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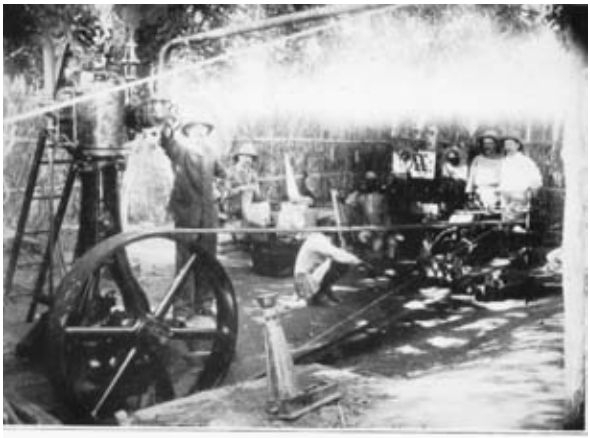


Photo I.

Photo II.

AN EXTEMPORIZED SEARCH LIGHT

FIELD AUTOMOBILE SEARCHLIGHT

NOTES ON SEARCHLIGHTS.

By R.W.

As searchlights will, without doubt, play a very important part in the night operations in future wars, the following notes on the plant for an automobile searchlight, may prove of interest. An extemporized searchlight was also used in the recent Roorkee siege manœuvres, and extracts are given from the Report of Lieut. B. C. Battye who was in charge of the plant. These extracts show the various uses to which the searchlight was put, and the lessons learnt as regards its employment.

(1). Automobile Searchlight Plant.

It is quite evident that all the European Powers are adopting this type of "aid" to night fighting. They are however guided by the fact that the primary use for this plant is in siege warfare.

We are situated differently. On the Continent the practice of siege warfare, though next in importance to the field operations, does come second. With us the need for its consideration and practice is not very often realized by the Army at large.

One result of the Russo-Japanese War has been to show that searchlights must be included amongst the material provided and used by the fourth arm in the next war.

It would now appear to be our duty therefore to pass from the purely experimental stage to that of a recognized organization, which could take its place as an aid to infantry defence and artillery fire in the field, or be useful on lines of communication and in the attack of a fortress.

Our trials up to the present have resulted in the production of horse-drawn plant suited primarily to field operations. This type of plant could of course be used for siege operations, but the number of horses required would make it a serious undertaking.

In field operations the two main disadvantages of the automobile searchlight are

(*a*). That when employed in a defensive position the projector could never be retired in time (it is most useful naturally at short ranges), and would inevitably be captured.

(*b*). That it is never possible to state, with certainty, that the projector can be sited in any required position.

When teams of horses are used (*a*) can be overcome, for the case is similar to that of a field gun. Where, also, the projector can be detached from the trail carriage the disadvantage at (*b*) disappears and the searchlight becomes more mobile than the field gun, for it can be got into position on a church tower and no reasonable field site will be denied to it. The engine plant in being horsed, too, can always be got to within the required distance (300 yards) of its projector.

Other disadvantages are the necessity of having highly-trained *personnel*, and that automobiles at the front are generally a nuisance.

In siege warfare the disadvantages of an automobile plant disappear on the whole as the operations are more deliberate, and European Powers would appear to be working on these lines.

Another use is that, in coast defences, it is becoming more and more apparent that auxiliary mobile lights will be required to supplement the permanent lights during the precautionary and war periods. Reliable automobile sets might well be used for this purpose, their chief *rôle* being to co-operate with the mobile armament in repelling determined boat landings, or even assisting in the defence of the port on its land side.

(2). AN EXTEMPORIZED SEARCHLIGHT.

The following notes are extracted from a Report by Lieut. B. C. Battye who was in charge of a searchlight plant which was used in the recent Roorkee siege manœuvres (December, 1909).

The plant used included :—

1. A 90-c.m. coast defence Mark III. projector mounted in a bullock cart without motor-directing gear (see *Photo* 2).

2. 14-H.P. vertical steam engine and a compound wound (110 v. 200 a.) dynamo (see *Photo* 1).

3. A portable boiler borrowed from the Balloon Section.

The *personnel* consisted of 2 European non-commissioned officers, 21 native non-commissioned officers and sappers. The use of a power line $1\frac{1}{2}$ miles long, made up of bare copper wires, was necessary on account of the immovability of the engine plant. The plant was taken over on November 13th, and the first trial run was carried out on November 20th. The manœuvre ground was 14 miles distant.

The light was run every night for a week, as under :—

In Attack.—(1). To assist a reconnaissance by night from a balloon. (2). To illuminate targets which were to be shelled by mountain artillery.

In Defence.—To disclose the attacking entrenching parties.

On one night the beam was reflected from a "home-made" metal

screen and howitzer practice was carried out against this at a range of 3 miles. Before firing took place the light was extinguished. The result of this practice was that all the shells fell within a few feet of the mirror, which would probably have been destroyed had they contained full charges.

The following lessons were learnt :—

(1). Some form of artificial command, for the projector, is an absolute essential in flat country. (2). Great care must be exercised in selecting a site for the light, to avoid any possibility of it being screened by any natural or artificial obstruction. (3). The observer should take advantage of every bit of command which he can get in the way of trees, houses, etc. (4). It might even be worth while carrying a portable mast to observe from, like those carried by wireless telegraph sections, which could be erected in the outpost line after dark and taken down before dawn. (5). It is worth while sacrificing some hundreds of yards in range, both for the light and the observer, if command can thereby be obtained. (6). The artillery observer should be as far ahead of the light as safety permits, and should be in close co-operation with the searchlight director.

Tactical Exercises Recommended.

There should be very close co-operation between the light and the infantry firing line, the light being actually directed from the firing line in attack practices. For this reason, one light should be told off for each section of the attack from as far to the front as possible, and each light should be actually directed by the O.C. of its own section. This needs a great deal of practice, to make it work properly.

Dousing and sudden exposure, in combination with magazine and machine gun fire, should be practised.

Reconnaissances should be practised, using a balloon and directing the light *from the balloon*. There is little doubt that excellent work could be done on a dark night in this way. The balloon is quite useless on a moonlight night, and probably even on a starry one.

Counter-attacks from a flank under the cover of the blinding effects of the beam should be practised.

Reconnaissances should also be practised from land by sending scouts out each at the end of a telephone line. The lines converge on to the director who should have established a post in the outpost line, and should then direct the light according to the information received from the scouts, who would observe and report in turn.

The only protection against artillery fire, would appear to be :—

Either by practising the Port Arthur ruse,* in the hopes that the artillery would give up attempting to hit the light, or else by arranging to move the projector quickly from one position to another, and back again as soon as the range was found.

It is interesting to know that this question is being at last taken up in India, but it would appear that the trials of a pack transport set would be in the first instance of more value. There are no great difficulties in the way of devising a complete pack set for one 30-c.m. electric light. The whole with stores could be carried by six mules, but practical experiments are most necessary before a final reliable and useful type can be evolved.

* This was—"To douse the searchlight when the firing was getting too hot, and to light up again some time after the firing had ceased."

MILITIA POST, MIRANSHAH, TOCHI VALLEY.

THE following short history of the Militia post at Miranshah, halfway up the Tochi Valley, is by Major McNeile, 19th Lancers, Commandant, Northern Waziristan Militia. It has been forwarded by Colonel J. A. Tanner, D.S.O., Secretary to the Chief Commissioner, N.W. Frontier Province, who has also kindly added a tracing of the post and a short account of its construction.

Up to October, 1904, there was a regular regiment of the Indian Army in Miranshah, the Northern Waziristan Militia holding the rest of the Tochi Valley. The Government of India however decided that from that time forth, the Northern Waziristan Militia were sufficient as a garrison for the whole valley, extending from Mirzail to Datta Khel. Since this distribution was to be permanent it was found necessary to build a new post at Miranshah for the headquarters of the Northern Waziristan Militia as the post which the regulars occupied was manifestly unsuitable for conversion to a permanent post, as the perimeter was too large for defence by the proposed new garrison, and in addition the sanitary arrangements were not such as to be suitable for permanent occupation.

Site of Post.—A suitable water supply was the main difficulty as regards the new site, but experimental wells were sunk and water was found on the Dandi plain at a depth of 120′. Two wells were then sunk and the new post built round them about 2 miles north of the Tochi River and 37 miles west of Bannu. As before mentioned the whole of the Tochi Valley is now occupied by the Northern Waziristan Militia, a local corps numbering 1,200 infantry and 100 mounted infantry, and like the other frontier corps, is under the control of the Honourable the Chief Commissioner, N.W. Frontier Province. The infantry are divided into 12 companies, 6 companies being composed of local men and the remainder of other classes of Pathans, *e.g.* Afridis, Khattaks and Orakzais. The Militia acts in concert with the Political Agent for maintaining peace in the valley.

The British officers numbering five, are selected from the Indian Army and are seconded from their regiments for three years for duty with the Frontier Militias, officers being liable to be transferred from one corps to another by order of the Chief Commissioner.

A portion of the post is divided off for the Political Agent, Tochi Valley, and his staff. Quarters are also provided in the Militia post for the Military Works Services Establishment.

Inhabitants.—The Tochi Valley is divided into Upper and Lower Daur. Lower Daur extends from Khajuri to within 5 miles of Miranshah. There are a few Tori Khel Wazir villages in the vicinity of Katira

otherwise the inhabitants are Daurs. The Daurs, being surrounded on all sides as they are by different Wazir tribes, have suffered considerably from their stronger neighbours. They are not properly speaking Pathans although they are a Pushtu-speaking race. They are supposed to be descended from one "Hussein" by a Mirasi wife.

On the north and north-west of Miranshah lies the territory of the Darwesh Khel Wazirs. The Darwesh Khels are a migratory tribe, their chief occupation being pastoral and it is in search of grazing for their flocks and herds that leads them to wander up and down their country. They are descended from one "Wazir" who had grandsons named Darwesh and Mahmud. Darwesh again had two sons Utman and Ahmad, and from these spring the whole Wazir race consisting of Mahsuds and the Darwesh Khels the two main clans of the Darwesh Khels being Utmanzais and Ahmadzais.

The Tochi Valley itself is extremely fertile, wheat and rice being chiefly grown. The cultivation however only extends from a short distance on each side of the river. All this cultivation belongs to the Daurs who are at present the only revenue-paying people in the valley.

There are many villages on both sides of the river. As a rule each village has a tower. These towers are usually well built and have a foundation of stone to a height of about 15′. Above this the tower is built of rough mud bricks to a height of 40′ or 50′. A roof is then put on and the beams of the roof project beyond the tower to a distance of 3′ or 4′ to form a machicoulis. On the top of all this there is usually a parapet.

As regards the construction of the post, with the exception of ammunition and arms stores, the work in the perimeter wall and in the buildings is practically all sundried brickwork. The Officers' Mess and quarters have jambs, arches and faces of exposed walls in burnt brickwork. The roofs are all mud on tiles. The whole post is surrounded by a wire entanglement which includes the stables and transport lines, these being placed outside the perimeter for sanitary reasons. These excrescences and the civil post are commanded from the walls of the Militia post.

Miranshah is the last headquarter post built for frontier corps, the others being Wana, which is reached from Dera Ismail Khan by the Gomal Road and is the headquarters of the Southern Waziristan Militia; Parachinar, at the head of the Kurram, 56 miles beyond railhead at Thal, is the headquarters of the Kurram Militia; Lundi-Kotal in the Khyber, about 30 miles from Peshawar being the headquarters of the Khyber Rifles.

The Samana Rifles have their headquarters at Hangu, about 30 miles west of Kohat and share with the regulars the holding of the Samana Ridge.

The Border Military Police help to keep order along the administrative frontier behind which are the regular garrisons.

AN INVESTIGATION OF THE SECTION OF FIRE TRENCHES.

Translated from the Japanese by CAPT. A. M. CARDEW.

THIS article is taken from a lecture, given by Capt. Uemura, Engineers, before the Research Society of the Nagoya garrison.

The object of fire trenches is the development of fire effect together with the protection of the garrison. It is therefore necessary that they should be constructed with a section that will enable the foregoing two objects to be attained, in other words every effort must be directed to thorough protection of the garrison so far as such will not impede firing.

Although what I am going to say about the degree to which the modern firearms affect the selection of such entrenchments, will of course be far from original, being matters of common knowledge, still I shall try to introduce to your notice one aspect of public opinion about the selection of fire trenches as opposed to modern firearms.

1. EXTERIOR SLOPE.

Since the exterior slope is the most external portion of the fire trench and receives by far the largest number of projectiles, the most advantageous method of construction would be to make it in precisely the same manner as the roof of a cupola, with a certain degree of slope given to it so that every projectile which struck it should be caused to ricochet off harmlessly.

Now, projectiles will usually ricochet when the angle of impact is less than 17°, that is, is less than 1/3·6, and the angle of impact of shells fired by long guns with fixed charges, at ordinary ranges, is far less than 17° and may be taken, as a mean, as 6°.

If therefore the angle of the exterior slope be made 17—6° or 11°, that is to say about 1/5, every projectile that hits the slope should ricochet. But, needless to say, in order to make the exterior slope more effective as a means of causing such ricochets, its surface must be well trodden down and consolidated.

2. SUPERIOR SLOPE.

In the present-day vogue of low parapets, the general custom is to make the superior slope horizontal; the reason being that on account of the lowness of the parapet the dead ground caused by such treatment is very small and almost negligible.

In the case of fire trenches in exceptional ground or for a special object, however, there is no objection to the use of any degree of slope; but in flat country, as mentioned in connexion with the external slope, a greater degree than 1/5 must be avoided on account of the object of causing projectile to ricochet.

Supposing that an angle of 1/5 be given, then the superior and exterior slopes would merge into one, and the section would become the so-called "triangular section." This section is held in especial favour in France, and appears to be very effective when employed in connexion with an obstacle. But though such prolongation of the slope should, in accordance with the theory, cause every flat trajectory projectile to ricochet, still the lips of the countless craters caused by curved fire projectiles would reduce the effectiveness of grazing fire, and lastly on ground of rather steep slope it would be almost impossible to construct such a parapet.

3. THICKNESS OF THE PARAPET.

If the parapet be given sufficient thickness to resist the penetrative power of the various natures of projectiles, it will be sufficient. Those thicknesses are laid down clearly in the *Provisional Field Fortification Manual* and need not be mentioned by me.*

* The table referred to is as follows:—

Against Rifle Bullets.

	Metres.	Approx.
Sand	0·75	2′ 5½″
Sand in sandbags	0·40	1′ 3¾″
Ordinary earth	1·00	3′ 3″
Piled-up sods, mud	2·00	6′ 6″
Consolidated snow	2·50	8′ 2″

Against Field Artillery Shell.

(*a*). Against shrapnel bullets or splinters—		
Ordinary earth	·4—1·0	1′ 4″ to 3′ 3″
(*b*). Against whole shell—		
Ordinary earth	1·0—2·0	3′ 3″ to 6′ 6″
Snow	about 8·0	about 26′

Against Field Howitzer Shell.

Ordinary earth—		
(*a*). Against shrapnel bullets and splinters	1·0	3′ 3″
(*b*). Against the whole shell ...	3·0—4·0	9′ 9″ to 13′

[TRANSLATOR.]

But, although in order to ensure safety against the penetrative effect of shell fired by long guns with fixed charges, a thickness of several metres must be provided, if as already stated means be adopted of making such shells ricochet, the protection of the garrison will be fully accomplished by the construction of a parapet with the exterior slope at an angle of 1/5 of a thickness of 1 m. (3′ 3″), which is sufficient to resist the penetrative effect of rifle and machine gun bullets.

4. Height of Parapet.

It being a matter of impossibility to protect the garrison, by means of field fortification, against the fire of high-angle fire common shell, the only point to be tried for is to make the enemy's correction of fire as difficult as possible. As a result the following two principles arise :—

(*a*). To reduce the height of the parapet as much as possible,

(*b*). To employ every means of making the fire trench difficult to be discovered by the enemy.

But if in order to carry out the first principle the parapet is made too low, the protection of the rear edge of the trench against the enemy's bullets becomes insufficient, the construction takes a long time, and the further disadvantage will be incurred that the rear edge of the trench is liable to be exposed to the enemy's view. And so, as laid down in the Manual, the parapetless style of trench cannot be made unless the ground is suitable and there is plenty of time, and thus is not a pattern to be invariably adopted. Although it is absolutely impossible to protect the rear edge of the trench by the height of the parapet against high-angle fire shells, still no great anxiety need be felt against low trajectory shells with a mean angle of impact of 6°, as the length of the safety zone given by a 0·50-m. (1′ 7½″) high parapet is about 5 m. (16½′).

Again, as the angle of descent of the lower edge of the narrow cone of dispersion of shrapnel is about 1/4, by making the slope of AB (see *Fig.* 1) steeper than 1/4 the interior of the trench can be protected against such fire. The standing position fire trench *Fig.* 2, and *Fig.* 3 and *Fig.* 5 fire trenches, fulfil this condition.

If the parapet err on the side of being too low, although its discovery will be made difficult, disadvantages will arise both in construction and in the degree of cover afforded. If, on the other hand, it errs on the side of being too high, albeit the cover may be thorough, the principle of concealment will be disregarded. A height of parapet of 0·50 m. (1′ 7½″) appears to be the golden mean, the reasons being that such a parapet is easy to construct and relatively difficult for the

enemy to correct his range by, and if suitable limits are placed to the width of the trench it enables a defilade of 1/4 to be obtained.

Fig. 5 with a height of parapet of 0·90 m. (about 3′) gives very thorough protection in the trench, but has the disadvantage of facilitating detection by the enemy. As laid down in the Manual, such things as the widening of trenches and the increase of the height of parapets in an infantry position, can only be carried out when the question of detection by the enemy no longer needs consideration. With regard to the question of rendering the detection of the trench difficult for the enemy, the avoidance of straight lines in the various slopes, which would cause lines of differing shades due to the light striking on their surfaces and which would be easily detected by the eye, and such means as the scattering of vegetation, earth, or grasses in the vicinity on the parapet, need no mention on my part.

But when the enemy employ balloons, it becomes extremely hard to render the discovery of trenches difficult, owing to the difference in colour between the trench and the parapet. However, a balloon sent up to the height of 1,000 metres (1,094 yards) at a distance away of 5,000 metres (5,468 yards) from a trench, observes the latter at an angle of 1/5, and so, theoretically, if the height of the parapet be made so that the line from the crest to the rear edge of the trench be 1/5, complete immunity should be obtained from the view of balloons. But in this case if the line of view from the balloon makes an angle of 45° horizontally with the crest line of the trench, the trench would be easily visible; and so it appears to be most important that the angle of defilade of the point A (see *Fig.* 1) should be at least 1/4.

Thus it will be seen that the angle of 1/4 laid down as necessary for protection against the enemy's bullets, also happens to give a good result in preventing observation from balloons. (The Japanese idea is that captive balloons cannot be sent up to a greater height than 1,000 metres or at a closer range than 5,000 metres).

5. WIDTH OF TRENCH.

For the reasons mentioned above, the width of the trench should be determined on a basis of the height of the parapet, but it is especially important to reduce the width against time shell. The reason is that by drawing the lines AC, BD, parallel to the lines *ac*, *bd* which shows the limits of the angle of dispersion (see *Fig.* 1), we find that, should the shell burst in the area between these lines, its effect is completely nullified. But, on the other hand, the trench occasionally has to be widened to facilitate communication. *Fig.* 4, designed for a protracted defence, is an instance of such.

In the case of this fire trench, defilade is a matter of the greatest difficulty owing to the width of the trench, but, as compared to

Fig. 5, the lower parapet would probably facilitate the carrying out of methods to prevent its detection by an enemy unprovided with balloons.

Moreover the Manual may be said to have taken every precaution by laying down that in such trenches as *Fig.* 4 the rear step should be made in the rear face of the trench as shown in *Fig.* 6, thus emphasizing the importance of defilade.

6. Interior Slope.

The necessity for making the interior slope steep is not only to reduce the distance AB, but also because it possesses another great advantage, the reason for this second advantage being as follows:—

High-explosive shells possess a wide cone of dispersion and adding the angle of descent, that is, 6° with the horizontal, the splinters reach the men behind the parapet at an angle of 61°.

The angle of a 3/1 interior slope to the vertical is 18°, and in this case the width of the defiladed area BPQ is only that subtended by an angle of 11°. And thus the width PQ of the protected area behind a parapet 1·30 m. (4′ 3″) in height, would not exceed 29 c.m. (11·4″). But if the interior slope be made vertical the width PR of the protected area becomes 0·72 m. (2′ 4″), and soldiers sitting with their backs to the parapet would be entirely protected.

For this reason, in all circumstances, it is most suitable to make use of any materials in the vicinity in order to try to make the interior slope vertical, and, if the nature of the soil permit it, advantage will be gained from undercutting the interior slope (Boer system of trench.—*Translator*).

The foregoing, however, has been argued from the point of view of fortification on level ground, and, needless to say, in some cases the employment of a less steep slope is possible.

7. Height of Line of Sight and the Firing Step.

According to one book the height of line of sight of 1·3 m. (4′ 3″) is argued to be suitable for a man 1·54 m. (Japanese 5·08 shahu, English 5·05′) in height, but the origin of the 1·54 m. (5·05′) of a man's height is not clear.

I only know that it is an average height of line of sight, but in the special circumstances which demand a non-steep interior slope, this height must be rather reduced.

If the firing step be too narrow, the firing motions are hampered and there is a fear of its collapsing, if it be too wide, it needlessly increases the width of the trench and makes the degree of protection insufficient.

A width of 40 c.m. (1′ 3¾″) appears to be the most suitable; with such a width, when the men are resting seated on the step with their

backs to the vertical interior slope of a parapet 1·3 m. (4′ 3″) high, there is a protected area, as mentioned before, of 72 c.m. (2′ 4″) against the angle of descent of 61° of the lower portion of the cone of dispersion of high-explosive shells. And so beyond the 40 c.m. (1′ 3¾″) width of the firing step, there is a further width of 32 c.m. (1′ 0½″) in which the man can put his legs with absolute safety.

Again, in the fire trench with a height of 1·10 m. (3′ 7″) and an interior slope at 5/1 as laid down in the Manual, a protected area of about 40 c.m. (1′ 3¾″) width is obtainable. In other words the firing step forms the protected area.

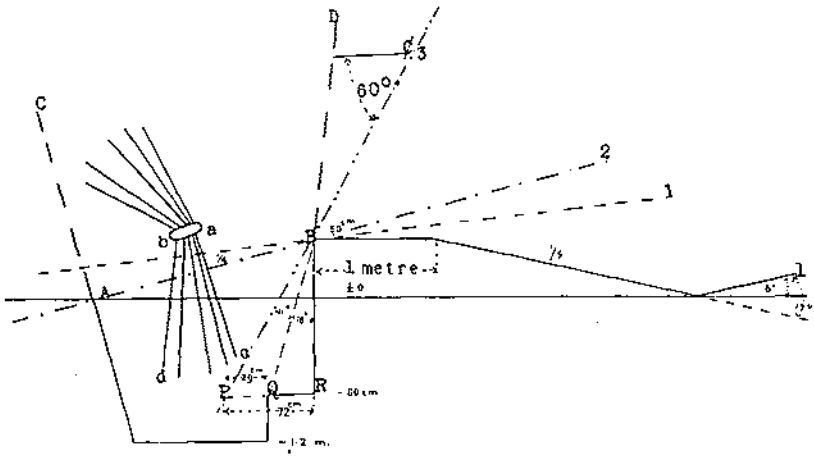
8. Elbow Rest.

There appear to be several ideas as to the necessity or not of the elbow rest. In the recent war, according to the experience of a certain regiment, the men experienced no inconveniences as regards firing from a parapet without elbow rests, but found the picking up of ammunition from the bottom of the trench, in the confusion of night, very inconvenient; and from misapprehension were constantly complaining of lack of ammunition, when at daybreak in the bottom of the trench plenty of cartridges would be seen scattered about.

Looking at this it would seem that, if there was some other convenient method of storing ammunition in the firing line, the elbow rest could be abolished. But the harm ascribed to the elbow rest of reducing the effectiveness of protection for the trench, does not appear to be really so great as theory tells us; especially when the first consideration is that of the development of fire which is one object of the trench, such minute questions of defilade are not worth consideration.

In addition to the foregoing there are points in connexion with the rear edge of the trench, the bottom of the trench, etc., which are worthy of investigation, but since they follow naturally from the foregoing points, I shall not enlarge upon them.

Briefly, it is impossible practically to provide a fire trench with all the foregoing requirements as regards *remblai*, communication, etc., but if a knowledge of such be applied to the study of the sections laid down in the Manual, it will be seen that the various measurements are not arrived at by mere chance, and further it will be seen that each section has its own particular nature, in accordance with which each has a separate and distinct use.



1. 1. Mean angle of descent of trajectory (6°).
2. Angle of descent of lower edge of cone of burst of time shrapnel, and line of view from balloon.
3. Half the angle of burst (in vertical section) of high explosive time shell.

FIG. 1.

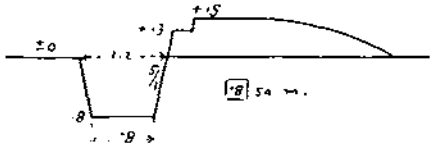


Fig. 2.

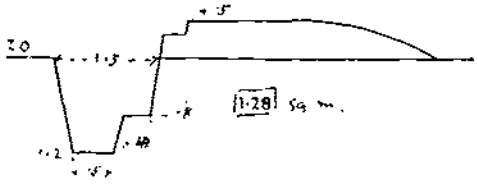


Fig. 3.

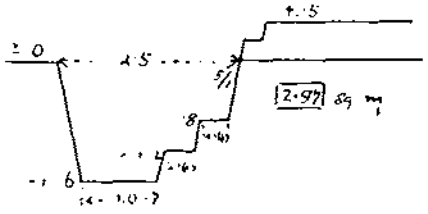


Fig. 4.

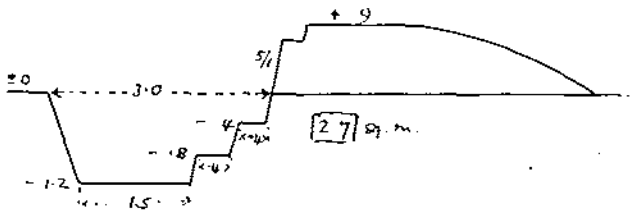


Fig. 5.

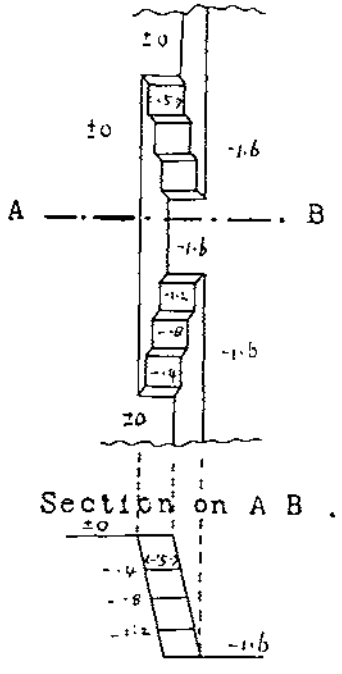
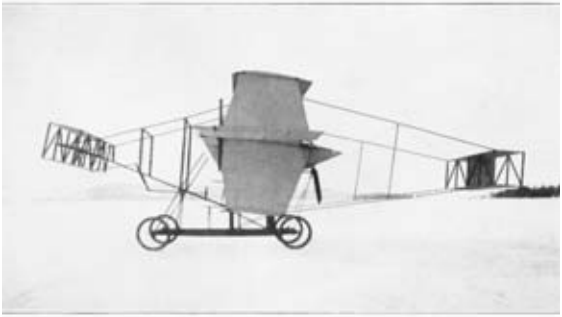


Fig. 6.

All measurements shown on the figures are in metres.

1. "Baddeck No. 2."

2. "Baddeck No. 2."



3. "Cygnet No. I."

4.—"Oiseau No. 1."

5.—"Mike" Monoplane.

6.—Power Ice Boat with Crew.

AERONAUTICS AND ITS PROGRESS IN CANADA

By Major G. S. Maunsell, Royal Canadian Engineers,
Director of Engineer Services, Canada.

Canadians have read, with great interest, the numerous articles written by Colonel F. G. Stone, *p.s.c.*, Royal Artillery, and Colonel J. E. Capper, C.B., Royal Engineers, in the Royal Artillery and Royal Engineer Journals, upon the advance in aeronautics up to the present date.

It might be interesting, in return, to give a few notes upon the progress made in this important and interesting study in Canada.

It will be remembered that, in July and August, 1909, Messrs. Baldwin and McCurdy experimented at Petawawa (the Central Canadian Camp) with two aerodromes,—the "Silver Dart" and "Baddeck No. 1." After several successful flights, the former, unfortunately, was badly damaged in landing, and the latter, while being adjusted, met with a mishap, which necessitated repairs and readjustment at their own workshops.

During the winter, these aviators have been busy, and were able, lately, to show how far they had progressed in the art of flying.

The writer was fortunate enough to have an opportunity of visiting the Canadian Aerodrome Company's Works, at "Beinn Breagh," near Baddeck, Nova Scotia, during the second week in March, and is indebted to Messrs. Baldwin and McCurdy for much of the information, and the plates contained in this article.

He was, also, fortunate in witnessing, as well as accompanying Mr. McCurdy, in flights in his "Baddeck No. 2," during Canadian winter weather, over a sheet of smooth ice, about a mile in width, and several miles long, the thermometer standing at zero at the time. The ice proved a very satisfactory starting and landing field, but great care had to be taken to prevent the machine from skidding against rough ice when alighting, which would have damaged the landing wheels.

In all these flights the extra weight of one passenger did not affect the machine in any way, and the aerodrome moved so smoothly, that a passenger could scarcely tell the moment the machine had left the ice, or when it landed again.

The longest flight made by "Baddeck No. 2" upon this occasion, was one half hour over the course above mentioned, making thirteen circles of about 1½ miles in circumference. The aviator then alighted,

(when that time had elapsed) as had been prearranged. The height was between 50′ and 100′.

The difficulties yet to be overcome, in all aerodromes, would appear to be—(*a*)—the question of certainty of power, (*b*)—the control in the wind, and, (*c*)—landing on, and rising from, uncertain ground.

With an absolutely reliable motor, there appears to be no reason in proper weather why these machines need come to the ground except to replenish their petrol. It is quite possible that future developments will adopt two motors, either one of which will keep the machine in the air.

In the case of the above aerodrome, the engines now under order by the firm are under a guarantee of an hour's flight.

The control in the wind has yet to be improved. Although no accidents have occurred to these aviators from that source, owing to their skill and caution, yet it is only fair to say that aviators prefer to fly in calm weather. Sudden gusts of wind, are, of course, most to be feared, but must be encountered and conquered.

It will be noticed that none of the machines, so far made by Messrs. Baldwin and McCurdy require a starting pole, but can lift from the ground in a few hundred yards run, on smooth ground. The landing question appears rather more serious. Ground, which from a distance looks sufficiently desirable as a landing place, may not prove so when reaching it, and the result may not be what was intended. But, as the engine power becomes more certain and control of the machine more perfect, this disadvantage will to a certain extent be eliminated.

The question of starting the engine without assistance must, also, be taken up before long. The machines mentioned in this article require the assistance of one man only at the propeller, to set the machine in motion, but, before regular flights can be made from place to place, it must be made possible for the pilot to set his engine in motion himself. This is now under consideration by these aviators.

The following aerodromes are about completed, and are being experimented with by the Canadian Aerodrome Company :—

"Baddeck No. 1" and "Baddeck No. 2" are biplanes of the type which so far proved themselves most satisfactory. They were built on the "Silver Dart" lines, but with many improvements. "Baddeck No. 2" is shown in *Photos* 1 and 2. The lateral balancing planes of the former are between the two main planes, and those of the latter are on the extreme ends of the main planes. In both cases, they are true planes not curved surfaces, and, when balancing is resorted to in the air, the rudder is not required to counteract this movement as in some machines.

The machine is controlled by the natural balance motions, *i.e.*—when the pilot wishes to lower the bow control he leans forward naturally and pushes the controlling wheel in that direction; when

leaning back and drawing it towards him, the bow control is lifted and an upward motion is effected. In a similar way, when leaning to the right when that side is high, the balancing planes are moved with the shoulders, and tend to lower that side, and *vice versâ*. The rudder is also guided by the same wheel as the bow control by a turning motion, and the engine throttle is secured to it as well. The pilot's hands therefore need not leave the controlling wheel.

The engine preferred so far by Messrs. Baldwin and McCurdy and installed in these machines, is a 6-cylinder, water-cooled, 40-H.P. gasolene motor-car engine, weight 320 lbs. Several radiators have been tried, including a specially made one of small resistance in the air, which has proved very satisfactory.

The propeller now in use, after careful experiments, is a 7′ 6″ two-bladed one, made of British Columbia fir and with moderately sharp blades.

The bow controls and tails of these machines require no particular description. They are shown in *Photo* No. 1, and give great stability. The surfaces are slightly curved in the same way as the main planes.

The three landing wheels are of bicycle pattern (pneumatic) and are secured upon heavy coil springs to a small wooden frame. This frame acts as a skid if a wheel gives way, and protects the body of the machine. The advantage of this skid was shown in the tests made on the ice recently, where a wheel broke through the surface when alighting, but the main planes were carried on the skid.

The framework of the main planes is made of British Columbia fir; the struts between the two planes are of the same material. The covering is a special material of silky cotton appearance, strong and light. The edges of the main planes are covered with aluminium.

"Oionos" is a triplane of tetrahedral design. This particular construction has been a study of Dr. Graham Bell's for some time. It has been proved that kites of this design fly well, but in the full-sized machines would appear to offer too much resistance, and are too heavy. The "Oionos" has not yet been tried with a sufficiently powerful engine to lift her, but has been run over the ice with a small 12-H.P. engine to test her balance, etc. The result of her proper test will be most interesting. This type is shown in *Photos* 3 and 4, and is controlled in a similar manner to "Baddeck Nos. 1 and 2." The bow control and tail are also very similar in construction to those of the first-mentioned types. The engine proposed is a 40-H.P.

The "Oionos" is the result of tests carried out with the "Cygnet" which is of tetrahedral construction but of numerous small silk-covered cells. It is one of the older types, and has not proved satisfactory, but as a kite it flew well.

The "Mike" monoplane is the first monoplane built by the Canadian Aerodrome Company, and is, also, their first order. It is

being built for Mr. Gardiner G. Hubbard, of Boston, U.S.A. This machine is shown in *Photo* 5; is 34′ from tip to tip of wings, and 32′ from propeller to rudder. The engine is a 40-H.P., similar in type to the biplanes above mentioned, and placed in the body immediately in rear of the propeller. The control motions are similar to those described for the biplanes, but the elevating and depressing plane is in the tail.

This is the smallest full-sized aerodrome made by these aviators. A delay in the delivery of the engine prevented its being tried at the recent ice tests. It gives one the impression of being a very fast machine. Whether it will be as stable as the biplanes above described, has yet to be proved.*

Hydroplanes are being experimented with by this firm, and great strides are being made. It is expected before long to have an aerodrome that will rise from the water and be capable of landing again in it with safety.

Ice Motor Boats are rather novel, but successful machines, made and used by these aviators for getting from place to place on the ice. They are of very simple construction, with three skate-like runners, one in front guiding the machine. A motor, borrowed from a motor boat for the winter, answers the purpose and an ordinary wooden propeller driven in the air, completes the machine (see *Photo* 6).

Messrs. Baldwin and McCurdy make all parts of the aerodromes in their factory, even the bicycle wheels used in the landing carriages (except the rims, tires and spokes).

They are much handicapped by the want of a large training ground for summer use. (The ice training ground, above mentioned, is a luxury which is only available for a few weeks in the year). The country surrounding Baddeck is hilly, and an aerodrome to soar across country, must rise about 1,000′ above sea level.

The term "aerodrome" is used by these aviators instead of "aeroplane," as the latter is not considered applicable to a machine which is made up of curved surfaces and not planes.

Messrs. Baldwin and McCurdy are most fortunate in having the advice of such an inventor as Dr. Graham Bell to guide them in their work, as although they are mechanical engineers, and thoroughly well up, both technically and practically in their work, the advice of such a genius as Dr. Bell must be of the greatest value to them.

* Since the writer's visit to Baddeck, this machine has been tested, and made a number of very successful flights, with Mr. Hubbard as aviator.

MAJOR-GENERAL SIR WILLIAM REID, R.E., G.C.M.G., K.C.B., F.R.S.

(Continued).

By Col. Robt. H. Vetch, c.b., late R.E.

Reid arrived at Negril Bay, Jamaica, with Major-General Sir Edward Pakenham and his Staff on the 13th December, 1814, to find that Major-General Lambert with his troops, who had sailed from England a week earlier, had only just reached the rendezvous. As we have already seen, the Admiral, Sir A. Cochrane, with the force from the Chesapeake, and the reinforcements brought out by Major-General Keane, were already before New Orleans, and were busy destroying the enemy's flotilla of gunboats and disembarking the troops, at the time of Pakenham's arrival at Negril Bay. He does not seem to have had any certain information of the whereabouts of the Admiral and Keane, but he decided to proceed without delay to New Orleans, the object of the expedition; and directing Major-General Lambert to follow as soon as possible, he sailed at once in H.M.S. *Statira* for that city.

The following is an extract from Burgoyne's journal :—

"*December 13th.*—At 8 a.m., while hauling round North Negril Point, fell in with the *Vengeur* (74) with her convoy, General Lambert and about 2,000 troops—7th Fusiliers, 43rd Regiment, etc. The *Vengeur* made the signal for us to speak, and the captain (Ricketts) and General Lambert came on board. After a consultation we left them laying-to off Negril, and made sail for the channel round the west point of Cuba. The *Vengeur* and convoy sailed from Plymouth a week before us for the same destination and service. We suppose they will now water in Negril Bay before they continue. Sir Alexander Cochrane was to have brought down the army lately under General Ross, together with the reinforcements they had received, consisting principally of 2,000 men under General Keane, who sailed from England nearly two months before us.

"*December 21st.*—In the evening we ran into the bay to the west of the mouths of the Mississippi, and at 15 miles distance could not see the land.

"*December 22nd.*—We learn that the Admiral and fleet are laying to the north of the Chandeleur Islands preparatory to landing the troops up Lake Pontchartrain. Five gunboats have been taken thereabouts out of six, and the other destroyed.

"*December 25th.*—Landed near the Mississippi with Sir Edward Pakenham."

Sir Edward and his staff had left their ships on the 24th and proceeded in boats for 40 miles, reaching the *Britannia* transport at 10 p.m. Here they learned that there was another 30 miles before them. They reached the landing place at the head of the creek next day, the 25th, Christmas Day, at 11 a.m. and had to traverse a marshy footpath along the bank of a little canal, or bayou, which extended from the creek almost to the Mississippi, for over 2 miles before reaching the headquarters of the army. They found the army on the ground on which they had fought on the 23rd, the number of men landed having been increased to 3,500. Pakenham arrived to find his troops brought into a situation from which all his abilities could scarcely expect to extricate them. On the 28th a forward movement was made and the troops arrived within half a mile of the first line of entrenchment. Batteries were then thrown up which opened fire on New Year's Day. The result was unsatisfactory and the guns were withdrawn at night. On the 4th January General Lambert's reinforcements came up. A small canal was cut from Lake Pontchartrain to the river to convey boats into the Mississippi, carrying a storming party to attempt the capture of the 20-gun battery on the opposite bank. The whole enterprise miscarried. The 42 ships' boats to carry 1,400 men under Colonel Thornton to storm the battery could not get through the canal. The soil through which the canal was dug, being soft, parts of the bank gave way, and choking up the channel prevented the heaviest of the boats from getting forward. These again blocked up the passage to those behind and thus only boats containing some 350 men reached their destination. Even these did not arrive at the appointed time. By sunrise on the 8th January Colonel Thornton was to have carried all the batteries and pointed the guns, when, on the throwing up of a rocket he was to begin firing upon the enemy's line, which, at the same moment was to be attacked by the main army.

As day broke on the 8th and the signal rocket went up Colonel Thornton with barely 350 men was moving out of the canal and in silence and with muffled oars was pulling away in the river to the batteries, 4 miles away, which should have been captured hours before. In the meantime the main body had moved forward in front of the piquets, but Pakenham found that the 44th Regiment, which had been ordered to carry the fascines and ladders for crossing the ditch and scaling the ramparts, had left them behind. The situation was difficult and Pakenham decided to advance, trusting that if Thornton had not succeeded he would at least have created a diversion. A 3-gun battery was stormed and taken but was recaptured ; with no ladders the odds were awful. The 44th Regiment was sent back for the ladders, and after it returned with them Pakenham was leading it on to the attack, when he was killed by a bullet. On the other side Thornton had routed the outposts and then captured the batteries in

spite of a storm of fire. General Lambert having succeeded to the command recalled the troops out of the heavy fire to which they were exposed, and in spite of the capture of the batteries by Thornton, a council of war decided to abandon the undertaking and retreat to the ships.

In this unfortunate business Lieut. Wright, R.E., the gallant young subaltern who had earned for himself a reputation in the Peninsular War similar to that won by Reid, and who had been engaged in many of the same sieges, was killed. The Duke of Wellington used jocosely to couple the names together of these two of his favourite youngsters, and called them "Read and Write."

To cover the disaster at New Orleans from which General Lambert had withdrawn against the advice of his Commanding Royal Engineer, it was decided to attack Fort Bowyer, a strong work at the point of the bay leading to Mobile. The troops were landed on the 8th February and the fort invested. Burgoyne was Commanding Royal Engineer and Reid, who had been promoted 2nd Captain on the 20th December, 1814, was among the officers employed. A parallel was opened the same night. Batteries were constructed and armed, and on the 11th the fort was summoned. The commander capitulated, and on the following day the garrison 400 strong surrendered themselves as prisoners of war. On the 13th February, 1815, news arrived that the war was at an end, peace having been signed at Ghent on December 24th of the preceding year! Reid returned to England with the expedition in May, 1815.

Capt. Reid had no sooner set foot on shore in England than he was ordered to join Wellington's Army in the Netherlands. Napoleon, having escaped from Elba, had returned to Paris in March, and the services of all available officers of Royal Engineers were urgently required in the Netherlands—the cockpit of Europe—where the contest between Europe and the French Emperor was to be fought to a conclusion.

Wellington had asked that the whole Corps of Royal Sappers and Miners should be sent to join his army. Seven companies of that Corps, officered by Royal Engineers, were hurried to Ostend between the 24th March and the 10th June, 1815. Reid joined the army on the 9th June. The Royal Engineers and the Royal Sappers and Miners were distributed among the frontier posts and fortresses that most required their service. Very few officers of the Corps were therefore present at the Battle of Waterloo, but most of them accompanied the army of the allies on the march to Paris and Capt. Reid was among them. Sir Henry Cole mentions in his *Fifty Years of Public Work* that he recollects Reid telling him of his experiences on the march when one of his duties was to cut the roads leading to Paris so as to make them impassable to the French Army. Reid was present at the capture of Paris and took part in the triumphal entry of the allied army into the city on the 7th July, 1815.

While Reid was employed with the Army of Occupation in Paris he was greatly concerned to find that no promotion to the brevet rank of Major was given him, although he had been a Captain for many months. No longer could want of precedent be urged against his promotion, and he began to think that his case had been forgotten. After consultation with some of his brother officers he decided to write officially to the Commanding Royal Engineer on the subject, and to request that his letter might be submitted to His Grace the Duke of Wellington.

The following is a copy of the letter written :—

Letter from Capt. William Reid, R.E., written at Paris in 1815 to Colonel Carmichael Smyth, Commanding Royal Engineer of the Army of Occupation.

"SIR,

"Sir Richard Fletcher, when on leave of absence in the winter of 1812–13, having had several communications with H.R.Highness the Duke of York concerning the promotion of subalterns of Engineers who should be considered worthy of advancement, and having proposed to H.R.Highness that the late Lieut. Wright and myself should have the rank of Captain, the Duke objected to giving brevet rank to subalterns; this occasioned a memorial to His Grace the Duke of Wellington previous to opening the campaign of 1813, which His Grace forwarded to the Commander-in-Chief but with no further success.

"Sir R. Fletcher having frequently assured me that it was his intention to push this matter, or in case that it was inadmissible, to recommend Lieut. Wright and myself for a step when we should have attained the rank of Captain by regular rotation, I have been induced to beg of you to submit this to His Grace the Duke of Wellington, in the hope that I may now receive the rank which a rule of the Service* prevented my receiving while a subaltern.

"With regard to my services: I served the last four years and a-half of the Peninsular War with H.G. the Duke of Wellington. I have been at seven sieges, five general actions, besides a great many smaller affairs; having served two years (1813 and 1814) as senior officer of Engineers with the Light Division; during which services I received three wounds and lost three horses shot under me.

"During the short interval of peace with France I was in the Gulf of Mexico, and on the 9th June I rejoined the army in the Netherlands.

"I have, etc.,
"WM. REID,
"2nd Capt., R. Engrs.

"To COLONEL C. SMYTH, Commg. R. Engr."

On the reduction of the British Army of Occupation in France, which took place in January of the following year, Capt. Reid returned home and was given two months' leave of absence. He no doubt spent part of this time with his aged father in Scotland. He

* Note by Sir William Reid: "I had not served seven years, the time required by the Regulations."

had, however, seen some of the officials at the Board of Ordnance as to his grievance, and one of them sent him the following letter :—

Letter from Major William Gosset, R.E., to Capt. William Reid, R.E.*

"JERSEY, 23*rd February* (1816).

"MY DEAR REID,

"Before I left London I saw Lord Mulgrave.† I again pressed your case upon his lordship, but he fought off upon the old ground: your case is the hardest of that nature that ever occurred. Suppose you were to draw up a memorial of your services, accompanied by the many testimonies which you have, and can procure, and present the same to the Master-General, making it as strong as possible. . . .

"Yours very truly,

"WM. GOSSET."

The fact was that most unfortunately for Reid's interests a matter was at this time in dispute, in which he was in no way concerned, but which proved for a time fatal to his hope of promotion.

The "old ground" referred to in the letter evidently means the determination of the Master-General of the Ordnance to give no officer of the Corps brevet rank until the question of succession to a vacant colonel commandantship was settled. The question was whether the vacancy should be filled, as of old, by regimental seniority, or whether, since the removal of general officers other than colonels commandant from the active list of the Corps in December, 1814, they were to be eligible for colonel commandantships according to Army seniority. Until this question was settled the Master-General would not recommend any officer for brevet promotion which might serve as a stepping-stone to the battalion.

In March, 1816, Reid was ordered to join at Woolwich, and in the following month he was appointed Adjutant of the Royal Sappers and Miners, whose headquarters were then at Woolwich. But he was not yet to be allowed to settle down to the prosaic duties of an Engineer officer in time of peace. Another opportunity was to be given him to distinguish himself on active service, and this time after a different fashion to any former experience. A few words are necessary to explain how the occasion arose.

During the great wars that took place in Europe between 1793 and 1815, the pirates of the Barbary States carried on their predatory warfare with little check from the naval powers. Both Lords St. Vincent and Nelson, it is true, had chastised them, and more recently the American Commodore, Stephen Decatur, had given them severe punishment, but they continued to seize trading vessels in the Mediterranean, and to consign all captured Christians to slavery. At the time at which we have now arrived—the spring of 1816, renewed

* Afterwards Major-General Sir William Gosset, Kt., K.C.H., C.B., who died in 1848.

† Master-General of the Ordnance.

outrages had led the British Government to send Admiral Lord Exmouth to the several Barbary States to demand the liberation of all Christian slaves who were subjects of our allies. The Beys of Tripoli and Tunis promised compliance with all the demands that were made; but the Dey of Algiers would not consent to abolish the practice of Christian slavery without the sanction of the Sultan of Turkey, and time was allowed him to communicate with Constantinople. This service being accomplished, the Admiral set sail for England. Scarcely had he quitted the Mediterranean with his squadron when a number of Christians, employed in the coral fisheries at Bona, were wantonly murdered by the Algerines. When intelligence of this atrocity was received in England it was determined to send out Lord Exmouth with a squadron to bombard the Dey's capital.

Under the idea that it might become necessary to land a party to destroy some of the batteries and works protecting the harbour of Algiers, Major William Gosset, R.E., was sent with the 7th Company of the 1st Battalion of Royal Sappers and Miners, commanded by Capt. Reid, with three subalterns under him—Lieuts. Whinyates,* Lempriere† and Hotham,‡ to join the fleet.

Lord Exmouth hoisted his flag on board the *Queen Charlotte*, 100, Capt. Brisbane, and sailed from Plymouth with a large squadron on the 26th July, 1816. He had with him the *Impregnable*, 98, Capt. Brace, C.B., bearing the flag of Rear-Admiral David Milne, his second in command; *Superb*, 74; *Minden*, 74; *Albion*, 74; *Leander*, 50; *Severn*, 40; *Glasgow*, 40; *Granicus*, 36; *Hebrus*, 36; *Heron*, 18; *Mutine*, 18; *Prometheus*, 16; and 40 or 50 gun vessels, bomb vessels, etc.

Reid's company was 84 strong, and was divided between the *Queen Charlotte* and the *Impregnable*, the two flagships. Major Gosset, Capt. Reid, and Lieut. Lempriere were in the *Queen Charlotte*, with 45 rank and file while Lieut. Whinyates was in the *Impregnable* with 39 rank and file, and Lieut. Hotham was in the *Minden*.

The fleet arrived at Gibraltar on the 9th August and found there a Dutch squadron under the command of Vice-Admiral Baron T. F. van Capellen, consisting of four frigates of 40 guns and two sloops of 30 and 18 respectively. The Dutch Admiral proposed to Lord Exmouth that he should co-operate with him in the action about to be taken, to which his lordship readily agreed. On the 14th August, 1816, the combined fleet left Gibraltar for Algiers.

In his despatch Lord Exmouth says:—

"An adverse wind destroyed the expectation of an early arrival (at Algiers), which was the more anxiously looked for by myself, in consequence of hearing the day I sailed for Gibraltar, that a large army had been assembled, and that very considerable additional works were throw-

* Afterwards Major-General Frederick William Whinyates, who died in 1881.

† Lieut. Thomas Lempriere, died in 1820.

‡ Afterwards Capt. George Hotham, who retired in 1839 and died in 1860.

ing up, not only on both flanks of the city, but also immediately about the entrance of the Mole; from this I was apprehensive that my intention of making that point my principal object of attack had been discovered to the Dey. . . . This intelligence was greatly confirmed by the *Prometheus*, which I had despatched to Algiers some time before to endeavour to get away the Consul. Capt. Dashwood had with difficulty succeeded in bringing away, disguised in midshipmen's uniform, his wife and daughter, leaving a boat to bring off their infant child, coming down in a basket with the surgeon who thought he had composed it but it unhappily cried in the gateway, and in consequence the surgeon, three midshipmen and in all 18 persons were seized and confined as slaves in the usual dungeons. The child was sent off next morning by the Dey and, as a solitary instance of his humanity, it ought to be recorded by me.

"Capt. Dashwood further confirmed that about 40,000 men had been brought down from the interior and all the janissaries called in from distant garrisons, and that they were indefatigably employed on new batteries, gunboats, etc., and everywhere strengthening the sea defences. The Dey had closely confined the Consul, and refused either to give him up, or promise his personal safety; nor would he hear a word respecting the officers and men seized in the boats of the *Prometheus*."

Algiers was a very strong place, well defended with batteries mounting in all over 1,000 guns. Of these 80 guns were on the north side, where the shoalness of the water prevented any large ship getting within range. About 220 were on the Mole, 50 on the east sea front, and the rest in batteries on the high ground behind the town. There were in the harbour four 44-gun Algerine frigates, five large corvettes of from 24 to 30 guns each, and some 40 to 50 gun and mortar boats. The garrison of the place was estimated at 40,000 Moors to which had been added the large force mentioned by Capt. Dashwood.

It was on the 16th August that the *Prometheus* from Algiers rejoined the fleet, but owing to the adverse winds it was the 26th before the land to the westward of Algiers was made. Next morning at daybreak the British and Dutch fleets came in sight of the city and, being becalmed, Lord Exmouth despatched a boat under cover of the *Severn*, 40, with a flag of truce and the demands he had to make. These were the release of all Christian slaves, the repayment of ransoms exacted by the Moors, and the liberation of the British Consul and sailors.

After a delay of three hours, during which the sea breeze had enabled the fleet to reach the bay, the boat was seen returning with a signal flying, that no answer had been received. Lord Exmouth made signal to know if the ships were all ready, and being answered in the affirmative the *Queen Charlotte*, followed by the rest of the fleet, bore up for the appointed stations. At 2.35 p.m. the *Queen Charlotte* anchored, with springs in her cables, about 50 yards from the Molehead and shortly afterwards the battle began by a shot fired

from the shore at the *Queen Charlotte*. The positions were from the north:—*Impregnable*, 98; *Albion*, 74; *Minden*, 74; *Superb*, 74; *Queen Charlotte*, 100. Then 2,000 yards N.E. of the Mole, the bomb, gun, mortar, and rocket vessels. The bombardment was of the fiercest character and was maintained till 10 o'clock at night. The Royal Sappers and Miners and the officers of Royal Engineers, owing to the daring intrepidity and able manœuvring of Lord Exmouth, were not required as miners on shore, but throughout the action fought at the guns with the seamen of the *Queen Charlotte* and *Impregnable*, and gained equal credit with the Navy and Marines for their conduct. Sub-Lieut. Calder and 15 rank and file were wounded.

At 4 p.m. one of the Algerine frigates was set on fire, and by 7 p.m. the town, arsenal, storehouses, and the vessels within the Mole were burning briskly. The Admiral in his despatch says:—

"About sunset I received a message from Rear-Admiral Milne conveying to me the severe loss the *Impregnable* was sustaining, having then 150 killed and wounded, and requesting I would, if possible, send him a frigate to divert some of the fire he was under.

"The *Glasgow*, near me, immediately weighed, but the wind had been driven away by the cannonade, and she was obliged to anchor again, having obtained rather a better position than before.

"I had at this time sent orders to the explosion vessel, under the charge of Lieut. Fleming and Mr. Parker, by Capt. Reid of the Engineers, to bring her into the Mole; but the Rear-Admiral having thought she would do him essential service if exploded under the battery in his front, I sent orders to this vessel to that effect, which were executed. I desired also the Rear-Admiral might be informed that many of the ships being now in flames and being certain of the destruction of the whole, I considered I had executed the most important part of my instructions, and should make every preparation for withdrawing the ships, and desired he would do so as soon as possible with his division."

Between 8 and 9 p.m. the explosion vessel was run on shore near the battery north of the lighthouse, and blew up soon after 9 o'clock with tremendous effect. About midnight after much warping and towing, by the help of a light air of wind the Admiral withdrew his ships out of reach of shells, and came to anchor about 2 a.m. on the 28th August after 12 hours' incessant labour.

The flotilla of gun, mortar, and rocket boats shared in the honours of the day and performed good service; it was by their fire that all the ships in the port were in flames, which extended rapidly over the whole arsenal. The Dutch frigates covered the British ships from the enemy's flanking batteries, on which Admiral van Capellen kept up a good fire. Altogether the British and Dutch ships fired 50,000 round shot and the casualties were 141 killed and 742 wounded.

The Dutch Admiral in his despatch says:—

"The destruction of nearly half Algiers, and at 8 o'clock in the evening the burning of the whole Algerine Navy have been the result of the

attack. Till 9 o'clock Lord Exmouth remained with the *Queen Charlotte* in the same position, in the hottest of the fire, thereby encouraging everyone not to give up the begun work until the whole was completed, and thus displayed such perseverance that all were animated with the same spirit, and the fire of the ships against that of a brave and desperate enemy appeared to redouble. Shortly afterwards the *Queen Charlotte*, by the loosening of a burning wreck, being in the greatest danger we were, under the heaviest fire, only anxious for the safety of our noble leader."

At daylight on the 28th the Admiral repeated his demands upon the Dey, which were then acceded to. Over 1,000 Christian slaves were freed; the abolition of Christian slavery was promised; due reparation was made to the British Consul and nearly £80,000 was recovered of ransoms paid.

Two accounts of the action by Engineer officers engaged have been preserved, one by Capt. Reid, who was on board the Admiral's ship, is addressed to Lieut.-Colonel Burgoyne and runs thus :—

"*Queen Charlotte*, OFF ALGIERS,
"*August 28th*, 1816.

"MY DEAR BURGOYNE,

"I have made a rough sketch of Algiers, sufficient to give you an idea of our attack, though not otherwise much to be depended on. I have not time to detail the action, which you will have in the despatch.

"This ship led and anchored head and stern within less than 120 yards from casemated batteries obliquely. It was the admiration of our fleet, and astonished our enemy, who were driven from them the first broadside. But the batteries farther from us were not so easily silenced, and wherever they could fire long shots they had the advantage. During the action the *Queen Charlotte* was veered round to different batteries as on a pivot, and when a large enemy's frigate on flames was coming on board of us, she veered away both cables, and hauled in a hawser and saved herself.

"Major Gosset, with an officer of the Navy, and one of the Marine Artillery, boarded the nearest frigate under a heavy fire (she was not manned), and set her on fire. I think it was our carcasses set fire to the others, and caused amongst our enemies a general conflagration.

"It was intended to have stormed the Mole opposite the *Queen Charlotte*, but it was the difficulty of communicating with us, and getting us off again that prevented Lord Exmouth's ordering it. The ships would soon have fired away all their ammunition (for we had thundered from 2 or 3 till 10 at night), and if the rigging had been totally ruined we ran the risk of being all taken.

"Audacity has a great effect in war, and here it has succeeded. Our Sappers were prepared with their arms, hand grenades, smoke balls, and rockets, to storm. We had 13 wounded at the guns. Neither rockets nor shells would set the town on fire. The most of the Algerine guns are very long. I saw as we dropped our anchors two men outside the casemate, one at each end of an immense sponge getting it into the gun. In case this should be the first you hear of us I should say that we gained a victory and made a peace. I have not time to say more."

The terms of peace were the abolition of Christian slavery for ever; the delivery to Lord Exmouth's flag of all slaves in the dominions of the Dey, to whatever nation they might belong, by noon of the next day; at the same time also to deliver all money received for the redemption of slaves since the beginning of the year; and an apology and reparation to the British Consul.

On the 1st September the Admiralty was informed that all the slaves in the city of Algiers and its neighbourhood were embarked and also 280,000 dollars had been handed over for Naples and Sardinia. The fleet left Algiers on the 3rd September and the Admiral was greatly gratified that he had not left a single Christian a prisoner in Algiers. Capt. Brisbane arrived at the Admiralty on the night of the 14th September with Lord Exmouth's despatches. The 7th Company, Royal Sappers & Miners, and the officers of Royal Engineers returned to England in the *Queen Charlotte* and the *Glasgow* frigate. As a reward for their services each soldier received a gratuity of two months' pay. Major Gosset was given a Brevet Lieut.-Colonelcy and again Capt. Reid, who had taken an active part in the engagement and had exposed himself to a heavy fire in an open boat in carrying out the Admiral's orders, was passed over.

On Reid's return home from the bombardment of Algiers he was given two months' leave of absence. He had greatly impressed Lord Exmouth with his ability and his coolness under fire, and, as had several times before happened with other commanders under whom he had served, had inspired his lordship with a personal attachment, which showed itself in the great concern he felt for the unjust treatment which Reid had received, and in his determination to do everything in his power to obtain some official recognition of his merits. He recommended him for promotion for his services at Algiers and wrote privately to the Master-General of the Ordnance, the Earl of Mulgrave, on the subject.

Reid's friends in the Corps were by no means inactive. Lieut.-Colonel C. Pasley, then head of the instructional school for the Corps and for the Royal Sappers and Miners at Chatham, wrote to Lord Exmouth, telling him exactly what the difficulties were that lay in the way of Reid's promotion. He pointed out that what was most wanted was that the powerful influence of his lordship and others should be brought to bear on the Master-General of the Ordnance to induce him, in spite of these difficulties, to recommend Reid for the promotion he had earned over and over again.

The Admiral wrote to Lieut.-Colonel Pasley in reply :—

Letter from Lord Exmouth to Lieut.-Colonel Pasley.

"JORDAN'S HOTEL, ST. JAMES'S STREET,

"*29th October*, 1816.

"MY DEAR SIR,

"I have received your very strong letter in favour of my friend Capt. Reid's claims to brevet rank for his late services under my flag at

Algiers. I was not aware that there were any rules which could operate so fatally to his interest as that you mention. I had written Lord Mulgrave upon it from Cheltenham, saying everything in my power in his favour, and I shall, I am sure, be as happy as Reid himself can be if my application is successful; for no person can have a higher esteem for him than I have. If I should have the good fortune to meet Lord M. next Thursday at Lord Bathurst's dinner I shall embrace the opportunity of entering upon the subject with him, and urge the sensible and strong arguments you have advanced for his being excepted from the general rule before it is established.

"I beg to return you my thanks for your information and for your civil expressions towards myself, and have the honour to be

"Dear Sir,

"Your very obliged and obedient servant,

"EXMOUTH."

The same day that the Admiral wrote the above letter Lieut.-Colonel Pasley had an interview with the Inspector-General of Fortifications on the subject of Reid's promotion, and next day wrote to Reid as follows :—

"LONDON, *the 30th October*, 1816.

"DEAR REID,

"I yesterday spoke to General Mann in your behalf. He was very ill, poor old fellow, so I was obliged to be rather more brief than I could have wished in order to spare him.

"He told me that he had fully as strong a sense of your merits, as I appeared to have (which I doubt), but that *he* could not do more than he had done. That he had already fully explained to Gosset, *you*, and some other person, the circumstances under which *he* himself had acted, and that the sole impediment to your promotion was Lord Mulgrave.

"I concluded by remarking, if *that* was the *case*, that Lord Mulgrave could not do an action that would render him more obnoxious to the Corps of Engineers, or to the Army, than to stop your promotion, but I supposed his lordship was proof against public opinion.

"I this morning received a very civil note from Lord Exmouth* in reply to my letter, that I wrote to him about you. I enclose it for your perusal. You will see that he appears to be as zealous in your cause as you could wish.

"Your very sincere friend,

"C. W. PASLEY."

On the 30th October Lord Exmouth wrote again to Capt. Reid, sending him a letter he had received from Lord Mulgrave dated 26th October, which had been sent to him at Cheltenham and had followed him to town. The letter from the Admiral and its enclosure are as follows :—

"JORDAN'S HOTEL, *30th October*, 1816.

"MY DEAR REID,

"The enclosed came to me this evening and sorry, very sorry am I to send it to you. If I dare do such a thing without permission I would send

* This is the letter of 29th October given above.

Lord Mulgrave the very sensible and well-argued letter which Lieut.-Colonel Pasley, a stranger, sent to me in your behalf wherein he does you most ample justice. I must not send it without Colonel Pasley's consent, but I have a great mind to send it to you that you may know how he values you, not however more than I do, I assure you. If I meet Lord Mulgrave to-morrow at Lord Bathurst's at dinner I will certainly speak to him upon it again, or I will send him any statement you please to make in refutation of his statement in which I would fain hope he is mistaken.

"Believe me, my dear Reid, ever your sincere and faithful servant and friend,

"EXMOUTH."

Letter from Lord Mulgrave to Lord Exmouth enclosed with preceding letter.

"MULGRAVE CASTLE, *October 26th*, 1816.

"MY DEAR LORD,

"I am fully sensible of the general merits of Capt. Reid, and know of no recommendation that would have more influence than yours in any measure which I should feel at liberty to adopt, but Capt. Reid has but seven 2nd captains under him in the Corps of Royal Engineers and has not yet served the two years in that rank which are necessary for promotion to the rank of field officer; there is however a still stronger (were he qualified to receive the brevet) which is that about 70 senior officers would be affected in their ultimate views of arriving at the command of a battalion by Capt. Reid receiving brevet rank, and I am persuaded your lordship will at once see that in so meritorious and distinguished a Corps many highly meritorious officers of eminent service must amongst that number be passed over. I am obliged therefore from consideration to the Corps at large, however desirous of attending to the services of Capt. Reid, and to your wishes in his favour, to decline recommending the brevet promotion of that meritorious officer. I trust this explanation will satisfy you and leave no doubt of my desire in all things possible to manifest the sincere respect and esteem and with which I am, my dear lord,

"Yours most sincerely,

"MULGRAVE."

All the efforts of Reid's friends to get him some reward in the shape of promotion for his war services proved unavailing. Want of precedent had stood in his way when he was a subaltern and prevented his promotion to Brevet Captain, which had been so strongly recommended by the commanders under whom he had served in the field, and now that he was a Regimental Captain another difficulty prevented him getting a Brevet Majority. Pressed, however, on all sides to do something for Reid Lord Mulgrave asked for a Companionship of the Bath for him, but this also was barred. On the 28th November Lord Mulgrave had to write to General Mann that he was not aware when he made the application that the order was not given to an officer under field rank, adding, "if you think the knowledge of an unsuccessful effort in his favour would

be satisfactory to Capt. Reid you can make such use of the enclosed letter as you think proper." The letter was as follows :—

"*November 25th*, 1816.

"DEAR MULGRAVE,

"According to the existing Regulations the 3rd Order cannot be conferred on Capt. Reid, but you will see Lieut.-Colonel Gosset's name inserted in the gazette for that honour to-morrow or Saturday.

"Yours very sincerely,

"BATHURST."

Reid also received the following letter from his cousin by marriage, Lieut.-Colonel Cornelius Mann, R.E., who was aide-de-camp to his father, the Inspector-General of Fortifications :—

"PALL MALL, *27th November*, 1816.

"MY DEAR REID,

"I cannot learn that any correspondence of yours to Lord Exmouth passed through the General*; but I find that two or three of your letters to his lordship were sent to us for the purpose of being forwarded direct under our franks. This was done by your desire as you did not know where to address him.

"I fear now by the last correspondence with the Master-General all prospect of success has entirely vanished, so completely have the Earl† and the General* closed the door by a determination on both sides not to give in. Nothing will or can make the General recommend while the obnoxious Regulation is considered to have effect.

"You must not take the General's meaning as a want of desire to serve you, I can assure you that he feels considerably distressed that you should be the sufferer; he has more than once expressed himself how happy it would make him to see your wishes fulfilled, and indeed I believe there is no one here, but what would be equally rejoiced.

"All your friends at Lewisham are in good health and desire their best regards.

"Ever faithfully yours,

"CORNELIUS MANN."

If envy had been in Reid's disposition he might well have envied Gosset's good fortune. For his services at Algiers, where he was the senior officer of Royal Engineers, Gosset not only had been promoted a Brevet Lieut.-Colonel, thus cutting away the main ground of the protest against Army rank carrying the commandantship, but he had also been created a Companion of the Bath. Envy was far from Reid, but he felt the insincerity of the argument advanced for denying him brevet rank, when it was conferred without demur upon another.

On the 4th December, 1816, Colonel (afterwards Sir) John Jones wrote to Reid the following letter, and it is strange that he does not

* General Mann, I.G.F.
† Earl of Mulgrave.

remark on the inconsistency of the position adopted by the authorities :—

"MY DEAR REID,

"I have taken different opportunities since the receipt of your letter to speak with everyone concerned respecting your promotion; and I am exceedingly sorry to add that I think it no further advanced than at your first application.

"The succession to the battalion is a stumbling block that can only be removed by some general decision on the subject.

"I hear such is now under consideration in consequence of Nepean's death; as J—— should succeed by regular rotation, and K—— by the senior brevet rank; as the latter has never been on service and obtained his promotion in a fencible corps in Newfoundland, the case is deemed favourable to make a stand against the Regulation, and General Mann is now doing so.

"This information is *entre nous*, but I have mentioned it, as if carried for the regular succession, your promotion will, I think, follow.

"Lord M. is, I believe, already shaken on the point.

"Believe me, etc.,

"JOHN T. JONES."

By this time Reid was beginning to lose patience and a sense of bitterness took possession of him for a time. He even went to the length of writing to the Master-General of the Ordnance asking permission to resign his commission in the Corps. His uncle, Lieut.-General William Fyers, C.R.E. in Ireland, heard of it and wrote the following letter, which is dated December only, but from internal evidence it must have been written, it is thought, at the beginning of the month :—

Letter from Lieut.-General William Fyers, R.E., to his nephew, Capt. William Reid, R.E.

"DUBLIN, *December*, 1816.

"MY DEAR WILLIAM,

o o o o o

"I had a letter from Colonel Mann lately which gave me much uneasiness on your account.

"He informed me that you had written to the Master-General of the Ordnance soliciting his leave to resign your commission in the Corps of Royal Engineers.

"I am sure I feel as much mortified as you yourself can be at your merit, services, and sufferings not meeting with the recompense which, I must own, you had a right to expect.

"They will not, you may be assured, be forgotten, and the reward will come in due time;—but it grieves me to see you displaying a spirit of resentment, which can only injure yourself.

"What your expectations may be from other quarters I do not know, but this I am sure of, that a commission in the Corps of Engineers, with

the rank and character you have attained in it, should not be surrendered on slight grounds. Nor is this 'kicking against the pricks' a wise course to pursue. I flatter myself, however, that the Earl of Mulgrave, who has always expressed himself favourably towards you, will show himself so much your friend as not to take you at your word. I am sure it would be a sad grief to your father and mother, as it would to me and all your friends and well-wishers.

"Pray remember me most kindly to Colonel Pasley.

o o o o o

"I have had a very tedious and rather uncomfortable journey round this island, but that I believe I mentioned to you before.

"I begin to be afraid from the delay that there is some hitch about filling up the vacant battalion.

"I remain, my dear William,
"Very affectionately yours,
"WILLIAM FYERS."

o o o o o

His uncle's good advice did not have much effect on Reid, who wrote in reply on the 6th December a wild sort of letter, in which he proposed all manner of ways of bringing his wrongs to notice. After all he was but 25 years of age and such a succession of disappointments after all his brilliant war service was enough to fill him with indignation and make him lash out rather freely in his letter to his uncle. Perhaps the General took him a little too seriously, but he administered a wigging, while, at the same time he gave him good advice, as the following letter shows :—

Letter from Lieut.-General William Fyers, R.E., to his nephew, Capt. William Reid, R.E.

"DUBLIN, 13*th December*, 1816.

"MY DEAR WILLIAM,

"I have just received your letter of the 6th, and lose not a moment in giving another dose of advice, as you profess to respect mine in the beginning of the letter though you seem to forget that profession before you conclude it. I can, you must be sensible, have no motive but your interest in giving you advice.

"In the first place, I think nothing can be more impolitic than pressing your suit in the manner you propose at the present moment.

"It happens fortunately that the battalion vacant by the death of General Nepean will bring the matter to a crisis, and I have reason to believe there will be some hesitation in bestowing it according to Army rank instead of rank in the Corps. . . .

"It does not follow that your brevet appointment coming somewhat later prevents its being antedated, so as at least to bring you on a par with those who are your contemporaries in rank and employed in the last expedition.

"You may depend upon it that your projected petition to the Prince Regent would do you more harm than good and I wonder your own good

sense does not suggest this to you, and that it would, as a matter of course, be referred to the Master-General of the Ordnance, who has, as yet, no reason to be your enemy, unless by a flippancy of conduct (I am persuaded not natural to you) you should make him so.

"Your idea of an appeal to the people is still more ridiculous and absurd. It might completely ruin your prospects of advancement.

"If you have any respect for my opinion and advice I now give it to you under a conviction that it is the wisest course for you to pursue.

"Abandon your scheme of petitioning the Prince Regent, and also that of an appeal to the Spa-fields mob. It makes me sick to think of it.

"Whatever representations you have to make make them to *General Mann* with that modesty and respect I know to be so natural to you, and which is the best foil to your merits and distinguished deserts.

"You may be sure that such representations will not be suppressed, or withheld, and that instead of weakening they will add great force to your claims and arguments.

"But, perhaps, at the present moment the wisest course will be to remain quiet and wait to see what will be done.

o o o o o

"I remain, my dear William,
"Your very affectionate uncle,
"WILLIAM FYERS."

On the very day that Reid wrote to his uncle the letter of the 6th December, 1816, which called down upon him the reproof and advice contained in the above letter of the 13th December, Reid had suffered a great and irremediable loss by the death of his father. The Rev. James Reid died at the age of 85 years at Kinglassie Manse, having been minister of the parish of Kinglassie in Fifeshire for 43 years, and of the parish of Lamington in Lanarkshire for eight years. He was buried on the 12th December in the churchyard of Kinglassie. In those days the post was slow and evidently General Fyers in Dublin had not heard of his brother-in-law's death when he wrote to Reid on the 13th. After the death of his father Reid's mother went to live at Kirkcaldy.

In February, 1817, having returned from Scotland, Reid consulted his friends before taking any rash step. No notice had been taken by the Master-General of the Ordnance of his application to be allowed to send in his papers. The result was that he followed the advice of his uncle and his friends and made a final appeal to the Master-General. What was probably of much more use to him was a letter he wrote to the Duke of Wellington, then commanding the Army of Occupation in France, which brought him back to the Duke's recollection; while his friend, Lord Exmouth, not only wrote at the same time to the Duke, but had a conference with Lord Mulgrave.

Lord Exmouth wrote to Reid on the 22nd February, 1817, "I have had my conversation with Lord M. and should like to see you, when convenient, to talk it over."

Reid's letters to Lord Mulgrave and to the Duke are as follows :—

To the Rt. Hon. the Earl of Mulgrave, Master-General of the Ordnance, etc., etc., etc.

"CHATHAM, *16th February*, 1817.

"MY LORD,

"I beg to apologize after the many letters which have passed concerning my promotion, for troubling your lordship again with another.

"But I feel it due to myself, to all the captains of Engineers, and to all those who are yet to be captains, to ask (and I do it with profound respect) whether captains of Engineers are not to continue to look forward to the same rewards by brevet as captains in other corps.

"That such a Regulation would deeply affect the welfare of our Corps, I feel no doubt but that your lordship will be sensible of; and we may still trust that any officer showing sufficient merit will receive the reward due to him.

"I have been ambitious of meriting brevet promotion, and I flattered myself that by my good fortune and exertions I had gained it. For although I shall not presume to say that of all the captains of Engineers I am the fittest to be advanced in the service of my country (for we have men of first-rate talents amongst us); yet I will so far presume as to declare that I have been oftener engaged with the enemy than any captain of Engineers, either those who have received brevet rank, or who have not.

"If there should be any of the above number who can vie with me in point of applauses of commanders for general conduct while engaged, they have been much less engaged, and they are all Brevet Majors, or Lieut.-Colonels, with the order of merit, the 3rd Order of the Bath.

"I have been in thirty separate affairs with the enemy, among which are five general actions and seven sieges, besides Algiers. In the sieges I was employed in twelve assaults, the heads of three of which I guided; and by good fortune I was engaged in all the large sallies made in these sieges, and all these, although separate instances of being warmly engaged with the enemy, are not included in the thirty separate affairs before mentioned.

"I can add still more, my lord; that there are but two officers in the whole Corps of Engineers that have been more under fire than myself. These are Lieut.-Colonels Jones and Burgoyne.

"With such a claim as this, I think your lordship will excuse my numerous appeals; and I trust in your candour to forgive my entreating you again for brevet promotion.

"I have the honour to be, with the greatest respect,

"Your lordship's most obedient humble servant,

"WM. REID,

"*Captain, Royal Engineers.*"

The copy of the above letter kept by Reid has this docket: "Last letter on the Brevet Majority when forced to compare my services with others."

Letter from Capt. W. Reid, R.E., to the Duke of Wellington.

LONDON, *26th February*, 1817.

"MY LORD DUKE,

"I have the honour to enclose a copy of a very handsome letter,* which the Master-General of the Ordnance has done me the honour to write, by which Your Grace will see that he had recommended me for the Companionship of the Bath, but which I cannot receive, as I am not a Major.

"From recommendations which Lord Exmouth has been pleased to make on my behalf to promote me for my services at Algiers, the Earl of Mulgrave is desirous that I should obtain it, but as I did not command on that occasion, and as the services I have had the honour to perform under Your Grace have been so much greater (and though the other was brilliant), yet those under Your Grace were on such a different scale, he feels a diffidence in recommending my promotion without Your Grace's sanction and approbation.

"In stating my services to the Master-General of the Ordnance I have shown: that I have been oftener engaged with the enemy than any other captain of Engineers, not excepting any of the brevet majors or lieut.-colonels; and not the captains only but that I have been more under fire than any officer in the whole Corps of Engineers, excepting two—Lieut.-Colonels Burgoyne and Jones.

"Your Grace is also aware that although many attempts were made to obtain Brevet Captaincies for the late Lieut. Wright and myself by Sir Richard Fletcher, that rules in the Service prevented our promotion then.

"From these considerations and Your Grace's former honourable testimonials of my conduct before the enemy, as well as the consideration that a great part of the time I had the disadvantage of being a young subaltern in a large army, I think I may hope that Your Grace will not only approve of my being promoted, but that you will honour me with your support and recommendation.

"I have the honour to be with great respect,

"Your Grace's most obedient humble servant,

"WILLIAM REID,

"*Captain, Royal Engineers.*"

On the 13th March, 1817, Lord Exmouth wrote to Reid as follows:—

"MY DEAR REID,

"I send you a copy of the Duke's letter to me received this day. I have sent the original to Lord Mulgrave and do most sincerely hope your wishes will ultimately be crowned with success. Whatever may be the result I shall request to know it, for although our endeavours may fail for the present I shall never cease to embrace any occasion which presents for your attainment of an object so truly merited.

"Believe me ever most sincerely,

"Your attached servant,

"*13th March*, 1817." "EXMOUTH."

* This letter is not forthcoming.

Copy of a letter from the Duke of Wellington to Lord Exmouth.

"PARIS, *March 8th*, 1817.

"MY DEAR LORD,

"I received by this last post your lordship's letter of the 26th ult. and it has given me the greatest pleasure to have it in my power to join my recommendation to that of your lordship in favour of Capt. Reid of the Royal Engineers. I have written by this post in his favour to Lord Mulgrave in the strongest terms.

"Allow me to take this opportunity of congratulating your lordship upon the successful and honourable termination, under your command of the most arduous and brilliant operation and service that has occurred for many years. I assure your lordship that no person admired it more than I did, or was more sensible than I was, how much of its brilliant success was due to your lordship's combinations, and to your heroic conduct and example.

"I have the honour to be,

"My dear lord, ever your most obedient and faithful servant,

"WELLINGTON.

"ADMIRAL THE LORD EXMOUTH, G.C.B., etc."

Lord Mulgrave's reply to Lord Exmouth's letter enclosing the Duke of Wellington's, ran as follows :—

The Earl of Mulgrave to Lord Exmouth.

"HARLEY STREET, *Thursday Night.*

"MY DEAR LORD,

"At my return home I find your lordship's letter, and I lose no time in assuring you that my best exertions shall not be wanting to forward the promotion of Capt. Reid; indeed I have already made application to the Duke of York.

"I return the valuable letter of the Duke of Wellington, who, eminently qualified to judge of such achievements, is best able to express them in appropriate terms.

"It is no ordinary testimony of the merits of Capt. Reid to have excited the warm interest of two such commanders of his services. I beg leave to assure your lordship that I am with feelings of the highest respect and regard

"Your lordship's most faithful and obedient

"MULGRAVE."

Unfortunately the Duke's letter cannot be traced. It would have been interesting to know precisely how Reid stood in the eyes of the great commander and in what words of commendation the recommendation was made.

Whatever the reason may have been, it is clear that Lord Mulgrave was now more than "shaken on the point," as Colonel J. T. Jones had expressed it. In fact, as Colonel Pasley had suggested, the application of powerful influence had completely broken Lord Mulgrave's adherence to the views he had formed, and to which he had so pertinaciously held.

His application to H.R.H. the Duke of York, Commander-in-Chief, for Reid's brevet, coming from the Master-General of the Ordnance and backed by the support of the Duke of Wellington and of Lord Exmouth secured immediate attention and the brevet was sanctioned.

The Secretary of the Board of Ordnance wrote the following letter to the Inspector-General of Fortifications to inform him :—

From Lieut.-Colonel (afterwards Lieut.-General Sir) Stephen Remnant Chapman (C.B., K.C.H.), R.E., Secretary to the Master-General of the Ordnance, to Lieut.-General Gother Mann, Inspector-General of Fortifications.

"OFFICE OF ORDNANCE, 26*th March*, 1817.

"SIR,

"I am directed by the Master-General to acquaint you that His Royal Highness the Prince Regent has been pleased to confer the Brevet rank of Major in the Army on 2nd Capt. William Reid of the Royal Engineers, on account of the representation which has been forwarded by his lordship of the gallant and distinguished conduct of that officer in several instances while on service.

"I have, etc.,

"S. R. CHAPMAN."

It must be confessed that the letter is not worded enthusiastically. It seems to have been dragged unwillingly from the Commander-in-Chief. "Gallant and distinguished conduct of that officer (Capt. Reid) in *several instances* while on service" is a meagre and inadequate statement, to say the least, considering the extraordinary number of instances in which Reid had displayed gallantry and distinguished himself on service. But Reid had won the recognition he had wanted and was not only content but very grateful to all who had assisted him to obtain it. The promotion was dated 20th March, 1817.

The date on which Reid's promotion for gallant service in the field was first recommended was, it will be remembered, as far back as the 17th May, 1811, when Capt. John Squire wrote strongly in his favour from Elvas for his gallantry at the first Siege of Badajos, and the Commanding Royal Engineer, Colonel Richard Fletcher, forwarded a copy of a most honourable testimonial of Reid's conduct on that occasion to the Inspector-General for Fortifications. During the six years which had passed since that date he had added year by year to his claims for reward, and had been repeatedly recommended for it by the various distinguished commanders under whom he had served. This brevet majority was the first and only reward received by Reid for services in the Peninsula, at New Orleans, in the Netherlands, at the Capture of Paris, and at the Bombardment of Algiers. It would not have been more than a due recognition of these claims to have given him a second brevet and a C.B. But in those days rewards were for the favoured few, and his brevet majority remained for many years the only recognition of his merits.

DEPRECIATION.

A Paper read by MAJOR W. A. J. O'MEARA, C.M.G., *before the Institution of Post Office Electrical Engineers on April 4th*, 1910.

EVERY sound commercial undertaking presents to those responsible for its management one main problem, and that is, how best to provide an excess of revenue over expenditure, sufficient in amount to ensure the stability of the undertaking as a "going" concern. Naturally, the considerations which affect the solution of the problem differ very widely in different classes of undertakings, and according to the nature of the enterprise which is involved.

It is not my purpose, however, to deal with these considerations generally, but with one element only which affects this problem. I shall further endeavour to confine my remarks more particularly to those aspects of this element which apply to the telephone business. The element which I propose to deal with is that of depreciation, a subject which by itself requires the study of almost a lifetime, and forms a factor of most profound importance in every undertaking which depends largely for its existence on the employment of machinery or plant.

DEFINITION.

Depreciation has been defined as a "lessening in value from age and contributory causes," and it may be said to be, that deterioration or fall in value of physical property which is not made good by current repairs. It is evident that if impairment of the services rendered by the use of any machinery or plant subject to decay or deterioration is to be avoided, measures must be adopted for the replacement of the same, bodily, before it reaches that state of decrepitude which would result in a total or partial cessation of these services.

ASPECTS.

Depreciation can well be considered as having two aspects, namely, the Engineering aspect and the Accounting aspect; these two aspects, however, are intimately associated, since the provision made under the second named is determined almost wholly by considerations arising out of the first named.

I have to confess that I have found it by no means an easy matter to prepare this paper. The fact is that no two authorities on the subject appear to have included the same factors in the term "depreciation," and further there is no accepted standard method of dealing, from the accounting view, with the funds which should be set aside to pay for replacements of plant, etc., as they become due. For convenience I propose to deal separately with the engineering and accounting aspects of the question.

ENGINEERING ASPECT.

The principal considerations affecting the question of replacement of machinery and plant, and the buildings in which they are housed, are as follows:—

i. Physical decay.
ii. Obsolescence, sometimes called antiquation.
iii. Inadequacy.
iv. Tenure of holding.
v. Reconstruction requirements imposed by legislation.
vi. Unforeseen expenditure arising from accidents or other emergency.

The enumeration of these factors which are involved in the determination of the "life" which shall be assigned to physical property of various kinds, in order that proper provision may be made in the accounts of an undertaking to meet the charges in respect of depreciation, demonstrates, to some extent, the great complexity of the problem presented to the engineer who has to prepare estimates dealing with this important subject.

PHYSICAL DECAY.

It is well known that buildings, machinery, and plant, however well they may be constructed and cared for, gradually deteriorate so that ultimately they must be replaced, hence the necessity for providing against depreciation has been universally admitted so far as it concerns the factor of physical decay, and at one time this deterioration was thought to be the only item which had to be taken into consideration in assessing the "life" of machinery, etc. It would, at first sight, appear that little difficulty need be experienced in making the necessary allowance to provide for this item, but if it is agreed that the basis on which the "life" of such a class of property is estimated must have a surer foundation than that of the mere expression of an individual opinion, then it will be no easy matter to frame suitable estimates to provide for depreciation.

To make the matter somewhat clearer, let us consider a few of the factors which will enter into the engineer's calculations in connection with depreciation on some of the classes of property necessary for the conduct of a telephone enterprise.

Probably it will not surprise you if I commence by mentioning land. On the completion of a development, study the acquisition of a site, for the central station equipment is the first matter which has to be considered. The members of this institution are well aware that it is necessary to establish telephone exchange buildings as near as possible to a certain theoretical centre, and unfortunately, however careful may have been the study on which the fundamental plan was based, it is known that telephone business is apt to develop in an erratic manner in some localities. When this is the case, the exchange building is no longer situated in the position which is most economical from the point of view of the provision of external plant, and in consequence the land value deteriorates, not only because the location of a site has not always the same economic aspects in other undertakings as in a telephone enterprise, but also since the buildings thereon may have to be removed at considerable cost to render the site free for the undertaking which it is proposed shall replace the telephone exchange. Land is liable to further deterioration from causes apart from the character of the business carried thereon. The nature of the subsoil may be treacherous, and subject to subsidence owing to mining or other causes; these factors may involve enormous unproductive expenditure in connection with foundations and other subterranean works. The deterioration in such cases can, I think, often be quite logically regarded as in the nature of physical decay of the land.

A reference to the conditions affecting depreciation upon buildings seems to follow appropriately here. My last remarks indicate, I think, that the character of the land on which buildings are erected is a factor which in some cases may have considerable influence in the estimation of their "life." This land may be freehold or leasehold. The nature of the servitudes, if any, on the site, and the duration of the lease and the terms under which it is held, are naturally factors which will play a determining part in the Engineer's calculations. Further, the character of a building is an important factor in fixing its prospective "life." Little expert knowledge is required to decide whether a building having a substantial foundation laid in concrete, a skeleton framework of steel, and stone casing, will outlast a jerry-built brick structure. Again, the durability of each class of buildings will depend largely on the character of the periodical repairs which may be carried out.

What I have said in respect of the effect in the value of land owing to the shifting of the economic centre applies equally to the value of telephone buildings. However, in both cases, in certain

circumstances, instead of a lessening in the value, an actual appreciation in value may accrue to both the site and the building. The appreciation may arise from a natural increase in land values, or it may be brought about by the erection of high-class buildings in the immediate vicinity of the property in question. There are other more remote causes which sometimes affect land values.

The causes affecting the full "life" period of plant and machinery are more numerous than in the case of buildings. There is the inevitable wear and tear resulting from the operation of the plant or machine; further, negligence and incompetence naturally accelerate the rate at which deterioration takes place. For instance, the "life" of accumulators is largely dependent on the care which is exercised in charging and discharging them. In other classes of plant, under the expression "wear and tear" have to be included not only the destructive forces which come into play owing to the actual user, but also those external forces which contribute to the destruction of certain classes of property. Take the cases of subterranean and aerial cables: the principal causes of deterioration which affect their "life" are:—

1. Mechanical injury.
2. Chemical decomposition.
3. Electrolysis.
4. Vibration.
5. Lightning.
6. Attack by insect—*e.g.* by the cable bug whose appearance in Australia, California and southern portion of the United States has been notified.

Similarly, poles are liable to:—

1. Mechanical injury.
2. Attack by fungus growths.
3. Destruction by woodpeckers and insects.

In both these cases, clearly the external forces are more potent than those arising from the "duty" imposed by the user of the plant; that is, the factors usually referred to as wear and tear.

I think it is unnecessary to refer to any other parts of a telephone system, for illustrations of the causes which so largely determine the "life" of the various classes of physical property necessary for the conduct of a telephone enterprise, more particularly as the "life" of the only other items of real importance, depends on considerations which play a more influential part than wear and tear and which will be dealt with later. Those items are the Central Office equipment and apparatus.

The most correct estimates of the average "life" of the various classes of plant involved in any undertaking can best be secured by means of statistics. Depreciation is to some extent dependent upon the character of the day-to-day maintenance which has been provided, but it should not be forgotten that local conditions also play an important part. The chief requirement in order that an engineer may be properly assisted in this matter clearly consists in the preparation of a carefully compiled record in which the various descriptions of machinery and plant are properly classified. Such a record should show the causes for which any machinery, plant, etc., have been put out of service, the period during which they were in use, and a statement of local conditions likely to have affected their life.

I think I have now said sufficient on the "age" aspect of depreciation, and will turn my attention to the "contributory causes" of depreciation.

Obsolescence.

The first of these causes, namely obsolescence or antiquation, is a factor of much moment in an undertaking such as the telephone enterprise, particularly in the present stage of its development when the art is rapidly changing owing to the progress of invention.

The substitution of new and up-to-date machinery and appliances for old plant cannot always take place, but only at such times as the management of a concern can justify the change owing to the economies which it is hoped to effect by the abandonment of old plant in favour of newer designs. Another influence prevails. It must be remembered that the public nowadays soon learns that much more convenient service may be afforded by some new invention, and at once commences to clamour for its introduction. Few administrations can withstand the pressure of the public when the convenience of the latter is seriously affected, and the result is that often before the natural "life" of old plant is exhausted, the newer design has to be substituted. During my stay in America, I learnt that frequently it was due to such pressure alone that common battery systems had replaced magneto installations. We have not reached finality in the design of switch equipments; auto-manual and automatic equipments are on the market, and must be taken into consideration in estimating the "life" of telephone apparatus.

Inadequacy.

The item affecting depreciation which is most difficult to cover by an estimate is that of inadequacy; it is largely governed by the original fundamental plan or lay-out, which in its turn is dependent on the development study. In the case of a telephone undertaking,

not only the rate of growth of the subscribers, but also their distribution may have been inaccurately predicted. It has already been stated that one effect of this is the disturbance of the economic centre; unfortunately, the mischief does not end here, but other results may be that the switchboard equipment is housed in buildings which cannot provide for efficient development at the higher rate demanded by the public requirements. It may also become necessary to replace overhead distribution immediately by means of an underground system, owing to insufficient carrying capacity having been provided in the original pole lines, and in some cases cables may have to be withdrawn within a few months of being laid to be replaced by others containing larger numbers of conductors. Electric lighting undertakings suffer from the same difficulty in connection with the design of their distribution system. The Post Office engineer is unfortunately also liable to the same errors as prophets in other fields.

TENURE OF HOLDING.

Tenure of holding may affect any class of telephone plant. It is quite a common practice to instal switchboards in a rented building; in such cases it is the term of the lease, and not the character of the equipment which may determine the "life" of this plant. Further, it is unfortunately necessary at times to place external plant, both underground and open, on private property under a wayleave agreement containing a removal clause; and here again the plant may have to be disturbed, with consequent loss, before the expiration of its natural or even useful "life." If the cases of removal due to these causes are carefully recorded it will not be difficult to make a fairly satisfactory allowance for such disturbance in estimating depreciation.

RECONSTRUCTION REQUIREMENTS IMPOSED BY LEGISLATION.

It sometimes happens that reconstruction of plant has to be carried out by its owners owing to the exercise of statutory powers conferred on public authorities and corporations.

I have in mind such cases as the disturbance of pole and pipe lines by the widening and regrading of streets by city authorities, and by the widening of railways, reconstruction of sidings and stations, etc.

In such cases the disability under which public companies often have to operate is also felt by a State department. Cases are not unknown in which the Post Office has been called upon to pay for the reconstruction of its telegraph and telephone lines, in connection not only with alterations to streets, but also in connection with the widening of railways.

The burden thrown on the Post Office by the alterations to railway works has been particularly heavy. In one case in which a very

considerable mileage of wire was affected, the payments in respect of the reconstruction of telegraph lines involved amounted to 50 per cent. of the capital value of the plant disturbed, after making due allowance for value of recovered stores.

Unforeseen Expenditure Arising from Accidents or other Emergency.

I now come to the last of the factors mentioned as requiring consideration in connection with the replacement of machinery and plant, namely unforeseen expenditure arising from accident or other emergency. I am inclined to agree with those engineers who hold the view that any replacements on a considerable scale, rendered necessary in such circumstances, should really be provided for by means of an insurance fund or by payments of annual premiums to an insurance company. Annual sums set aside for this purpose would of course form a part of the working costs and they should be debited as headquarter charges. Consequently this item need not be included in the appraisal of "lives" of machinery and plant.

Estimates of "Lives" of Machinery and Plant.

The foregoing cursory investigation of some of the details of the factors which determine the useful "lives" of machinery and plant, etc., seems to indicate that if estimates relating to depreciation are to be tolerably reliable, it is desirable that the machinery or plant shall be scheduled under a sufficient number of distinct classes. Such classification will enable the engineer to give proper consideration to the effect which each of the first five factors mentioned by me as influencing depreciation will probably have on the peculiarities of each type of machinery, plant, etc.; for admittedly all the factors mentioned do not affect every type of machinery or plant in the same degree. As an illustration it is necessary to mention a single factor, only, namely, obsolescence. Little experience is necessary to tell us that in the past the internal plant of a telephone system has been affected by this factor to a far greater extent than the external plant, and that this condition of affairs is likely to continue.

In an undertaking which has been in existence for a considerable number of years and which comprises fairly large quantities of plant of the various descriptions required for its conduct, carefully kept records relating to such plant will afford a secure starting point for the appraisal of the "lives" of various classes of machinery and apparatus employed in the undertaking under consideration, and they will give fairly accurate information concerning the average "lives" of certain classes of plant, the replacement of the greater proportion of which has arisen so ly on account of physical decay. Such

"lives" may be considered to be the maxima for these classes. In order to estimate the useful commercial "life" it becomes necessary to make deductions from the foregoing maxima in respect of those factors which particularly affect the depreciation of any class of plant. The approximation of the deductions to the true value will depend not only on the extent and quality of the experience of the engineer responsible for the estimate, but on the possession by him of early and accurate information of the nature of the progress inventors are making in the design of new plant, and of a correct appreciation of the real importance of the improvements foreshadowed. Some persons appear to have a highly developed intuitive faculty for prognosticating coming events, and, in view of the problems which will fall to the lot of the engineer, it seems desirable that members of our profession should be well endowed with the quality for accuracy in prediction, that is with a prophetic insight.

I have prepared a table (Appendix I.) showing the estimated years of life which have been assigned to certain classes of plant. It is hardly necessary for me to state that the inclusion of the table in this paper is in no way to be considered as an acceptance on my part of the accuracy of any of these estimates. The statement of "lives" is placed before you rather with the object of showing that engineers are not entirely in agreement regarding this important matter. It may reasonably be asked, how the disagreement of experienced engineers on this question is accounted for. It is possible that an explanation for the divergence of views may be found in some or all of the following considerations :—

1. Engineers do not yet work to standard specifications; for example, tin is not contained in the lead covering of all aerial cables; again, in some cases petroleum jelly is employed as a lubricant when lead-covered cables are being drawn into ducts, and in other cases no lubricant is used. I need not enlarge on this point, as the other classes of plant in which differences in actual character are to be found will readily occur to you. The variations in the specifications relating to the two examples mentioned above no doubt appear small, but they prove to be important factors in actual practice. The absence of tin or the addition of 3 per cent. of this metal in the lead sheathing of an aerial cable really determines whether the "life" of the cable will be a comparatively short one or long one.

In the case of underground cables, the use of petroleum jelly has actually proved to be a protective agent against chemical attack, and in consequence cables treated with this substance have a longer average "life" than those which are not so treated. Each engineer naturally relies on his own experience and records for his estimates, and the foregoing statements disclose grounds for different "life" values being assigned to classes of plants which though generally considered similar are really dissimilar.

2. Since machinery and plant of similar types are not generally exactly similar in all respects, it follows that the character of the day-to-day maintenance in connection with their operation also varies. This appears to be particularly the case in connection with telephone enterprises.

3. In determining "lives" the same factors (*i.e.* obsolescence, inadequacy, etc.) are not always included, nor are the same values attached to those factors which have been included in the calculations.

4. Not only do views vary on the policy to be adopted in discarding obsolescent plant, which is largely a question of the temperament of the responsible officials, but as already stated, the extent of knowledge regarding improvements in progress and the experience and judgment of different engineers naturally vary considerably, and hence the personal equation of the responsible engineer has considerable influence on the completed estimate.

Depreciation which covers the total annual loss on the plant is sometimes divided by engineers, (as shown in Appendix I.) under two heads which may be termed "ordinary depreciation" and "extra-ordinary depreciation." The former term takes into account the life of the plant due to age and to advances of the art, and the latter expression covers wastage due to the necessity for reconstruction brought about by legislation.

I cannot leave the engineering aspect of this subject without a reference to "scrap" values. The price, obtained from the sale of machinery or plant when put out of service, is of course available to pay some part of the cost of replacement. In consequence, it is customary to estimate the probable value that machinery and plant will have at the end of their useful commercial "life," in order that the sums set aside for replacement may be suitably reduced in amount so as to provide as nearly as possible the actual cost of the replacement. The prices, obtained for old material at sales held over a considerable period, will, in the case of the majority of plant in use, readily enable an engineer to arrive approximately at the average percentage values on cost price which should be allowed for the various classes of "scrap."

Accounting Aspect.

When the engineer has settled the basis on which the proper allowances for depreciation can be provided in the most effective manner, the first question which has to be considered is the method by which the determined amount for depreciation shall be made available when renewals become necessary. This is almost entirely an accounting matter.

It may be well to explain that accountants usually apply the term "depreciation," to represent "the amount which has to be charged against the Profit and Loss account in respect of any class of wasting

or perishable assets, before the real profit from an accountancy point of view is arrived at." The items which have hitherto been referred to as buildings, machinery and plant, are known amongst professional accountants as "wasting assets."

But the expression "wasting or perishable assets" covers much more than physical property, the expression includes also intangible property, for example, "goodwill." Intangible properties like physical properties are subject to depreciation, as the exhaustion of the field of development, or the termination of an enterprise may extinguish their values as assets in a commercial undertaking.

The time at my disposal will not allow me to deal with the subject of depreciation from the enlarged point of view of a board of directors, moreover, it might lead me into fields which are far more controversial than those which I have already traversed. It is well to remember that some persons hold that there is an unexplored region of human faculty transcending the normal limitations of sensible knowledge. This being admitted, it is possible to contemplate the discovery of some means for the fertilization of these unexplored regions of the human faculty, and further, that by their intensive cultivation, the powers of telepathy may eventually become so highly developed and universal as to enable the human race to manage its affairs without the aid of telephone systems.

I am sure that you will agree that notwithstanding the advantages which this idea, if materialized, would bring, it is natural that we should regard at least one of its consequences with some misapprehension. I allude to the disappearance of our occupation—a contemplation which would give an undesirable countenance to the subject which I have in hand. I therefore dismiss it at once.

The law relating to the responsibility of directors of a limited liability concern is very strict. The management has to keep proper control over the plant employed in the business and to maintain it in working order; in consequence, a legal obligation is implied that sums shall be set aside to replace unserviceable plant, and that records relating to such provision shall be available for the information of the shareholders; nevertheless, no standard method of dealing with depreciation in the accounts of a public company appears to have been evolved.

The members of this institution are doubtless aware that the capital expenditure in connection with many public utility services undertaken by local authorities in the United Kingdom, is raised by means of loans authorized by the Local Government Board, and that in such cases it is expressly provided that these loans shall be repaid within stated periods. In the case of electricity supply undertakings, the practice has been to allow a period of 25 years for the repayment of the loans; this period being supposed to represent the average "life" of the various sets of machinery, plant and buildings upon which the

capital expenditure is incurred. These repayments are secured by the creation of sinking funds.

In the case of a long-established railway corporation owning hundreds of miles of track and large quantities of rolling stock, depreciation is cared for year by year by the replacement annually of a suitable number of locomotives, wagons, etc., and also by the renewal annually of portions of the permanent way, storehouses, station buildings, etc.

In the past, the Post Office has in respect of the renewal of the telegraph and telephone systems, practically followed a plan very similar to that adopted by railway companies; the sums expended for this purpose, however, were formerly merged with the account for day-to-day maintenance, but in recent times a special subhead of the Vote has been introduced to which renewal expenditure is charged.

Further, in connection with the Post Office telephone business, the Postmaster-General renders a financial statement in order to indicate the commercial results obtained. On examination of this statement, it will be observed that amounts expended in respect of depreciation are separately recorded.

In addition to the methods for dealing with depreciation mentioned above, others are also to be found. In fact Professor Dicksee has mentioned that he himself has found six methods in vogue for writing off depreciation, namely :—

1. Charging each year with the actual cost of repairs and small renewals and an equal fraction of the original cost of the asset.

2. Charging each year with repairs and small renewals, and with a percentage for depreciation calculated at such a rate as to reduce it to its then realizable value by the time it becomes useless for revenue-earning purposes.

3. By estimating in advance the total sum chargeable against revenue for repairs, partial renewals and original cost and charging each year an equal portion of it.

4. By charging revenue with such sum as will, at the expiration of the life of the asset, write off the original cost thereof, plus interest on the capital from time to time invested therein.

5. By charging revenue each year with actual or average expenditure upon repairs and small renewals, and with such further sum set aside and invested at compound interest as will accumulate to the original cost of the asset at the expiration of its estimated life.

6. Charging revenue with the difference between the book value of the asset and its actual value at the present time as estimated by an expert valuer.

The results which would be obtained by tabulating the anticipated expenditure in repairs and renewals under each of the above methods, in respect of a machine of which the original cost and the estimated

life are assumed to be £1,000 and five years respectively, are given in Appendix II.

It will be observed that no allowance has been made for the "scrap" value of the machine in these calculations, and that current repairs have been charged to the depreciation account, and in these respects the methods given do not agree with the practice adopted by the authorities quoted earlier in the address—in fact maintenance appears to have been confused with depreciation.

The conditions affecting various classes of undertakings differ so widely, that it certainly cannot be asserted that any one of the methods for dealing with depreciation is the best. It is sometimes the case that during periods of depression the temptation to divert sums which should be provided for depreciation to other purposes is very strong, and in consequence the method adopted should be one in which the risks arising from the starving of the depreciation reserve are not likely to affect the commercial soundness of the undertaking. The really important matter is not the scientific correctness of the records in the company's account books, but the necessity of having cash available at the moment it is required to pay for replacements which may have become necessary. This requirement points to the necessity of forming a "depreciation reserve," and renders it undesirable to employ funds set aside for this purpose in the undertaking itself; rather is it desirable that such funds should be invested in easily realizable securities.

It will doubtless occur to most that in those cases in which services have to be provided under contracts for stated periods, there is some advantage in making provision for depreciation on a basis which involves equal annual payments as the rates to be charged, which are naturally a function of the annual expenditure incurred in providing the service can thus be readily calculated. Methods 1 and 5 given in Appendix II. are both equally satisfactory from this point of view, and in consequence are eminently suitable for adoption in connection with telephone undertakings and similar enterprises.

Before leaving the accounting aspect of the subject, it may be well to draw attention to the fact that so far as it relates to the statements of accounts, depreciation affects both capital and revenue, since depreciation gradually reduces the value of wasting assets, and the revenue or the profit and loss account has to provide the amounts by which the wasting assets are written down in value. From what has already been said on the subject of replacements, it is evident that cases must occur in which the plant retired from service has a capital value which differs from that of the plant which replaces it. This necessitates the adoption of measures for adjusting the Capital Account. One method proposed for bringing about such adjustments consists in the establishment of three separate accounts under the designations of "plant account," "depreciation reserve," and "plant deductions."

The manner in which transactions would affect such accounts is perhaps sufficiently indicated in Appendix III.

The object of the various methods of calculating depreciation, is to represent the real value of the material part of machinery and plant by means of records in accounts, instead of by a process of revaluation by an expert.

It has been asserted that greater accuracy in determining the value of "wasting assets" would be obtained by periodic valuations, and writing off such loss as these valuations show than by a mere process of book-keeping. The principle of such periodical valuations has been accepted in America and also to some extent in this country, and there certainly appear to be some advantages in adopting this method of treatment. One of these advantages, but not the least, is that a useful check is established for comparing the actual with the estimated depreciation in any case.

When such valuations are part of a system, and are carried out by independent experts at regularly recurring intervals, another of the advantages is that opportunities will be afforded to adjust the provisions made for depreciation, in those cases in which insufficient allowance may have been made for the influence of some of the more variable factors which affect the situation.

Conclusion.

I come now to my final remarks.

It is generally accepted that often it is on the rate provided for depreciation alone, that the fortunes of an undertaking may turn in deciding whether a profit or loss is being made at every period of its existence. The duty of the engineer is concerned not only with the design of works alone, but also with their operation and commercial value, and, therefore, his advice will often decide the fortunes of an engineering enterprise.

In every important phase in the development and progress of such enterprises the engineer is faced with the problem of depreciation; he is further much concerned with the exact method of providing for depreciation. If a wrong choice is made money is absolutely wasted.

The problem confronts him from the earliest days of the inception of an engineering project, and matures when competitive tenders for the work first come under consideration. We know that it is not the capital cost alone which determines whether one scheme is more advantageous than another; a comparison of total annual costs in respect of the tenders received, is necessary to enable an engineer to decide which scheme is the more profitable one to adopt, but annual costs are made up of interest on capital, of depreciation and of operative or running costs. As regards any particular tender, the interest on capital and the operative costs are together a constant

quantity. The method of allowing for depreciation may however vary, and it will therefore be seen that according as Method 1, Method 5 or some other method shown in Appendix II. is adopted to complete the figures for the comparison of tenders in respect of two alternative schemes, the annual balance may turn in favour of one tender or another. The engineer is not always in a position to dismiss the question of depreciation from his thoughts, when it has been finally decided that some particular tender for plant or machinery required for his purpose is the most advantageous one, and when in consequence that tender has been accepted. It has already been stated that allowance will have been made in engineers' calculations for obsolescence. In many cases his anticipations in respect of this factor will be realized, for the inventor is sure to come to his assistance with improvements and claims. In practice, however, it will often be difficult to decide exactly at what date it will be justifiable to replace plant doing effective service, by some new invention which may have been "proved in" as eminently satisfactory on being "tested out." In such cases the engineer has to compare a situation in which he has fairly complete knowledge of the value of the various technical and financial factors requiring consideration, with one in which he cannot with the same certainty attach reliable values to the important elements coming into play in connection with the invention, and, further, the value of apparently efficient plant or machinery to be scrapped is sure to attract considerable attention, and in such cases the charge against the depreciation account will indeed loom large. A bold and courageous policy has often proved advantageous in the past in connection with the handling of obsolescent plant, and it is certain to do so again in the future.

In considering the very important question of turning out good plant in favour of new designs of machinery alleged to be more economical, the problem resolves itself into a consideration of the question whether the difference in annual costs likely to be incurred in respect of the new machinery, and the actual annual costs incurred in respect of the existing plant, is sufficiently great to pay for the "wastage" or value of the unexpired useful life of such parts, and of the cost of removing such of it as may be "scrapped." For instance, in the example given in Appendix III. the loss shown under plant deductions will have to be extinguished within a reasonable time after its replacement. In such cases, also, depreciation and the method by which it is provided may clearly be the ruling factors in the commercial situation.

The considerations affecting the aspects of depreciation just referred to are very familiar to the members of this institution. There is still another aspect of the case, which, although of not such frequent occurrence is of immense importance, and that is the aspect in

connection with the valuation of the property of a "going" concern for the purposes of a purchase. The question of the allowance to be made for depreciation becomes in these cases perhaps more controversial than in any other situation. The engineer advising the purchasing party has a double duty to perform. He has to protect his own client and at the same time he has always before him the responsibility of being just to the selling party.

The engineering problems relating to a proposal to purchase a "going" concern, for all practical purposes involve considerations similar to those connected with alternative tenders, for it is simply a case of considering annual costs in respect of the "going" concern, as compared with such costs in respect of the new plant which would do the same work as well, if not better.

The subject of depreciation is of vital importance to shareholders of public undertakings, and it is certainly of no less importance to the public generally, who are to some extent involuntary shareholders in the undertaking which absorbs our energies.

A public utility service managed by a State department must be not only the best of its kind, but the charges made for it must be reasonable and such as not to involve a burden on the ordinary taxpayer. Thus we see that ultimately depreciation finds its way into the rate charged for our telephone service, and must react on the same with every change in engineering policy.

Since writing this paper my attention has been drawn to an interesting pamphlet entitled "Introductory Notes on Leake's Register of Industrial Plant." Mr. Leake is a great authority on depreciation and I can thoroughly recommend not only a study of his introductory notes, but also the perusal of the papers on depreciation which he read before the Institute of Directors in March, 1907.

APPENDIX I.

TABLE SHOWING DEPRECIATION OF PLANT CONNECTED WITH A LOCAL TELEPHONE SYSTEM AS ASSESSED BY VARIOUS AMERICAN AUTHORITIES.

Property.	*Engineer, Manufacturers Telephone Co.					*Engineers, Chicago Telephone Co.					*Chicago Telephone Commission.					Another American Authority.				
	Further Description of Property.	Depreciation.				Further Description of Property.	Depreciation.				Further Description of Property.	Depreciation.				Further Description of Property.	Depreciation.			
		Life in Years.	Per Cent. †No Interest.	Scrap Value.	Per Cent. to ‡Reconstruction.		Life in Years.	Per Cent. †No Interest.	Scrap Value.	Per Cent. to ‡Reconstruction.		Life in Years.	Per Cent. †No Interest.	Scrap Value.	Per Cent. to ‡Reconstruction.		Life in Years.	Per Cent. †No Interest.	Scrap Value.	Per Cent. to ‡Reconstruction.
Conduits	All Types	50	2	—	3¼	Main	33	3·3	0	1	Main	50	2·0	0	1½	Main	50	2·0	0	Figures not available.
	—	—	—	—		Subsidiary	14	7·1	0	2	Subsidiary	20	5·0	0	2	Subsidiary	15	6·7	0	
Underground Cables ...	All Types	20	5	—		Main	16½	3·5	42	2	Main	20	3·0	40	2	Main	20	3·0	40	
	—	—	—	—		Subsidiary	12	4·8	42	2	Subsidiary	15	4·0	40	2	Subsidiary	13	4·6	40	
Aerial Cables	All Types	20	5	—		—	11	6·0	34	3	—	15	4·0	40	3	—	12	5·8	30	
Poles, including Cross Arms	—	20	5	—		—	8½	11·8	0	6	—	10	10·0	0	4½	—	10	10·0	0	
Aerial Wire, Copper ...	—	—	—	—		—	15	2·0	70	5	—	15	2·0	70	3	—	12	5·0	40	
,, ,, Iron ...	—	6⅔	15	—		—	—	—	—	—	—	—	—	—	—	—	8	12·5	0	
,, ,, Drop Wires	—	—	—	—		—	7½	11·7	12½	10	—	8	10·6	15	4	—	10	9·0	10	
Aerial Terminals ...	—	—	—	—		—	12½	8·0	0	8	—	12	8·3	0	3	—	10	10·0	0	
Subscribers' Instruments	—	10	10	—		—	10	10·0	0	5	—	10	9·5	5	2	—	10	10·0	0	
Private Branch Exchange Boards	All Types	12½	8	—		—	10	10·0	0	5	—	8	10·0	20	2	—	8	11·3	10	
Central Office Switch Boards	All Types	12½	8	—		—	7	14·0	2	6	—	8	10·0	20	2	—	8·4	9·9	17	
Buildings	—	20	5	—		—	33	3·3	0	1½	—	40	2·5	0	1	—	24	2·6	38	

* Extracts from Report of Special Telephone Commission, Chicago, 1907. † Ordinary Depreciation. ‡ Extraordinary Depreciation.

APPENDIX II.

SIX METHODS OF DEALING WITH DEPRECIATION BASED ON TABLES CONTAINED IN "THE COMMERCIAL MANAGEMENT OF ENGINEERING WORKS," BY F. G. BURTON. THE SCIENTIFIC PUBLISHING COMPANY OF MANCHESTER.

ORIGINAL COST OF MACHINE, £1,000. ESTIMATED LIFE, 5 YEARS. ANTICIPATED EXPENDITURE ON REPAIRS AND RENEWALS, £120.

Year.	1st Method.			2nd Method.			3rd Method.			4th Method.			5th Method.				6th Method.		
	Annual Depreciation.	Actual Repairs and Renewals.	Total.	Annual Depreciation.	Actual Repairs and Renewals.	Total.	Annual Depreciation.	Actual Repairs and Renewals.	Total.	Annual Depreciation.	Actual Repairs and Renewals.	Total.	Annual Depreciation.	Interest 3 per Cent. Compound.	Actual Repairs and Renewals.	Total.	Annual Depreciation.	Actual Repairs and Renewals.	Total.
	£	£	£	£ s.	£	£ s.	£	£	£	£ s.	£	£ s.	£ s.	£ s. d.	£	£ s. d.	£	£	£
1st	200	—	200	500 0	—	500 0	224	—	224	181 0	—	181 0	188 7	—	—	188 7 0	400	—	400
2nd	200	10	210	250 0	10	260 0	214	10	224	190 1	10	200 1	188 7	5 13 0	10	204 0 0	190	10	200
3rd	200	20	220	125 0	20	145 0	204	20	224	199 11	20	219 11	188 7	11 9 6	20	219 16 6	100	20	120
4th	200	60	260	62 10	60	122 10	164	60	224	209 11	60	269 11	188 7	17 9 6	60	265 16 6	120	60	180
5th	200	40	240	62 10*	40	102 10	194†	40	234	219 17	40	259 17	188 7	23 13 0	40	252 0 0	190	40	230
TOTAL			1130			1130 0			1130			1130 0				1130 0 0			1130

* Balance of total written off. † Difference between estimated and actual result corrected in last year.

Note.—The first method represents equal annual contributions towards depreciation.
In the second method depreciation is represented at 50 per cent. per annum on actual value of asset.
In the third method the total amount in respect of depreciation and repairs in each year is equal.
In the fourth method the net charge to revenue each year is the difference between depreciation and interest plus provision for repairs.
The fifth method contemplates the building up of a reserve fund.
The sixth method is arbitrary. In this case revenue is charged with the difference between the book value of the asset and its actual value at the present time, as estimated by an expert valuer.

APPENDIX III.

EXAMPLE SHOWING METHOD OF RECORDING TRANSACTIONS RELATING TO REPLACEMENT OF A SWITCHBOARD IN ORDER TO ADJUST CAPITAL ACCOUNT AUTOMATICALLY IN RESPECT OF THE SAME.

PLANT ACCOUNT.

Dr.		Cr.	
Switchboard installed	£2,000	Switchboard withdrawn	£2,000

DEPRECIATION RESERVE.

Dr.		Cr.	
Unexpired "Life" Value of Switchboard withdrawn ... ... (Price obtained for "Scrap" Value of Serviceable Parts credited to Plant Deductions).	£600	Set aside from Current Earnings for Depreciation on Switchboard:—	
		1st Year	£200
		2nd ,, ...	200
		3rd ,, ...	200
		4th ,, ...	200
		5th ,, ...	200
		6th ,, ...	200
		7th ,, ...	200
		Total	£1,400

PLANT DEDUCTIONS.

Dr.		Cr.	
Switchboard withdrawn	£2,000	For Depreciation Reserve	£1,400
Cost of removing Board	170	For Sale of "Scrap"	130
		Value of Parts again returned to Service	280
		Loss (Current Expense)	360
Total	£2,170	Total	£2,170

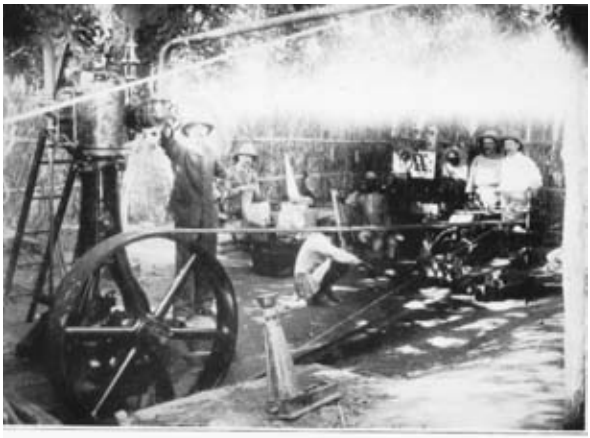


Photo I.

Photo II.

AN EXTEMPORIZED SEARCH LIGHT

FIELD AUTOMOBILE SEARCHLIGHT

TRANSCRIPTS.

FIELD AUTOMOBILE SEARCHLIGHTS.

THE following is a translation of a pamphlet recently issued by the French firm Sautter, Harlé & Cie, who have a very long record of experience of searchlight work.

This plant was inspected in March and seen at work in Paris. As it had just undergone extensive trials during the "flood" weather round Paris and had come through them all very satisfactorily, it is thought that the short description may be of general interest, although of course it must be remembered that the pamphlet is compiled by the makers themselves.

"*The new automobile searchlight plant*" which we have just constructed answers to all the requirements of the present day tactics of an army in the field, and is also of use for coast defence purposes.

The carriage is very strong and at the same time light. It consists of a chassis provided with 4-cylinder petrol motor of 18-H.P. and a chain drive on the hind wheels.

The gear box has four speeds, and one reverse. It has very strong springs. The front tyres are of solid rubber; the hind wheels are extra large and are fitted with studs of rubber arranged "*en chevron*"—thus allowing the vehicle to traverse all kinds of ground.*

The engine runs on petrol; the ignition is high tension. It is remarkably flexible and silent. Lubrication is automatic. The cooling system is of the usual type and water consumption even at full power is negligible. The entire engine is very accessible in all its parts.†

The friction clutch, metal to metal pattern, is very flexible, it takes up the drive gradually and without any jarring to the mechanism.

The vehicle carries five men comfortably, including the driver.

Lamps are provided in front and in rear, and there is also one powerful acetylene headlight, which can be doused at will from the dashboard.

Projector.—This is placed on the body of the carriage, at a convenient height. It is 90 c.m. in diameter and has a metal (gold-plated) mirror. It is very light, weighing in fact only 950 lbs. (425 k.g.).‡ It is mounted on four rubber-tyred wheels which allow it to be easily wheeled along the ground.§

* This is of course doubtful but special attention has been given to the point, which is essential to a useful and reliable plant of this type.—*Trans.*

† This cannot be said of the dynamo, which is under the driver's seat.—*Trans.*

‡ This is really very light as it includes directing motors and a shutter.—*Trans.*

§ This is really a weakness for field work; because the wheels are some 14" diameter only, and have small 1¾" tyres. The projector would soon stick in soft ground. This disadvantage could of course be overcome.

Electric Control.—The light can be either controlled by hand or electrically from a distance. The dousing shutter can also be controlled electrically.

The "distant control" has been brought to a high state of perfection. For this purpose one telephone cable of two conductors is sufficient, which allows for control within a radius of 330 yards of the vehicle. This cable is wound on two light drums, which can be easily carried by one man.

Lamp.—Finally the lamp can be extinguished; this is combined with the operation of opening and closing the shutter. The result is that there is quite an appreciable saving in the amount of carbons used, while the beam is "doused."

Accessories.—Specially made drawers and boxes are provided for all necessary accessories, carbons, drums of cable, telephones and a telescope.

Spares.—The boxes also contain all necessary spares and tools for the maintenance and running of the plant.

Dynamos.—The dynamo revolves continuously with the engine, and the circuit can be closed, while the vehicle is in motion. It is therefore possible to run the light at average power, at the same time that the plant is proceeding towards its observation position.

Observation of the Ground.—This is a great advantage, for reconnaissance by the directing officer is made considerably easier, and can be carried out as he approaches near the observation position, and also while he is moving along the road.*

Ease of Dismounting.—If it is necessary, (as may arise in coast defence), to get the projector into a position that is so very steep that the vehicle itself cannot get there, it is quite easy to remove the projector from the vehicle and to haul it to the selected spot. A 4-core cable is provided, 110 yards long, mounted on a drum on the vehicle, and which can be unreeled so as to connect up the projector with the dynamo.

The projector can also be put back on to the vehicle very easily by one man, by means of special gear.†

Complete Weight.—Speed.—This vehicle only weighs 3·45 tons (3,500 k.g.), on the road, which allows it to negotiate the most difficult tracks, ramps of $\frac{1}{4}$ and $\frac{1}{6}$ and on the flat to reach a speed of 20 m.p.h.

R.W.

* This would only be possible in very open country and where the roads ran along ridges.

† This gear consisted of a hinged pair of rails, and a block and tackle—it would take one man all his time to do this, and he would have to be a young Samson.

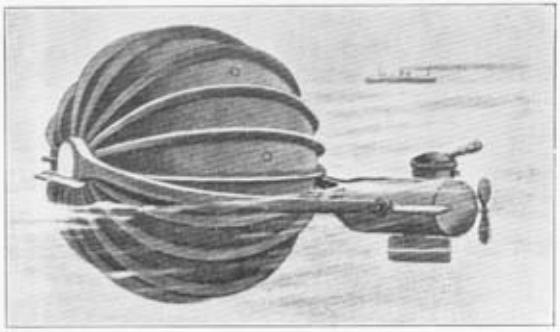
THE "CARL BAYER" SUBMARINE AND SURFACE BOAT.

From the *Kriegstechnische Zeitschrift*, April, 1910.

Although all the great sea powers of the world have been experimenting on submarines for many years and at great cost, they have none of them yet succeeded in producing a really seaworthy submarine capable of attacking hostile vessels at any time and under any conditions. The author thinks that success will not be obtained as long as the present type of elongated boat is adhered to, as it requires too much manœuvre room, is easily turned over in rough weather, and has no power of resistance.

The submarine invented by Carl Bayer of Stuttgart is declared to be free from these defects, and has consequently attracted considerable attention in Germany, where it has been patented.

The inventor was struck by the slow progress made in submarines and was led to ascribe it to their external shape, and it occurred to him that a form resembling two hollow bullets coupled together would be more efficient.



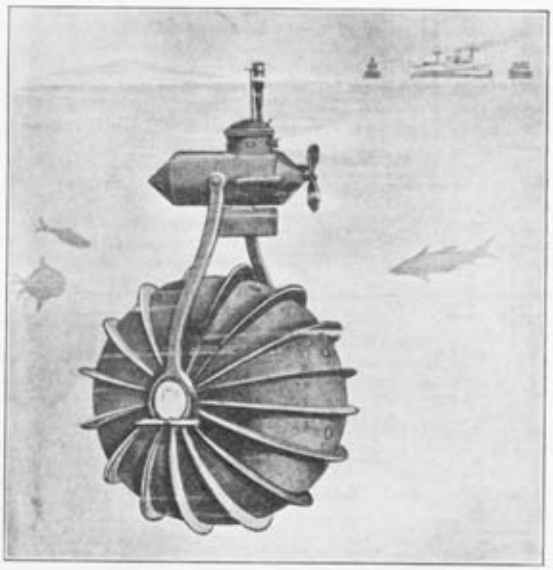
No. 1.—*Submarine Travelling on the Surface of the Water.*

The chief requirements of a submarine are that it should be stable and capable of rapidly turning in any direction without any risk of being capsized; furthermore it must be able to sink quickly beneath the surface at any moment, and remain under water at any given spot. A submarine

THE "CARL BAYER" SUBMARINE AND SURFACE BOAT 1

should also be of great value in discovering the whereabouts and strength of the enemy's fleet. As the "Carl Bayer" travels equally well on or under the surface and has a high turn of speed, it seems exceptionally well equipped for scouting work.

The first illustration shows the vessel on the surface of the water, moving from right to left with a speed of 30 knots. It is claimed that a speed of 100 knots will be obtainable because the faster the spherical portion revolves the less is the draught and consequently the friction.



No. 2.—*Submarine at Rest Under Water.*

The main part of the vessel consists of two concentric hollow spheres, one inside the other. The inner one is so pivoted as to remain always in the same position, while the outer one rotates in cylindrical hollow trunnions.

The steering mechanism is accommodated in a separate cylindrical chamber connected with the rest of the vessel by a large buckle or coupling.

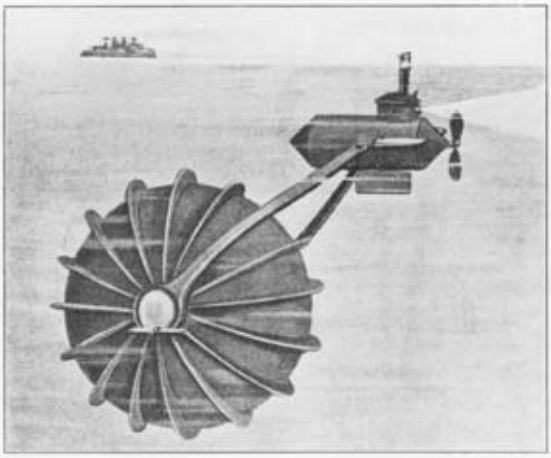
THE "CARL BAYER" SUBMARINE AND SURFACE BOAT 2

The inner sphere hangs on ball bearings on the axle of the outer sphere in such a way as to remain stationary while the outer one is rotating.

The motive power is provided by a dynamo in the inner sphere which rotates the main axis, and, with it, the outer sphere which is provided with paddles on the outside as shown.

The steering chamber is provided with horizontal and vertical rudder planes and a screw propeller.

There is accommodation here for two men, one to steer, and the other to use the periscope.



No. 3.—Steering Chamber Moving into Position for Travelling Under Water.

The space between the inner and outer spheres is a vacuum, and when the vessel is to be used as a submarine water is admitted into this space until it sinks to the required depth, and the steering cylinder is similarly treated.

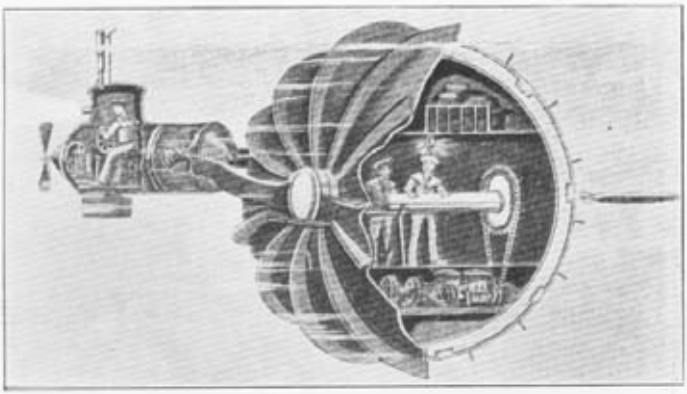
When under water the external sphere no longer revolves but the vessel is driven by the screw propeller on the steering cylinder. The depth is regulated by the horizontal rudder planes and the direction by the vertical ones.

The steering chamber is in this case in front and the two spheres trail behind.

To take observations, if the screw is reversed and the rudder planes slightly tilted, the steering chamber can be driven into a position vertically

THE "CARL BAYER" SUBMARINE AND SURFACE BOAT 3

above the spheres and, by adjusting the amount of water in the air-tight chamber, the level required to take observations through the periscope can be attained.



No. 4.—*Section through Submarine.*

To return to the surface the water is pumped out of the cylinder and also from the space between the two spheres.

The writer concludes by saying that exhaustive experiments were made with a large-sized model at Stuttgart and proved thoroughly successful.

C. OTLEY PLACE.

THE "CARL BAYER" SUBMARINE AND SURFACE BOAT 4

NOTICE OF MAGAZINE.

BOLLETTINO DELLA SOCIETÀ AERONAUTICA ITALIANA.

October, November, 1909.

A long paper on winds in Italy which has been running for some months, is concluded with an interesting series of maps of Italy showing prevailing winds in different quarters of the year; in the hot and cold months during the year; and throughout the year. Also showing the frequency with which each wind blows during each quarter of the year in each locality.

Such investigations entail a very large amount of labour, and the results concisely put in a few coloured maps, must be of the greatest use to Italian balloonists. It is to be hoped that some time in the future our meteorologists will do the same for the British Empire.

S. Laboccetta begins an article which discusses the question of the relative excellence of airships of diverse types. Capt. Castagneris has also discussed the same question at length. An attempt is made to arrive at a formula, but the article is not finished in this number.

M. Riabouichnski contributes an interesting photograph of currents set up by a square plate in an air stream, and also a proposal to furnish "Balloons Souda" with small flags which would be dropped from time to time automatically, compensating for the loss of gas. He thinks that thus a balloon might keep up for a very long time.

An account is given of the proceedings of the IVth International Aeronautical Congress. Official delegates were sent by the Governments of Belgium, France, Italy, Russia and the United States. England and Germany were not represented.

Commandant Bouttieaux reported the progress made with dirigible balloons. The "Zeppelin" has achieved voyages up to 23 hours in duration and up to 1,400 k.m. The speed is reported as 50 k.m. per hour and the height reached as 1,200 m.

The "Gross" has voyaged for 13 hours and has a velocity of 47 k.m. per hour.

The "Parseval" is particularly noted for the ease and rapidity with which it was filled in the field, and although it met with a bad accident it was out again in six days. It has reached an altitude of 1,500 m. and manœuvred there for over an hour. Its speed is 47 k.m. per hour.

Stress is laid on the necessity for having two motors and two sets of propellers. The first is a recognized necessity, but provided each motor can work the propellers there does not seem the same necessity for the others. A large reserve of ballast is also laid down as requisite.

As regards flying machines Commandant Renard pointed out the importance of laboratory experiments, and how little these were regarded by the public and even by constructors, compared with the results of experiences of practical aviators. He very truly remarked that, but for the laboratory work of a century, there would to-day be no practical aviators.

In communicating the results of the Brescia meeting, Capt. Castagneris expresses himself very confident of the future of aviation as a practical means of transport. He points out that immense strides have been made in only four years, far greater progress in a short time than has been made with any other means of transport, and even expects to see dirigible balloons as locomotives dragging others behind them just as railway trains are built up behind the engines.

He also notes the results of other aviation meetings and mentions a variety of points that ought to be considered in fixing on the ground for an aviation meeting—viz.: a large enough circuit, smooth surface, direction of prevailing winds, a good starting place, methods of judging and signalling, position of sheds, etc.

He also communicates a very appreciative account of the late Capt. Ferber.

At the Paris Salon he selects the Santos Dumont, Bleriot, and Antoinette monoplanes, in the order given, as best complying with the technical demands of aerodynamics.

Notes are given on a large number of aeroplanes, all modifications of well-known types, and an ornithoptères, none of which have yet proved successful.

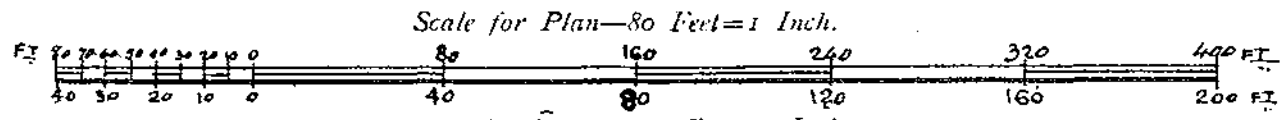
There is an interesting article on dirigible balloons at military manœuvres, and a discussion as to the requirements of war as regards these machines. The writer favours, I think rightly, different types, viz.: large cruisers for strategical work, and smaller vessels for tactical work. He considers that details of a battle will be reported by aeroplanes, general information by dirigibles.

An account is also given of the journey of the Italian military dirigible "I. Bis," from Vigna di Valle to Naples and back *viâ* Rome to its hangar. The journey was entirely successful, Naples was reached in 5 hours 45 minutes. On the return journey Rome was visited (10 hours from Naples) and a descent made for petrol. The departure from Rome was delayed owing to a fatal accident to an officer, the return from Rome to Vigna di Valle being made in 1 hour. The total distance run without descending was 460 k.m. in 14 hours.

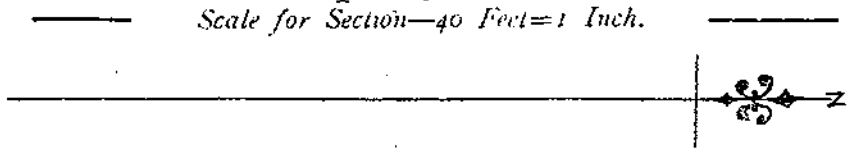
J. E. CAPPER.

MILITIA POST, MIRANSHAH, TOCHI VALLEY

Scale for Plan—80 Feet=1 Inch.



Scale for Section—40 Feet=1 Inch.



SECTION ON A.B