The Great Workshop of Science

Unsung Heroes of the War

IN the battle of Seicheprey it is said the Germans concentrated their artillery fire on the American telephone and telegraph wires, which were in consequence cut many times.

But our boys were not to be beaten in that way, and almost as fast as the enemy shells disrupted them the men of the Signal Corps, in the face of the heavy bombardment, restored the wires.

It is heroic work, that of the daring linemen who fix battle telephones, and one of the most important of all scientific ends of modern warfare, yet outside of the service it is rarely mentioned.

When the fighting begins over the top with the charging infantrymen go the linemen, generally with the second wave, in charge of an observing officer. Immediately, in magnificent disregard of danger, they begin coolly to string lines behind the advancing first line, so that the artillery may be kept informed of the advance or told to concentrate their fire on a certain Boche gun crew who, in a well protected position, are making things obnoxious for our men.

—*Gilliams Photo*

Usually the linemen as quickly as possible make for a point where they can establish an observation post, and as they pass on and through the enemy's barrage they unroll their line. One of them carries a field telephone through which he somehow manages, in the din of battle, to make himself heard.

That telephone is like a battle flag, and many a man goes down with it, only to have it picked up and carried forward by another member of these non-combatant troops whose only business is to serve, not to fight.

When the battle moves forward rapidly and the telephone and telegraph wires have to be moved at top speed to keep up with the advance the importance of the signal service is demonstrated in a way as impressive as the onward rush of light artillery going into action.

When a division moves to another position with it go two cable wagons, carrying cable which is attached at one end to a permanent line. They are autocrats in their way, these wiremen, and no one is permitted to interfere with the swift execution of their work. They have the right of way over troops and supplies, and at a rapid trot dash through the roads, the men on the wagon paying out the cable. Back of the wagons ride men on horseback who with hooked sticks toss the cable into ditches and behind hedges, out of the way of troops and transport wagons, while further back other horsemen tie the line and make it secure.

They are in the forefront of every advance, and in the retreat are sometimes the last to leave the front line, where they stick to the end of their wires under terrific shell fire until ordered to rejoin their commands, if they can get through alive.

At another time, when no real battle is raging yet No Man's Land is swept by constant artillery fire, when the night is dark and when the troops huddle in their trenches and dugouts to keep warm and escape the stray enemy bullets, somewhere in the battalion headquarters signal office or dugout where the hundreds of wires from the trenches and observation posts centre and where the receivers hum with the constant tremors of a world under fire, a lineman lounges in a corner rolling a cigarette.

"The wire to B Battery is down," the lineman's superior officer says, turning to him.

"All right, sir," is the answer. And the man climbs out of the dugout, repair kit over his arm and tin hat on his head.

In the trench he finds the wire that is broken and begins to follow it along. It is hot work; shells are dropping thickly; but he doesn't mind much. He follows the wire down a communication trench and then for a long time into the open, where he has to crawl along looking for the hole that will mark the place where the line has been broken.

He gets nearly there when a stray shell ends his career.

After a time back in the dugout, the first man having failed to report, another one is sent out. Perhaps he is luckier than the first repairman and finds the break. Then he has to sit down in the shell crater, the smash of bursting shells so close that sometimes he is half buried in dirt, calmly making the connection that will enable the observation officer up front to get in touch with his battery again. If he gets back to the dugout he wil' be sent out again and get again if the bombardment is heavy and wires frequently broken. Often for days and nights at a time these men are under fire, snatching a nap now and then in the dugout between breaks.

The linemen also have regular patrols, stretches of line which have to be constantly examined, not only for breaks, but also to make sure that they have not been tapped by enemy spies in such a way that every bit of information sent over them finds its way to the Germans.

One day not long ago a lineman passing along a road in the Aisne district noticed a lot of cable lying at one side. He started to coil it up and found that a piece of wire had been tied to the main line. When he traced it he discovered that it ran to a haystack. He went on, tapped the line and sent word to headquarters and an armed escort found a spy hidden in the hay with several days' supply of food.

What the nervous system is to the human body the telephone and telegraph systems are to the modern army, which cannot see, feel or move without them. It must be remembered that battlefronts to-day are conducted on a very different principle from what they have been in previous wars. Then the forces of opposing armies as a rule only extended a few miles; to-day a 100-mile front is common and the army commander wishing to move a portion of his line fifty miles away or to change the rapidity of his artillery fire or to receive information of enemy movements would be helpless without this aid science has given him—the electrically controlled slender threads of copper.

Despite the constant efforts of the Huns to prevent it all along the Allied fronts the lines are kept open somehow all the time, or are broken only for short intervals.

The tremendous use of the telephone and telegraph in this war is partly the result of the impetus arising from the American application of electrical communication on a large scale in the Spanish War. Uncle Sam's Signal Corps as it now exists is a comparatively recent evolution.

The idea first arose in the mind of a young army surgeon, Albert James Myer. The office of signal officer of the army was created in June, 1860, the first of its kind, and Myer was appointed. He was sent with an expedition against Navajo Indians in New Mexico, and his crude apparatus at once demonstrated its worth.

When the Civil War broke out he was ordered East and opened a school for signallers, and in that was the definite beginning of the present Signal Corps. Wires were carried on horse and muleback then; the instruments were imperfect, and telegraphic communication was a rare and precious thing. The service took on tremendous importance in the Spanish War and followed the troops through Cuba and the Philippines, and in China was the only means of communication for a week between Pekin and the rest of the world.

But the task that confronted our signal men in these wars was play compared to the work that is being done every day by these boys on the western front. They have an area to cover as big as some of our largest eastern states, and they have gone at it with vigor and efficiency.

The hardy linemen who have strung lines and repaired breaks on the Western plains or battled with great floods and storms in the Rocky Mountains have taken to this new work with a zest which is inspiring. On the foundation of the French system they are building a signal system that will be a model of its kind.

Up to within four miles of the front construction is not different from what it is in the United States. The wires are strung on poles and most of the poles have been planted by the French. But inside the shell-torn section that stretches at least four miles from the front wires have to be protected by being buried from six to eight feet deep, so that only a direct hit by a large shell will disturb them. Within half a mile of the front not even this protection is sufficient, as the shells churn and re-churn the ground. Therefore all wires in this zone are duplicated and are strung along both sides of the trenches. Sometimes a trench wall is covered with wires.

These hundreds of lines back of the front are joined into main lines or cables, which hold from twenty to fifty circuits. According to the present increase of our forces in France it will not be long before we will need probably 30,000 miles of circuit, and at least 12,500 men will be necessary to keep it open and in repair.

Trucks to Pump Out Trenches

MEN in the trenches have made a feeble effort to save themselves from rheumatism and pneumonia by bailing out the water with buckets. The British army is now employing trucks to pump out the flooded trenches.

The new apparatus consists of a 32-horse-power, four cylinder gasolene motor mounted in the body of a motor truck, and connected to a dynamo furnishing current by flexible cables to three motor centrifugal pumps.—From *Popular Science Monthly.*

Gassing Germs in Books

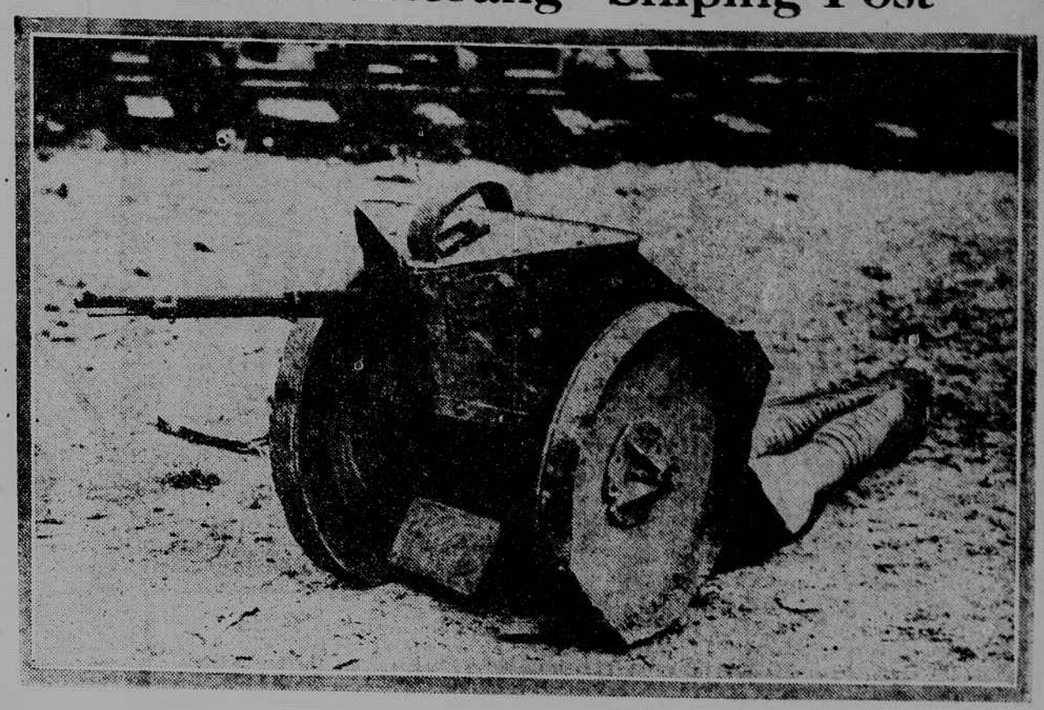
ALMOST the first thing to meet the eyes of French hygienists in their war-time campaign for protecting the younger generation was their old enemy, the circulating book, well known as a carrier of disease. The many obvious solutions of the problem shared one disadvantage: while killing the germs they destroyed the book also.

For the method perfected by Dr. Marsoulan and now practised in the Institute for Wounded and Infirm Workmen, at Montreuil, it is claimed that for one-fourth of a cent for each book and with safety to operators books can be sterilized without the slightest injury. Two pieces of very simple apparatus are used: a beater and a disinfector.

The beater is a long box open at one end and communicating at the other with an ordinary stove. Inside of the beater are wooden rods so arranged that the turning of a handle will cause them to strike on the books placed on a sliding frame. As the rods beat the books the heavier particles of dust fall out into a tray of disinfectant below, and the lighter are carried by an exhaust fan to a stove, where they are burnt.

The books are hung, open, by spring clips from a skeleton framework, and wheeled into the disinfecting chamber, which is equipped with a tank containing a solution of formaldehyde. The temperature is raised to 120° F., the formaldehyde kills the germs and the fumes are carried off by a funnel.—From *Popular Science Monthly.*

The Boomerang Sniping Post



—Canadian official photo, from Underwood & Underwood.

A German variation of the tank, recently captured by the Canadians. A one-man affair, it is used as a sniping post. When once behind it the operator can move, with more or less ease, forward or backward.

Why Not Electricity From the Ocean?

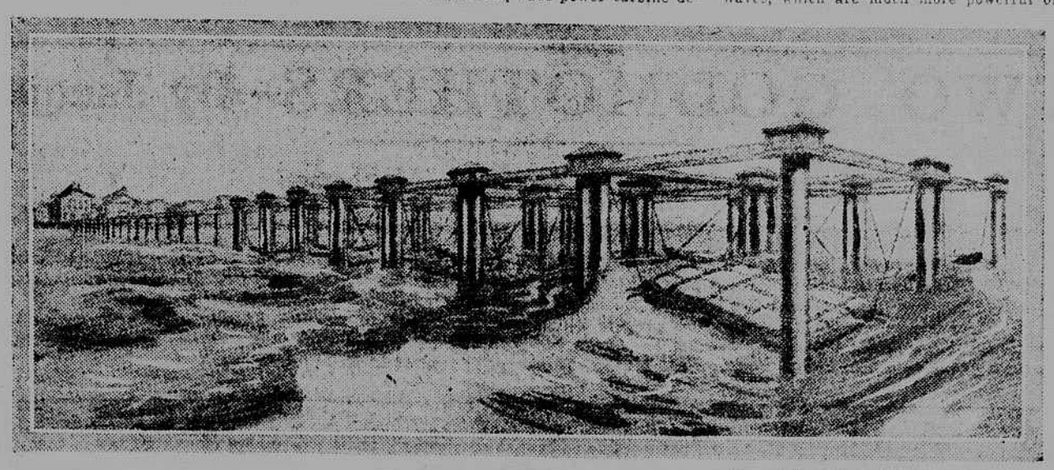
WITH the idea in mind of utilizing the vast power resources of ocean waves, E. T. Stodder, of New Rochelle, N. Y., has invented a "wave motor," which is described in "The Electrical Experimenter." The illustration here reprinted shows how the device would be installed. "The Experimenter" says of the idea:

"The basic idea of this wave motor involves the utilization of the powerful lifting force exerted by the waves as they rise and fall, and to this end the inventor proposes the use of large steel float members, each float in a commercial sized machine to measure about 80 feet square, thus giving an area on which the wave can exert a lifting action of 6,400 square feet, while a number of these floats can be placed along the pier as our illustration shows. At each end of these float members, which are airtight, of course, there are two steel cables which lead upward to specially devised air compressors, so that no matter in which direction the float rises or falls efficient work is performed by each and every movement of the float.

"All of the compressed air generators connected with the cables from the floats are connected with a main pipe line, and this in turn feeds a compressed air motor connected with an electric dynamo. The dynamo produces electrical energy which can be fed into storage batteries, and also to the wires supplying electric lights, etc. . . .

"There are several very good features as disclosed by Mr. Stodder, and among others we find the following: By extending the pier out into the ocean, as the illustration shows, and by having a successive series of floats arranged along the pier, use is made of each wave as it progressively rises and falls in its motion toward the shore, and thus a steady stream of compressed air is kept flowing through the pipe line to the pneumatic motors and dynamos, owing to the fact that while one float may be all the way down or part of the way up another may be two-thirds the way up to the limit of its motion, etc. By looking at the various positions of the successive floats in the illustration this feature will be clearly understood. The invention seems to be better in this respect than those designed to be installed in any spot, and which are intended to absorb the energy from the waves as they pass that spot. In such a case it is evident that as the wave receded from the side of the wave motor, then practically no power is given to the floats or other devices which may have been provided. Also, in one wave power turbine devised for the purpose, the receding waves could not clear the blades efficiently.

"To those who have not experimented with a float mounted on such a body of water as to give it appreciable power whenever waves were produced, such as on rivers, lakes, or perhaps on the ocean shore, it is probably a little difficult to perceive that such a power plant as this will develop any really appreciable amount of energy. The reader may form a good idea as to just how much power even a small wave will give by an instance which the author noted not long ago. In this case, the float (on the shore) measured about 10x20 feet and was used as a launch landing on a river a mile wide. Whenever one of the steamboats plying this river passed at a distance of half a mile, i. e., in midstream, the waves created from the sidewheels of the boat were sufficient, when they reached the shore, to oscillate the float (on which rested one end of a fairly long and heavy gang plank) with surprising power, and to give an idea of just how powerful this action was, it can be stated that with four people, weighing about six hundred pounds in the aggregate, the float was thrown rapidly up and down on its guide poles a distance of about four feet, much as if it had been merely an eggshell resting on the water. By comparison it is easy to see that the ocean waves, which are much more powerful on the average, would exert an infinitely greater power. In the case of the float just cited, the work expended by the waves amounted to 2,400 foot-pounds, or considerable over one foot-ton. The float was capable of lifting a much greater weight than that mentioned, but this will serve as a practical example to show the great power possessed by a moving body of water."



—From *The Electrical Experimenter*

Reading by Ear for the Blind

THE utilization of selenium for "converting light into electricity" is one of those things which have been carried farther in Britain than anywhere else. The optophone, exhibited at the British Scientific Products Exhibition, is an illustration of what can be done in that direction. It enables blind people to read any ordinary book or newspaper by ear instead of relying on the use of raised type, according to "The Illustrated London News," which gives the following facts concerning its construction and development:

"The optophone is the invention of Dr. E. E. Fournier d'Albe, late lecturer in physics in the universities of Birmingham and of the Punjab. The test carried out last year by representatives of London blind institutions showed that it was possible to read an ordinary newspaper without an error by ear. Since then the instrument has been greatly improved, and the result is the book-reading optophone now exhibited for the first time. A number of blind people have been taught to read with it, one of these being a British officer blinded in the great Somme battle of 1916.

"The type-reading optophone is the last link in the evolution of the instrument, which began with the 'exploring optophone.' That instrument enabled a blind person to locate windows, lamps, the sun and moon and the skyline over a building. It was, however, considered to be of little practical utility to the blind. 'The blind problem,' said a well-known blind solicitor, 'does not consist in locating windows, but in earning one's living.' The inventor, therefore, set to work to devise something of undoubted usefulness, and the result is the type-reading optophone of to-day.

"The instrument consists essentially of an electric lamp, a perforated disk, spinning rapidly on its axis, a perforated selenium 'tablet' and a sensitive telephone receiver. The disk breaks up the beam from the lamp into five tiny shafts of light, each flashing rapidly, and each at a different rate, ranging from 200 to 400 flashes per second. These five tiny shafts of intermittent light travel side by side in close array until they fall upon the sheet of printed paper. There they produce a line of luminous dots just the size of the letter 'l.' If, now, a selenium tablet, connected with a battery and telephone, is placed near this shining line the light from each flashing dot produces a current in the selenium which surges to and fro at the same rate as the flashing of the dot, and each dot thus produces its own musical note in the telephone. By converting, so to speak, the light into electricity, selenium bridges the gulf which ordinarily separates seeing from hearing.

"Now what happens when the line of dots passes across a printed letter? Some of the dots will fall on the white spaces. The notes corresponding to these will continue sounding in the telephone. Others will fall on the black body of the letter. These notes will be silent. And as the letter is passed the chord changes and the letter, so to speak, sings out its name. A word sounds like a sucession of harmonies and discords, mixed with squeaks and twitters. The characteristic sound of each letter must be learned. It can be done in a fortnight, and another six weeks' practice suffices for learning to read with accuracy. Speed comes later. So far the record is some ten words a minute, but this will probably be more than doubled soon. It is found that typewritten letters, and even letters written by hand, in imitation of type, can be deciphered with the optophone.

"But, for the present, it suffices that the printed literature of the world is once more open to them that dwell in darkness."

Have You Beets to Store?

BE SURE and pull the crop of beets as freezing weather comes and store either in the root cellar or in a pit, says the National War Garden Commission of Washington. Take up the beets when the ground is dry if possible and cut off all but about one inch of the tops. If the ground is wet when the beets are pulled let them dry before storing. Handle them carefully and place in crates or in ventilated boxes or barrels if they are to be kept in a root cellar. Where plenty of room is available they may be placed in small piles or a long pile on the floor.

Try to keep the air in the storage room moist enough so the beets will not wither. If there is an earth floor there is usually no danger of withering, but if the floor is of concrete it will need to be sprinkled with water occasionally. A couple of inches of sand or earth spread over the floor is of great help in controlling moisture.

The Liberty Starter

THE Liberty starter is an air motor and compressor in one. While acting as a starter it runs as a four-cylinder air motor, cranking the aeroplane engine through a train of gears inclosed in its transmission.

At the end of the transmission is a final drive that connects direct to the crankshaft of the engine. This drive runs continually at engine speed and operates a small pump which furnishes pressure for the gasolene feed. After starting the engine the Liberty starter automatically disengages and remains so until needed for further use either as a starter or compressor.

In order to keep an adequate air supply in the tank the starter is engaged as a compressor by pushing a button on the control valve while the aeroplane engine is running at low speed.

When engaged the engine must be speeded up to 1,200 to 1,400 revolutions a minute. At 230 pounds pressure the compressor automatically disengages. There are over nine hundred of these starters in use on 'planes in this country, and the United States Mail Service is installing them wherever possible.

Now the Liberty starter is ready for foreign service. It has been thoroughly tested and in every instance has shown itself the best type of aeroplane. First, it is light, weighing but thirty pounds; second, it is compact, measuring eight inches long; third, it is efficient, cranking the aeroplane engine at 150 revolutions a minute or more, and replenishing its own energy in thirty seconds, less than any other device known; and finally, it is simple; as there are no pipes leading to the aeroplane engine, this leaves the engine in its natural state. The tank weighs twelve and one-quarter pounds, making the complete outfit forty-nine pounds.—From *Aerial Age Weekly.*

Tunnel Warfare: Preparing for the Attack

By Lieut. J. C. Roscamp, R. E.

This is the second of three articles by Lieutenant Roscamp on the hazardous work of those underground fighters, the tunnellers.

THE tunnellers had been busy day and night putting in the charge of explosive to blow the mine. It was no small undertaking, for the gallery in which it was laid was over a hundred yards from the shaft or outlet and only measured about 3 feet high by 30 inches wide.

All the explosive had to be carried very carefully and placed in position, and the Boches were working so close to us that it was imperative to make no noise or the whole business would be given away. After the explosive a quantity of "stemming," consisting of sandbags well filled with clay and rubbish, had to be built up to prevent the force of the explosion following the line of least resistance and simply expending its force along our own gallery and probably damaging our own lines.

This particular mine was so close to the German trenches that you could hear the rifle bolts click as they unloaded after firing. Moreover, with a view to blowing a ready-made communication trench the mine was so close to the surface that the concussion from the explosion of even the lighter shells from our guns falling short and anywhere near us put all the candles out.

One of the greatest difficulties connected with these operations is to ventilate the galleries and yet avoid the noise made by mechanical ventilators or fans. As the "stemming" has to be passed from hand to hand to insure quiet, the number of men necessary in a gallery a hundred yards long is so considerable that the air is rarely good enough to allow a candle to burn.

In this instance we were also without electric lamps, and the work had to be done almost entirely in the dark—at any rate, during the last twenty-four hours.

* * *

The infantry attack was timed to begin at 4:30 a. m., and the mines had to be exploded at 4:29 a. m., so that the infantry might rush forward under cover of the smoke from the explosion. It was very important, therefore, to have our watches set to the exact time of the Brigade Headquarters, so that there would be no confusion and that our infantry might not start too early and be blown up by our own mines. The strain of the last few minutes was very trying. The seconds passed like hours.

However, we had had one difficulty on top of another to contend with, and it was 4:25 a. m. before we were actually ready to fire. So that we had only four minutes to spare.

By this time it was raining shells and trench mortars all around, and in the darkness before dawn the vivid flashes of our own guns, as well as those of the bursting German shells, blazed out, even though the air was thick with the fumes and rock of the explosives.

Still our men, who had put in such strenuous work for so many hours, were glad when they were ready to get away, and left the front line to go down the communication trench with as little concern as ever, despite the fact that these communication trenches and the second and reserve lines are always constantly bombarded during an attack to try to prevent reserves coming up to the front line.

Fortunately they all got out without a scratch, but they dropped a quantity of their "tackle"—hammers, saws, airpipes, shovels and the like—in their hurry, as I discovered afterward when I left after firing the mines.

* * *

In order to blow up this mine to form a ready-made communication trench the charges had to be laid in a series, equidistant and of equal amount, except for those nearest our own end, which for safety's sake were made lighter. These charges were connected up electrically in series and in parallel so that there could be no possible doubt of their exploding as soon as the exploder, or battery, was used. To make doubly sure a fuse had been attached, so that if the electrical connections failed the safety fuse could be employed.

The disadvantages of the latter method in a case like this is that the rate of the fire travelling along the safety fuse is one foot in 30 seconds. As our nearest charge to the shaft was some forty feet off it would have been necessary to leave a length sufficient for a minute or two on the fuse to allow the man who lit it to get out, and, as I have pointed out, we were tied down to a minute. Of course it could have been done with instantaneous fuse, but it would have required all the length to the shaft top from each separate charge, and as the tunnel was exceedingly wet this would not have been practicable.

As it was, we had twelve "leads" or cables coming out of the shaft top which were all marked and numbered so as to prevent any mistake, and all brought to a point behind a thickish part of the parapet, where we rigged up a few stout poles and props as a covering at any rate against splinters.

Here we crouched and waited the time when our watches should point to 4:29 a. m.

* * *

The time came at last, and we pushed down the handles of the exploders. So great was the concussion of the shells dropping at the time that I thought the charge had failed, though such a charge or series of charges as we were firing was sufficient to shake down dugouts several hundred yards away.

To make sure we hurriedly changed the connections on the batteries, using three exploders for each separate charge, and then when our minute's grace was almost up we gave up troubling further and came out from our improvised shelter feeling that we had failed.

How pleased we were to meet a cheery captain as we went along the front line toward the communication trench, who told us the mine had exploded splendidly! The captain was now in the same state of excitement awaiting his time to lead his men over the parapet and across to the German lines as we had been waiting for 4:29 a. m.

He was the captain of the second line, which was now manning the front line trench, while the front line fellows were already in No Man's Land and lying hidden in a ditch.

At last the moment arrived, and the order to charge forward was given. Away they rushed across the open and in less than half an hour had taken the first three lines of German trenches. The sappers, too, had rushed out, and with pick and shovel were busy making the connection blown by our mine into a communication trench by which ammunition and reserves could be brought forward to the lads in front.

This work brought to light the fact that we had blown in a German gallery within four feet of our own and had killed at least four Germans by the explosion—how many more there might have been in their demolished gallery one could not say.

For our part, tired out by the exertions of the previous few days, it was not long before we were back at billets and fast asleep.