton passed on to his Asiatic friends just what he had to pass on, a christian code of ethics, a firm adherence to equality before the law and a passion for games." He might have borne testimony to the patriotism which filled the ranks of the British Companies of Volunteers with keen recruits: but he is probably wise, on the whole, to ignore altogether the prickly subject of " Defence."

T.F.

INFANTRY ATTACKS

By General Field-Marshal ERWIN ROMMEL, translated by Lt.-Col. G. E. KIDDÉ, U.S. Army. 265 pp.

(Published by The Infantry Journal, Washington. Price \$3.00)

This is an American translation of a book published in Germany in 1937, when its author was a Lt.-Col., Instructor in Infantry Tactics at the Dresden Military Academy. The translator appears to have done his work well, although he has somewhat disfigured it by the use of American slang.

The matter of the book is drawn almost entirely from the author's own experiences on the French, Rumanian and Italian fronts, during the years

F

1914-17. It traces his advancement from scout, patrol, and platoon-leader up to the command of an infantry and machine-gun detachment, approximating in strength to a German regiment. Each chapter consists of the description, in great detail, of some infantry-action in which he played a responsible part, followed by "observations" pointing out some of its lessons. This would be an excellent method, either for a book or for a course of lectures, if each narrative were illustrated by a large-scale map. It is here that the book fails. There are no maps, and the numerous little thumb-nail sketches in the text are not an adequate substitute. Still, the book may be studied with both interest and profit by regimental officers and N.C.O.s of all grades. It emphasizes the importance of thorough preliminary reconnaissance, the value of surprise, the advisability of "digging-in" at every opportunity, and the necessity for " sticking it" up to the limit of human endurance.

Incidentally, it shows Rommel to have been a resolute and resourceful leader, cautious but ever ready to take a worth-while risk, self-reliant and fully imbued with the aggressive spirit and the will to win.

On occasions he demanded almost the impossible from his men but they always responded willingly; and this must be attributed largely to the cordial personal relations which, obviously, he maintained with them, and to his constant solicitude for their well-being. In this respect, he appears to have been more like a British than a typical German officer.

T.F.

THE ART OF WAR ON LAND By Lt.-Col. A. H. BURNE, D.S.O., R.A. (Methuen and Co., Ltd. Price 10/6)

Studying the abstract principles of war, as set forth in the military manuals, is a somewhat stiff proposition for the student, especially when he has had no previous experience of war to guide him. The principles appear to be common sense-" to get there fustest with the mostest "-but it is in their application that lies the difficulty. This book is therefore of great value to the student of the military art, as it contains not only a careful analysis of the principles, but backs this up with a sketch of twelve campaigns, ranging from Kadesh 1288 B.C. to the Tunisian theatre in A.D. 1943, pointing out in each where the principles have been observed or neglected by the opposing commanders. The author admits that Part I is stiff reading, but Part II giving the examples well repays the effort, as the summaries of the campaigns selected are absorbing. Lt.-Col. Burne regards the eight principles as only part of the first of the four strands of war. These strands he defines as the commander, the troops, morale, and resources. This is a fair estimate and has been proved to the hilt in the present war. No generalship could compensate our men in N. Africa in June, 1942, for their inferiority to the enemy in tanks and guns. Gen. Montgomery fully realized this when he promised the Eighth Army before El Alamein that their armament was in every way on a par with that of the Huns. Moreover it was only the perfection of technical equipment, arrived at after exhaustive experiment, together with the severest of training of the troops, that made the Normandy landing possible. Even so bad luck in the shape of the weather, which the author tables as a variable factor, nearly jeopardized the success of the expedition.

Of the examples chosen many such as Poitiers, Ramillies, Fontenoy, Salamanca, Atlanta, and Megiddo are well-known. It is, however, interesting

to read accounts of Cæsar's abortive invasion of Britain in 54 B.C., of the fighting at Lake Trasimene, recently in the news, of the German invasion of Poland in 1939, and of Gen. Alexander's Tunisian Campaign.

The author omits almost all reference to air power as he says he is dealing with strategy as opposed to tactics. Strategical bombing, however, is playing such a prominent part in modern war, that it is hoped the next revise of this book will include it. Lt.-Col. Burne is an ardent advocate of exterior versus interior lines, and uses his examples to prove his case. Exterior lines are often dictated by geography and are usually the attribute of the more powerful force. In Europe and in the Far East we are fighting on a large scale on exterior lines, and the author should soon be able to add to his collection some further convincing examples of the advantages of their use.

C.G.F.

PLANE AND GEODETIC SURVEYING FOR ENGINEERS

By the late DAVID CLARK, M.A., B.Sc., Professor of Civil Engineering, University of Dublin. Vol. II., Higher Surveying, 3rd Ed., revised and enlarged by JAMES CLENDINNING, O.B.E., B.Sc. (ENG.), with an Appendix on Mechanical Computing by L. J. COMRIE, M.A., PH.D. Demy 8vo, xvi. 511 pp., with 175 figs. London : Constable and Co., Ltd., 1944. Price 30s. net.

From the times of Colonel Alexander Ross Clarke, R.E., the foremost geodesist of his generation, down to to-day, the corps has contributed perhaps the lion's share of British geodetic literature. For the last thirty years, however, our text-books have suffered as much from war interruption as has the mapping of the Ordnance Survey. In a constantly expanding subject that fact has its dangers, and we must welcome with all the more warmth the appearance of an up-to-date book of reference. J. Clendinning brings to his task a long experience largely in the forest-belt, for he was Surveyor General of the Gold Coast. Now precise traversing, so necessary in the forestbelt, is not a subject which has been intensively practised by either the Ordnance Survey or the Survey of India. In the book under review it is adequately and competently dealt with. So are modern instruments—the tools of geodesy—whilst the atmosphere of reality throughout witnesses to the fact that this is the work of a practical surveyor.

There are no geodetic tables given, nor are there examples enough to guide the surveyor in every emergency, but these are to be found in "Survey Computations" which should be neighbour to this volume on all surveying book-shelves. Proofs of formulæ are not always included, but then many surveyors will confess with me and without shame, that if we have good authority for the limits of precision guaranteed, we can dispense with the proof. There are minor matters in the last two chapters—on Topographical and reconnaissance surveying, and on map construction—which R.E. survey officers would criticize. Of these later— The book is essentially one on instrumental and mathematical surveying. We welcome it, and for topography and air photo surveying will look elsewhere.

Chapters I and II are, respectively, an introduction to, and the practice of, Field Astronomy. Chapter III is the practice and conduct of geodetic control. Chapter IV is Survey Adjustment; Chapter V geodetic computation and Chapter VI geodetic levelling.

In Chapter VII—Topographical and Reconnaissance Surveying—the R.E. officer will welcome most the descriptions of Barometric Levelling and the use of aneroids generally. Here again we profit from experience of the forest-
helt. Chapter VIII is something of a hotch potch, ranging from Map Projections to the plotting of control on field sheet or final map, and finally to the representation of relief. It is relevant, here, to point out that surveyors, providing a careful control, are increasingly occupied with the use of 'coordinates on an orthomorphic projection. The precise formulæ in question are essential in such cases, and this point is dealt with in Chapter V, not in Chapter VIII. We use such a projection (the transverse mercator) in Great Britain to-day. We shall use them increasingly in colonial surveys. A valuable appendix, by no less an expert than Dr. L. J. Comrie, is that devoted to mechanical computing. There are many of us still who look back, not without pleasure for distance lends enchantment to the view, to long midnight wrestles with "Shortredes" logs. To-morrow few will do so. Geodetic computation needs restating in forms applicable rather to the machine than to the logarithm. Other useful appendices, answers to examples, and an admirable index complete, in 511 pages, a well printed and most useful volume.

Having made plain the value of Chapters I to VI let us look at one or two points of interest in Chapters VII and VIII. On page 397 we are told that a preliminary reconnaissance, before beginning the control for topography, can never be dispensed with. But many good surveys prove to the contrary. Providing that trig. has a start, say a fortnight, on topo., and providing the country is suitable and visibility good, this is a rule more honoured in the breach than in the observance. Again when we come to plot (p. 455) we shall not do so as here advised. If all control points are computed on some projection (the ruling points precisely) then plotting will be by rectangular co-ordinates. If not, as the meridian of the point in question is easier to plot than its parallel we start with the former by measurement (and check) on the north and south bounding parallels. Once it is plotted the correct meridional distances are easily measured and checked from the nearest given parallels. Moreover subsidiary (tertiary) points are then plotted in groups, by rectangular plane co-ordinates, each group depending on its central ruling point, and the whole checked by trig. distances. This last check is essential.

Another small point. Hachures, vertical or horizontal, have probably had their day, but the illustrations on p. 458 are very poor indeed. The hachuring is badly done whilst the oblique illumination is all wrong. The author states that light is arbitrarily assumed to come from the north-west corner. But his illustrations use a west light. It is not arbitrary, but correct, that light should come from the north-west, because for a right-handed man at a table the light does normally fall on the map from that direction. On page 439 it is explained why shadows on an airphoto should be made to fall towards the observer. Correct, but, as in the case of the conventional map shadow, for the reason that light is free to come only from opposite the observer, and so explains the shadow.

The following misprints are noted, more in admiration for their paucity, than as criticism:

Page VIII, line 12 from bottom, for "G," in Dr. Comrie's initials read "J."

, II, " 7, for " latitude " of the pole read " altitude."

" 46, " 14 from bottom, for " topical " read " optical."

" 55, note 2, 1st line, after " reflection " insert "depends."

" 141, line 14 from bottom, omit "s" from " measurements."

", 263, ", 17 for " $\sqrt{3r_0}$ " read " $\sqrt{3r_0^2}$."

" 263, " 23, the same.

••

, 321, ,, 10, last term of formula (11), for sina read sin²a.

403, " 21, for " Azumith " read " Azimuth."

H.S.L.W.

THE HONEYWOOD FILE THE HONEYWOOD SETTLEMENT

By H. B. CRESSWELL

(Publishers Faber & Faber. Price 7s. 6d.)

These two books were first published in 1929 and 1930 respectively. They have recently been reprinted. They consist of letters taken from an Architect's file, together with comments by the author on the various points raised in these letters, which deal with the planning and construction of, and settlement of the contractor's bill for, a medium sized country house.

The Honeywood File deals with the correspondence up to the end of the building stage and The Honeywood Settlement deals with the settlement of the contractor's account, together with correspondence regarding defects which arise, and the contractor's responsibility for initial maintenance under the terms of the contract.

Although in certain details the responsibility of a civilian architect to his client differs from that of an R.E. Works Officer to "Q," who may be considered as the client in the army, yet in general the position is very similar. R.E. Works Officers will learn much by reading these books and may obtain good value by lending them to their "Q" Staff. They are written in a light and amusing vein, but at the same time contain many useful and practical hints.

The impatience of the client to get work started and the repercussions of alterations, made after the plans and contract have been prepared, are clearly shown. The importance is stressed of giving written orders for all deviations and of making a note of the approximate cost at the time, if, later on, arguments with the contractor regarding extras, and difficulties with the client about a large excess over the original estimate are to be avoided.

The importance of clearly specifying work to be done and making an agreement as to price is shown when a valuable horse has to be destroyed after falling into trial trenches, which were not protected, and the contractor submits a very high price for the excavation work. To save time the Architect had merely told the contractor to dig the trenches, while the main contract was being prepared.

The R.E. Officer, normally, will not experience the difficulties which arise here between the Architect and the local authorities as the W.D. is not bound by local regulations. At the same time local authorities must be consulted early about water supply and disposal of sewage.

The difficulties which may arise through the use of unknown makes of materials, such as paint, are demonstrated at some length and useful hints are given in connexion with dry rot and damp protection.

The relationship between contractor and Architect is discussed. A good contractor can, and often will, give valuable advice and assistance to the architect, but the latter must know his job thoroughly and so be able to give clear and sound orders when difficulties arise. The contractor's foreman will usually be an expert at his job and can often get the better of an architect in arguments about cost of work done. It is essential therefore, that the architect should keep full records of all work ordered and carried out.

Correspondence between the Architect and his client and with contractors must be carefully considered and weighed. Never say too much and always use language to which the recipient cannot take exception. The reader will clearly see what should be avoided in the lengthy, chatty letters to the client and the several hastily written letters to contractors. R.E. Officers must not expect to get out of the many difficult situations, which arise, as easily as the Architect did in these books.

C.C.P.

MAGAZINE REVIEWS

EMPIRE SURVEY REVIEW, January, 1945

Brigadier Sir Lewis Clinton concludes his *Recollections of a Survey* Officer in India. His reminiscences are interesting and amusing, and no one reading them could say that a surveyor's life lacks variety.

Brigadier Winterbotham contributes an exhaustive discussion on the Final Report of the Departmental Committee on the Ordnance Survey, published in 1938. He makes some trenchant criticisms, based on his own intimate knowledge of the history and work of the Ordnance Survey. His most severe strictures are on the Committee's apparent lack of knowledge of certain items in the recent history of the Survey; on the adoption of the kilometric grid; and on the alteration in shape and size of the new plans. Whether one agrees with all his criticisms or not, few can fail to be impressed by his arguments, or to be delighted by his biting humour. In connection with this article, the letter from Sir Charles Arden-Close on the length of the standard yard should be read.

Dr. A. L. Higgins discusses *Defects of Surveying Telescopes*, mainly with regard to a comparison between modern internal-focussing instruments and the older form of external-focussing.

A. V. Lawes in *Rewebbing Diaphragms without Tears* describes a practical method of dealing with these somewhat elusive objects. He begins his account with the words "First attach a web...." The value of his useful article would have been enhanced if he had added to it how to obtain the web. The late G. T. McCaw told the reviewer that, when faced with this problem in Central Africa, he found the most difficult part was to get hold of a suitable spider.

E.M.J.

GEOGRAPHICAL JOURNAL, July-August, 1944

This number contains the President's Address at the Annual General Meeting held in June.

J. A. Steers contributes a highly informed paper, based on a personal inspection of nearly 3,000 miles of coastline, on *Coastal Preservation and Planning* illustrated by a large number of beautiful photographs.

K. de B. Codrington gives the first part of A Geographical Introduction to the History of Central Asia, a valuable contribution, also illustrated by fine photographs.

W. Livingston gives an interesting account of *The Structure of Bermuda*, mainly from the geological aspect.

E.M.J.

MAGAZINE REVIEWS

THE ENGINEERING JOURNAL

(Published monthly by the Engineering Institute of Canada)

November, 1944.—The first article in this issue describes in some detail the Manufacture of Large Calibre Cartridge Cases by cold drawing. 70/30 brass is found to be the most suitable material. Hydraulic pressures up to 2,500 lbs. sq. in. are used in the presses, the actual pressure required varying with the size and length of the draw. The cycle of operations is clearly explained.

The Growth of Research in the British Electrical Industry is next dealt with briefly by V. Watlington the Director of B.E.A.M.A. He sketches progress from Faraday to J. J. Thomson and Rutherford.

Some interesting features of damage to buildings in Cornwall, Ontario, during the earthquake of September 5th are then described.

An article entitled How can we improve Engineering Education next appears, in which the writer points out that not more than 50% of the students who graduate in Canadian Engineering Colleges are destined for the technical or operating side of Engineering. He advocates the segregation of the two types of student and the provision of special courses for those intending to take up the administrative or business side of Engineering.

The concluding article in this issue is a somewhat unusual one for an Engineering Journal. It deals with *Nutrition* and explains the main food requirements, viz., proteins, fats, carbohydrates, minerals and vitamins. Seven rules are given for ensuring a correctly balanced diet.

The December number begins with an article on Ends and Means in Soil Mechanics, in which the author points out that a large number of foundation failures have occurred due to the unreliability of empirical rules and he proceeds to attack the problem scientifically. Examples are given of excessive settlement due to deep layers of soft clay 30 to 70 feet below top layers of dense sand and gravel. Soil classification by grain size is first considered but the properties of sands and clays are then separately considered and the Atterbury limits for clays are explained.

Britain's New Research Centre recently established at Leatherhead, Surrey, is briefly dealt with.

The functions and organization of the Corps of Royal Canadian Electrical and Mechanical Engineers are described at some length.

In an article on Gas Turbines and Jet Propulsion the author explains the special advantages of this form of propulsion that compensate for its lower efficiency. With a thermal efficiency at present of 15-16% the gas turbine is valuable for many applications such as naval destroyers, aircraft and standby plant in power stations.

The V1 rocket is briefly described and we learn that its efficiency is only $2/2\frac{10}{2}$ and, with the weight of explosive twice the weight of fuel, its range is limited to 100/130 miles.

The January, 1945 issue is almost entirely devoted to the Steep Rock Mining Project which is an outstanding example of Engineering achievement. At least 31,000,000 tons of iron ore (61% iron) are known to be available, a considerable national asset, as Canada has hitherto been almost entirely dependent upon foreign sources for this commodity.

The ore bed is situated under the bed of Steep Rock Lake and the project, therefore, necessitated emptying the eastern portions of the lake (118,000,000,000 U.S. gallons) and diverting the River Seine for a distance of 15 miles (rock excavation 582,000 cub. yds., earth 1,184,000 cub. yds.).

W.M.

JOURNAL OF THE UNITED SERVICE INSTITUTION OF INDIA

October, 1944.—The Post War Indian Army discusses the future of defence under Dominion status. Complete Indianization of the Army is possible in 20 years, says the writer. In addition to the army, a sizeable navy and a largish air force will be wanted. The author is optimistic on the financial aspect of the question, but admits that one object of the article is to stimulate discussion, which it certainly ought to.

The United States Military Academy is an excellent description of life at West Point. In normal times, about 45% of the officer corps, of all branches of the service, graduate there. The course is three years in length, and it comes as a bit of a surprise to learn that the cadet gets no leave whatever for the first year and a half. The life is a strenuous one; in the author's term, apparently one-third failed to run the course. There is much technical, but little tactical, training, that being left for subsequent periods, when the cadet, now an officer, has joined his unit.

Down on the Farm contains some very wise remarks on the pitfalls awaiting those who, led on by a recent optimistic article in the *Journal*, retire to own and cultivate a piece of England.

The Girls they left behind them—a plea for education on the right lines of the women-folk of the sepoy—will open the eyes of the older generation of *koi-hais* as to how far emancipation has got. But, the authoress asks, is it on the right lines ? She has met Indian girls whose Westernization has not got beyond lipstick and cocktails.

Elephants in Burma is written with a view to the instruction of the army of liberation now ousting the Japs. There are, or were, some 6,000 tame elephants in the country, of which a large proportion will be available for transport. An average elephant will carry 500 lbs. over almost any kind of country, marshes excepted.

A visit to Portugese Daman is full of interesting facts. The colony consists of two parts, separated by a corridor of British India, and enclosed in the larger part which is entirely inland, is a piece of an Indian state! The settlement seems to be clean and well run, and the population peaceful and law-abiding.

Education and Leadership in India. There are, says the author, three types of leader, the institutional, the dominant and the persuasive. The first of these requires a good deal of aloofness plus pomp and circumstance to make his power felt. There is a place in the army for each, but the first requisite with all is "knowing one's job." The system of education in India is strongly criticized; leaders for India under Dominion status will not spring from the youth being educated by existing methods. A bit more of constructive criticism would however be welcome.

The Tiddim track by Lt.-Col. Towers, D.S.O., R.E., describes a great feat of engineering, namely the construction of about 100 miles of lorry road where only mule tracks, or nothing at all, existed before. Though it was found advisable, on account of treacherous ground, to keep to ridges and valleys as faraspossible, in places work had to be carried out on sidelong slopes of 1 in 2 or even 1 in 1.

Bulidozers worked outwards from accessible spots on the alignment, doing about 300 yards a day. Probably security reasons forbade a map in the *journal*; that and photos would have shown very vividly what was evidently terrible country.

War within war deals with the iniquities of vocabularies of stores. An article may be described differently by each one of the services; nay more, there may be more than one name for the same article in use in different parts

of the vocabulary in the same service. The remedy is an inter-service provision service.

Review of N.W. Frontier Policy from 1849–1939 is concluded. The author sums up by saying that in trying to solve it, "we have not yet succeeded, but neither have we failed, and we must continue to struggle." He laments so much destructive criticism as he has felt bound to put forward, but there is much that is useful. If, says he, the tribesmen could see the British and Indian armies not as instruments of power but as friends in some work where co-operation could find place, the feeling of fear might go, for Tommy Atkins and Jack Sepoy are excellent ambassadors of Empire. The difficulty is to find suitable jobs.

Evacuation is a tale of the difficulties of an officer in taking in and repatriating some 10,000 Indians in April, 1942, from Kyauk-pyu, on the Arakan coast. The tale is told with a lively humour which must have stood the author in good stead in a truly horrible situation.

Military bridges for post-war reconstruction. A useful article giving the advantages and disadvantages of using surplus equipment bridges for civilian purposes.

F.C.M.

THE INDIAN FORESTER

November, 1944.—Grass that fights snakes and malaria sounds too good to be true. It grows in Venezuela, but may be an import in colonial times from Africa. Not only does it keep out snakes and anopheles mosquitos, but ticks, tsetse flies, fleas, ants and many other animal parasites as well. It is said to provide excellent hay, and very good fodder for horses, mules and cattle.

December, 1944.—Lopping in Kumaon Himalayas records the disastrous effects of allowing almost unrestricted lopping by villagers in oak and other forests, which were denuded to danger point. Had not legislation been introduced, erosion would have set in and what remained of the forests been completely destroyed. The evil though checked, has not been entirely averted; some useful suggestions are made.

Entomological Notes contains a statement that it is the custom in Balkan countries to trap bedbugs by spreading common bean leaves on the floor. It is startling to learn that one investigator collected 2.25 lbs. of bugs in this manner from one room alone. A paragraph on termites records that they have been known to make tunnels round sheet metal projecting two inches horizontally, in order to get at soft wood above.

The Double Coconut is a native of the Seychelles Islands. Until their discovery, in 1743, it was known only from specimens of the fruit washed up on the shores of the Indian Ocean ; it was therefore believed to grow under the sea, and was credited with wonderful medical properties. Curiously enough it has never established itself elsewhere than in the Seychelles, which is very different from the habits of the single coconut, which has spread from South America to the shores of practically all tropical countries.

January, 1945.—With this number the magazine enters on its 71st year. Good luck.

Mine eyes unto the Hills is a story of two months leave spent in hunting rhododendrons and takin, the latter with no success, on the Burma-Chinese frontier beyond Myitkyina. Needless to say it was before the Japanese invasion, but we get a vivid idea of the country over which the liberating army fought.

Lt.-Col. Ogden's article in the June number of The R.E. Journal is quoted in extenso.

F.C.M.

INFANTRY JOURNAL

November, 1944.—Battle Facts, by a number of officers, are a series of useful, brief articles on actual experience in war, covering a diversity of subjects including "Tell it to the Cannoneers" which explains the necessity of keeping the C.B.O. informed of details of all enemy artillery fire and also of particulars of artillery support required by the Infantry. "Reverse Slopes" gives the advantages and disadvantages of siting defences in this way.

The New German Carbine gives some particulars of this weapon, which has a high muzzle velocity and a rapid rate of fire.

Tank Destroyers in Direct Support explains the method of their employment and the importance of previous reconnaissance for getting these weapons to the right place and properly concealed. Details are given of such support at the crossing of the Volturno River and their employment in the attacks on Cassino.

Not According to Hoyle gives an account of two successful battalion attacks on German positions in the Cherbourg Peninsula. Instead of employing the usual methods of holding the enemy by fire from the front and moving round by a flank, a very great concentration of fire was brought down immediately in front of the Infantry who were in a very compact formation. In the first case the assault went right through but left a number of enemy positions uncleared. In the second case a much heavier concentration of fire was put down and then a large part of the enemy surrendered as soon as the barrage lifted. A second barrage was then ordered and the remainder of the enemy surrendered when this lifted.

December, 1944.—The first article in this issue is by Lt.-Col. J. J. Gillespie and Capt. L. E. McBride and gives a good description of the gallant fighting of the 100th Battalion (Nisei) in Italy during the crossing of the Volturno River and subsequent operations. This battalion is composed of Hawaiianborn Japanese Americans. The battalion was cited in War Dept. Orders for its "outstanding performances of duty in action" and, in addition, to a very large number of individual decorations, the Presidential Citation ribbon was specially awarded to "D" Coy. Battle Facts are continued and include Heavy Mortars in Direct Support, Control of Men, Combat Feeding, Snap Shooting in Close Combat, etc.

January, 1945.—Siege Methods, 1945 by Lt.-Col. F. C. Walker. This article starts by laying down that "the important thing to remember about modern fortified positions is not to attack them." It then goes on to describe some of the consideratons if you do have to attack them and hope for a reasonable amount of success. Planning and preparation will represent 50% of the task, knowledge of weapons and demolition 5% and successful exploitation of the breakthrough 45%.

The success of the assault on a fortified zone is dependent on the following :

(i) Dominating observation and potential fire superiority.

- (ii) Finding the enemy.
- (iii) Rehearsing and building confidence.
 - (iv) Destructive preparatory fire.

Battle Facts include Selection of Command Posts, Mortars in Combat, Front Line Illumination, Defence of Reverse Slopes, and Dogs in the Jungle.

The Soldiers Pay Load by Lt.-Col. C. E. Parker is a short article on the important subject of the load carried by the soldier and how best to distribute it. Several recent developments in the arrangement of packs are also described.

C.C.P.

MAGAZINE REVIEWS

THE MILITARY ENGINEER

(Published by the Society of American Engineers)

November, 1944.—Along the Ledo Road by John R. McDowell tells some of the story of how the Engineers complied with General Pick's order "Keep the Ledo road open, weather be damned:" Engineering experts said that the road could not be built, and indeed they seem to have had every reason to say so.

The article refers particularly to the work required on the Paktai sector; a stretch of 110 miles where in a five-month period there is a rainfall of over 200 inches.

Bridges over the rivers were being continually damaged by the tons of debris washed down against them, landslides blocked culverts and caused the collapse of the road itself, the incessant rains undermined huge trees which fell across the road. These difficulties were made worse by the importance of the time factor.

That the road was kept open so successfully, and still is, was due largely to the plan of "preventive maintenance" which was developed early on; a survey and careful study of all potential danger spots were made and plans evolved in advance to deal with likely damage. "As a result maintenance crews are seldom caught with their trousers at half mast."

But, as is always the case, it is "the men whose graves are the milestones of the Ledo road," working to round the clock schedules, knee deep in mud and harassed by insects and oppressive heat, who have made the job possible.

Airborne Engineer Training by Capt. Ed. J. Flynn.

The author gives an interesting picture of the training of Parachute and Glider-borne Engineers.

The greatest attention is paid to the physical training side of the course, in fact, though not stated in so many words, the idea seems to be to make the men's bodies splinter proof if not bullet proof.

The technical training does not differ essentially from that for normal field Engineers, but the men are taught how to "make do" with the lighter equipment they bring with them, and the use of captured enemy gear.

Glider-borne engineers are also taught how to load and lash their heavy equipment in their gliders, a highly skilled and vitally important job, as, should any of this move or even rock in flight, the lives of the whole crew would be endangered.

In Aleutian Water Transportation Problems Lt.-Col. David G. Hammond describes how port facilities were provided for unloading the stores required in the occupation of these islands in the days before the special landing equipment such as L.S.T.'s, L.C.T.'s and L.C.V's were available, a situation likely to recur.

December, 1944.—Normandy's Artificial Harbours by Rear Admiral John J. Manning, U.S. Navy.

This Officer of the Civil Engineer Corps tells the story of the planning and building of the artificial harbours, one of which was for use by the Americans, and gives a good idea of the magnitude of the task involved in the preparations.

In spite of the fact that the damage by the storm, which began on June 10th and swept the site for four days, was such as to cause the original American plan to be abandoned, the breakwaters were repaired and proved of great value and the job of landing men and material was successfully carried out.

Heavy Construction in Tropical Swamps by Major G. M. Zucco. This article gives the writer's experiences and the lessons learnt in road construction and maintenance on a large, low, muddy and rainy tropical island.

January, 1945 .- Entomological Engineering by Capt. W. D. Reed describes

the methods now being adopted by the U.S. Army to combat damage and disease caused by insects, rodents and vermin, one of the responsibilities of the Corps of Engineers, on Army property.

An Insect and Rodent Control Unit, controlled by an entomologist, has been set up in the Office of the Chief of Engineers and the job tackled with all the science and force of battle.

It is claimed that, in spite of the cost of such thorough going methods as are being adopted, the net result of reducing the damage and suffering caused by these pests will be an enormous saving in cash and comfort.

Training Military Road Builders by Major E. F. Clements. This article outlines the methods employed at the Officer Candidate School, which forms part of the Engineer School, Fort Belvoir, for teaching the construction and maintenance of military roads. To take the place of some of the practical work, which lack of time and other facilities makes virtually impossible, the training aids used are; first, a demonstration area providing a series of models of standard type military roads; second, training films, eight in number of from 10 minutes to 20 minutes length, and third a set of special notes on the lessons given.

At the end is given an outline for eight lessons as a guide for the training in Field Units.

A.R.A.I.

AN COSANTÓIR

Journal of the Eire Army

December, 1944.—Usual selection of reprints from American Military Journals (two based on Russian originals) and a few original articles, good but of elementary interest.

A Day on Kwajalein (U.S. Inf. Journal), has already been reviewed in the original. This interesting article is continued in the January and March issues.

An amusing extract from the same Journal, explains "How to tie your shoe-lace," in the manner of a drill manual. It is interesting to note that there must be a strong family likeness between U.S. and British Army life—as well as between the (basic) sense of humour in both !

A couple of articles (from Russia via U.S.A.) on German Field Fortifications and Clearing Road Blocks Under Fire are based on the experience of our allies in the East. The care and thoroughness of the plans, as well as the "volume" of work done, are most impressive and suggest that German Cdrs. and their General staffs study the deliberate defence with more attention to the Engineer problem than it normally receives in this country. Either they have a specialist Section of the General staff to deal with these situations—or they give their Engineer Officers a freer hand, a higher priority for labour, etc., and MUCH MORE TIME in which to prepare and carry out a project.

January, 1945.—In this number a series of short biographies of the modern Irish national leaders commences with that of Tom Clarke—shot after the abortive Easter Rising of 1916. Its interest is historical and political rather than military, which puts it outside the scope of this review.

The usual reprints from various U.S. Military Journals make interesting reading and are well chosen to rub in the importance of paying serious attention to what the training manuals teach. It is interesting to see that as long ago as 168 B.C.—Lucius Aemilus Paulus, on being appointed to command the Roman Forces for a campaign in Macedonia, had a lot to say about the "armchair critic." The U.S. Inf. Journal reprints a long extract of his speech as recorded in Livy Bk. 44 Ch. 22. Remarking that "every circle, nay every table" held people who knew exactly what he should do and how he should do it. He stressed the fact that the Cdr. in the Field ought to have ready access to the best counsels; so he invited them to come with him at his expense, into the field and help him there. But if they preferred the repose of the city, would they kindly confine their discussions to the abundant topics the city provides.

February, 1945.—Thomas MacCurtain is the subject of this month's biographical sketch; chief organizer and Commander (1913-20) in the Cork and Munster area generally. It touches on the vexed question why Cork did not "rise" at Easter, 1916, with Dublin—but leaves the point unsettled.

Under the heading *Hedgerow Fighting Series* a number of articles, descriptive of the day-to-day fighting in Normandy, are reprinted from the U.S. *Inf. Journal* with a Foreword and a commentary by Maj.-Gen. Costello and the 1st Divn. Staff. Interesting and in fuller detail than in our "Notes from the Front." Another article *Position in Depth*, from the same journal, describes how two actions in Sicily were needed to prove to the Bn. Cdr. that the text book insistence on organizing a position in depth really did make the difference between success and failure in defence.

A short original article on cross-country running gives some helpful hints to the Unit Sports Officer.

March, 1945.—Sean MacDermot is the subject of this month's biography which again has no specific military interest.

U.S. Rangers in a Night Attack reprints an article describing a night operation on a Bn. scale in Tunisia—apparently the same operation dealt with by Ralph Ingersoll as a War correspondent in The Battle is the Pay-off.

Staff Officers from the U.S. Inf. Journal, gives some excellent "fatherly" advice to the novice on general behaviour and Radio communication in the Field is an elementary survey of the problem for the non-technical reader.

An original article on compilation of a Pln. Cdr.'s diary is of interest and another original article on *Town Planning and Defence* touches rather lightly on a problem which surely deserves serious attention at a high level.

D.R.ff.M.

SPECIAL NOTICE

The fact that goods, made of raw materials in short supply owing to war conditions, are advertised in this magazine should not be taken as an indication that they are necessarily available for export.

CORRESPONDENCE

GEOLOGY AND DOWSING

To the Editor, The Royal Engineers Journal

Sir,

The letter of Dr. W. B. R. King, dated January 3rd, in the March *Journal* ends with a request for the official opinion of the British Society of Dowsers on the problem of dowsing for water on maps.

A Society being composed of individuals, each with his own ideas, can hardly possess an official opinion on any particular matter, but as I have been in close touch with dowsing in all its aspects for the last dozen years, I will give my own opinion for what it is worth.

When I first heard of this strange practice I regarded it as pure nonsense, but in face of recurring examples of its successful performance I came to the conclusion that certain people possess a psychic faculty, akin to clairvoyance, which enables them to acquire knowledge inaccessible by normal means, when a connecting link has been established. In the case of a dowser this connecting link is a map of the locality to be surveyed. The fact that the dowser has to go through the same performance in miniature with his instrument as he would do on the actual ground, is no more strange than the action of the automatic writer who records his impressions in script.

As regards dowsing of the physical kind, one gathers that geologists claim to be able to give the same information regarding an underground supply as the dowser professes to do, namely (a) exact location for a well or bore, (b) depth to water, (c) yield. Can the geologist really do this ?

If so, one would much like to know how he finds the position of a water bearing fissure and also how, knowing the general depth of a water bearing stratum, he discovers the point of greatest supply.

Perhaps Dr. King will tell us.

Yours faithfully, (Colonel) A. H. BELL, President of the British Society of Dowsers.

Professor W. B. R. King has replied to the last part of Col. Bell's letter as follows :---

"Geologists do not claim to locate fissures or give exact yields. But by considering all available geological evidence, including that from existing boreholes, they give an estimate of the probabilities."

Editor's Note.

It is regretted that it has not been possible to publish certain other letters received on this subject and the correspondence must now cease.



"GRACING THE TABLE"

WHO was it wrote "the table was graced with some fine pieces of silver"? He may have been famous or unknown but he was surely a poet. For "gracing" is just what fine silverware does. In the after-the-war world to which we look forward and about which we are all thinking and planning a wider appreciation of good design will be one measure of our worthiness. Of vital importance to industry will be the artist and the craftsman and on the measure of opportunity which is given them to bring beauty into our every day lives will depend largely whether that future is the gracious one which years of sacrifice and endeavour surely merit.

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If you had been a soldier in 1830

At home in barracks, you would have had only two meals a day—at 7.30 a.m. and 12.30 p.m., and the cost stopped from your pay. For 19 hours each day you would have been without food.

In the evenings, you would have drunk your fill of bad liquor in barrack canteens conducted by private contractors, often unscrupulous, who paid to the State a monthly sum called "privilege money" for the right to trade. This right was considered a rich prize, and large sums were offered which could be recovered only by excessive prices. The canteens were frequently dirty and ill-lighted hovels, notorious for their exorbitant charges and poisonous liquor—the cause of much drunkenness and crime.

Reforms were gradually introduced, and in 1917 the contractor system was finally abolished, and control of Service canteens taken over by the Navy and Army Canteen Board, operating on the principle that canteen profits should be returned to the Services in cash or amenities. In 1921 this principle was permanently established with the birth of the Navy, Army and Air Force Institutes—Naafi as it is today.

NAAFI

The Official Canteen Organisation for H.M. Forces NAVY, ARMY & AIR FORCE INSTITUTES, Ruxley Towers, Claygate, Esher, Surrey



CEMENTONE No. 8

Hardens concrete quickly

Costs little,

Counteracts frost,

Prevents "Dusting,"

Increases tensile strength,

involves no additional process.

The rate of hardening can be varied to any extent from normal to instantaneous so that work need not be interrupted by wet or frosty weather. Think what this means when you want, quickly, to bed down vital machinery—repair or relay a concrete floor without interrupting workshop operations stop a water seepage (instantaneous hardening can be a godsend here)—or do any cement work in a hurry. The time saved is the difference between a week (or more) and a weekend.

CEMENTONE No. 5

cures dusty concrete floors

Wasted labour in sweeping and sprinkling floors; wear and tear of machinery, menace to health; in fact an intolerable nuisance can be eliminated with the minimum of cost or effort.

JOSEPH FREEMAN

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