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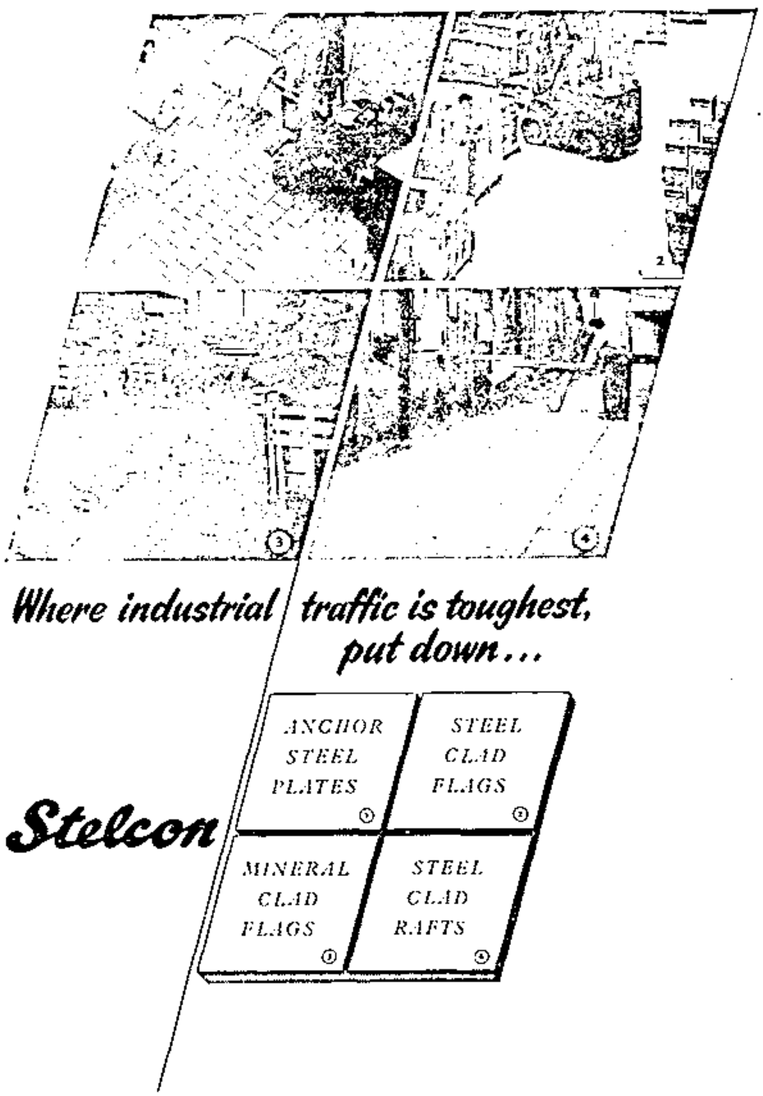
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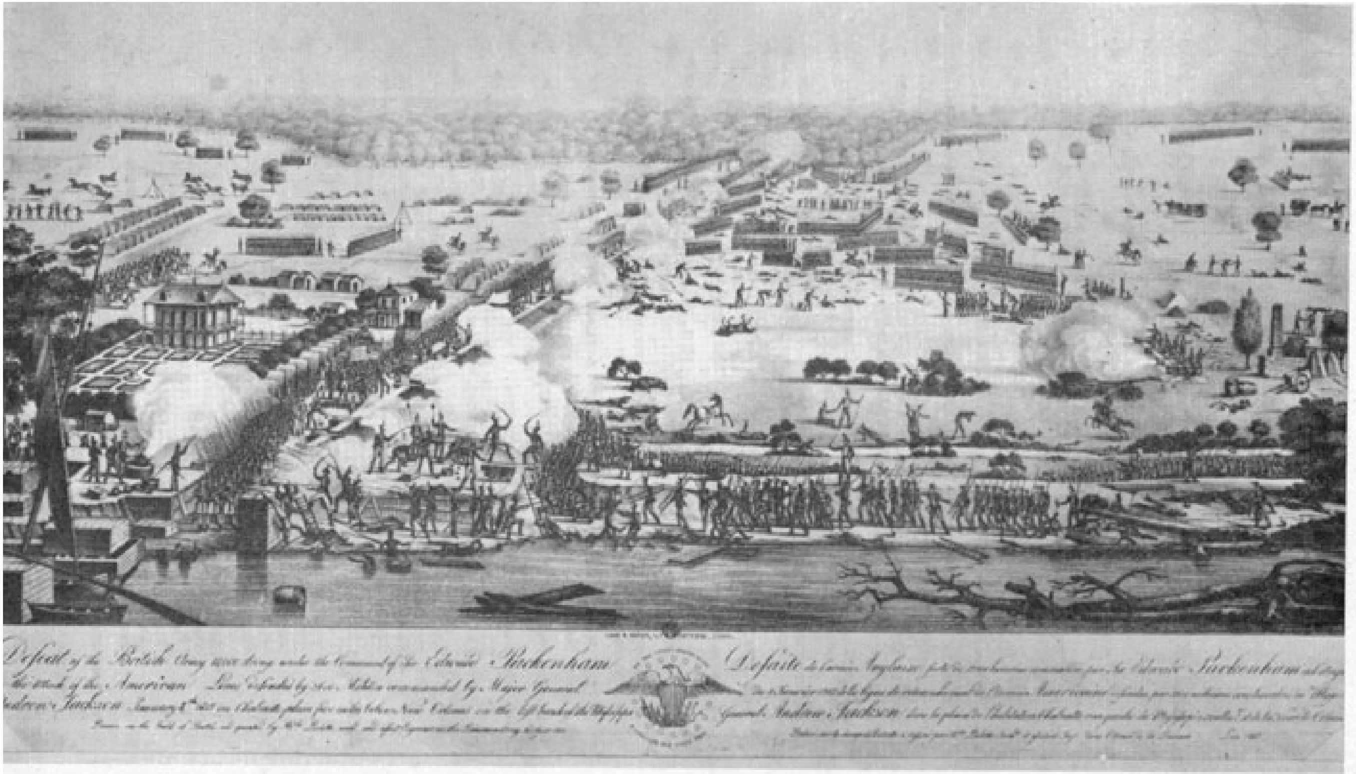

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From the Crookshank Collection

Some Engineer and other aspects of the attack on New Orleans 1814–15

By MAJOR A. A. T. HISCOCK, R.E.

INTRODUCTION AND BACKGROUND

MAJOR-GENERAL WHITWORTH PORTER in his first two volumes of the *History of the Corps of Royal Engineers* covered from the earliest times up to the year 1886. His treatment of the subject could not therefore be exhaustive, and he himself describes his History as "a framework". Among the interesting campaigns to which he was not able to give adequate space is the American War of 1812. Few actions of the war are more rewarding of study than the siege of New Orleans, and I have attempted in this paper to give a brief and critical account of the attack, complete in itself and stressing its engineer aspects. I do not agree in all respects with Whitworth Porter and I have appended a note on the sources of my material. I have not given detailed references by means of footnotes to the text as I believe them to be irritating and distracting to the reader.

Up to the year 1814 the war had been carried on without much advantage to either side. All attempts by the Americans to invade Canada had been disastrous and the only positive success the British had achieved was the destruction of Washington. This, however, was of no military value and only embittered the United States without enfeebling them to any appreciable degree. Negotiations to end the war were begun in Ghent, but meanwhile it was decided to make an attack on New Orleans.

After certain changes, the officer eventually given command of the expedition was General Sir Edward Pakenham, a young and distinguished Peninsular officer. It was evidently hoped that Pakenham, brother-in-law of the Duke of Wellington, and formerly his Adjutant-General, would be just the very man to bring this enterprise to a successful conclusion and thus have a strong influence on the terms of the peace treaty under negotiation.

At the time of the expedition New Orleans was a city of about 17,000 inhabitants. From the purely military, as distinct from the political aspect, little could be gained from its capture except that had the British been able to hold it the trade of the lower Mississippi would have been greatly impeded. This has led Porter, Fortescue, and others into placing too much reliance on the contemporary gossip that the prime mover of the expedition was Admiral Cochrane and that his main reason for wishing the expedition to be carried out was the hope of a large distribution of prize money! In fact an expedition to Louisiana had been under preparation before the receipt of Admiral Cochrane's letter dated 20th June, 1814, which recommended action against both Louisiana and Florida. The effect of Cochran's suggestions was to reduce the size of the expedition although it is true that he encouraged the authorities to continue with their plans.

A contemporary War Office memorandum on the subject in the Public Record Office concludes with the following summary:—

"General reasons for undertaking expedition to the American Coast.

1st. Diversion for Canada,

2nd. Injury to the enemy,

(*a*) Harrassing Militia.

(*b*) Increasing expense.

(*c*) Dissatisfying people."

It goes on to say:—

"Reasons for the Southern Coasts

1st. Season of the year.

2nd. Farthest from Canada.

3rd. Dissatisfaction prevalent in Spanish population."

It should be remembered that ever since Louisiana had been purchased from Spain there had been boundary disputes between Spain and the United States. In addition, Florida still belonged to the Spanish.

There is no doubt that once Louisiana had been decided upon, New Orleans was the most valuable objective, although the military commander was given considerable latitude provided that control was gained over the lower Mississippi.

The Commander of the New Orleans garrison was Andrew Jackson, a future President, and generally considered to have been the best American Commander produced by the war. A man of furious energy, not always well applied, Jackson, after initial delay caused defences of a formidable character to be commenced around the previously defenceless city. The work was mainly done under the supervision of Major A. Carrière Latour, a French officer with the American Army, who has left a comprehensive account of his work.

The force allotted to Pakenham numbered in the first instance about 6,000 men. This number was made up of two elements, the force which had been engaged at Washington and Baltimore earlier in the year under General Ross, and a force of Peninsular Veterans which came out from England under General Keane. The expedition formed up at Negril Bay in Jamaica, and set sail for the Mississippi under the command of General Keane, Pakenham and his staff not having arrived. The final approach to the mainland was extraordinarily difficult and, due to the shallow water, involved an 80-mile journey rowed in open boats in heavy rain. The force landed on 23rd and 24th December at the head of Lake Borgne to the east of New Orleans. (See map facing page 223.)

The Engineer Organization

Before following the expedition in its attacks it is of interest to examine the organization of the Engineers with the force. Two companies of Royal Sappers and Miners were present, the 7th of the 1st Battalion and the 2nd of the 4th Battalion. The 7th/1st was commanded by Captain (later Major-General) A. Emmett, R.E., with Sub-Lieutenant Calder, and the 2nd/4th was commanded by Captain (later Colonel) Thomas Blanshard, R.E., with Lieutenant West. Blanshard's company had sailed for America in May, 1814, and had been present at Bladensburg and Washington. Blanshard had been charged with the task of destroying the public buildings of Washington. He was estimated to have done £365,000 of damage.

On 25th October, at sea, Blanshard's company was sixty strong, including two drummers and one sergeant.

When Keane's force from Europe joined Ross's in Negril Bay in November, Emmett's company accompanied them, sixty strong with two drummers and four sergeants. It may be assumed that the organization was not radically different from that put in force from May, 1811, when there were four eight-company battalions of Royal Military Artificers, each with one Sub-Lieutenant and eighty-eight N.C.Os. and privates. The Sub-Lieutenant was an officer promoted from the ranks and the remaining eighty-eight were organized as follows:—

five sergeants (one colour sergeant added later)	six bricklayers
five corporals	four smiths
five 2nd corporals	two wheelers
three drummers	two collarmakers
fifteen carpenters	one cooper
ten masons	thirty miners

It will be seen that both companies were well below strength in sergeants and one month later, 25th December, the total between the two companies had been made up to nine. It is probable that the overall numerical deficiency was due to the fact that the establishment of miners was below strength, there being no great use foreseen for them in this expedition.

The exact amount of engineer stores and equipment actually taken forward is not known and, because of the difficulties of the final approach to the mainland, the bulk cannot have been very great. Some idea of the items provisioned can be gained from a return of engineer stores on board the *Maria*, transport of 241 tons.

Among the 166 different items of stores listed are the following:—

Spades	500	Tool chests	
Shovels, common	1,000	carpenters'	1
Shovels, miners'	500	smiths'	2
Pickaxes	500	collarmaker	2
Mattocks	100	wheelers'	2
Hand hatchets	200	miners'	2
Hand bills	200	Chevaux-de-frize barrels	50
Axes, broad	20	Petards, complete	2
Axes, felling	100	Cartridges, complete, filled	
Saws, hand	100	with 11lb. of powder	4
Saws, crosscut	50	Barrows, wheel	300
Pitsaws	12	Barrows, hand, double	50
Sandbags, bushels	25,000	Barrows, hand, single	200
Forge wagons	4	Earth rammers	100
Chests of tools for do.	4	Ballast baskets	300
Anvils with blocks	4	Carpenters' adzes	46

In addition there were considerable quantities of miscellaneous carpenters' and other tools, nails, screws and spikes, timber, tarpaulins, crowbars, cordage, lanterns and so on.

Unfortunately the *Maria* parted company with her convoy *en route* from Jamaica and did not arrive until the New Orleans attack was over. The *Lively*, transport of 345 tons, did however arrive off Cat Island on 2nd

January with Engineer stores, entrenching tools and medical stores. Unfortunately details of her cargo have been lost. Thus it seems that although the engineer stores position must have been unsatisfactory, it was due to misfortune rather than oversight. That there had been engineer stores planning in consultation with the C.R.E. is demonstrated by a letter from Lord Hill, at one time nominated commander of the expedition, to the C.R.E. designate, dated 9th August, 1814. In this letter Lord Hill requests details of "every arrangement you may think it necessary for us to make for the Engineers Department." He also requests names of R.E. officers selected by the C.R.E. to accompany the force.

The C.R.E. was John Fox Burgoyne, at that time a Lieut.-Colonel, aged 32, with a very creditable record of service in the Peninsula and already a formidable reputation, and he was, as is well known, destined to become one of the most respected and influential officers ever to serve in the Royal Engineers.

Blanshard, commanding the 2/4th Company, has already been mentioned for his part in the Washington attack. He subsequently became well known in the Corps as the inventor of a pontoon. Emmett, who had seen a remarkable amount of active service by 1814, was made C.R.E. at St. Helena during Napoleon's exile and remained in that gloomy atmosphere until Napoleon's death in 1821. The other R.E. officers with the force were Lieutenants Tapp, Reid, Wright, Metson, Elton, Robe, West and Wortham. Nearly all these officers had previously seen a good deal of active service and it is clear that Burgoyne had gathered together a very good team. Reid later became a Major-General and was Chairman of the Executive Committee of the 1851 Exhibition. Wright was killed during the attack.

In addition to the two companies which accompanied the expedition, a third Company, the 8th of the 2nd Battalion with Captain H. D. Jones (later Lieut.-General Sir Harry Jones) and Sub-Lieutenant P. Johnston arrived at the end of February, too late to take part in the operations.

Artillery

At the same time as the C.R.E. was making out his demands for Engineer Stores, the C.R.A., Colonel Dickson, was putting up his proposals for Artillery requirements. In a letter of 5th August he proposed two 9 pdr. brigades (i.e. batteries), two light 6 pdr. brigades, pontoon equipment and a proportion of rockets. In addition he proposed a reserve of one 9 pdr. brigade, three 3 pdr. mountain brigades and one 18 pdr. brigade. The ammunition suggested for the force was 1,500 rounds per gun, 6 million musket ball cartridges and a proportion of rifle ammunition for light troops. The C.R.A. also proposed that for siege operations, were they contemplated, a further four 24 pdrs., six 10-in. mortars, six 8-in. mortars, four 68 pdr. carronades and twenty $4\frac{1}{2}$-in. mortars would be necessary.

In fact the C.R.A. did not obtain exactly what he had asked for, and as far as can be ascertained the following were made available to him.

24 pdr. guns	4	3 pdr. guns	4
24 pdr. carronades	4	8-in. mortars	2
18 pdr. guns	8	10-in. mortars	2
12 pdr. guns	8	$5\frac{1}{2}$-in. mortars	3
9 pdr. guns	2		—
6 pdr. guns	4	Total	41 pieces
400 32 pdr. rockets		100 12 pdr. rockets	

Some of the guns were manned by seamen and some by Marine Artillerymen, although the majority were manned by the Royal Artillery. As the expedition eventually consisted of three brigades, the equivalent of a modern division, it is interesting to compare this quantity of Artillery with that permanently available to an Infantry Division in the 1939–45 War, i.e. 72 × 25 pdrs. alone, apart from mortars, anti-tank and anti-aircraft guns.

Administration

It is not possible to make an exhaustive study of the administrative side of the expedition in a short essay of this nature. Nevertheless, as such aspects are rarely mentioned in the conventional historical studies, it is of interest to examine some of them. Already mention has been made of the supply of Engineer stores and the requirements of the Artillery. Considerable quantities of small arms ammunition were taken. Returns of 2nd September, 1814, show the following loaded, with other items, on four transports.

500,000 rifle ball cartridges	300,000 carbine ball cartridges
1,000,000 musket ball cartridges	300,000 pistol ball cartridges

The supply of clothing and accoutrements was not neglected. The transport *Norfolk* contained, in addition to a proportion of ammunition, a quantity of clothing. This included:—

2,000 red jackets	3,000 forage caps
1,000 green jackets	3,000 prs. gaiters
10,000 prs. shoes	15,000 linen shirts
3,000 waistcoats	5,000 blankets
3,000 trousers	

In addition to this supply a further quantity of clothing, including:—

20,000 prs. shoes	6,000 greatcoats, etc.
12,000 linen shirts	

was sent in October with the Third Brigade under General Lambert.

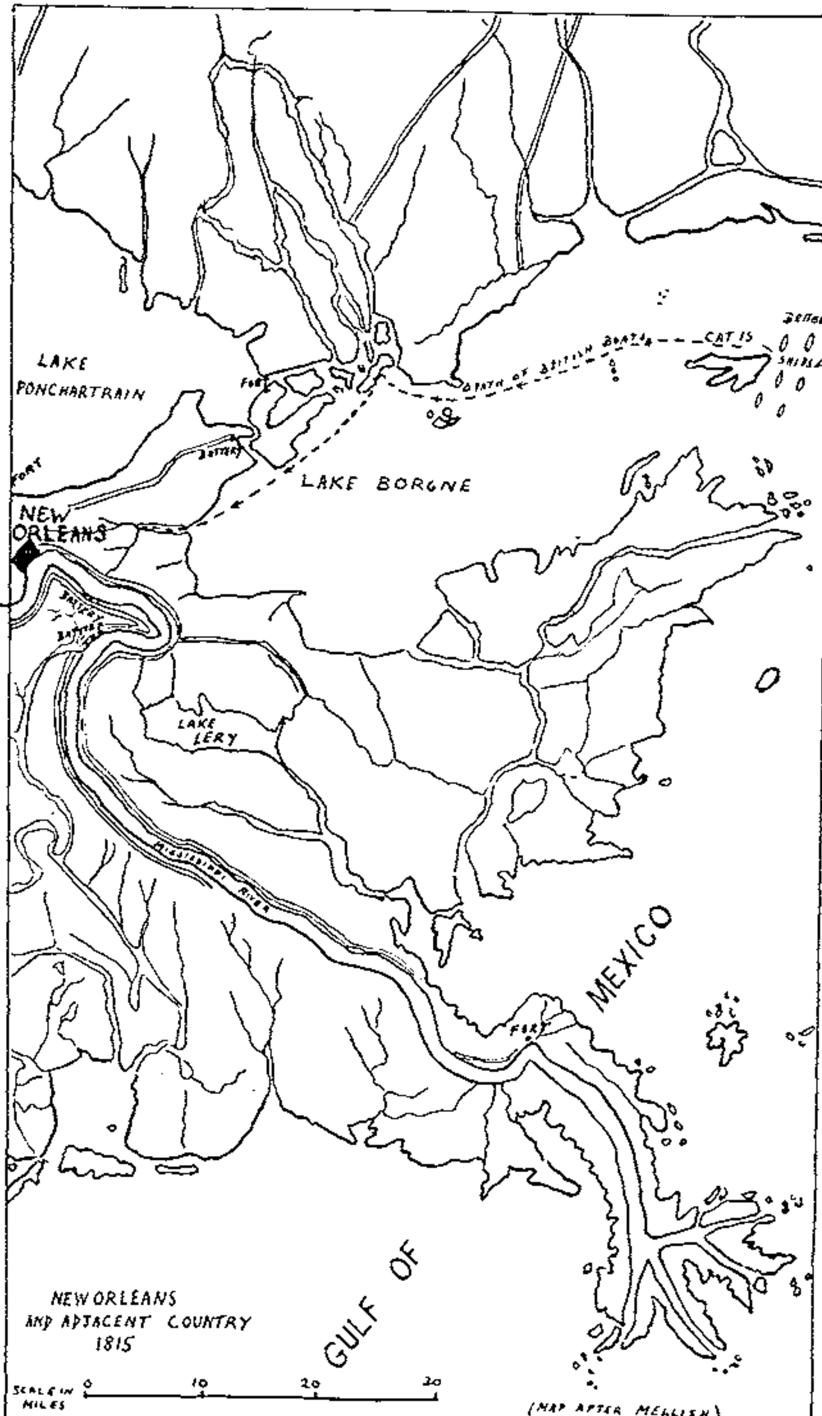
On board the transport *Norfolk* was a supply of "presents for the Indian Campaign to the Southward". I have mentioned this campaign very briefly later. In order to help it along the following items were sent out:—

225 prs. $2\frac{1}{2}$ point blankets	225 pieces cotton calico
85 pieces blue stroud narrow cord	2,380 yards Irish linen
115 pieces blue stroud broad cord	940 hunting saddles
5 pieces red stroud narrow cord	100 dozen looking glasses
12 superfine scarlet uniforms	1,200 Canadian pipe hatchets with handles
50 inferior scarlet uniforms	

Few can fail to be disappointed at the thought that many of the Indian braves, who figured so largely in the literature of their boyhood, rode saddles made in Walsall and used "Canadian" pipe hatchets made in Birmingham!

The Defences of the City

The British intention of making a move against Louisiana had been known or suspected by the Americans for some months before the expedition landed. Although it was reasonably clear that New Orleans would be one of the first objectives, very little had been done to put the defences of that city in good order. General Jackson had been put in command of the 7th Military District, including New Orleans, in June, but he made no balanced appreciation of the situation. He expended a prodigious amount of time and energy dashing



NEW ORLEANS AND ADJACENT COUNTRY 1815

here and there with no very clear idea of what he was about. A most energetic British officer, one Colonel Nicholls of the Royal Marines, had been landed with a small cadre at Mobile in Spanish territory, and was enjoying himself hugely by stirring up the Creek Indians and making small raids and colossal noise. Jackson was stung by Nicholls' enterprise and apparently completely hoodwinked, for he did not return from Mobile Bay until 2nd December, when the British were well on the way and even President Madison had taken to sending frantic messages to Jackson. Until that date lack of confidence in the military and civil power and conflicting opinions on the defensive measures to be taken had led to an almost fatal inaction. There was in fact a state bordering on panic among a great part of the heterogeneous population of the whole State of Louisiana.

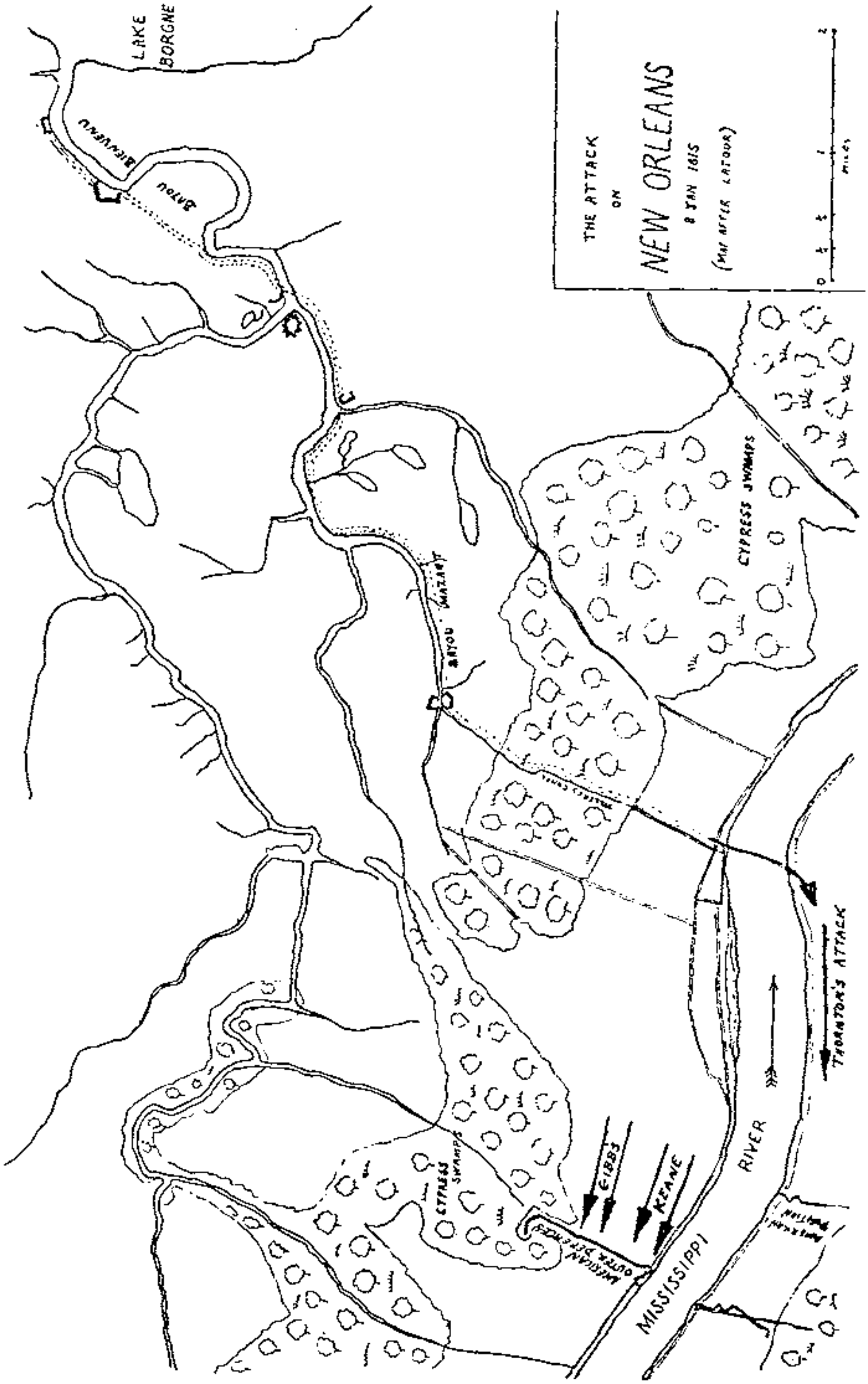
The natural surroundings of New Orleans were in any case a considerable deterrent to an attacking force. Some idea of their swampy nature can be gained from the accompanying maps which show the city situated on the left bank of the Mississippi and between Lake Pontchartrain and Lake Borgne. There were only two roads leading into New Orleans, across a swamp intersected with small canals, known locally as "bayous".

Jackson caused three lines of entrenchments to be thrown up, the outer being about four miles, the second two and a half miles, and the third about a mile and a half in front of the city. The outer and second lines were immediately in rear of Bayous and a new ditch was constructed for the inner line. Also on the opposite or right bank of the Mississippi, a battery of twenty guns was mounted hastily with the intention of covering the ground over which the British must attack the left bank defences. The general layout of the fortifications is shown in the map facing page 225.

The actual number of American troops in the New Orleans garrison has been the subject of much controversy and propaganda, but it seems reasonably certain that there were about 6,000 men under arms by the end of December, 1814. They were a very mixed force consisting mostly of militia, with some Regular Infantry and some Artillery. In addition Jackson had a fourteen-gun schooner, the *Carolina*, and a sixteen-gun sloop, the *Louisiana*. These lay in the river at New Orleans.

The Preliminary Stages of the Attack

As already related, the force under General Keane landed after a journey of immense discomfort and difficulty, on 23rd and 24th December, 1814, at the head of Lake Borgne. The advance guard, consisting of the 85th Light Infantry and 95th Rifles under Colonel Thornton, were the first to land. This they did at the mouth of Villerés Canal (see map page 224) after penetrating some way inland up the Bayous Bienvenu and Mazant. The landing of these two regiments was unopposed and was complete by 10 a.m. on the 23rd, and it appears that the Sappers had already by this time started building bridges over streams and clearing the way for the advance southwards to the bank of the Mississippi. It is known that both Blanshard and Emmett landed with the advance guard, and both the Sapper and Miner Companies were included in the first wave of the landings. By midday, the 4th Regiment had also disembarked and the Sappers had done enough work to allow the column to move south, the total number ashore being now about 1,200. The force proceeded along Villerés Canal, moving at first through a cypress swamp and eventually coming out into an area of enclosed stubble


LAKE BORGNE
BAYOU BIENVENU
BAYOU MAZANT
THE ATTACK ON
NEW ORLEANS
8 JAN 1815
(MAP AFTER LATOUR)
MILES
CYPRESS SWAMPS
THORNTON'S ATTACK
RIVER
MISSISSIPPI
GIBBS
KEANE
AMERICAN OUTER DEFENCES
CYPRESS SWAMPS

fields where the ground became much firmer. After further progress a militia picquet of thirty men, commanded by Villerés himself, was captured in Villerés house and the force then gained the main road running along the river. Between the road and river was an embankment about four feet high.

By this time it was early afternoon. Piquets were posted and reconnaissance parties sent out. No enemy was found within range, and the force therefore halted where it was, between the river and the cypress swamp. The troops were almost exhausted. Foraging parties were sent out, fires were lit and meals cooked. At about 3 p.m. there was an alarm due to the approach of some cavalry. Darkness fell and the camp continued in a state of relaxation. At about seven or eight o'clock the schooner *Carolina* dropped down the river and, having anchored abreast of the British camp, opened heavy fire. Shortly after this the Americans attacked from New Orleans with two columns, one down the road on the left, and one across the stubble fields near the cypress wood, on the right of the British position.

As may be imagined, owing to the relaxation of discipline, there was confusion and panic in the British camp. The situation was only restored with difficulty, aided by the arrival of two more companies, and it was not until the early hours of the 24th that the attack was finally beaten off. The Americans streamed back in disorder. The night became very dark during the attack and there was much savage hand-to-hand fighting. Something over 2,000 casualties were suffered by each side. Emmett, tired and wet as he no doubt was, must have been very annoyed by the night's proceedings. He says in his Journal: "My servant and kit taken by the Yankees."

On the 24th the remainder of the force continued to arrive and the majority were ashore by nightfall of that day. The disembarkation was complete by midday on the 25th, and after some readjustment of positions, the composition was as follows:—

Left	"Advance"	85th Light Infantry
		95th Rifles
		4th Regiment
Centre	1st Brigade	21st Regiment
		44th Regiment
		5th West India Regiment
Right	2nd Brigade	93rd Regiment
		1st West India Regiment

On the same day, the 25th, General Pakenham arrived at last, after considerable adventures in the creeks *en route*. He was accompanied by the C.R.A., Colonel Dickson, and the C.R.E. Colonel Burgoyne. Pakenham had been extremely anxious to arrive before operations started, particularly since he was suspicious of Admiral Cochrane's motives. As he feared, the force was already in a difficult situation and a man of his experience must already have had a forboding of what was to come. One of his first actions was to reorganize the force as follows, preparatory to an advance.

Left Major-General Keane's Brigade consisting of:—

85th Light Infantry
93rd Regiment
95th Rifles
5th West India Regiment
$3 \times 5\frac{1}{2}$-in. mortars
some rockets

Right	Major-General Gibb's Brigade consisting of:—	
	4th Regiment	
	44th Regiment	
	21st Regiment	
	1st West India Regiment	
	four light 3-pdrs.	
	some rockets	
In reserve	2 × 9 pdrs. 2 × 6 pdrs.	To move with General Keane

The remaining guns were placed in battery on the river bank.

In the meantime Colonel Dickson, the C.R.A., had taken steps to eliminate the schooner *Carolina* which continued to harass the left flank of the force. Dickson was well known for his liking for the use of red-hot shot. True to form he had batteries erected on the river bank (probably with the aid of Blanshard's Company) and a rather testy Emmett tells us, "27th: Blew up the American Schooner (i.e. the *Carolina*) with red hot shot from brass field guns, which ought to have been done sooner . . ." (191 rounds of shot were expended on this task). The American sloop, *Louisiana*, did however escape damage by shifting her position.

The First Attack

Finally, on the 28th December, a forward move, more in the nature of a demonstration or reconnaissance in force than a well planned attack, was made. The two brigades made an advance of some three miles to within 800 yards of the partially finished American position.

The Americans opened heavy fire, particularly on the British left which was exposed to the fire of the sloop. Pakenham, after consultation with Burgoyne, decided that the position could not be taken without more artillery and more detailed preparation, and withdrew to a line about two miles from the enemy. This did much to lower morale and Pakenham was undoubtedly wrong in advancing the whole force if his intention was merely to make a visual reconnaissance with the C.R.E. In any case the American position cannot have been very strong, considering that it was only started in earnest on 25th December. Although the bayou in front of it may have appeared very formidable, Captain H. D. Jones, R.E., who examined the defences subsequently, stated that it was filled with large brambles which would have helped fascines or ladders put over it. The British casualties were less than fifty killed and wounded.

The Second Attack

Eight 18-pdr. guns and four 24-pdr. carronades were brought forward from the ships to reinforce the light artillery already in position. The movement of the guns was a most arduous task owing to the lack of proper transport facilities. Moreover, although enough ammunition had been provided for the expedition, all the cartridges had to be remade, probably owing to the wet conditions. This severely limited the subsequent availability of ammunition. The guns having been brought forward, and sixty-eight rounds per gun and eighty rounds per carronade having been prepared by the 31st December, six batteries, including two rocket batteries, were erected. The batteries, within 500 yards of the enemy defences, had to be erected between

8.30 p.m. on 31st December and 5.45 a.m. the following day, and so were constructed in great haste, of sugar casks filled with earth not rammed, one cask in thickness and "backed up". The batteries were only one cask in height and so gunners were exposed head and shoulders while serving the guns. "The platforms were very ill-laid, uneven, and unsteady." It seems that Emmett was employed on this very difficult and hurried task.

Fire was opened from these positions at 8 a.m. on New Year's Day, 1815. The four days which had elapsed since the 28th had enabled the Americans to complete strong batteries. The American guns were served admirably and their heavy shot penetrating the flimsy British batteries, caused heavy casualties. Soon the British ran out of their meagre ammunition supply and were silenced. Thus, as the attacking artillery had failed to destroy any part of the American position (which had on the contrary become stronger) the infantry did not attack and were once more withdrawn. The majority of the British artillery was withdrawn in the night under conditions of great difficulty.

This second retirement must have had the effect of further lowering the morale of the Army. Since the first day of the landing there had been constant activity by American patrols. In addition there had been steady harassing fire from the *Carolina* until she was destroyed, and from the *Louisiana* subsequently. Guns landed on the right bank of the Mississippi also kept up constant fire on the British left flank. The rations were poor and the weather was bad. Most important of all, it seems that Pakenham on arrival had openly expressed forcible views on the situation of the Army in general and upon Admiral Cochrane's part in it in particular. These views were repeated around the camp.

Preparation for the Final Attack

Pakenham now decided that he could only succeed by enfilading the American positions from the right bank of the river, that is by an encircling movement from the British left. Before renewing his attack he decided to await the arrival of reinforcements under General Lambert. Lambert had originally been ordered out to Bermuda on the news of the British success at Washington, and had eventually been ordered to join the combined force before New Orleans. He landed with the 7th Fusiliers, the 43rd Regiment, a squadron of the 14th Light Dragoons, and a Company of Staff Corps on 6th January. The Brigade was about 1,700 strong.

As already mentioned, Jackson, in addition to erecting defences on the left, or New Orleans bank of the Mississippi, had also erected a twenty-gun battery on the right bank of the river, and it was considered that the attack could not be successful without subduing this battery, as the Royal Navy were unable to advance up the river from the sea. Admiral Cochrane suggested that Villerés Canal be widened and extended so that the boats could be brought up to the left bank via the Bayou Bienvenu. A column could then be carried across to the right bank to attack the American battery. The Admiral's suggestion was adopted and the Engineers now had the following main responsibilities:—

(i) The completion of a road some eight or nine miles long, from the junction of the Bayou Bienvenu with Lake Borgne to the British H.Q. near the bank of the Mississippi. This road had been given a high priority by Pakenham on his arrival, but it had not been completed by the beginning of

January. It was in fact a most difficult task as the ground was extremely soft and needed skilful draining. Heavy rain and high tides added to the difficulties. A large number of stream crossings had to be constructed and fascines of reeds were laid the whole length of the road.

(ii) The widening and extension of Villerés canal up to the Mississippi and the construction of a dam to contain the water in the canal once the river bank was breached. This undertaking involved immense labour, but by employing infantry working parties day and night it was finished on the 6th, apparently to the satisfaction of the Naval officers whose boats were to use the canal.

(iii) The strengthening of existing batteries and the construction of new ones to cover the advance. Owing to the necessity for surprise the new batteries were constructed, as before, during the night previous to the attack. Emmett seems again to have been employed on this task.

The Plan of the Final Attack

The force detailed to cross the river on the left was under command of Colonel Thornton of 85th Light Infantry.

It consisted of:—

85th Light Infantry,	Strength 300
Royal Marines,	Strength 200
Seamen,	Strength 200
5th West India Regt.,	Strength 200 (?)
9-pdr. guns	2
Mortars	2

This force was to cross the river in ships' boats dragged into Villerés Canal in readiness; it was to take the American battery on the right bank and to turn its guns on to the American flank. This was to be completed by dawn, at which time the main frontal attack was to take place.

The main frontal attack was to be made on the right by the 2nd Brigade under Major-General Gibbs. On Gibbs's left, the 3rd Brigade under Major-General Keane was also to attack frontally. The 1st Brigade under Major-General Lambert was to be in reserve.

The allocation of troops on the left bank of the Mississippi, i.e., the British right was therefore as follows:—

Left

3rd Brigade	Major-General Keane		
(*a*) *Left*	The Light Companies of the	7th Fusiliers 43rd Regiment 93rd Regiment	under Colonel Rennie
	100 men of the 1st West India Regiment		
(*b*) *Right*		93rd Regiment 1st West India Regiment 95th Regiment (two companies)	

Right

2nd Brigade	Major-General Gibbs	4th Regiment 21st Regiment 44th Regiment 95th Regiment (three companies)

Reserve		
1st Brigade	Major-General Lambert	7th Fusiliers 43rd Regiment

Colonel Thornton's Attack

The canal having been completed sufficiently, between forty-two and fifty ships' boats were brought up it on the 7th and dragged to within a short distance of the Mississippi, opposite Villerés house. A dam was then constructed behind the sternmost boat. The movement of the boats was apparently observed by the Americans and reported to Jackson, but little or no action was taken by him despite the obvious threat to the isolated American battery on the right bank.

The time fixed for crossing was 9 p.m. on the 7th and Thornton's force accordingly arrived at the river bank ready to embark exactly on time. However, it was not until 1 a.m. on the 8th that the boats started to arrive at the Mississippi, and it was not until about 5 a.m. that sufficient boats had arrived to embark a reasonable number. Thornton, who was a courageous and resolute commander, decided to carry on with a reduced force and accordingly set out with only the 85th and one hundred seamen and marines, a total of about 400 men. The party crossed the river safely and half an hour after landing put an advanced party of Americans to flight. Coming upon the redoubt which was held by the American General Morgan, Thornton attacked and after a little or no resistance the garrison, largely Kentucky troops, fled, leaving the British in possession. The British casualties were eighty-three killed and wounded. Blanshard, now a major, was mentioned in dispatches for his services.

This success had placed Jackson in a most difficult position and caused great alarm in the American camp. However, as will appear, the course of the main attack was soon to relieve the American anxiety.

The Frontal Attack

The frontal attack was to be made at dawn on the 8th, and Pakenham waited in suspense for the prearranged rocket signal which was to signify the success of the boat party in taking the right bank battery. As already explained, this party had been seriously delayed and so Pakenham waited in vain.

He was now in a serious dilemma. This was to be the third attempt on the American position and he was loth to call off the attack. Accordingly he delayed as long as possible, with his assaulting troops on the start line waiting for the order to advance.

As the dawn broke and no welcome rocket signal came, he was left with no alternative but to attack, for the troops had they retired would have been caught in daylight retreating from their assault positions. The order to advance was therefore given and a signal rocket fired.

General Gibbs's 2nd Brigade went forward on the British right, with the 21st Regiment leading and the 4th in support. The 44th Regiment under Lieut.-Colonel Mullins had been detailed to carry fascines and ladders for the assault, but for one reason or another this battalion, which was undoubtedly undisciplined, was not in its proper place at the right time. A detachment of Sappers accompanied the Brigade, but no details are available of its organization or specific tasks.

The Brigade soon came under heavy fire, both from New Orleans and the right bank battery. The heavy casualties caused the attack to waver, indiscriminate firing commenced and panic began to set in. Despite this, a number of the 21st reached the entrenchments, but owing to confusion among the 44th no fascines or ladders were at hand and although a few men managed to scramble across the ditch and up the earthworks, this penetration was not followed up and all chance of success by the Brigade was lost. The panic in the main body soon spread. Gibbs was killed as he tried to rally his troops. Pakenham rode over and made a further effort to maintain the advance, but he too was killed. The Brigade streamed away to the woods on the right, a disorderly rabble.

Keane's Brigade on the left fared rather better at first. The left half consisting of the three light companies under Lieut.-Colonel Renny advanced boldly and penetrated the redoubt on the extreme right of the American line. The right half Brigade, including the 93rd, should have been available to exploit this success, but had become completely out of position during the battle and were situated a considerable distance to the right of Gibbs's Brigade, where they were halted in close column under enemy fire until 500 of them were killed. Renny had no possibility of exploiting his success and fell back. Renny himself was killed and Keane was wounded. The command now devolved upon Lambert and he ordered a withdrawal out of range.

The situation just before the withdrawal is shown in the lithograph frontispiece. This lithograph was "Drawn on the field of Battle" and painted by "Hth Ladotte Archt and Asst. Engineer in Louisiana Army the year 1815". It seems to be reasonably accurate. The Mississippi is shown in the foreground with the American positions to the left and the British attacking from the right. Representations worthy of special notice are those of Lieut.-Colonel Renny being struck down (left foreground, Renny with sword in one hand, pistol in the other and right foot on a scaling ladder) the, body of Pakenham being borne off the field, the confusion on the British right and centre, with scaling ladders scattered all over the battle-field, and Andrew Jackson and his staff in a well formed group round the American flag in the left foreground.

Lambert called a Council of War in a small cottage near by to determine the action to be taken. Just as it met news came of Thornton's success across the river. Thus some of the most devastating enemy fire had been silenced and it would have been possible to renew the attack with a fair prospect of success. However, the troops taking part in the main attack had been badly shaken, having lost 1,750 killed, wounded and missing out of 3,000. Further, the newly taken battery on the right bank seemed to some to need considerable reinforcement to make it secure. A fog was now coming up which increased the isolation and apparent insecurity of this position.

There was a strong body of opinion for calling off the attack altogether. Colonel Burgoyne the C.R.E. had some support, however, for wishing to press home the advantages gained and there seems to be little doubt, that had the attack been resumed, Jackson would, on his own admission, have been forced to retreat. Nevertheless, with the information available to them, the majority of the Council of War were for calling off the attack and so the decision was taken to return the whole force.

A flag of truce was sent to Jackson asking for suspension of hostilities to collect the wounded and bury the dead, and Thornton's force was withdrawn from the right bank, Colonel Dickson, the C.R.A., being dispatched for the latter duty.

The Retirement and Embarkation

During the advance, men and a great quantity of stores had been brought as far forward as possible by boat, following the creeks as already described. However, owing to the shortage of boats and the critical situation it was considered essential to withdraw the whole force by land as far as possible and then withdraw further by boat.

This involved further heavy work on the road from the junction of Bayou Bienvenu with Lake Borgne, which has already been described. Few details of the road are available except from American sources. Latour describes bridges as being built over a number of small streams and also two boat bridges, over larger confluences. At various strategic points on the road entrenchments were constructed.

It was not until the 18th January that work had progressed sufficiently for the force to retire and so on the night 18th-19th the withdrawal took place to the mouth of the Bayou Bienvenu.

The men were exhausted and by what Fortescue describes as a "miracle of imbecility" the boats which arrived to take them off had brought no food, other than that for the crews. The West India Regiments and the 44th were taken off, the remainder waiting for a further two days until the boats could return from their 160-mile journey, bringing rations, and taking off more of the force. The re-embarkation continued until the end of the month, by which time all were aboard their ships. During the waiting period earthworks were constructed but the enemy did not attack.

An additional hardship was the lack of fuel, reeds being the only combustible material available.

General Comments and Conclusions

The most important comment must inevitably be that the operations had all taken place after the official cessation of hostilities, for peace preliminaries had been signed at Ghent on 14th December, 1814, ten days before General Keane had landed at the head of Lake Borgne. In the days before telegraphy such occurrences were not unknown and could hardly be avoided. However, it is alleged also that Admiral Cochrane omitted to inform General Lambert of the cessation of hostilities until some time after the fact was known to him and there was certainly a quite unnecessary delay in returning the men to Europe, where they were urgently needed.*

Whatever may be said, and much has already been said by many writers, against Admiral Cochrane's influence on the mounting of the expedition and his reasons for wishing New Orleans to be taken, there is no doubt that the decision to make the expedition was taken without his opinion and either before, or about the same time as he took over command of the station. There

*On 26th February, 1815, Napoleon set out from his exile in St. Helena and set in motion the events which led to the battle of Waterloo in June, 1815. The Sappers and Miners of the force did not embark on the *Hyperion* from Dauphin Island until March and did not arrive in Woolwich until June. None of them took part in the Waterloo campaign.

is no doubt, however, that he encouraged the authorities at home to believe in the feasibility of the enterprise and that his dispatches encouraged them to continue in their plans. In my opinion he was correct in his appreciation of the insecurity of the whole area, and the success of Colonel Nicholls' force of Marines with the Creek Indians in causing "flap" among the Americans was a fairly reliable guide to the much greater "flap" which was caused when the expedition, even though much publicised, actually landed. I believe that had the force been boldly led, a quick and decisive victory could have been obtained. The force was defeated however and a number of important lessons may be learned therefrom.

Tactical Lessons

1. The Commander was not appointed, for a variety of reasons, until far too late, and two brigades set sail from Jamaica, landed on American soil and had the first encounter with the enemy before he arrived from England. This was a fantastic state of affairs and naturally led to delay once Pakenham took command, particularly as his C.R.A. and C.R.E., both first-class officers, arrived with him and were also ignorant of the situation. Most readers have no doubt read Field -Marshal Montgomery's opinions on the late appointment of commanders under such circumstances.

2. An expedition such as this, which was in reality a large raid, cannot delay even for an instant. By the time Pakenham arrived there had already been sufficient delay. Even a small force, resolutely commanded by such a man as Thornton, would probably have taken New Orleans on the 23rd or 24th December.

Once Pakenham had arrived he wished to regroup the force, which was reasonable enough, but the forward move which took place after three days, on the 28th, looks like the sort of dithering which has caused many a senior officer to lose his command. It is clear that *Carolina* and *Louisiana* were a major difficulty. The *Carolina* was, it is true, blown up on the 27th, but many casualties were caused by the *Louisiana* in the attack of the 28th, and it appears that the fire of the sloop was one of the main reasons why the line had to be withdrawn once again. Really energetic action should have been taken to get rid of both vessels at the very beginning.

3. The second attack, on the 1st January, which was made with a certain amount of artillery support from positions prepared overnight, was an inevitable failure. The blame must be given to Pakenham, his C.R.A. and C.R.E. In the first place it was obvious that the American defences were very much stronger than on the 23rd, whereas the British positions were much the same, with the addition of a few field guns in pitifully inadequate batteries. Secondly, the artillery ammunition available was inadequate owing to the necessity of remaking the cartridges. Thirdly, the morale of the force was declining rapidly. Pakenham himself had contributed to this by expressing for all to hear, his views on the lamentable situation of the Army and upon Admiral Cochrane. A commander who himself spreads despondency cannot hope to win. It is not known what views Burgoyne and Dickson expressed on the suitability of the batteries and the adequacy of the ammunition supply, but there is no doubt that they should have seen the doubtful wisdom of the attempt at a direct frontal assault with the forces at the Commander's disposal.

4. The third and final attack, with the reinforcements provided by General Lambert's Brigade, should have been a success. Some such plan, if carried out two weeks previously, would undoubtedly have succeeded. The plan decided upon, however, although bold, was too complex in view of the communications available. The success of the enterprise depended in the first place upon the cutting of the canal and the successful passage of the boats through it and across the Mississippi. Undoubtedly the canal cutting was a difficult proposition owing to the tides, but the fact must be faced that the Engineers were ultimately responsible for the success of this part of the operation and they failed to carry out their part of the job properly. The part played by Naval officers in this fiasco is not entirely clear, although they too had fingers in the pie.

5. As already explained, Pakenham had a most difficult decision to make when dawn arrived on the 8th January and no signal had been received from Thornton. It is to his credit that he took the decision to advance. Through his staff, however, he was ultimately responsible for the failure of the 44th Regiment under Mullins to get the fascines and ladders to the right place at the right time. The assault failed and the C.O., Mullins, was made the scapegoat, court-martialled and cashiered. I have not, unfortunately, been able to trace the proceedings of his court-martial, their place in the Public Record Office being occupied by a summary only. I believe that they would show the Staff and Engineer organizations to have been defective. It is difficult to see how a failure like this could have occurred without the Engineers being in some way implicated. Perhaps some reader can throw more light on the matter. It is unfortunate that Burgoyne's diaries, usually so full of detail, are very sketchy on New Orleans. There is, however, the undisputable testimony of Sir Frederick Stovin as related in Chapter I of the Corps *History* that Burgoyne was for pressing home the attack at the eleventh hour when the news of Thornton's success was received, and he can therefore be acquitted of half heartedness here, as indeed always. The lesson then is one which has been well learned this last 130 years. A deliberate divisional attack by all arms can only be undertaken successfully by a well trained formation with a well trained staff and in which there is complete mutual confidence between the various arms.

6. It is notorious that decisions taken by councils and committees are rarely bold and decisive. The Council of War held by Lambert just as news of Thornton's success arrived was no exception. In difficult circumstances military action can only be brought to a successful conclusion by the force of will of the Commander.

7. There are two main lessons to be learned from the Americans. First comes their neglect of the defences of the city until the eleventh hour. This very nearly lost them New Orleans. In the second place there was Jackson's complete failure to harass the British as they withdrew. He anticipated further attack and thought it prudent to make preparations against it. So he, like the British, failed to follow up the advantage which was his and which might have given him a great victory. As it was, Jackson's failure enabled the British to take Fort Bowyer in February and make a serious threat against Mobile, which was only averted by the arrival of news of the Treaty of Ghent.

ADMINISTRATIVE LESSONS

1. It is fashionable in some quarters to suppose that Administration was non-existent in the British Army until an interest was taken by certain ladies and gentlemen during and after the Crimean War. I have given enough facts to show that this, in general, is incorrect as far as the New Orleans Expedition is concerned, but there were nevertheless a number of blunders.

2. The supply and distribution of rations was entrusted to a Naval officer of doubtful competence, Captain Codrington, and the force was undoubtedly ill fed for most of the time. On the other hand I cannot find justification for Fortescue's statement that "the total quantity of supplies in the fleet did not exceed one months store". According to a return of 20th January, 1815, four Army victuallers arrived off Cat Island with a convoy of ships from Cork via Jamaica on 10th January.

3. It has already been shown that the supply of ammunition had been taken seriously. The lack of ammunition for the guns before New Orleans appears to have been partly due to defects. It is not unreasonable to suppose that these defects were due to damp both on the journey and ashore. Even today we have not solved every problem caused by the effect of climatic conditions on equipment, and so ammunition difficulties may be partly excused. However, the shortage was also due to the lack of boats to carry the ammunition from ship to shore, and this lack of sufficient boats seriously hampered all phases of the operation. Fortescue gives Admiral Cochrane the blame for this, but here again bad staff work by the Army Staff must be suspected.

4. The C.R.A., Colonel Dickson, is quoted in *The History of the Royal Artillery*, Volume II, as saying "with respect to our own ammunition and stores great quantities of articles have been sent that are perfectly unnecessary and have never been demanded, whereas others greatly required have never been sent although demanded." Undoubtedly Dickson had much to complain of and the Artillery even more than the Engineers were suffering from the effects of being controlled by the Office of Ordnance and serving a different master from the rest of the Army. This was not corrected for many years.

Celebration of the 50th Anniversary of the Granting of the Title "Royal" to the Corps of Australian Engineers

By LIEUT.-COLONEL D. CAMERON, C.I., S.M.E., R.A.E.

On the 19th November, 1907, the Corps of Australian Engineers was granted the privilege of the prefix "Royal". On the 21st and 22nd November, 1957, the Royal Australian Engineers celebrated the fiftieth anniversary of this event.

The celebrations were held at the School of Military Engineering, Casula, where the Corps was honoured by a visit from the Governor General of Australia, His Excellency Field-Marshal Sir William Slim, G.C.B., G.C.M.G., G.C.V.O., C.B.E., D.S.O., M.C., K.St.J.

Representatives of the Royal Australian Engineers from all commands, regular and C.M.F., officer and other rank, servicemen and ex-servicemen, started to assemble at the S.M.E. on the 21st November. That night, commemorative dinners were held in the R.A.E. Sergeants' Mess and the Sappers' Mess. The Representative Colonel Commandant, accompanied by the Engineer-in-Chief and the C.Es. and C.R.Es. of each command visited both dinners.

November 22nd was the day for the main celebrations and for His Excellency's visit. The form of celebration was planned along similar lines to that for Her Majesty's visit to the Royal Engineers at Chatham, and it was somewhat amusing to see in certain aspects just how close this similarity was—even to the single press car, filled with photographers, appearing unexpectedly and most inconveniently just before the arrival of His Excellency.

It was a hot dry day with brilliant sunshine and His Excellency's arrival down Chatham Avenue was a stirring spectacle enhanced by the colour of the full Royal Escort of motor cyclists drawn from Eastern Command Provost Company and 1 Infantry Brigade Provost Platoon wearing No. 1 ceremonial dress with white accoutrements.

The Governor-General was received at the Corps War Memorial by Lieut.-General R. G. Pollard, C.B.E., D.S.O., the General Officer Commanding Eastern Command, who presented the official party:—

The Honourable J. O. Cramer, M.P., Minister of State for the Army.

Major-General R. E. Wade, C.B.E., Adjutant General.

Major-General L. G. Canet, C.B.E., Master General of Ordnance.

Brigadier L. C. Lucas, D.S.O., O.B.E., M.C., V.D., Representative Colonel Commandant, R.A.E.

Brigadier P. P. Jackson, A.D.C., Engineer-in-Chief.

Lieut.-Colonel I. D. Cameron, Chief Instructor, S.M.E.

After these presentations His Excellency moved forward to the front of the Guard of Honour which, with the R.A.E. Band, was drawn up at the corner of Ripon Road and Chatham Avenue facing the memorial. The guard, commanded by Captain G. J. Jenkinson was provided by 7th Independent Field Squadron.

Having been received by a royal salute, His Excellency, attended by the Representative Colonel Commandant, inspected the guard and the R.A.E. Band. On completion of this inspection His Excellency laid a wreath on the Corps War Memorial then escorted by the Representative Colonel Commandant, and followed by the official party, moved on foot to the R.A.E. Officers' Mess.

En route to the mess, a party of sixteen warrant officers, non-commissioned officers and rank and file, representing regular and C.M.F. units of the Corps throughout Australia, were presented to His Excellency by W.O.I H. B. Laxton, R.S.M., S.M.E.

His Excellency was met, on arrival at the R.A.E. Officers' Mess, by the President of the Mess Committee, Major H. G. Mahalm, who conducted him into the mess ante-room where the officers were assembled. Prior to lunch twenty-five senior officers were presented to His Excellency by the Engineer-in-Chief. Amongst those presented was Captain H. F. Ransom (R.L.) who first joined the Corps in 1893 and has since served in the Boer War and both World Wars.

Seventy officers of all ranks, drawn from all Commands from the Active List, Reserve of Officers and Retired List, dined with His Excellency, Colonel M. W. Biggs, O.B.E., R.E., representing the Chief Royal Engineer.

After luncheon a demonstration was presented showing a representative number of the Corps activities and this took the form of a mobile

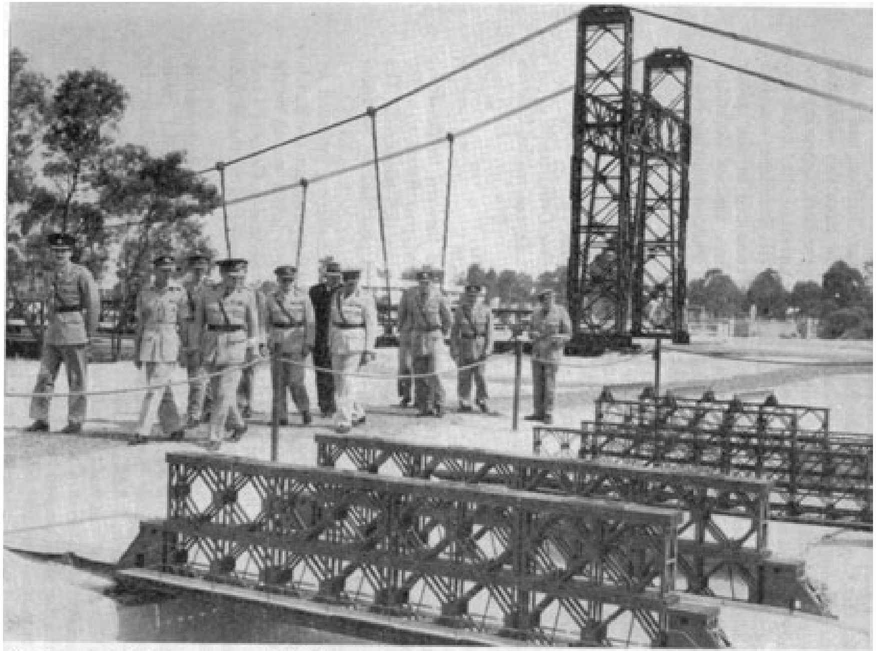


Photo 1.—The official party inspects the bridging display from left to right:—
Major M. A. P. Mitchell, Coldstream Guards, A.D.C. to Governor-General; Major P. S. Codde, O.C. Bridging Troop, S.M.E.; Brig. P. P. Jackson, Engineer-in-Chief; His Excellency the Governor-General, Field-Marshal Sir William Slim; Lieut.-Col. I. D. Cameron, C.I., S.M.E.; Lieut.-Gen. R. G. Pollard, G.O.C., E. Comd.; Right Honorable S. O. Cramer, Minister for the Army; Brig. L. C. Lucas, Colonel Commandant; Lieut. (T/Capt.) A. M. Orr, P.A. to G.O.C.-E.-Comd.; Maj.-Gen. L. G. Canet, M.G.O.; Maj.-Gen. R. E. Wade, Adjutant General.

Photo 2.—Sappers in the uniform of the late nineteenth century operating a ropeway.

demonstration and a static display. For ease in marshalling and traffic control, all spectators were moved by bus to the mobile demonstration area during which time the vice-regal and official party were conducted through the static display which was set up in the "dry gap" area.

His Excellency was first conducted through the bridging exhibit which included a Bailey bridge, Bailey suspension bridge, extra widened Bailey bridge and a heavy girder bridge together with several examples of improvised bridge construction, designed to show different methods and techniques. His Excellency appeared very interested in a jungle type suspension bridge of light steel wire rope and saplings, which possibly brought back memories of Burma. In addition to these full sized equipment bridges, there was also a display of models to show the various types of construction for each.

His Excellency then visited the Transportation Training Centre's display which showed the various facets of the transportation and movement control services and, of course, included many railway models—some static, some working—greatly to the delight of the boys between 6 and 60 who viewed them later in the afternoon. The vice-regal and official parties were then conducted through a works display featuring modern methods of concrete mixing, transporting and placing, and from there to a display embracing electrical and mechanical equipment and field engineering. Here were displayed portable cool rooms, ice-making plants, distillation units, generating and welding sets and from the field engineering side—a brigade water point, a demolition and mine-warfare exhibit including "Tiger", an uncanny mongrel mine dog. A further exhibit of pneumatic tools and bomb disposal equipment completed this particular stand.

At the conclusion of this visit to the static display, the official party was escorted to the mobile demonstration area while the Engineer-in-Chief presented to His Excellency a group of other ranks who had been responsible for the work, erection and manning of this static display. After these presentations His Excellency, attended by the Engineer-in-Chief, drove to the mobile demonstration area where he was received by a royal salute from the R.A.E. band and his standard broken above the vice-regal box.

This mobile demonstration area, better known as the "dust bowl", had been completely reshaped into the form of a large arena for this event. Two gravel circuit roads had been built round the perimeter and a large dry gap constructed for a bridge demonstration. Two banked earth grandstands had been built to accommodate 1,000 spectators and on the top tier of the first of these grandstands, a striking but simple vice-regal box of contemporary design had been built by the 17th Construction Squadron.

His Excellency then proceeded with the investiture of the George Medal to Lance-Corporal R. T. J. Eggington of the 9th Field Park Squadron and the British Empire Medal to Warrant Officer Class II W. T. Royal of the 17th Construction Squadron. His Excellency commended Lance-Corporal Eggington for his gallantry which earned this decoration, when at great risk and although injured himself, he stopped a runaway bulldozer and saved its unconscious driver from serious injury or death.

The first item presented was a bridging demonstration. Detachments from 7th Independent Field Squadron and S.M.E. constructed a bay on a heavy girder bridge using the latest type of bridging crane and on an extra widened Bailey bridge using fork lift trucks. Both bridges were then boomed out across the gap. Whilst this was in progress, to illustrate the improvisation of the ubiquitous sapper and to give a link with the past, a further detachment from 7th Independent Squadron, dressed in the uniform of the latter part of the last century, constructed an aerial ropeway and carried a small Howitzer across the gap. They carried on their demonstration of improvisation by then manning the gun and producing a remarkably realistic fire affect—much to the consternation of spectators who were close to the simulated shell bursts. At the conclusion of this item a demonstration of minelaying was given by the Field Engineering Troop, S.M.E., showing the comparison between hand laying and the mechanical mine layer.

The next item showed the importance of the sappers' tasks in the maintenance of communications and was introduced on an historical note by tracing the development of sapper roadmaking equipment from the horse-drawn scoop of World War I, through the light dozers and graders of World War II to the heavy earth-moving equipment in common use today, and included a demonstration by the Howard soil stabilization "train".

Similarly the sapper's role in excavating and providing field defences was shown by comparing sappers in period uniform constructing a sap under the cover of moving fascines to modern excavators, earth augers and similar digging devices.

Heavy earth moving equipment formed the final item, and equipments currently in use in the Corps were displayed, including large rear and bottom dump trucks, a range of light and heavy dozers, both tracked and wheeled, and a series of five different types of motorized scrapers.

As a finale the massed bulldozers and graders, which had by this time formed a line across the arena, advanced slowly forward in line while the heavy wheeled equipment drove past the official stand. His Excellency commented that he had seen many types of parades, in many places in the world, but never before had he seen an "Advance in Review Order" by a fleet of bulldozers.

At the conclusion of the Demonstration the Chief Instructor, S.M.E., presented to His Excellency a group of officers and other ranks who had been responsible for the over-all planning and presentation of the day's activities or had taken a leading part in the mobile demonstration. Those presented were:—

Major H. J. C. Nicholls, Staff Officer responsible for planning and coordination throughout celebrations.

Major D. R. Eales, R.E., Officer responsible for both preparation and presentation of both mobile demonstration and static display.

Major I. K. Miller, Officer responsible for all administration and ceremonial aspects of celebrations.

Major R. Pugh, O.C. mobile demonstration.

W.O. J. J. Scott, Sapper N. B. Lovelace, members of Plant, Roads, and Airfields Troop, S.M.E., both of whom had played a significant part in the presentation of the mobile demonstration.

After these presentations had been made His Excellency, attended by Representative Colonel Commandant, left by car for the R.A.E. Officers' Mess followed by the remainder of the official party. As His Excellency's car moved off a Royal Salute was played by the R.A.E. Band and his standard was struck above the official stand.

Whilst the vice-regal and official party had afternoon tea in the Officers' Mess, prior to their departure from the area, the spectators were conveyed by buses to the static display area where, after having inspected the exhibits, they were served with afternoon tea.

His Excellency, followed by the majority of the official party, left the S.M.E. area from the R.A.E. Officers' Mess informally after afternoon tea. The spectators were then marshalled on the parade ground for a presentation of the sunset ceremony by the R.A.E. Band, the guard being supplied by 7th Independent Field Squadron. The salute was taken by the Representative Colonel Commandant attended by the Engineer-in-Chief and the Chief Instructor S.M.E. The guard dressed in No. 1 ceremonial uniform and the band in scarlet, presented a colourful spectacle against the setting sun as the Corps flag was lowered to the notes of Retreat.

At this stage the Officers' Mess, Sergeants' Mess, and Sappers Club were open so that members of the Corps present could entertain their guests in true Sapper tradition.

That night a Corps Dinner was held in the R.A.E. Officers' Mess, attended by some 150 officers on the Active List, Reserve of Officers and Retired List. After the port had been passed the Engineer-in-Chief read the following signals:—

"To:—Engineer-in-Chief
From:—Chief Royal Engineer

Corps of Royal Engineers send hearty congratulations and best wishes to all members past and present Royal Australian Engineers on celebrating 50th Anniversary of the granting to them of the title 'Royal'."

"To:—Engineer-in-Chief
From:—Chief Engineer New Zealand Army

On the occasion of the celebration of the Golden Jubilee of the Corps of Royal Australian Engineers, the Corps of Royal New Zealand Engineers offer their heartiest congratulations and best wishes for second half of the century."

The Engineer-in-Chief also read the signal which had been sent that day, to Her Majesty the Queen, Colonel-in-Chief, Royal Australian Engineers:—

"To:—Her Majesty the Queen, Colonel-in-Chief, Royal Australian Engineers
From: Brig. L. C. Lucas, D.S.O., O.B.E., M.C., V.D., Representative Colonel Commandant Royal Australian Engineers.

The officers and men assembled at the School of Military Engineering to greet the Governor General Field-Marshal Sir William Slim, G.C.B., G.C.M.G., G.C.V.O., G.B.E., D.S.O., M.C., K.St.J., at the celebration commemorating the 50th Anniversary of the granting of the title 'Royal' to the Corps of Australian Engineers (permanent military forces) desire to express their loyalty and devotion to Your Majesty and to wish you long life, health and happiness."

Subsequent to the Demonstration, the following signal was received by the Representative Colonel Commandant:—

"From:— Buckingham Palace
To:— Brig. L. C. Lucas, Representative Colonel Commandant, Royal Australian Engineers.

I send my sincere thanks to the officers and men of the Royal Australian Engineers assembled to celebrate this 50th Anniversary of the granting of the title "Royal" to the Corps. My sincere thanks for their kind message of loyal assurances and good wishes which I deeply appreciate.

Elizabeth R., Colonel-in-Chief"

All conceded the celebration to be a success and prior to his departure from the mobile display area, His Excellency congratulated the Corps on its performance that day and directed the Chief Instructor S.M.E., who had been responsible for the planning and presentation of the programme, to pass on to every man concerned with the day's efforts, in whatever capacity, his congratulations for a good job well done.

The interstate representatives moved out on Saturday, 22nd November to their home states and units, leaving S.M.E. and 7th Independent Field Squadron the task of dismantling and clearing away, a task made much lighter by the warm greeting of the Colonel-in-Chief and the congratulations of His Excellency.

Trade Training

By Lieut.-Colonel J. M. Montrésor, R.E.

"Men of the producer trades MUST receive training and practice at their trades as an essential part of the annual training cycle of every R.E. unit."

("*Engineer Training*", *Section 26*)

It is suggested that, too often, trade training lacks the officer-supervision that it warrants, not least because officers feel that they are in no position to correct the faults of tradesmen instructors who are better qualified than they are themselves. The object of this article is to record some ideas and experience from a unit with a trade training role, in the hope that it may prove useful to any officer who is concerned, directly or indirectly, with an aspect of R.E. training which, though important, differs only in detail from other forms of training. The principles are no different.

Aim

Although the final aim of trade training must be to produce a man with the skills required by the Corps, if the enthusiasm of the man is to be enlisted by incentive, it is probably best to set the passing of the trade test as a target. Most of the knowledge and skills set down in the test are of value but, before criticizing the inclusion of those that are not, we must remember that tests must be maintained at a standard acceptable to the Trades Unions against the day when a man leaves the service. There is, however, a need to consider his unit's requirements for items outside the test. For example, the Painter and Decorator (BIII) can pass his test without painting a vehicle or his regimental badge but, as these are likely to be more than useful accomplishments to his unit, they should be included in his basic course.

It must also be borne in mind that a basic course must instil into the man the *correct* method of using his tools. A Class III test may well be passed by the 'handyman' using rough, ready, but wrong, methods, many of which will have to be unlearnt when he wishes to advance himself.

Instructors

There is generally little choice of instructor. A note in the appropriate column of the field return (AFW 3009) may produce a "Corporal (must be Carpenter and Joiner)" but there is no guarantee that, when he arrives, he will not have been employed for the past five years as a regimental policeman, or that he is keen on instructing. He will almost certainly need practice at his trade and three weeks will show whether he is likely to come up to the standard of skill required. If he shows no promise by then, it is best to give him a reassessment test and disrate him. Posting to another unit is less ruthless but infinitely more trouble!

Skill at his trade is not the only requirement. He must receive training in Method of Instruction. "Successful Instruction" 1951 (W.O. Code 8670) contains some valuable stuff and the instructor should be made familiar with it, not only before he starts, but also subsequently to inspire him to try new and better ways of "putting over" difficult items in his syllabus. The officer supervising him should also read "Good Instruction" (W.O. Code 8163).

The man management of tradesmen instructors produces some interesting problems. Very few, who have not instructed before, take to it readily. Inexperience in instructing and lack of practice at their trades cause a lack of self-confidence for about three months and it is during this period that they must be closely but sympathetically supervised. The improvement normally shown during this period will give ample opportunity for encouragement and this opportunity must be taken. The instructor must be set up as the greatest local expert on his own trade and, where he is found to be at fault technically, it is better, rather than that he should be corrected out of hand, that the point at issue should be regarded as a doubtful one to be settled by reference to a standard work on the subject. This encourages him to use textbooks (which must be available) and to find his way about them. It also brings home to him that, even if the officer has only a superficial knowledge of the trade concerned, he is well aware of where information is to be found. As a useful by-product, the officer himself will add to his knowledge.

It is impossible that any officer should be more knowledgeable and skilful at every trade than any of his instructors. It is enough that he should administer trade training with energy and foresight, take an interest in the trades and seek to improve his knowledge. *Engineer Training* makes a point of stressing that Officers i/c Workshops should have sufficient administrative backing. If their horizons are clouded by too many accounting worries, stocktaking boards, writes-off, vouchers and sterile demanding of stores, the balance of their work will be uneven and it is training that will suffer. Many officers who claim to know nothing of skilled trades have painted the kitchen, decarbonized the car, or acquired a small collection of tools for odd jobs about the house. All such experience can be used to promote discussion and so improve officer/instructor relationship. Many officers, indeed, could pass some trade tests with very little work (draughtsmen, electrician). In general however, the officer is more facile at referring to textbooks and this advantage must be used.

The instructor must have incentive and this is generally to be found in a recommendation for a Clerk of Works course, or the opportunity to prepare himself for up-grading. There are useful opportunities for trade instructors outside the service.

The Trainee

Selection of trainees is a matter that concerns every officer, but sometimes it seems that too little thought is given to the qualities that each trade demands. First and most important is enthusiasm. Whatever vacancies may exist on establishment, a man with an ambition to operate a tractor is unlikely to make a good carpenter. Secondly, we must look to education. A man will never learn to read a vernier who does not understand decimals, nor measure if fractions are beyond him. A critical comparison must be made between the syllabus of the Army Certificates of Education and the trade tests. And lastly, for a trade such as blacksmith, physique must be considered.

It is essential that trainees are reported on weekly and records of performance kept. By study of these, the "patently unsuitable", the "slow starter", the "enthusiastic-starter-who-tails-off" and others, may be identified and appropriate action taken. These are particularly valuable in an establishment that runs courses for other units. If the trainee's own officer can find time for a visit, by looking at the record and interviewing the man he can often correct his attitude to his work, or advise the instructor how to handle him. Records can also be used to demonstrate that justice has been done when it is necessary to "return to unit".

The environment in which he works is also a telling factor. Light, well-built and airy workshops, well-kept machinery, attractively painted; and well-designed benches, all give an atmosphere of efficiency from which the trainee will set his standard.

Tools and Materials

Too often poor quality tools and materials are considered good enough for trade training. A carpenter learner can be knee deep in shavings before a piece of timber is squared to his instructor's satisfaction. If the timber is unseasoned he may return next day to find that his achievement has taken on a graceful arc and he has to start all over again. If the trainee is to gain encouragement, he must be conscious of his own improvement and there is nothing more discouraging than the feeling that circumstances, and not himself, are the bar to his progress.

For most trades two kits exist: "basic" and "supplementary". One might guess that "basic" contained all that the Class III man requires: and that "supplementary", all for the Class II. Not at all! Several important tools are missing and must be procured.

Estimating and procuring the tools and materials required is part of the job of the workshops officer and foresight must be used if everything is to be at hand for the trainee. The first step is the "bid" for an allotment for the following year from the local D.C.R.E.'s Part III Funds. Timber must be stockpiled to ensure that it is properly seasoned when training begins. Tool lists must be compared with actual holdings and authority obtained for excess issues. Every student must have a set of his own which he will look after and arrangements must be made for any broken tools to be replaced at once. Students break tools easily and delays in replacement cause frustration. As many expendable stores as possible should be obtained on the authority of the unit's A.F.G. 1098 or local equipment table (not chargeable to training grant) and the remainder ordered from the D.C.R.E. Once trade training is on a fixed cycle, "Provision Action Figures" can be inserted on bin-cards or ledgers to make re-ordering of expendables automatic.

All this planning is of course based on the appropriate sections of *Regulations for Army Trades and Employments, 1952* (W.O. Code 227C.R.E.).

METHOD

Each trades instructor should prepare an outline syllabus as a guide for the whole course well beforehand. Subsequently he should produce a weekly programme, a week in advance. These must be discussed and approved by the workshops officer who will ensure that the method of instruction is the best for the matter in hand. His main pre-occupation will be to find practical methods of instructing material that would otherwise be taught by lecture.

Films, of which there are many, stimulate interest but careful subsequent recapitulation is necessary to ensure complete comprehension and proper note-taking. Diagrams and simple models are better designed by an officer with a working knowledge, recently acquired, who has often a more sympathetic understanding of the student's difficulties than by an N.C.O. instructor who tends to try and teach too much at a time.

Workshop discipline must be good. Care of tools, tidiness, safety precautions and correct methods have constantly to be impressed on students at all levels.

However much care is taken in selection, there will always be those who find difficulty with the mathematics required for their trade. The necessary revision can be done by the trades instructor but, if R.A.E.C. personnel are available, they should be used. It brings home to both student and instructor that education has a direct bearing on a man's everyday work and is not just a matter of acquiring Army Certificates to swell the numbers on the Unit Education State.

The main complication to trade training is the demand that it should be productive. Desks for the C.O., cupboards for the Quartermaster and jobs for the General all help to raise the popularity index. The D.C.R.E. may feel that, as he has provided the stores, he is entitled to some return. Care must be exercised. Provided that the work can be properly supervised (which excludes many small maintenance services for the D.C.R.E.), such tasks are useful for collective trades training and for the practice that the Class III man needs before he goes for upgrading. They should only be accepted for basic and upgrading courses with reserve. After four or five weeks of unproductive work, the trainee will respond well to being given a productive job that practises what he has learnt and such work should be sought and accepted. Harm will result if the work he is given at this stage is too difficult, too repetitive or too simple. Demands for a number of identical items (doors, window-sashes, for example) are useful because all trainees can be given the same work, stimulating competition and facilitating supervision. Usually the problem is to select suitable work for carpenters and painters from the mass of requests and to seek work for other trades.

During his course, it is essential that the trainee keeps a notebook. He should be instructed how to keep it and a very high standard should be demanded at frequent inspections. By learning to illustrate well, he will acquire "finger dexterity" and will later learn more easily to read a drawing. His notebook should be a useful reference to him for ever. Precis are not advocated. They get lost and the man does not learn as much from them as when he makes fair notes. Reference tables and lists should however be duplicated and issued. In this respect, a very useful table is one which shows all the tools and materials used in his trade, by correct Army nomenclature and vocabulary number. Often a duplicated drawing is useful but should only be issued *after* the man has made a fair effort at producing it himself.

If time permits, a tradesman should be given brief instruction in trades allied to his own. A carpenter, for example, should know enough about metal-work to make adjustments to metal fittings.

Testing

The tests are given in *Regulations for Army Trades and Employments 1952* and generally authority is given for the exclusion of any item for which equipment or materials are not available.

The main concern with trade testing is to ensure good security and for this reason the instructor should be excluded from setting the test, whenever possible. If question papers are required, they should not be typed by men who come into contact with the trainees and they must be constantly changed. Tests must be properly invigilated. It should however be noted that at Class III the requirement is often to be done "under supervision" and there is no objection to the instructor being present to direct and advise, but not, of course, to handle tools.

Suggested Improvements

The increase in the number of Army trades and the reduction in the number of groups have led to many anomalies and there is no doubt that trades in the same group may vary greatly in the amount of knowledge and number of skills required. Before reform is applied, a critical study is required of each test to see whether the requirements of the test and of the Service coincide. Too often skills appear that the tradesman will never use, for which equipment is not provided or which by existing regulation he is forbidden to practise. Although the Trades Unions' requirements must be met, it is felt that there is scope for deleting skills no longer required, and adding others to bring them into line with modern practice or needs.

The trades allied to Fitter contain similar skills, but the tests are worded to make small differences. The training problem would be simplified by standardizing common skills in all these trades.

Finally there is a need for a critical study of tool kits. Not only do the contents require revision but more fittings should be designed and provided to prevent edged tools becoming blunted. It is valueless training a man to look after his tools with care if he is not given proper storage for them; nor can it be expected that tools which have rattled loose in a box in the back of a truck will be ready for use when the job is reached, in peace or war.

One of the simple pleasures of life is to watch a master craftsman using tools to perfection. This is well matched by the sense of achievement in watching an unskilled man surely progressing in skill and confidence as the result, direct or indirect, of your own training skill.

Work Study

By Major-General W. S. Cole, C.B., C.B.E.

It is sometimes said that there is nothing intrinsically new in work study. This may be so. What is new, however, and what we cannot afford to ignore, is the ever increasing, and highly spectacular, impact of modern uses of work study, both upon industry and in the fighting services. For example, the annual increase in productivity in Imperial Chemical Industries has risen from a pre-war figure of $1\frac{1}{2}$ per cent per annum to between $7\frac{1}{2}$ and 10 per cent per annum with a notable contribution coming from the increasing use of work study.

We as a Corps have usually led the Army in the development of some new technique. In work study we are in danger of lagging well behind.

I feel, therefore, that we must give very careful consideration to the application of work study to our own activities. It may be that we cannot apply these techniques exactly as other people can to their own specific problems; that is what everybody thinks to begin with; but what we can not do is to disregard them since their virtue is that they can be adapted to any form of activity.

The aim of work study can quite simply be defined as making the most effective and economical use of the three components of any work:—

Manpower, Materials, and Machines.

Anything which attempts to do this must surely be of interest to Sappers.

It can well be said that as Sappers we are already trained to do this. What in fact do we do when we plan any work? In what way is work study different from the age-old "Time, Men and Tools"?

I agree that we are trained to plan and organize our work, but unless we know something of the techniques of work study we are not using a modern tool. We are trying to do a job with antiquated machinery.

Work study is the systematic, objective and critical examination of all the factors governing the operational efficiency of any specific task in order to effect improvement.

It is, therefore, a challenge to your own powers of clear logical thought, since the basis of its approach is the application of scientific method to the study of the problems of work in the widest sense of what has to be done.

What do we mean by scientific method? In simple terms it comprises three essential stages:—

The definition of the problem.

The recording of all the factual data relevant to the problem.

The analysis of this data in relation to the problem.

Having first defined the problem, therefore, we must begin with a factual recording of what is done, or what it is proposed to do. This record of facts, not opinions, must then be examined with a view to identifying and eliminating all work that is unnecessary and unproductive. The essential work which remains is then examined to determine the most economical way of carrying it out.

Thus for any given piece of work the problem can be broken down into finding the answer to two fundamental questions:—

What is the best method?
How long should it take?

The techniques of work study have been developed in order to answer these intensely practical questions. In other words, work study is organized, albeit highly organized, common sense, and can be applied equally successfully to small jobs or whole organizations.

WORK STUDY METHODS

Work study can be divided into two main subjects, Method Study and Work Measurement. These two subjects are mutually supporting but it will simplify explanation to consider them briefly separately.

Method study can be defined as the study of the ways of doing things, or as the critical examination of existing or proposed methods with a view to their improvement. Clearly, as I have said above, an exact record must be made of what is at present being done, or what it is proposed should be done. Each item on this record is then challenged with the questions:—

What is done—is it necessary?
Where is it done—why there?
When is it done—why then?
Who does it—why that person?
How is it done—why that way?

This critical examination is done with a view to eliminating all that is unnecessary and putting what is essential into the best possible sequence. This analysis can sometimes be done by one man, but in many cases the correct solutions to all the problems raised, technical and administrative, may require the combined abilities and experience of a small team. Finally, the improved way of doing a job must be produced, introduced and subsequently maintained or revised.

The second part of work study, which is work measurement, can be defined as the determination of the proper time to allow for the effective performance of a specified task. This knowledge enables the correct number of men or man hours to be allowed for a job. It also makes possible a much higher degree of accuracy in planning the future requirements of men and machines.

Work study is therefore an attitude of mind that all of us ought to have in dealing with our own day-to-day problems. This attitude has been vividly expressed by one of the leading personalities in industrial work study circles as "asking the 'evangelical why'."

It can even be argued that work study is a mental discipline in the academic sense in that it teaches us to think. There is a lot to be said for this argument and there is no doubt that an elementary training in work study would help every officer and N.C.O. It is not designed to help the genius, but for the ordinary fellow who makes the ordinary number of mistakes! However, if genius is "an infinite capacity for taking pains", then work study has some of the aspects of applied genius, since its meticulous recording and critical techniques leave little to guesswork.

Simple problems can be tackled and solved with an elementary knowledge of the techniques, but when a fairly complicated operation or sequence of operations is to be examined, then more than just an elementary knowledge of work study is required. What is then needed is a sound knowledge of the techniques, confidence through practice in their application and time to carry out the study. In other words, you require a trained work study operator.

At the conclusion of this article I have provided a reading list for those who wish to know more of the techniques of work study. I do not propose to discuss them further here. Instead, I would like to explain the present position in the Army under the following headings:—

Can the Army use work study?
How is it proposed to use it?
What has been achieved?
How does this affect you?

Can the Army Use Work Study?

It is very common for anyone faced with the question of applying work study to his own activities to feel that, however useful it may be elsewhere, these techniques could not apply to his own tasks. "My job is different," he says, "it is highly specialist, seldom repeated . . ."

The general idea behind this is the assumption that work study can only be applied to long-run, mass-production engineering.

Nothing could be more mistaken.

Work study can be applied to any job, no matter how simple or how complicated.

Let us take as an example the application of work study to a job which, up to quite recently, has been carried out in almost every unit in the Army all over the world: the 406 Inspection of a vehicle.

Have you every watched a fitter carrying out one of these inspections? When a chargehand in a large industrial firm, who had been trained in work study, recorded what one of his fitters actually did in the course of an inspection very similar to our own, most people had a severe shock. To begin with the man walked 546 yards in the course of the inspection. Why? Because he was following the sequence of an inspection procedure which was tabulated in a logical sequence from the point of view of a man sitting at a desk. The various components of the vehicle had been listed according to their function, and not according to their position on the vehicle. Merely by planning the work of the fitter so that he went round the vehicle once, and by translating the plan into a series of instructions to the fitter, the firm halved the time that their vehicles were off the road for inspection and maintenance.

There have been many similar applications to the kind of job that we do every day in any unit, and the real question, therefore, is not "Can work study be applied to our job?" but "Is it worth while applying work study?"

I propose to show that it is.

We employ a very large number of soldiers and civilians in our world-wide administration and their task is daily becoming more and more complicated as the weapons and equipment they use and service increase in complexity. We all want to increase the ratio of teeth to tail. We must, therefore, be completely certain that every man we demand and every pound we spend in these administrative functions is absolutely essential.

Let me here state quite categorically that we are not as inefficient as the popular press sometimes tries to make out. Are we however certain that we can afford to dispense with something that can help us to be more efficient? The answer to this must be a very emphatic No!

The second reaction of the unconvinced when faced with work study is:—

"We have always done it."

You can quite justly tell me that you draw your pay precisely because you do study the methods by which your task, whatever it is, is to be carried out. You may well say (as so many have already done), "We may not use the techniques of work study, but is there any difference between these and the writing of an appreciation?"

The immediate answer to this line of thought is to agree that we do study our methods; but how often have we written an appreciation to fit a plan? We have all been guilty of jumping to conclusions. We are all far too apt to rely on intuition and call it experience. Experience based on facts is good, but how often is so-called experience based on hearsay? Work study is based on a critical examination of facts, not opinions.

There are no short cuts in work study. It takes time and toil to dig down and obtain the full facts.

We are not trying to build work study into the Army on any foundation of inefficiency. It has, however, been proved that in any place where work study has been introduced into the Army, improvements have been made; even on the basis of what previously appeared to be a thoroughly efficient method or installation. Can we afford not to use this hard-won experience based on facts?

How is it Proposed to Use Work Study in the Army?

Let me now state quite bluntly that it is the intention of the Quarter-Master-General that work study should be developed in the "Q" services as quickly as our resources, training facilities, and the continued maintenance of good industrial relations will permit.

There is no need to elaborate the meaning of the word "intention" in the above context.

The Army Council have endorsed this and have laid down the following principles for the development of work study in the "Q" services:—

(*a*) Each Service Director to develop the use of work study upon lines appropriate to his own service.

(*b*) There should be a chain of technical control from the Service Directorate to the unit or establishment.

(*c*) Both military and civilian staff should fill whole-time work study appointments on establishment; but no one should make a permanent career in work study.

(*d*) Training should be organized by service directors in their own schools, but there may ultimately be a need for some centralized training.

(*e*) Work study should be developed throughout the "Q" services as fast as manpower, training facilities, and the maintenance of our existing good industrial relations will permit.

It is perhaps worth elaborating certain of these principles.

Each "Q" Service Director is responsible to the Quarter-Master-General for the efficiency of his service. It is therefore obvious that anything that can help a Director to increase the efficiency of his service must be under his own direct control. Moreover, work study can only achieve its maximum results if it is accepted throughout an organization and is an integral part of that organization. It achieves little when imposed from above.

The chain of control from the War Office Directorate to the unit or establishment is normal and obvious. So is the principle that no one should make a permanent career in work study. It follows the normal practice of alternating staff and regimental employment. All officers, both civil and military, benefit from a work study job. It teaches them to think clearly. They are forced to base their decisions on facts. They have to dig down and get these facts. This basic training is, however, also valuable in other spheres and a constant exchange between the work study "world" and the Command (or in civil life the managerial) "world" has been found to be of the greatest value to both.

The question of whole time appointments on establishments is most important. Work study on a part time basis in an installation will never produce the very satisfactory results that have been, and are now being, obtained from full time teams. It must be realized that the use of work study clearly means an increase in staff in order to obtain the gains in efficiency which they can bring by the application of work study techniques. Experience has, however, proved that such results when costed very much more than offset the cost of the team.

The last principle, the maintenance of good industrial relations, needs no emphasis. The War Department is one of the largest employers of civilian labour in the United Kingdom and also employs many thousands of civilians abroad. Here it can be stated quite categorically that the experience of both British industry and the Services is that work study, correctly and intelligently applied, leads to better industrial relations and a healthier team spirit. No organization, as we all know too well, can be really efficient unless there is harmony throughout the organization.

What has been Achieved

Work study has been applied over a wide range of activities, but so far we have not attempted to produce an over-all balance sheet, since many of our criteria cannot have numerical values assigned to them. Clearly there is only one common denominator to which savings could be reduced—£. s. d.; but in the Army we are not cost accounted, accurate costs are often difficult to obtain and often finance may not be a valid yardstick by which to measure our gains in efficiency.

I will therefore consider in very general terms the Corps where work study has been employed, and describe some of the results which have been achieved. I have not listed the Corps in order of Army seniority!

In the Royal Army Ordnance Corps work study has probably had the longest continuous application. Work study, about ten years ago, was grafted on to the depot planning staffs, and full time work study operators are now employed on the staffs of all central Ordnance installations and ammunition depots in the United Kingdom. They are also being introduced to all Command depots in the United Kingdom and to major depots overseas.

The R.A.O.C. have now a force of some 200 work study personnel, both military and civil. Training of these as operators and also of many senior officers in the appreciation of work study is carried out in the R.A.O.C. school.

Largely as a result of work study so much better use has been made of existing covered accommodation, by methods of improved storage, that 30 per cent more stores are now under cover.

In the Royal Electrical and Mechanical Engineers considerable work on a part-time basis has been done for many years but only recently have whole time work study teams been introduced into main workshops.

Costed savings since 1950 amount to about £250,000, but they are beginning to be overshadowed by the initial results of the whole time teams; 350 officers and 350 warrant officers have been trained, and method studies now average about a hundred a year.

In the Royal Engineers, the Director of Engineer Stores has had eighteen officers and warrant officers trained and has now established work study teams in the E.S.Ds. in the United Kingdom. Studies are now being carried out.

The Director of Fortifications and Works has had one officer trained, and another is to be trained shortly. Pilot studies of the application of work study to design have been carried out. The results have been most remarkable.

The Director of Transportation has now had two officers trained.

The Director of Army Postal Services has set up a team of one officer and one N.C.O. in his main sorting depot in the U.K.

In the Royal Army Service Corps the first teams were set up in supply depots and in petrol depots last year. More recently D.S.T. has decided that work study should be applied throughout the R.A.S.C. and teams are being set up to look at the far wider range of problems in connexion with transport units.

In addition to the above "Q" services the Royal Army Medical Corps have also entered the field. Their first four officers have been trained and are carrying out studies. The Director-General of Military Training is setting up a team to examine basic training programmes.

In work study it is not enough merely to train the technician, i.e. the work study operator. Those who use his service must also be trained to have a full understanding of what work study can, and can not, accomplish. Similarly those whose work is to be studied must have some knowledge of how the work study operator functions, so that suspicion and mistrust can be avoided.

Army Council policy is that training should be carried out in the schools of each Corps. I have already mentioned the training in the R.A.O.C. school. In the R.E.M.E. school the full range of training is also carried out, although they have capacity only for about half their requirement for operator training. In the R.A.S.C. school appreciation courses for the users of work study are being held for all R.A.S.C. officers down to the rank of major, and all long technical courses now include ten days of work study. Some similar training is also carried out in the Engineer Resources Training Centre. Finally, a series of one day courses have been held in the War Office and at Command Headquarters. It will be seen that this leaves many gaps. One at least has been filled by arranging a series of special, tailor-made courses to train operators at the Civilian Work Study School, Cranfield. Other Army students have also been sent to Manchester University, Bristol University and Leicester College of Technology.

I am sure you will be interested in some of the results which have been achieved in the Army, and I have listed a very few of these at the end of this article. You will note their very wide range and I suggest that they may give you much food for thought.

How Does this Affect You?

What are the basic problems that confront us as Sappers in the streamlined modern Army? Surely they are, firstly, keeping abreast of modern developments in military and technical fields and developing them to the maximum to fit our present and future tasks; secondly to extract the best from our resources in men, material and machines.

Work study is a modern technique which we should use and develop to help us to solve these problems. It can be applied to any work and is an extremely powerful aid in making the best use of our resources, whatever they may be.

I am convinced that we must all learn something about it.

Conclusion

I would now like to summarize what are to my mind the highlights of work study.

It is a proven "tool" of "management" using the term management in the broadest sense, but it does not in any sense replace good management. Never forget you are dealing with human beings. It is a very sharp "tool" and must be correctly and intelligently used. So used it produces remarkable results in improved efficiency.

It can only be applied effectively if right through the organization there is a knowledge of the capabilities and limitations of the "tool" and full confidence in those using it. There are still those who fear the effects of work study on industrial relations, but if confidence and mutual trust exists then work study correctly and intelligently applied has been proved to lead to better industrial relations than ever before.

Work study can only thrive and achieve results on a foundation of basic honesty.

A work study operator must be honest with his superiors, with those below him (particularly as when civil labour is employed he is dealing with their vital interests) and above all he must be honest with himself.

Work study in the Army is not the prerogative of the Quarter-Master-General or of any particular branch or arm of the service. The basic techniques can be applied to any work. We in the service have only scratched the surface and are now realizing the vast fields which can and should be covered.

It is a continuing process. You can work study any job now and install improvements and then maintain them. You then work study the improved job again in, say a year's time, and can make further improvements.

Work study deals with facts, NOT opinions or hearsay. It takes time to dig out these facts. They may not always be palatable when they are revealed, but they are facts none the less.

Work study provides a convenient "shorthand" with which to set out clearly on one sheet of paper the facts of what is happening in quite a complicated sequence of operations. You probably could not set this down in writing on twenty sheets of foolscap. Moreover, this shorthand highlights the delays, movement and storage which add nothing but cost to any process.

Finally, in industry it is accepted that the main purpose of work study is not to make workers work harder, but to help management manage better. As I see it, therein lies a challenge to every Sapper—and one which, if accepted, cannot fail to bring the due reward of facing the facts.

Some Results of Work Study in the Army

The following examples have been selected from the very many available. They represent a cross section of the wide variety of tasks to which work study techniques can be applied.

R.E. (D.E.S.)

1. A study was undertaken to examine the segregation and inspection of Bailey bridging stocks with a view to increasing output and reducing the time taken on the task.

One operator was employed for twenty-two days, with the following results:—

(*a*) Increase of 20 per cent in daily output of connecting posts.
(*b*) Increase of 100 per cent in daily output of bolts bracing.
(*c*) Increase of 20 per cent in daily output of frames bracing.
(*d*) Increase of 100 per cent in daily output of chesses.
(*e*) Net saving in labour costs of £1,440 per annum.

No additional equipment was required.

2. Minor changes in working methods for the preparation of vegetables in a unit cookhouse resulted in the reduction of a daily working party from nine men to four.

3. An examination of a dining hall cleaning party in a unit resulted in the reduction of the daily working party from six privates to two.

R.E. (D.F.W.)

4. A "pilot" study on design layout was undertaken to propose changes to the "Q" brief for the rebuilding of Knightsbridge Barracks.

Two officers were employed for ten weeks.

The study showed that the following improvements to the originally proposed layout would be possible, among others:—

(*a*) A larger parade ground.
(*b*) A centralized stable and working area.
(*c*) A more efficient forage storage system.
(*d*) A site for married quarters away from the stables and troops living accommodation.

Note: It was evident that a much longer and more detailed study (possibly six months) was really required, but enough was done to indicate the value of work study at the design stage of a project.

5. A preliminary study on a R. and F. cookhouse indicated that capital savings of the order of £5,000 should be possible in future designs. A further detailed study is now in progress on the present type of standard R. and F. cookhouse. The study also highlighted the fact that too much of certain equipment and too little of other equipment had been provided, and that in preparing the main course of a meal for 425 men a cook walked no less than 2,360 yards!

R.A.S.C.

6. A study of the assembling of fibreboard cartons for ten-man compo rations was carried out in a supply reserve depot. In the original method four teams of five produced 2,000 cartons per day. The improved method produces the same number of cartons with two teams of six, i.e. a 66 per cent increase in productivity. There was also a saving of 1,460 sq. ft. of storage space, and working conditions were greatly improved.

R.A.O.C.

7. A study of the receipt, sorting, storage and disposal of empty ammunition packages resulted in the following savings:—

(*a*) A 40 per cent decrease in staff required.

(*b*) A reduction of 50 per cent in handling.

(*c*) An annual saving of approx. £17,000.

One operator was engaged on the study for nine weeks.

8. A study of the operations of the traffic branch of a C.O.D. gave the following results:—

(*a*) Elimination of much unnecessary paperwork.

(*b*) Increased use made of existing mechanical handling equipment.

(*c*) Staff reduced by two clerical and thirty-eight industrial grades.

(*d*) An annual saving of approx. £16,000 was effected.

This somewhat complicated study was completed by two operators in seven months.

R.E.M.E.

9. A study was made of the clearance of waste material, clinker and ashes from three boiler houses in various parts of a workshop area.

The original method entailed about six man hours with two labourers per day in winter and weekly in summer. The improved method uses one labourer for two hours daily in winter and weekly in summer. There is a considerable increase in tidiness.

10. A study was undertaken on the use of internal transport in a Command workshop with a view to improvement of man machine utilization. The work of a team of four for one month had the following results:—

(*a*) A 50 per cent reduction in equipment holding.

(*b*) A 43 per cent reduction in labour.

(*c*) Financial savings of approximately £16,000 in the first year and £7,400 per annum thereafter.

(*d*) An improved internal transport service for the whole workshop area.

11. In a workshop a thrice-weekly coke working party for the men's billets was costing 180 man hours per week of skilled craftsmen's time, there being no G.D. men available to do the work. A three-day study by a trained operator reduced the time taken to 20 man hours per week.

General

12. A parachute battalion asked for a study to be done on the issue and handing in of arms in the armoury of one of its companies. Results were as follows:—

(*a*) A 75 per cent reduction in the time involved, and hence an equivalent saving of training time.

(*b*) A considerable reduction in unnecessary documentation in arms registers.

(*c*) Improved working conditions for storemen.

Note: There was no relaxation of security regulations as laid down.

13. A study just completed at the Army M.T. School on servicing schedules and unit inspections indicates that on one main type of vehicle the time spent on the driver's daily schedule can be reduced to approximately half. A standard method which consumes the minimum time and labour has also been suggested for periodic servicing and unit inspections.

14. A unit Q.M. stores has recently been studied. The results are most interesting in the light of the enormous field for this type of study throughout the service. The stores were originally contained in nine scattered buildings occupying almost 10,000 square feet. The layout was illogical and the racking and cupboard space was not designed for the job. Lighting, heating and working conditions generally were extremely poor. The project was studied by one officer and one warrant officer for approximately three weeks, with the following results:—

(*a*) All holdings reduced either to authorized establishment or a realistic working figure.

(*b*) Two buildings now occupied instead of nine, with a reduction in storage space of over 5,000 square feet. This was achieved largely by re-design and re-location of racking and cupboards.

(*c*) Three other ranks previously mis-employed in excess of establishment returned to their proper duties.

(*d*) The elimination of a system of duty storemen.

(*e*) In general, a great improvement in working conditions which is much appreciated by the civilian staff permanently employed.

A Suggested Work Study Reading List

All the following are available from the War Office Library.

Title	*Author*	*Publisher*	*Price* £	s.	d.
Introduction to Work Study		International Labour Office	1	1	0
Outline of Work Study		British Institute of Management			
Part I (Introduction)				3	6
Part II (Method Study)				7	6
Part III (Work Measurement)				12	6
Motion and Time Study	Mundel	Bailey Bros. & Swinfin Ltd.	3	3	0
Introduction to the Theory and Application of Work Study	Anne Shaw	H.M.S.O.		6	0
The Purpose and Practice of Motion Study	Anne Shaw	Harlequin Press	2	10	0
Work Study (Case Histories from fifteen industries)		British Productivity Council		2	6

Teach Yourself to be a Garrison Engineer

By MAJOR D. E. THACKERAY, R.E.

SOME officers dread the thought of a posting to Works; others look forward to it as a golden age of free Saturday mornings and endless cups of Civil Service tea. A third category, to which I used to belong, just don't consider it likely that they will ever be trusted directly with so much of the country's money to spend.

It was therefore something of a shock to learn, some little time ago that, after a year as second-in-command of a regiment, I should be required to do "a tour in a Works Service appointment". As the months slipped by I searched my mind, and everybody else's, for a clue as to what being a Garrison Engineer actually involved. Apart from the remembered dictum of a distinguished Sapper officer who once told me it was all "commonsense coupled to a good knowledge of the jargon", the sum total was disappointing, not to say alarming. For this reason perhaps a brief recapitulation of one's introduction to the mysteries of a junior works appointment may lessen the uncertainties for others similarly placed.

In due course my allotted span in Germany came to an end, farewells were said and, with considerable apprehension and a very overloaded car, I made my way back to the U.K. and Salisbury Plain. Here I was lucky enough to find a quarter awaiting my arrival: almost too literally for, as the Garrison Engineer, I also had to decide off the cuff whether it should be modernized by T.C. (Term Contractor) or D.E.L. (Directly Employed Labour). The hasty adoption of a British compromise enabled me to draw breath and seemed to satisfy everyone temporarily!

My first impression of Works Services was that, like most military organizations, it was a machine into which one would have to fit. Whereas with most military formations one generally hopes in time to work the machine satisfactorily, it seemed possible that, if not carefully watched, Works Services might work you instead! Some suggested handles to pull to avoid this are examined later. My own particular part of the machine appeared, fortunately, to work with little fuss but considerable longevity! A reassuring prospect.

The second and outstanding impression in my own case was of the genuine friendship and help extended by everyone to make you feel one of the family, and to teach one the maximum possible with the minimum fuss. The care and patience displayed with one's early fumblings and indecision was not only invaluable in itself but smoothed over all possible difficulties before they arose. This sense of *esprit de corps* is very strongly marked in our sub-area and is, I believe, a great source of strength at all levels; in the office, on the shop floor and on site. As an example our occasional cricket matches and similar events, although not brilliant sporting functions are amongst the pleasantest and friendliest one could wish to enjoy.

What then are the essentials of getting along as a Garrison Engineer? There seem to be two main requisites. First to get a grip of the financial side of the business and second to apply the resulting works potential with the maximum imagination and realism. Financial control at first sight often appears the enemy of imagination and drive. At the low level of a Garrison Engineer this is, however, very often a fallacy. It can of course always provide a useful excuse for not doing things; but a clear understanding of where, why and how much you are spending is a pre-requisite to putting first things first and getting real essentials on the move. At the present time it is doubly important to grasp this nettle of finance very firmly. Money is constantly getting shorter and due to the dilapidated state of much of the War Department's property this is never enough to do all that one would like to do. There are no (or a very few) non-essentials and money will be frittered away if it is not constantly and actively directed towards the first priority essentials only.

Incidentally there is no abracadabra about finance. Basically it is addition, subtraction and simple fractions plus adjustments for human frailty (your own), wind, water, and Acts of God. Don't allow anyone to persuade you otherwise or life may be difficult. The necessary figures should be readily obtainable, on a day to day basis if necessary, from your staff, and will tell their own story. The important thing is to have a system which enables you to put your finger on expenditures and commitments at any time. No one else can do this for you accurately and time spent on perfecting a system is literally priceless. Once you have it (I was lucky enough to find it ready made) the worries and apprehension surrounding such bugbears as getting your annual Part III expenditure within a half per cent largely fall into their proper perspective.

Having such a system behind you will also give you more confidence and much more time to learn the jargon. Like most jobs, constant association teaches you more quickly than any amount of book lore. You will be surprised (at least I was) at how soon you are giving P.R.Es. (Preliminary Rough Estimates) (usually wrong in my case) off the cuff, and discussing V.O.Ps. (Variation of Prices), deviation orders, liquidated damages and the like with the best of them.

With these tools in your hands the next thing is to get the best work done with them. There are obviously many different ways of achieving the necessary results. My own small experience confirms that the key man on the ground is the Unit C.O. or O.C. If he is happy (or as happy as you can make him) a lot of problems will automatically solve themselves and your whole area will work more smoothly as a result. Visit C.Os. constantly, find out what they want and why they want it. Basically the barracks are an R.E. responsibility, but the unit which lives in them will want the same result as you do, i.e., for them to look and be as smart and as comfortable as combined efforts can make them. So give all the practical help you can, and help units to help themselves with paint, distemper and advice as often as they want it. From the unit (and practical) point of view many existing regulations, e.g., internal painting once every eight years, are not only ineffective but lunatic. Try and get round them when it's really justified. There are plenty of ways and means and the Army will benefit as a result. Try and keep the unit "in the picture" all the time. Then they can plan accordingly. Moreover if anything does go wrong, you will hear of it directly and not through "the normal channels". Things are bound to trip up from time to time and early realization is infinitely preferable to belated justification, however effective your hastily erected umbrella may be. Let the C.O. and 2 I.C. know you are on their side and not just standing on the side lines. If a C.O. rings up personally try and help by doing something at once. This is alien to normal procedure but produces tangible results in many unforeseen ways. Your yard will almost certainly want clearing up. The well disposed unit will help you if they feel they have a personal stake in its efficiency, and if it has helped them round an awkward corner in the past.

In addition to units' requirements you will of course develop your own plans for long and short term improvements. There will be an infinite variety of these from which to choose. Look at your rubbish tip and incinerator; it may be first class or it may (like mine) give you a nasty jolt. In any event you will be delighted by the unexpectedness of much you will find and by the scope for improvement. Colour schemes in married quarters alone can give endless fun.

Over and above the bread and butter of the daily round you will have the jam of knowing about and doing things that might not otherwise come your way and which are inherently interesting. A selection might include the baking of bread by the latest machinery (Photo. 1), the modernization of a Black Hole of Calcutta cookhouse (Photo. 2) and the running of pumping stations and boiler houses.

On the man-management side the problems of the Sapper and his family are replaced by those of the Whitley Council and Trade Unions relations, all of which create problems of a different and stimulating nature. Incidentally it pays hand over fist to devote as much time as you possibly can to ordinary man-management of your staff and D.E.L. The latter especially tend to get dealt with through intermediaries and I think it pays big dividends to make personal contact, pay them yourself every month or so and interest yourself in their doings and problems exactly as one would with a military unit.

It is possible to amplify the varied aspects of the job almost endlessly. The important thing will be to get out and see them, and the people who make them tick, for *yourself*. In this way you will be able to get to know a great assortment of units and installations, and be the better equipped to appreciate their problems. At times you may be able to anticipate everyone and solve them in advance. Be catholic in your approach to visiting. Everyone is glad to see the Garrison Engineer, especially if they own a quarter or hiring. By having a wide circle of acquaintances many useful pointers can be picked up and acted upon, often some time before they percolate to you through official channels.

Providing you are reasonably lucky your office work, although impressive in volume and signature statistics, should not tie you unduly. Your staff will be considerably older and more experienced than you could ever expect to have in a unit, and will give you far less to do in making detail decisions as a result. Once you have followed through a few jobs to check that the system works it is probably better to leave the technical detail to your subordinates (making certain that they don't blind you with science—or not too obviously), and spend most of your own time on the site or visiting units. By the nature of things the pace is less exotic than in most field units and in any event there are fewer people trying to clamber up over your courtmartialled remains if anything should go awry!

From this brief synopsis one can perhaps gather that life is very much what you make it. Clearly it is easier to hide your head in the sands of Works than in some other jobs. The chances of getting a kick where the monkey got it are indubitably less. On the other hand you have much more fun in controlling quite a large (and relatively completely private) army, and in seeing things actually happen which *wouldn't* if you hadn't thought of them first.

Photo 1.—An up-to-date Army bakery.

Photo 2.—A modernized small unit cookhouse.

Things don't of course always run smoothly. There can be too much water in the drains and too little in the taps. Boilers do burst and houses get struck by lightning. Lorries are always backing into the doorways of Generals' houses and lesser mortals hardly ever seem able to pull the plug without causing a flood. But by and large there is never anything one can't do something about; and if you don't like the expedient you have adopted there is nearly always time to change your mind! Which is more than you can say when the H.G.B. comes off its rollers!

The Construction of Ditches by Means of Explosives

By 2ND LIEUTENANT D. J. PERRY, B.SC., R.E.

INTRODUCTION

THIS paper is submitted in the hope that the information given will be of some use for military engineering purposes. The details given are based on the writer's experience in Norway where he was employed on ditch dynamiting for a period of three months in the summer of 1954. The figures given in Table I are based on notes produced by the Norwegian Forestry Society for the guidance of landowners.

Ditch dynamiting came to Norway in the 1920's from the U.S.A., and the production of ditch dynamite was started by "Norske Spraengstofindustri A/S" who also held demonstrations throughout the country. After the Second World War ditch blasting increased because of the expense of labour. Systematic experiment was carried out by the Director of Forestry with great success. Indeed so successful has the method been that most of the forestry drainage in Norway is carried out by means of ditch dynamite. The change which has taken place is shown by the increase in the production of this particular explosive: 1948—23 tons, 1949—55 tons, 1950–177 tons, 1952—250 tons (planned production).

Ditching in 1948 amounted to 170,000 metres (blasted 90,000 metres)

Increase in 1950 amounted to 700,000 metres (blasted 650,000 metres)

Ditch-blasting has not been developed in this country, although a demonstration was given to the Forestry Commission after the war. Machinery rather than explosive has been developed for ditching for civilian purposes.

It is not known if ditch-blasting is used by the Norwegian Army although army personel have certainly been used in this work.

The paper has been divided into two parts, the first considering the principle of ditch-blasting and the second part some of its practical applications.

THE PRINCIPLE OF DITCH-BLASTING

The object of ditch-blasting is simply to use explosive to do work which would otherwise have to be done by hand or machinery. The ditch or shallow trench is achieved by burying a large number of explosive charges about a foot apart along the desired ditch line. One charge usually at the end of the line is initiated by means of a detonator and the detonation wave passing through the soil is sufficient to detonate the adjacent charge and so on along the line. This method of exploding the line of charges is known as sympathetic detonation.

For sympathetic detonation to be satisfactory the explosive must have two outstanding characteristics:—

(*a*) Be sufficiently sensitive to explode when hit by the detonation wave.

(*b*) Be stable enough for safe handling and transport.

Ditch-dynamite

This explosive is pale yellow in colour and has the smell and consistency of marzipan. It is slightly more sensitive to shock than ordinary dynamite and has a higher speed of detonation. This special dynamite is produced by the Nobel Factory in Norway under the name of Gröfte Dynamite (Ditch Dynamite). It is sold in 100 or 75-gram cartridges measuring approximately four inches long by one and a quarter inches in diameter; the cartridge is covered with waxed paper and may be used whole or cut in half according to the depth of the ditch required.

Sympathetic Detonation

This is the means by which explosive can be employed to blast an indefinitely long and narrow crater in the ground, which will serve as a drainage ditch. By detonating a number of small charges placed close together the resulting crater is in the form of a shallow trench or ditch. The detonation wave brought about by the explosion of the cartridges is so rapid that it seems as if the whole line is fired simultaneously. A successful explosion throws the soil 100 to 300 ft. in the air spreading the spoil to both sides of the ditch. After blasting, a somewhat uneven ditch about twice the depth of the position of the cartridge is obtained. In order to be fully effective the ditch must be cleaned to get rid of the loosened soil, stones, etc.

Blasting of ditches by means of dynamite

In order to obtain a successful explosion there must be no interruption of the detonation wave and the out-throw of the spoil must be satisfactory.

The blow to all cartridges is mainly dependent on the distance between the cartridges and their size. If the limit of the blow or wave is overstepped it will stop and sympathetic detonation will not be obtained. Any failure in the explosion is usually due to an incorrect estimation of the possibilities of the blow. As the consumption of explosive and the cost get smaller the greater the distances between the cartridges it is important that the greatest possible distance be used in each case. Such an estimation can only be made after an appreciation of the following factors.

(*a*) *Water content of the soil.* This is the dominant factor, the higher the water content the better the blow or transmission of the detonation wave. In dry earth the cartridges must be placed so closely that the method is no longer economical under ordinary circumstances. If however it is necessary to blast under such conditions this ought to be done in the spring or in the autumn when the earth contains the maximum amount of water.

The usual method of burying the charge is first to make a hole in the ground by means of a steel jumping bar, the cartridge is placed in the hole and pushed to the correct depth by means of a wooden tamping stick which is suitably marked so that the depth may be obtained accurately. If the soil is so dry that a hole can be made only with difficulty by this method, ditch-blasting is not likely to be economical.

In order to facilitate the valuation of the water content of the soil the Norwegians have suggested the following graduation:—

Degree I. No water in the cartridge holes, low water content.

Degree II. Some water in the cartridge holes but the soil is not saturated and there is no surface water.

Degree III. The soil is saturated, the cartridge holes are full of water and pools are to be seen on the surface.

This classification has been used as the basis of a table suggesting the spacing of cartridges in the ground. (Table I) page 269.

The guide is a purely arbitrary one however and other factors should be taken into consideration at the same time. If a heavy rainfall should follow a very long dry period, the surface water will remain for some time while the soil beneath may be quite dry. On the other hand the soil may be saturated by the melting snow in the late winter but the surface appears to be quite dry. Because of these factors little significance should be attached to superficial observations, but more on the water content of the cartridge holes.

(*b*) *Type of soil.* The soil consistency will always influence the blow to a certain degree. Ditch-blasting is used extensively on ground which is virtually peat bog but the structure of the peat can vary considerably. On a badly humified peat (duff) there is a certain amount of elasticity which will absorb the shock. The cartridges must therefore be placed more closely than in firm and well humified peat with the same moisture content. In firm stiff clay soil a smaller distance is necessary than in gravel under the same conditions.

(*c*) *Quantity of stones and roots.* Large quantities of stones will make the blow difficult, causing an obstruction of the detonation wave. If such stones are traced during the digging of the cartridge holes, the holes should be made round the edge of the stone so that it does not form an obstruction to the detonation wave. It may be possible to place the cartridges under the stone in order to blow it clear of the ditch. Tree roots form similar obstacles which must be overcome in the same way.

The out-throw of spoil

The result of blasting is very much dependent on an effective out-throw, as little material as possible falling directly back into the ditch.

In order to get an effective out-throw the spoil must be blown well into the air spreading out to fall on both sides of the ditch. The power behind the explosion is not only dependent on the size of the charge, but also on the resistance the explosive pressure meets from the soil layers below. If for instance the blasting is on deep peat the pressure is softened because of the elasticity of the peat, consequently the out-throw may not be very successful. The same will happen in the case of a loose deep muddy soil. The best out-throw is obtained in mineral soil containing water or in firmer peats where the soil is no deeper than three feet. Generally speaking no matter how soft the surface material is, providing there is a firm or hard layer beneath, the out-throw will be satisfactory.

The spreading of the spoil will largely depend on its consistency. Grass turves or stiff clay are often thrown out as large sods which have a tendency to fall back into the ditch. If blasting under such conditions can be executed in strong side winds the spreading will be improved.

If blasting must be carried out in deep loose peaty ground which gives a bad out-throw under normal loading methods, a special double loading can be used with great advantage. The cartridges are placed in the same hole about one foot apart, and are fired by the same explosion. The shock from the lower explosion or charge will form the necessary resistance to the upper charge and the spoil should be spread satisfactorily. This method should only be used under very poor conditions, however, otherwise an exceptionally deep crater may be obtained.

Work technique for ditch-blasting

Ditch-blasting should preferably be done by working parties of two men. The work can be conveniently shared by two men, and provides two guards when the explosion takes place.

The length of the blasting section is dependent on the expected water influx in the blasted ditch. The force of the explosion causes the water to be practically blown out of the loose soil in the ditch, which facilitates its removal. If the loose spoil which remains in the ditch becomes soaked with water it increases in weight and is difficult to remove. The section to be blown should therefore be no longer than can be conveniently cleared before the ditch fills with water. Where a team of two men is employed the length of the section will vary from thirty to a hundred yards according to the water content of the soil. When it is desirable to blast a longer section larger working sections should be employed.

The work itself can be divided into the following operations:—

(*a*) *Loading*

Before the loading is commenced the distance between the holes should be determined, likewise the loading and depth of the charge. After the distance between the holes has been determined it is marked on a pole about twelve feet in length which is laid on the line of the proposed ditch. With practice this is not necessary and the distance can be judged by eye, the line of the proposed ditch being marked by stakes at intervals. The hole can be made by means of a heavy steel bar such as a jumping bar, although special digging bars have been designed and used in Norway. A hollow pipe of $\frac{3}{4}$-in. steel with a welded tip and cross handle is sometimes used but a simple straight bar is generally more practical.

The depth to which the cartridge is to be buried varies, depending on the size of the charge and the soil conditions. The depth is usually from twelve to eighteen inches, and is estimated by experience. The ditch formed by such loading is usually about twice the depth of the cartridge depth.

When cleaning open ditches in fields where the old edges should preferably be left untouched the holes may only be four to six inches deep for 100 gram cartridges.

Usually one man will make the holes while his companion does the loading. On stony ground the digging will take longer than the loading and under such conditions the loader's working power is not fully utilized. This can be corrected by letting both start the digging in the first part of the blasting section, before the loader starts placing the charges. In loading, a round wooden bar about two feet long and one and a half inches in diameter should be used, first to clear the hole so that the cartridge will slip in easily and secondly to push the cartridge to the required depth which can be marked on the stick itself. A broken spade handle makes a useful tool for this purpose. Special tools designed for the job are found to have little advantage over the methods described above.

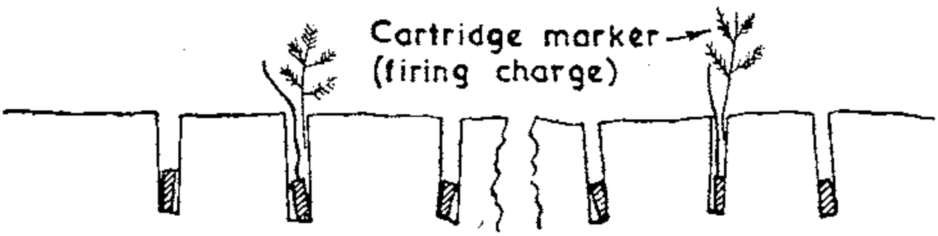


Fig 1. Sectional view of the firing line

The hole in which the firing charge is to be placed is left empty and is clearly marked. If there are any obstructions in the proposed firing line the firing charge should be placed as far away from these as possible. Normally the second or third hole at each end of the line is reserved for the initiation set. By having a double initiation there is less chance of a failure due to an obstruction in the line. The speed of the detonation wave will increase away from the firing charge, the greater this speed the greater the force of the blow. In order to see that the whole length loaded is fired, the last hole should be marked with paper or a stick.

Since the distance between the cartridges in the ground is of the greatest importance care should be taken to see that all the charges are upright in the holes and are all buried at the same depth. Failure to do this may hinder the detonating wave or give rise to an uneven ditch.

(*b*) *Firing*

The line of cartridges is detonated by means of a 100 or 75-gram cartridge using a No. 8 civilian type detonator and a short length of safety fuse. The fuse is ignited by means of an ordinary match and should be two to three feet long to give a delay of one to one and a half minutes. (The safety fuse employed in Norway burnt at the rate of 1 cm. per sec.)

The fuse is placed in the detonator carefully and the latter crimped by means of proper crimping pliers. A hole is made in the end of the cartridge by means of a piece of wood or soft metal and the detonator pushed into position.

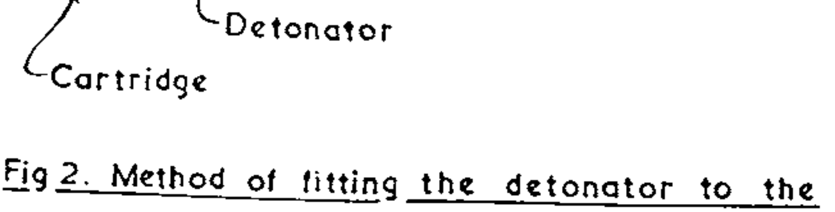


Fig 2. Method of fitting the detonator to the cartridge

In normal circumstances it is not necessary to secure the detonator to the cartridge in any other way but under very wet conditions the method shown in Fig. 2 may be used.

The completed firing charge should be pushed carefully into place by means of the loading stick, and the hole left clearly marked.

Before firing attention should be given to the following points:—

i. That any remaining explosive is placed at least 100 yards away.
ii. Tools, clothes and equipment should be removed to safety.
iii. There should be no animals within 150 yards.
iv. That a warning should be shouted out three times.

After lighting the fuse everyone should move at least 100 yards away and all paths and roads should be guarded. When both ends of the line are to be fired at the same time, the people concerned should be able to see one another and to correlate their actions by hand signals or by voice. If for any reason one man fails to light his fuse he should leave immediately his partner indicates that he has been successful in lighting his fuse.

The explosion produces a heavy smoke which will cause headaches and for this reason it is best to seek cover up wind. As soon as the smoke has cleared an all-clear is shouted and the cleaning commences. Unsuccessful blasting is usually due either to an obstacle interrupting the detonation wave or to too wide spacing between the holes. If the failure is due to spacing this may be overcome by adding half a cartridge in every or every other hole, or by loading new holes between the old ones. Both methods are unsatisfactory and it makes the work more expensive. As a general rule it is best to try a short line in the first instance. If on the other hand failure is due to one weak point, firing should be tried from the opposite direction after first reinforcing the critical point.

The explosive should never remain in the ground for more than two or three hours before firing, as both the blow and the blasting effect are impaired. Those cartridges which have been cut in half deteriorate more quickly than whole ones. It is important to have the necessary reserve of cartridges and detonators in case of unexpected failure.

(*c*) *Cleaning*

Ditch-blasting only does the hard work and the ditch requires cleaning before it is fully workable. The best tools for this purpose are a fork (with numerous closely spaced tynes (Photo 1) and a spade. The fork is used for removing the loose material and stones, while the spade is used for evening out the sides and bottom of the ditch. If the cleaning is done quickly before the water can reach the loose material the time taken is about one minute per yard.

The Practical Application of Ditch-Blasting

For Civilian Purposes

Ditch-blasting is used as a means of constructing new ditches and also for clearing old and over-grown ditches which have become choked with silt. New ditches are usually constructed for agricultural or forestry purposes and the soil types vary considerably. In the case of agricultural drainage the site is usually composed of mineral soil and this is also true in the case of established forests. Peat bogs present far greater problems as far as orthodox methods of drainage are concerned, involving laborious hand cutting of the peat or the use of expensive machinery. In Norway afforestation of some of the worst types of bog is being attempted and this is only possible because of the use which has been made of ditch-blasting.

Peat sites vary considerably, from fairly dry fibrous undecomposed matter arising on ground covered with heather to wet sphagnum bog over which it is practically impossible to walk until drainage is carried out. A typical basin peat bog which was drained by the aid of explosive is shown in Photo 1. The vegetation on the surface is cotton grass and sphagnum moss.

Where large areas of wet ground have to be drained the usual herring-bone pattern of ditches is constructed; the side drains leading into main drains and these in turn leading to the main drainage outlet. The main drain is constructed first of all and the side drains added later, thus maintaining a constant flow of water.

On sites where there are no trees the blasting is straightforward and presents no problems; in woodlands, however, trees must be taken into account. Very large trees should be avoided when laying out the ditch line, but smaller trees up to one foot in diameter are readily blown aside by the explosion.

Although the spoil is blown clear of the ditch, the blast is directed upwards, for this reason only very light material is blown any great distance from the ditch. Because of this it is possible to blast ditches very close to roads without having to clear away large quantities of debris deposited by the explosion.

Drains to be blasted in fields require more even and firmer edges than those in the forest. A field which is fairly free of stones and roots should be ploughed along both ditch edges before blasting. It is important to obtain the correct distance between furrows, allowing for the particular loading and type of soil.

When cleaning silted ditches it is important not to set the charges too deep or the blast may result in too large a ditch. Usually small charges in the region of fifty grams are sufficiently large for cleaning purposes. If the cartridges are placed too close together in very soft ground the initial explosion will blow the adjacent cartridge out of the ground so that it does not detonate. This is another source of failure due to an incorrect estimation of the distance between charges.

Ditch dynamite is used a great deal for cleaning streams and in this instance it is sufficient to remove only large turves, tree roots and large stones. The finer material is washed away by the water, and although this might seem enough to clear away the larger material as well there is always the danger of a blockage. Very large stones which cannot be removed by hand may be either broken by means of dynamite or blown out of the stream.

The value of ditch-blasting

Compared with digging by hand, ditch-blasting is remunerative only when conditions are suitable for blasting. On the normal types of soil encountered ditch-blasting is usually cheaper than digging. Machinery of the type used by the Forestry Commission in this country involves a large capital investment and can only be used economically on readily accessible areas where an extensive drainage system is to be constructed. Machinery cannot be used economically on small inaccessible areas. There are many such areas in this country which are drained at great cost by means of manual labour. For

Photo 1.—A Completed Ditch blown in dry peat type of soil.

successful ditch-blasting there must be a suitable moisture content and skilled labour or at least skilled supervision.

For normal civilian practice the Norwegians recommend that ditch-blasting should not be used when the moisture content of the soil is below Degree II. This recommendation is based upon economy, however, and it is possible to carry out blasting in drier soils. The disadvantages of a dry soil are, namely, the heavy consumption of explosive per foot run of the ditch line and in very hard ground the difficulty of making the charge holes. Ditch-blasting in Scandinavia is paid for on a tariff basis worked out by the Land Workers Union and the Forest Employers Union. This tariff price includes the cost of the explosive and is based on the average consumption given in Table I. If smaller amounts of explosive are used this is to the workers' advantage. Since work of this nature is carried out on a contract basis those sites which are most profitable to the worker (and these are plentiful) have been drained first.

Where economy can be sacrificed to some extent to achieve speed, ditch-blasting can be justifiably used where labour or machinery are not available, even on very dry soils.

In civilian practice where the worker pays for his own explosive the consumption of dynamite is kept as low as possible. This will influence the total expense as the cost of the explosive amounts to 60 to 70 per cent of the total cost. On the other hand the quantity of cleaning work to be done by hand is reduced by stronger loading, although this must be reckoned against the additional expense. Normally, the object is to obtain the correct balance between use of manpower and explosives. The economic profit from ditch-blasting is greatest on soil which is most difficult to dig by hand, but the

Photo 1.—A Completed Ditch blown in dry peat type of soil.

greatest advantage in using ditch dynamite is the effective use of manpower. The amount of work achieved is increased five times over hand-digging methods, and at the same time the work is considerably easier.

Economics of the method

The prices quoted here are those obtained in Norway in the summer of 1954, the rate of exchange at that time was 19.5 krone to the £1 sterling. For ease of calculation one krone has been assumed to be equal to one shilling.

A box containing $2\frac{1}{2}$ kilograms of dynamite costs 10s.; the cost of a 100-gram cartridge is therefore 4.8d. Using Table I as the basis for the consumption of explosive it has been possible to calculate the cost of ditch-blasting on different soil types. The costings shown in Table II applies to dynamite only, workers are normally paid on a piece work basis, the amount or rate of pay including the cost of the explosive. Where the type of soil and moisture content are such that a heavy consumption of dynamite is necessary the rate of pay is correspondingly higher. Similarly, if the high moisture content of the soil makes cleaning difficult a higher rate of pay is necessary. The average rate of pay, taking dynamite consumption and difficulty of the work into consideration, varies between two and three shillings per yard of completed ditch.

Ditches dug by this method are therefore cheaper than those dug by hand and the rate of work is increased considerably at the same time.

Possible Military uses of the method

There is possibly a place for ditch-blasting in any engineer operation involving the construction of ditches. Where a large or small area is to be drained and men and machinery are not available the method appears to be particularly suitable.

Where drains have to be dug for new roads or the drainage system of existing roads has to be improved there appear to be many instances where ditch-blasting would be particularly advantageous.

Culverts crossing roads could be blown before the road itself is built, while side drains could be added before the final road surface is added. In the case of emergency where roads must be laid across very wet ground the use of explosives for ditches might provide a means of drainage which would make it possible to construct roads on an otherwise impossible site.

Conclusion

The advantages of the method have been stressed throughout the paper and they may be summarized as follows:—

(*a*) Saving of man power
(*b*) Alternative to large and expensive machinery.
(*c*) Speed of digging increased.
(*d*) Economy, especially on very wet sites.

The efficiency of ditch-blasting on moist sites is beyond question but insufficient is known about the use of explosive on dry mineral soil. The work carried out on this subject so far seems to indicate that the limit as far as civilian operations are concerned is an economic one. Further experimental work would indicate on what sites the method could be used for military purposes. In 1954 ditch-blasting was becoming very much more popular with farmers and was being used for purely agricultural purposes as well as forestry in Norway. The information available on this subject has undoubtably increased since that date and help from det norske Skogselskap could be obtained.

The supply of explosive presents another problem and the writer does not know if a dynamite of this type is manufactured in Britain.

Table I. The Estimated Consumption of Dynamite

Two main soil types have been defined, peaty soil and mineral soil. The peat may be well decomposed, moderately decomposed or badly decomposed, the main factor apart from the moisture content of the soil which effects the consumption of dynamite.

In the case of mineral soil the stone and clay content are of importance.

The moisture content of the soil is based upon the Norwegian classification given on page 262, i.e.

Degree I. No water in the cartridge holes, low water content.

Degree II. Some water in the cartridge holes but the soil is not saturated and there is no surface water.

Degree III. The soil is saturated, the cartridge holes are full of water and pools are to be seen on the surface.

All distances are measured in centimetres and all weights are in grams.

TABLE I

ESTIMATED CONSUMPTION

Type of soil	Size of charge in grams	Degree of moisture					
		I		II		III	
		(*a*)	(*b*)	(*a*)	(*b*)	(*a*)	(*b*)
Peaty soil							
Well decomposed	100	33	300	40	250	60	166
	75	25	300	35	215	50	150
Average decomposed	100	30	333	35	286	40	250
	75	25	300	30	250	36	210
	50	20	250	25	200	33	150
Badly decomposed	100	25	400	30	333	33	300
	75	20	375	25	300	28	270
	50	17	300	20	250	25	200
Mineral soil							
Free of stone	100	25	400	35	286	50	200
	75	22	340	32	235	40	188
	50	20	250	30	166	35	143
Average stone content	100	20	500	30	333	40	250
	75	17	441	27	280	33	227
	50	15	333	25	200	30	166
High stone or clay content	100	15	666	25	400	33	300
	75	12	625	22	340	25	300
	50	10	500	20	250	20	250

Columns: (*a*) Distance between charges in centimetres.
(*b*) Dynamite consumed in grams per metre.

Note. By use of 100 gram charges the depth of the ditch is 80 to 90 cm.; 75 gram charges the depth of the ditch is 70 to 80 cm.; 50 gram charges the depth of the ditch is 60 to 70 cm.

L

Table II. Estimated cost of ditch-blasting

This table gives the cost of dynamite only and does not include the cost of labour which involves an increase varying from 30 to 50 per cent on the figures given.

According to 1954 prices dynamite costs 4.8d. per 100 grams. The cost in this table is expressed in shillings and pence per 10 yards of ditch.

TABLE II

ESTIMATED COST OF DITCH-BLASTING

Type of soil	Size of charge in grams	Degree of moisture I	II	III
		s. d.	s. d.	s. d.
Peaty soil				
Well decomposed	100	12 0	10 0	6 7
	75	12 0	8 7	6 0
Average decomposed	100	13 4	11 5	10 0
	75	12 0	10 0	8 5
	50	10 0	8 0	6 0
Badly decomposed	100	16 0	13 4	12 0
	75	15 0	12 0	10 9
	50	12 0	10 0	8 0
Mineral soil				
Free of stone	100	16 0	11 5	8 0
	75	13 7	9 5	7 6
	50	10 0	6 7	5 7
Average stone content	100	20 0	13 4	10 0
	75	17 7	11 3	9 0
	50	13 4	8 0	6 7
High stone or clay content	100	26 8	16 0	12 0
	75	25 0	13 7	12 0
	50	20 0	10 0	10 0

Costs are for dynamite only and do not include labour; the cost is expressed in shillings and pence per 10 yards of ditch and is based on a unit cost of ten shillings per 2.5 kilogrammes (1954).

Sputniks, Moon Rockets and Martians

By MAJOR J. EWART, B.Sc., A.M.I.E.E., R.E.

ERRATA

The following errors occurred in the above article published in the June, 1958, R.E. Journal.

1. p. 154, seventh line below Fig. I.

$$---- \int ax^n = \frac{ax^n + 1}{n + 1} \text{ as shown, should read } ---- = \frac{ax^{n+1}}{n+1}$$

2. p. 157, bottom of page.

$$\frac{b^2}{P^2} = ---- \text{ as shown, should be } \frac{b^2}{p^2} = ----$$

3. p. 158, sixth line below Fig. III.

$$\int_\infty^r \frac{KMm}{x^2\,dx} ---- \text{ should be } \int_\infty^r \frac{KMm}{x^2}\,dx ----$$

Setting out Work for Earth Moving Plant

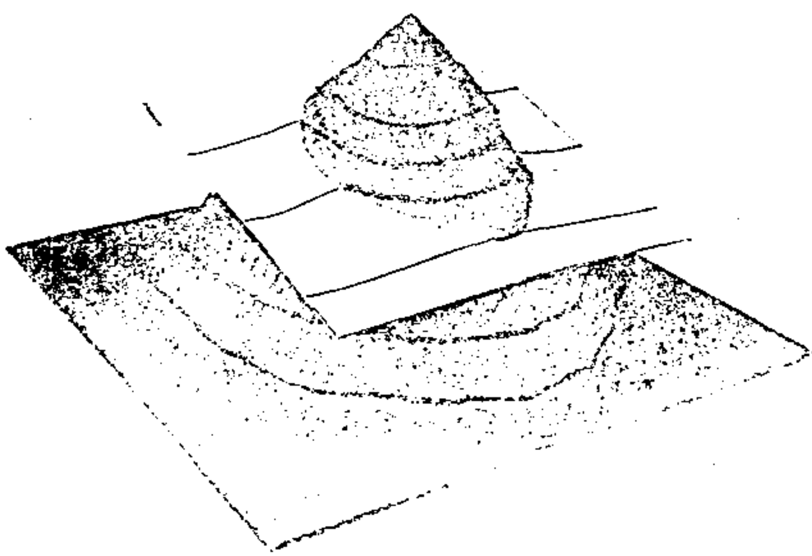
By Major J. P. Fitzgerald-Smith, B.Eng., A.M.I.C.E., R.E.

Introduction

Much has been spoken about the need for the careful control of plant during construction operations; but little has been written on the means of applying this control to plant engaged on large scale earth moving projects. Most engineers confronted with this problem apply some form of control, using survey methods that are more appropriate to setting out operations for road or drainage lines. It is in this fundamental approach that much of the difficulty arises during the later setting out. Essentially, the problem is a solid geometry one; and attempts to solve it by plane geometry methods may apparently simplify it, but in fact raise even more problems in the setting out stage and during the construction phase. The method described in this paper will show if the problem is tackled using the methods appropriate to solid geometry, that the planning, setting out and control are all simplified.

Students of geology will recognize in the method a marked similarity between the method now proposed and the method used by stratigraphers to plot boundaries of outcrops: indeed there is no coincidence in the similarity because it was this method that inspired the present article. As an illustration to the method a geological example will be studied. The photograph of the geological model shows a hill feature penetrated by a plane surface (in this case a boundary surface between two geological formations is represented).

The essential points to learn from this model follow from two definitions of geological terms, namely, dip, which is that line in the plane that has the



Geological Model.

Fig 1

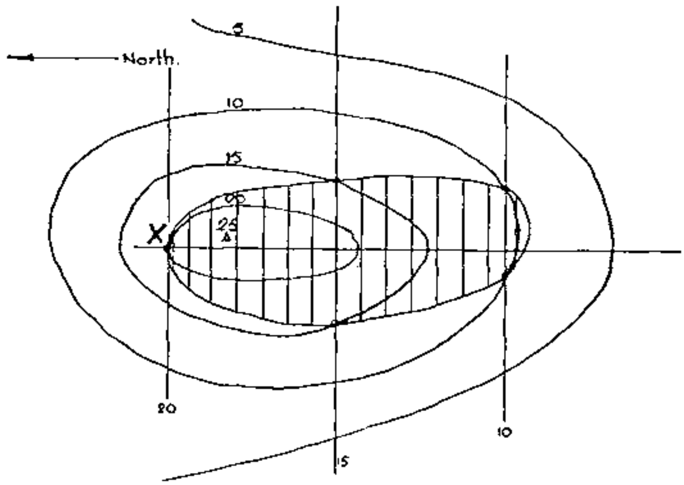


Fig 2

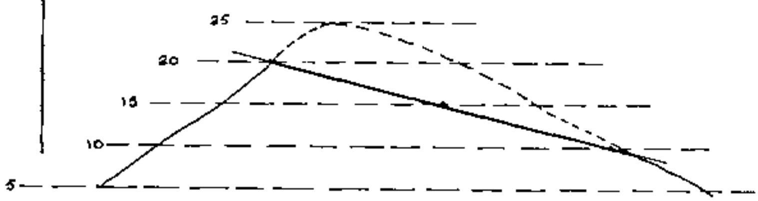
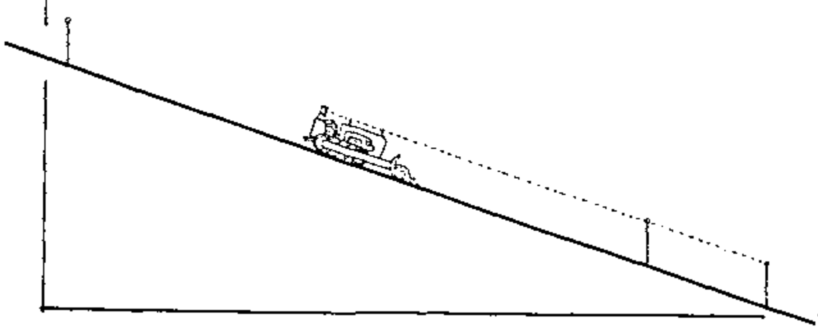


Fig 3



maximum angle of inclination with the horizontal, or more descriptively the direction of dip is that direction a ball bearing would roll if placed on the plane, and the angle of a dip is the angle this line makes with the horizontal. The other term is the line of strike, which is the line in the plane at right angles to the line of dip. It follows from this definition that strike lines are horizontal lines and these can be seen in the photograph as a series of parallel lines. It is quite in order to describe these lines by their level above any datum. It will also be seen from the photograph that a strike line through any level will intersect the contour for that level at one or more points. The method of drawing the outcrop of the boundary surface is as follows:—

Firstly the plane must be fixed in space, that is three points on the plane must be known, or a single point on the plane, and the dip of the plane would also be sufficient. Next strike lines are drawn at the same vertical interval as the contours have been drawn. Intersection points can now be marked where the strike lines and the contour lines for the same level intersect. Joining up these intersection points by a continuous curve gives the boundary of the outcrop. If the simple example included in this article is followed, the method will be clear.

Now it will be very obvious that if the plane surface in the above example represents the plane of construction which it is desired to set out, and which will eventually form the formation level, that the outcrop line arrived at in the manner described above will also represent the limits of operation, and a ready means of controlling the work is suggested by the use of the strike lines. An actual works example for a simple case will make the method clear. However, it will be seen that the solution for a very much more difficult problem follows exactly the same procedure and there are no complications.

Simple Example

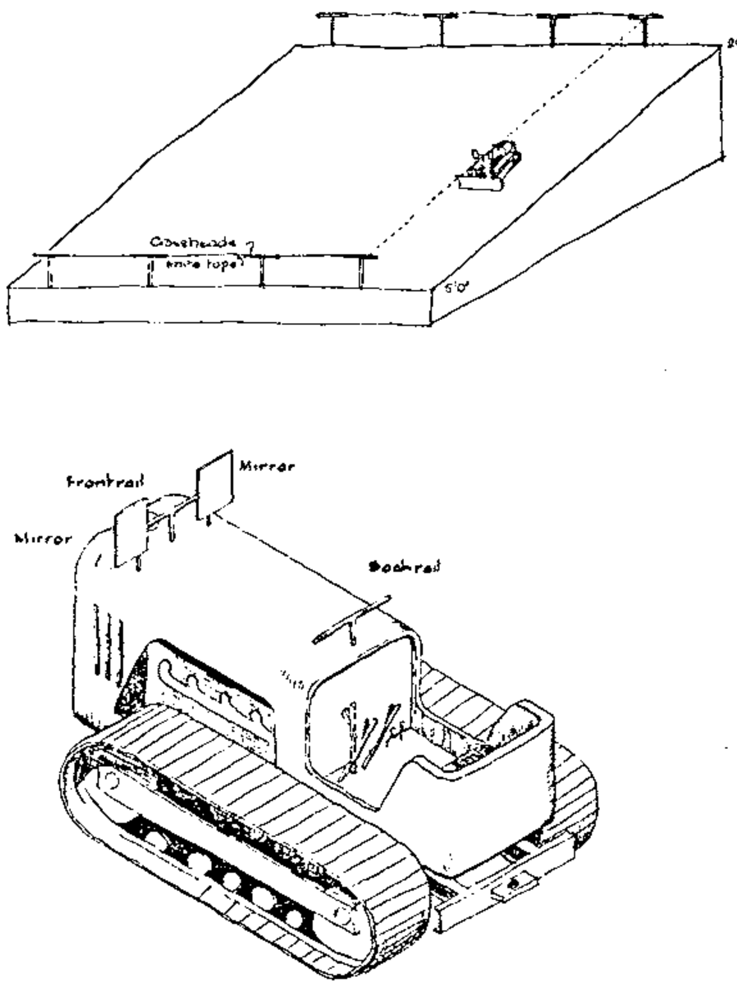
It is desired to cut a plane passing through the point marked X on the hill feature shown at Fig. 1. The plane is to dip to the south at an inclination of 5 ft. in every 100 ft. It is required to show the limits of the work and mark out the strike lines by which the work may be controlled.

Solution

Through the point X a line is drawn north-south in the direction of dip. Since point X occurs on the 20-ft. contour, the level of this is 20 ft. Now, if at 100 ft. horizontal intervals points are marked off along this north-south line, and horizontal lines at right angles to the line of dip are drawn through these points, these are then the strike lines for 15 ft., 10 ft., and 5 ft. respectively. The intersection of strike lines and contours for each level are marked and these intersection points joined up by a smooth curve. This represents the limit of construction. A section along the line of dip may be drawn to help visualize what exactly has been achieved; although there is no need for this to be drawn from the point of view of the completeness of the solution. This is shown at Fig. 2. A means of controlling this work is depicted at Fig. 3. The principle is the same as that used in aiming a rifle, namely a back sight and fore sight are aligned on targets set at appropriate levels. Details of how the work might be organized on a particular site using only two targets and a mirror sight on the tractor is shown at Fig. 4. (Page 274.)

A line of cross heads at a known height above the level of the strike line at each end of the work is levelled in. This height will be equal to the height of

Fig 4



the tractor sights above the base of its track. When the operator can sight the cross head at the lower end of the work in the space between the mirrors and the reflection of the cross head at the top end of the site on the same line, he can be assured that he is at formation level. With the heavy cut such as described in this article it may be desirable to bring the levels of the cross head down in 6-in. stages. This is easily done as only four levels are required to be set out at each corner of the site, the intermediate cross heads being boned in from this. A refinement to the method is to stretch white tracing tape supported on hooks at the level of the cross head which will assist the dozer operator in aligning his sights.

A More Complicated Example

It is desired to cut two planes in the valley feature shown in Fig. 5 such that one plane passes through the point *A* and intersects the other plane on the line *BC*, while the second plane passes through *D*.

Solution

The method applied to the plane passing through *ABC* only will be described although exactly the same method can be applied to plane *DBC*. In this case the plane is controlled by three fixed points. The first step is to determine the direction of strike and dip.

Steps in the Construction

1. Join the three points *ABC*. Since all three points lie in the required plane then all sides of the triangle *ABC* lie in this plane.
2. Find a horizontal line lying in the plane that passes through *C*. The level of *C* is 4 ft. and all that remains to be found to draw this horizontal line is to find another point in the plane at a level of 4 ft. Now the whole of *AB* is in the plane but one end is at a level of 10 ft. while the other is at 2 ft.; so a level of 4 ft. can be interpolated along this line, that is, it will be one-fourth the distance along *BA* from *B*. Call this *Y*.
3. Join *CY*, as this is horizontal and lies in the plane it must be a strike line for the level 4 ft.
4. A line parallel to *CY* through *A* will be the strike line for the level 10 ft. and similarly one parallel through *B* will be the strike line for 2 ft.
5. Any number of strike lines for any desired level may now be interpolated. If the levels are taken at regular intervals the strike lines will be equally spaced.
6. Intersections between strike line and contours of the same level are next marked (by circles in Fig. 5).
7. Joining these intersection points by a smooth curve gives the limit of construction.
8. A little consideration will show which area is in cut and which is in fill.

The solution of this problem by plane geometry methods would be cumbersome and setting out would be correspondingly more difficult. It will be seen by this solid geometry technique that the problem has presented little more difficulty in solution than for the simple example.

Determination of Earth Work Quantities

The work done during the planning stage can be readily utilized to determine earth work quantities involved. First of all consider how the outcrop line shown in Fig. 1 would appear if the level of the plane was increased

Fig 5

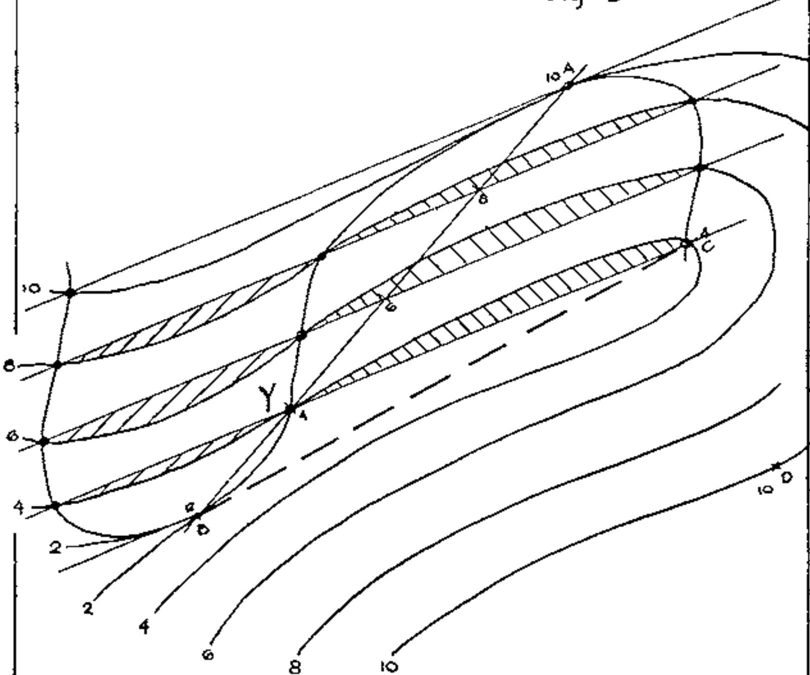
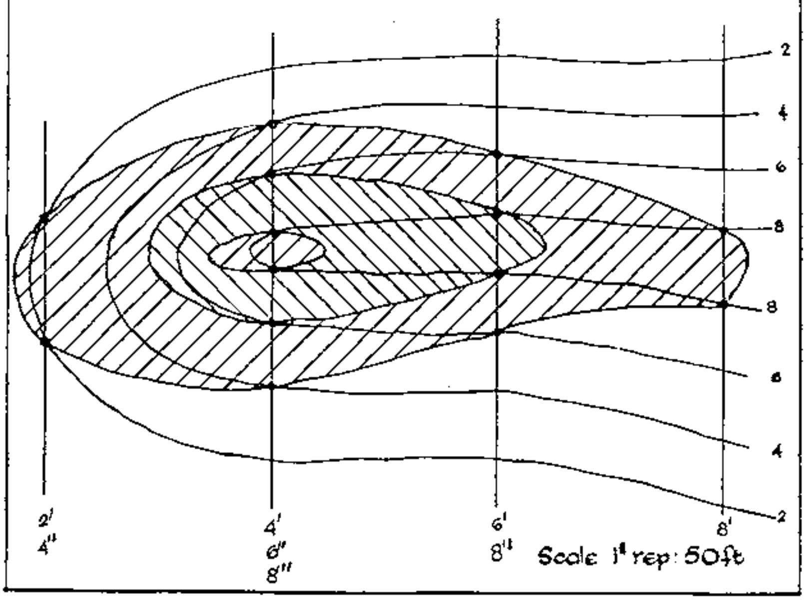


Fig 6



everywhere by 5 ft. Clearly, no further strike lines need be drawn, all that needs be done is to add 5 ft. to the levels appearing against each strike line. This will give rise to a separate family of intersection points through which a new boundary line may be drawn. It will be remembered that this boundary line shows the limit of excavation when the work has reached that particular formation level. The method of calculating the volume of earth work follows directly from this fact and from the fact that these formation planes are parallel to one another. The volume may be quickly calculated by taking the area of the curve between these boundaries at each phase and applying Simpsons Rule. Again, another worked example will clear up any uncertainties.

Example of Calculation of Earth Quantities

Consider the problem of estimating the volume of earth to be removed from the ridge like feature shown in Fig. 6 to produce the plane passing through Y with a dip of 2 ft. in every 100 ft. to the west. Boundary lines showing the limit of work when it has reached finished formation level and also when the construction plane is 2 ft. and 4 ft. above this are shown in Fig. 6. The areas enclosed by these boundary lines have been tabulated and using the well-known expression for Simpson's Rule the volume is:

A_1	A_2	A_3
548	8,050	26,650

Volume of earthwork removed by Simpson's rule:

$$\text{Vol.} = \frac{h}{3}\,[A_1 + 4A_2 + A_3] = \frac{2}{3}\,[548 + 32{,}200 + 25{,}650]$$

$$= \frac{2}{3}\,(59398) = 39{,}590 \text{ f.c.}$$

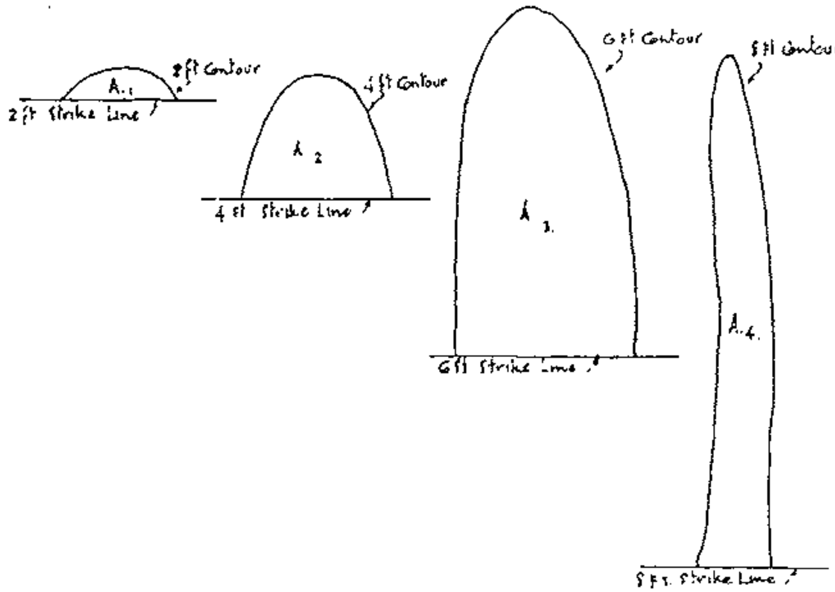
Alternative Method

An alternative method for which I am indebted to Lieut.-Colonel C. E. Warth, R.E., dispenses with the need to draw the lines representing the limits of construction at the three levels shown in Fig. 6. In this method once the lowest limit of construction line is drawn all that needs to be done is to take the area shown between a contour line and the strike line for the same level. The points of intersection will of course lie in the limit of construction line. Now since the contour and the strike line for any level all lie in the same horizontal plane these areas represent horizontal sections through the mass of earth to be cut or filled in order to produce the final plane of construction. All sections are parallel (all being horizontal) therefore Simpson's rule may be applied to these areas. The same example previously worked out will be used to provide a check. See Fig. 7 on page 278.

Conclusions

It has been shown that the simplest means of setting out a plane is to use strike lines for the plane. A method of setting up these strike lines suitable for use by mechanical plant has been described. The method has been used by the author to simplify planning and calculation of earthworks, but as far as is known the method of setting up profiles along the strike line with a travelling cross head on the tractor has not been used. The author would be interested to hear from plant users their experience of the method.

FIG 7.



A.1.	A.2.	A.3.	A.4
500	6120	9170	4120

Take Volume of A_2 A_3 A_4 By Simpsons Rule.
and add Volume of End piece between A_1-A_2

$$\frac{h}{3}\left(A_2 + 4A_3 + A_4\right) + \frac{h}{2}\left(A_1 + A_2\right)$$

$$\frac{2}{3}\left(6120 + 36680 + 4120\right) + \frac{2}{2}\left(670 + 6120\right)$$

$$\frac{2}{3}\left(46{,}920\right) \qquad + 6790$$

$$31{,}300 \qquad + 6790$$

$$= 38{,}090 \text{ f.c.}$$

It would have been preferable to have used an odd number of sections so that Simpsons rule could have been applied Directly without need for Addendum A_1-A_2.

A Trip to Jarvis and Penrhyn

By Major J. H. Clark, M.C., R.E.

The background to this unusual journey was Operation Grapple, the testing of the British hydrogen bomb. It is now well known that Sappers, supported by other arms of the Service and by the Royal Navy and Royal Air Force, prepared the base at Christmas Island in the Pacific and the target island at Malden. However, it is not so generally known that they were also employed on two other islands, Jarvis and Penrhyn, which also played a small but important part in the operation. This is the story of the initial preparations and tasks that were carried out on these two islands during January 1957, some six months after the Sappers started work on Christmas Island.

Jarvis is an uninhabited desert island belonging to the U.S.A., just south of the Equator (0° 23′ S.) and about 200 miles south-west of Christmas Island. Penrhyn is an inhabited island about nine degrees south and about 600 miles south of Christmas Island. Its sovereignty is disputed by the U.S.A. and New Zealand, but it is administered by New Zealand as a part of the Cook Islands group. It has about 500 Polynesian inhabitants, who are Christians. An alternative name for the island, and shown as such on many maps, is Tongareva.

Both islands can be found marked in the normal school atlas, both being about 159 degrees west, and right in the middle of the Pacific Ocean. The older school atlases show them both as British, and they are not by any means the only islands in the Pacific whose sovereignty is or has been disputed or altered.

For this operation both islands were to be used as Decca Navigational stations and Penrhyn was in addition to be a meteorological station. Christmas Island was also to have a Decca navigational station. Each Decca navigational station consisted of three 150 ft. masts in a straight line at 300 ft. intervals. These masts carried a powerful transmitting aerial capable of sending radar signals across many hundreds of miles of ocean. Jarvis was to be the master station and Christmas and Penrhyn the slave stations to the north and south. Any ship or aircraft carrying a Decca navigational instrument in the area covered by the signals from the three stations would know precisely and continuously its exact position in the Pacific Ocean.

The tasks at Jarvis were:—

(*a*) To get the equipment ashore through the reef and breakers.

(*b*) To construct concrete bases for the three masts (the masts themselves were to be erected on the next trip the following month).

The tasks at Penrhyn were:—

(*a*) To construct concrete bases for the three masts, and twenty-seven gabion anchorages.

(*b*) To erect the three 150 ft. masts and stay them to the anchorages.

(*c*) To rehabilitate the old war-time American airstrip so that it could take Shackletons, using local labour.

(*d*) To reconnoitre a camp site, camp facilities and meteorological facilities for the R.A.F. and civilian personnel arriving in March.

H.M.S. *Salvictor,* a small salvage, diving and mooring ship, was used for this expedition. She had been specially fitted so that she could carry an amphibious vehicle (a DUKW) on her deck aft. For this trip she embarked a DUKW, with its two R.A.S.C. drivers, two surf-boats, a Landrover and ½-ton trailer, an improvised sheer-legs complete with holdfasts, tackles, etc., fifteen drums of cement together with all concreting stores for hand-mixing, including water supply stores, two winches with sleepers for bedding them in, Sommerfeld track, Danarm saw, six naval depth-charges, Decca equipment including two generators, and 10 tons of Dieso. In addition the Sappers embarked many small stores and tools.

There was very little room in this ship for additional personnel. Her normal complement was five officers and about fifty ratings, but she was already carrying a sixth officer, and room had to be found for two R.A.S.C. drivers, a R.A.F. mast-rigger and two Decca civilians. There was therefore no question of taking a Sapper working party and it was decided that the engineer work would have to be done by naval ratings under the supervision of a Sapper officer and warrant officer. A most valuable addition also was a Sapper lance-corporal storeman, who was also an excellent carpenter and joiner.

The ship sailed from Christmas Island early on 5th January and arrived off Jarvis early on 6th January. This area is a porpoise breeding-ground (like the Azores) and the ship approached through an enormous shoal of porpoises. Soon the whole sea seemed alive with these huge fish, leaping and plunging in graceful curves, as far as the eye could see. The next remarkable sight was a dark cloud over one corner of Jarvis. Jarvis is a bird colony and the air over the island is so thick with gannets, terns and frigate-birds that they are a hazard to low-flying aircraft. Also the ground is littered with eggs and chicks. The sole animal life seen on the island were six wild cats and it is thought that, as there is no fresh water on the island, these cats subsisted entirely on bird eggs and chicks.

Unlike many coral islands, Jarvis is a solid piece of land, unbroken by lagoons, though it has clearly had at one time a large central lagoon which has now filled in; and in the centre is the only vegetation, a green straggly weed which looks like grass from a distance. The island is flat, roughly rectangular in shape, two miles by one mile, and is surrounded by a reef. Seventy years ago the British Phosphate Company worked guano there, and the workings and remains of decauville track and the ruins of shanties can still be seen. They blew a wide gap in the reef so that they could load the guano into ships waiting off shore in the lee of the island on the western side. This gap has now grown shallow with many coral-heads, some within a foot of the surface, and it was known that this gap would probably only be suitable for surf boats and unsuitable for the DUKW. It was also known that there was another gap at the south-west corner. It was a natural break in the reef, deep but narrow, and it was hoped that it would be possible to get a DUKW through it.

The ship anchored close inshore in deep water, where the coral shelf dropped sharply, opposite the western gap. The Sapper officer and the ship's first officer went ashore by surf boat, followed in the next lift by the two DUKW drivers. This gap was clearly impossible for DUKWs. The surf boat had had some difficulty in avoiding coral-heads as the breakers swept it in, and a DUKW was far less manoeuvrable in those swirling, seething waters and drew over four feet when loaded. The party then walked down to the south-west gap. This could only be seen by close inspection from the shore because it was so narrow that the breakers broke across it as if the reef was continuous. The DUKW drivers were not unduly dismayed by the narrowness of the gap nor by the breakers coming straight through it, because they noted that the breakers advanced regularly keeping parallel to the shore and without any tendency to slew sideways, so that there seemed little likelihood that the DUKW would be thrown on to the flanking rocks nor broach on the shore as long as it kept going under power. Also the exit from the gap was good, being firm, gently-sloping sand. Neither DUKW driver had previously driven a DUKW through such large breakers nor in such narrow waters in the open sea, but they both courageously agreed that they thought it was possible and that they would try it.

The captain of the ship, who commanded the expedition, would not, however, hazard the DUKW until Sommerfeld track had been laid on the shore and a winch had been embedded at the top of the beach. This was a wise precaution to take, but involved getting this equipment ashore through the gap on a raft. A motor-boat towed the raft, made of timber and 40-gallon drums, to the gap and controlled it from off-shore by two long lines. A surf boat took two other long lines ashore from the raft through the gap. This gap was hazardous for the surf-boat as the breakers tossed it high in the air, and on occasions it capsized and its occupants were washed ashore a tangled mass of arms and legs. When the lines were ashore the shore party hauled the raft through the gap as fast as possible, whilst those aboard the motor boat paid out on their lines. Man-handling the winch up the beach and bedding it in was an exhausting process in the humid heat and blinding glare. By the time the Sommerfeld track was ashore and laid there was little daylight left, so the shore party returned by surf boat to the ship.

The next morning the DUKW made its first trip through the gap with complete success and received a resounding cheer from the shore party. Its first load was the sheer-legs, which was shipped made up as complete as possible, and which was quickly erected behind the beach, opposite the gap, by naval ratings under the instructions of the Sapper serjeant-major. This was a great test in the handling of men, and there were several awkward moments before Sailors and Sappers appreciated that there was no need to invoke naval or military discipline so long as good humour prevailed. Several little difficulties were caused by terms having different meanings in the two Services. For example, when hauling on a lifting-tackle and told to check, Sappers will stand fast, holding the running end of the fall and taking the load, whilst Sailors will move towards the tackle holding the running end of the fall, but allowing it to run slowly through the blocks so that the load is gently lowered. Fortunately good humour prevailed throughout the expedition, and this was to some extent due to the mutual respect which each Service had for the other when they observed how efficiently they performed their own tasks and how willingly they would try their hands at the other Services' tasks. Anyway, on a beach, Sailors' and Sappers' tasks intermingle, and Sappers would pull happily on an oar in a surf boat, whilst Sailors worked on an R.E. type winch ashore. It was indeed a task for the Royal Marines, but the few that were on Christmas Island were already heavily engaged on port and beach duties.

On the next three trips the DUKW brought ashore two Decca generators, a ton of Dieso, cement and concreting stores, all of which were unloaded by the sheer legs at the back of the beach. When the DUKW was returning from the fourth trip, the engine failed whilst she was afloat in the gap, and in a moment she was at the mercy of the breakers. The shore party dashed down to the winch and tried to get the hook on to her stern to drag her out, but she had already been hit by two breakers in succession and had broached and grounded. This was serious because further breakers would tend to turn her over sideways, and a DUKW had already been lost on Malden Island in this way. However, the driver kept his head, and in spite of the buffeting that he received he managed to get the engine started and to reverse sideways and backwards along and on to the beach, before the shore party could take up on the winch.

Later the DUKW went out again safely, but as the tide was falling, the Captain of the ship decided to make no further trips that day. The shore party went ahead with digging the holes for the mast bases and fixing the shuttering in place ready for concreting the next day. The two Decca civilians pulled their weight splendidly throughout, both as technical advisers and as working numbers in the general chores on the beach. One had been a radio officer in the Merchant Navy throughout the worst days of the war, and later had had experience of Decca stations in such remote places as Newfoundland and the Sahara. In the Sahara he had been one of a team of three, the other two being a Frenchman and an Arab. None of the three spoke either of the other two languages, yet they apparently had an interesting, if not hilarious, time waiting for the monthly supply truck to reach them! The other had been a radio technician in the R.A.F. and had had experience at a Decca station on a remote desert island in the Persian Gulf. Both were married.

The next day the DUKW did two further trips with diesel fuel. After the first trip the sheer legs were backloaded as diesel drums could be unloaded by hand. After the second trip the DUKW was kept ashore to help with the concrete work. Sufficient coral shingle was found on the beach to make a good concrete, using sea water and coral sand. The concrete was hand-mixed on a large mixing-board, round the edge of which a 6-in. retaining board was nailed. When a complete mix for one base was ready, the DUKW towed the whole board up the beach to the site, the farthest haul being about 300 yds. It was difficult to avoid running over the young sea birds that littered the whole island. After the three mast bases had been poured, leaving a central hole for positioning the bottom section of mast with a rag-bolt, all the equipment except the winch was loaded into the DUKW. The winch was left in case it should be required for the next trip, and the ship carried a second winch if one should be required at Penrhyn. The DUKW then made its last trip back to the ship. This was quite a thrill, as it was the first time she had had to go out against the breakers fully loaded with men and equipment, and she had to negotiate two breakers before she was fully buoyant and clear of the rocks beneath and on either side. She took them both magnificently with engine going flat out and the whole hull vibrating as if she would burst. There was a tremendous back under-tow to the breakers which helped the craft out, and it was necessary to take full advantage of this after the first breaker in order to breast the second one. The second breaker was enormous and towered over the front of the DUKW, so that there appeared to be no escape from being swamped, but she rose to it, nose up and over and then nose down the other side with propeller racing out of the water, and then she was away and out of the gap.

The DUKW was hoisted back on to the ship's deck, and the ship sailed soon after midday on 8th January. The task at Jarvis had been completed successfully and ahead of schedule. It was a great experience, battling with Pacific breakers on a coral reef on a desert island. Relaxing in the ship's wardroom afterwards, talk naturally reverted to "Treasure Island" and other tales of pirates in the South Seas, coping with similar conditions, and one marvelled at the variety of Service life, which at short notice will transport one from the bowler-hatted, suburban-train existence at the War Office to all the rigours of a desert island. What a pity that one cannot publicize life in the services as being adventurous, because in fact so much of it is humdrum!

The trip on to Penrhyn took less than three days and was uneventful except for sighting whales spouting water. Early on 11th January the ship dropped anchor off the long, low palm-fringed coast. It was a pleasure to see green vegetation again, with a few huts and stone buildings dotted about. Penrhyn is a ring of long narrow islands round a central lagoon. The reef is almost continuous along the whole 40 miles of the circumference, but there are two gaps, one in the west and one in the north-east. The one in the west is the main approach to the atoll and the only one that the local trading steamers can use. Near this passage is the main settlement of Omoka on an island 4 miles long but only about 400 yds. wide at its widest point. On this island the Americans built an airstrip during the last war, and it was planned to rehabilitate the runway. Being in the rainy belt, there is lush tropical vegetation, but few tropical fruits are grown as the inhabitants find it is less effort to open tins bought from the trading store. Hurricanes rarely strike the island badly, as it is just on the edge of the hurricane area. The civil authority was the Resident Agent, a charming and intelligent Maori, a member of the Islands Administrative Service, based on Rarotonga and thence on Wellington. To assist him whilst Operation Grapple was in progress, the New Zealand Government had sent a liaison officer to the island on 9th January, where he had landed on the lagoon in a flying boat.

The Captain found that the anchorage off the reef was dangerous, as the wind swung his stern inshore, so he weighed anchor and did a circle out to sea. Whilst the ship was doing this, a motor launch was seen inside the lagoon approaching the passage. It contained the New Zealand Liaison Officer, the Resident Agent, a pilot and many islanders, curious to see this unfamiliar ship at close quarters. The pilot assured the Captain that he would be able to take the ship through the narrow passage and that the ship's draft of about thirteen feet was not too great. The Captain had no stern anchor, so not being able to anchor off the reef, he had little choice but to try to take his ship into the lagoon. This he did without incident, though there were some anxious moments, as the wind was blowing across the passage and it was difficult to prevent the ship yawing. Once inside the lagoon it was possible to see and avoid the coral-heads, and the ship anchored about a hundred yards from the wharf off Omoka. An easy exit for the DUKW was found in the little harbour close to the ship, and the reconnaissance parties were quickly ashore. As the DUKW made its first trip inshore, all the villagers turned out to watch, thinking it was an ordinary motor boat. As it climbed ashore and moved on its wheels, curiosity turned to surprise and alarm and they scattered in all directions wondering what this monster would do next.

The population of about 500 included about 200 men, and about 150 of them had gone away for several months' pearl fishing at Manihiki, so the useful labour force, excluding old men, was only about twenty. This was quite a setback, as it reduced the labour force for the work on the airstrip. The Decca mast bases were sited on the lagoon foreshore to the north of Omoka, just clear of the palm trees. Local advice was taken on high tide marks and the effects of storms. The lagoon was very shallow there for several hundred yards and the tide crept in over the coral shelf, so that there was no wave action at all. The damp beach made a good earth and tended to increase the efficiency of the aerial.

The sheer-legs were quickly erected on the beach and the Landrover and trailer were unloaded from the DUKW. Both were immediately filled by little black children and a number of toothless old grannies. The children insisted on riding in the Landrover all the time it was there. They sang songs as it went along, some English, some in Rarotonga language, as they are taught to be bi-lingual at school. When there was a rain squall, they started on "Rain, rain, go to Spain".

The rest of the equipment was quickly unloaded and the concrete mast bases poured. Naval ratings, under the instructions of the Decca civilians, erected the 150 ft. high masts very quickly and also dug out the anchorages and inserted the gabions filling them with coral rock. The rock was brought from the nearby reef in the DUKW. The mast base positions were fixed in relation to the one Trig Point on the island by a survey carried out by the ship's navigating officer. The Sapper officer had a sneaking feeling that perhaps the honour of the Corps was at stake when a survey had to be carried out on land by a sailor. However, he decided that as he was busy on other simpler tasks, and as most of the survey had in fact to be done in a small boat over water, and as his recollections of his survey course had got mixed up with dim memories of strong pre-war cider in Devonshire inns in summer, it would therefore be wiser not to press for the honour of performing this difficult technical task. This proved to be a fortunate decision, as the navigating officer, competent though he was, had considerable difficulty with the survey, and the Sapper officer was relieved when the task was completed without his assistance being called for.

The airstrip lay at the southern end of the island and was a clearing through the palm trees. The runway was 7,100 ft. long and 250 ft. wide, with a slab of concrete at the northern end 150 ft. square. The pavement was made of lagoon mud, a well-graded fine coral, which was in good condition and merely needed light grading to remove tussocks of grass and a flaky crust. However, the little local labour that was available quickly got to work clearing the tussocks and 300 ft. of approaches at either end of the runway. They also started work on clearing a fringe of palm trees on the eastern side, which acted as a windbreak, in order to ensure that aircraft did not suddenly run into dead air just before touching down.

Camp sites for R.A.F. meteorological parties arriving in March were found near the village. Raised concrete slabs used for hut bases by the Americans during the war were available. Two 10,000 gallon water tanks had been constructed under New Zealand Government arrangements under a large catchment roof and were already filling up with rainwater. This was the only method of obtaining fresh water on the island, and every roof was a catchment area. Meteorological station and wireless station sites were also selected.

There were also two social events during the ten days the ship was at Penrhyn. The first was a children's party on board the ship. All the little brown boys and girls were in their best clothes, and very smart they looked. The sailors were dressed as pirates and the ship was draped with flags and bunting. The biggest attraction was the DUKW which took the children for rides in the lagoon. The other notable event was a christening on board the ship on a Sunday morning. The child had been born soon after the ship's arrival, and the mother was determined that it should be called after the ship—Salvictor. It was never revealed whether the child was a boy or a girl, but it was duly christened on board in a most impressive ceremony. A female choir, dressed in white, sang hymns and responses in the Rarotonga language. The local minister took the service and christened the child using the ship's bell as a font, but the Captain had a fair share of holding the baby.

And so, having completed all the tasks, the ship sailed on 21st January, passing out through the narrow gap in the reef without incident, and reached Christmas Island three days later. There it was promptly put in quarantine as there was a case of measles aboard, which had been contracted at Penrhyn, where there had been a recent epidemic.

There are no important conclusions to be drawn from this story, but it does emphasise that a Sapper's life is an interesting one and may take him to the very ends of the earth in the company of that excellent Service, the Royal Navy.

Archeological Excursion

By "B.C."

THE Controller of Antiquities to the Provincial Government of Cyrenaica, who normally resides at Cyrene, had hinted to the C.R.E. on various occasions when he had passed that way and paused to display the ancient wonders to senior visitors, that among other assistance he would welcome from the Royal Engineers was a small job of re-erecting a column or two at the Temple of Zeus.

The suggestion, though tucked away for reference, had been received rather non-committally, as it was obvious that a fair number of soldiers for some time would be needed, and, normally speaking, the establishment did not cater for this sort of thing. However, with the reversal of British military intentions in Cyrenaica, the first thing to go was the building programme, so rapidly, in fact, that nearly completed buildings were stopped in their stride.

Official policy, however, took some months to hatch out and in the interim soldiers were flowing in to bring the unit up to the strength of its recently approved increased establishment.

There then arose that rare peculiarity, as regards R.E. Works establishments at least, of too many soldiers for too little work. Some form of collective training appeared to be quite the most profitable way of taking advantage of the situation and a combination of fieldworks and bridging, on a scale not usually attainable by the unit, seemed to offer the maximum benefit.

Most stations in Cyrenaica lie at sea level, which is hot and sticky in the summer, and are surrounded by the minimum of vegetation. Cyrene lies at nearly 2,000 ft. and in one of the prettiest parts of the Gebel Akhdar with pine woods and other greenery in the vicinity. Also, apart from Leptis Magna in Tripolitania, Cyrene is the largest exposed archeological site in Libya, if not in North Africa, and, being built on a hillside can be easily viewed from numerous vantage points. About fifteen miles away is its old port of Appolonia, now partly submerged, but still with interesting ruins as well as sandy beaches suitable for periods of physical training.

A fieldworks training camp at Cyrene to re-erect columns of an old temple seemed an ideal solution. Good field engineer training, the best climate with the most picturesque surroundings in the country, interesting work, canvas and open air instead of barrack room and dining hall, rope pulling instead of pen pushing, in fact, a really healthy change.

Small reconnaissance parties went off at intervals to survey the ground. Appreciations as to the manner in which one large piece of stone might be placed ever higher on another, induced in debate shade temperatures exceeding the normal, until subsequently reduced by the application of chilled fluids.

The drawing up, too, of a programme, stores lists, transport requirements and general administrative instructions provided interesting exercises in staff work differing from the hum-drum of works services.

In the meantime the necessary blessings were sought and obtained from higher authority.

Archeologically, the temple is usually dated about 480 B.C. and it is clear (to the archeologist) that it had needed extensive repair prior to its partial demolition during the Jewish revolt of A.D. 115. In the subsequent rebuilding the large outer columns were not used and so have laid prone ever since. These columns were (and one again now is) 30 ft. high and consisted of nine drums 2 ft. 9 in. thick, the bottom one being 5 ft. 6 in. in diameter, surmounted by a capital 9 ft. square and 5 ft. 3 in. thick.

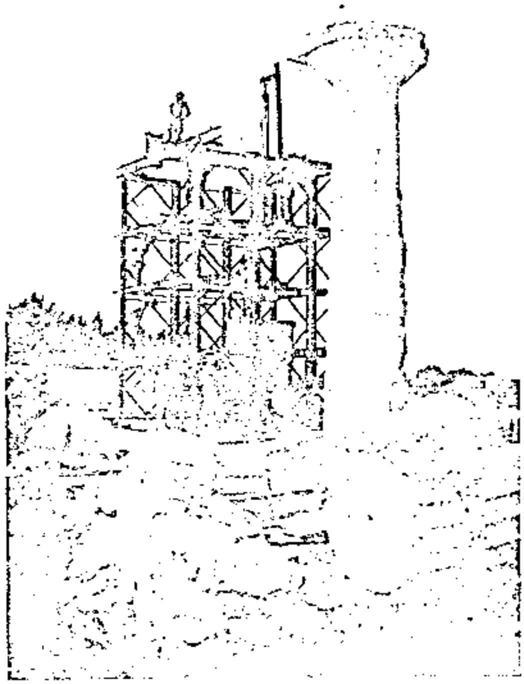
An experiment, after Archimides, was performed on a fragment of stone from which it was reckoned that the capital weighed 9 tons and the largest drum half that amount.

The plan for erection was to build a Bailey tower astride the base and out towards the fallen blocks and to lift them by chain tackle running on a gantry beam. The tower, in the first place 20 ft. of double-triple, to rise with the column by the addition of first one then another bay of single-triple.

A camp for sixteen men was established by the end of June, its idyllic setting being somewhat marred by a stores marquee and other camp structures, not to mention a hoard of small boys who were, however, less of an irritant than usual as, in exchange for crumbs, sizeable ones, that fell from the richer men's table, they performed a considerable portion of the camp conservancy.

Moving the drums into position for lifting, slinging them and finally placing them required considerable ingenuity, fathoms of cable, lots of packing, rollers and wedges, to avoid damage to the much weathered soft stone.

The capital, which had some rather large lumps missing, was drilled by hand at its centre of gravity and a 2 in. M.S. bar with forged eye let in. Two 5-ton chain blocks were used for lifting it, and during the lifting and lowering



Bailey tower showing method adopted for lifting stone into position.

it was necessary to remove and replace transoms successively to clear its 9 ft. width whilst maintaining rigidity.

After the completion of one column, a half column was erected on the adjacent foundation and two single drums placed to give an impression of the corner of the temple, and incidentally to perpetuate a form of the Cyrenaica district sign.

Work was completed, camp dismantled and stores returned by the first week in October.

A very large proportion of the unit passed through the camp, some of them twice, in fortnightly periods. The training value obtained was considerable; the archeological interest aroused, stimulated by frequent visits of the Controller himself, was surprisingly great; the enjoyment was quite evident and the material result aesthetically pleasing.

The Captain's Gig

By Lieut.-Colonel N. L. Blandford, R.E. (ret.)

Saturday morning, 25th April, 1908, the day of the Cup Final of fifty years ago, started as a bright sunny spring day in the Solent area. But about mid-day there began a blinding snowstorm, and in a very short time the snow was more than a foot deep and all traffic—even the Portsmouth trams—had been brought to a standstill.

In the Solent, visibility was reduced almost to nil, and two great ships were groping their way through the murk. The ten-gun cruiser, H.M.S. *Gladiator*, Captain Lumsden, was returning to Portsmouth from exercises off Portland, and the American liner *St. Paul*, 5,874 tons, Captain F. Passow, was feeling her way down the Solent outward bound from Southampton to New York.

Shortly after 2 p.m., when the *St. Paul* was in the area roughly between Fort Albert in the Isle of Wight and Hurst Castle on the mainland, her Captain saw something grey loom up dead ahead. He immediately ordered "Full speed astern" but, although by this action he may have lessened the impact, it was too late to prevent a collision, and the bows of the *St. Paul* drove a 50 ft. hole amidships in the starboard side of that "something grey" which was in fact H.M.S. *Gladiator*.

Some of *Gladiator*'s crew were hurled into the sea, such was the shock of the impact. Captain Lumsden immediately ordered all watertight doors to be shut, and fell in all hands on deck, where it is on record that they paraded as for ceremonial. He made full steam for the shore, grounding off the Isle of Wight, about 300 yards off Fort Victoria Pier, near Yarmouth. As she grounded, *Gladiator* heeled over and lay on her starboard side, more than half submerged.

22nd Company, Royal Engineers, was at that time stationed in Fort Victoria, under the command of Captain A. R. Walker, R.E. The disaster was seen by Lieutenant Wright, R.E., of that company, who immediately gave the alarm. The following account of the rescue operations is taken from Captain Walker's own report of the incident.

"As soon as Lieut. Wright, R.E. had given the alarm all the N.C.O.s and men who were in Fort Victoria at the time turned out and proceeded to the foreshore near the pier. Some tried to launch the Royal Artillery targets, but found it impossible, as they had been securely fastened with wire rope, others went to the R.E. boat sheds which they broke open, but only found a four-oared racing boat in a leaky condition, and a private sailing boat, which could not be used as it was impossible to row it; again, others broke open a private shed belonging to Colonel R. P. Crozier but found only a yacht's dinghy. A strong flood tide of about two knots was running at the time, and the sea was choppy.

In the meantime the pinnace of H.M.S. *Gladiator* came ashore full of men. It was washed broadside on the beach, and was listing to seawards so much that it got full of water.

No. 24984 Corpl. H. D. Griffith, R.E. and No. 755 L.Corpl. B. Poole, R.E., and the men who had arrived in her tried to launch her but could not do so.

L.Corpl. Poole stripped himself to the waist, swam out and brought in Torpedo Gunner J. H. Chapman, R.N., whom he handed over to Corpl. Griffiths, and then proceeded to swim out again and bring others in.

Corpl. Griffiths, in endeavouring to get Mr. Chapman ashore was dragged out of his depth, and only succeeded in rescuing him with the aid of an oar.

No. 16462, Bugler Ballard, R.E., assisted Corpl. Griffiths in getting several men out of the water, also going nearly out of his depth.

No. 11455 L.Corpl. R. Turner, R.E., No. 5245 Sapper B. Peacock, R.E., No. 151103 Sapper J. H. Southern, R.E., No. 23096 Sapper C. Hill, R.E., launched the before-mentioned racing boat, got into her and picked up Frederick Francis, Yeoman of Signals, Chief Stoker David Stacey, 2nd Class P.O. Clarles A. Gibbons and two other men. Sappers Hill and Peacock jumped out of the boat and proceeded to get these men ashore.

At that moment No. 22344 C.S.M. G. W. Greeth, R.E., who had just been in the water and had pulled Acting E.R.A. C. E. Berry ashore, jumped into the boat and called on L.Cpl. Turner and Sapper Souther to go out with him which they readily did, but they were driven ashore on to some piles, which made a hole in the bottom of the boat. Notwithstanding this they put off again accompanied by Gunner Nightingale and First Class P.O. C. Short both of H.M.S. *Gladiator* and picked up Lieut. Mainguy, R.E., 2nd Class P.O. Charles Saltmarsh, First Writer Cowdrey, and Steward Widgery.

C.S.M. Greeth jumped into the water to try and save Cowdrey, but he was already dead. Widgery died soon after.

By this time the boat showed signs of sinking so they put ashore.

I should at this point like to bring to notice the invaluable service rendered by Gunner Nightingale. In spite of the already very trying experience he had been through he not only went out in the boat assisting and shouting encouragement to the men in the water, but also worked assiduously on shore rendering first aid and resuscitating the men as they were brought up.

Whilst this was happening No. 2656 Corpl. J. Wiltshire, R.E., No. 16394 Sapper J. Peacock, R.E., No. 239 L.Cpl. R. Crisp, R.E., and No. 141 Corpl. G. Stenning, R.E., had broken open Colonel Crozier's boathouse and launched the dinghy, the two former first jumped into her and brought ashore L.Cpl. Clarke, R.M.L.I. Sapper Peacock got out and attended to Clarke on shore whilst L.Cpl. Crisp took his place in the dinghy and several men were brought in and handed to Corpl. Griffiths and Bugler Ballard.

In the meantime Corpl. Stenning divested himself of some of his clothing, put on a cork jacket, brought ashore the Captain's steward, and with the assistance of a bluejacket, carried him up to the N.C.O.'s mess. He then felt rather faint, so someone took off his cork jacket, but after taking some brandy he revived, ran down to the beach again, swam out six times, and brought ashore seven men (the last two he brought together clinging to a locker), until he finally sank down exhausted on the beach.

Whilst the men were being landed, the wives of the N.C.Os. and men, amongst whom I may mention, Mrs. Hodgson, Mrs. Griffiths, Mrs. Hardy, Mrs. Barnes, Mrs. Greeth, and Mrs. Wild (wives of N.C.Os. and men 22nd Co. R.E.) and Mrs. Twaddle (wife of the barrack labourer), lit fires, got hot water and blankets ready and between them attended to one officer and about forty men, who were injured or overcome by immersion or exposure. One of these died (Std. Widgery), seven were taken to hospital, but the remainder slept all night and were succoured in the quarters."

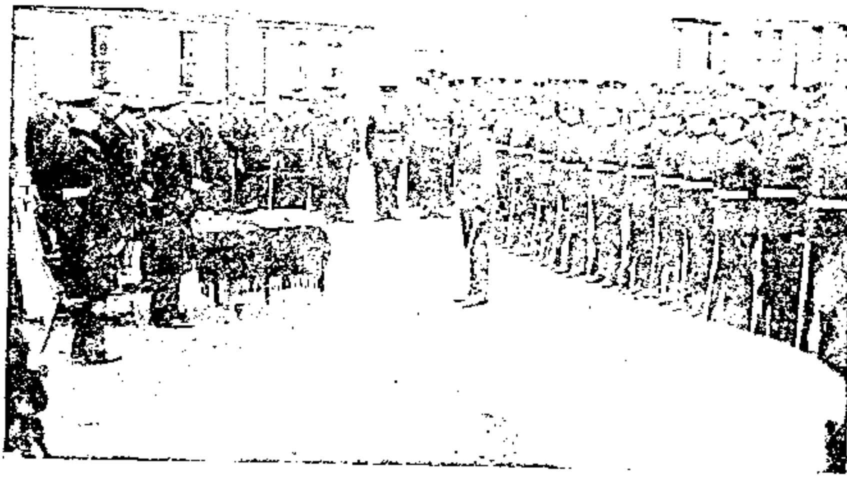


Photo 1.—Presentation ceremony.

Photo 2.—Launching the Captain's gig.

In recognition of the very gallant part played by 22nd Company, at a parade of the 4th, 22nd, and 42nd Companies, R.E., at Fort Victoria, on the 20th August, 1908, Admiral Sir Arthur Fanshawe, Commander-in-Chief at Portsmouth, presented the 22nd Company with a silver salver and the Captain's gig from H.M.S. *Gladiator*. They both contained the following inscription:—

"Presented by the Lords Commissioners of the Admiralty to the Officers, non-Commissioned Officers, and Men of the 22nd Company of Royal Engineers, in recognition of their assistance in the rescue of the crew of H.M.S. *Gladiator* on the 25th of April, 1908, when that ship was wrecked off Yarmouth, Isle of Wight."

On the same parade Corpl. Stenning was presented with the Royal Humane Society's silver medal, C.S.M. Creeth and L.Corpl. Poole

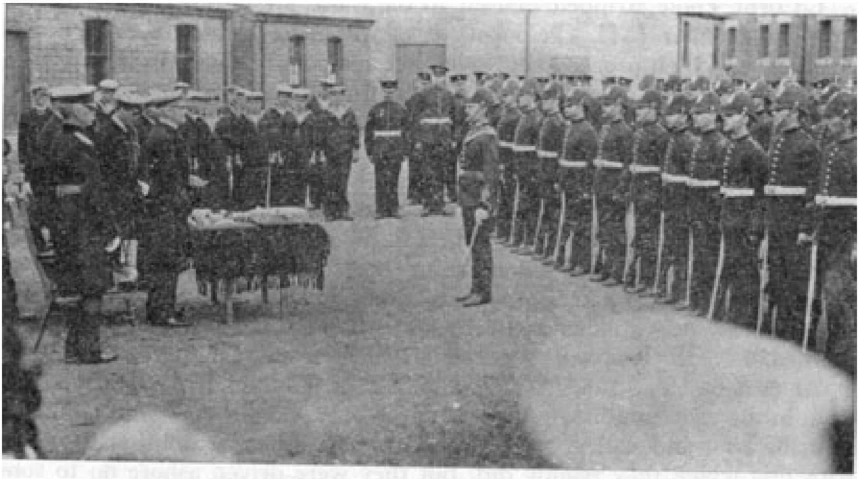


Photo 1.—Presentation ceremony.

Photo 2.—Launching the Captain's gig.

The Captain Gig 1 , 2

with the bronze medal, and the following with testimonials: Corpls. Griffiths and Wiltshire, L.Cpls. Crisp and Turner and Sappers Southern, Hill, J., and R. Peacock, and Bugler Ballard.

The gig, an eight-oared racing gig, was kept in the boat shed at Fort Victoria, and used as a lifeboat. Sgt. C. E. Kelly, R.E., remembers going out in her in that capacity at least twice in 1909. She also used to compete with considerable success in the regattas at Yarmouth and Freshwater.

In due course, 22nd Company disbanded at Fort Victoria, and was re-formed as 22nd (Boys) Company, R.E. at Fort Monckton, near Gosport. The gig was transferred to Fort Monckton, where she was housed in the Sally Port and continued to be used as a lifeboat and also for training in seamanship. In 1921, a crew of R.E. boys under a sergeant, manned her to rescue two boys and to recover the body of a man from a yacht which had capsized in the Solent. For this act a vellum testimonial was presented to the Company on parade by a representative of the Royal Humane Society, who referred in his speech to the earlier rescue of personnel from H.M.S. *Gladiator*.

In September, 1922, Sgt. C. E. Kelly, who had previously been in the Company in 1909, returned to the Company. He found the gig lying on the beach, badly knocked about. He interested the Padre in the old boat, and as she was no longer seaworthy, they managed to arrange for her to be brought up to the square, mounted on concrete blocks, and painted. From that time until the beginning of the Second World War she was cared for and cherished as an honourable trophy of the 22nd Company.

With the war came reorganization, and the disbandment of the 22nd (Boys) Company, and Fort Monckton ceased to be a Royal Engineers station. Owing, no doubt, to the war, when the Sappers moved out, the old gig could not be moved and she still rests, although in a very poor condition again, on her concrete blocks beside the square in Fort Monckton.

The Garrison Church of the Holy Nativity at Hameln

By 26 FIELD ENGINEER REGIMENT

THIS is the story of an old German army stable, later used by the British for a junk store and how it was converted into a church, leaving very few signs of its original purpose.

In early February 1953, when the Rev. D. D. Hart arrived in Hameln as Garrison Chaplain he found that the Garrison Chapel was an ordinary room in the administrative Barrack Block of Gordon Barracks. However, the old stable and junk store has already been earmarked by Lieut.-Colonel W. H. Aylwin, commanding 26 Field Engineer Regiment for conversion into a Garrison Church. Funds had been applied for and during the early summer of 1953 DM 7900 were allotted by H.Q. Hanover District.

The design of the church was done by 2nd Lieutenant M. de St. Croix, R.E., an N.S. officer who was a qualified architect, and Mr. W. C. Roberts, M.M., the Clerk of Works in Hameln. It was soon apparent that money was going to limit the scope of the work.

The existing building lies N.E.-S.W. At the western end there were big double doors. It was decided to leave these and make a new porch and entrance for the congregation at the east end. The altar was placed in an alcove, in a shallow parabolic wall set about three-quarters of the way from the east end. The effect is good.

The old stable floor was removed and was generally replaced by a high grade concrete floor which has since taken a high polish. The porch, the chancel and the outer edges of the central aisle were faced with tiles which though mottled give a general impression of black.

The chancel, immediately in front of the altar and the central aisle, leaving an edge of tile, are covered with a particularly fine royal blue carpet. Its origin is unknown but it is superior to that normally fitted in small garrison churches.

The main financial difficulty arose with the heating. The existing installation had unsightly long pipes with fitted fins. It was not possible to replace these with normal domestic radiators so they were encased in light oak and wire mesh frames which in fact set off the walls of the building far better than radiators would have done.

The murals, the kneeling desks before the front rows of chairs and the umbrella stand were given by units in Hameln.

The murals are the work of a local German, Herr Stanze; they cost DM 450 and are carried out in "sgrafitto" work which is a process characteristic of this part of Germany. The "Crucifixion" behind the altar has caused considerable controversy. It is at present (January, 1958) covered by curtains which match the walls of the alcove.

The murals were presented as follows:—

"The Crucifixion"—Officers Mess, 26 Field Engineer Regiment.
"The Nativity"—W.Os. and Sergeants Mess, 26 Field Engineer Regiment.
"The Annunciation"—Corporals Club, 26 Field Engineer Regiment.
"The Magi"—58 Independent Field Squadron, R.C.E.
"The Flight into Egypt"—125 Company (Bridge), R.A.S.C.

The kneeling desks before the front row of chairs in the nave were presented by 7, 29, and 60 Field Squadrons, 43 Field Park Squadron and 125 Company (Bridge) R.A.S.C. Surplus timber from these desks was used by Sapper Parker (7 Field Squadron) to make an umbrella stand for which the galvanized tray was made by 43 Field Park Squadron.

The big reading bible was presented to the church by 26 Field Engineer Regiment when they left Hameln.

The prayer book was presented by 60 Field Squadron in memory of one of their number (Sapper Reubens) killed in a traffic accident.

The blue carpet by the font was bought to commemorate the fourth anniversary of dedication.

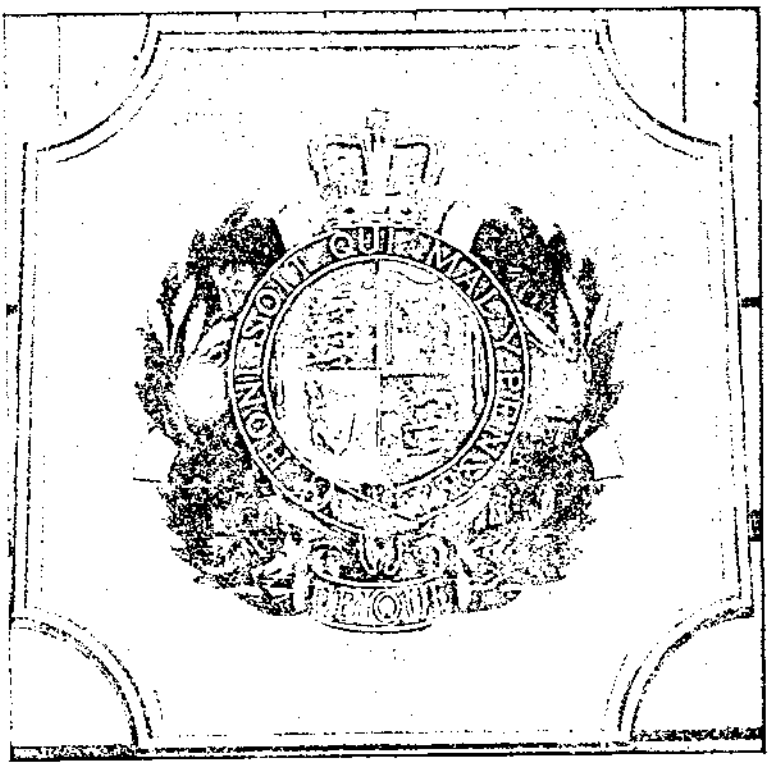
Behind the altar, there are two small rooms for vestry, with a door into the church, church office and parishroom. Over these rooms, there is, in the old hay loft, a room used for Sunday School, Cubs, and Brownies.

The church was finally dedicated on 9th October, 1953, by the Rev. R. Mayston, C.B.E., Assistant Chaplain General, B.A.O.R. The service was attended by members of the Roman Catholic and Lutheran churches.

All that remains to show the stable are the halter rings inside and out, the pillars and the double doors at the west end.

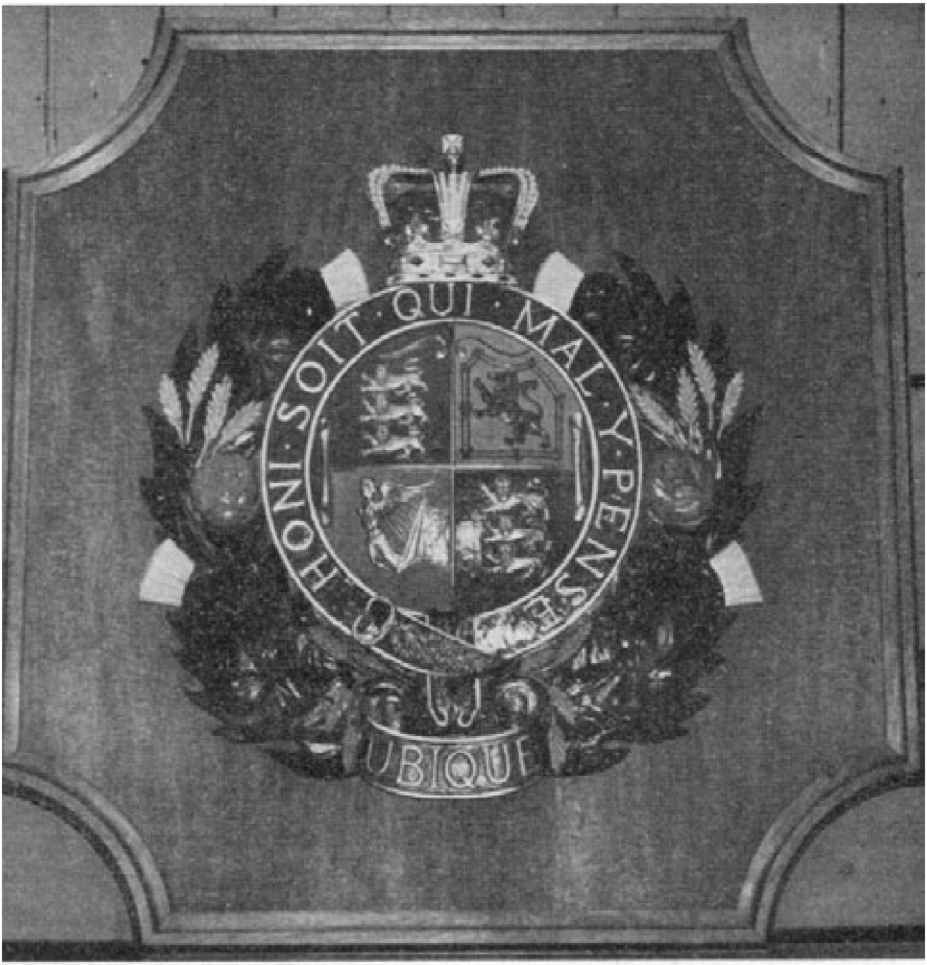
The Royal Engineers and British Columbia Presentation to City of New Westminster

Readers of the June 1958, R.E. Journal will have seen an article by Major Veitch, R.C.E. explaining the special ties the Sappers have with British Columbia, and in particular with the City of New Westminster. Part of the City's Centenary Celebrations included the official opening of the new City Hall. For this hall the Royal Engineers sent a plaque consisting of the badge of the Corps in 1858 which was fixed in the foyer, it was unveiled by H.R.H. Princess Margaret on 23rd July, 1958. The plaque was designed by Mr. J. Thompson of the S.M.E. from a belt buckle of 1858 on which the badge of the Corps was then worn. The design was 12 in. in diameter and this was sent with the belt buckle to John Bye an ecclesiastical carver in Oxford who was a Sapper. Bye carved it from limewood 3 in. thick and 4 ft. 6 in. in diameter in two months during his spare time.



The R.E. Park, S.M.E., Chatham, mounted the plaque on a mahogany blackboard 6 ft. square and painted it in heraldic colours. The result is a most outstanding piece of workmanship. The following inscription is engraved on a brass plate to be fixed in the wall below the plaque:—

"The badge of the Corps of Royal Engineers in 1858 when commanded in British Columbia by Lieut.-Colonel Richard Clement Moody, presented to the City of Westminster by the Corps of Royal Engineers in 1958."



The royal Engineers and british Columbia Presentation to city of New Westminster

Registration of Engineers

By Major D. M. R. Esson, R.E.

It is said that a small boy recently asked his father, "Is it true that you've got to be a Communist to be an engineer?" This query brings out the fact that from the President of one of the great chartered Institutions to a humble blacksmith's striker many people call themselves engineers: and from time to time ways and means of confining the appellation to the executive sections of the industries concerned are discussed. One of these ways is registration. It is the purpose of this article to consider how registration might affect sapper officers. For this we might first consider the analogy of the registration of architects in the United Kingdom.

Architects occupy a fairly closely analogous position to professional engineers: their work often overlaps, their contacts with the public are similar, so that the consequences of registration for engineers may be expected to be similar to that for architects. Architects, of course, are not the only professional people who require to be registered: doctors, dentists, accountants, lawyers, veterinary surgeons, nurses, chemists and so on, all require either to be directly registered or approved in some way by closely similar systems.

There are always unscrupulous sharks waiting to take advantage of the gullible sections of the public, and the period between the wars was no exception. In the building boom and housing shortage of the twenties, one particular type of racketeer decided to call himself an architect. Behind this façade, he sank to all forms of nefarious practice: he was in league with the jerry builder, he took commissions from hardware dealers and many more besides, he overlooked bad workmanship: in addition, he was probably hopeless as an architect. This sort of behaviour caused the reputable members of the profession to consider how best to preserve their own good name and to oust the blackguard. It was quite obvious that the pious resolutions of their professional institutions were useless: they lacked teeth. It was only when the improper use of the letters "A.R.I.B.A." occurred that anything could be done.[1] In that case an injunction forbidding further use of the letters was obtained. The only authority available to provide teeth was Parliament. Accordingly in 1931 a bill was promoted to register architects: this became law in due course as the Architects Registration Act, 1931.[2] But there were too many loopholes in this, so a further enactment was placed on the Statute Book in 1938[3]. This provides an adequate scale of punishment to enforce its provisions. The cumulative effect of these two enactments is to constitute an Architects' Registration Council with a duty of maintaining a register of architects, providing a Board of Architectural Education, an Admission Committee and a Discipline Committee. To be registered a budding architect must be a member of the Royal Academy or the Royal Scottish Academy, or have passed an examination in architecture at university degree level, or be otherwise acceptable to the Admission Committee of the Architects' Registration Council. If a registered architect commits a criminal offence, or is otherwise guilty of disgraceful conduct as an architect, the Discipline

[1] R.I.B.A. v. Hindle (1925), 69 S.J. 367.
[2] 21 and 22 Geo. 5. c. 33.
[3] 1 and 2 Geo. 6. c. 54.

Committee may recommend the removal of his name from the register. A scale of punishment is laid down in the 1938 Act,[4] which prevents anyone from calling himself an architect, other than a "landscape architect" or a naval architect, unless he is registered as such. Thus architects have a system ensuring that only qualified persons are admitted to the profession, and that the bad hats are ejected. The costs of the system are paid for by the architects themselves, by way of fees for registration, examination fees and so on.

But it is important to appreciate two points when considering the analogy between architects and engineers: the type of employer and the class of work. Civilian engineers acting in a consulting capacity, either directly or in salaried employment, are usually engaged by large organizations, whether governments, local authorities or great utility undertakings: those who work on the other side of the fence in the contracting businesses require substantial financial backing or its equivalent. The class of work, too, is generally on a much more substantial scale than "3 beds and all mod. con." There is not the same necessity and urgency to protect the more gullible sections of the public from the spurious engineer that there is from his counterpart in house building.

There is, of course, the right of any chartered institution to take steps to safeguard its good name, and indeed the Institution of Electrical Engineers in 1950 took similar action to the Royal Institute of British Architects when they obtained an injunction to prohibit a man from describing himself as a chartered electrical engineer.[5] Of more recent date the Institution of Civil Engineers has seen fit to write stern letters to various people falsely describing themselves as corporate members.[6]

In other parts of the English speaking world there is registration of engineers, and this question was considered at the 1946, 1950 and 1954 Conferences of the Engineering Institutions of the British Commonwealth. The 1954 Conference, reaffirming previous decisions, recommended that where registration was not in force "the public and the profession are best protected from the practice of unqualified persons . . . by maintaining a high standard of admission to the national institutions, and not by such registration." It is of interest to note that the New Zealand Institution's comment on this resolution was that "with the present increasing prestige of the New Zealand Institution of Engineers the advantages offered by registration are diminishing."[7]

The 1954 Conference also redefined the terms "professional engineer" and "engineering technician"? Put briefly, the former's work is "predominantly intellectual and varied, and not of a routine mental or physical character"; and he will be ready "to assume responsibility for the direction of important tasks in his branch."[8]

In spite of the resolutions of the Conference of Engineering Institutions of the British Commonwealth, which appear to be in conformity with the opinions of the great Engineering Institutions of this country, busybodies may at any time attempt to introduce registration of engineers. It would, of course, be paid for by the engineers themselves, and thus provide jobs for

[4]ss. 1 and 3.
[5]Institution of Electrical Engineers v. Emerson (1950), 67 R.P.C. 167.
[6]Chartered Civil Engineer, January 1956, p. 4.
[7]Chartered Civil Engineer, March 1955, p. 42.
[8]Chartered Civil Engineer, March 1955, p. 45.

the bureaucratic boys. Thus one is tempted to guess how far such registration would extend and what function it would perform.

The basis of registration must rest on theoretical knowledge and practical training, the two go hand-in-hand. In certain parts of the world engineers may be registered as such a fixed period of time after graduating or passing a qualifying examination. This system is satisfactory in general, but there is no sufficient test here of the value of the practical training. If the practical test is to be of any value it must comprise both an interview of the candidate by competent practising engineers and reports of his progress over a term by his employers. It may be noted here that this is substantially the requirement of the great institutions for admission to corporate membership. If then the basis of registration is to be this, it will parallel the great institutions, and it is hard to see the purpose it will fulfil other than the exclusion of the unqualified. If the qualifications are greater, the great institutions will oppose the scheme as unnecessarily complicating the professional life of engineers: if they are less, no great value will be placed on them. The privileges accruing from registration are hard to assess. Whilst it would be easy to prohibit non-registered persons from practising as consulting engineers, how the extension could be made effectively to the manufacturing industries it is almost impossible to imagine.

But the important point so far as Sapper officers in general are concerned is how it will affect them. From the *R.E. List* of May 1957 there appear only thirty out of a total of 471 regular majors who are corporate members of one or other of the three great engineering institutions. It is probable that a few have omitted to notify their qualifications, but if only 10 per cent of officers between the ages of 34 and 44 are so qualified, registration might come as a very severe blow to the remaining 90 per cent, particularly if the standard required for registration was high. It could not be doubted that most of the remainder would rapidly qualify for such registration if this became necessary, but they are deterred from taking any positive steps at present owing to the cost of corporate membership of the great institutions, the difficulties of satisfying their detailed requirements, and the doubt as to the worth of the qualification in the service. During his service, of course, registration could hardly affect an officer, but the moment he retired he might find difficulty in obtaining a suitable post. But whatever the qualifications and conditions imposed, it would be deplorable if any system of registration were to be introduced without the careful consideration of the claims of officers of the Corps. After all, the R.E. officer has a contribution to make to engineering, which was explained in detail just over three years ago by Colonel Binny.[9] In addition his education and training must cost at least twice as much as that of his civilian counterpart.

This question is nothing new. A distinguished officer speaking in Montreal in 1937 remarked: "Engineering in Great Britain is not a closed profession—it may be practised by anyone, for there is no registration of engineers. However, it may be regarded as a semi-closed profession, since it is advisable for any member of it who aspires to some degree of standing to join one of the few leading institutions and thereby gain the necessary status which this confers . . . Ours is a typically British system which has grown up with the

[9]Report on No. 1 Special Long Civil Engineering Course by Colonel R. A. G. Binny, O.B.E., A.M.I.C.E., *Prof. Papers of the Corps of Royal Engineers*, 5th Series, Appx. F. pp. 52–55.

development of engineering science and practice, and possesses an elasticity which enables it to include engineers of very diverse types . . . who are capable of maintaining our high traditions".[10]

Perhaps with this the writer may close with the suggestion that it would be better to put up with abuse about Communism than to bow the knee before the mammon of registration.

[10] *British Engineering Societies and their Aims* by Brig.-General Magnus Mowat, C.B.E., M.I.Mech.E.; Proc.I.Mech.E., vol. 137 (1937), p. 342.

Memoirs

MAJOR-GENERAL H. S. GASKELL, C.B., D.S.O.

MAJOR-GENERAL H. S. GASKELL's military career extended over a period of forty years, the greater part being spent in engineering appointments in India. His services were recognized at different times by the award of the D.S.O. and Bar and the brevet of Lieut-Colonel. He was mentioned in despatches four times. In 1937 he was appointed a Companion of the Bath.

He was a man of quick decision and great personal charm. He inspired confidence both in those he served and in those who served him. Underneath a cheerful, calm and essentially modest demeanour lay great firmness of purpose with sound professional knowledge. His was a most engaging and friendly personality.

The son of the late Lieut.-Colonel Thomas Gaskell, R.A., Herbert Samuel Gaskell was born on the 24th April, 1882. He was educated at Westminster School and passed into the "Shop" at the age of 16, obtaining a commission in the R.E. on the 18th August, 1900. After the usual training at the S.M.E. Chatham, his early postings were to Hong Kong and Ireland until he returned to the S.M.E. to attend the Part II Construction Course. On completion in March, 1907, he sailed for India where he was to become an Indian service Sapper until his retirement thirty-two years later.

During his spell at home he married to his lasting happiness and content, Sybil, the daughter of Mr. C. E. M. Hudson of Wick, Worcestershire, who survives him. Their family comprises one daughter and two sons and they celebrated their Golden Wedding in 1956.

Between the years 1907 and 1914, Gaskell was employed as Garrison Engineer in Kirkee, Poona, Dehra-Dun and Lansdowne, being promoted Captain on 18.8.1910. On the outbreak of war in 1914 he joined the staff of the C.R.E. 7th Meerut Division, Indian Expeditionary Force, serving in France and Belgium. Here he distinguished himself, being twice mentioned in despatches and earning the award of the D.S.O. in the *Gazette* of 1.1.16.

He accompanied the Division to Mesopotamia and took part in 1916 in the operations which ended in the fall of Kut. The conditions in the field at that time were notorious for their lack of amenities and general discomfort, but Gaskell's unfailing cheerfulness was an important factor in sustaining morale.

After the fall of Kut he was transferred as a Field Engineer to the Euphrates front until appointed C.R.E. Persian (L. of C.) Expeditionary Force in 1918 with headquarters at Kermanshah. The Commander of the Force was Colonel A. W. H. M. Moens, D.S.O., who later was to take up the post of Q.M.G. in India at the same time that Gaskell became E.-in-C.

Major-General HS Gaskell CB DSO

The main engineering task on the Persian L. of C. was the construction of a road to serve Dunster Force operating in the Caspian Sea area. Gaskell organized this with a number of field companies and as much local labour and plant as could be raised, and was successful in securing a metalled surface throughout some hundreds of miles to stand up to the rains and snows of a Persian winter. Despite lack of maintenance during the intervening years, this same alignment was used by the Indian Army in the Second World War. For this work he received a mention in despatches and the brevet of Lieut.-Colonel, and was awarded the Persian Order of the Lion and Sun.

In 1920, while so engaged, he took command of a column operating in the Quraitu-Qisil Robat area in connexion with the Arab Rebellion of that year. These operations were brilliantly successful and were recognized by the award of a Bar to his D.S.O. and a mention in despatches. The citation recounts how his Column effected the relief of two isolated posts and fought three actions "against a determined and numerically superior enemy. Although his troops were mainly young and untrained soldiers he inflicted heavy casualties on the enemy and cleared the area effectively. His many successes were mainly due to his rapid appreciation of a situation and his total disregard of danger."

He returned to England in 1921 for three years before proceeding once more to India in October, 1924. He held posts as A.C.R.E. in Northern Command until on promotion to substantive Lieut.-Colonel he went to Southern Command as C.R.E. Poona District where he remained for two years.

On promotion to Colonel (back-dated to 1.1.1923) he was to gain valuable experience over the next four years as Deputy to the E.-in-C. at A.H.Q. Delhi, and later to the C.E. Northern Command. He was also Secretary P.W.D. to the Government of the N.W.F. Province for all engineering work in the tribal areas. In December, 1932 he was promoted to C.E., N.C. in the rank of Brigadier.

At the conclusion of his term as C.E., N.C., he went home for a short period on half-pay, but in March, 1936 he returned to India for the last time as Engineer-in-Chief with the rank of Major-General. Space does not permit of any detailed account of his successful tenure of this high office, but mention must be made of his biggest task, planning for the rebuilding of Quetta Cantonment after it had been largely levelled to the ground by the devastating earthquake earlier in that year. With the deteriorating international situation there was much activity also on the G.S. and M.G.O. side and on all these matters Gaskell was particularly well equipped to give wise, quick and firm decisions on which his staff could act with confidence.

He retired on 1st October, 1939.

During the 1939/45 war Gaskell served for a short time as Chief Engineer G.H.Q. Home Forces and then worked for two years in the Ministry of Aircraft Production, being responsible for the erection of hutted camps in connexion with the vast expansion of aircraft factories. At the end of 1942 he went to live on the Devon-Dorset border busying himself in A.R.P. and similar duties.

He was appointed Colonel Commandant R.E. on 17th May, 1940. He died on Christmas Eve, 1957, at the age of 75 years.

H.E.R.

Colonel Sir John Fisher Turner Kt.CB DSO

COLONEL SIR JOHN FISHER TURNER, Kt., C.B., D.S.O.

John Fisher Turner was born on 24th April, 1881, and was commissioned in the R.E. on 6th January, 1900.

After a tour on the Gold Coast with the Anglo-German Boundary Commission, he spent the whole of the rest of his military service in what was then India, except for the five years between 1917 and 1922 when he was in Mesopotamia. Here he was five times mentioned in Despatches and was awarded the D.S.O. in 1918.

In 1922 he became A.C.R.E. Ambala which was then the location of H.Q.,, R.A.F. India. It was here that he began an association with the Royal Air Force which was to last more than twenty years, beginning with his appointment as C.R.E., R.A.F., in 1923. In 1928 he was appointed Chief Engineer R.A.F. and remained in that post until his retirement in 1931 when he became Director of Works and Buildings at the Air Ministry. This appointment he held until 1939, being awarded the C.B. in 1936. During the war years he was specially employed by the Air Ministry and was knighted in 1941.

"Conky Bill" was a man of outstanding energy and ability and from his earliest days showed himself not only a master of any job he undertook, but an adept at cutting his way through red tape, and this in spite of his difficulty in keeping patience with those, whatever their rank, who seemed to him to be obstructive.

In 1909 he was G.E. Malakand and the handing-over notes which he left for his successor—although definitely "not for publication"—demonstrated these points to the full and were treasured in the office over twenty years later.

Although "Conky Bill" was liable to be brusque indeed when thwarted or dissatisfied, he was essentially honest and warmhearted and could be most amusing when telling of the rebukes which his pungent (and sometimes ribald) remarks had earned him on these occasions.

He was immensely popular with the R.A.F. both in India, where he obtained, for what was then a very young service, buildings much better than those which housed the Army, and later at the Air Ministry. He was already well on in his forties when he learned to fly, and in 1929 he piloted his own light aircraft home from India.

In the years since the war he became interested in the work of the Church of England's Children's Society. Lady Ismay, writing in *The Times* says:—

"He was Chairman of the Homes Committee and before his increasing ill-health prevented him he visited Homes all over the country, taking an equal interest in children, staff, and practical questions. He did quietly and unobtrusively all the rather dreary day to day Committee work, and his wise, kindly advice was always ready for those who consulted him. Headquarters Staff were devoted to him and all his fellow Committee members loved him. There will be a lump in all our throats when we look back on some of his caustic and sometimes almost unprintable entries in the minute books.

"He joked about his work, but I think that it became his greatest interest. Certainly the Society owe him more gratitude than they can ever express and he will never be forgotten".

"Conky Bill" was unmarried. He died on 21st May, 1958.

H.C.T.F.

Major General KJ Martin DSO

MAJOR-GENERAL K. J. MARTIN, D.S.O.

Kevin John Martin, who died on 27th February, 1958, after a short illness, at Budleigh Salterton, was born on 3rd July, 1890, at Ootacamund, India, the only son of his parents, his father being in the I.M.S.

Educated at Beaumont College he passed into the R.M.A. in 1908. Owing to the threat of war, his batch at the Shop was of double size, seventy G.Cs. and their course was reduced from two years to eighteen months. There were seventeen sappers, Martin passed out ninth and was commissioned 2nd Lieutenant, Royal Engineers, 23rd July, 1910.

At the S.M.E. his incisive character and energy, marked him from the start as a potential leader, and from Chatham Martin was posted to the 11th Field Company, 2nd Division at Aldershot. A good linguist he became an interpreter in both French and German.

The outbreak of war in 1914, the first major war in which our Army had been engaged for a hundred years, was a time of challenge and of opportunity for the R.E. Field Company officers and their sections in the B.E.F.

Most of the officers were young, Martin with four years service was the senior subaltern in the 11th Company; there were many casualties, he came out of it with a severe wound and a well-earned D.S.O.

The official recommendation is for: "Conspicuous gallantry in taking his section across heavily fire-swept ground to prepare a house with loopholes from which our infantry hoped to be able to overcome enemy, who were fortified in some other neighbouring buildings. He successfully placed a machine gun in position and helped the infantry for the rest of the day. Again on November 12th did good work and was wounded."

In 1915 he married Hilda Burkinshaw, the sister of a fellow cadet in his term at the Shop, a gunner, killed in action. It was a happy marriage, there were two daughters and a son, his wife and daughters survive him.

After recovery from his wound, Martin's war career followed the pattern of the marked good soldier: Adjutant 25th Divisional Engineers—G.S.O.3 25th Division—Brigade major 32 Infantry Brigade—the battle staff officer.

He was promoted Captain 23rd July, 1916, Brevet major 1st January, 1918.

In May 1918 he was picked as G.S.O.2 on the small staff of the C.-in-C. Allied Forces, Marshal Foch; a special honour and an honour for the Corps.

Besides his D.S.O. he received the Legion of Honour, Order of La Couronne, Croix de Guerre and was mentioned five times in despatches.

After the war ended, Martin returned to Chatham as Assistant Instructor, Construction School. There was a quite understandable tendency then, for officers to say: "We have survived the war, we are only young once, let us take it easy for a bit." Not so Martin. With his lively energy he threw himself into the life of the S.M.E., which was working under full pressure, crowded with Y.Os. and officers commissioned during the war, doing Supplementary courses.

In 1920 his fine war record earned him a much coveted nomination for the Staff College. A year's hard work at Camberley and he sailed for India to be Brigade Major of the 11th Infantry Brigade, the Gurkha Brigade at Abbotabad.

In 1924 he returned to England to do the second half of his four-year staff tour as G.S.O.2, 43rd T.A. Division.

In 1925 he was back at Chatham, being promoted substantive major 16th May, 1926.

After going on a Naval War Course, 1926–27 he became Assistant Military Attaché Paris in November, 1927.

A year later he was Military Attaché Warsaw and a temporary Lieut.-Colonel. Brevet Lieut.-Colonel 1929.

In November, 1931, he returned once more to Chatham, as D.C.R.E. Works. It was here that his young son contracted that dread disease, infantile paralysis; fortunately he recovered and, in due course, regained his health.

From Chatham, Martin returned to India in 1934. Promoted Lieut.-Colonel, 23rd February, 1934, he was C.R.E. Baluchistan, doing good work in the Quetta earthquake; then going to Poona as C.R.E.

Promoted Colonel 23rd February, 1938, with an ante-date to 1st January, 1933, on account of his brevet, Martin came to the War Office as G.S.O.1 in M.I.3.

When the Second Great War started he was at once made D.D.M.I. but soon left the War Office to command the 127th Infantry Brigade.

In 1940 he went over to Administration, being successively: A.Q.M.G. Northern Command, D.A. & Q.M.G. Scottish Command and Major-General in charge of Administration Eastern Command, with the rank of acting Major-General, 6th October, 1941, and a temporary Major-General a year later.

This was a time of considerable frustration and in 1941 his gallant son, given back to him and to health by, as it were, the hand of God, was killed in action.

Martin's heart was set on command. He relinquished his job as M.G.A. in December, 1942, going in 1943, to the command of Worcester Sub-District, where there was but little scope for his tremendous drive.

He would, surely, have made a fine leader in battle and it must have been hard for so well-qualified and so ardent a soldier to appreciate that age was against him. In 1945 he retired. He was A.D.C. to H.M. The King, 1942–5.

On retirement, Martin went to U.N.R.R.A. to head a food and supplies Mission to Norway. This job he carried out with his usual thoroughness, going on an arduous and hazardous winter voyage, in a small vessel, far up the arctic coast of Norway. There was no direct means of access, by rail or road, to many of the outlying districts, Martin went to see for himself exactly how the food distribution was being carried out.

The Norwegians, who were paying for the Mission, greatly appreciated his work, but the time came when he thought that he was no longer giving them full value. Characteristically he then recommended the abolition of his Mission.

In final retirement his energy was turned, as always, to the help of others. The local war memorial took the form of a youth club and was his particular care. He built, almost single-handed, a new hut for them, possibly straining his heart at this time.

A few years ago he gave up his pleasant house at Forest Row and moved to smaller quarters at Budleigh Salterton for the closing years of his life.

Early in 1958 his heart gave out and he died after a very short illness, at least spared the restraint of being an invalid. His fiery spirit quenched.

Many and varied were the jobs that K. J. Martin did and he did them all well. He pulled his weight for the Army and for the Corps.

To those privileged to know him he was an ever helpful friend and the soul of honour, it was just not possible to imagine Kevin Martin doing anything in the slightest degree petty or mean.

A great number of friends, in and out of the Corps, must grieve at the passing of this upright soldier. May peace be with him.

J.A.C.P.

BRIGADIER C. C. PHIPPS, C.B.E., M.C.

Charles Constantine Phipps was born at Guildford on 17th November, 1889 and was the son of Lieut.-Colonel (then Captain) E. V. A. Phipps, R.A.M.C. He was educated at Temple Grove then located in its original home at East Sheen, and at Cheltenham and R.M.A. Woolwich. He was commissioned in the Corps in February, 1910, in a small batch of eleven Sappers. After completing the Chatham Course he was posted to India and joined the Military Works services at Bangalore as Garrison Engineer Civil and Bellary. At Bangalore there was no P.W.D. establishment and the Garrison Engineer Civil was responsible for all the usual P.W.D. services such as the upkeep of the Residency, a large civil hospital, post office, civil court, and police barracks.

After two and a half years at Bangalore, Phipps was appointed to the Oudh and Rohilkund railway as Asst. Traffic Supt. in June, 1914. In those days the Indian Railways provided a wonderful opportunity for quick advancement for R.E. officers and the appointment of Agent (or Manager) on the government-owned railways was often held by a Sapper Major. He was naturally delighted to have a chance of such a good opening. The war started, however, in August, 1914, and Phipps together with practically all other R.E. officers on the Indian railways was sent home in October, 1914.

On arrival in England he was posted to 108 Fd. Coy., which was one of the new Kitchener Army Companies in the 26th Division. The company did not go to France until September, 1915, by which time it was a thoroughly efficient and well-trained unit. Officers and men had done the whole of their training together from the start and therefore knew each other well.

Very shortly after arrival in France the C.R.E. of the 26th Division was changed and the new C.R.E. (Lieut.-Colonel C. G. W. Hunter) selected Phipps to be his adjutant. In November, 1915, the 26th Division moved from France to Salonika, for the start of the Balkan Campaign. The move was complicated by the separation of men, animals and transport during transit, and their arrival at Salonika a month or two apart.

Phipps remained as Adjutant until July, 1916, when he took over command of 131 Fd. Coy. also in 26th Division. He remained with this company on the Salonika front till April, 1918, when in view of the possibilities of operations on the Indian Frontier he was sent to India with several other officers who had been there before. He was awarded the M.C. in 1916 and was twice mentioned in despatches.

On arrival in India in May, 1918, he was posted to Quetta with the intention of taking charge of the work of construction of the Bolan Road from Sibi to Quetta. This work was however, temporarily postponed and he was then sent to Secunderabad as Garrison Engineer.

Brigadier CC Phipps CBE MC

In October, 1918, he was appointed Staff Officer to the Chief Engineer Northern Command at Rawalpindi and a few weeks later took over temporarily the duties of Deputy Chief Engineer, which he held till the arrival of Lieut.-Colonel W. H. Evans from the U.K. in April, 1919.

On the outbreak of the Afghan War in May, 1919, Phipps went as Staff Officer to Brigadier-General R. F. Sorsbie, who was Chief Engineer at Forces H.Q. at Peshawar. Shortly before this he had had an attack of dysentery and had not really recovered from this. In consequence after a few weeks at Peshawar he was boarded as temporarily fit for duty in the hills only and returned to his old appointment as Staff Officer to the Chief Engineer Northern Command at Murree. He was awarded the Indian General Service Medal with Bar Afghanistan, 1919.

In December, 1920, he was posted as Technical officer to the Small Arms School, Hythe.

On leaving Hythe four years later, Phipps went to Chatham for a short spell, and in April, 1925, he was posted as a Staff Captain in the War Office (F.W. 4) and shortly afterwards was made D.A.D.F.W. in F.W.3 at the War Office. In this appointment he had the most interesting task of planning all the defences and barracks for the new Singapore Base, as well as being on a War Office committee for reorganizing all the coast defences at home and abroad. On completion of this work he was awarded the O.B.E.

In March, 1929, he was appointed Chief Instructor of the Construction School at the S.M.E. and held this appointment for four years. During this time he was promoted Brevet Lieut.-Colonel on 1st July, 1932.

In May, 1933, he was posted to Egypt as O.C. 42nd Fd. Coy., R.E., but on arrival found that the C.R.E. Lieut.-Colonel C. G. Blunt was just about to proceed on two months leave and so Phipps took on the duties of C.R.E. Canal Zone at Moascar. On his return from leave Blunt decided to retire and Phipps was officially appointed C.R.E. in his place. During his time there work proceeded on the gradual replacement of hutted accommodation by permanent buildings at Moascar.

On 1st January, 1937, Phipps was posted as C.R.E. Palestine, but in September, 1937, he returned to U.K. to take on the appointment of Deputy C.E. Eastern Command which he held till taking over as Chief Engineer Northern Command in February, 1939. During his time there was a great deal of very interesting planning for the rebuilding of Wellington Barracks and Regent's Park Barracks in London, and Brompton Barracks at Chatham. Plans for all these were well in hand and work about to commence when the war started.

On the outbreak of war Phipps at once took up his mobilization appointment as Chief Engineer 2nd Corps and went to France about the middle of September.

During the Dunkirk evacuation Phipps was placed in charge of the beach at La Panne on 31st May, 1940 with the intention of evacuating the 3rd and 4th Divisions during the night of 31st May-1st June. Owing to some misunderstanding no boats arrived at La Panne and hurried arrangements had to be made during the night to march the two Divisions along the beach towards Dunkirk as only a small perimeter round Dunkirk could be held for one more night 1st-2nd June.

Fortunately most of these two divisions were evacuated safely from Dunkirk and beaches near there.

On 13th June, Phipps returned to France, landing at St. Malo, with an enlarged 2nd Corps H.Q. which were intended to take over as a new British G.H.Q. Owing to the fall of France they were however, evacuated a second time within a few days.

He was made a C.B.E. for his services.

In August, 1940, he was posted as Chief Engineer, Scottish Command, on its expansion to a first-class command with three deputy C.E.s for operations, training and work. During the war, Scotland became one of the main training centres for all overseas operations as well as H.Q. for Combined operations training. There was a great deal of very interesting work including the construction of two complete new Ports built entirely with military labour.

In 1942, Lieut.-Colonel E. V. Binney the secretary of the Institution of R.E. who had been seconded for Military service was killed, and in 1943 Brigadier Phipps was elected to succeed him. He was not however able to take up this appointment until the 13th January, 1945, two weeks after he retired, and relinquished his post as Chief Engineer, Scottish Command.

In 1947, he was made a Commander, Royal Order of St. Olav (Norway).

He has remained as Secretary to the Institution of Royal Engineers until his death at St. William's Hospital, Rochester, on 26th July, 1958.

In addition to his invaluable work on behalf of the Institution when he maintained the R.E. Journal at a high standard, and helped considerably to improve the R.E. Museum and the Corps' Library, he took an active interest in the Officers' Association, and in the local branch of the R.E. Association of which he was Vice-President.

He had a kindly nature and a very wide circle of friends in the Corps by whom he will be severely missed. Perhaps his very kindliness concealed sometimes his firm grasp of essentials and his determination to see a job well done at all costs.

He married Marjorie, daughter of C. J. Copner, Esq., of Ilfracombe, in 1914. The sympathy of all officers in the Corps goes out to her and to their son in the loss they have sustained by his death.

BRIGADIER F. B. BARKER, O.B.E.

Two days before his sudden death on 22nd May, 1958, FRANCIS BROCK BARKER, always known as Brock to his many friends, sent the writer of this memoir a letter in which he commented on a number of fairly recently published war books, pointing out how often it seemed from them that commanders were blamed for failure when the real cause of the failure lay in the actions of their superiors. He said: "It was my job to train my juniors effectively and, if things went wrong, it was my responsibility and I took the blame. That does not say that I did not give them hell afterwards—but to shelter behind them—that was simply not done." This quotation gives an idea of Brock's outlook on life, throughout which he never spared himself and became known to all with whom he came into contact for his enthusiastic approach to all the tasks given him and for the immense amount of hard and thorough work he put into them.

Brigadier FB Barker OBE

He was educated at Stonyhurst; as Colour-Sergeant in the O.T.C., he was given by the vote of the whole school the Coronation Medal awarded to the school. After two years at the Shop, where he won the Saddle, he was commissioned in the Royal Engineers on 17th July, 1914, in the last batch before the outbreak of the First World War. On joining the Royal Engineers he was both a keen horseman, with an ambition to ride in the Grand National, and a man whose heart was also in all things mechanical—attributes which at that time were not usually found together. Fate denied him his ambition but led him to become an E. & M. expert.

His career fell into seven distinct phases. The first was service with the 10th Divisional Signal Company in Macedonia in the First World War, during which he was awarded an O.B.E. This was followed by a supplementary course at Chatham and an E. & M. course in the industrial areas of Britain. The third was a long period of service in India from 1923 till 1933, with only one short break for a refresher E. & M. course. While in India he held the appointments of Garrison Engineer (E. & M.) at Nowshera, Garrison Engineer and later A.C.R.E. (Civil) at Dera Ismail Khan, A.C.R.E. Meerut and S.O.R.E. 1st Grade (E. & M.) at Army Headquarters. The fourth lasted for some three years from October, 1933; after that he commanded 26th Field Company at Aldershot, a command which he looked upon as the highlight of his career and which enabled him to indulge once again in his passion for horsemanship. He took the Company to Palestine and remained with it till promoted Lieut.-Colonel early in 1937. The fifth was a period of four years in Malta, where he was first C.R.E. (Roads and Buildings) and later, on promotion to Colonel in 1940, Chief Engineer at Malta. In October that year he was struck down by ill-health and invalided home. The sixth was a trying period of two war years, during which he held various appointments in England such as Chief Engineer Aldershot District and D.D.F.W. (War Office) with the rank of Brigadier. The seventh and final period was three interesting years as Chief Engineer South Wales District. He retired in August, 1946.

Retirement did not spell idleness to Brock. He promptly bought a somewhat neglected farm in Devonshire and with his usual energy and spirit set to work to turn it into a first-class and efficient organization. This he succeeded in doing, and within a few years had formed a pedigree herd of cattle with which he took many prizes. The hard work of farm life proved, however, too much of a physical strain and in 1954 incipient heart trouble forced him to give up the farm and take life more easily. Early in 1958 he was struck down by an attack of coronary thrombosis. With his usual pluck and determination he weathered that storm, and those of us who knew him well hoped to have him with us for a number of years. But it was not to be.

In 1921 he married Susannah Mary Kathleen, elder daughter of Brigadier-General J. A. S. Tulloch, C.B., C.M.G., late R.E., at that time Chief Engineer Western Command, and had two daughters, all of whom survive him.

S.W.K.

LIEUT.-COLONEL C. E. G. VESEY

Charles Edward Gore (Carl) Vesey was born on 27th May, 1871, and came of a soldier family. His father was in the Royal Artillery and his brother retired after being Adjutant General at the War Office.

He was commissioned from the "shop" in 1891, and after a Chatham course served as a subaltern in the Field Depot and Bridging Battalion at Aldershot, and in the 41st (Fortress) Company at Singapore. He served with the Ashanti Expedition, 1895–6. As a Captain from 1901–5 he commanded "B" Troop Bridging Battalion at Aldershot and Chatham. From 1905–8 he was Adjutant of Troops and Companies, R.E., at Aldershot. In 1909 he joined the 9th Field Company at Colchester, went to Egypt and took command of the 2nd Field Company in Cairo. He held this command for five years and did much good work in Egypt. The R.E. were quartered in the Kasr el Nil Barracks and had a comfortable mess on the banks of the Nile.

When war broke out in August 1914, the Company went to France and joined the Division, and helped to hold the line for many months. Vesey remained with the company at a time when a Field Company Commander's job was a strenuous one, and dangerous too, and commanders seldom lasted more than a few months. Vesey was given a Brevet-Lieutenant Colonelcy in 1915 and made C.R.E. 5th Division. In 1916 he was home on sick leave for nearly four months, and then went to the R.E. Training Centre at Ripon. In 1917 he was appointed C.R.E. VII Corps of the Expeditionary Force and after the war was over he held various commands, such as O.C. Bridging Battalion at Christchurch, C.R.E. Hounslow, and Commandant, Railway Troops Depot, Longmoor until he retired in 1923.

Carl Vesey was a quiet, rather silent, good natured man; with much good common sense, a very efficient and good R.E. Officer, but no "medal hunter".

He was a keen horseman, who rode well and hunted whenever he could.

He married Mary Dorothea Loring in December 1920 and had a son and daughter. The son was a gunner subaltern, killed in the War in Italy.

He died on the 17th April, 1958.

D.M.G.

Book Reviews

THE INDIAN ENGINEERS 1939–47

By LIEUT.-COLONEL E. C. W. SANDES, D.S.O., M.C., R.E. (RET.)

(Published by the Institution of Military Engineers, Kirkee, India.)

(A limited number of copies will be available for re-sale by the Institution of Royal Engineers from October 1958, and orders may be booked now, Price 10s. to members of Institution of R.E., 21s. to non-members.)

This is the History of the Indian Engineers during the Second World War and after, up to the attainment of independence by India and Pakistan and the partition. It is a history, therefore, which is common to both the Indian and Pakistan Engineers.

The author, who is well known to readers of this journal for his histories of military engineering in India and the Sudan, and for his History of the Sappers and Miners, to which this is, in effect, a sequel, has set out to write a history which, in his own words " will tell of great achievements and gallant deeds" and be an inspiration to future generations of Indian Engineers, rather than a detailed account of which the chief value would be as a book of reference. No great attempt has, therefore, been made to present the engineering problems of the various campaigns from the point of view of the over-all planning of the provision of resources, nor is there much technical detail of the engineering works carried out or information about the works on the L. of C., in base areas, and in India. A separate volume would have been needed to deal with these. On the other hand sufficient descriptions are given of the military situation, climate, and physical features in every case to make the engineering problems clear, and to provide the necessary background for a proper appreciation of the difficulties which were met and overcome.

The author has succeeded in his object and the book conveys a vivid impression of the life of the front line units of the Indian Engineers, mainly Sappers and Miners, in every theatre of war. Theatres which were alike in the demands they made for courage, initiative, endurance and the cheerful acceptance of danger, hardship and fatigue, but which differed widely in climate and physical geography.

In the first chapter the events in India during the opening years of the war are described, and there is an excellent resumé of the means by which the relatively small and inadequately equipped force consisting of the three Corps of Sappers and Miners and the Military Engineer Service was expanded to meet the immense demands of modern war for specialized units of all kinds. This, apart from a sevenfold expansion of the Sappers and Miners, involved the formation of six new groups to provide units such as E. & M. and artisan works companies, heavy bridging units, and many more, and the units needed by the transportation service, railway, docks and inland water transport companies. A summary is also given of the great achievements of a much augmented military engineer service.

In subsequent chapters each theatre of war is dealt with separately in a continuous narrative. We are given a clear account of the strategy and tactics of the campaign, or battle, and then details of the actions of the engineer units engaged, interspersed with stories of individual heroism or anecdotes of humorous or unusual events, which sometimes lighten the burden of war. The names of officers are freely given, which enhances the interest for the contemporary reader but may prove distracting for future generations.

The last chapter brings the story to a close with the return of the units to India, demobilization and the reorganization resulting from partition. It also tells of the ending of the partnership between British, Indian, and Pakistani Engineers which, as Lieut.-General Sir Harold Williams says in his Foreword, had developed over many years on a basis of affection and comradeship in arms, and which remained firm to the last.

The book brings out in a striking way the magnitude and character of the engineer contribution to the ultimate victory over Germany and Japan. The picture left in the mind is of the never ending strain of mine clearance, often under fire; of the building of improvised or equipment bridges over every kind of gap, and operating ferries; of track and road building and maintenance through mountainous jungle in monsoon rain, and of fighting as infantry and working as engineers alternately without rest, and of many other feats. It is a picture which is a fitting memorial to all ranks of the Indian Engineers who lost their lives in the war and to whom the History is dedicated.

The book is printed by the press of the College of Military Engineering at Kirkee which is to be congratulated on the result. The maps are clear and sufficient for following the narrative, but they would have been easier to read had the roads and rivers been shown in different colours. There is a good Index. J.S.W.S.

THE JAPANESE THRUST (AUSTRALIA IN THE WAR 1939–45)

By Lionel Wigmore

(Published by Canberra Australian War Memorials. Price 30s.)

This is a comprehensive and readable record, by an Australian, of the loss of Malaya, the Netherlands East Indies, and New Britain, with shorter accounts of the actions in Hong Kong and the Philippines, where there were no Australian forces. Part III is a long, harrowing description of life in various prison camps, including those on the line of the ill-famed Burma–Thailand Railway, the construction of which caused the deaths of over 12,000 men in the prime of life.

Readers will welcome the dating of each page and the clear maps and sketches.

The book reveals its author as a sincere, fair-minded and painstaking judge. With the help of interesting extracts from Japanese war accounts he deals impartially with all those, of whatever nationality, who bore the chief responsibilities on the side of the Allies. He also sets out in detail the names and activities of many Australian combatants, whose personal records will inspire, and in a few cases warn, the future defenders of their continent and its dependencies.

Some hitherto unpublished cables exchanged between London and Canberra are revealed. They provide, among other things, a picture of the dilemma which arose when Singapore fell: should the remaining seasoned Australian divisions be used in the Middle East and Burma, or more directly to protect Australia?

The danger to their homeland was in any case to be largely averted. The farther an aggressor goes the more his strength is spent. By the middle of 1942 Japan had widely scattered new conquests to hold and to put in order. In Burma she was running up against difficulties of topography, distance and disease. She was still fighting in China. In the background Britain was beginning to shake the dictators' confidence, and furthermore the United States and Russia, licking their wounds, had unexpectedly been granted the respite they prayed for. In these conditions the little yellow men dared go no farther south.

Lionel Wigmore is a journalist by profession, and not much concerned with strategical or tactical methods. He does, however, make clear the Australian view of the wider aspects of the war, particularly of the war in Malaya, where the Australian division was clamouring for its third brigade to be sent from Australia, and where he was present in a civilian capacity before and during the campaign. This view is that by the turn of the year 1941 gloom had settled upon the British and Indian troops; that better use could have been made of the fine offensive spirit and more complete training of the Australians; that their division in Malaya should have been kept together at any cost; that they should have been used, like the Japanese, in an attacking role only; and that, though the risks were great, time would have been gained to allow the approaching British 18th Division to take a fuller part in the struggle.

A land, however, of many covered approaches and few fields of fire favours the invader. With this difficulty before him, a hostile sea on either side, and a—not always—helpful civil administration behind, General Percival had nothing but unsound plans from which to choose.

Without the Navy it would in any case have been a desperate finish in Malaya, but if the Australian Imperial Force there had been built up, and given its head, there would no doubt have been creditable results. Mens' spirits would have risen throughout the free world, and incalculable benefits would have accrued.

K.B.S.C.

THE SCHLIEFFEN PLAN

By Gerhard Ritter

(Published by Oswald Wolff Ltd., London, W.1. Price 30s.)

This critical study of the Schlieffen legend is in the best tradition of German objective writing. Its learned author recalls the widespread controversies which the famous Plan has created and its importance in connexion with the study of German militarism. Ritter had access to Schlieffen's original text in Washington and published it with his commentary in 1956. Now we have an admirable translation in English with a carefully written foreword by Captain Liddell-Hart. A photograph of Graf von Schlieffen would have been interesting and a map of the Russian front would have been useful at the beginning of the story.

Ritter's verdict entirely agrees with that so clearly expressed by Sir James Edmonds in the British official history of the 1914–18 war, i.e. the plan was technically too grandiose for the available German forces. Touching the violation of Luxembourg and Belgium, which for Germany was a political disaster, Ritter defends Schlieffen, saying that he gave the German Government ample opportunity to object to this part of his plan. No objection, of course, was ever raised. In the author's view, therefore, the 1914 war provides the most shattering example in history of the total eclipse of policy by military planning.

So much for the main issues. Of interest is the fact that Schlieffen was 72, when he was compulsorily retired in 1905. He had countenanced the totally unrealistic series of "Kaiser manoeuvres" of that period, as well as the General Staff war games in which colossal enveloping operations took place without much reference to time and space. Ritter also points out that Schlieffen often failed rather curiously, to distinguish between tactics and strategical operations. A brief reference to tactics is contained in the postscript to the 1912 draft of plan written by the Graf's son-in-law. It is there suggested that "with their present-day fighting strength, augmented by machine guns and heavy artillery, 20 battalions and 90 field guns can quite safely take over the operational area of 24 battalions and 144 field guns, even allowing for suitable disposition in depth." This very meagre appreciation of the probable effect of machine guns and Q.F. artillery betrays how little Schlieffen foresaw the changes which they would actually bring to the tactics of the battlefield. Such transparent unawareness throws considerable doubt on a recent contention that the defensive power of the machine gun was to be the tactical basis of the Schlieffen plan and that the British official history had failed both to report or to understand this epoch-making development. Since the various texts show that Schlieffen only twice made a casual allusion to machine guns, the contention can in truth only be described as rubbish.

Ritter, sticking firmly to his brief, forgoes the temptation to point out that the legend of the plan did not end with its shipwreck in 1914. Embodying, as it did, the absolute war of Clausewitz, Schlieffen's idea persisted between the wars as the "primum mobile" of German military thought. Thus in 1939–40 Manstein condemned the original scheme for the defeat of France in the very idiom of Schlieffen, by saying that it would lead only to an "ordinares Sieg". Manstein's suggested penetration about Sedan, on the other hand, gave promise of Cannae style envelopments and great victories of annihilation. And indeed so it fell out. The tiresome old Graf with his universal nostrum for solving all military problems certainly had a touch of genius about him.

B.T.W.

PROCEEDINGS OF THE SECOND CONGRESS OF THE F.I.P.

(Published by Cement and Concrete Association. Price £5.)

The proceedings of the Second Congress of the F.I.P. (Fédération Internationale de la Précontrainte) held at Amsterdam in 1955 are now on sale, price £5, post free. The royal octavo volume of (viii) plus 990 pages is handsomely bound in buckram and contains all the papers, reports, etc., presented to the Congress. The contributions are printed in whichever language they were presented, so that there are nineteen texts in French, eighteen in English and three in German. However, each is summarized in all three languages and each group of papers is analysed in all three languages, so that the book is not as formidable as it seems at first sight.

The main themes discussed were:—

Ia. Function of grouting and anchorages in the behaviour of prestressed elements.

Ib. Experience and problems concerning the manufacture and the use of steel for prestressing.

II. Progress of precast work in the factory and the assembly by prestressing on the site of precast units.

IIIa. Moment distribution in statically indeterminate prestressed structures beyond the elastic phase.

IIIb. Influence of plasticity on the strength and instability of thin prestressed shells.

Two late papers dealt with a comparative analysis of specifications in various countries and the economic advantages of prestressed concrete. There are also seven extra contributions, of which five are in untranslated French, and two are in English. These two cover a method for the direct reading of the loss in stress due to creep, and an analysis of equilibrium in highly prestressed beams.

It is impossible to condense all the lessons to be learnt from such a monumental reference book, but the following points are extracted as being of very general interest.

1. Cable ducts should be properly grouted, both to achieve adequate bond and also to prevent corrosion and eliminate frost action. Considerable thought has been given to the possibility of water lying in a duct (particularly one which is concave). It has been recommended that additives should be used to improve the flow of grout, and to prevent water from segregating out of the grout. Ducts should never be flushed through with water, but should be cleaned by blowing air through them. Calcium chloride is sometimes used in frosty weather. It is possible this may be bad practice in grouting, due to corrosion.

The examination of beams cast ten years before has disclosed only negligible corrosion and this is reassuring. Good grouting will seal off standing water from air, unless deep hair cracks permit access to air. It is plainly good practice to take all care in grouting.

2. Several systems of anchorages are described. The principle aim of new systems seems to be to improve the measurement of the strain in the wires, both during and after pretensioning. Some anchorages can be reconnected with the jack to add a further prestress, either to make up the losses due to creep, or to alter the total stress at successive stages in building. Anchorages should be "built in" to protect them from rust and corrosion; they must also resist vibration from dynamic loading.

The losses due to creep, etc., have been calculated by various means, and a value of 13 per cent is common.

3. At least one new jack is capable of automatic action, connecting itself to a wire, stressing and anchoring the wire, and releasing itself. The pressure gauges of pumps can be readily tested by connecting two pumps in opposition. Their readings should be equal. These gauges do not give conclusive results as to the stress in the full length of wire: their function is to check the more accurate measurement of extension of the wire. Where disparity exists it is likely that the wire has been obstructed. In measuring

the extension of a wire, particularly in a short length, the extra movement of a tensioning mark on a portion of the wire which is first tensioned, and later released, must be allowed for.

4. Failure is seldom attributable to fatigue of a prestressing wire. Extreme cases should be allowed for, but in normal work failure is likely to be due to corrosion (if badly grouted) or due to an unnoticed slag intrusion, or a poor weld, in the wire which has affected its strength at a particular point. Faulty handling can cause notches and kinks which may weaken the wire, although carefully controlled indentations can improve bond strength and this fact is normally utilized in wires exceeding $2\frac{1}{2}$ mm. in size.

5. Precast prestressed beams reduce the need for form work and may improve "headroom" under a bridge. When used with *in situ* concrete slabs, a good bond should be achieved by roughening the top of the beam or else inserting anchorages. Calculations for what does happen in such circumstances are, however, most complicated, as indeterminate stresses are set up internally. In cold weather steam or electric heating can be applied under portable covers, or cloches. Relatively large ducts in small sections can be cast by using a rubber former over a stiff, straight bar, and inflating the rubber.

T.W.T.

MECHANICS APPLIED TO ENGINEERING

By G. H. Ryder

(Published by Cleaver-Hume Press Ltd. Price 21s.)

There are many excellent text books which provide a firm basic knowledge of statics and dynamics. This new book has several advantages. It is reasonably small and compact; it is concise and logical; above all it is *practical*. The examples given cover a wide field of engineering problems and well illustrate the author's claim to show "how these subjects stem from the same roots".

Two of the illustrations (Figs. 31 and 39) could be improved and the section devoted to clearing up the vexed problem of "absolute" and "engineer" units of mass and weight is not as easy to follow as the remainder of the book. These two slight criticisms apart, the author has produced a very practical text book which should stimulate a student at the start of his engineering training and speedily refresh anyone in need of revising basic principles.

T.W.T.

GIFFORD-UDALL—CCL HANDBOOK

By Udalls Prestressed Concrete Ltd.

(Published by Messrs. Cable Covers Ltd. Price 25s.)

Much care has been taken in producing this book to combine general information on the technique of prestressing with the detailed use of the many products of the firm.

The result is a very handy textbook, excellently illustrated, with a comprehensive index for ready reference.

The system is now standard W.D. practice, and therefore all the tables and charts which give "short cuts" to design are of great value to Sapper officers. Even where other systems of prestressing are used, the general information given forms a clear and simple text book of the principles involved, and the worked-out examples form a handy guide as to method of attacking prestressed problems.

The illustrations are so much clearer than the roneoed instruction pamphlets so far issued, that this handbook makes a big advance in explaining the Gifford-Udall-CCL technique.

T.W.T.

Technical Notes

Notes from *Civil Engineering*, April, 1958.

Combating Erosion

Uncorrodible gabions (steel wire mesh baskets filled with rock) have been used in Ontario, Canada, as current and wave deflectors. They are easily transported to site and filled by unskilled labour without the need for heavy machinery. Being flexible, they will re-adapt themselves to the effects of extra-severe scouring where a rigid sea wall would be undercut. Moreover, their permeability permits pressure to equalize either side, thus avoiding over-pressure and under-pressure.

Compaction of Dry-lean Concrete

The article shows that a system of quality control can be based on the results of density and crushing tests, provided that the compaction is partial, and in a standard manner. If the compaction is not standard, false readings of strength and density will be achieved, similar to the effects of over-rolling or under-rolling the bulk material.

Timber in Civil Engineering

This edition contains a group of papers on the structural uses of timber which merit a full study. These papers are summarized very briefly in the following paragraphs:—

Foreword

The writer describes the main fields of research undertaken by the Forest Products Research Laboratory and the Timber Development Association. These are: the standard strength properties and structural uses of timber; its identification and utilization of species; the prevention and treatment of decay and insect attack; the effectiveness of preservatives; kiln layout and drying schedules; the production and commercial use of plywood and allied products; and the utilization of wood waste.

These efforts have resulted in such achievements as a bowstring truss of 180 ft. span, observation towers 80 ft. high, glued laminated beams for a 40-ft. span road bridge and glued laminated portal frames of 46 ft. span.

The Economic Importance of Timber Preservation

The author points out that a stitch in time saves the cost of cutting out old damaged material before replacement, and quotes on costs of 10–25 per cent for preservation as against expenses for subsequent replacement 300–400 per cent of the cost of the material in the first place. The writer also quotes American figures showing that untreated timber lasts only a third as long as treated timber.

It is interesting to note that while untreated heartwood is normally resistant, compared with sapwood, heartwood is difficult to treat with preservatives. Permeable sapwood can now generally be treated economically to achieve almost the durability of heartwood.

This article finishes with a very comprehensive list of articles published in *Timber Technolgy* which is worth noting for reference.

Developments in Glulam Structures

The title refers to glued laminated work: it may unfortunately stick as being brief, though ugly.

The author points to future research needed in the field of curing adhesives. Radio frequency R.F. heating has not been a success and it is still necessary to cure for long periods at high temperatures and pressures.

It seems that straight beams have big advantages, by being capable of batch production with space-saving, and particularly because pressure treatment is possible after manufacture—i.e. there is no problem in glueing treated surfaces to treated surfaces.

The advantages listed for glued laminated wood are: low operational costs; resistance to rust, corrosion, shock and vibration; good appearance; easily painted; shock absorbing in seismic tremors; easily repaired; fabricated in sizes impossible to obtain in solid timber; shaped to suit the most exacting requirements; precambered to counteract deflection.

Plywood for Concrete Formwork

The advantages illustrated by the writer are chiefly described under the heading of "high re-use factor". In the article good advice is given on handling plywood (the most sensible being to stack flat and apply paint to all edges in the simplest manner).

With care, forty uses are common, and one hundred uses with one sheet have been achieved. Even then the plywood may be of use for other jobs on the building site. Some simple designs for shuttering are illustrated, and a useful table of spacings for centres of supports is given. Durability (resistant to weather, micro-organisms, cold and boiling water, steam and dry heat) is claimed for modern adhesives, and in fact the glue line now is normally stronger than the timber it bonds.

Other advantages claimed for the use of plywood as formwork are: a wide range of finishes enables an economical grade to be selected; form oil is usually all that is needed to achieve a fair face; double headed nails assist stripping; screws, instead of nails, enable both sides to be used; curved surfaces are easy to form; handling is easy; boards can be nailed very close to the edges; the boards are resistant to vibration and high impact loads, warping and shrinking; plywood does not need heating and covering in very cold weather, unlike metal formwork.

Design of Timber Joints

This article gives excellent tables setting out the permissible loads of nails, screws, bolts, and several types of timber connectors.

Corrosion Resistance of Timber

The author describes the various ways in which timber loses strength. He emphasises that preservation before use is an economic factor of importance, and that even surface treatment is well worth doing.

The actions of acids and alkalies on timber are described, and also (of importance to marine engineers especially) the electrolytic action of dissimilar metals on timber in the presence of an electrolyte such as sea water.

Shell Roof Construction in Timber

The article points out the value of plywood in a form of construction in which predominantly direct stresses occur in a complex two-dimensional system and where the weight of the load carrying part of the structure forms an appreciable part of the total load. Other advantages are thermal insulation and lightness in handling which permits much larger sections to be prefabricated.

The disadvantages of timber is the requirement for fire proofing impregnation and painting, but modern techniques are coping with this problem.

Building the Yangtze River Bridge (Part 2)

This second chapter deals with the colonnade foundations. The technique was devised from the problem of a very uneven bedrock on which it was thought a coffer dam would prove a difficulty. A large steel guiding framework was floated out by pontoon and suspended by blocks and tackles from two guide pontoons previously correctly positioned. This frame was then lowered into the water, and two successive tiers built up and lowered, until the framework was in a position to cover all the concrete work later to be required. A group of tubular columns was then sunk, through the sand layers, to bedrock and filled with concrete. These then supported the frame, through which large diameter precast pipes were driven by means of jetting and vibratory hammers. The vibratory hammers were made up on site, and consist of twin axles carrying eccentric weights, rotating in opposite directions, and arranged so that their horizontal components balance each other, but their vertical components either drive upwards or downwards in succession. At speeds of 1,000 r.p.m. vibratory forces of the order of 120 tons were obtained.

After reaching bedrock, concrete was placed under water by tremie, to seal off gaps caused by the very uneven surface of the rock, and the rock bored out by a percussion rig so as to continue the bore of the pier column tube into the bedrock. A clay paste was used in boring through the limestone in order to facilitate the removal of the debris.

Once the columns were sunk in position a steel sheet coffer dam was wrapped round the colonnade group, sealed off, dewatered, and a solid R.C. pier constructed, with the bottom level some way above the bed of the river.

The Weinland Bridge, Switzerland (Part 2)

Further details are given of the factors considered by the Prize Awarding Panel. These are of interest in their order of priority, which was:—

1. *Quality of design;* system of construction selected, foundations, design of false-work, programme of erection, utilization of materials.
2. *Aesthetic appearance* and general arrangement; fitting into the landscape, position and shape of supports.
3. *Costs;* total cost, worthiness of expense.

Stabilization of Soil with Cement

Both the mix-in-place and single-pass methods are well described. A few facts are given, although not enough for comparisons to be made.

The author notes that modern equipment can stabilize 8 in. at a pass, and that, by a method of successive layers, up to 18 in. thickness of stabilized soil have been laid. He recommends two or three coat work for surfacings under heavy traffic.

A small attachment to a Fordson Major tractor is now marketed to construct 3 ft. wide paths, berms and pavement widening. This could have a military significance for camp paths, and the temporary construction of light roads, using basic military equipment.

Notes from *Civil Engineering*, May, 1958.

The Design of Interconnected Bridge Girders

A relaxation method for analysing the deflections and stresses in all the beams of a grillage is described. The final solution is accurate and is obtained with relatively little arithmetic, after setting out the problem in a notation reminiscent of a moment distribution. As an example calculations are shown for a group of main beams and transverse beams interconnected along two axes of symmetry. Each joint is considered to rotate in two directions, as well as suffering vertical reactions. Deflections therefore are incurred due to these three forms of loading. The method considers the controlled "locking" of joints with a view to following the repercussions of each loading in turn through the structure, in order to arrive at the final answer. Although the arithmetic, which will continue into a further instalment, may be simple, and the initial setting may commence with simple beam theory, a very cool head is required to visualize the behaviour of the beams in order to set out the initial "grid".

The Grouting and Bond Strengths of Plain and Deformed H.T. Prestressing Bars

Tests have been carried out at the Battersea College of Technology to investigate bond stresses achieved in ducts in which post tensioned cables have been grouted. K. J. Brown, M.Sc.(Eng.), describes these tests which emphasize several practical problems in grouting post tensioned cables.

For example, there is a lower limit for fluidity below which the grout congeals rapidly and blocks either the grouting nozzle or the ducts before it is filled. For a similar reason, the setting time must be considered in relation to the time required to fill the duct.

Low temperatures improve the flow of grout, though frost action must be carefully avoided. Excessive vibration, like high temperature, appears to accelerate the chemical reaction for setting.

It was found necessary in the tests to wash out ducts where there was not impermeable sheathing in order to prevent extraction of water from the grout due to absorption into precast concrete. This would appear to be necessary, if long ducts are filled with a grout with a low water content (care being taken to blow out all surplus water with compressed air before grouting.)

Notes from *Civil Engineering*, June, 1958

Modern Forging Hammer Foundations

Although the title specified forging hammers, the author is quick to point out that vibrations and shock arise from a variety of causes, i.e., pile driving. The modern use of delicate instruments and machinery makes the problem of reducing shock waves and vibration very important.

In this first instalment a general picture is given of the problem. Calculations will probably follow in further instalments.

There appear to be two distinct aspects to the reactions induced, the violent shock of the hammer blow and the periodic vibration of the earth itself set up in damping out the oscillation of the anvil block. Different soil types have varying frequencies of natural vibrations and it is possible to strike a resonant frequency at some distance from the application of the initial blow.

Calculations for the reduction of the nuisance appear to lie in smoothing out the initial acceleration (or shock) and in ensuring that resonance does not occur.

Laboratory Work in Prestressed Concrete for Students

This article gives a comprehensive description of the difficulties incurred in trying to instruct students in practical work under laboratory conditions. Many very useful hints are given for overcoming snags.

An Investigation of Scour at Bridges Caused by Floods

Severe floods in Connecticut caused unprecedented damage. The opportunity was seized to study damage caused to seventy-five bridges with a view to improving modern techniques.

Most of the bridges were old, and much damage would have been avoided by better design to modern standards. The following salient points were noted as to causes of failure:—

(*a*) shallow foundations vulnerable to stream bed scour;
(*b*) bad alignment of the channel;
(*c*) debris jammed against piers and super structure;
(*d*) turbulence, resulting in impact and vibration;
(*e*) slope paving failure on wingwalls.

Conclusions reached, for good design, were that piles formed the best, but most expensive foundations. If it is necessary to prevent scour, water channels should be as wide and shallow as possible, so as to avoid large vertical clearances and small spans. Box culverts, ensuring a smooth passage into the culvert and away from it, are excellent for avoiding scour. Railings and suspended utilities can cause obstructions to the passage of debris.

THE MILITARY ENGINEER

JOURNAL OF THE SOCIETY OF AMERICAN MILITARY ENGINEERS
NOVEMBER–DECEMBER, 1957

"Nuclear Explosives for Blasting," by Jack de Ment

The author is a research chemist and director of the De Ment Laboratories at Portland, Oregon. He was present at the Bikini Atomic Tests, and is interested in the design and development of speciality atomic weapons and counter measures.

The advent of the clean, or practically 100 per cent fall-out free, hydrogen bomb opens up a variety of possibilities for the application of nuclear explosives to peace time blasting tasks in major engineering projects. These possibilities include directed blasts for splitting small mountains and explosive techniques having shaped as well as barrier charge effects.

The blasting power of a small hydrogen bomb is enormous. A one-megaton bomb has the explosive power of 2,000 million lb. of T.N.T. A bomb of this size may be considered small when compared with the 10 to 20 megaton bombs that have been tested and yet it is more powerful by a factor of 1,000 than the largest non-atomic explosives ever detonated. As a very rough estimate it could be expected to loosen upwards of 3,000 million tons of rock.

The use of nuclear explosives in blasting would allow operations on a hitherto unimagined scale in canal construction, diversion of rivers, open cast mining, tunneling, iceberg and ice breaking, removal of undersea obstacles, construction of artificial lakes and underground storage vaults and volcano control.

There are many outstanding problems to be considered. Induced radio-activity must be kept to a minimum and a cooling-off period after the blast would have to be allowed. The indiscriminate use or ownership of nuclear explosives presents obvious problems. Effective international agreements or a "nuclear blasting control agency" might be the solution. Nuclear explosives would still be potential weapons and could be criminally misused if not effectively controlled.

JANUARY–FEBRUARY, 1958

"Combating Fire in an Atomic Attack," by John D. Grabski

The author has been Chief of the Equipment Section, Fire Fighting Branch, Engineer Research and Development Laboratories, Fort Belvoir, Virginia, since 1953.

There is a tendency for more to be written about atomic attack than defence. The author attempts to correct this with an interestingly illustrated article on the tremendous problem of containing fires resulting from nuclear attacks. It is one of the tasks of the Army Corps of Engineers to provide protection from atomic fires in advanced military bases which may or may not be connected with large cities. A comprehensive research and development programme to this end is in hand by the fire fighting branch of the E.R.D.L.

Standard commercial equipment does not usually cover the wide functional requirements of service use, such as cross country mobility, lack of water supply, extremes of cold and hot climates, enemy action and air transportability. A fire-fighting truck capable of operation under wide climatic extremes and a submersible pump and pipe line system has been developed.

The new aluminium fire truck, towing an auxiliary 2,000 gallon water trailer, is completely winterized for use in temperatures as low as −65°F. with a completely enclosed cab for six men and a 1,500 g.p.m. remote control turret mounted on the roof. Foam concentrate is injected into the water by a foam proportioner. The truck and equipment is centrally heated throughout, it is also suitable for tropical temperatures up to 125° F.

The submersible, high capacity, low head pump and pipe line have been developed to bring 1,500 g.p.m. to the fire truck from the nearest source of natural water on the assumption that in a nuclear attack the existing water supply system is destroyed and streets are blocked with rubble. Both pump and oil filled motor are completely enclosed in a single casing 78 in. long and 14 in. in diameter. This 550-lb. unit will work equally well when completely immersed in a water source or when installed in a pipe line for use as a booster pump. It is powered by a specially designed lightweight 60 kw. engine generator-trailer which can be positioned by helicopter if necessary. The pump can deliver 1,500 g.p.m. at 120 ft. head through 1,000 yds. of 8-in. hose to the fire truck. The hose, in 500-ft. lengths, can be laid by either truck or helicopter. Delivery over longer distances is achieved by inserting booster pumps with every additional 1,000 yds. of hose.

March–April 1958

"Planning Amphibious Operations for Atomic Warfare" by John F. Michel.

The author, a civil engineer, was, when a Lieut.-Colonel in the Corps of Engineers, engaged in the development of the Engineer Amphibious Support Command from 1954 to 1957.

In an interestingly illustrated article "The Beach Usability Diagram" is explained as a useful means of presenting beach hydrographic intelligence in a form in which it can be used with a minimum expenditure of time and effort to determine at varying states of the tide when and where landings can be made. The Beach Usability Diagram simply integrates information on beach profiles, landing craft characteristics, and time-tide relationships. Should any of these conditions change a new diagram must be prepared. The technique described by the author is equally applicable to amphibious operations in conventioned or atomic warfare. For the latter case the greater degree of dispersal needed requires the use of a greater number of beaches including many probably previously considered as marginal or unusable. The Beach Usability Diagram clearly indicates graphically the precise periods during which such marginal beaches can safely be used.

May–June 1958

"Nuclear Energy—The Challenge to Think" by Brigadier General Alden K. Sibley.

The author has had a distinguished career as an engineer, an educationalist, a nuclear physicist, and a planner. As a Rhodes Scholar, Oxford University, he took three degrees in nuclear physics and subsequently conducted an extensive scientific expedition to measure cosmic rays. He was later Deputy Chief of Staff, Middle East, and Chief of Staff of the S.H.A.E.F. Mission to France.

The author considers that the dramatic record of basic research behind the development of the atomic bomb and nuclear energy has a three-fold lesson for all thinking men in this nuclear age; (1) the overwhelming importance of pure science in man's struggle to master nature; (2) the deep and genuine need for mutual understanding and co-operation between scientists and engineers; (3) the need for imaginative thinking and for the free examination of ideas in industry, politics, and statesmanship which a new scientific concept creates.

The General then traces in some detail the paths of basic research on the structure of the atom; the development of radioactivity, fission, the atomic bomb (fusion) and the thermonuclear bomb with its significant freedom from the limitations of critical mass which with the abundance of required hydrogen isotopes in sea water make the production of cheap H-bombs possible without any upper limit of size or number. Unfortunately the H-bomb is not the H-furnace and unless this problem of controlling the thermonuclear reaction is solved before depletion of the remaining sources of fission energy, the prospects will be bleak within a few generations. The real war of today and tomorrow is the thinking war. To survive, American minds must be trained to win the thinking war of pure science and fundamental research which leads to the command of unlimited energy, a priceless possession. The military engineer today cannot afford to ignore the methods and achievements of pure science, nor can he continue to rely on the pieces of scientific knowledge which fall from the tables of others. The social and economic progress of the United States is dependent on the consumption of energy in ever increasing quantities. Here, the author considers, lies America's real challenge. His views are well worth serious consideration.

ENGINEERING JOURNAL OF CANADA

Notes from *The Engineering Journal of Canada*, March, 1958.

Planning New Towns in Canada

The many new towns laid out in Canada in recent years are primarily industrial in character and sited in undeveloped areas. Their planning is discussed in terms of general layout and street planning, and the design of town centres is briefly considered. The old "company town", built by private enterprise, is in the main being superseded by the Government controlled "garden city", and the author's conclusions as regards suggested principles of control and development are very interesting. His analysis of what constitutes a good street plan clearly shows that the once popular grid plan has only the advantages of reducing primary costs and municipal expenses: its disadvantages are considerable. The case for the employment of professional planners of high standing is clearly made out.

St. Lawrence Estuary Submarine Power Transmission Line

This paper describes the design and installation of submarine cables, some thirty-two miles long, to connect the expanding population and industry of the south shore of the St. Lawrence to the great power resources available on the comparatively barren north shore. Both economic and design considerations are briefly discussed, and the practical difficulties encountered in installation are cogently recorded.

The F.N. Rifle

The adoption of the F.N. rifle by several nations for standard service use has involved the conversion of Belgian specifications to suit other manufacturing techniques.

The complexity of the work involved indicates clearly the difficulties and delays inherent in adapting equipment for common use by a group of nations.

Notes from *The Engineering Journal of Canada*, April, 1958.

This is the fortieth anniversary issue of *The Engineering Journal*. It contains no technical papers as such, but constitutes a most interesting and well illustrated record of engineering and industrial achievement in Canada in 1957.

The main headings are mineral resources, power, communication and transport, construction, industrial production, pulp and paper, national defence and defence construction, government works, and research and development.

Notes from *The Engineering Journal of Canada*, May, 1958.

Composite Construction of Bridges

Tests have shown that, when a heavy concrete slab rests on a steel member, it reacts as a composite member to the stresses induced by superimposed loads. Design utilizing composite action is both logical and economical, and it is generally less complicated than reinforced concrete design. This paper sets out design aspects and construction procedure in relation to bridges, and outlines methods of computing stresses and failure loads, and of determining the effects of shrinkage, creep, and thermal movement. Shear connectors are considered, and prestressing methods are briefly discussed. The presentation of the paper is logical and clear, and mathematical examples are excluded from the text by grouping them in a concise appendix.

The A.A.S.H.O. Road Test

The American Association of State Highway Officials is sponsoring a comprehensive road research project, devised to evaluate the performance of road pavements of varying design under axle loads representing a wide range of intensities. There are four main test loops, each about 7,600 ft. long, and two shorter auxiliary loops. Each loop comprises two 24-ft. roadways with 10-ft. shoulders, and sixteen 50-ft. span test bridges (steel I-beam, prestressed concrete, and normal R.C.) are also included.

The layout is designed to test both rigid and flexible pavements under loads ranging from 2,000 lb. on single axles to 48,000 lb. on tandem axles. Great care has been taken to provide an identical subgrade throughout. Rigid pavements, both plain and reinforced, vary in thickness from 2½ to 12½ in., on sand sub-bases of 0, 3, 6, and 9 in. depth. Flexible pavements, with varying thicknesses of surfacing, base, and sand sub-base, have a total thickness ranging from surface dressing to 31 in.

Final results will probably not be available until 1960 but, as there are 640 possible combinations of loading and rigid pavement section alone, reduced for practical purposes to about 300, a great mass of valid data should then be available.

THE CONTRACT JOURNAL

Notes from *The Contract Journal*, April, 1958.

Completion of the Mackinac Suspension Bridge (U.S.A.)

The main engineering problems overcome by this spectacular suspension bridge were the wide, deep, glacial gorge through the middle of the Straits (which ruled out the possibility of intermediate piers in the central area), the pressure of winter ice and high wind velocities.

With so much capital value at stake, the factors of safety adopted were five times max. recorded ice pressures, and 2.5 times max. wind velocities ever recorded. In addition, the piers are protected by armour plate, and steel sheet.

In placing the concrete in the pier foundations, 6,250 cu. yds. were placed underwater by the Prepakt method in a 24-hr. cycle from one floating rig.

Loch Long Ocean Terminal for 100,000-ton Oil Tankers

The new jetty is 1,000 yds. long by 300 yds. wide, backed by four storage tanks (to be increased to six later). The tanks are bunded and the whole spill area sealed with a concrete membrane to prevent seepage. All spill will pass through oil separators before discharge into the Loch. Minimum depth at the jetty head is 55 ft. of water.

Discharge from the tanker will be by 2 × 24-in. pipelines—at a rate of 6,000 tons crude oil per hour. All valves will be automatically power operated by remote controls activated by the level in the tanks. These controls are all duplicated for safety, and trip off alarm signals in the control office. There are four fire-monitor towers on the jetty, with pumps capable of providing 4,000 gallons of water a minute to the jetty, where an independent foam supply can be mixed with the water.

An 8-in. potable water line is provided to pump 100 tons an hour from 350,000 gallons storage.

The jetty is connected by a 57 mile pipeline working at 1,000 lb. per sq. in. Cleaning this pipe of wax deposits will be by a "go devil" in which will be mounted a radio-active isotope for location of a stoppage by means of a geiger-counter. The pipe is protected by a bitumastic coating and cathodic protection by means of magnesium anodes set at intervals.

Building Research Station Digest No. 109: Building Economies

The paper may be useful in promoting plans for new construction.

The paper analyses some of the costs consequent on design decisions, in particular, reviewing the effects of annual maintenance costs compared with initial costs.

Plans should be compared by reviewing aspects such as external wall area over enclosed area, or access over gross floor area. The added costs of user requirements for extra head room, column spacings, etc., must be assessed.

Materials should be selected for their initial cost, upkeep, life expectancy, ease of erection, fabrication, mechanization, even flow of production, requirement for painting or other protection.

The annual maintenance should be compared with the loan rate. If it rises above this yardstick, a cheaper construction and a rebuilding programme is indicated.

A wage of £500 a year represents £10,000 at 5 per cent interest. Any plan which saves this expense, and costs less than £10,000 initially, is economical.

Heating and ventilation, forming probably a third of the annual cost, must be studied carefully. By insulation, reduction in wasted air volume, or utilizing well designed heating systems, considerable economies may be made.

Notes from *The Contract Journal*, May, 1958

This copy of the journal contains three articles of considerable interest to military engineers.

The description of a combined showroom, factory and garage erected at Southampton shows practical details of prestressed concrete construction in which small precast members are linked up, post-tensioned, to form a complicated framework.

In an article dealing with "Trends and Problems in Prestressed Concrete design in Great Britain", Mr. G. J. Harris illustrates the rising importance of prestressed work. He indicates, from the tonnages of steel used, that prestressed work represents a fifth to a quarter of the volume of reinforced concrete work being carried out in the country.

A description of a ready mixed concrete plant erected at Mitcham (Surrey) by Messrs. Blaw Knox shows some of the great technological advances of modern batching practice. The whole plant is operated by two men to provide 60/90 cu. yds. per hour. Control is virtually automatic, once a card has been punched to represent the mix required and inserted into a power samas card reader.

Notes from *The Contract Journal*, June, 1958

THE THIRD INTERNATIONAL PRESTRESSED CONCRETE CONGRESS

The article summarises very briefly the contents of the papers read at the Congress. A list of the main subjects covered by such a gathering of experts indicates the general trend of thought in modern design.

Experiments are being carried out with a view to establishing higher permissible stresses for concrete when compressed in two directions, or even triaxially. The restraint offered by such combinations of loads undoubtedly assists the concrete to withstand crushing.

Theories on shear strength abound. It is probable that failure at different points occurs due to different combinations of shear and direct stresses, and the search for a single, simple, shear theory continues.

The principle of "prestressing" is being applied to a variety of materials other than concrete, e.g., stone blocks with tendons passed through grooves.

Methods of grouting, and the dangers of leaving free water inside ducts, were discussed at length.

Improvements aimed at speed and simplicity in anchoring devices are still to the fore.

Efforts are being made to produce a method of testing prestressing cables electrically before use to discover faults in the wires which are not easily detectable.

One of the chief snags in practical work has been found to be distortion of members during casting or stressing, resulting in the rejection of items being out of true alignment.

REPORT ON THE WORLD CONFERENCE ON PRESTRESSED CONCRETE

HELD AT SAN FRANCISCO, CALIFORNIA, U.S.A., AUGUST 1957

While the notes prepared by the delegates may not be easily available to members of the Corps, certain important extracts are contained in this precis as giving a line on up-to-date thought.

TENDONS

(*a*) Stranded cables have increased in popularity. They bulk less, thereby decreasing the voids due to ducts and enabling the steel to be positioned where required instead of where space can be found.

(*b*) The wires are "stress relieved", with a straight stress-strain curve up to 80 per cent of their tensile stress (approx. 240,000 lb./in.^{2}) with an elastic modulus of 27 to 28 $\times$ 10^6 lb./in^2 at a working stress of 132,000 lb./in.^{2}).

(*c*) Rolled steel bar, of oval section, has been tested successfully in Germany. The oval section cuts out the need for spacers.

(*d*) Friction due to changes of direction of the tendon can be greatly reduced by casting in curved steel bearing plates, greased with paraffin wax.

ECONOMICS

Prestressed concrete floors are cheaper than reinforced concrete, but prestressed airfield runways are still slightly more expensive.

ANCHORAGES

(*a*) A German system was described in which the ends of cables are grouted into prefabricated cylinders precast round threaded bars. The bars can be locked to a steel plate against which a single jack can bear in order to stress several tendons at a time. The excess length is cut off, after grouting.

(*b*) A design of "fan" anchorage for a multiwire cable was described, as also a cheaper form where the cable is taken round a semi-circular precast block and grouted.

(*c*) A Russian system was described whereby the wire is continuously threaded round external anchor pins, under tension throughout—somewhat like a taut "cats-cradle"—eliminating the need for jacks and built-in anchorages.

GROUTING

(*a*) The use of calcium chloride in admixtures has been shown by X-ray examination to cause severe pitting to steel tendons where steam curing is used. This effect is not so serious with hot water curing, and less with atmospheric curing.

(*b*) Emphasis was placed on higher grouting pressures to enable drier grouts to be injected with less risk of free water.

Correspondence

Maralinga Project Office,
Box 1424H, G.P.O.,
Adelaide,
South Australia.
15th April, 1958.

To the Editor
Royal Engineers' Journal

Dear Sir,

May I, without wishing to appear obtrusive, comment on two letters in the correspondence section of the March, 1958, R.E. Journal.

First, I would like to support Major Goodall in the comments and suggestion he advances in his letter about "Armoured Engineers". They must be called "Armoured," they must be accepted as specialists, and they cannot too casually be integrated with ordinary sappers. I am sure it is a wrong approach to think they can be created *ad hoc* for any future war—there just won't be the time. Far more important, though, I believe we—as a Corps—have got to accept the fact that there will be no time or need for the niceties of engineering in the field during the actual period of fighting in any future global war. What will be needed is very rapid engineering sufficient only to provide mobility for our fighting arms and to impede the enemy. This we must do with the greatest possible economy of man-power, while at the same time providing the best possible protection for our sappers. Armoured Engineers, with the help of their A.V.R.E.s, are the only people who can look at these tasks; it is not sufficiently widely appreciated how quickly, and with what economy of man-power, they can bridge minor obstacles, doze and demolish. There ought to be many more of them in peace-time, or they will not be available when they are wanted desperately. At the very least they should be integrated in adequate numbers with the new Armoured Brigades.

Turning now to the letter from Colonel Lewis about my article "The Division in Nuclear War", apart from thanking him for his charitable remarks, I would crave his indulgence because I wrote the article early in 1956, and I do not now in every case agree with myself. I would, however, take issue with him over the American Pentomic Division. That Division seems to me no more than an inflated brigade, and I had in fact expanded my brigade on to a "pentomic" basis. It obviously sounds better to be able to say that one is supporting NATO, etc., with so many Divisions, rather than the same number of brigades; but "what's in a name?" I did eliminate Corps; something must go, but, since I came to stand on my head down here, I will not quibble as to whether it is Corps or Army.

Yours faithfully,
R. A. Barron, Colonel.

Junior Leaders Regiment R.E.
Malta Barracks, Aldershot, Hants,
14th July, 1958.

The Editor,
Royal Engineers' Journal

Dear Sir,

Rather belatedly I must enlarge on some points to support my article in this Journal on Armoured Engineers of almost a year ago and in reply to Major Goodall's letter published in your March issue of this year.

I commanded a variety of "armoured engineer" squadrons in Italy during the last war. The first, a field squadron had all its troops carried in "sawn-off" Honey tanks. The conversion was carried out in a matter of weeks entirely from the field squadron's personnel and the three armoured field troops operated successfully hundreds of miles apart simultaneously. Admittedly, there were no Churchill maintenance and spares problems but the R.E. fitters quickly learnt to master the Honey tanks with the occasional help of armoured regiment L.A.D.s. Following this I commanded the R.A.C./R.E. assault squadron who were mounted in Churchill and Sherman tanks. More than half of the commanders, drivers, wireless operators and fitters were R.A.C. but many of the better men were Sappers who had quickly taken to R.A.C. ways. Later on I converted a field squadron to a Churchill and Sherman tank assault squadron. As far as I remember this conversion was completed in under three months with the help of a few selected R.A.C. personnel and the R.A.C. school who instructed the R.E. personnel.

From this experience I consider a field squadron could train sufficient personnel to man and look after 9 A.V.R.E. in a matter of months. I'm sure I did not imply it would be done "overnight".

My original proposal was framed to meet the problem where the ratio of armoured engineers is low in comparison to the number of armoured regiments they are trying to serve, bearing in mind the terrain and the distance apart of the armoured formations. I well remember in Italy the difficulty of quickly reinforcing one half squadron separated 50 miles from my H.Q. and other half squadron.

My remark about training A.V.R.E. crews as field engineers was only meant to apply to the future all regular army. There should then be time in units to train all R.E. drivers, including A.V.R.E. drivers, as field engineers so that they can help in a dismounted role in emergency.

Extra skilled fitter support would have to be ensured by training field squadron fitters concurrently with the proposed training of field squadron A.V.R.E. crews. Then a suitable dilution with the armoured engineer squadron fitters would be workable. The F.A.M.T.O.—a reduced scale—would be carried in the vehicles asked for. In emergency the field squadron would fall back on specified armoured workshops who would be suitably scaled to deal with all armoured engineers in the theatre. It is to be hoped that in the not too distant future this particular problem will disappear automatically by the introduction of different equipment.

I tried to make the point that all field squadron officers must know more about A.V.s R.E. so that they can use them intelligently to assist the armour which the field squadrons are supporting. There are not enough armoured engineer officers to go round. The field squadron officers given command of the proposed extra A.V.R.E. troops must of course receive full training in looking after A.V.s R.E.

Yours faithfully,

R. L. France, Lieut.-Colonel R.E.,

Transportation Inspectorate R.E.,
H.Q., B.A.O.R., B.F.P.O.40.
11th June, 1958.

The Editor,
Royal Engineers' Journal

Dear Sir,

In the memoir of the late Lieut.-Colonel G. R. S. Wilson, C.B.E., published in the June 1958 Journal, there is an incidental reference to Major-General Sir Charles Pasley as being the first Inspecting Officer of Railways in 1841.

According to Mac. Dermot's *History of the Great Western Railway*, Vol. I, p. 117, the first Inspector-General of Railways was Lieut.-Colonel Sir Frederic Smith, R.E. appointed in 1840 under the Railway Regulation Act of that year. It is further recorded on p. 136 that General Pasley had succeeded Colonel Smith by 1842.

Colonel Smith served on the Gauge Commission of 1845 in company with the Astronomer Royal and Peter Barlow, Esq., who was at that time Professor of Mathematics at the "Shop". According to another source, Smith and Barlow also served together on the Royal Commission of 1839, appointed to report on a number of alternative rail-routes proposed to link England with Scotland and with Ireland.

On p. 229, Mac. Dermot gives his full name as "John Mark Frederick Smith."

Yours faithfully,

N. B. Peatfield, Major R.E.

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