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NOTES ON DEMOLITIONS CARRIED OUT IN A LARGE MANUFACTURING TOWN, AFTER A RECENT AIR RAID.

By " SAP."

Introduction.

5

After an air raid many buildings are so damaged, especially those that have been burnt out, that demolition of the remaining walls is essential if traffic is to use in safety the street below. Municipal authorities require certain routes to be re-opened as soon as possible and along these routes R.E. units will often be asked to carry out demolition with explosives.

Requests may also be made for demolition of buildings to create fire-breaks. Fire brigades tend to be optimistic and will frequently delay in asking for this until too late for methodical attack. Hasty demolition in such a case means large charges to avoid any possibility of even partial failure, and there will rarely be time for more than intelligent guesswork.

The aim of this article is to describe methods found by experience to be effective with the type of buildings encountered, in the hope that they may be of some interest and assistance to other R.E. officers faced with a similar task.

Object.

In every case but one, the object of the demolition was to bring down a building already damaged, and in a condition considered unsafe.

The one exception was the creation of a fire-break.

Considerations.

i.—Types of buildings: (most demolitions were done in one area of the city). Most were large warehouses, or office buildings. In almost all cases they were shells; the centre had either been gutted by fire, or destroyed by bombs. Some were steel-framed; often this was not obvious, and when met with, it led to difficulty.

ii.—Placing of charges: this was often complicated by the following factors:

(a) access barred to the building, either by fires burning inside, or by the inaccessibility of the windows.

(b) the state of the building considered too unstable for the use of compressor tools.

(c) as little explosive as possible to be used, in order to do as little damage as possible to surrounding buildings.

(d) as little debris as possible to be thrown up, to reduce the F

work of clearing to a minimum. Buildings had therefore to be collapsed into their own area as far as possible.

iii.—Speed in carrying out the demolition was important—the sooner demolition work was done, the quicker clearing could start.

Methods.

i.—Borehole charges in the main pillars of the structures.

ii.—Cutting charges, placed in the most suitable position available. These might be the pillars, by the windows and doors, or in any cracks already open in the building.

iii.-Concussion charges.

(i) was used wherever possible; obviously it is the most satisfactory. It could not be used when the building was in an unsafe condition, or when fires were burning strongly inside and showed signs of spreading before preparations were complete.

(ii) and (iii) had to be used in cases where (i) was barred; no hard-and-fast rules could be found to deal with different situations—each case had to be treated on its own merits.

(iii) was occasionally found very effective, but on a steel-framed building was useless.

The following are examples of demolitions that were carried out; they cover the main problems that were encountered. They were done in the space of 4 days, by one section of a Field Company though two other sections were employed for one day.



1. State of Building. (Fig. 1).-Large warehouse completely gutted.

There were 7 pillars on the front, with 2 ft. thickness of masonry, and 14 inches brick. The walls were 14-inch brick and 9-inch stone facing.

Object of Demolition.—To bring down wall without blocking street on the front of the building.

Method.—As shown in Fig. 1, three 24-inch boreholes were made in each pier, 22 in all being bored. Holes were staggered 18 inches apart.

12 oz. of gelignite were placed in each hole.

Commercial detonators were used—it was found not to be reliable to fire as many as 22 together, and therefore firing was done in two halves.

Result.—The demolition was completely successful. Explosives Used.— $16\frac{1}{2}$ lbs. of gelignite.



2. State of Building. (Fig. 2).—Both buildings were burnt out. The walls were of good brick in cement mortar, but they had been shaken considerably by a landmine. The communicating passage was a steel frame attached between the two walls. It was impossible to enter the buildings, owing to fire in the cellar.

Object of Demolition.—The corner A, the connecting passage, and the wall B were unsafe. They were to be demolished, in order to make the street running along the line of "road level," as shown on the sketch, safe for traffic. Also the side street running under the connecting passage was to be kept as free from debris as possible.

Method.-The corner A was to be demolished by 3 small mined

charges placed at the foot of the pillar. Bricks were knocked out, the chambers filled and plugged up with wet clay. The charges were fired electrically. 25 feet of the wall at B was to be cut with G.C.; the inside was inaccessible owing to a fire still burning in the cellar. The wall was badly shaken, and no other wall remained tying it in. It was therefore decided to use less than the 2 slabs per ft. run, and 30 slabs were used. The charges at A and B were connected in series, and fired electrically.

Result.—The demolition was successful. Explosives Used.—30 lbs. G.C. 14 lbs. ammonal.



Indicates I lb. Gelignite tamped into side of window opening.
 Indicates 2 lbs. ditto.

3. State of Building. (Figs. 3(a) and 3(b)).—Warehouse gutted, walls approximately 2 ft. thick. The cornice was in a very dangerous condition.



Object of Demolition.—To bring down the shell of the building, without blocking streets in front, or to the side of the building.

Method.—Boreholes were not possible, owing to the cornice. It was decided to attack the first storey windows (see Fig. 3(a)): this would leave only the ground floor walls standing, and the building

would be safe enough to permit traffic at the corner. Bricks were knocked out of the corners of the windows, and charges of gelignite were placed in the cavities so formed. The charges were then well tamped with sandbags.

Result.—The building was almost completely flattened but part of the stonework of the ground floor was left standing, a ragged edge remaining. At CC a dangerous overhanging section was left. This was made safe by a charge of 2 lbs. of gelignite placed at X, which made a clean break AA (see Fig. 3(b)).

Explosives Used.—13 lbs. of gelignite, for both demolitions.

4. State of Building. (Fig. 4(a)).—The building was completely gutted but the remaining shell was apparently quite stable, except for a heavy masonry cornice considered unsafe.



Object of Demolition.-To bring down the corner, and make the road junction safe for traffic.

Method (i).—It was not realized that there was girder reinforcement inside the masonry of the walls. It was decided to demolish the building by charges of 5 lbs. of G.C. over the lintel, and 4 lbs. tamped into a window, as shown at A in Fig. 4(b).

Result (i).—This failed to demolish the building, but succeeded in shaking the top. A crack opened in the wall, and a 9×5 inch I-section steel R.S.J. was uncovered at the lintel.

Method (ii).—The building was then attacked by placing 4 lbs. in the crack opened at the first attempt, and 5 lbs. well tamped at the foot of the arch, as shown at B in Fig. 4(b).

1941.]



^{&#}x27;A' - FIRST CHARGES 'B' - SECOND CHARGES

Result (ii).—The second charges totally demolished the building, which fell on to its own base, causing no obstruction to the corner. Explosives Used.—18 lbs. of G.C.

5. State of Building. (Fig. 5).—The building was burnt out, but for a short distance from the front wall the party walls and the floors still remained.

Object of Demolition.—To demolish the shell of the building, as it was not considered safe as it stood.

Method (i).—Borehole charges were driven in the piers and walls, as shown on the sketch. 12 oz. of gelignite were fired in each borehole, by F.I.D. connected to eight 3-primer junction boxes.

Result (i).—The front of the building was brought down to first floor level only: the party walls, and the girder frame inside the building held up the remainder.

Method (ii).—Charges of 15 lbs. of ammonal were then placed in the party walls; 3-lb. charges were tied to the R.S.J's, and ammonal sausages on two cast-iron stanchions in the basement. These charges were fired electrically.

Result (ii) — The demolition was successful.

Explosives Used.—19 lbs. 8 oz.—gelignite.

32 Ibs.—ammonal.

6 lbs. —guncotton.



NOTES ON DEMOLITIONS.

6. State of Building. (Fig. 6).—Gutted warehouse, the outside walls alone standing. These were of 18-inch solid brickwork, still in good condition.

Object of Demolition.—To bring down the walls, as they were not considered strong enough to stand the vibration caused by heavy traffic passing.



Method.—Bricks were removed in the corners of windows, and charges A, B, C, D, E, were placed in the holes so made, and well tamped. The charges were fired electrically.

The sizes of the charges were :---

A 10 lbs. ammonal.
B 10 lbs. do
C 5 lbs. gelignite.
D 10 lbs. ammonal.

E 10 lbs. do

Result.—Complete demolition of the front of the building. Explosives Used.—40 lbs. ammonal.

> 6¹/₄ lbs. gelignite (4 oz. cartridges of gelignite were used in lieu of primers).

7. State of Building. (Fig. 7).—Warehouse, 6 stories, 60 ft.-70 ft. high, the roof and top 4 stories well on fire. The walls were 18-inch brickwork, with 9-inch masonry facing; Fig. 7 gives details of the surroundings.

Object of Demolition.—To prevent the fire already burning in the building and behind it from spreading to the intact buildings across the street.

Method .- It was originally intended to place borehole charges along

the end and side walls of the warehouse, but streets were so blocked with debris and fire hoses that compressors could not be got there in time.

It was therefore decided to place concussion charges near the two corners of the building, in the basement. Guncotton charges were fixed to cut the iron grill over a basement window, but before these were fired the roof and two upper stories collapsed, and this method had to be abandoned. Access was possible to the hall, but the staircase was on fire, and there was not much time to spare. Further, a varying wind made approach from more than one direction at a time extremely difficult. A crate of ammonal of 63 lbs. was placed in the entrance hall and fired.



A second 63-lb, crate of ammonal was placed against the remaining front corner, and fired. There was no time to tamp it.

Result.—25 ft. run of the front wall and 15 ft. of the side wall on the S.E. corner collapsed. 25 ft. run of the front wall, and 15 ft. run of the side wall on the S.W. corner collapsed, together with the whole of the central portion of the building. 10 ft. of the centre of the front wall remained standing, but collapsed shortly afterwards. The fire was dropped to ground level by the demolition, and was soon under control.

Explosives Used.—126 lbs. ammonal. 8 lbs. G.C.

No attempt at calculation was made as time pressed.

ENGINEERS IN COMBAT.

By DONALD B. ADAMS, Lieutenant-Colonel, Corps of Engineers Reserve.

(Reprinted from The Military Engineer (Washington) Nov.-Dec. 1940.)

THE statements, opinions, and suggestions advanced in this article are based on the experiences and observations of the author. They are based on over twenty years of service divided among the three components of the United States Army. The writer realizes that exception may possibly be taken to some of the statements made and to several of the suggestions offered. No implication or representation is made that the opinions and suggestions, as set forth, are in any way official in character.

For the engineer there is no clear cut line of demarcation between "attack" and "defence"—that is unless the specific movement includes a retreat with actual displacement to the rear and a rearguard action. "Defence," to the engineer, is a temporary stabilization of the situation preparatory to going forward. Engineering measures for defence must be undertaken with full consideration that such measures must not handicap a resumption of the offensive unless actual displacement to the rear is ordered.

In order to follow the development of engineer troops, their mission and equipment, this survey has been divided into three phases. First, some of the work the engineers did in the war in 1917 and 1918, and what they had to do it with. Second, the theories relating to the use of engineer troops as developed during the intermediate period from about 1919 to 1939. As typical of this intermediate period the theories as taught by the Command and General Staff School, Special Class of 1935 have been taken. For the current period, the engineer organizations and their work during the Corps Manœuvres of April, 1940, has been singled out and is commented upon.

During the first period referred to, the author was with a famous regiment of combat engineers organized in 1917 and sent to France soon afterwards. It saw service first with the British and Anzac forces, later with an outstanding American division of the Regular Army, and carries seven battle streamers on the regimental colours.

The second period—twenty years of peacetime development of military engineering practice and theories followed. Mechanization, firepower and mobility all gradually increased. Unfortunately these increases in all respects were almost entirely in theory. This long intermediate stage can be appropriately typified by theories regarding the use of engineer troops, as were taught at the Command and General Staff School in 1935. While still conforming closely to the basic theories practised in 1917-1918, in 1935 engineer units were faced with some problems, at that time new, of engineer missions over areas greatly extended to the front and flanks. Wide enveloping forces presented novel problems for the engineers, as did the theory of the "all round protection in defence." In addition to their technical work it was normal to designate the engineer regiment for reversion to the division reserve, thus implying active participation in the firefight, if necessary. Mechanized vehicles, both wheel and tread types, were making their initial bids for important roles in the United States Army. Radio control was playing an ever increasingly prominent part in the communications system. Animals were being displaced by motors. Speed of movement was increasing for all branches. Even the old improvised water supply was going "streamline" and was developing into a compact mobile truck-borne unit, able to move at a satisfactory relative speed and capable of supplying the water necessary for the whole division.

With the ominous threat of another European conflagration, early in 1939, the third period, that of "limited emergency," began. This is the situation in which the country finds itself today. The question now is, will this nation sooner or later pass into the definitely critical stage. However, the lessons of the past form the basis of any prognostications in reference to the future.

Typical of the "limited emergency," the Corps Manœuvres of April, 1940, were chosen. These Corps Manœuvres, held in the vicinity of Fort Benning, followed the initial manœuvres of August, 1939, participated in by Regular and National Guard units, and the division manœuvres of the Regular divisions at their southern stations during the fall of 1939 and winter of 1940.

In the Corps Manœuvres of April, the "streamlined" regular divisions functioned as integral parts of an army corps, with the heavy corps artillery and air force in support, and with the corps administrative facilities available. Mobility reached a point now considered ample. Speed of movement was several times that achieved by the "old armies" of 1918. Mechanized vehicles, both tread and wheel, were in great evidence. Area of operations was greatly expanded. The importance of roads, bridges, and supplies of corresponding mobility became primary considerations. Therefore, the engineers became of relatively greater importance—an importance yet unrecognized in the absence of actual demolitions, actual airbombing, and actual artillery fire. It is very difficult to simulate these destructive forces, and it is still almost impossible to visualize the full necessity and importance of trained engineer troops.

WORK IN THE WORLD WAR.

To trace the mission of the engineer unit in attack, it is advisable to start with the achievements of that "old" 1917 combat engineer regiment. This regiment was composed of high grade enlisted men, vitalized with a few "old army" non-commissioned officers, officered by Reserve lieutenants, Regular Army captains and field officers, and commanded by a series of well-known Regular Army Colonels of Engineers, many of whom have since become general officers. The regiment acquired and held a superb regimental morale. The outfit landed in France in the fall of 1917 and remained in foreign service until the fall of 1919. This included almost a year in the Army of Occupation on the Rhine.

The slogan of this regiment was, "Get the Infantry Forward." Colonel Edmund L. Daley (now Brigadier General in command of the Department of Puerto Rico) installed this basic idea into the regiment. This idea was inclusive. When in a stabilized situation all preparations were made not only to be able to remain in position, but to go forward when the time came. As the infantry could not advance by itself, it meant that the artillery had to be in support. And as the infantry and artillery needed roads and bridges, both to the rear and to the front, routes of communications were constructed and maintained by the engineers. In short, when any other arm needed assistance of any kind, the engineers were there to complete the job.

First, last, and all of the time, communications in the divisional area had priority. In 1917-1918 there was normally little new road work to be done, but there was a great deal of road maintenance. However, in the Meuse Argonne, when the advance brought "noman's land," which had endured shell fire for four years, within the divisional area, an axial road was built from Hill 304 nearly to Montfaucon. It was built approximately where a road was once known to have existed, but of which hardly a trace remained. Over terrain of interlipped shell-holes filled with water, the road was constructed, using picks and shovels, with sand bags to bring in rock fill. The road was completed and maintained while carrying the maximum possible traffic; it was in use by bumper-to-bumper traffic almost as soon as the work was started.

Bridges have always been the responsibility of the engineers. Foot bridges were constructed of whatever would float or could be improvised to do the job; pontoon bridges often were built of captured enemy pontoons; semi-permanent bridges of trestle and crib types were built of green round timber or of whatever material was available; and permanent fabricated steel truss bridges—all were constructed by the engineers in order to get the other arms forward. In almost every instance these bridges were constructed under the fire of small arms, machine-guns, artillery or of bombing planes. In constructing bridges under small arms fire, the covering fire of friendly troops was a practical necessity. The experienced engineer officer was very careful about his arrangements for this assistance. It always proved most advantageous to check up carefully on the artillery assistance, no matter what provision had been made by higher command. It was equally important to make sure of the small arms covering party. Good judgment dictated being ready to provide covering fire by engineer troops if such became necessary, as it sometimes did. Engineer reconnaissance of bridgesites, and of the available material, checking on assisting fires, and carefully arranging a timetable for the entire operation, all were absolutely necessary for a bridging operation, and time for all this was generally at a minimum.

Organization of the ground consisted of trench traces and supervision of infantry digging parties; the construction of machine-gun emplacements which were generally unsatisfactory to the machinegun officer who was to occupy them; work on shelters for various regimental and higher headquarters, and the construction of wire entanglements.

On the subject of wire, several interesting situations arose. Acting on orders of higher authority, an engineer party during one night strung wire in front of a line established early in the evening by the infantry. The infantry commander finding the wire later in the night, proceeded to locate the engineer officer in charge of the detail and directed him to "Get that — — wire out of here ! How do you expect us to advance at daylight." The engineer officer cut the wire out before daylight.

On another occasion an engineer party was sent up to run wire in front of a small engineer force which having taken the objective in the morning had been later in the day surrounded by the enemy. After fighting back and reorganizing, this force, reinforced by an additional company of engineers, retook the objective later the same afternoon. To the wire detail the position was entirely strange and in addition it was heavily wooded. The wire was run during the night, but with daylight it was discovered that the wire had been run in almost a complete circle. However, inside the circle, there was an enemy outpost which had been neatly wired in. The engineer detail took the outpost and left the wire.

Traffic control, through plans recommended to the division commander, directed by adequate road signs and the clearing of traffic jams, was a normal function. Trails separate from the highways for foot soldiers and machine-gun carts, provided shelter for the approach march, helped to relieve road congestion, and kept concentrated bodies of men and animals away from points subject to harassing artillery fire.

The reverting of the engineer troops to the reserve, in addition to

their routine tasks, was also normal. Much of the combat engineer's work was near or in advance of the front line. It often happened that the engineer troops just naturally found themselves in a fire-fight of one kind or another. As "reserves " the engineer went into positions of readiness to join in the battle when called upon. This sort of thing occurred so often that the engineers equipped themselves with machine-guns considerably in excess of organic numbers, and these guns were very useful on many occasions.

Continual tactical reconnaissance to be, if possible, a jump ahead of the other branches, and technical reconnaissance to locate various available supplies, became a matter of second nature.

Water supply points, bathing facilities, and delousing plants pretty much took care of themselves in France at that time.

Railroad work was restricted to narrow gauge lines immediately behind the front. As the air force in those days played a less important role, engineer work in connection with this branch consisted of advanced landing fields, graded sufficiently to set down a few ships of the type existing in that era.

During the rest periods which occurred between the active phases, the organization not only toned up by close order drill, calisthenics, and the reconditioning of equipment, but carried on experimental training in addition. Various methods of crossing deep wire entanglements were tried out. One method developed was crossing bands of barbed wire by throwing over it mats of chicken wire. Wire cutting by means of various types of Bangalore torpedoes was tried out.

In the 1917-1918 period, trained engineer troops not only knew the feel of picks and shovels, could handle with efficiency all of the tools in the tool wagons as the occasion required, and were thoroughly familiar with the handling and use of TNT, but they also were good fighting troops. The engineers demonstrated on many occasions their readiness and ability to get into the fire-fight, and went in to do a satisfactory job as infantry. The particular engineer regiment referred to, was known to have entered a fight without orders from higher authority. Recognizing that the situation demanded a fight rather than engineer work, they promptly threw down their engineer tools and supplies, entered the fight and stayed in until the division was relieved a week later. Engineer troops were good soldiers as well as technically trained men.

PERIOD OF CHANGE.

The changes which took place during the twenty years following the war which ended in November, 1918, were gradual and remained for the greater part in the theoretical state. Weapons were improved, mostly on an experimental basis. The mechanization of the army increased, particularly on paper. The Air Service saw constant advances, and so did the anti-aircraft weapons. But there was no great increase in the number of military planes, and the modern electrically controlled anti-aircraft batteries were still sufficiently rare to be items of curiosity.

At the Command and General Staff School, which the writer had the privilege of attending in 1935, the ideas of the duties and missions of engineers had changed somewhat from the corresponding ideas of 1918. Mechanization was forging to the fore, and armoured vehicles of the tread and wheel types had already displaced many of the animal-drawn loads and most of the mounted personnel. These changes brought to the engineers new problems, though on paper and in theory only. Even then had the political system as applied to military matters permitted existing units of the Regular Army to be assembled in units of not less than a division, many new changes, existing only on paper, could have been studied in the course of division manœuvres. A division was and is the smallest unit utilizing the co-ordination of all arms. The division on manœuvres is the best method yet devised to approximate actual conditions for training the fighting forces of the Army.

The area in which the engineers could expect to operate was much extended both to the front and flanks. As the mechanized units in the course of gathering information were largely road bound, the engineers were a necessary part of such reconnaissance units. Road blocks and demolished bridges were considered definite contingencies of every advanced situation. Without the engineers, any dash of armoured vehicles to the front to establish contact, or on sweeps around the enemy flanks, was considered unlikely to reach the objective. Engineers were considered necessary to overcome the obstacles which the enemy would normally install. The theory of the wide envelopment was emphasized. A small holding force on the existing front, while the main body executed a wide encircling movement, was stated as the answer to the concentrated fire power of an enemy solidly established in a defensive position.

The "wide enveloping force " needed engineers to repair demolitions and to remove obstacles which might hinder this mobile enveloping force from getting into position to launch its daylight attack on the enemy's flank. The direction of such attacks was generally considered best when launched against the rear segment of the enemy flank. On the way to the attack position the enveloping force was open to flank raids, particularly by hostile mechanized elements. The engineers were called upon to block off such threats which, if they penetrated the protective screen, could disrupt the entire plan of the attack.

The teachings of the School contemplated further details, such as engineering work in connection with night attacks, cutting the enemy's wire, assisting to consolidate the ground gained, extending routes of communications to include the captured territory, and supplying the usual engineer material. Nor was the availability of the engineer regiment as a reserve, in addition to its normal duties, overlooked. As the engineer regiment was at that time one of the five divisional regiments of foot soldiers, a normal and supplementary mission of the engineers was to revert to brigade or division reserve, available in case of necessity. For this work the engineer regiment had approximately the same equipment and the same engineer supplies as had been standard in 1917-1918. Mobility and speed of movement had been somewhat increased by replacing animals with motor vehicles. The motorized water purification plant was in its initial stages, but was operated by water units and not by the combat regiment.

PRESENT-DAY STREAMLINED DIVISION.

Passing to the engineers of the streamlined division of early 1940, numerous changes in organization, in equipment, and in missions are strikingly obvious. The Corps Manœuvres of April, 1940, at Fort Benning, Georgia, are taken as the example.

The combat engineer unit, that is, the divisional engineers, has been reduced to a battalion of three lettered companies, two platoons to a company. The battalion normally assigns one platoon to each of the three combat teams. These three assigned platoons pass from under the control of the Division Engineers and to the control of the commanders of their respective combat teams. They revert back to their own organization control only on orders of the Division.

In connection with this organic change it should be noted that the streamlined motorized division is equipped to function as a fast moving unit capable of delivering a swift blow at any distance up to about 150 miles within a 24-hour period, and of bringing to bear the maximum fire power in delivering the attack. To cover distances ten times as great as was considered possible twenty years ago, this force is much more sensitive than before to passable roads and bridges. Obviously the engineer requirements in the streamlined division area have been immensely increased. In no respect have the duties of the engineers been in any way decreased. On manœuvres, while much can be simulated, in the absence of demolitions, artillery fire, and bombing on arterial roads, it is exceedingly difficult to visualize how great would be the need for engineers and their technical equipment. The missions of the three platoons, one-half of the battalion, now normally assigned to the three combat teams, as well as the mission of the battalion as a whole, have changed and increased as will be described.

It is exceedingly questionable whether or not the present-day

engineer combat battalion will be adequate to cope with the calls sure to be made upon it under conditions of actual warfare. In the opinion of the writer serious and immediate consideration should be given to this question. It is suggested that a fourth lettered company of three platoons be added to the engineer battalion. The three platoons of this fourth lettered company would then be available for normal assignment to the combat teams, leaving under command of the Division Engineer the three full companies. In consideration of the certain great increase in necessary work, the question would still remain as to whether the engineer man power would even then be sufficient under war conditions.

Such an arrangement would not constitute anything new or novel, inasmuch as the present "separate battalions" are four-company organizations. It would seem to be a question of some such arrangement, or a return to the engineer six-company regiment, or providing for a generous supply of attached "separate battalions" which, however, do not possess the necessary mobility to be where needed when required.

It also seems that with the increased "technical work," the Division Engineer, in his dual capacity of troop commander and technical assistant to the Division Commander, should rate the experience and rank of a full colonel.

The engineer battalion is, of course, entirely motorized. It carries the same technical equipment and engineer supplies as formerly, but with some striking additions. Each company has a bulldozer, each platoon an air compressor, and the battalion, a water purification unit and twenty assault boats.

The assault boats nest and are easily transported. They are light three men can pick up a boat, carry it to the water and launch it. As articles of river crossing equipment, to launch during the initial stages of the crossing, and later to service the pontoon bridges, they are an excellent addition.

The water purification unit can equal the mobility of the division; it can be put into operation in approximately one-half hour after it arrives at the designated water point, and it can supply the water needs of the entire division. Only a comparatively small stream is sufficient for the supply. A few sand bags in the absence of other arrangements form an adequate pool for the intake. The purification unit takes practically any water and quickly makes it available in potable condition for the water cans as they arrive on the motor trucks of the division units. By means of the canvas storage tanks and auxiliary hand pumps this purification unit is well able to fill completely and quickly the water requirements of the division.

The air-compressors—they were in transit to the organization in April—constitute a most useful accessory in defence and in offence as well. In these days when speed is paramount, the mining of roads, particularly concrete roads, will be quickly possible. Before the addition of this item, the mining of a highway, unless a culvert was obligingly present, was a matter of many man-hours of work. The placing of obstacles, where the terrain is best suited to make them most efficient, can now be easily done. The air compressor will greatly facilitate the clearing away of debris resulting from demolitions, and the work of preparing the site for repairs.

The bulldozer is a very important and highly efficient machine. It is quite possible that more of these will be needed in actual warfare, bearing in mind that, to make speed, the motorized forces must keep to roads. It is logical to expect an enemy to direct his heavy artillery and bombers at critical points in the road net. The resulting shell holes must be filled and filled quickly. For this the bulldozer is admirably suited. New roads, bypasses, cutoffs, earth barricades can all be easily constructed by this machine. Besides the bulldozer feature, the winches on the caterpillar will be available for all sorts of jobs, very awkward to do by man power or even with the use of tackle.

It is perhaps in their different forms of mission that the engineers show the most striking differences. Although basically the same, the execution of their various missions now requires an entirely different approach, both physical and mental. The engineers, being motorized, possess the same mobility as the other elements of the streamlined division. However, the period of time for planning, preparation, and execution, is enormously reduced. It was formerly true that, could the engineer unit be only a short distance ahead of the rest of the division in its planning, there would generally be enough time to do whatever was necessary to "Get the infantry forward." Now, with all divisional elements travelling at 30 miles an hour, careful preliminary planning must make up for the lack of time available for execution. For instance, the press reports German bridge trains following on the heels of the advance parties, equipped with prefabricated bridges constructed to fit exactly the specific sites which it had been calculated in advance would need those bridges. That may or may not be an exaggeration, but it is certain that any considerable delay to a motorized force is very likely to disrupt the whole scheme of the Commander, and may also result in disastrous losses of vehicles. of all kinds.

Beginning with the work of the engineers in 1917 and 1918, and following the developments through to the critical year of 1940, it should not be too difficult to visualize, in the light of the changes in those twenty years, the duties of engineer troops in the immediate future. In particular it should be possible to build up a picture of engineers in the attack, what the engineers will be called upon to do, and how they are going to do it.

ENGINEERS IN THE ATTACK.

In order to start the attack a force must be ready for it. The personnel must be rested, adequately fed, both men and machines. They must be in "good running condition" and well supplied with whatever they may need in the course of the activity coincident with the attack. This means that roads and railroads must be built or put into serviceable condition, in order to bring up rations, gas, ammunition, replacements of personnel, arms and equipment, and many other items needed to put an army in fighting trim. These lines of communication must be maintained in passable condition by the engineers. In this preliminary stage, the supply of pure water and some of the details of sanitation also come under duties of engineers.

Presumably such a force will, during this period, be vulnerable to minor attacks or at least to raids in force, if for no other reason than the enemy's desire to obtain information. In these days of speedy mechanized units, such raids can be expected from every direction, including the rear. In protecting against these attacks, sudden punches of speedy armoured elements, the engineers will be called upon to do a major part of the work. Bridges, not to be used during the advance, will be mined with TNT ready for instant demolition. Roads which likewise are not likely to be used by friendly troops, will be prepared for defence by mining, by road blocks of large trees felled across the roads, by cable blocks, by earth barricades, and in some cases by concrete or steel tank blocks. All of this will be done by the engineers.

And, while on this general subject of blocking mechanized vehicles, it might be worth while to consider the teamwork involved. While the engineers are equipped and able to construct the blocks which are intended to bring the mechanized vehicles to a halt, it is the mission of the heavy weapons companies of the infantry, and of the artillery, to destroy the vehicles once they are halted. Wheeled vehicles must, in general, stick to the roads. Tread vehicles can only make speed off the roads when the terrain is favourable. Armoured vehicles of both kinds are very difficult to hit with sufficiently heavy guns when the vehicles are travelling at 40 to 50 miles per hour. Therefore, against mechanized forces, it is the job of the engineers to halt them so that they can be destroyed by the covering fire of the infantry and artillery.

Continuing with the engineers' mission of stopping hostile armoured vehicles, the so-called "land mine" is sure to be of primary importance. A charge of ro pounds of high explosive in a mine is sufficient to smash any wheel or tread which will detonate it. In April, samples of such a mine were on hand, but mines were not yet available in quantities to the regular divisions. The mine is of the contact type, is small, and easily and quickly handled, can be concealed by burying in open spaces such as roads, and is inconspicuous in areas covered by high grass, weeds and underbrush. It detonates only under sufficient pressure not to interfere with foot troops.

It seems to the writer that this type of mine is so very necessary that supplies of TNT, or other suitable explosives, and the containers, should be available in sufficient quantities so that the engineer commander can count on using a maximum 50,000 pounds per mile of defensive front. The amount actually used will depend on the terrain. This figure may sound like a great exaggeration, but a sufficient supply of land mines, installed by well-trained engineers, and adequately covered by the fire of anti-tank weapons, will go a long way toward obviating such advances as the German mechanized units were able to achieve in Holland, Belgium, and France.

To build these different types of road blocks, to perform the demolition work, to place the land mines, and to do all the necessary technical work, the combat engineer unit, as now constituted, carries with it the equipment and has every facility for performing its various missions. The only exception to this is the possibility of insufficient man power to perform all of the allotted tasks in the time allowed.

During the advance to the attack, the army still continues to be vulnerable to attacks and raids from the flanks and rear. The engineers must continue to give engineer protection. Unless the distance to be travelled during the advance is extremely short, the engineers will be called upon to repair the roads which have suffered from artillery fire, bombs, and mines. It will be their duty in conjunction with the other arms to remove all types of road blocks which presumably will be covered by hostile fire. Small bridges must be replaced with the maximum rapidity, often under fire. At all times the most careful planning for such situations will be the responsibility of the engineer commander, as the mobility of the advance must not be lost and delay must be at an irreducible minimum. Obviously an important part of the success of the supreme commander's whole scheme will rest on the ability of the engineers to foresee every possible situation, to provide material promptly where needed, and to execute the necessary work in a minimum time despite any and all obstacles. The battle still generally goes "to him who gets there 'fustest' with the ' mostest ' men."

When in the course of an advance a large river is encountered, the enemy will hold the position and resist the crossing. All bridges, boats, and other means of crossing will of course have been removed. The engineers will be called upon to perform their functions involved in a river crossing.

Engineer reconnaissance will begin at once. The engineer commander will anticipate the request of the superior commander for suggestions as to points of crossing detachments in search of information, for suggestions as to the most favourable locations for crossing the troops in an attack, as to the best sites for pontoon bridges, and for the engineer phases of a plan of attack. The engineer will also make a thorough engineer reconnaissance to familiarize himself with any available supplies or equipment. At the earliest indication as to what ferries, foot bridges and pontoon equipment may possibly be required, the engineer commander must satisfy himself that the material, sufficient for his troops to perform properly their missions in a river crossing, has been ordered forward, and that such material will be at proper locations at the designated time.

Meanwhile the assault boats operated by the combat engineer troops are immediately available for the crossing of such small detachments as may be ordered forward. During all of the preliminary phases of planning the attack, the engineer commander in his capacity as a staff officer should figure prominently. In conjunction with the division commander and members of the division general staff, the engineer should assist in working out all of the details of the approach march to points of concentration, plans for crossing the initial infantry troops in the assault boats and possibly in pontoons, plans for troops and equipment to be rafted to the other side of the stream, plans for the installation by the engineers of foot bridges, and plans for the construction by the engineers of the pontoon bridges. The engineers must check and supervise the bridge guards furnished by the pontoon units, and if required so to do, should promptly initiate measures to facilitate the construction of semi-permanent or permanent bridges by engineers of special units attached to higher echelons. As soon as a bridge-head is established the engineers resume their normal missions incident to the advance, as before described.

Once a decisive action appears imminent, the modern mobile type of division brings about additional missions for the engineers. These missions are relatively new, at least in their form of execution. By reason of the newly acquired mobility, it will be possible for small forces to penetrate or to swing wide around the enemy flanks and to sever the hostile lines of communications by demolishing bridges. Obviously such a mission calls into play all the teamwork of engineers and infantry, possibly even of the artillery. The same mobility which makes possible the covering of great distances and large areas, perforce produces a probable loss in cohesion. Opportunities will often occur when lateral liaison will have been temporarily lost by hostile units. Such lapses, if seized by an enterprising commander, will enable sudden thrusts through or around the enemy, and by the destruction of bridges, important hostile bodies may be cut off from supplies and support.

The size of the present-day combat unit, that is, a battalion cut in half by the normal assignment of three platoons to the combat teams, makes it improbable that engineers will be thrown into the fight as infantry. The smallness of the man power, as well as fire power, militates against the engineers passing into division reserve. While this condition was more or less normal in the case of the engineer six-company regiment, it will hardly be possible in the organization of the streamlined unit. However, engineer elements will very often find themselves involved in minor actions in connection with screening obstacles, road blocks of all kinds, mine fields, and in outguard operations. If anything, the necessity for the engineer to be a soldier as well as a technical man has increased rather than decreased.

RECAPITULATION.

Throughout the entire period from 1917 to date, certain basic engineer missions remain the same as they were. Some have increased in importance; the "tools" to accomplish them have increased in number and in adaptability, but the basic mission of the engineers is to "Get the infantry forward."

The installation and maintenance of all lines of communication within the divisional area constitutes the first responsibility of the combat engineers.

When the advance commences, roads, trails, and bridges must be provided in order that the infantry and its associated elements may go forward. The engineers will be called upon to install and maintain all types of bridges, from the most incidental footbridge up to and including permanent steel truss bridges. As the present-day armies are to a very large extent "road-bound," the ability of the engineers to maintain the roads, to build, repair and replace military bridges is indispensable for the success of the whole scheme of manœuvre.

Plans for traffic circulation, traffic regulation and road sign are staff and technical functions of the engineer components. Engineer reconnaissance, both tactical and technical, is a necessity. An adequate supply of drinking water is among the various responsibilities of the engineers. The engineers are also charged with the physical installation of bathing and delousing units whenever required.

Engineers, generally specialized units, are charged with the responsibility of the standard guage railroads leading to the railheads. The combat engineers must be capable of installing the narrow gauge railroads from the railhead forward whenever such rail facilities are dictated by the situation. The grading of forward air fields falls among the duties of the engineers.

Experimental work of technical nature should always be a primary consideration of all engineer units.

Possibly the one necessity never to be overlooked, is that the combat engineer must be a well trained soldier, capable, and ready to function in a fire-fight. Because of the reduction of man-power of the modern engineer unit (even if increased by an additional three-platoon unit) the combat engineer unit will rarely, if ever, be called upon to pass into the reserve. Under actual conditions, against a strong opponent possessing artillery and air support, the calls on the engineers for technical work will probably be greater than their ability to cope with, under the present-day organization. However, because of the work required in and in front of the forward divisional areas, the engineer troops will very frequently find it necessary to engage in a fight of one kind or another, in the course of carrying out their missions.

Careful consideration should be given as to whether or not the man power of the combat engineer battalion as now constituted is sufficient to accomplish the tasks required on the part of the divisional engineer unit.

Consideration is also recommended as to the rank of the commander of the divisional engineer unit. According to the Tables of Organization, this commander, who has both staff and command functions, and whose duties and responsibilities are obviously increasing, is designated as a lieutenant-colonel.

The addition of a buildozer per lettered company and of a compressor per platoon are important steps forward. Both of these pieces of equipment will have an important influence on the time element in offence and defence. The assault boats now included for purposes of training, in the normal equipment of the combat battalion, will likewise be most advantageous.

In order to furnish adequate protection against hostile mechanized elements, a well equipped, well supplied, and well trained engineer force can play a most important part in bringing such vehicles to a halt. It is then the function of the other branches to destroy the enemy machines.

All lessons of the recent campaigns in Europe show that missions within the capabilities of the engineers are of greatly increased importance. As part of the army team the engineers can carry out their missions with the co-operation of and co-operation with the other branches. Whenever called upon, the engineers have the equipment and " what it takes " to " Get the infantry forward."

DIVISIONAL R.E. UNITS EQUIPMENT ON ACTIVE SERVICE.

(Note:— The following two articles have been received in answer to the request made on page 67 of The R.E. Journal of March, 1941.)

(A)—THE FIELD COMPANY

By CAPTAIN R. T. WILTSHIRE, R.E.

WITH mobilization being ordered, the flood gates opened and we were deluged with masses of equipment. Despite previous careful loading trials, new items had been introduced which had not been allowed for. Companies on embarkation found it difficult to get all the paraphernalia of battle on their transport, and when this was accomplished the vehicles were sadly overloaded. This is how we left for France for the great unknown of War. After the usual shaking-down period on the Franco-Belgian frontier, work was started with plenty of variety. The main items to be wrestled with were briefly as follows :—

- (a) Reinforced concrete anti-tank gun pillboxes.
- (b) ,, ,, machine gun and L.M.G. posts.
- (c) Anti-tank ditches and defences.
- (d) Roads and maintenance.
- (e) Battle Headquarters, etc., for their various formations.
- (f) Preparation of Demolition Belts.

To start with, the designs and drawings for (a) and (b) were more or less left to Units; later, G.H.Q. standard drawings appeared which cut down our scope considerably. Jobs for all trades were plentiful particularly carpenters, concretors, draughtsmen and blacksmiths. With the remainder, it was mostly plain sailing, except with (f).

Northern France is a flat, muddy place, and water is reached very quickly below the surface. Platoon posts were invariably full of water, and pumps found plenty of work, so all the practice with camouflet equipment was, in reality, futile. Many devices were tried for the placing of road crater charges, and all had their points. These were adequate for deliberate demolitions, but the difficulty was to carry out hasty cratering without digging and pumping. A short criticism of the different types of equipment is the best way of bringing out these points.

I. L. and F. Pumps. Breakdowns occurred due to the moving

parts being of soft metal. This would not have occurred if the necessary precautions had been taken, but the loaning of these pumps to other arms often caused the damage. To recall one case of this—A private of a Battalion was seen going through the motions but no water appeared at the delivery end. His actions were laboured and when asked what he was doing, he said in a broad North-country accent, "It's stopped sucking, but the handle still goes!" On looking at the suction end, the hose was minus grill and sandbag, and the valves were jammed with dirt. This was invariably the cause and an efficient item of equipment was unjustly condemned. Now tougher working parts have been fitted; it was suggested that the commercial sludge pump, capable of pumping almost anything liquid, would have been an asset.

2. Pumping Sets No. 4 were not often used. They were found excellent units and if used for water supply and not trench pumping, then no unreasonable mechanical faults appeared. True they did fail, but on investigation it was usually traced to ill-usage. The well-head gear was rarely used, and an oil-drum or barrel would have been just as good.

3. Compressors stood up to all requirements. The most use was made of them in altering the existing French anti-tank pillboxes, to take our pattern guns. The outcome of one of these jobs had a twofold effect. One day, while drilling holes in a concrete floor an air-raid alarm was sounded. Besides the Sappers working inside, a bunch of the "feet" came in, complete with gun, and to our horror we found they were the A.A. L.M.G. crew. On investigation I found the Junior N.C.O. had interpreted his orders in such a manner that, although being local A.A. defence, he insisted that his retiring into the casemate with his merry men was correct. An old Sapper aired his views on the matter and the "feet" withdrew, wiser and enlightened.

The collar on the picks broke after a few hours' work, but this had been foreseen and spares were available. The number of spanners and wrenches were far in excess of needs. It was generally agreed that the truck was a vast improvement on the trailer compressor.

4. Light and Heavy camoufiet sets as previously described did not shine in France, but should not be dismissed as useless. In a less water-logged terrain they would be invaluable. The "Auxiliary Cratering Equipment" has solved the difficulty of the water, and makes a useful addition to Company Equipment.

5. Demolition equipment generally was good. The lack of plastic was regrettable, and it is hoped it will be made available. Exploders were found to be excellent, but the Wheatstone Bridge was too plentiful.

6. Earth Augers gave no trouble, and the new design is an improvement.
7. The lack of an accurate levelling instrument was felt. With such flat country, gradual falls, hardly apparent to the eye, had to be made use of in trench drainage.

8. Company dinghies were used only by rowing enthusiasts in the flooded anti-tank ditches, a real need being felt for a reconnaissance boat for the section officer's truck.

9. Tool chests would take too long to deal with in detail, but to say they were adequate was an understatement. Many tools carried were never used, and that was in both static and mobile warfare.

10. Unit M.T. on embarkation was of a high standard, and stood up to the heavy loading and transporting quite well. The pavé roads of Northern France had to be used continually, and the excessive vibration tended to shake everything to pieces. Our Field Company, after practically four months of work on defences, when the transport had a pretty severe doing, moved 300 miles in two days with all its equipment. The period was just before Christmas, 1939, and the weather intensely cold. Drivers, despite constant exposure to the elements, came through, and the vehicles behaved extraordinarily well. Incidentally, from the way the French Division to whom we were attached, welcomed us, one would have thought their troubles over, and the war as good as won. In actual fact, the Company had more M.T. vehicles than the whole French Division. On the return journey conditions were much worse. Roads were icebound, but despite many alarming escapes, all got through with the exception of D.R's who had to creep along on their own, and one truck which burst an "unburstable" tyre. The latter had to be leapfrogged with two others, there being no spare tyres of this type carried. As a contrast it might be worth while stating that at the same time as our Field Company left this Sector, the French Division also changed over ; with horse transport they managed about 10 to 12 miles a day, against the Field Company's 150. Outside all this, many horses had to be destroyed due to falls on the hard frozen roads. Winch lorries 6-wheeled were invaluable, and with an Ordnance holdfast many rescues were made which would otherwise have necessitated Ordnance Recovery Vehicles. One small improvement could be made to the cable fairleads with the fronthaul type. This fitting frequently broke when an absolutely direct pull was not practicable. Four-wheeled 30 cwts. were quite good, but the crosscountry performance was considerably restricted. This was found with all 4-wheeled type vehicles, and the possibility of a 4-wheeled drive has been investigated. Motor-cycles were mechanically sound, but the fittings on the handle-bars were of soft metal and needed daily maintenance.

In conclusion it can be said that a detailed investigation has been carried out since Dunkirk and that all the experiences and comments have been sifted. The points that we came up against have all been dealt with and no doubt many others from different sources which have not been mentioned here. Revised scales of G.1098 equipment have been prepared and are actually in operation now. This has entailed a large saving in tools and to a lesser degree, M.T. Slightly different organization between Field Company and Field Park is being adopted.

Briefly, it takes this form. Field Company sections carry only the bare essentials of mobile warfare. Company headquarters hold a small pool to supplement the sections. Behind, the Field Park carries additional tools necessary to the Field Company for static conditions. From this it can be seen Field Troops R.E. are becoming more and more fighting troops and less like Carter Patersons. So the Royal Engineers keep pace with the tide of war.

(B)-THE DIVISIONAL FIELD PARK COMPANY.

By MAJOR W. H. AYLWIN, R.E.

THE Divisional Field Park Company is a mobile unit—but only just ! With its heavily laden lorries and trailers it is almost entircly dependent on roads and, when spread out at intervals which afford some protection against hostile aircraft, is practically defenceless against ground troops and is certainly not fully under the command of its O.C. Consequently the most important item of equipment is the transport, and right well did it stand up to the test. Rigid maintenance and inspection—never popular with officers or men proved their worth right up to the hilt—and, when the time came to destroy the vehicles there was a very definite air of sadness about the proceedings. The W.D. pattern were universally good, but the impressed type were a great trial to all ranks, until they were through their Service " teething troubles."

Motor-cycles were invaluable and invariably at a premium, but the bumpy *pavé* roads and occasional cross-country use resulted in several fractures of front springs. This of course did not immobilize the machine but it certainly took away a lot of the joy of riding it.

As to the bridging equipment, little can be said, as both F.B.E. and S.B.G. had been well tried beforehand, and no troubles were encountered. One point worthy of mention is the danger of loss, when dismantling in the dark, of the dogs of the S.B.G. bridge. These dogs are, of course, absolutely vital, and it was found that trays to the carrying locker of the lorry, divided with the necessary number of holes, not only carried the dogs well, but enabled a "check at a glance "to be made. It was also found useful to paint a white ring round each of the holes in the box and hornbeam sections, to help the sapper who is trying to fit in the dogs. One last point with regard to the S.B.G. equipment is that the girders tendto rust; painting with old sump oil stops this and incidentally, considerably improves the appearance of the loaded lorry.

The reconnaissance boats were seldom used but the assault boats were always in demand. The latter needed a lot of attention, partly due to wear, where the canvas joins the gunwhale, and partly because at least some of the wooden interior struts were invariably broken when the boats were loaded at night by tired and disinterested infantrymen.

The Divisional reserve of tools was carried (most uneconomically) in two six-wheeled G.S. three-ton lorries—a scale which has since been halved. An experiment with racking these picks and shovels was rudely interrupted by the events of May 10th and onwards, but, although a good idea, it is not worth reviving, as there would not be room in the new scale of transport, and, in England, half-inch steel bar does not arrive in daily 50-ton trucks as it did in Field Park dumps a year ago. However, the old but often overlooked principle of packing picks with their heads towards the tail-board is well worth remembering. Some of us have ugly memories of a dark night, a very dark wood, a lot of bangs, a lorry-load of wrongly packed picks, and seemingly no top layer of helves at all !

The equipment of the workshop section was universally good and, with such small exceptions as a set of o-60 twist-drills, quite adequate. The only setback was that the oxy-acetylene set needed adaptors before it could be used with Belgian bottles, which, incidentally, were far below English capacities.

The two lorry-loads of anti-tank mines were a sore trial. They are never congenial companions when things are unhealthy, and are continually being called for, dumped, and then requiring collection again. However, they are very handy when one does not like one's neighbours. A seemingly careless reference to the fact that " those two lorries over there would make a lovely bang if they went off," always resulted in a move of the unwanted unit.

The electric-lighting was, if anything, too lavish. In fact the fittings were seldom used, as it was usually possible to clip in and use the existing house-wiring and fitments. This is a very good way of enhancing the prestige of the corps. Lighting of every room in Divisional Headquarters within half an hour or so, never fails to create an impression of magic efficiency, and usually produces a few mis-quotations from Kipling.

The derrick lorry was a disappointment. It could lift five-(shhor more!) tons, but-and a big "but"-could not swing its load. However, the new type overcomes this difficulty.

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The Pumping Set No. 4 was a boon and a blessing. Providing one did not try to use it as a sludge pump, for which, of course, it was not designed, it worked well and required little attention. The engines were the weakest point in that they required rather frequent decarbonizing (probably due to a low-grade petrol), and also the valve metal appeared to be on the soft side.

Two final points are worthy of mention. Firstly, our old friend, the Company bicycle once more proved its worth. What more need be said than that given a good C.Q.M.S., it was apt to reproduce itself mysteriously but regularly whenever the Company moved ! Secondly, a good Agent de Liaison was of enormous importance to the Field Park Company Commander. Schoolboy French and a lively imagination were sufficient for Miami, or even the Rue Nationale, but dealing with hard-hearted contractors required a much more detailed knowledge of the vernacular. Where our Liaison friends are now, we do not know, but we wish them luck and—au revoir.

THE OIL SITUATION IN RUMANIA.

(Contributed by an Engineer long resident in Rumania.)

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MODERN warfare depends almost entirely upon adequate supplies of oil products. Although it is known that Germany built up a large reserve of various oil products before the war, and also spent vast sums on the construction of synthetic oil plants, the duration of the war depends very much upon future supplies, now mainly cut off from the Axis by our blockade.

Nobody can estimate the volume of oil products now remaining in Germany from the pre-war reserve, after the Polish and French campaigns and after the persistent bombing by the R.A.F. of oil targets in Germany and in the occupied countries. It may be assumed however, with assurance that Germany's oil reserves are fast becoming depleted, and that present sources of supply are not sufficient to provide for all Navy, Army and Air Force requirements.

It is therefore interesting to review the volume of crude oil available per year to the Axis, taking 1940 figures as a guide. The figures given in the following table are from competent American sources:—

Tons.

Germany,	Austi	ria, Bohe	mia-M	Ioravia	a, occu	pied Fr	ance	
and occ	upied	Poland	•••	••		• • •		1,143,000
Hungary	••		•••	••	• •	••		282,000
Italy, incl	uding	Albania		••	• •	••		211,000
Rumania		••	• •	••	•••	• •	• •	6,000,000
								·
Total	••	••	• •	••	••	••	••	7,636,000

From this total of 7,636,000 tons per year of crude oil it is calculated that about 6,500,000 tons of refined oil products, suitable for war purposes, can be produced. This total is lower than the total normal peacetime consumption of the countries named, and must therefore be far below the actual wartime requirements of the Axis, which has to allocate a considerable proportion of the total of refined oil products available for industry, domestic transport and other services in the Axis and occupied countries. The importance of Rumania is evident from the table given above, and in considering the oil situation of that country it must not be forgotten that Germany did not occupy Rumania until September, 1940, before which date the volume of oil products transported from that country to Germany and Italy was very small in comparison with the total exports.

The peak of oil production in Rumania was reached in 1936, when 8,704,000 tons of crude oil were produced. Since that year production has dropped steadily to around 6,000,000 tons in 1940. This decline does not necessarily indicate that the oil reserves of Rumania are becoming depleted. Surveys by various methods during the past ten years have shown conclusively that there are very large potential oilfields in the country, the oil industry of which was founded and developed almost entirely by foreign-owned companies.

The fiercely nationalistic policy of the Rumanian Governments during the past five years is responsible for the decline of oil production, as everything possible was done to reduce the operations of the great foreign companies and to encourage the small indigenous companies to expand. The first aim was realized, but the second failed. Onerous conditions were placed upon the large foreign oil companies, when they bid for new areas to be developed, with the result that no new oilfield has been opened up since 1936. The small Rumanian oil companies had neither the capital nor technical experience by which they could avail themselves of the preferential treatment accorded them by the Government.

Foreign exchange restrictions, operating for many years past, resulted in very little American oilfield equipment being imported, so that when Germany occupied Rumania it was only to find the rate of oil production dropping, no new areas tested by drilling, and a great shortage of modern drilling and production equipment. All the foreign engineers and refinery specialists, apart from the few Americans employed by the Rumanian subsidiary of the Standard Oil Company, of New Jersey, were forced to leave the country in 1940, and the lack of skilled supervision will be another factor to restrict crude oil production.

The various factors mentioned above are very favourable to us, but there is a still more important aspect which should not be overlooked, and that is the lack of transport facilities for the oil products so abundant in Rumania and now at the disposal of the Axis. In normal times Germany and Italy received the bulk of their Rumanian oil product purchases by the sea route, from Constanza, on the Black Sea, via the Bosphorus and the Mediterranean, a route closed immediately by our blockade. No less than 85 per cent. of the normal oil exports from Rumania went via Constanza, with 5 per cent. of the balance going by rail and the remaining 10 per cent. by river transport on the Danube. The occupation of Rumania by the Nazis resulted in Constanza becoming useless as an oil export port, and transport facilities out of Rumania were restricted to rail and river services, normally taking only 15 per cent. of the total oil exports.

The lack of sufficient transport facilities must have resulted, in September, 1940, in the immediate restriction of the then decreasing crude oil and refinery productions, as storage space in Rumania is scarce, as was evident when, in September, 1939, the outbreak of war led to a temporary shortage of tankers at Constanza. The figure for Rumania, given by American sources, of 6,000,000 tons of crude oil during 1940 did not, it is believed, take into consideration the fact that the last four months of last year covered a period when crude oil production had to be decreased on account of lack of storage. A figure of nearer $5\frac{1}{2}$ million tons would be more accurate, according to competent observers with intimate knowledge of Rumanian oil affairs.

The refineries in Ploesti and Campina have capacities almost double that of the present crude oil production, and with German refineries thoroughly bombed by the R.A.F. it is logical to assume that the Nazis are trying to take as many refined oil products from Rumania as possible over the restricted transport routes.

When considering the rail transport facilities it is necessary to point out that official information indicates that the single-track line leading from Ploesti, north-east via Buzua and Czernautzi, to Russianoccupied Poland, has not carried any oil traffic to Eastern Germany since January, 1940. This railway line was prominent in the news of late 1939, when it was authoritatively stated by the Germans that the Russians had agreed to one complete division of German troops guarding this line all the way from Eastern Germany through Lemberg to the Rumanian frontier, which was, before the seizure of Bessarabia by the Russians, north of Czernautzi.

The second railway line from Ploesti goes north through Brashov, Oradea Mare, to Budapest, and is single track from Brashov northwards. The doubling of the tracks from a few miles north of Campina through the difficult stretches in the Carpathian mountains to Brashov was completed in 1940, under insistence from the Nazis. Being only a single-track line from Brashov, the capacity for transport of oil products is very restricted, especially when it is remembered that this route was the main track for the thousands of troops, with full equipment, rushed into Rumania and Bulgaria during the past few months. The line also has to carry normal timber, cereal, passenger and other traffic, so that it is evident the Nazis cannot transport much oil on this route.

A third line from Ploesti goes down to Bucharest, between which two points the line is double track. From Bucharest westwards, however, through Turnu-Severin and Timisoara into Jugoslavia, the



Map of the Balkan Communications.

line is single track only and normally carries a considerable quantity of miscellaneous traffic between Italy, Germany and other Central European countries and Rumania. The restricted capacity of this line for oil shipments must render it relatively unimportant.

It is interesting to mention that the second line, Ploesti through Brashov, passes through the Carpathian mountains for many miles immediately north of Ploesti. In some places the line runs in defiles, 30 ft. wide, through which a mountain stream also courses. With precipitate mountain slopes above, accurate low-level bombing attacks would certainly bring down tons of rock to block the line.

The Bucharest-Jugoslavia line also runs through mountains both east and west of the town of Turnu-Severin, which is situated on the Danube, a few miles downstream from the Iron Gates. Low-level attacks in the many defiles, especially those between Turnu-Severin and Caransebes, might have good results.

The main outlet for shipments of oil products from Rumania is, of course, up the Danube, and it is on this route that the Germans have concentrated most of their efforts. The main river port in Rumania is Giurgiu, south of Bucharest, and there are four pipe lines now operating from Ploesti to Giurgiu. Two of these lines are old lines, which carried crude oil only, and the other two have been laid since the Nazi occupation in September, 1940, for the pumping of refined products from the great refinery centre to the river.

Storage installations at Giurgiu are heavily defended by A.A. guns and the Germans evidently anticipate an attack there. At Ploesti a great concentration of defensive equipment has also been massed in this very vulnerable refinery area, a sketch map of which accompanies this article.

The Danube has, fortunately for the Axis, not been frozen for more than a month during the past winter, but normally it is blocked for at least two months. The ice floes brought down with the thaw floods have passed out of the river by this time and navigation is now comparatively normal, except for the speed of the current, which is still above the usual rate, owing to spring rains in the vast areas drained by this most important river.

Transport of oil products from Giurgiu has to be made by barges up to points such as Regensburg, well above Vienna, and the time taken for a return trip between Giurgiu and Regensburg must be at least one month. Every effort has therefore been made to speed up river transport, but it is doubted whether the round trips of each barge train per year can be increased.

To overcome the slow haul up river the Nazis commandeered from France a quantity of 12 in. pipe line, which was seized when the French collapsed in June, 1940. A pipe line is being laid west from Ploesti through Tirgoviste to Turnu-Severin, on the Danube. From that point the Carpathians, coming to the river at the Iron Gates,

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Sketch Map of Ploesti.

have forced the Germans to plan the pipe line along the banks of the Danube and thence to Moldova Noua.

It was stated by the German Press that this important line would be completed by April 1st, 1941, but it is well over 200 miles long, expert pipe line men are not available and modern pipe-laying equipment is not to be found in any part of Europe under Axis control. Competent authorities estimate that the Ploesti to Moldova Noua pipe line will not be in operation before the end of this year, unless it is laid without due regard to normal procedure followed by experts in pipe line construction. Undoubtedly many constructional risks will be chanced by the Nazis to get the line into operation, but speed of construction will not guarantee it working without constant breakdowns.

The attack on Jugoslavia by the Axis was not unexpected when one considers that this country was in a position to block one of the two railways from Ploesti towards Central Europe and also to close the Danube completely to traffic.

Reference to the map will show that the Timisoara line from Bucharest goes into Jugoslavia well north of Belgrade to Subotica, near the Jugoslav-Hungarian frontier. From Subotica one line runs north towards Budapest and Germany, whilst another runs west towards Zagreb, from which city two lines go to Fiume and Trieste, respectively. The importance of this railway line for oil transport to both Germany and to Italy may be well appreciated, especially as a proportion of the oil shipments up river were transhipped in Jugoslavia for rail transport to Italy via Zagreb.

The line between the Rumanian frontier and Subotica runs through a plain, and Nazi troops, sweeping westwards and southwestwards from Rumania and from Hungary, have had little difficulty in pushing back the Jugoslavs towards the Danube.

. Other divisions advancing from Southern Austria, towards Zagreb, would have to fight through mountainous country for most of the way, but the map shows that the entire railway line from Timisoara, through Subotica, Zagreb and thence to Fiume or Trieste, must be quickly freed by rapid advances if it is to continue to be used for transport of oil products from Rumania to the Axis countries.

The attack launched from North-Western Bulgaria towards Belgrade was destined to link up with the advances mentioned above, as the Jugoslavs must be pushed well back from the line of the Danube to permit river transport of vital supplies, both up and down river, to continue.

Reports indicate that these attacks were launched before adequate preparations had been made to get the full number of troops and full supplies into position. The importance of keeping both the railway line and the river clear for transport was not under-estimated by the Nazis when planning the concerted advances from many directions upon the northern section of Jugoslavia.

At the Iron Gates, where the Carpathian mountains cause the Danube to flow through a narrow gorge, the Rumania bank of the river consists of precipitous rocky slopes. It is doubtful whether lowlevel bombing attacks at this point, with suitable types of bombs, will be able to bring down quantities of rock sufficient to impede navigation in the river channel.

The present output of refined oil products is estimated to be around 14,000 tons daily, although the refinery capacity is almost double that figure. When considering the possible distribution of the quantity of oil products available per day it should be remembered that the Nazis are facing great difficulties in maintaining supplies of fuel, lubricating oil and other items to their troops operating in and from Bulgaria. The roads in this country are, in an area of Europe notorious for bad roads, outstandingly poor. The country is generally mountainous, and the few railways, winding in and through the mountains, are all single track.

The Nazi troops in Rumania and those on the German-Russian frontier, running from the Baltic to the Danube, do not consume a great quantity of oil products except for training purposes.

The difficulty of increasing exports over the two railway lines and by the river route has already been thoroughly discussed. Recent information received from Rumania shows that the storage problem there is very acute and that there is a large quantity of surplus refined products. Internal domestic consumption has not been much reduced owing to the surplus of oil products in the country. Competent authorities consider that, out of the 14,000 tons of refined oil products produced per day in Rumania, less than 7,000 tons daily are being exported to the Axis countries and to countries under Axis control served by the three routes out of Rumania.

American sources give what are presumably official figures for total exports of crude oil and of oil products from Rumania during 1940. The German share is shown as 1,554,000 tons, whilst the Italians received only 365,000 tons. Italy, of course, continued to receive Rumanian oil shipments by sea until almost halfway through 1940, and the small total quantity for 1940 shows that this end of the Axis is certainly not receiving a fair share of the oil spoils from Rumania.

Rumania was not occupied by the Nazis until early in September, 1940, and up to that time the Allied economic warfare missions saw to it that as little oil as possible was shipped to Axis sources and that as many transport difficulties as possible were created by purchasing or chartering all available tugs and other river craft on the Danube. It is understood that some numbers of these craft were taken out of the Danube carly in the autumn of 1940, after we had seized four Rumanian ships in Egyptian and Sudan waters in reprisal for the seizure of tugs and barges owned by British and French interests.

The Germans were forced to take as many river craft as possible from their own rivers and canals to increase the rate of transport of products on the Danube, which even now, as conclusively shown above, is far below the maximum rate desired by the Nazis. The preparation of the Balkan offensives, by moving vast numbers of troops and equipment through Hungary and Rumania to Bulgaria put a great strain on the already overburdened transport routes, and it is clear that shipments of oil products from Rumania will continue to be curtailed until further transport facilities are available.

When computing the estimated total of 7,000 tons daily of oilproducts exported from Rumania, every factor favourable to the Nazis has been included, so that the estimate may be taken to be anything but conservative. The refineries of Rumania are mainly grouped around Ploesti. A sketch map of this area accompanies the article and it will be noted how close together the refineries are placed in this one highly vulnerable area. There are many small and unimportant plants at Bucharest, Ramnicul-Sarat (near Buzau), Moinesti, Tirgoviste, etc., but only one large plant with a capacity of 5,000 tons per day, is found outside the Ploesti area. This refinery is at Campina, 20 miles north, on the railway line and road leading from Ploesti. In addition to being the refinery centre of Rumania, Ploesti is also an important railway junction, serving most of the north and north-cast portions of the country by the two lines going north and north-east, respectively. A large armaments works is also located in Ploesti, near the south railway station, and forms part of a line, including five refineries, marshalling yards, etc., which is but part of the many perfect bombing targets in the district.

Ploesti is situated on the northern edge of the great Danubian plain, and the Carpathian foothills come to within a few miles of the east and north-east of the town. The converging railways and main roads, together with several rivers, the Carpathians and a large lake only 15 miles to the south-east, make identification of the town very easy from the air. It is to be hoped that this very vital area, producing the majority of the Nazis' oil products requirements in the Balkans and in South-East Europe, will be very thoroughly dealt with by the R.A.F.

Oil targets in Germany and in occupied countries have been incessantly bombed for many months past, with extremely good results, on the whole. The production of refinery and storage plant in Germany is not very great and all repair work on damaged oil targets must be necessarily slow.

Whilst on the subject of bombing oil objectives it would be as well to explode, once and for all time, the fallacy that oil wells should be and could be bombed. So many references to this subject have appeared in the Press during the past few months that it would seem that all the writers responsible for the insistent suggestions that the R.A.F. should bomb Rumanian oil wells have one thing in common----an utter and complete ignorance of what a modern oilfield and modern oil wells look like. Possibly innumerable oil company share certificates-often, unfortunately, worthless-scattered throughout the country and bearing optimistically beautiful pictures of oil gushers, are responsible for the prevalent idea that all oil wells are gushers. Nothing could be further from the truth, as methods of bringing in oil wells have changed completely during the past fifteen years. Any gusher that may be seen in a modern oilfield indicates neglect on the part of the engineers responsible, and every well is now brought in under complete control, being entirely closed in with surface control equipment. It is possible to walk through many modern oilfields and not see a sign of any crude oil, either on the ground, around producing wells or around the field storage tanks. In Rumania out of the total of nearly 2,500 producing wells, less than 200 are flowing wells, and these are generally to be found spaced far apart, 400 yards being the usual distance between wells. Most of the remainder are pumping wells, and in some fields it is true that many of the smaller productive wells on the pump are fairly close together.

To bomb an oilfield successfully, however, it is necessary to hit the vulnerable area of producing wells. In the case of flowing wells in Rumania the vulnerable area consists of a 7 in. diameter casing, put down inside a surface casing of about 14 in. diameter. The derricks are raised from the ground level on a wooden substructure, 20 ft. high, and the derrick floor is supported at each of the four corners of the derrick by concrete pillars a yard square. Inside the substructure of each derrick and immediately around the centre of the 24 ft. square derrick floor, more massive concrete pillars are placed to support the load on the rotary drilling table which carries drill pipe and casing down to 10,000 ft. or more. The surface casingabout 14 in. diameter-extends upwards from ground level almost to the derrick floor and is usually set to a depth of several hundred feet. After setting the surface casing drilling is customarily carried down to the production level, many thousand feet below, and a production string about 7 in. diameter is set. During the life of a flowing well the oil is produced through this oil casing string, which extends up above ground level through the derrick substructure to the derrick floor. The inner (production) casing is coupled by special and heavy rings to the outer (surface) casing and on top of the production casing is placed the Christmas tree-as the assembly of 3 in. or 4 in. valves, connected by short pieces of pipe, is named. This assembly includes special valves, which permit the oil to flow through an orifice sometimes as small as $\frac{1}{8}$ in. The well is under complete control all the time and the Christmas tree has a superficial area of about 8 in. wide by 6 ft. across by 8 ft. high.

After studying the above facts, is it possible or logical to adjure the R.A.F. to waste good bombs on a target with such a small vulnerable area and which is very adequately protected, in the case



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of flowing wells by massive concrete pillars all around the section most liable to damage by blast ?

In the case of wells produced by pumping the vulnerable area is even smaller, as tubing, 2 in. or 23 in. in diameter, is placed inside the production string. Pumping rods, with suitable working barrel placed on the tubing, or on the rods, go down inside the tubing. The surface installations on pumping wells have a maximum superficial area of about 8 ft. by 15 ft., on an average, but the vulnerable area of the well is confined to 2 in. or $2\frac{1}{2}$ in. tubing, with massive forged steel connections to the 7 in. production casing. There is no adventitious oil laying all around in a modern oilfield, neither is the natural gas produced with the oil permitted to escape unburnt into the atmosphere. The fact that the most modern field in Rumania, North Tzintea, is mainly in a thickly forested area renders possible damage by bombing even slighter, as the trees would help to act as blast screens. Forest fires were a normal hazard in the North Tzintea area. but there is no record whatsoever of any oil well being damaged or catching on fire owing to a forest fire, no matter how intense it may have been.

One lucky hit may cause a well to get ablaze and cause an oil well fire similar to those which have been so widely publicised in the Press. But the numbers of bombers required to obtain one lucky hit would be considerable, and the ultimate results would be negligible, from the point of view of interfering with the crude oil production of Rumania. Less spectacular, perhaps, but more effective, is the bombing of refineries and their adjoining storage tanks, and there are sufficient of such targets in Rumania to avoid the wasting of good bombs on the actual oilfields and wells.

The question of Russian oil shipments to Germany has received much attention from time to time, and it is as well perhaps to discuss this matter. The map will show that Russian oil products, if shipped to Constanza, on the Rumanian Black Sea coast, or up the River Danube, via the Black Sea, will only add to the present transport difficulties of the Nazis, who have a larger supply of oil products in Rumania than they can handle. These two routes may be eliminated, therefore.

It is known that shipments of Russian products have been made across the Black Sea from Batoum and other oil shipping points to Varna, on the Bulgarian coast line. A single-track railway connects Varna with the interior, and although it is reported that the oil storage at Rustchuk, on the Danube opposite Giurgiu, has been greatly increased, any Russian shipments taken from Varna by rail to Rustchuk will only add to the up-river transport difficulties already existing with Rumanian oil exports. It is known that Russian products have been taken through on the single-track line from Varna to Plevna and thence to Sofia, where the line joins the Belgrade-Sofia-Istanbul mainline. This route is very long and costly and, furthermore, is very restricted in capacity, as the country through which the line passes before it joins the main Orient Express line at Sofia, is mainly agricultural and has to carry considerable miscellaneous traffic.

It is logical to assume that the main route for transport of Russian oil to Germany is by Black Sea passage from Batoum and other oil ports to Odessa and thence up through Lemberg to Eastern Germany. This route, it is noted, links up with the line from Plocsti to Lemberg through Czernautzi, and it is reasonable to suppose that the Ploesti-Lemberg line was closed to Rumanian oil traffic to permit larger quantities of Russian oil products to be shipped *via* Odessa and Lemberg to Eastern Germany. The Russian lines north of Odessa are also being used for oil transport from the Caucasus and Don areas, but these lines are few, poorly organized, and the distances between the oilfield areas and Lemberg are considerable.

In any event, shipment by rail of Russian oil is difficult, as the broad Russian gauge entails the pumping of oil from the Russian tank cars to the German tank cars at frontier points. It is not possible, as in the case of Rumania and Bulgaria, to ship oil right through to Germany by railway tank car. It is considered that Germany receives less than 500,000 tons of Russian oil products per year, and this estimate is based, once again, on all factors which may favour the Nazis.

With the German offensives in the Balkans the old bogey of a drive to the Near East or Russian oilfields is again raised, and many writers, commenting on these possibilities, refer to Near East or Russian " oil." By infiltration and internal treachery the Nazis took over the Rumanian oil industry with all drilling and producing equipment, refinery and storage plants, intact. One may hardly suppose that Russia or any other country invaded forcibly would permit its valuable oil equipment to be left undamaged, as a present for the invaders. Without pipe lines or storage tanks the crude oil could not be used, even if it were possible to resume production in occupied oilfields. Until crude oil-apparently referred to by the experts mentioned above as "oil "-is refined, it is useless and we may be sure that our Forces and Bombing Command in the Middle East would ensure that the great refineries for Iraq crude-at Haifa, at the end of the long pipe line from Mosul to the Mediterraneanand for Iranian crude at Kermanshah, Abadan and Bandar Shahpur would be left in an unusable condition, should the Nazis ever penetrate to the oil-producing regions of the Near East.

CONCLUSION.

From the facts presented we may conclude that the Axis Powers are getting very short of oil and have had to open a new campaign in the Balkans partly for the reason that two of the three routes for Rumanian oil products were jeopardized in their passage through Jugoslavia.

It is not possible for the Nazis to increase crude oil production in Rumania, even should they desire to do so. There is already a huge surplus of refined products, which cannot be transported to the various fighting fronts from Rumania.

Even should drives be made successfully against the great Russian oilfields of the Caucasus and of the River Don area, and also against Iraq and Iran, the oilfield equipment, storage and refinery plants would be destroyed, so that many months would elapse before any use could be made of the crude oil production of these countries.

On the whole it is an encouraging picture which, we may hope, will be coloured very highly, so far as the Rumanian refinery plants are concerned, by the results of bursting British bombs in the near future.

1941.]

OBSERVATIONS OF A BRITISH STAFF OFFICER.

Notes by Brig,-General H. S. Hawkins, Vice-President, United States Cavalry Association.

(Reprinted from *The Cavalry Journal (Washington*) of January-February, 1941.)

We are so prone to jump to conclusions. The events of a single campaign as reported, rightly or wrongly, by various observers, military or civilian, astute or stupid, are taken as conclusive evidence that all the old forms and principles are wrong and that everything new is right and permanent. We wish to rush to new forms because they were successful, apparently, in some special case. The observations of civilian critics have too much influence on military minds. They are sometimes right, but they should be accepted with caution and only after weighing carefully all the factors which have brought success or failure in any campaign. Military critics, also, are liable to error, although they have more fundamental knowledge on which to base their conclusions. We should listen to all such criticism and try to separate the chaff from the wheat ; but we should restrain our own inclinations to rush to conclusions.

The recent campaign in France has illustrated many virtues in the German army and many faults in the French army. We in the American army recognize many faults in the French army that we ourselves possess; but we should not overrate the new things developed in the German army. Their chief virtue was in their understanding of the faults and weaknesses in the equipment, organization and training of their opponents, and their ability to take advantage of the special situation that thus confronted them. The Germans are apparently wise enough not to believe that the tactical methods and arms that brought them such success in Poland and France will be successful again without modification or complete change to meet the next military situation with which they may have to deal.

The principal fault with the Poles and the French, and to some degree the British, was in lack of imagination and failure to realize what the new equipment in the German army meant and how it was going to be used. Insufficient and wrong training for open warfare, and inadequate weapons to combat the new German equipment, was the result of this failure. 1941.]

DISCUSSION OF DIARY.

In the Saturday Evening Post of December 7th and December 14th, 1940, there were published some extracts from the diary of a British staff officer written in France during the recent campaign. Diaries, written on the spot and at the very time of the various occurrences, are the most valuable of military records. This officer seems to have been particularly astute in his inferences and conclusions. No doubt, many officers have read this diary. Some of the entries, however, are so important to us now in building our new army that they deserve to be extracted and emphasized for study. They are here quoted in part and followed by pertinent remarks.

(1)* "May 10, 1940—The contrast between the real thing and the opening phase of an exercise is very forcible. In theory, the messages flow in thick and fast. Intelligence summary trumps intelligence summary. There is not a second to spare. And now the fact, the real thing in practice. There is no news of our own troops or aircraft. No messages, no intelligence summaries, no telephone."

This confirms our own experience and shows how impractical and misleading our command post exercises are.

(2) "May 13, 1940—The only dark feature is a threat to the French Seventh Army's left by a German mechanized column. This column is reported to be twelve miles long, closely spaced, and is now passing through Breda. The Bomber Command sees in this a useful target and is about to deal with it."

The Bomber Command, however, did not deal with it. Nor did they even delay it. Only an extremely large bomber force could have stopped it, and the bombers were off somewhere else on their own. This not only shows the necessity for having air forces subject to command by commanding generals of ground forces, but, also, the indispensability of large cavalry forces equipped with squadrons of anti-tank guns. It would have been too risky to have sent motorized infantry on this mission. They would have been outflanked and their parked motor trucks probably captured.

Writing about the German break-through near Sedan :

(3) "May 14—Not so very long ago I went right through the fortifications on this front and estimated that a well-organized and determined resistance would cost the Germans half a million casualties if they were to break through. And what has happened? The Germans have walked through five miles of fortifications in depth with a loss of probably 500 men. It appears that, as the Sedan sector was considered so strong, the most inferior of the French divisions were posted there to hold it. They were mostly Parisians and their morale was of the lowest order. When the dive bombers came down on them, they stood the noise

* Quotations numbered for convenience in summarizing.

(there were hardly any casualties) for only two hours, and then they bolted with their hands over their ears."

This shows that only well trained and well disciplined troops can be trusted in modern war. Our one year enlistment is too short. By the time a recruit is only fairly well trained and disciplined he goes out and we get no service from him. We have trained him for nothing unless he re-enlists. He renders no service. He is merely trained to render service.

(4) "May 16-While the German army is pouring through France the bombers direct their effort on Essen. The bombing of Essen will not stop the German onrush in France. The maximum effort of the Bomber Command should be directed to concentrating on the major crossings of the Meuse and on breaking up the recklessly unorthodox formations, the close-packed columns pouring down every main road leading from east to west."

This shows again the lack of wisdom in having a separate air force not under control of the army commander.

(5) "May 17—The fog of war grows thicker, but nonetheless there emerges the gloomy bulk of the fact than many units of the French armies are not really fighting. The German armoured divisions are too much for them. It is Poland over again."

This loss of morale was due to lack of adequate numbers of antitank guns organized in separate battalions, and lack of training for open warfare.

(6) "May 18—News of the sort we had expected from the first came in today in a series of messages from various sources. The French have turned on the Germans. General Giraud, for example, states, in a message just received, 'Am attacked by fifty light and fifty heavy German tanks. Am destroying them progressively.' Now, this is the language of the old days. It is characteristic of the type of officer on whom we had relied to hold up the German advance."

This shows that with proper ideas of open warfare and reliance on guns properly used and courageously manned, the German tanks could be stopped even though the French did not have adequate numbers of anti-tank guns of large enough calibre. The idea that has spread over the world that mechanized forces are invincible is absurd. Proper guns properly organized is the answer to tanks. The Germans know this.

(7) "The French tanks have been fought magnificently. The mechanized cavalry have certainly shown great dash and daring, but the heavier-armoured German tanks have been too much for them, and they have been shot to pieces."

This shows that mechanized troops cannot stop or even delay the enemy stronger mechanized forces. Only cavalry equipped with anti-tank guns can delay enemy mechanization long enough to enable our infantry, itself equipped with anti-tank guns, to establish itself in position to resist an enemy mechanized attack. Our artillery can certainly assist in repulsing enemy mechanized attacks. Our own mechanization is not very effective to stop enemy mechanization unless we have a great superiority in numbers of tanks. Without this superiority, the most effective use of our own mechanization is for the counter-attack after the anti-tank guns of our infantry, or cavalry, have crippled the enemy tanks.

Our British officer goes on with :

(8) "Personally, I am amazed that more heroic measures have not been taken. A few .75's shoved into every road in the path of the Panzers and to the flanks, firing point-blank, would blow them to kingdom come."

This would have required the initiative developed only by training for open warfare. It was not possessed by an army trained only for defensive warfare in accordance with the advice of certain French soldiers and certain pseudo-experts in England.

(9) "May 19—The Germans have taken every risk—criminally foolish risks—and they have gotten away with it. Thay have laid themselves open to destruction from the air in close columns; they have laid themselves open to attack from exposed flanks; they have made themselves vulnerable by allowing their mechanized units to outstrip, by far too great a distance, their main body; they have done everything that should not be done by orthodox book-trained, stereotyped soldiers, and they have made no mistake. The French General Staff has been paralyzed by this unorthodox war of movement."

The fact is that there was nothing unorthodox, except to the French and those who followed the French doctrine, about the German war of movement. Audacity is orthodox, especially when your opponent is inert. The French army, with no cavalry except mechanized cavalry, with no anti-tank guns worthy of the name, and imbued only with the spirit of the defensive, was an open victim to just such audacious and vigorous attacks. The Germans knew this full well. It is a credit to their intelligence that they took advantage of these conditions. The Poles had cavalry, but it was improperly armed, and they had no anti-tank guns to speak of in their infantry. The French might have observed these defects, but they contented themselves with the idea that overwhelming numbers of the German army was the only reason for the Polish defeat. The French were touted as the finest army in Europe, and they were very complacent about it. They had their political troubles, but there was no excuse for their military blindness. There will be no excuse for us if we continue to imitate the German method and organization which was designed for a special situation in France and would undoubtedly be changed for new situations. The Germans did not use cavalry extensively, but they did not need to do so in the absence of French and British cavalry and the lack of opposition to the Panzer Divisions. To the contrary, we in the Western Hemisphere will

always need large forces of cavalry in addition to mechanized forces and motorized infantry and much " marching " infantry.

The British officer again comments on the wrong idea of their air forces—the same idea that prevailed at that time in our air force. His diary continues :

(10) "May 20—This is a soldier's point of view and this is a soldier's battle, but our airmen do not, perhaps, see this phase through soldiers' eyes. To us they seem to be wasting their efforts and will be likely to lose the bases through which they operate, as a result of this inability to spare aircraft for close-in co-operation with the army in this, its very desperate hour of need."

This is just further evidence that all air forces, except the German, failed to see that their most important mission was the support of the army as long as an army was operating in the field.

(II) "May 21—France lacks imagination. There has been no effort to mine and bomb with grenades the Panzer columns on their line of march. There have been no improvised bottle bombs wrapped in blankets that burst into flames and wrap themselves round the tank tracks. There have been no enterprise and no show of initiative by junior officers and men. They have become Maginot minded; a false sense of security has robbed them of initiative."

Thus the Panzer divisions had little or no opposition. Nothing to test them against real resistance.

(12) "May 22—Still no French counter-attack to pierce the bulge. Precious opportunities have been thrown away. General Georges was asked point blank why the promised counter-attack had not been delivered. His liaison officer spoke for him and answered that the General could not give orders so far in advance of the inclinations of the divisions. This was an eye-opener, and it is only now that it is brought home to me that the formation of soldiers' committees, regularized in the French army in 1936 by Blum's regime, have so far undermined discipline."

Here is indeed an eye-opener to those in our country who encourage socialism.

(13) "Our own one and only armoured division was landed in France yesterday, and is to set off from Rouen to try to deal with the German tanks. They will be very unfairly matched, alas."

Another example of the improper use of armoured units when the army is on the defensive.

(14) "The German efficiency is well illustrated by the following wireless interception—this message was sent in the clear by the Germans. It says, 'All bombers to Cambrai.' Again at 14.00 hours (2.00 p.m.) today, 'All fighters to Arras,' and at 14.10 hours we intercepted the reply; it read, 'All fighters on the way.'"

"This record is a reflection on Allied procedure. How do we send out our messages? How do we send out our executive orders by wireless? As far as I know, it has never been in the clear. The Allies send out orders calling for immediate action, but they send them in code, and this means that by the time the message is coded by the sender and decoded by the recipient some hours will have elapsed and the fleeting-opportunity target will no longer present itself for attack. It will be too late."

Certainly, our officers with experience will sympathize with this statement.

(15) "May 23—General Georges has just explained that three French light motorized divisions are moving north from the line of the Seine at Paris to the sea, with the intention of taking up positions on the south bank of the Somme to stop up the southern side of the bottle-neck. The Belgians are detaching one or two divisions to move in on the pocket from the north and north-east. In this way it is hoped to pen in the Panzer divisions. The whole of the Allied bombers are to go in during the day and try to smash the Panzers. Our own armoured division is moving onto the Somme and will go into the pocket after the aerial bombardments and clear up the mess. This is the plan, but the duty allocated to our armoured division appears to me a hopeless task."

Here again we see the idea of trapping the Panzer divisions by infantry divisions without anti-tank guns in any numbers and by attacking the German tanks with a single armoured division which is sure to be wasted. Accoplane bombing against the mechanized Panzer divisions after the latter were deployed and no longer massed on the roads could do little good. A large Cavalry force with their anti-tank guns, and backed up by the armoured British division. moving in between the Panzer divisions and the German main bodies which were well in rear, could have done something to delay the German movement, interrupt communications and give more time for other French divisions to be brought up for the attack against the German motorized and marching infantry divisions. No mechanized or other troops could do this so well ; but to attack the Panzer divisions by using infantry without anti-tank guns was a hopeless task. There was no co-operation however, and the attempt was called off. Thus the hope of converting the situation from a defeat into a major victory for the Allies went glimmering, and with it all hope for France.

The remaining entries in the diary are very interesting but contain no tactical conclusions which might be used for the purposes of this article.

SUMMARY.

To summarize the implications of these notations :----

(1) The unreality of Command Post Exercises.

(2) Necessity for cavalry to guard flanks in addition to aeroplanes, mechanized or motorized forces.

(3) Only well trained and disciplined troops are trustworthy.

(4) Necessity for air force being subject to orders by commander of ground forces.

(5) Loss of morale due to lack of anti-tank guns and lack of training for open warfare.

(6) Good troops can improvise some defence against tanks even without adequate numbers of anti-tank guns.

(7) Mechanized troops cannot fight delaying actions against superior mechanized forces without total sacrifice. Only cavalry equipped with anti-tank squadrons can do that.

(8) Initiative is developed only by training for open warfare.

(9) The apparent reckless audacity of the Germans was justified by the situation. Nothing unorthodox about that.

(10) The real mission of air force with an army in the field is tactical co-operation.

(11) No imagination in French army. Panzer divisions had no real test.

(12) Dangers to the army of any country given to socialism.

(13) Another example of improper use of mechanized troops.

(14) Only simple and brief orders are necessary to issue to commanders who know their business. Rigid regulations against sending radio messages in the clear are foolish.

(15) Futility of attempts to attack mechanized troops without proper weapons, and necessity for cavalry in effort to cut off enemy detachments that are too far advanced without support.

* * * * *

Finally, all reports from the campaign in France emphasize the necessity for one supreme commander, for discipline and obedience to orders under all circumstances, and for initiative on the part of subordinate commanders of units large and small.

Initiative does not mean disobedience of orders. On the contrary it means carrying out of orders in the face of unforeseen difficulties. Faith in one's commander means not only faith in his wisdom but also the belief that, if one does his best in carrying out the spirit of his orders, any failures will be understood and excused.

WARTIME BUILDING.*

By R. FITZMAURICE, B.SC.

(Reprinted from Civil Engineering and Public Works Review for April, 1941.)

WARTIME building presents peculiarly difficult problems for the designer, since a number of factors unknown in peacetime become of the utmost importance. These factors tend to impose conflicting requirements, and the resolution of a given problem calls for a good deal of care and thought to ensure that none of the factors has been overlooked.

The Building Research Board was requested by the Works and Buildings Priority Sub-Committee to take as a first task during the war the solution of problems of building created by the changed position of supplies of building materials. A special committee was appointed by the Board in March, 1940, and the work carried out as a result is summarized in a series of publications, known as the *Wartime Building Bulletins*, published by H.M. Stationery Office. As might be expected, the most important part of this work has arisen in connection with factory buildings for the production of munitions of war and other vital commodities. The first task undertaken was a study of methods of factory construction suitable for wartime conditions.

FACTORY DESIGN.

At this stage it is appropriate to consider what are the factors to be taken into account in the design of a factory. They are as follows :

1. Suitability for the particular process to be carried out in the factory.

2. Speed and case of erection, taking into account the conditions of supply of material and labour prevailing at the time.

3. Economy in the use of materials and labour for which demands are heavy in wartime.

4. Ease of concealment from the air.

5. Resistance to damage by air attack.

In the urgency of war, the tendency is for speed to override everything else; it can be shown, however, that all the factors can be taken into account without sacrifice of speed, provided they are properly dealt with in the earlier stages of the development of a project.

The suitability of a factory for the production of a particular product is a problem differing in no way from peacetime practice, and does not call for lengthy discussion here. One point, however,

* Abstracts from a paper read before the Institution of Engineers and Shipbuilders in Scotland. is worthy of mention. There has been a tendency in recent years to design factories in a grandiose manner, with elaborate elevations fronting on main thoroughfares and with vast clear spaces in the shops. It will be realized that the wartime factory must be shorn of embellishment, for every single brick and ton of steel must be used to maximum advantage.

It will be shown at a later stage that large clear spaces have their disadvantages in that big spans need more steel than smaller ones and the damage due to the explosion of a bomb may be more widespread. Consequently the architect or engineer should be at pains to ascertain the genuine requirements of the works management in respect of maximum clear spans, but should exercise a restraining influence where the technical needs for such spans cannot be shown to be paramount.

The whole problem of ease and speed of erection turns on using to the maximum advantage such materials and labour as are available at the time. It is wrong to allow a prejudice in favour of one particular type of structure to impose it on a project when the conditions are unfavourable. Thus in a building consisting mainly of structural steelwork it is desirable to find out from the steel fabricators what range of sections is most readily available at the time required. If reinforced-concrete structures are proposed, it may be well worth while to give the contractor some latitude in such matters as the use of pre-cast elements or work poured "in situ," depending on which suits his particular organization best. Again. some simple modification in design to suit a contractor's shuttering equipment may greatly expedite a project at a time when shuttering is hard to obtain. The essential condition for speed in building in wartime is collaboration between all parties concerned and avoidance of too rigid adherence to the original detail and specification. However carefully these details may have been prepared in the first instance, it is better to adjust a project to the changed conditions than to delay it by insistence on carrying it out exactly in accordance with the original intention.

BUILDING MATERIAL.

War introduces difficulties in the supply of building materials and labour to handle them. So far as the building carcase is concerned, the materials which have to be husbanded are steel, timber, cement and bricks. Consequently, studies have been made of the economical use of these materials and, in many instances, it has been possible to cut down quantities considerably below normal peacetime standards. Some notes on the directions in which these economies have been made may be of interest.

There are various ways of setting out to find the most economic method of covering a given building space. One would be a methodical research on a mathematical basis. The co-operation of a group of leading structural steelwork designers was enlisted through the kind offices of the British Steelwork Association and the Director of Structures of the Iron and Steel Control.

This group assembled a series of designs of structural steelwork for single storey factories; these were tabulated and reviewed and the less economical rejected. The final selection, for roof spans of 22, 33, 40, 55, 77 and 110 feet, was then again reviewed critically and designed to close limits with the additional aid of a small committee of engineers having special experience in this work, and the results were made available in *Wartime Building Bulletins Nos.* 1, 4 and 10. The designs have recently been reviewed to incorporate the results of experience of actual air attack and are available to any individual or firm who is interested.

An important phase in this investigation was to design these structures so that a wide range of steel sections was used, thus avoiding an undue load on any one section of the rolling mills. The designs provide for system of roofing built up of light angle sections and others using heavy joist sections carrying lighter built up members. The investigation has shown the importance of the economy which can be got by making use of continuity to keep bending moments to a minimum. This has been applied fully to all beams. It will be shown later that structural continuity also contributes materially to resistance to effects of bomb explosions.

CONCRETE CONSTRUCTION.

To use reinforced-concrete construction is an obvious method of economizing in the use of steel, since the major part of the compressive loads is carried by the concrete and steel can be used almost entirely in tension. Moreover the depth of beams can often be adjusted to conform to the bending moments, with a further economy in the use of steel. Some typical structures have been designed, suitable for dormitory hutting and temporary hospital accommodation, as well as single-storey factories.

Arch structures in reinforced concrete represent a still further move towards the ultimate economy in steel, since the arch involves mainly compressive forces and bending moments can be kept small. The potentialities of reinforced-concrete arched construction have been little exploited in Britain, though in France, where a number of leading contractors were interviewed prior to her collapse, very interesting projects have been carried out.

The use of reinforced concrete in wartime is made somewhat more difficult by the need to economize in timber for shuttering. It has been found, however, that by keeping structures simple and repetitive, and by designing in terms of specific, recoverable systems of shuttering, that the waste of timber can be kept very small indeed. This and other aspects of reinforced-concrete construction are discussed in Wartime Building Bulletins Nos. 3 and 5. It will be evident that economy in shuttering must be related to the time allowed to elapse before its removal. Recommendations have been made for minimum periods to be allowed for stripping of shuttering and formwork, so that contractors may hope for some uniformity of practice and the question is not left to be decided according to the custom or prejudice of ill-informed supervisors.

Cement, like steel, is required for a great number of purposes in wartime and, as might be expected, the demand tends to be a seasonable one, being at its maximum in the spring and summer months when daylight is longest and weather favourable for concreting. It may be desirable to be economical in its use at times of \leq maximum demands. Generally speaking, great quantities of cement are used in roads, paved areas, runways and solid concrete floors in factories.

Tar macadam can be substituted when necessary for concrete for roadways and paved areas out of doors, and recommended specifications are given in *Wartime Building Bulletin No.* 9. For concrete floors in huts, offices, factories, etc., there is no scientific basis of design, and after reviewing the matter it was considered that the thickness of concrete floors could in many instances be reduced without any serious loss of efficiency and that at any rate the floor thickness might well be related with the ground condition on the site and with the type of service to which floors would be subjected.

It will be found as a general rule that the quantity of cement going into the building structure proper is small in comparison with that used for floors, roadways, etc. Moreover by carrying cement economy to an extreme in the building structure, the burden is thrown back on to steel, which must always be husbanded; consequently it is recommended that cement economy should first be looked for in roadways, pavings, floors in buildings and mass concrete.

TIMBER IN SHUTTERING.

Mention has already been made of the investigations into economy in the use of timber in shuttering and formwork for concrete construction. The practical recommendation is to keep the saw away as far as possible and to go easy with skew-nailing. The designer must work out his scheme so that this can be done, for the problem with shuttering is simply a question of using foresight to avoid sheer unnecessary waste.

In other structures, however, there are great opportunities for economy in the use of timber, for habit and custom have been almost the only criteria for the use of timber in the past. There is no reason why timber structures should not be made the subject of sound engineering design just as much as any other structures and when this is done, remarkable results can be obtained. The Forest Products Research Laboratory of the Department of Scientific and Industrial Research is preparing data on working stresses to be used in the design of timber structures and these should be available in the near future. Information on the economical use of timber can be obtained on application to the Director of the Laboratory.

CAMOUFLAGE.

Concealment from the air is a very important aspect of wartime construction. As with all other A.R.P. questions, it is an elementary precaution to assume that the worst form of attack may come at some time or other and to leave nothing undone which can reasonably minimize its effects. It is a dangerous view to take—but one which is often expressed—that there is no possibility of daylight air attack on our industries and the worst that is to be feared is very haphazard bombing by night.

One method of approach to the problem of concealment is to disregard it entirely, allowing the building project to take whatever shape it will both as regards layout and construction; then at completion to call in the camouflage expert to disguise the resulting structure. This is the worst possible approach and the camoufleur is presented with a task which, at best, is difficult and expensive in time and badly needed material, and at worst may be impossible to conceal satisfactorily.

If on the other hand the principles of concealment are observed from the earliest stage of a scheme there are much better chances of making it inconspicuous with the expenditure of a minimum of effort. The problem of concealment involves care in the selection of sites, care in the choice of methods of construction, suitable treatment in the distribution of buildings on the site and in particular, attention to the layout and construction of roadways.

It is strongly recommended that the Civil Defence Camouflage Establishment, Ministry of Home Security, should be consulted at the earliest stage in a wartime building project. Advice is given free of charge and, by taking the necessary precautions at the earliest stage, the efficiency of the camouflage scheme will be enhanced and the cost reduced to a minimum.

The following are some of the more important factors to be observed :

(a) Choice of site. Avoid conspicuous landmarks such as the confluence of rivers, important junctions of roads and railways, lakes, etc.

(b) The orientation and arrangement of the buildings on the site should be contrived so as to avoid conspicuous regular patterns. Consideration should be given to the type of building development in the locality which so far as is possible should be simulated.

(c) Saw-tooth and northlight roof lighting should as a general

rule be avoided. The deep shadows cast by vertical and steeply pitched glazing are very difficult to conceal.

(d) Where ground has to be excavated the soil may with advantage be blanked against the north, east and west sides of the buildings to conceal the shadows cast by the walls. Generally speaking, the buildings should be kept as low as possible in order to minimize the shadows they cast.

(c) Natural features on the site such as clumps of trees, hedges, ditches and streams should be preserved as far as possible and advantage should be taken of them in working out the camouflage scheme.

(f) Building work should be restricted to the minimum possible area of ground. Heavily scarred ground is difficult to conceal and even if ploughed and planted at completion, a considerable time must elapse before the scars recede into the general tone of the landscape.

(g) Great size of individual buildings makes concealment difficult, and factory units should be kept to the smallest size consistent with a satisfactory production layout. A maximum dimension for a unit of 200 ft. in any direction is a desirable limit to aim at.

WAR DAMAGE.

There are three main lines of approach to the problem of minimizing damage by air attack, firstly, by disposing the buildings on the site so that the likelihood of damage by direct hit in any one attack is reduced; secondly, by constructing the buildings so that in the event of a direct hit or near miss by high explosive bombs the resulting damage is reduced to a minimum and production can easily be started again; and, thirdly, by constructing the buildings so that damage by fire resulting from incendiary attack is minimized. All these aspects are of importance and have been the subject of study by various organizations.

Bombs are dropped in rows or "sticks," so that other things being equal, it is well in laying out a new site to keep in mind the possibility of reducing the chance of a single stick of bombs hitting a number of buildings in line. For instance, if site and other conditions lend themselves to such treatment, arrangements of buildings in curves or crescents on plan is advantageous.

It is a gratifying fact that factory buildings can be made highly resistant to demolition by direct hits or near misses by high explosive bombs. A study of this aspect has been made by Prof. J. F. Baker, of the Research and Experiments Department of the Ministry of Home Security, and the advice of this organization is freely available and consultation at an early stage in a building project is advised.

The studies made by Prof. Baker are particularly complete for

single-storey buildings in structural steelwork. The aim should be for such structures to be so designed that any one main member can be cut without causing adjacent members to collapse. This sounds a more exacting condition than it actually is, for the explosion which cuts the member, whether stanchion, beam, truss or lattice girder also removes a large area of the roof covering and in doing this, takes off a large part of the superficial load.

With very little or no additional steel a great many normal roof types are capable of satisfying this condition, but there are other types which are inherently so unstable that injury to one member may lead to progressive collapse extending to the whole of the shop concerned.

The ability of a soundly designed structure to withstand the demolition of a main member without significant deflection of the remainder has been amply proved in recent raids. It may be remarked that these principles have been observed in the buildings which are dealt with in *Wartime Building Bulletins Nos.* I, 4 and 10, and the revisions which are now just complete.

Briefly the following are the main principles :

(i) Trusses and lattices of an unbalanced type should not be arranged so that the removal of a supporting member at one end causes adjacent members to collapse.

(ii) Beams and built-up girders should be designed to develop full continuity in their lower flanges or chords over stanchion supports, so that in the event of stanchions being removed or damaged the beam or girder can span between adjacent stanchions without collapsing.

(iii) Roof systems generally should be braced more liberally than would normally be provided for wind action, realizing that damage to a truss or its supports may induce considerable forces which will be transmitted along the line of the purlins.

Fires due to incendiary attack have caused very serious damage and it is important to ensure that this aspect receives proper attention in new buildings. It is suggested that some discrimination needs to be exercised between buildings where the occupancy is such that the fire hazard is important and those where it is negligible.

Where the fire hazard exists, the roof structure may with advantage be made resistant to the small incendiary bomb but, in addition, the building should also be divided up into compartments of moderate extent by adequate fire walls carried right up to the roof with openings closed by fireproof doors (not self-acting). It is suggested when considerable quantities of combustible goods are stored or handled, that a limit of 10,000 sq. ft. of floor area should be the maximum size for any one compartment. In addition, all steel work in the building should be encased in concrete or otherwise protected against fire.

TANKS AND THE FALL OF FRANCE.

ANONYMOUS.

* (Reprinted from Infantry Journal (Washington) of February, 1941.)

The INFANTRY JOURNAL presented the notes and comments which follow not as another discourse on Why France Fell, but simply as a memorandum on one aspect of the débâcle : the failure of French anti-mechanized measures. The author of these notes and comments must remain unnamed; but it can be stated that he is one who was in a position to observe intimately the events of May and June, and who was qualified to evaluate what he saw and viewed it all with a detached and somewhat cynical eye.

Germany's superiority over France in numbers of tanks was at least three to one; and if space were at sufficient premium, no further explanation of the collapse would need be offered. If anything like equality of tank forces had existed, the hoped-for counter-attacks against the very extended German communications north of the Somme would probably have materialized, and the story might have been entirely different.

This all is to say that the best defence against tanks is—tanks. To our observer, that is the great lesson deriving from the Fall of France.

* * * *

If the French can find any satisfaction in anything growing out of the disaster that befell them, it is in the performances of their own tanks. The German had the most tanks by far; but they did not have the best ones. Three of the French tank-types proved especially effective, and, tank-for-tank, superior to any comparable German unit. The general characteristics of the three tanks in question follow:

DESIGNATION	WEIGHT (tons)	SPEED (mph)	Armour (mm)	ARMAMENT
Somua	20	30	30 all-aroun 40 on turret	d One 37-mm. gun ; One MG
R-35	14	, 13	40	One 37-mm. gun One MG
Char B	32	20	40 all-aroun 60 on turret	d One 75-mm. gun One 47-mm. gun Three MG's.

Our observer states unequivocally that the B-tank was the king

of the battlefield, "dominating its every opponent." Unfortunately, it was available only in miniscule quantities.

With its hopeless inferiority in quantities of tanks, France was doomed to defeat; and so, presumably, would be any nation which might find itself in a similar predicament. There being no question on that score, the following thought arises: what would be the situation of a nation whose inferiority as regards tanks was not so hopeless? This brings up the possibilities of an AT defence in which terrain, obstacles, mines, guns, and tanks are integrated. Our observer considers these items in order.

The Maginot Line, he notes, remained tank-proof until the last days of the campaign, by which time the will to resist and the means to counter-attack had both dissolved. However, the Maginot Line rested on fallacious doctrine. Its supposed (perhaps so far as the Line itself is concerned "actual" is the word) impregnability numbed all thought as to other methods of defence. And its tremendous cost drained from the treasury the funds which were needed by other elements of the army. The French conveniently assumed that, with the Line holding fast, any threat north of Sedan could be met and vanquished by the *masse-de-manôeuvre* which would assemble under the protection of the Line itself. The terrible consequences following an outflanking of the Line were never properly considered.

Nonetheless full use must be made of all natural and readilycreated obstacles in any system of AT defence. This brings up the matter of demolitions on routes of communications, and thereby touches another of the many weak points in the French armour. The French had mined only the bridges near the border, and apparently had never considered seriously the possibility of having to demolish the ones farther to the rear. Even at the front many of the bridges fell intact into German hands, this largely as the result of the highly centralized system of control under which it took practically an authorization from Paris to get a bridge guard to pull the switch. The civil administration remained in the saddle even after the front had crumbled and the panzer units were abroad. The civil officials were reluctant to authorize any demolitions which might interfere with the evacuation of civilians. And so, after the breakthrough, the German armoured and motorized columns found themselves cruising over unguarded bridges on the world's densest net of good roads, while a bewildered populace did little more than look on.

These remarks serve to establish the point that demolitions-indepth, comprehensively planned, painstakingly prepared, and ruthlessly executed (without regard for civil rights), form an important element in an effective defence against tanks.

Like all the others, the French searched constantly for an AT

obstacle which would be effective, inexpensive, light, simple and quick to construct, and difficult to neutralize or remove. Like all the others, the French compromised with the ideal. Some of the obstacletypes they found effective are described briefly below.

Ditches. Favourite obstacle of the British. Slow and difficult to construct, especially if power earth-moving machinery is not available. Easily bridged, in some cases by the expedient of sacrificing the first tanks, driving them into the ditch and then driving the following tanks across on the first ones.

Driven railroad rails. Most common French obstacle. Difficult to construct, practically requiring power-driven machinery. Individual rails can be demolished by tank-cannon fire.

Monolithic concrete pedestals. Chief obstacle of the Westwall. Slow and difficult to construct. Demolished by artillery fire, or by fire from 47-mm. tank cannon.

Concrete eggs. (On end, 7 feet high by 5 feet wide.) Called "kiwitts" by Finns, and found by them to be effective. Slow and difficult to construct in adequate quantities, but also difficult to demolish.

Steel hedgehogs. Must be pre-fabricated, but are semi-portable. Demolished by tank-cannon fire aimed at centre joint. Easily pulled or pushed out of position.

Steel frames. Used in places along Westwall. Must be prefabricated. Difficult to transport and install.

Steel tetrahedrons. Tested by French, but never available in quantity. Considered best of semi-portable obstacles. Must be pre-fabricated, but may be dismantled into two parts, each weighing about 300 pounds. Difficult to demolish.

The explosive mine has many of the military characteristics of the ideal AT obstacle. It has one peculiar characteristic in that through its action the tank is not only stopped, but is put out of action. However, to be effective, mines must be usually available in great numbers (say, one per yard of front), and their positions must be camouflaged. The laying and camouflaging of large numbers of mines is a time-consuming operation and one on which it is not practicable to employ labour-saving machinery. Finally, the minefield may be destroyed by heavy bombardment (it must be heavy, though); or a path through the field may be blazed by heavy rollers or ploughs which, pushed ahead of pilot tanks, cause premature detonation of the mines.

However, the French experiences as regards mines form an especially black chapter in a book which has no bright chapters. Not only were the French woefully short on quantities of mines, but, until too late, the mines that they had were of inferior quality. At the start of the war, the standard French AT mine was rectangular in shape, this as a result of some peacetime mathematical niceties which showed the rectangular shape to give the optimum efficiency
in covering a given length of front. Unfortunately, the mathematics were based on an assumption that failed to last out the first month of war. The mathematics were further at fault in that they failed to evaluate the fact that it takes " ten times more work to machine a rectangular metallic body than a round one." The mine in question was elaborately equipped with safety devices, these being monuments to peacetime committees, but often complete mysteries to the soldiers who handled the mines (with the result that a French minefield was as likely as not to be ineffective due to the failure of the mines to detonate under any pressure). Finally, the mine was small, this as a result of the premium put on lightness in peacetime manœuvres. The German tank encountering the French mine had its track broken. But the French tank encountering the husky German mine had its belly breached in and its crew killed or maimed. It wasn't long before the French field officers who had demanded lightness above all in peace were crying for a heavy mine like the German one.

It is beyond the scope of these notes to discuss the capabilities of the several types of AT guns used by the French. However, all AT guns have one characteristic in common : there are never enough of them. Since there are never enough of them, it is essential that those that there are be kept highly mobile and that they be supplemented by other portable weapons. Our observer advocates placing many of these mobile guns in the hands of "territorial troops, civil guards, and rural policemen," to organize resistance to small bands of tanks infiltrating through positions and cruising around the countryside.

After natural terrain has been utilized to best advantage, and after it has been integrated with demolitions, obstacles, mines, and guns into a comprehensive system of AT defence, the breakthrough still may come (although under these conditions it is likely to be canalized). This means that the situation must be re-established through the counter-attack. And herewith we return to the opening theme of these notes : only tanks can counter-attack effectively against tanks.

The tank counter-attack must be executed swiftly and in great force. The assembly of the necessary elements presents a difficult problem in this day of aerial reconnaissance and bombardment. Our observer believes that the solution may lie in a return to something like the Vauban system of *places fortes*—that is, in individual fortified areas, spaced so as to be mutually " co-operating " without forming a rigid Maginot Line. The idea is that these *places fortes* would provide protected areas in which mechanized forces could assemble, recuperate, and refuel, and from which they could be launched on tank-against-tank counter-attacks such as might have saved France during the latter part of May.

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DRAMATIC DISCIPLINE.

By "SENTRY."

Sketch I.

THE scene is the anteroom of an officers' mess. Four officers are sitting in easy chairs, enjoying their leisure and digesting their dinner. Captain Hamsburne is a good-looking man, though in a supercilious and rather unpleasant way. 2nd-Lieutenant Bathbegdon is very youthful, but with a shrewd and somewhat humorous expression. Major Yexbulby is a solid, red-faced individual, who though big, looks fit and active. Captain Lush-Rider is a big loosely-built man, wearing horn-rimmed glasses.

- *2nd-Lt. B.*: What was that yarn you were telling Chapplebobble the other day, sir?
- Major Y.: I never yarn, and I don't remember telling any particular anecdote.
- 2nd-Lt. B.: Sorry, sir. I meant the one about the famous Indian character.
- Major Y.: That bloke. He was a bit of a lad. He succeeded in getting himself on to parade in nothing but a topi, with a shaving brush stuck in its side, and a pair of boots. Working for his ticket. When the C.O. took the case, he tipped the table over, and the whole party had a sort of rugger scrum. As soon as he got out of clink, he went sick, and when the M.O. told him he'd been marked "duty," he called him a something whatnot. When he came in front of the C.O. this time, all sorts of supers stood ready to pounce on him, but when the C.O. asked him if he had anything to say, he startled everyone by saying, "I'm verra sorry, sir." The C.O. asked why, and was told "Sirr, I'm verra sorry I didna slosh the . . . and make a proper job of it."

Capt. L.: What's the moral of that one?

- Capt. H.: If you ask me, I'd say it was to get rid of a bad bargain before he starts tipping the table on you.
- Major Y.: Don't altogether agree. What that chap probably wanted was a damn good scrap with someone a bit over his weight about once a month. But I won't argue.
- 2nd-Lt. B.: What was your line for keeping order when you were a don, Lush?
- *Capt. L.*: I could beat the lads to more effect than anyone else, and only did it about once a year.
- 2nd-Lt. B.: What about the rest of the season?
- *Capt. L.*: Attention to detail mostly; watching the chaps; spotting who wanted it, and making them look B.F's occasionally.

- Capt. H.: No good with soldiers. The C.O. wields the big stick. You're bound to have petty offences, and you've got to make the consequences follow automatically.
- Capt. L.: You may be right; depends on whether you accept that you are bound to have a lot of petty offences. If you can stop them off, I think something like my way works all right. Where I'm a bit at sea is dealing with fellows who aren't just privates. I'd be a lot worried if I wasn't sure of the C.S.M. or a Serjeant. Doesn't



crop up in schoolmastering; not till you're a Housemaster, and not then really.

- Major Y.: That's true, but it's not so difficult for us as for the wretched Lance-Corporal. I sometimes wonder what does go on. All this discipline stuff is a matter of getting things done properly without fuss and bother, rather than the big stick. If everyone always knows you mean business, and aren't a born fool, they'll do what they're told, whether they like it or not.
- Capt. H.: I think it's easier than that. I tell my N.C.O's that an order's an order, and if there's anything but immediate obedience, they must run a case, and I'll back them up.
- 2nd-Lt. B.: What about that Corporal Wuckle the other day?
- Capt. H.: I think he's quite a good bloke. Very bright.
- Capt. L.: What happened?
- Capt. H.: A case of answering back and arguing about a fatigue. I ran the man up, and the C.O. gave him the hell of a crack. Then he had the Corporal up, and ticked him off for being the sort of N.C.O. a private answers back. Then told me I'd got a dud, and should have got rid of him ages ago.

(Enter the C.O., Lt.-Colonel Fricklist.) The officers get up and say, "Good evening, sir." The C.O. replies, and goes across to the bell.

- Col. F.: Excuse a moment's shop. I've been dining with the Brigadier, and it looks as if you'll be taking your Company on 'detachment for a bit, Lush-Rider. Off the day after to-morrow. We'll fix up details later.
- Capt. H.: You'll be able to try out your system uninterruptedly now, Lush.
- Col. F.: What's that?
- Capt. L.: They've been getting at me for running my Company on the same lines as when I dealt with schoolboys, sir. (Enter waiter.)
- Col. F.: Four beers, and a small whisky and soda (exit waiter). Discipline what? A big subject, and mixed up with a lot of others too. When it comes to punishment, the main thing is to show the man you know everything there is to know about both sides of the case; and then no compromise. And no subtle penalties tacked on to the award you give. Talking of discipline, and running a show generally, it reminds me of what I read somewhere the other day. When you start thinking about it, you think it's largely brawn and some brains. Later on, you think it's mostly character. When you really get wise, you decide it's only personality that counts. I don't think I altogether agree, but there's something in it. By the way, Lush, you'd better look up your powers as a detachment commander. No need to tell you how I use mine.
- Capt. L.: Right, sir. As a matter of fact I haven't had a case in front of you for about four months.

2nd-Lt. B.: How do you use your powers, sir?

- Major Y: Twenty-eight days, unless you can find an excuse to make it twenty-one.
- Col. F.: Shut up, Yex. (Enter waiter, who hands round the drinks.) As a matter of fact, you're not altogether right anyway. Well, here's luck.

* * * * * * Sketch 11. Scene I.

The scene is the usual one in a Company Office. The Company Commander sits at a trestle table covered with an old and inkstained army blanket, with three trays and a muddle of books lying on it. In a corner of the room is another table, with no blanket, at which is seated a Subaltern. The Company Commander is in the chair, and the C.S.M. is at attention, facing the former.

Capt. H.: (For it is our friend Hamsburne again.) He's quite a bright chap, isn't he?

C.S.M.: Yes, sir. It looks as if he's a bit too bright, sir, but he's a good worker.

- Capt. H.: Only a case of absence so far. What do you think of him, Bathbegdon ?
- 2nd-Lt. B.: I've always thought him a good soldier. I think he's a bit independent-minded, which may have made him unpopular sometimes. He's certainly got brains and guts. I'm surprised at this charge.

Capt. H.: Bring him in, Serjeant-Major.

(Exit C.S.M. In due course, after no small clatter over the bare boards, the mat lying in front of the Company Commander's table carries from left to right, a soldier as escort, the accused, Private Copple, and two witnesses, Corporal Rubb, and Serjeant Toffy.) 7576334, Private Copple.

Pte. C.: (Who knows the ropes.) Sir.

Capt. H.: You are charged with stealing a silver cigarette case and a fountain pen, the property of Corporal Rubb. (The C.S.M. ushers Serjeant Toffy from the scene.) Corporal Rubb.

Corp. R.: Sir, on 25th March, I saw Private Copple using that cigarette case, which I identify. I said to him "That's mine," and he said, "That's right." I reported the matter to Serjeant Toffy. Serjeant Toffy, with me and the accused, searched the accused's kit, and that fountain pen, which I identify as mine, was found in his kit. I had not had possession of either for about four months. Sir.

Capt II.: Any questions, Copple?

Pte. C.: No. sir.

(Corporal Rubb is replaced by Serjeant Toffy.)

Capt. H.: What do you know about this case, Serjeant ?

Sjt. T.: Sir, on 25th March, Corporal Rubb reported that Pte. Copple was in possession of his cigarette case. I sent for Pte. Copple, who on being questioned produced this case, which I identify. I placed the accused in close arrest, and searched his kit in his presence. This fountain pen was found, which I identify, and which Corporal Rubb identified as his, sir.

Capt. H.: Any questions, Copple?

Pte. C.: No, sir.

(Serjeant Toffy is exilled).

Capt. H.: What have you got to say about this, Copple ?

Ple. C.: Nothing, sir. I was going to give 'im back 'is things, sir.

Capt. H.: If you'd had the things four months it doesn't look as if you meant to give them back. Very serious charge this. Remanded for the Commanding Officer.

SCENE II.

Colonel Fricklist is in his chair, with Captain Hamsburne and the Adjutant in the room.

Col. F.: Stealing, Hamsburne. I didn't know you had any of that trouble.

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- Capt. H.: I haven't, sir, up to now.
- Col. F.: What is the man like?
- Capt. H.: He's had a good name up to now, sir. Possibly a bit over-. clever, sir, but a good fellow at his work, sir.
- Col. F.: What about the Corporal? He's the man's section commander, isn't he?
- Capt. H.: Yes, sir. He's a fair Corporal, sir, a bit weak. I think his section is a bit of a soviet, or he tries to run it like one.
- Col. F.: Bring them in, R.S.M., please.

(The usual martial movements and noises take place. The case proceeds as in Company office, up to the end of Corporal Rubb's evidence.)

- Col. F.: Anything to say, Copple ?
- Ple. C.: No, sir.
- Col. F.: Had you been using this case and pen while you had them ?
- Pte. C. (Hesitates) : Yes, sir.
- Col. F.: I suppose you'd not seen Private Copple using your things before, Corporal?
- Cpl. R. (Very promptly) : No, sir.
- Col. F.: Bring the other evidence please, R.S.M.
 - (Sjt. Toffy is inducted, gives his evidence, and is withdrawn.)
- Col. F.: Well, Copple, what have you got to say about having these things?
- Pte. C.: I was goin' to give them back to 'im, sir.
- Col. F.: You'd had them for four months, and you said you'd been using them. How did you get hold of them?

(Pte. Copple maintains an obviously embarrassed silence. His normally ruddy face is by now a deeper red, and is slightly moist. At this moment, the Adjutant, who has been jotting something down, puts a slip of paper in front of the C.O. The latter glances at it.)

Right. R.S.M., march out the accused. I'm going to see if there's any more evidence available. Hold the witnesses for the time being.

(The party clatters out.)

Hamsburne, I think there's a bit adrift in this case. It's not a good charge for stealing as it stands, anyway. What did you put that chit on my table for ?

- Adjt.: There was a case that looked as if it might have been theft just after we arrived, sir, and I rather think this Corporal Rubb was in some way mixed up in it. If you remember, the people we relieved said they'd left a wireless set behind, and it wasn't found, though there was an idea that it might have been in the room Rubb's section were in.
- Col. F.: Bit far-fetched, still you never know. Hamsburne, get hold of a couple of sensible men out of Rubb's section; men who have been in it some time. I'll see them in a couple of hours' time. Keep the Corporal out of the way in the meantime.

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SCENE III.

It is Orderly Room again, about two hours later. The C.O. is in the chair, and Copple with satellites is at attention in front of him. The Adjutant, Capt. Hamsburne, and the R.S.M. are in the background.

Col. F.: R.S.M., bring in one of those men, please.

(A large red-faced man, with a somewhat hurt expression, is produced in the usual manner.)

(Pointing to the cigarette case and pen.) Ever seen these ?

Pte. Akestle: Yes, sir. I've seen the case, sir.

Col. F_* : When ?

Pte. A.: 'E's been using it, sir.

Col. F.: Do you know if it's his?

Pte. A. (Long pause): I don't know, sir.

Col. F.: I think you do.

Pte. A.: Well, sir, I 'ad an idea they was the Corporal's, sir.

- Col. F_{i} : Both of them? Did the Corporal say anything about having missed them?
- Ple. A. : Not to me, sir.

Col. F.: Now, look here. You knew these things belonged to the Corporal, and that Copple had them. Didn't you ever think of asking Copple about them, or the Corporal?

Pte. A.: No, sir.

Col. F.: R.S.M., march out this witness and bring in Corporal Rubb. (The change takes place.)

Corporal, I've a pretty good idea you knew all along that Copple had these things of yours. Copple, did the Corporal owe you money?

Pte. C. (Very long pause, heightened colour, more moisture.)

Col. F.: Corporal Rubb, did you know Copple had these things?

Corp. R.: Did I . . . sorry, sir ?

Col. F.: You heard my question Corporal. I'm going to have an answer, and I warn you I'm going to get to the bottom of this. You'd better be careful how you tell the truth.

Cpl. R. (Some hesitation) : I 'ad some idea, sir.

Col. F.: Did you owe Copple money?

Cpl. R. : 'E thought I did, sir.

Col. F.: That's a bit thin, considering he got the things, apparently with your knowledge. Now you got these things soon after the Battalion arrived here. I'm going to ask you rather a curious question, Copple. I've been looking into the loss of a wireless set which took place about that time. I've got an idea you know something about that too?

Pte. C. (No answer, but the silence is expressive.)

Col. F.: Now, Copple, I've got a good idea of what happened and it looks to me as if your offence wasn't theft at all, but something

which may be less. I want you to speak up. I'm going to find out anyway.

Pte. C. (Decides the pace is too hot): I found the set in the room when we come 'ere, sir, and we used it as we didn't think there was any 'arm, sir. Then Corporal Rubb said as it 'ad got to go back to office, sir, so as it could be sent to the chaps who were in our room before we come 'ere. Then I sees it in a shop in the town, and I found Corporal Rubb 'ad sold it for three quid, sir. So I tells 'im I was goin' to 'ave a quid of that, sir, and 'e says 'e's spent the money, and gives me the cigarette case and pen till 'e could pay me, sir.

Col. F.: Any questions, Corporal.

Cpl. R. : No, sir.

Col. F.: You'll both remain in close arrest for the time being. R.S.M., march out.

(Exense all but the three officers.)

Company Commander's job that, you know, Hamsburne.

Sketch III.

Scene I.

In a ground-floor room of a small seaside town hotel, requisitioned as quarters for troops. There are eight beds in the room which shows signs of military occupation. There is a caricature of a well-known German leader on one wall, and a not so good representation of an Italian leader on another. The beds are in a mess, as the occupiers have turned out for a spell of P.T. between reveille and breakfast. There is much equipment on the floor. The room is empty.

Enter seven soldiers. The most striking man is about six feet two in height, and broad and heavy. He has in the past been an unsuccessful heavy-weight professional, a bookie's "assistant," and may have other qualifications. He is the "senior soldier" in the room. His name is Quiggs; his title is Private. The names of the other soldiers are Gotes, Greenop, "Chips," "Blanco," Cogmother, and Wooser.

Ple. Q.: Now then, Private Carpenter, let's see that bed done sharp. *Ple. C.*: . . . off.

Pte. Q.: He's fresher than usual for Saturday mornin'. I 'ope there's decent grub for breakfast to-day.

- Pte. W.: Wot was all the row last night?
- Pte. Q.: The last I 'eard was "Fall out two men." I always stops listening after that. I 'eard as one of our police was taken off. (Enter Corporal Husk.)

Cpl. H.: Fall in for breakfast.

Chorus : We don't never fall in for breakfast.

(The Corporal has left.)

Ple. Q.: I 'ad to salute twice for three bob yesterday. It's against union rules to 'ave a breakfast p'rade for that.

(The men are making up their beds, and piling equipment on the top in the locally approved manner.)

(Enter Corporal Husk.)

Cpl. H.: Now then, wot did I say. Fall in, I said. Get a move on.

Ple. $Q.:\ldots$ off.



Cpl. H.: I means wot I sez; get on out of 'ere, and right away. Don't you 'ear what I said. Get out at once.

Pte. Q.: 'Ere stop that, we ain't on parade now; nor we ain't in stir. Cpl. H.: You've got to get on p'rade; it's orders. Clear out now the lot of you. Don't you people 'ear what I'm saying.

Ple. Q. (Who up to now has been sitting on his bed, gets up): Did you 'ear wot I said, Corporal. I said " ... off."

(Exit Corporal).

I say, look 'ere, they're all fallin' in. It's got something to do with last night. Better get out before the serjeant comes along. (Excunt.)

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SCENE II.

A room in the same hotel. The time is the same as that at which the previous scene started. Eight men enter. Their names do not matter except for that of one man, called Wankstaff. He wears glasses, he has a sulky and rather discontented expression. While the others set about tidying up, he leans against the wall, with his hands in his pockets, and his legs crossed. There is some conversation about the quality of the local beer, and the local Romeo is complimented on his last night's selection.

(Enter Lce.-Cpl. Listwell.)

Lce.-Cpl. L.: Fall in you people. And look lively about it, if you want any breakfast. I warned you to be ready before we come off P.T. You got to come along right away.

(He turns for the door, and as he is just over the threshold—) Pte. W.: Wot the 'ell's all this panic about.

(The Lce.-Cpl. pauses, obviously in doubt whether to show if he's heard the remark. He realizes that everyone knows he has and turns back.)

Lce.-Cpl. L.: 'Oo said that about panickin'?

(No reply, and the N.C.O. goes up to Pte. Wankslaff.) Was it you?

Pte. W.: Yes.

Lce.-Cpl. L.: Wot 'ave you been told, to call me " Sir "?

Pte. W. : No.

Lce.-Cpl. L. : That's right, but wot were you told ?

Pte. W.: Corporal (long pause) Corporal.

Lce.-Cpl. L.: Get away from that wall.

(Pte. W. conforms, to the minimum possible extent.)

Now take them 'ands out of your pockets. That's better, and put 'em down by your side.

(Pte. W. again conforms.)

Get your feet together.

(Pte. W. again does what he is told. He is by now more or less standing to attention and is looking very foolish; some of his friends are a little amused that he seems to be a bit scared.)

Now let me tell you, Wank-bloody-staff, if there's any panicking to be done round 'ere, it's goin' to be you wot does it, not me. O.K. ?

Pte. W. : Yes, Corporal.

(Exeunt.)

Sketch IV.

SCENE I.

A railway station in a town in the Home Counties. There are about a dozen passengers awaiting the up train. One of these is a certain Private Ratson, and with him are his wife and two young children. Ratson's obvious excellent health contrasts favourably with that of his family. While the children look rather " peaky " they are cheerful and chattering. The wife looks pale and tired.

Pte. R.: Well, it was worth it, to get you settled in 'ere with Mother. It's all right up there, but there ain't no sense in staying if you've got somewhere else like this to go. It was worth it all right, as you'd never 'ave gone if I 'adn't got you away.

Mrs. R.: Wot you mean, 'Arry, worth it?

Pte. R. : Well, I tried for leave, but I couldn't get it, so I'm A.W.L. see, and I'll get a bit when I go back. I'm C.O.'s driver, and I've always done 'im proper. 'Is car's a treat, and I looks after it all right too. They won't do much, so don't worry.

(Mrs. R's protests are drowned by the incoming train. Ple. R. gets into the train, which pulls out.)

SCENE II.

Company Office, of the H.Q. Coy. Pte. R., having spent, for the first time in his life, a night behind the bars, finds himself in front of Major Doe. Before his state entry, the C.S.M. had removed his cap. He is feeling his position. This the more so, as the Major is not very well-known to the men, and the C.S.M. is not liked.

After the usual introduction-

Major D.: You are charged with absence from 2130 hours on 24th April, till apprehended at King's Cross Station by the military . Police. Cpl. Jabb.

Cpl. J.: Sir, on 24th April I was Orderly Corporal. I called the roll at 2130 hours, and the accused was absent. sir.

(Exit Cpl. Jabb, with martial footwork.)

Major D. : The other evidence is a report from the Military Police, that you were taken in London without a pass at 1430 hours on 26th April. Anything to say to the evidence ? Pte. R.: No, sir.

Major D.: That's two days' absence, Ratson. Can't have you men taking days off whenever you feel like it. You forfeit two days' pay, and you'll do seven days' C.B. March out.

(Exit Ratson, escort, and followed by the C.S.M.)

SCENE III.

Outside Company Office, immediately after the above scene. The party has been formally dismissed.

C.S.M.: Here, you ruddy jailbird.

Pte. R. (There being no other addressee, Ratson replies) : Sir.

C.S.M.: What d'you go off for ?

Pte. R.: I wanted to get my family out to my mother's, sir.

C.S.M.: Yes, I know that one. Two days' boozing in London's what you went for. Seven days' C.B. won't stop that, but you'll find there's more in it than that,

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Pte. R.: It's quite true, sir. They wasn't 'aving much of a time in London, sir, and I applied ...

C.S.M.: Stop that, and clear off.



SCENE IV.

Three weeks later. It is Friday night, and the scene is in the public bar of the "Birch and Bottom," a favourite *rendez-vous* of the soldiery. In one corner, four men are grouped round a piano, which, under the ministrations of a fifth, is playing out a superlatively sentimental dirge. The four soldiers are singing the refrain. The atmosphere is overpoweringly close; so much so that one soldier has just remarked to his friend, that this makes the third boozer they will have been steamed out of. At a table in the corner, sits Private Ratson, and his chum (pronounced to rhyme with room), one Private Tarpaver.

- Pte. T.: Browned off, mate?
- Ple. R.: 'Ave bin, ever since I done my C.B.
- Pte. T.: C.B. ain't nothing. 'Oo minds C.B.?
- Pte. R.: I didn't mind that. I knew that was comin' all right. It's wot went with it.
- Pte. T.: You mean putting you on cookhouse?
- Pte. R.: Wot the 'ell's the sense in putting a driver mechanic on spud peeling all day. I know I was doin' O.K. on the car; the

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new chap, 'e's let the C.O. down all right once already. Took 'im out without the key of the tool chest, and then 'ad a stoppage 'e 'adn't any business to anyway. Proper dust-up there was too. The old man ain't no silent sufferer. You ought to 'ear him in the office.

- Ple. T.: You wos fair nuts on that car. You got a cushy job where you are; plenty of grub, and shorter hours too.
- Pte. R.: I'm properly browned off, I am. I'm goin' up in front o' someone soon. See if I can work some of it off on them I am.

Scene V.

Orderly Room, some three weeks later. A procession has just gone off: our Private Ratson is now number two in a file of three, heading for the cells. He therefore is, perhaps unfortunately for his peace of mind for the next three weeks, unaware of what is now to take place. Colonel Fricklist, Major Doe, and the Adjutant are present. The Adjutant exits.

- Col. F.: I was a bit puzzled about that man. He's quite the best driver you've ever given me, he spent hours on the car, and as far as I could judge from talking to him he seemed a most respectable sort of fellow. Yet he gets run in for an absolutely senseless bit of repartee with the cookhouse serjeant.
- Major D.: He went absent, sir, and when he came back the C.S.M. thought he'd better come out of the M.T. section.
- Col. F.: Didn't you see him?
- Major D.: Oh yes, sir, I gave him seven days' C.B. It was his first offence.
- Col. F.: I don't suppose there was any idea of taking him off work he liked and was some use at, and putting him in the cookhouse as some additional punishment, was there ?
- Major D.: I don't think so, sir. I didn't give any orders.

Col. F.: Well, it's damn silly having a man like that away from M.T. It isn't as if we had so many good chaps. My present fellow is beyond hope. A few days ago he took me out, knowing there was an unrepaired slow puncture; then when the tyre went flat, found he'd left the key of the tool box behind. I had to walk home about five miles. Then the otner night he planted a bag of tomatoes of all things in my seat, and I only found out they weren't a map when they got through to the skin. And his actual driving combines the art of figure skating with the uncertainty of blind man's buff. I tell you what; as soon as Ratson is out, give him a week or two somewhere in the M.T. section to shake off jail fever, and then let me have him back again.

Major D.: Very good, sir. I'm sorry about your present driver; I'll try to get someone a bit better.

(As Major Doe leaves the Orderly Room, the Adjutant comes in.) Col. F.: What sort of a man is the C.S.M. in the H.Q. Company?

Adjt.: I've never liked him very much, sir; I wouldn't trust him

very far myself, as I rather suspect him of being a hit of a tyrant. May be all right. Doe speaks very highly of him, sir.

Col. F: Well, between you and me, I'm not altogether happy about that combination. We'll have to see what can be done.

Sketch V.

Colonel Fricklist is seated at the table in his office.

(Enter Captain Lush-Rider.)

Col. F.: Hullo, Lush. Brought your chaps back all right ?

Capt. L.: Yes, sir. They've had a meal and are settling in quite happily.

Col. F.: How did you get on, on your own? You had a couple of months away, didn't you?

Capt. L.: Thoroughly enjoyed it, sir.

Col. F.: Yes, I thought you would. A Company doesn't really find itself till it gets off on its own for a bit. Have any difficulties?

Capt. L.: None at all, sir. We had that Court Martial of course, but I'd been waiting for that to come off for a long time. The fellow was a bad hat, but we hadn't been able to catch him out before. Col. F.: I saw you'd put up one or two fellows.

- Capt. L.: Yes, sir. We had one or two quite useful jobs, and it found out some of the weaker section commanders. I told them I thought they weren't up to their jobs, and two of them put in their stripes without any fuss. They are actually much happier where they are. I got a couple of really good fellows up in their places.
- Col. F.: You're pretty satisfied with your show, are you ?
- Capt. L.: Well, sir, we were able to work to a much cleaner chain of command somehow out there, and everyone got quite clear what his job was, and that if he didn't do it, no one else would. Then there was plenty of interesting training and work to do. We kept the chaps pretty busy, you know, sir.
- Col. F.: They didn't seem to be suffering from lack of spirits coming in.
- *Capt. L.*: They've had quite a decent time, sir. We had a very good liaison with the people living round about, and they were amazingly good about helping us.
- Col. F.: Do you remember talking, about three months ago, about running a Company on the same lines as schoolmastering? How did it work out?
- Capt. L.: Far easier soldiering under these conditions, than at school, sir. Don't know about when the men are a bit stretched, sir. No parents, no posing as a saint, and everybody seems dead out to help, sir. Still, it's got a good bit in common, sir. Watching out for little symptoms and hints all the time, and knowing what's important and what isn't. There was one thing I was a bit puzzled about.

Col. F.: What was that?

- Capt. L.: It sounds a bit stupid, sir. You know we had to find a special officer's guard each week-end. Well, about the third time, I thought I'd spend a night with them, to see how things were going. I found out that it was generally the custom for the Subaltern to feed with the men; there were no special arrangements, and they were all under canvas. I mucked in myself when I was out there.
- Col. F.: You'd pretty often have to on service. But it wasn't quite the same thing of course. It ought to work out all right; depends a good bit on the individuals; if everyone's sensible, it should be rather a good thing, now and again, when there's obvious sense in it, like then.
- Capt. L.: Well, it was all right except for one incident. One subaltern insisted on having his stuff brought to him on the far side of a hedge. He was a bit annoyed at breakfast, after smelling bacon for some time, to find he got none. So he shouted for some. All he got was an anonymous voice, "Sorry, sir, there was one ration short."
- Col. F.: Typical. Still, there was no harm done. By the way, the 'General rang me up after that visit he paid you. He seemed rather pleased with the show. I don't know if I'd have offered him beer at 9.30 a.m.

Capt. L.: He had it, sir.

- Col. F.: He was particularly pleased at the demonstration you were running that day. What was that?
- Capt. L.: We had any number, sir. Pretty well everyone had to work up a demonstration of some sort. They all got quite interested.I think that was one of the reasons everything went so smoothly. As a matter of fact, I hadn't seen that effort before the General came, and I was a bit anxious. Some of them were a bit . . . well, lively, sir.
- Col. F.: Well, you all seem to have enjoyed yourselves, and if you're happy about your show, I am.

(Exit Captain Lush-Rider.)

Colonel Fricklist idly takes up a pencil and paper. He writes "Discipline is a system whereby individuals are trained or coerced to regulate their actions towards a common purpose." He read what he had written, frowned and crossed it out. He then wrote "British discipline is a science, which if properly applied causes each individual to do what he thinks or has been taught is right, no matter how irksome or unpleasant." He again frowned, and produced a third effort, "Discipline in the British Army is an art, through which everyone acts in important matters as his commander orders, or wishes (or would order or wish)." He throws the paper in the W.P.B. and says to himself—

"What rot. It's all personality, common-sense, and guts."

1941.]

THE RUSSO-TURKISH FRONTIER COMMISSION IN ASIA MINOR, 1857.

Extracts from the Journal of my Life. By the late MAJOR-GENERAL E. RENOUARD JAMES.

I HAD been abroad three years, and had been looking forward with pleasure to a return to England, so that the order to go to Constantinople came in some degree as a disappointment to me. But the anticipation of seeing a most interesting country, which I should not have ever visited in the ordinary routine of service, was a very ample compensation for not going home immediately.

We arrived at Constantinople on the 21st April and went to Missires Hotel to await the English section of the Russo-Turkish Boundary Commission in Asia Minor, which was composed as follows:—Lieut.-Colonel J. Lintorn Simmons, R.E., Commissioner; Lieuts. E. R. James, C. G. Gordon and H. Helsham-Jones; Captain de Norman, from the Foreign Office; Assistant-Surgeon Woodfall R.A., medical officer; two interpreters; Serjeant Fisher, R.E. and ten Sappers; mess waiter, cook, servants, syces, muleteers, etc.

After the arrival of Lieut.-Colonel Simmons our time was occupied in preparing camp equipage, buying horses and stores and so on, The and we left Constantinople for our new work on the 1st May. Kars, our ship, was a dirty and uncomfortable Turkish coasting steamer. Coasting along the north of Asia Minor, we put into Incboli for a few hours, and, soon after daylight on the 3rd, reached Sinope, where we stopped most of the day and had time to land. The anchorage in the bay is good for ships of light draft, and before the war of 1853-6 the sailing ships of the Turkish navy lay there often. In 1853 the Turkish squadron anchored there, under the command of Muzafir Pasha (Admiral Slade), was attacked and destroyed by the Russian fleet under Admiral Nachimoff ; scarcely any resistance was offered by the Turks and nearly every ship was sunk. In the four years that had elapsed to the time of my visit the Turks had done nothing to remove the wrecks.

Our ship anchored in Trebizond bay on the 5th, and we landed and encamped, in preference to occupying the filthy huts placed at our disposal by the authorities. We almost invariably lived in our tents while on Turkish soil, but on the Russian side of the frontier we were glad to avail ourselves of the comfortable houses provided for us.

The English section was now compact, and with our servants and grooms, not including the muleteers in charge of the contract packanimals, we numbered about thirty individuals. Our transport beasts and private horses, together, numbered about 110; and we pitched some twenty tents daily.

The English consul came on board to meet us, and we landed under a salute of I do not know how many guns. The French Commissioner had arrived before us. An old man and rather infirm, he was eminently unfitted for the arduous work and frequent exposure which we had before us. Fortunately he had the assistance of a most able man of the French diplomatic service, on whose shoulders all the work for his government practically fell.

The Turkish Commissioner arrived the day after us, and with him was a squadron of cavalry to act as escort to the different sections of the Commission. We were on friendly terms with our Turkish colleagues, and they trusted Colonel Simmons especially on account of the great reputation he had made for himself with their army. Formal visits were at once interchanged between us and the other commissioners, for we were not to be joined by the Russian section until we should reach the frontier.

We stopped at Trebizond a few days to organize our caravan, and had time to see the place. The town resembled every important place in Asia Minor; the so-called streets being narrow lanes winding without method between blank walls, behind which are unseen In the centre of the town the bazaars, in a houses and gardens. street of open stalls filled with the most heterogeneous collection of goods, resemble each other everywhere. But outside this quarter Trebizond is a place of the highest antiquarian interest, for it was an important Greek colony as long ago as the time of Xenophon. The harbour and line of walls were erected in the reign of Hadrian; the place was sacked by the Goths and left in ruins in Λ .D. 260. In the 18th century the family of the Commeni, expelled from the regions over which they had been rulers, assumed the government of the duchy of Trebizond, which is said to have extended to the borders of Circassia. With ludicrous assumption, though nominally subject to Byzantium, they asserted to themselves the title of Emperors of Trebizond, and the troubadours made this the site of many an apocryphal adventure in their tales of chivalry. When the victorious Mehemet II raised the Mohammedan crescent at Constantinople in 1641 and David Comninus, the last of the emperors of Trebizond, submitted to the great conqueror, he and all his race were massacred.

The Greek and Byzantine remains which accumulated in sixteen centuries are full of interest. The cathedral of Santa Sophia is a remarkably fine example of an early Christian edifice of the Byzantine type and contains some of the richest frescoes of the 12th century. The citadel is enclosed by walls and towers of the so-called Genoese type, similar to those of the castles of the Bosphorus, and some of the Byzantine gateways are very fine. For many years this place had been the terminus of the pack-lines by which valuable goods were brought from Persia to Europe, the journey of each convoy taking some months to complete and being fraught with risks. But the Russians, having now acquired the port of Batoum, and constructed a railway to the borders of Persia, merchandise can now be carried to the Black Sea without the old risks and in as many days as months were necessary in the old time.

There were no carriage roads in Asiatic Turkey and the industry of contracting for baggage animals was an important one in 1857, but when the mountain passes are open during the summer season large pack-trains passed to and fro by way of Bayazid and Erzeroom, and we had no difficulty in obtaining the animals we required during the Commission. We left Trebizond on the 9th May, the march was eighteen miles only, and we reached our camping ground at Djevislik before it was dusk.

Our head muleteer, or Katirji Bashi, was a person of great importance; a solemn old Turk, but a very fine specimen of humanity, he was enlaced in gold embroidery and much beturbaned and armed. Riding a good horse covered with decorated saddlery, he smoked his long-stemmed pipe; he did not condescend to put his hand to any work, but gave orders to his men with the most perfect dignity. At the head of the train, as is customary, was an old horse which carried no load, whose duty it was to trace the path.

One of our surveying instruments was a large wheel which was pushed along by one of the sappers on foot and recorded the distances as we marched. The men took this duty in turn, grumbling much at having to do it, and they christened the thing "the plough." The officers recorded the distances of the objects along the road, the summits and depressions, crossings of streams, villages, etc., took bearings of hill tops and of the direction of the march, and made a rough sketch of the country marched through. From the field notes thus made I elaborated afterwards a sketch survey of the route from Trebizond to Erzeroom and Kars. We were provided with sextants, theodolites, transit instruments, mountain barometers, boilingwater thermometers and drawing materials, and devoted our spare time to practical astronomy.

The route followed by the party is shown on the sketch map, and as far as Erzeroom followed the ordinary trade route. On the 7th day we crossed an important pass, which I will call the Tchadrak, at 6,170 feet and descended along the course of a small tributary of the Tchoruk Sou, a river which has its outlet into the Black Sea near Batoum. In studying the military question between Russia and Turkey the course of the Tchoruk Sou must be carefully noted, for the summit we had just passed, not difficult from either side, might become one of the most important of positions, whether held by Turkey or gained by Russia in a future war. If this position



were seized the valley of the Kharsit would be open to the Black Sea at Tireboli, and the entire *pachalik* of Trebizond would be cut off from communication with Baiburt and Erzeroom. Trebizond must fall and Tireboli (fifty miles further westward) would become a new base of operations. Erzeroom would be attacked by a force which would advance from the valley of the Araxes, the easily-taken pass of Deve-Bouinou being the only defensible position the Turks would take up in opposition to the enemy's advance in that direction, and it may be assumed that Erzeroom would soon fall. Russia would then command the head of the Euphrates valley, and the formidable pass of Khosharbounar, between Baiburt and Erzeroom, would be at her mercy.

Having Tireboli, Batoum and Kars as three bases of supply, and holding all the passes by which a Turkish advance could be made from the west, Russia would have gained the advantage of being in a position from which she could soon become master of a new line of crests commencing with the Tchadrak pass and ending near Satala, to a point 90 miles west of Erzeroom and ten miles west of Erzingan on the Kara Sou, or upper Euphrates. I submit that all this might be the consequence of the capture of the Tchadrak pass early in some future war.

We reached Baiburt on the 16th May and Erzeroom on the 22nd, having then marched over 187 miles. Local tradition makes Erzeroom the site of the Garden of Eden, and the fact that the mountain ridges that surround it contain the sources of four rivers flowing to as many seas gives some colour to the claim. Three of these rivers spring from a ridge on which Bacdagh, a little to the north-west of Erzeroom, is the highest point ; they are the Tchoruk Sou, to the Black Sea ; the Araxes, to the Caspian ; and the Euphrates, to the Persian Gulf ; while, a very few miles westward, rises a fourth river which flows to the Mediterranean. The country round Erzeroom bore rather evidence of being under a curse than of ever having teemed with luxuriant vegetation. The scanty crops of corn which were reaped on the plain owed less to the cultivators' art than they did to the beneficence of nature.

The town of Erzeroom resembled most towns in Asia Minor in being a congeries of narrow ill-paved lanes between high walls, congregated round a citadel. In the centre of the place there were some mosques, the usual bazaars, a fountain or two, while the barracks, the arsenal and some government buildings were in the citadel, which is surrounded by walls of so-called Genoese type. Throughout the region the use of varied coloured lavas is general in the buildings, both in those of the Saracenic and the Armenian styles. The most notable building in the town is the Iki Tchifteh, a pair of fluted columns inlaid with bricks of bright red, blue and white metallic colours. Near our camp on the plain, a marsh afforded good sport, and among the various wild fowl which came in well for our table I remember killing a wild goose at an incredible distance.

We stayed nine days in camp, resuming our journey to the Russian frontier on the 31st May. Leaving the plain when we had travelled five miles, the road ascended by an easy slope for 260 feet to the summit level of the pass of Deve-Bouinou, which is the watershed line dividing the basins of the Persian Gulf and Caspian Sea. We reached Ardost, about 48 miles, on the second day, and from there, being no longer on the caravan route, the track become a mere stony path, narrow, dangerous and impossible to trace without a guide. But the path we were following, though much less frequented than the road from Persia, was the one connecting the two important towns of Erzeroom and Kars, and was also the central link connecting Russian and Turkish lands in Asia Minor, and we were to see many worse in the course of the summer. Toiling slowly up the side of a torrent, we encamped at the village of Yenikioi at an altitude of 5,977 feet on June 2nd, after a fatiguing march of $21\frac{1}{2}$ miles.

At a few miles from Yenikioi there is an ancient ruin which was described to us as "the tower of the son of Cyrus," and although it cannot pretend to the antiquity of the retreat of Xenophon, the name seems to indicate some local tradition connected with the Greek army. We had heard of Xenophon at Trebizond, but nothing more until we reached Yenikioi, but in these places I possessed starting points for a study of the topography of Xenophon's march.

We resumed our forward journey early on the 4th June. The march was one of the most difficult made by us in the whole summer, being alternately up and down with few level intervals. The loose scoriæ, lava and obsidian that covered the surface of the track made it most dangerous for the horses, and we might as well have marched among broken bottles. At the summit of the Soghanli Dagh we came to the slope of the Caspian basin, which we did not leave for some months. The scene itself was most dreary but the distant view was magnificent. The barometer reading on the pass was 7,533 feet, but to right and left the mountain peaks towered up to certainly 0,000 feet. Our descent to the village of Tcherpakli on the edge of the level plain of the Kars Tchai, was very rapid, the horses sliding and stumbling along. As we proposed to rest a week or more in Kars, we preferred to make one march only of the remaining 204 miles. We were on the level plain and forded several minor rivers during the day, and finally crossed the Kars Tchai by a stone bridge near the town, outside of which we encamped, at an altitude of 5.416 feet.

The situation of Kars is similar to that of many places we saw in Asia Minor; a citadel on a rocky height and a walled town clustered under it. The river, within cliffs, wound round the rock. Simul-

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taneously with the Crimean War, the Turks, under Fenwick Williams, had been besieged here from the 18th June, 1855, until their surrender from starvation on the 28th November. The ancient stronghold being commanded by the heights on the north had no value, but the place was defended by detached forts which covered an area of about $7\frac{1}{2}$ square miles, the greatest diagonal of which was $3\frac{1}{2}$ miles. Gordon and I with our sappers stayed a fortnight in the camp while the Commissioner went on to Alexandrapol to meet the Russian section. The place abounds in Byzantine and Armenian monuments, ruins of mosques and Christian churches and the citadel is Genoese.

Orders came at last to join the Commissioner at Alexandrapol and we left Kars on the 18th June and completed the 32 miles in three easy stages. The ancient Armenian town of Gumri, on the river Arpa Tchai, to which the Russians have given the name of Alexandrapol since it came into their possession in 1828, had had a modern quarter added to it, while a small fortress with Vauban fronts had been erected on the north side to command the river valley and the approach from Turkey. We were given spacious quarters in a Russian house, and made the acquaintance with the Russian section of the Commission. At its head was General Tcherikoff, a wily diplomatist of pleasant manner, and second to him was Colonel Ivanine, a military expert, a rather tacitern, but withal agreeable man. Attached to them was a large body of Cossacks of the Black Sea to act as our escort on the Russian side of the frontier.

On the 24th June the united Commission started down the course of the Arpa Tchai, which for 45 miles to its junction with the Araxes was the undisputed frontier line. Beyond the determination of the " thalweg " this part of the line afforded no opportunities for differences of opinion. We had left the ordinary routes and the country was strikingly picturesque. At Kazarabat, on the second night, Gordon gave us a display of his fearlessness in attacking a mountain bear, riding after it and hacking at its head with his sword. The bear turned on him, and the adventure might have ended seriously if some of our party had not hastened to his assistance and driven the infuriated beast away. The third day's halt was at Kizil Kilissa (Red Church) where we stopped an entire day to explore the ruins of Ani. The old city of Ani, on the right bank of the river, was originally founded as a Greek colony and became the capital of ancient Armenia, from the 5th to the 14th century. The remains of at least twenty important buildings, the massive walls, and the extension of the ruins of dwelling houses outside the city show without a doubt that it was a very large city and probably the finest, in its prosperity, between the Black and Caspian Seas.

On the 29th June we reached Hadji Bairam, at the confluence of the Arpa Tchai with the Araxes, encamping in a grove of stunted trees, at the height of 3,456 feet above the sea. The Araxes ran in a wide deep stream, only fordable here and there. I marked a temperature of 100 degrees at midnight and was severely punished by mosquitoes. Four days later we moved camp five miles up the Araxes to Parnaout, following the frontier line, from which point it was arranged that it was to go southwards until it reached the watershed of the Ararat range. Before the exact line from Parnaout to the crest could be decided it was necessary to ascertain the wishes of the tribes who encamped on the pastures every summer, as to the nationality they would elect to belong to in the future. On the 7th we moved to higher ground at Kizil Kaparan, some miles south of the great river. While there we made the ascent of Perli Dagh, a peak on the Ararat range (10,500 feet), in an afternoon's ride. From the top we had magnificent views in every direction. To the south was the plain of Bayazid, and to the east was the crest of the mountain chain, bounded in the distance by the snow-covered cone of Mount Ararat, 17,000 feet above the sea, and more than 14,000 immediately above the Araxes plain.

On July 13th, we crossed the ridge into Turkish territory and halted at Balyk Gol (fish lake) at an altitude of 7,340 feet. Here we had some fishing and the best of rough shooting; hares, rock partridges and any quantity of wild fowl, etc., in the marshy bottoms. On this first examination of the frontier it was sufficient to describe the frontier as the watershed line, the detailed survey being left to a sub-Commission in the following year. It was therefore resolved to adjourn the proceedings and to reassemble at a later date at the village of Sardar Boulak on the col between Great and Little Ararat. This pause gave the English section time to make a two days' excursion to Bayazid, the capital of the Turkish province. In aspect Bayazid was, I think, more wild and picturesque than any of the places we had seen.

On the 22nd July, a ride of 33 miles brought us to our camp on the Sardar Boulak pass, which was very easy of ascent on both sides. At the top it was a wide, level and green valley, at an altitude of about 8,000 feet. When I recall the region of Ararat I can say confidently that in most of the points which make up the beauties which spring from desolate grandeur and the impression of infinite size, it produced in my mind a deeper sensation of awe than I have experienced anywhere else. Throughout the summer season, when the whole region except the summit of the cone of Ararat is free from snow and the valleys round it are green, some four thousand feet are everlastingly crowned with a white cap, which shines in the sun's rays, which are reflected from it and mark the mountain at the enormous distances from which the summit can be made out. On the mountain itself there is no vegetation and nothing but bare rocks where the snow does not lie. To members of the Alpine Club the ascent is by no means difficult, when the climbers come provided with ropes, ice-axes and trained guides. To us however it was not easy. Charles Gordon, with Corporal Fisher, R.E., tried the ascent, but failed, though his companion asserted he had gone on by himself to the top, but few of our number believed it.

The ascent of Little Ararat (12,875 feet), was comparatively easy and was made on horseback. At its peak the boundaries of Russia, Persia and Turkey joined, and it is the eastern extremity of the Ararat chain, with the great river Araxes and its small confluent running down the Bayazid valley surrounding it on three sides. The view from it well repaid us for the ride.

We left Sardar Boulak on the 2nd August. Our first stage was to Aralyk, which lies close to the banks of the Araxes, a distance of 20 miles. Between morning and evening we experienced a complete change of climate and scenery. In place of Kurds we now saw Persians, for we were in the ancient Persian province of Erivan which had become Russian since 1828. The mosquitoes near the river were a perfect plague, and we resumed our march at an early hour on the 3rd August. Our destination was Etchmiadzin, a distance of $24\frac{1}{2}$ miles. This was a most interesting place. The cathedral and monastery mark the foundation and central government of Armenian Christianity and possess relics held in the highest sanctity. The members of the English Commission were hospitably received by the Patriarch, who displayed the famous relics for our inspection.

The distance from Etchmiadzin to Alexandrapol, where the Commission was to reassemble to carry on the work northwards, was 63 to 65 miles, but as the track is round the base of Mount Alagos and has a rise of 4,000 feet in the centre, it was necessary to allow the pack-animals four or five days for the journey. The English officers utilized the time in visiting Erivan, the old capital of the Persian province. It is a remarkably situated place built on the summit of a cliff overhanging a rapid torrent, which is crossed by a bridge just under the fort. There are some typical Persian buildings, especially the ancient palace in the fort, which contains a remarkable Selamlik, or reception hall. The ancient quarter and the bazaars were most interesting to us, as they were the first we had seen of a Persian character. To the south of the old town a modern Russian quarter had been built, and we went by invitation to see a beautiful old Persian fruit garden, now the Governor's Garden, in the centre of which was a kiosque, with corridors surrounding a fountain in a white marble basin.

Leaving Erivan on the 7th August, we rode 27 miles to Ashtarak, and after a short night's rest, to Kazafar at the foot of Mount Alagos, 23 miles further and about 7,000 feet above sca-level. The second day in this camp was utilized by us in making an ascent of Alagos, 13,500 feet high. The path was steep and rugged but by no means difficult, and we reached the top with comparative ease. On the precipitous cliffs round the mountain veins of pure rock sulphur jutted out in inaccessible places, but the local peasantry obtained blocks of the mineral in a curious way, by firing bullets at the cliffs and collecting the sulphur which fell. In our descent Gordon had a narrow escape when rashly sliding down a snow slope, but escaped with a few bruises.

A march of 27 miles took us to Alexandrapol, from which we now started along the northern section of the frontier. Ascending the Arpa Tchai nearly to its source, three marches brought us to Bogdanovka in the basin of the river Kur. We had crossed a mountain ridge of 7,515 feet and suddenly entered the lovely forest region of Georgia, known under the general name of Adjara. Descending rapidly, the next stage brought us to the large town of Akhakhalakha, and here we diverged some way from the frontier line to avoid some difficult hill marches through the dense forest. The frontier was to be along a well-defined watershed and there were no political difficulties at this part. Throughout Adjara the population live in wooden houses much similar to Swiss chalets. We left the town on the 15th August, and marching fifteen miles westward, reached the point on the Ardahan branch of the river Kur at which it was proposed to fix the frontier. We stayed three days at this camp, the Commissioners riding out each day to examine the various ridges. There were beautiful views from the hill-tops, lovely dales in which lay charming lakes amid forests of virgin timber.

We left on the 20th, and encamped at the head of a mountain torrent, the Kharsameti Tchai, from which point the frontier followed a series of ridges. Making Khona our resting place for nearly a week, we spent a day visiting the town of Akhaltzik, the most important place between Alexandrapol and the Black Sea. As beautifully situated as it is possible for a place to be, a mixture of the picturesque and the modern, it had extensive barracks, a large military hospital, churches, etc. But we did not care to waste time in a town in this lovely autumn season. Game was in abundance, and we furnished our table daily with what we were able to shoot with small trouble. Mounting to the ridges again after leaving Khona we made several short stages, still amid the forest scenery. On the 5th September we reached Osurgeth, in the province of Guriel, at 12 miles from the coast. We stayed there a fortnight to complete the protocols and close the main operations of the Commission. We left Osurgeth on the 16th September and marched 12 miles to the port of St. Nicholas, where we encamped for the night. From this place to Batoum the distance along the coast is 25 miles, which we did in a day. After marching a short way we

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crossed the river which formed the frontier and were once more on Turkish ground.

The harbour at Batoum has a better anchorage than at Trebizond. Since 1878 it has become Russian and all is changed. A railway has been made, and Batoum has become the port of exportation for the oil from Baku. Other lines have been made, and Batoum is rapidly replacing Trebizond as the point at which the goods from Persia are embarked for Europe.

A small dirty trading steamer took us to Trebizond, where we took passages by the regular Turkish mail-boat and reached Constantinople on the last day of September. There we separated and returned to England by separate routes.

In the following year James and Gordon were appointed to act as absolute umpires between the topographical officers to be employed in marking the frontier line, and carried out the work in the summer months, James taking the southern half of the line and Gordon the northern half. The sub-Commissioners started from the north and south and met at Alexandrapol early in October. From there James and Gordon, with Dr. Woodfall, paid a flying visit to Tiflis, the ancient capital of Georgia, which lies on both banks of the river Kur. Here they were hospitably entertained by friends whom they had made on the Commission and during the few days they were able to spare visited most of the sights in this interesting Russian, Persian and Armenian city. The accompanying photograph shows the members of the sub-Commission.

General James shows in his sketch the revised frontier line existing after the Russo-Turkish War of 1878. It is curious to note that the present line, since 1926, is almost identical with that laid down in 1857, except that Russia now holds Batoum in the north, while in the south their frontier is drawn back to the line of the Araxes (Aras) and the whole Ararat range now belongs to Turkey.



Herr Stabb, Interpreter. Licut, C. G. Gordon, R.E. Capt. Ogranovitch. Harif Bey. Licut, Effinofsky. Licut, E. R. James, R.E. MEMBERS OF THE SUB-COMMISSION FOR THE DEMARCATION OF THE FRONTIER, 1558. Phase is Commission, 180.

The Russo-Turkish frontier commission - opp p 244

By " PIONEER."

NOTE :--My father was a Pioneer in India, and has always prided himself on this fact, especially in the presence of Sappers. Not having had myself the fortune to serve in India, the following article, by my father, is submitted in the hope that it may induce a Sapper who has had more fortune than I to go "one better" in a spirit of friendly rivalry and follow up with a strange tale, from that land of strange episodes.

* * *

If one could only understand. Curses are strange things, sinister and inexplicable, and yet sometimes believed-in only through lack of evidence; a chance scrap of information, and the whole fabric falls away and the secret is revealed.

I have always been extremely interested, particularly in fakirs' curses, and have had personal experience of three while I was in India. Two have never been explained. Doubtless there were excellent reasons why the curses proved so alarmingly effective, but I could not discover them.

In the first case I was with my battalion in 1899 in Mian Mir. Opposite the C.O.'s bungalow was a small grave reputed to be that of some fakir. The servants would often make the night hideous observing strange rites, and the C.O., liverish from many years' service, would be kept awake by the noise. He therefore ordered the tomb to be levelled, and the order was immediately carried out.

A few days later a fakir came to the lines and cursed the regiment, saying that within a year the three senior officers would die.

In September, 1900, and within one week, the C.O. died of dysentery in England, the second in command died of enteric in Simla, and the third senior officer died of cholera in Mian Mir. As a result our orders for China were cancelled and another battalion was sent instead. To add to our discomfiture we had to hand over our new rifles and take those of the other battalion. Surely this was a heavy price to pay for the C.O.'s hasty judgment.

A few years after the War I was commanding my regiment in Delhi during the cold weather of 1923. The Sikhs were causing the Government a certain amount of trouble, and orders had been issued that Sikh priests were not to be allowed in the regimental lines, as they had been responsible for disaffection among the troops.

One day two priests attempted to enter the line, and refused to go

away when told to do so by the line sentries. As they still refused to move, the sentry beat them and drove them off. The outraged priests turned on the sentry and cursed him, saying, "Before the sun rises you will be lying dead." They likewise cursed the C.O. (myself) for issuing the order.

The sentry, a strong and healthy lad of twenty-two, laughed as the priests stumbled out of sight:

That evening, within two hours, he was taken ill and died. Every effort was made to find out the cause of his death. A post-mortem was held, but the doctors could discover nothing. Here was a man, physically perfect, dead for no apparent reason. He had eaten nothing nor had anything to drink from the time the priests cursed him until he died. "There must be some explanation of this strange illness," reasoned the doctors. Coincidence, perhaps, but the man was cursed.

A few weeks later I was talking with an officer from another battalion about plans for spending my leave shooting in the hills. After various discussions he decided to come too and try for red bear in Chamba State. Over dinner I told him about the curse.

We started our leave, I remember, on a Saturday about the middle of April, Colonel X, my wife and I. The banks were shut, and, needing money for the journey, I went to a garage where I frequently changed my cheques. I was met with the pleasant news that the bank had closed down that morning. As every penny I possessed was in that bank I was faced with the cheerful prospect of starting a three months' shooting trip with exactly one anna which I had in my pocket.

"Your curse?" asked Colonel X.

However, as it happened, the secretary of the Delhi Club very kindly lent me the required 300 rupees.

We left Delhi that night, arriving at Pathankote at daybreak the next morning. On going into the carriage in which my friend Colonel X had travelled, I found him doubled up with sciatica and quite unable to move.

"There may be something in your curse after all," he groaned as we eventually got him into a car and to the hospital at Dalhousie. Here we left him and went on to Chamba.

Luckily he was able to join us after ten days, and we proceeded on our shoot to our reserved block, Soop Nala. Our camp kit consisted of two eighty-pound tents, and after a trek of about thirty-two miles we arrived on the evening of the second day, having climbed some four thousand feet. We were now at a height of eight thousand feet.

The weather unfortunately broke. Everything we had was soaked. Having recently arrived from the heat of the plains we were frozen stiff, but managed to restore ourselves with two bottles of sloe gin. The following day news of a bear came in. We tossed for it, and the Colonel won. He left the camp shortly after midday, and returned within three hours with a very fine red bear.

Now every *nala* has its own goddess, and it is the custom, when anyone has any luck shooting, to sacrifice a goat to her, or in other words, give the shikari and coolies a good feed. Colonel X. gave five rupees to the shikari for his goat. Later, the shikari came to me and asked for another five rupees to make a further sacrifice. I expostulated and said, "I have not yet got my bear, nor does my God like sacrifices." He tried hard to persuade me by saying that I should not get my bear unless I sacrificed, but I was adamant.

Next day came news of another bear. Being my turn, I went after it. I tracked it for a good three miles over the rocky hillside and eventually got within seventy yards of it. It was a perfectly easy shot. I fired and the bear rolled over. I expected to find him dead when I reached the spot where he had fallen, but he was gone. Wounded, perhaps, but not vitally.

We stayed here a week but with no further news of bear, so I wrote to the Rajah asking if possible for another block. He, very kindly, allowed me to shoot in his reserved blocks at Burmour, some fifty miles distant on the borders of Tibet.

Colonel X. left us, and went to another *nala* after thar and ibex. It took us five days to do the next part of the journey, climbing most of the way. Sometimes for as much as a hundred yards we were unable to go forwards, but had to climb crab-like along the wall of the rock at the edge of a precipice with a drop of a thousand feet to the valley below. We reached the shooting ground at last, ten miles from Burmour.

We saw many traces of bear, and when I went out that evening I saw one feeding about a hundred and fifty yards across the valley. I had a shot with my .310, and missed.

The next morning we were out at daybreak, and came across a fine red bear. Not trusting my .310, I had a shot at fifty yards with my five hundred, and to my horror again a miss ! Again the shikari reminded me of the goddess of Soop Nala.

"You cannot hope for a bear without the sacrifice. Give me the five rupees." I was more determined than ever to defeat the curse.

The next day we were out again, and again came across a bear two miles from the camp. I had another shot, this time at seventy yards, but only wounded him. He was, however, badly hit, and I had every hope of retrieving him. We traced him into a small copse. This time I would defeat the goddess I felt sure. My wife, the orderly and I were at one end, and the shikari and coolies beat in from the other. The orderly had my .310. Between us and the copse was a glacier which went down about five hundred feet.

The beat started, and very soon out came the bear opposite the

orderly, who fired. The next thing I saw was the orderly slipping down the glacier followed by the bear. Even in this perilous moment the Pathan orderly's first thought was for the rifle, which he held above his head all the time, rather than that he and the bear might meet on the glacier. It was a most ridiculous sight, and I regret that I roared with laughter. Luckily the orderly managed to snatch at a dead tree and this stopped his descent.

Alas, we never found that bear, he disappeared on the glacier. It was getting beyond a joke. I had come for red bear, and red bear I would get if I died in the attempt. There was more in it than my vanity as a shot.

The shikari then told me of a holy man at some village who possessed a charm sometimes known to defeat a curse. Would I let him fetch it for me? I said, "Be damned and go."

He came back late that night. According to the custom he lit a bonfire, and placed the charm, a bag of powder, in the centre. Blue, green and pink flames flared into the air. He held the rifle barrels . over them while he sang an incantation. The ceremony ended about eleven, and we retired to our tents unconvinced.

It was hardly daylight when I was woken by the excited voice of the shikari exclaiming, "*Balu*, *sahib*, *balu*!" Hurriedly dressing, I seized my rifle and left the camp. Within five hundred yards I had a shot at a bear among the rocks. He dropped stone-dead, shot through the heart : he was, in addition, a record.

I paid my five rupees to the goddess on the spot.

But I was far from satisfied. There was something I did not understand. I was determined to get to the bottom of it. Why had I missed such obviously easy shots? Why had the goddess of Soop Nala this uncanny power over my rifle? It was absurd.

Then quite suddenly I knew. I sent for the orderly who had looked after my rifles all the time. The weather, you will remember, had been wet, and he had kept them well oiled as a protection. Had he, I asked, always thoroughly rag-cleaned the rifles before I went out? In his answer, "No, sahib," lay the explanation : I had been shooting with oily barrels. It was only when the barrels had been cleared by being held over the fire during the incantation that I was able to shoot true.

So much then for the goddess of Soop Nala. I was satisfied. But we still have the other curses unexplained. Was it coincidence that all three senior officers died within a week of each other and within the year? Was it coincidence that the sentry died, and that everything went wrong on our shooting trip? Or were there forces at work of which we know nothing? We shall never know.



Brigadier-General G. A. F. Sanders, C B., C.M.G.

MEMOIR.

BRIGADIER-GENERAL G. A. F. SANDERS, C.B., C.M.G.

GERARD ARTHUR FLETCHER SANDERS, son of the Rev. H. M. Sanders, Vicar of Sutton-in-the-Forest, near York, was born at Skidby, Yorkshire, on the 28th June, 1869. He was educated at Rossall and passed into the R.M.A. in 1886. He was commissioned as 2nd-Lieut. Royal Engineers, on the 27th July, 1888, and served at Chatham for the next two and a half years.

Posted to the Indian Establishment in March, 1891, he was at first attached to the M.W.S. at Lucknow, but after a few weeks was transferred to the "Queens Own" Sappers and Miners* at Bangalore and continued to serve in that distinguished Corps until October, 1899. During this period he took part in the operations of the Kaptial Column in the North Chin Hills campaign of 1892-3 and, three years later, proceeded in command of No. I. Co. Q.O.S. & M. to Suakim as part of the Force sent there from India under Brigadier-General C. C. Egerton. There was much engineering work to be done during the next seven months, but no fighting.

In September, 1898, he succeeded to the Adjutantcy of the Madras Sappers; but resigned that appointment in October, 1899, reverted to the Home Establishment and held command of "B" Co. at Chatham for the next two years. He then passed into the Staff College and gained his "p.s.c." in December, 1903.

1904 found him again in India, where he served as Garrison Engineer, M.W.S., at Poona and Quetta for about a year before entering upon his first tour of staff-employment; and, hereafter, practically the whole of his service was on the staff or in command of troops. During the years 1905 to 1915, he held successively the following appointments:—Brigade-Major, D.A.A.G., (officiating) D.A.D.G.M.W., D.A.A.G. for R.E. in India and G.S.O.2. 6th (Poona) Division.

In the latter capacity he went to Mesopotamia in November, 1914, with I.E.F. "D", and six months later became Divisional Engineer Commander of the 6th Division; but was almost immediately invalided to India. After a short spell of sick-leave, he was given the temporary command of the 3rd (Bombay) Sappers and Miners for five months and was then appointed G.S.O.I. of the 2nd (Rawal Pindi) Division; but higher promotion came to him very soon when

[•] The "Queens Own" Sappers and Miners have had several changes of designation in the last fifty years. Their present title is "Queen Victoria's Own Madras Sappers and Miners."

he was transferred to A.H.Q. Simla in August, 1916, as Deputy Q.M.G. in India with the temporary rank of Brigadier-General.

Fifteen months later he returned to Mesopotamia in command of the 53rd (Indian) Infantry Brigade. During his three years in this appointment he took part in many important operations and played a distinguished part in them. From October, 1920, to February, 1921, he commanded the 17th (Indian) Division with the temporary rank of Major-General, during the infliction of penalties on the Arabs who had revolted against us in the summer of 1920. He performed this difficult duty with marked success, displaying a quite exceptional combination of firmness and consideration, which won for him not only the high approval of the G.O.C.-in-C. but also the respect of those whom he had to punish.

He was next appointed to "special duty" with the local Levies (Arab, Kurdish and Assyrian) in Mesopotamia, henceforward designated "Iraq," and was charged with their organization, practically *ab initio*. He tackled this rather ticklish, semi-political job with characteristic enthusiasm and thoroughness and evolved so good a system that he was offered the command of the Levies for a term of years. But he had had enough of Iraq and elected to return to India in June, 1921. He was immediately posted to "special duty" at A.H.Q., Simla, in connection with the revision of the Adjutant-General's Branch. On completion thereof, he took over command of the 15th (Indian) Infantry Brigade at Quetta, an appointment which he held until his retirement on 1st May, 1923.

His devotion to duty may be judged from the fact that, during his 35 years of strenuous service, he took only twenty months of leave other than "privilege" and "temporary" leave. In the Great War and the Iraq operations, 1919–20, he was six times mentioned in Despatches and, throughout his career, his good service was frequently brought to notice by the General Officers under whom he served. His decorations included the C.B., C.M.G., six war-medals and the Order of the Crown of Rumania. He was promoted to a Brevet Lieut.-Colonelcy in 1915 and to a Brevet-Colonelcy in 1919.

Retirement brought no slackening of his energy. He threw himself heart and soul into the Boy Scouts movement and for many years was District Commissioner for Christchurch (Hampshire) and was responsible for the forming of many new troops in that area. In 1936, on his removal to Shipston-on-Stour, Warwickshire, he founded the Ilmington troop and was soon appointed Deputy Chief Commissioner for the County. He was well-known both in Hampshire and Warwickshire for his many other public activities. Among them may be mentioned his presidency of the British Legion at Ilmington and his appointment as Deputy District Head-Warden of the Shipston Section of A.R.P. He also took a leading part in the formation of a Fire-fighting Service in Ilmington.

MEMOIR.

He died suddenly on the 8th March, 1941. Up to the end there had been no flagging in his energy, no warning of any weakness in his heart. He literally died in harness, for he had taken his weekly Boy Scouts meeting on the night before his death and was working in his garden with his little grandson and a Boy Scout next morning when the end came. It was the end which he would himself have chosen for his busy life of enthusiastic accomplishment.

To the bald record of his army appointments must be added some mention of his more distinguished services. In the spring of 1918, after the murder of our political officer at Nejef, it was Sanders who was sent with his brigade to restore our prestige and to exact retribution from the inhabitants of that holy Shiah city. Grave political issues were involved : but he made no mistake and did his allotted task with conspicuous tact and efficiency. In the autumn of the same year, when "Bob" Cassels (lately C.-in-C. in India) had placed his Cavalry Brigade across the Turks' line of retreat from Shergat to Mosul, it was Sanders who, by a forced march up the left bank of the Tigris and by a most hazardous fording of that river in 41 feet of swift-running water, made Cassels' success secure. In 1919, Sanders was the specially chosen G.O.C. Line of Communications of the Southern Kurdistan Field Force, which put down the rebellion of Shaikh Mahmoud and re-established British control at Suleimanie. In this capacity, he had to carry out many minor operations before the main column left its base and he carried them out most thoroughly. During the campaign itself, he showed administrative qualities of the highest order.

Of his work in the Arab rebellion of 1920, General Sir Aylmer Haldane, the G.O.C.-in-C., writes-" On the 6th August, an organization under Brigadier-General G. A. F. Sanders began working on a line of block-houses from Baghdad to Hillah. . . . This organization comprised the garrisoning by five battalions of some 300 blockhouses and 25 railway stations, distributed along 250 miles of railway. A little later he was entrusted with the construction of blockhouses with the object of reopening communications with Fallujah. . . . Opposition was daily met with, but by the 26th September communication by rail and road was re-established. On the 11th October Sanders, in command of a mixed force consisting of two squadrons Cavalry, three batteries of Artillery, one company of S. & M. and five battalions of Infantry, operated from Hillah and captured Tuwairi with inconsiderable loss. . . ." Reference has been made already to his efficient exacting of retribution from the Arabs. " In this work," writes General Haldane, "Sanders was most energetic and successful."

Something must also be said of his personality. Sanders was essentially a man's man. Like all Yorkshiremen, he was a lover of horses and was a very good rider and horse-master. He was one of the leaders of those ardent subalterns who, in the middle nineties, revived polo in the Madras Sappers and paved the way to the many successes which they have since gained in the polo-tournaments of Southern India. He was fond of shooting and took part in all the games and athletics which form such an important part of a sapper's training. On the rifle-range, whether with rifle or revolver, and at Assaults-at-Arms, he won many honours for himself and his men. After his retirement he became a keen gardener.

His friends will remember him most for his enthusiasm for the job in hand, an enthusiasm which he had the gift of communicating to all about him. A strict disciplinarian, he was nevertheless a genial and sympathetic commander, and superiors and subordinates alike found him easy to work with. His was, indeed a happy temperament. He was rarely out of temper, never sulky; and he was incapable of prolonged ill-will towards anyone. Yet he could keep a very stiff upper lip when necessary and had no compunction in inflicting welldeserved punishment on individuals or communities without any softening. On duty, he wasalwaysa reliable co-operator; off duty, he was always the best of " pals."

His family-life was of the happiest. He was married in Bangalore, on the 13th April, 1898, to Evelyn Bertha, daughter of Dr. Thomas Kitchener, first cousin of the late Field-Marshal Lord Kitchener, and had two daughters, both of whom married, and a son who died in 1904.

His friends will associate themselves with the words of the Vicar of Ilmington, who concludes an "In Memoriam" appreciation in his Parish Magazine thus—" Our sympathy goes out to his widow and family in their bereavement. At the same time we rejoice with them in the memory of a life filled to the full with honourable and selfless service for God and King and Country. He was in truth 'a good soldier of Jesus Christ.'"

Υ.F.
BOOKS.

(These books are now in the R.E. Corps Library at Chatham.) THE BROTHERHOOD OF ARMS.

By MAJOR-GENERAL GEOFFREY BROOKE, C.B., D.S.O., M.C.

(William Clowes & Sons, Ltd., Axtell House, Warwick Street, London, W.I. Price 6s.)

The author in his preface states that it was the desire to recall the indomitable good humour of the fighting man in the past that induced him to put pen to paper. He has succeeded admirably in his task, as this booklet breathes the spirit of cheeriness, which pervaded the Imperial Army in the last war, and animates their descendants in the present one in all three services. The old soldier will find in these pages many anecdotes and incidents to remind him of the days spent in France, while for the present day soldier it contains much useful advice on the relation between officer and man, and above all on the necessity of smiling.

Mention also must be made of the delightful illustrations by Captain Bob Needham in the book, which can be cordially recommended as a very pleasant evening's entertainment.

C.G.F.

"THE CURRENT OF WAR." By CAPTAIN LIDDELL HART. (Hutchinson & Co., Ltd., London. Price 125. 6d.)

This volume of over 400 pages consists chiefly of newspaper articles published between 1926 and January, 1941, on army problems and the progress of the war. It also contains a couple or so of unpublished articles, and as a preliminary, an essay written in 1922 for the Gold Medal of the R.U.S. Institution, which incidentally did not gain a place amongst those selected for a prize. There are copious footnotes to many of the articles, and the tendency of the book is to prove the forethought of the author in advocating the mechanization of our army, after, as he writes, constant debate with Colonel J. F. C. Fuller.

Not many readers nowadays have the time or inclination to disinter the controversies of the past, and to apportion the blame for the unpreparedness of our army in September, 1930, and still more so in the previous year. The blame must ultimately rest with the Government, who dictate the policy and provide the money, and it cannot be placed on the shoulders of the Army Council (vide p. 172).

To the ordinary reader the impression conveyed by the speeches of the Secretary of State for War in 1938 and 1939 was that far reaching improvements had been made in the modernization, strength and equipment of the army. Most of these schemes (as for example the doubling of the Territorial Force) were only on paper, and it is not surprising therefore that the orator has not retained his place in the Cabinet.

The book contains interesting accounts of the operations of the war and also many true remarks, notably one that "the first care of a peaceful nation should be in peace to ensure the power to deter a would-be aggressor" (page 141).

Later, the author mentions disarmament as the best guarantee against aggression, and considers that in May, 1935, we should have accepted Hitler's offer "to eliminate weapons specially suited to the purposes of attack" (page 167). He does not describe however how we could have insured that Hitler would adhere to the treaty.

What however makes this book more harmful than useful is that in his article in "The Psychological War" (page 216), which appeared on 3rd March, 1940, Captain Liddell Hart maintains that we cannot win, and describes the Government's assurance of victory as fantastical by likening it to a well-known fairy tale by Hans Andersen.

Moreover, in his final chapter published in January, 1941, the author's recipe for success consists, not in winning victories by sea, on land and in the air, but by creating a new order in Britain, ready for extension abroad, that will be superior in nature and attraction to the Nazi order " (see page 406).

.. (JUNE

Anyone with a knowledge of modern Germany is aware that many Germans realized that life in Great Britain was much better in almost every way for the bulk of the population than in the Reich. This would seem to be borne out by the recent arrival in this island of Rudolf Hess. Comparisons of conditions in the two countries did not stay the Hun from striking, and assuredly it will have no effect in curtailing hostilities. Most people prefer to agree with the Prime Minister as to final victory, though as to how and when it will come there are many differences of opinion.

I cannot therefore subscribe to the publisher's notice that this is "a book of supreme and topical importance by the world's greatest writer in military aflairs." nor do I think it of value to the modern soldier or general reader.

C.G.F.

FREDERICK THE GREAT. CREATOR OF THE PRUSSIAN ARMY.

By PIERRE GANOTTE. Translated by R. A. Bell.

(Bell & Sons, London, 1941. Price, 158. od. net.)

This biography gives a vivid description of Frederick the Great's forebears, boyhood, military training and campaigns till death ended his most remarkable career. His most extraordinary and versatile character is very clearly outlined in this volume. The appendices at the end of the book give useful data and instruct the reader as to what authorities to consult.

His most extraordinary upbringing might have easily ruined his moral fibre and future, but this only tends to show up what an outstanding character he was to become when he succeeded to the throne, when his genius as an administrator and military commander was to be given ample scope. The story of his life is painstakingly and cleverly told in this volume.

Unlike his successors, Frederick had a wonderful sense of humour and did not object to being caricatured, in contrast to the present holder of the supreme position in Germany, who resents anybody disapproving of his actions and policy.

And whereas Frederick did believe in a Supreme Being, if a rather impersonal and aloof one, the present ruler in Germany is a pagan. Frederick was a realist and believed in practical Christianity and would not put up with subterfuge and trickery. He was broadminded and never interfered with his subjects' religious beliefs, but was a constant railer against the rigid dogmas of the Roman Catholic and Protestant ecclesiastical rulers.

Once firmly scated on the throne, wars worried him far less than peace. Like the ancient Indian potentates, he deemed his neighbours his enemies and was constantly at war with them, enlarging his dominions at their expense, in spite of making mistakes and being beaten sometimes.

In political and military matters he adopted every guile and deceit to gain his own ends and it was during his reign that Poland was shamelessly dismembered between Prussia, Austria and Russia, only to suffer much the same fate 170 years later.

G.A.B.

THE ART OF CAMOUFLAGE.

By LT. COL. C. H. R. CHESNEV, D.S.O. (Late R.E.) and J. HUDDLESTONE.

(Published by Robert Hale, Ltd. Illustrated. Price Ss. 6d.)

I'ew people will deny that Beverley Nichols has a flair for writing about a subject in a way that makes one reconsider and often modify one's views.

In his book The Art of Camouflage, Lt. Col. Chesney has achieved the same success.

This book, which was selected by *The Times* as one of nine books "recommended" for the week ending 19th April, has a particular appeal to all R.E. Officers because Col. Chesney makes it abundantly clear that the control of Camouflage schemes must be in the hands of the Engineer, with the Artist as an adjunct, an idea which is not as universally accepted as it should be.

In view of the great stress laid upon this point by the authors, it may be of interest to the reader to know that they can both claim to be artists; the illustrations of animals by Mr. Huddlestone prove his claim, the writer can vouch for Col. Chesney's from personal knowledge.

The opening chapters deal with Camouflage in nature, the source from which so much help has been derived, but from an imperfect study of which so much misconception has arisen.

The relative importance of the part played by Shape, Tone and Colour, an appreciation of which is vital, is well brought out, and a number of fascinating examples, some pictorially, are given.

Man's efforts at camouflage began with the War of 1914-18, and the author was one of the pioneers, who learnt in that best of schools, experience, the practical side of the work. The story of this R.E. War Baby, besides being of great interest, emphasizes the importance of personal liaison between the maker of any device and its users, both before and during its employment, the latter because unless maintenance is practically possible, the cleverest piece of apparatus will be uscless.

The next section of the book deals with the theory and practice of present-day camouflage. The consideration of the problems is divided into three categories in their order of importance (1) Form (2) Texture (3) Colour, and, because on this depends the whole question and the success or failure of any scheme, the point is argued at some length. If the reader agrees with these ideas, as indeed few can fail to do, the author's main contention will be clear, *vis.* that, as the designer, architect or engineer, must decide the form of any structure, any scheme of camouflage must originate from and be controlled by him. Their application to practical problems is explained, to illustrate these points.

The chapters on Military History, though unexpected in a book on Camouflage, are in keeping with the mental attitude required in tackling a purely camouflage problem, and, besides being a reminder of the connection between the camoufleur and the fighting troops, impress upon the reader the vital necessity for producing surprises in every branch of warfare. This the average Englishman seems to be constitutionally unable to bring himself to do. No doubt hundreds of people thought of the idea of the dropped despatch case, but it took a very great Commander to put it into execution.

The epilogue may seem to those under forty unnecessary and even quite out of place, but to those of us who knew it all once as everyone does now, the need to be prepared for future wars can never be stressed too often. It is a part of \bullet the book that will be completely up to date when the youngest reader is well past the three-score years and ten mark.

The whole book impresses the reader with the feeling, which is a fact, that the author is no theorizing professor, but that, though he propounds theories, they have been forced upon him from practical experience.

A.R.A.I.

DIESEL ENGINE RUNNING AND MAINTENANCE. By P. H. Smith,

(Constable, Price 3s. 6d.)

No apology is necessary for drawing attention to the Second Edition of this valuable primer which was first issued in 1927. It is of great value to every officer, mechanist N.C.O. and engine fitter who may have Diesel Engines to deal with.

The author has had long and wide experience of the running of Diesel Engines and the book is essentially a practical one. It is full of those solid hints and tips which are of far greater value than theory, necessary as it is, when one is faced with the responsibility of keeping a somewhat doubtful diesel-driven power station or pumping plant in operation.

Being first produced in 1927, the book deals principally with older types, particularly the slower speed blast-air injection. This need not worry Sappers unduly, since they will undoubtedly, on active service conditions, find themselves called upon to run plant of ancient vintage. The author in this new edition has not rewritten the book, ior, as he modestly says, the original has much of interest. He has, however, added a new chapter in which he criticizes fearlessly in the light of modern experience and development what he has said before. On the question of cylinder wear, for example, the author states that his previous solution for this trouble by using hard piston rings has proved fallacious. He has the courage to say that he does not know as much about cylinder wear today as he thought he did then. Such admissions add to one's confidence in an author.

F.M.H.

SURVEY OF INDIA.

PROFESSIONAL PAPER NO. 30. GRAVITY ANOMALIES AND THE FIGURE OF THE FARTH.

By B. L. GULATER, M.A. (CANTAB),

(Sifton, Praed & Co., Price, 5s.)

The excellence and high standard of the publications of the Geodetic Branch of the Survey of India are well maintained in this professional paper. This publication should be read in conjunction with the Department's Geodetic Reports for 1938 and 1939 and their very useful charts.

The paper deals thoroughly, if briefly, with the fundamental problems of Gravity bringing all the investigations up to date, and also with the relative weights of the various experts' formulæ analysed.

Chaps. I and II deal generally with Gravity formulæ and Anomalies.

Chap. III deals more particularly with the complicated shape of the Earth on the assumption of hydrostatic equilibrium below the crust of the plauet.

Chap. IV is of interest to Geologists and Seismographers, especially the former.

Chap. V deals with the deviation of the earth from the form of the theoretical geoid. Chap. VI deals with the choice of a reference surface for gravity work and the difficulties met with in this problem. G.A.B.

SURVEY OF INDIA.

GEODETIC REPORT, 1939.

(Sifton, Praed & Co. Price 58.)

This Report deals with all the operations carried out by the Geodetic Branch of the Survey of India during the year under report. Although financial stringency, which has been the ruling factor for several years in succession, has curtailed the field work of the Branch, yet the Report, in spite of this handicap, does great credit in the amount that it has been found possible to carry out.

This Report and that of 1938 may very usefully be read in conjunction with Professional Paper No. 30 of the Survey of India (reviewed above).

This Report deals with (i) Spirit-Levelling, (ii) Pendulum operations for Gravity. (iii) Latitude observations at Agra, (vide p. 46), (iv) Office Work and Routine, future Programmes and other interesting notes of a technical nature.

Apart from its Geodetic sphere of usefulness spirit-levelling of high precision is of the utmost value to the Irrigation Department in the design and lay-out of canal works.

The work of the Tidal Section is of the greatest importance to those "Who go down in ships," to whom an accurate forecast of the rise and fall of tides is most essential.

Gravity Anomalies are even of great use to Oil Companies in the search for fresh areas of oil supplies (p. 22). Pages 47-55 will be of interest to Seismographers. Other technical notes will be found in the Report. Chart VII will be of special interest to Geologists. G.A.B.

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THE JOURNAL OF THE UNITED SERVICE INSTITUTION OF INDIA. JANUARY, 1941. VOL. LXXI, No. 302.

Fifty Years Ago is a reprint of part of an article by Capt. A. C. MacDonnell, R.E., then D.A.A.G. for Instruction, India. Many Sappers of a former generation will remember him as Instructor in Survey at the S.M.E. in and around 1900. The article stresses the need for greater attention in training to Duties in the Field. The Editor in comment says "Our troubles are not new."

Land Warfare is based on a lecture by Brigadier E. E. Dorman-Smith, and is good and heartening reading. Part 1 deals with the eternal principles of war, and their exemplification in 1914-18. Part 2 summarizes the preparations made in belligerent countries for the present war, Great Britain suffering from "the abiding vices of democracy, pseudo-intellectualism, parsimony and a middle-class dislike of fighting men," and carries history up to Dunkirk. Part 3 is largely a forecast, which, though uttered as long ago as August last, has so far fulfilled itself remarkably accurately. We have got the country behind us. "We have got the cause, the time, the men, the money and a clear-cut target. We have world industry behind us. There is nothing in the world to stop us winning the war except the remains of that ignorance, timidity and financial turpitude which has cost us so dear in the last twenty years."

The Problem of Force to Space, by 2nd-Lieut, M. E. Cooke, forms a useful adjunct to Brigadier Dorman-Smith's article. 'The army of tomorrow must consist of a bunch of A.F.V's striking from a guard of fortresses, with siege trains of heavy guns to reduce hostile fortresses when the vehicles have disposed of their opposite numbers. It sounds very simple, but is as well to be reminded by Brigadier Dorman-Smith's article of Napoleon's dictum " in war it is the simple that is difficult."

An Interlude in the Campaign in Norway describes the adventures of some officers of the Indian Army attached to some independent companies, whose rôle was to delay the advance of the Germans on Narvik. It was a very hard task, as they found themselves outnumbered, outmanœuvred, insufficiently equipped, with little air support, and in a country thick with fifth columnists. The Germans had been training special troops for this particular kind of warfare for years, a precaution very much harder for a non-aggressor nation. An extension of the map to show Namsos and Narvik and other places mentioned would have been an advantage.

"Karshish" seems to know most languages. Learning Greek is as much a history of post-1918 events in the Near East as a philological study, though the information about the language is both timely and useful. To illustrate the democratic nature of the Greek army, the author quotes a Greek sentry outside a conference room door, who butted in with "General, I disagree with your point of view." M. A. B. Johnson is, by the way, mentioned as the author of 450 Miles to Freedom although he was only one of the two, the other being K. D. Yearsley of the Corps.

Spain is a good and succinct account of the characteristics of the Spaniard.

Army and Civil Life. How often has the cry been heard "If only the army were run on business lines." E.C.O. gives some suggestions towards this desideratum, some valuable, some which would probably break down owing to the personal factor.

In the last number, "Balu" recommended the abolition of the officers' mess; in the present number, "Monse," an officer well known to readers of the *Journal* for his pungent wit, combats Balu's article with his usual skill. It would seem, however, that the main reason for abolition, namely the heavy expense entailed on the individual officer, still stands.

Personal Experiences are two short tales of the last Great War, and are good reading, as is also Duffer In Assum, which one suspects is a personal experience also.

F.C.M.

THE MILITARY ENGINEER.

(January-February, 1941.)—Engineers in Battle. By Captain P. W. Thompson. This is a series of accounts of Engineer actions during the recent campaigns in Europe. This particular article deals with the war in Poland, and is taken from Vierteljahreshefte für Pioniere, 1st and 2nd Quarters, 1940. It consists of three parts.

I. Diary of a Campaign deals with bridging and fighting on the road to Warsaw, in which the 31st German Engineer Battalion was engaged. Early in the campaign an 18-ton pontoon and trestle bridge was built across the Warta. Other bridges were built on subsequent occasions, but in very few cases was there any enemy activity. After the Polish surrenders on the Bzura (September 19th) the 31st Engineers were employed on missions connected with the siege of Warsaw.

II. Assault Operation describes the part taken by the 88th Engineers in the capture of Fort IX, one of the ring of old forts round Warsaw, which had held out against the first assaults. The fort was finally stormed after four too-lb charges of T.N.T. had been fired against the outer west wall.

III. Barrier Operation is the description of the laying of a mine-field by the 19th Engineers, with the object of blocking a main road. The density of mines in the field was about $\frac{4}{5}$ mine per lineal yard. (The American Field Manual lays down the minimum density as $1\frac{1}{2}$ mines per lineal yard.)

Emergency Cantonment Construction. Prepared in the Office of the Quartermaster General.

This article shows the problem with which the Construction Division was faced when, owing to the present emergency, it was found necessary to increase the available housing accommodation to meet an increase in the strength of the army from 300,000 to 1,400,000 men.

As a start, funds were provided for the construction of hutted camps for four of the proposed National Guard divisions. Water supply, hospitals, and other general utilities were to be provided at other sites selected for the remaining divisions. Advantage was taken of the experience gained in the Great War.

The article gives details and shows the lay-out of a hutted camp for a division, costing \$5,000,000, and of a tented camp, costing \$5,000,000.

The new barracks will be lined, inside and out, with composition insulating board covered with heavy planks, and will be warmed by a hot-air heating plant and fans. Showers, wash basins and toilets are located inside the barracks. Each mess hall is provided with mechanical kitchen equipment. Altogether, the American soldier is very much better provided for than he was 25 years ago.

Santee-Cooper Development. By K. H. Talbot.

This is a description of the harnessing of the Santee and the Cooper Rivers for transportation and power. Among the various items included in the scheme are the building of a 210,000 h.p. hydro-electric plant, and the construction of the highest single-lift lock in the United States. (75-foot lift, 60 ft. wide, 180 ft. long).

The Strategic Value of Alaska, By A. J. Dimond.

Alaska owes its geographical importance to the fact that it lies on the great circle route between the United States and Japan. Large sums have been spent on defensive works in the Hawaiian Islands, but, taking Seattle as a base, the distance to Yokohama is 4,924 miles via the Alcutian Islands, as against 6,316 miles via the Hawaiian Islands.

The American Government is alive to the importance of Alaska, and substantial military and naval works are being undertaken there, though, in the writer's opinion, they are not adequate. The Navy is building three air bases on the coast.

The writer urges the improvement of communications with Alaska by constructing a road through Hazelton, in British Columbia. The present time would be very suitable for such an undertaking, in view of the excellent relations established with the British Empire, Apart from its strategic importance, Alaska possesses considerable wealth, both developed and potential, in minerals, forests, fisheries, and agricultural and grazing land.

An Analysis of the New Organization of General Engineer Units. By Captain C. M. Myers.

Details are given here of the latest engineer organizations. In these no distinction is made between peace and war strength. The units described are: the combat battalion (the engineer component of the triangular infantry division), the combat regiment (square division), the squadron (cavalry division), the armoured battalion (armoured division), the combat regiment (corps), the general service regiment (army and higher units), the aviation regiment (G.H.Q., Air Force), the separate battalion (army and higher units).

Investigation and Reconstruction of the Fort Peck Dam Slide. By J. S. Leland.

An article that appeared in *The Military Engineer* of Jan.-Feb., 1939 gave a comprehensive picture of the actual construction of the Fort Peck Dam up to the time when a large land-slide occurred. This article gives a description of the slide, an investigation into its cause, and the remedial measures carried out in reconstructing the dam.

The Selective Service System and its Co-operation with Industry. By Major J. F. Battley.

The national defence programme of the United States is divided into two main sections. One is the selection and training of military man-power. The other is the provision of the food, clothing, armament, equipment and housing for the armed forces. Selective service, as its name implies, is the check-valve between the two. It is regulated by the Selective Training and Service Act of 1040.

The actual selection is made by Local Boards, and each case is treated individually. The act is a peace-time measure (as opposed to that of 1917, which was a war-time measure). It provides for a year's military training to a number of young men at no time to exceed 900,000.

Air Raid Shellers. By C. G. Flebus.

After the experiences of the Spanish Civil War, all European governments were confronted with the necessity for providing security for strategic objects of military importance, as well as for the civil population. With the latter object in view, reasonable protection to the civil population was divided into three major designs :---(1) Light Bombproof Shelters-against splinters and light bombs; (2) Medium Bombproof Shelters-against H.E. bombs, up to 550 lbs.; (3) Heavy Bombproof Shelters-against all types of bombs, although, in point of fact, no shelter can be considered absolutely bombproof.

The light type calls for no special comment. Medium shelters may be surface or underground structures. If the roof is flat, it will, in the first case, consist of a concrete slab 5 ft. thick, reinforced at every foot of depth; in the second case, the slab will be 4 ft. thick, and located 15 ft. to 20 ft. under ground.

Heavy protective shelters are built at least 30 ft. underground. Their capacity should be limited to 750 persons. Points that require attention are :--gas-proof entrance chambers, air conditioning, hospital and sanitary arrangements, sleeping accommodation, lighting, water and feeding arrangements.

The Engineer Board.

Colonel R. C. Crawford, President of the Board, tells us of some of the projects that have engaged its attention during the past year. Amongst other things a new 25-ton pontoon bridge was designed, and the new 10-ton pontoon equipment was tested. In both the pontoons are of aluminium.

New England Harbours and Channels. By J. B. Luby.

This is a description of the main harbours in New England, of which the two most important are Boston and Providence, and of the commerce that passes through them, also of the improvements made in recent years. An important means of communication that shortens the voyage from Boston to New York is the Cape Cod Canal, that cuts across the Cape Cod peninsula. This waterway was purchased in 1927 by the Federal Government from the company that previously owned it, and has since been greatly improved.

Fuelling the Mechanized Units. By B. O. Lisle.

The problem of supplying fuel to its mechanized units in war-time is very much simpler in the United States than it is in Europe. The States are the largest producers of oil in the world, and possess an enormous network of oil pipe lines, aggregating 59,000 miles.

Tanks and heavily armoured units carry fuel for an operating range varying between 75 and 140 miles. In ordinary circumstances, several hundred oil-tank lorries would be required to bring up fuel for the numerous mechanized divisions in a Blitzkritg, such as was carried out by the Germans on the Western Front. But there is no evidence that such convoys were used on a large scale. It has since been established that, during the lull after the capture of Poland, the Germans had been accumulating large reserves of fuel oil in underground reservoirs close to the Western Front. When the vast mobile divisions began to advance, the engineer corps became busily engaged in laying pipe lines in their wake. Oil can be pumped through a pipe line much faster than it can be carried by road. The Germans are said to have used a variety of materials for their pipe lines : metal for river crossings and rubber hose-pipe for some portions of the line. The latter was made up in lengths, coupled together, which could be taken up and used again elswhere. Ordinary rubber swells and perishes rapidly when in contact with petrol, but the synthetic rubber (Buna) which was used has none of these disadvantages, and has considerable tensile strength. The Germans have, for years, devoted their energies to the production of this material.

Your World and Mine. By J. F. Partridge.

The writer mentions the reasons why the United States should be interested in developing their trade with the other countries in the Americas. He gives a list of the so-called strategic minerals, *i.e.*, those of vital importance in the manufacture of military necessities. They can all be obtained in sufficient quantity from Canada or South America. Rubber from the Amazon will eventually replace plantation rubber' from Malaya.

Tank Camouflage at Fort Benning.

Lieut.-Col. W. F. Heavey describes an experiment made with the camouflage of tanks in open country, bare with the exception of tree trunks and small bush. The materials used for concealing the tanks were in some cases visinet (camouflage nets made from pulp-wood, 30 ft. by 30 ft.), and, in one case, chicken wire. The results obtained from aerial photographs were satisfactory.

A.S.H.

REVUE MILITAIRE SUISSE.

(Dec., 1940.)—Natalité et défense nationale. By Major de V. An examination of the effect of the birth-rate on the annual quota of recruits for national defence. Switzerland, like most other European countries, is alarmed at the falling birth-rate. Out of 20 countries named in a table of births during 1938, Switzerland stands 14th in the comparison of excess of births over deaths per 1,000 of the population. Great Britain stands next below her. There are some interesting facts concerning the movement of population in some of the Swiss Cantons.

The conclusion is that the downward trend is gathering speed, and that by the year 2000—not so very far away—the population of Switzerland may be reduced to 774,000.

La bataille des Alpes. By Lt.-Col. Pederzoni. The concluding instalment of thissketch of the Italian operations against France in June, 1940. It deals with the small sector of the frontier from la Pointe Merciantaria to the Peloux, forming a French salient. The French held the sector with $1\frac{1}{2}$ battalions and a group of artillery; while the Italians employed 6 battalions (of which 4 were Alpini) 2 groups of artillery (4 batteries), a machine-gun battalion, and some Sappers. The operations were similar to those previously described, of no great importance, and of no great severity. In four days, the armistice put an end to them.

The author, as usual, praises to the full the exploits and élan of the Italian troops, and enlarges on the adverse conditions of the weather. He concludes with a grandiloquent farewell order of the day of the Prince of Piedmont to his Army Group on its disbandment.

Education Physique. By Dr. Sandoz. A medical investigation into the evil effects of "doping," now on the increase, in order to achieve outstanding athletic provess.

Commentaires sur la Guerre Actuelle. Deals entirely with the Italo-Greek campaign. At the time of writing, the Italians had failed to make headway, and the Greeks had scarcely begun their successful counter-invasion of Albania.

"In spite of the efficiency of the Italian Navy," says the commentator, "the English fleet, having at its disposal the innumerable Greek islands as bases, can seriously hamper the communications between Italy and Albania."

(Jan., 1941.)—En lisant quelques itudes sur la campagne de Pologne. By Colonel Montfort. An article on the events of the Polish campaign, so far as they are known up to the present.

The Germans certainly obtained a valuable rehearsal in Poland of their plan of battle for the West; and, as a result, increased their armoured divisions.

The Poles endeavoured to defend their frontier, but they had neither the means to do this effectively, nor the time to place their armies in position. It is a false strategy to attempt to hold such a long frontier; there can be no depth in the defence, and the very essence of defence today is depth. Without depth, the defence cannot check a mechanized force which has broken through. In Poland, the break-through was immediate, and the rapidly moving German columns allowed the Poles no time to assemble their forces in rear. The French made the same mistake.

The Poles only managed to place one out of 28 covering divisions on its allotted position. The main reserve—10 divisions—could not reach its concentration area.

The Germans used 15 armoured divisions; S heavy and 7 light. These, supported by an overwhelming air force, broke through with case, and the light divisions spread fanwise through the gap. Columns of infantry, pioneers and artillery in lorries followed, and took over the territory gained. Staffs were captured, and all organizations in rear dislocated. It was a whirlwind,

The article concludes with a narrative by a German N.C.O. who, as a section leader of a tank company, took part in a five-hour raid on Warsaw. The raid failed. The episode shows that a good defence can drive off an attack by tanks if the defenders are stout enough to keep their heads and utilise cover to get near enough to bomb the armoured vehicles.

Le combat de rencontre. By Capt. Ernst. Points out that although the Swiss Army can never be in a position to sally forth to meet its enemy until it has a powerful air force and some armoured divisions, the study of the encounter battle must not be neglected, as the active defence is the strongest defence.

"Whenever a solid front is formed, the opportunities of the armoured troops "diminish considerably. By moving out to meet them instead of waiting for them, "solidly established behind a continuous obstacle, we are doing them the greatest "service."

Commentaires sur la guerre actuelle. Deals exclusively with the Italo-Greek campaign. The Greek counter-offensive, which seemed to have slowed down in December, was beginning to move forward again. The operations were taking the

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form of guerrilla actions, marked by superior handling of mountain artillery by the Greeks.

Reference is made to the value of British Naval aid in hampering the flow of Italian reinforcements, and the indirect assistance afforded by the operations in Cyrenaica.

W.H.K.

JOURNAL OF THE INSTITUTE OF PETROLEUM. (The following "Abstract" is republished by permission.) WAR INTENSIFIES OIL SEARCH IN EUROPE.

Anon. World Petrol. July, 1940, 11 (7), 37-41. In 1932 Germany's oil production was 237,000 tons; in 1939 647,000 tons. During the past three years Soo,000-900,000 ft. were drilled annually. In 1939 two-thirds of the drilling was as extensions and exploration in new areas. The main new production in 1938-1939 was from Nienhagen and Reitbrook. The initial well at Reitbrook gave more than 1000 brl./day. Drilling in 1940 would probably be double that in 1938 and 1939. At St. Ulrich, Austria, a well came in at 500 brl./day. In addition to the fields of Austria and Czechoslovakia, Germany acquired Polish fields yielding about 1,000,000 brl. of oil/year, and which are probably capable of expansion. Germany's 1940 output will exceed 1,000,000 tons, for all wells are being pumped hard to get the maximum output.

The political situation in Rumania does not encourage drilling activity, and so in 1940 less footage will be drilled than in 1939.

Exploration in Italy has defined a petroliferous fold at Fontevivo, which has given several thousand tons of oil, and has opened important gas reservoirs in the Emilia region of the Apennine foothills. Deeper drilling is deemed necessary to reach oil horizons in the Po Valley. In the past five years Albanian production rose from 6,000 tons in 1935 to more than 200,000 tons in 1939. In the Devoli fields there were 380 wells up to 1939 and they averaged 2,000-2,500 ft. in depth.

In Hungary some forty wells have been drilled, yielding about 5,000 brl./day, and with new wells it is expected that production will be at the rate of 2,000,000 brl./year before the end of 1940. It is mainly from the Lispe area. There have been favourable shows around Lake Balaton. The wells range from a few hundred to more than 8,000 ft, in depth, and average 5,000 ft.

Concessions are said to have been granted in Yugoslavia, and geological investigation for oil has been undertaken in Bulgaria. In Greece, oil shows have been encountered in a well at 3,000 ft. A well near St. Marcet, Herault, France, met a heavy flow of gas at 5,000 ft., and a second well on the same structure, at Pinat, was at 0,000 ft. in May, and was reported to have found oil of good quality. In April, a well at Torres Vedras, 30 ml, north of Lisbon, Portugal, had good oil showings at 2,000 ft.

It is reported that during the last five years more than forty fields have been discovered and brought into production in the Ural-Volga, Middle Asia, and Far East regions of the U.S.S.R., together with new areas developed in the Baku and Grozny districts. Drilling is one of the weak points of the Soviet oil industry, and in recent years has been only, on the whole, 50-60% of that planned.

G.D.H.

ROAD ABSTRACTS.

SOIL STABILIZATION WITH MOLASSES.

In Road Abstracts for 29th April, 1941, attention is directed to a Report by the Director, Irrigation Research Institute, Lahore, on *Soil Stabilization with Molasses*. The tests were confined to clay soil. Additions of molasses up to 5% to sand-clay-mixtures containing respectively 30 and 40% of clay proved highly effective.

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The sand-clay-molasses mixture formed a thin surface crust, the underlying material remaining soft. The crust was sufficiently strong to bear pneumatic-tyred vehicles but was quickly destroyed under the feet of cattle. The incorporation of lime converted the sugars into insoluble saccharates which remained diffused throughout the mixture and produced uniform hardening. The stability and permeability of stabilized mixtures, some of which contained molasses, have been tested under heavy rain, with satisfactory results. A field test demonstrated that a damaged road surface containing sand-soil mixtures stabilized with molasses could be repaired simply by wetting the material and reshaping.

F.E.G.S.

THE INDIAN FORESTER.

(November, 1940.) Erosion in the Punjab Himalayas, due to tree felling and overcultivation, has long been a menace; among many other evil effects, it produces violent and disastrous floods during the monsoon, and a shortage of water in the large rivers in the cold weather, with the result that canals are not getting their fair share of water, and irrigated land is suffering. Fortunately, the Punjab Government has taken up the subject seriously, and a "forest circle" has been started to attempt to stop further erosion and to reclaim areas already laid waste.

(December, 1940.) True symbiosis in the hills—a forbidding title—is on the same subject as the last-named article. There are photos showing damage done, and so great is the struggle for existence that, according to one photo, goats have learned to climb trees the better to browse.

The Haunted Hill is a good story of the cerie.

Timber exploitation in the Punjab, Hills is an account of the methods by which timber is grown, cut, transported and delivered to the consumer. Those of us who have used deadar, chir, hail and palandar usually have little idea of the methods by which all this is done. The working plans of the Punjab forests envisage a cycle of 150 years; that is to say, a tree planted in a Government forest this year may not be felled until 2007. Felling in the remoter hills is if possible done in the snow to avoid damage. The trees are generally cut up into marketable sizes on the spot and then carried by coolies to the nearest ropeway (the three cable system is most in vogue) which conducts the scantlings to the banks of the nearest waterway. Thence they are dependent on floods for their voyage, on the average 250 miles, to the timber depots, which, as most officers who have travelled by the N.W.R. know, are generally situated where that line crosses the five rivers.

The theme of *The National Wealth of the Forest* might be described as "a forest officer's life is not an easy one." "They have to perform many functions. They are trained engineers, surveyors, planters, business and estate managers and lawyers. They design and build their own wells, buildings and bridges, align and construct roads, canals and tramways and maintain them; survey and prepare maps and demarcate boundaries; raise plantations and exploit the mature crop as interest, leaving the capital; manage the forest estate and villages, settle disputes and decide forest cases."

The report of the Soil conservation and afforestation sub-committee of the national planning committee gives a colossal programme of development of forests and prevention of erosion. It remains to be seen how and when it is to be translated into legislation and action. It would seem that a very large increase in the establishment of the forest service will be necessary to carry out even a small part.

(March, 1041.)—The article of most interest to us in this number is "Control of *hintana* by a sodium chlorate spray." Most officers who have served in India know this aromatic flowered shrub, which, introduced originally as an ornamental garden

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plant, is becoming an intolerable pest to the Indian Forest Service. The treatment recommended solves the problem and does not harm adjacent and useful vegetation. A former number of the *Journal* (Feb. 1933, reviewed in *The R.E. Journal* of the following June) recorded how elephants had been trained to eradicate the noxious shrub.

F.C.M.

AN COSANTOIR.

An Cosantbir, A Review for Army and L.D.F. is published monthly under the auspices of the Southern Command in Eire at the Collins Barracks, Cork. Vol. 1 No. 10, of 28th February, (price 2d.), most of which is in English, is full of useful teaching and deserves the instruction "Keep your copies in a safe place. You will want them for reference later."

Some idea of the range of subjects treated may be gleaned from the headings " Engineering Instruction," "First Aid Organization," "Service," "Writing a Message," " Notes for Army Motor Cyclists," and "Safety First." The Engineering Instruction is not a specially written article, but a normal routine instruction issued by a Local Defence Force District Staff Engineer to his sub-leaders. The instruction in map-reading and engineer reconnaissance is very detailed and stress is laid on co-operation with Transport, Communications and Combat Sections. The location of Road Blocks, Dumps, cover and protection from observation and weather, Observation Posts, Streams and areas suitable for inundations is also stressed and also the "port-holing" (sic.) of walls, fences and houses in commanding positions to cover advance or retreat of combat sections. In "Notes on destruction of Bridges" one is rather surprised to read "It is only in a few cases that the destruction of bridges (especially in secondary and bye-roads) is of any military value whatever." But it is added that " most of the important Bridges are already chambered, and the charging and demolition of these will be dealt with by Officers of the Military Command, or by selected Squads from the Local Defence Forces."

"The Mallow Raid, Attack and Capture of Mallow Military Barracks," on September 27th, 1920, may be read with mixed feelings, but is certainly a lesson in the value of surprise.

F.E.G.S.

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