

# GAS AND FLAME

## IN MODERN WARFARE

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up a high standard of training, he will not do much damage, though for that matter the same thing is true about gas shells and trench mortar bombs.

## CHAPTER VII

The rising importance of the gas shell—The variety of gases practicable with the shell—The deadly Green Cross Shell—Risks of transporting "duds" for chemical analysis—Reduced Allied casualties—German blunders in shelling tactics—Importance of universal discipline.

ONE of the most interesting things about the development of gas warfare has been the way in which the gas shell, from being the least important method of poisoning the air, has become the chief gas weapon in the German armoury.

The reasons for this extraordinary development, though various, are not far to seek. They lie chiefly in the fact that unlike the gas cloud we have not even yet approached the limit of the number or size of the gas projectiles that can be used. Nor, which is even more important, is there any limit to the variety of the poisons that can be used in gas shell.

The fact of the matter is that the gas shell

is not really a gas shell at all. It is nearly always a "liquid" shell and sometimes even a "solid" shell. The term "gas shell" is used because the liquid or solid contents are atomised by the explosion of the bursting charge or are distributed round in the form of such tiny particles or droplets, as the case may be, that they act almost as a gas. In the latter case they form what might be described as a mist or smoke, but with this difference from ordinary smoke—that the gas mist or smoke is generally, though not always, invisible.

Just imagine what would happen supposing a shell were filled with water. Burst such a shell with a sufficiently big charge of high explosive and all the water would be distributed into the air in the form of such finely divided spray that it would form a mist. This mist would either vapourise into the atmosphere completely or hang about like a cloud, according as the air was dry or moist. In any case, if the burster were big enough no water would be spread on the ground; nor would any big drops be formed.

This is just what happens with any of the poisonous materials filled into a shell. In-

deed if the burster were big enough and carefully chosen it would be possible to form a "gas" with treacle. With a volatile material like gasoline on the other hand all that would be needed would be a burster just big enough to open the shell.

It can be seen therefore that the choice of materials for gas shell is practically unlimited and is governed only by their being poisonous enough and by the ease of production.

Another thing in which the gas shell has the advantage over the cylinder gas is in getting surprise, which is naturally much easier to effect with shell. By the way, if the reader wishes to be counted among those who knows, he will always speak or write the plural of shell without adding a final "s." To talk of a number of shells is very civilian.

As I pointed out before, we were expecting something new to happen in the gas-shell line during the whole of 1916, and had an idea that the new arrival would be something of a cyanide nature—possibly prussic acid itself. When it did come, however, it proved to be a liquid filling closely related chemically to phosgene and to the K-Stoff,

which I have previously described. These new gas shell were the first of the present series of German gas shell, which are all distinctly marked with coloured crosses and named accordingly. These particular shell were the Green Cross Shell, a green cross being painted on the base of the cartridge or on the side of the shell or sometimes on both. They made their appearance on the Somme Front about a fortnight after the battle had started—that is, about the middle of July, 1916—though a few of them had been used against the French on the Verdun Front sometime in June.

It was not long before blind or unexploded shell—"duds," we call them—were collected and sent back for examination. This is one of the disadvantages of using gas shell—your opponent can always keep track of what you are doing. Sooner or later a fuse will not function or a bursting charge will not explode and your watchful enemy carefully collects the shell, and has for examination a considerable amount of the poison material. I say "carefully collects," for it is no child's play dealing with shell which may go off in your hands

on the slightest provocation. However, it has to be done, and as it is the gas officer's pidgin he manfully shoulders his task and the shell and has it brought in. Very frequently the fuse fails to act because a powder pellet holding up the striking needle has not burned away; but I remember one case where the gas officer of one of the armies took back a big dud gas shell. It meant transporting the weighty souvenir in a not particularly well sprung car over very bumpy roads, and he was quite relieved to arrive at his destination—the field laboratory. Here it was reverently taken to bits by the experts. Imagine the gas officer's horror to find he had been bumping along for several hours in the company of a shell the powder pellet of which had burned away and whose only safety device was the weakest of weak creep springs on which the striker rested. A hard knock or a drop of six inches would almost certainly have exploded it.

The laboratory officers, who are experts at the game, may have to go up to the Front themselves to solve important duds which are regarded as dangerous and require ex-

pert attention. In one instance the officer concerned—in civil life a very celebrated professor at one of the London colleges—went up to the salient and explored about a mile and a half of trenches and finally located his prey—a fine dud 4.2-inch howitzer gas shell—out in the open.

Though the place was pretty unhealthy he “climbed the bags” and made a careful examination of the shell where it lay, finally bringing it back in with him. I forget whether he drew its sting on the spot, but in any case it was a pretty good effort, especially for a man no longer in his first youth.

Chemical analysis of the blind Green Cross Shell showed the contents to be a colourless liquid known to chemists by the extensive name of “trichlormethylchloroformate.” Its effects are just as ferocious as the name implies, and experience showed it to be very poisonous. Indeed it is as poisonous as phosgene itself. The Green Cross Shell gas—“diphosgene,” to give it its short name—has many effects and symptoms that make it a dangerous weapon. When dilute it has a peculiar though not particularly nauseating smell, a smell variously de-

scribed as “earthy,” “mouldy rhubarb”—whatever that smells like—and damp hay. Unlike the shell gases we had encountered before, it has very little effect on the eyes and causes practically no lachrymation. And this was a trap, because we had been used to lachrymators, so that many men despite the obvious smell were not particularly quick in protecting themselves because of the new symptoms.

Of course this applies only to such low concentrations as would take a long time to gas a man. In the higher concentrations the Green Cross very quickly asphyxiates—just as phosgene and chlorine do—and there is no question of whether it is deadly or not. The old Army quip about there being only two kinds of people in gas warfare, namely “The Quick and the Dead,” certainly applies if you get a Green Cross Shell bursting close to you. But even for gas shell bursting some distance away immediate and complete protection is necessary because of the delayed or after effects of the gas, which are exactly similar to those of phosgene. Every care that is taken with regard to men

poisoned with phosgene has to be taken for men poisoned with Green Cross gas.

Those suffering from the effects of the gas are not allowed to exert themselves at all or to take heavy meals. They are kept under close observation for at least two days, and are treated, in fact, as casualties even though they are not apparently ill. Before the need for this was understood an officer I knew was slightly gassed with shell gas but thought nothing of it. Later on he felt a bit queer, and the regimental medical officer advised him to go down to the dressing station. He walked the length of the communication trench and then mounted a "push bicycle" for a mile's ride to the aid post. The exertion was too much, however, and he reached the aid post only to fall dead.

The danger of not treating gassed men as casualties and resting them for a couple of days, after which they would probably be fit for work again, is shown by a case where forty men were lost to the line for a considerable time, though fortunately none of them died. These men were part of a working party engaged in the construction of dug-outs. They were caught in a surprise bom-

bardment, but were apparently not much affected. After completing their night's work they marched back to billets and turned in as usual. The next morning several of them were so ill—nearly to the point of collapse—and the remainder were so visibly affected that the medical officer ordered the whole party to be sent down to the casualty clearing station, where they were evacuated to the base.

In still another case I remember a sergeant and twenty men of a wiring party engaged in the consolidation of a recently captured position were similarly caught by a sudden and intense Green Cross bombardment. A number of the men were gassed and felt pretty seedy, but continued their work and then withdrew. The sergeant felt no ill effects until an hour after turning in, when he woke with a bad cough and internal pain and died two hours afterward. One private went to bed without complaining at all and was found dead next morning. Another died soon after getting up. A third reached headquarters complaining of shell shock and died three hours later. I mention these cases so that my reader will

realise why such great care is now taken with men who have been exposed to poison gas, and how by looking after them in this way it has been possible to reduce the number of delayed cases of death or serious illness to a minimum.

Talking of delayed effects of gas shell reminds me that at least two documents were captured during the Somme—one of them I got myself—which were obviously notes of lectures given to officers at a German gas school or staff course. In both of these sets of notes there were references to the Lusitania, showing that the German Higher Command was trying to explain that dastardly act to its own troops by making out that the Lusitania was sunk because it was carrying phosgene shell for the Allies. This lie can easily be nailed to the board, as not a single drop of phosgene—or any other poison gas or liquid, for that matter—was shipped from America before this year, 1918. Both of the paragraphs I refer to contained a double lie, for they each asserted that the French started the use of gas shell. One of them ran as follows: “The French first started the use of gas shell—

with great hopes, but with little success! The most striking result was that experienced by the passengers of the Lusitania, whose rescued mostly died later.”

But to return to the Green Cross Shell. These were used during the Somme Battle in enormous numbers, far surpassing anything we had had before in the extent of the bombardment. There were a great many new features about these shell quite apart from the altered nature of the gas. First of all there was the size. Until then we had had gas shell of only two sizes—150-millimetre howitzer shell and the 105-millimetre howitzer shell. The former contained from five to eight pints of liquid according to the construction of the shell, and the latter about three pints. To these longer shell were now added shell from the ordinary field gun, or 77-millimetre gun—quite a small affair compared with the others and containing only two-thirds of a pint of liquid poison. But then, though so small, it could be fired more rapidly and accurately and could bring off an initial surprise in a way that the bigger guns could not do. Shell of these three sizes were used then

on nearly all occasions and in very large quantities. One thing that made large numbers possible was the simplicity of the shell compared with the old pattern. There was no separate lead container and the "gas" was filled straight into the body of the shell, as the new material was unacted on by iron or steel. The head of the shell was screwed in and kept in position and perfectly gas-tight by means of a special cement.

As very little explosive was needed to open them up and spread the contents round the noise made by the burst of the Green Cross Shell was little more than a pop—at any rate when compared with the high-explosive shell or the old tear shell. The result was that at first men were apt to regard them as duds and to delay the putting on of respirators until it was too late.

These gas shell are supposed to make a peculiar wobbling noise in the passage through the air because of the liquid inside them, and in this way to be recognisable beforehand. Personally I cannot tell any difference in the noise compared with H. E. or shrapnel of the same calibre, though I have heard thousands of both kinds; but I

dare say some people can, as the belief is fairly widespread.

Of course Fritz's liberality with his gas shell caused us a lot of casualties, but not nearly so many as we might have had if he had known how to use them. The fact was he had not at that time got hold of the proper technic—developed later on by the French—of concentrating his gas shell on special targets. By now, of course, he has; but at that time he still clung to the idea of being able to poison big areas with his shell gas by putting down a series of barrages over the country to be attacked. Either he had not enough shell or he chose his areas too big, for he did not produce effective concentrations anywhere but locally. If he had, our losses might have been tremendous. As it was it became rather a hit-or-miss proposition, and I have seen hundreds and hundreds of these shell drop into absolutely unpopulated areas of the devastated Somme battlefield.

In one case a battery of field guns came in for its share of one such promiscuous bombardment while I was there. The number of shell coming over was so great that

it was like a magnified machine-gun shoot, but only a very few got on to the battery and the casualties were only two—both caused by a direct hit on one of the guns by a gas shell. If the boche had been able to concentrate his shell on and round the battery instead of giving it just the same amount as the unoccupied surrounding country the effect might have been very different.

One possible reason for the promiscuous and sometimes very casual shooting may have been the fact that the boche at that time had practically no air observation. Our flying fellows had temporarily chased his planes out of the skies and had shot down all his observation balloons. This made it impossible for him to pick his targets, and he either had to bombard the countryside or shoot "by the map," neither method being particularly conducive to good results with gas shell.

On the other hand, one or two places that he knew were pretty certain to be occupied by our troops were given their full dose. One such place was Caterpillar Wood—a big narrow spinney running off from the Fricourt Valley and so named because of

its shape and the fact that on the ordnance maps, on which the woods are colored green, it looks just like a green caterpillar crawling over to the shelter of Mametz Wood. This place was continually shelled with large numbers of the Green Cross Shell, and as it stood in the side of a valley the gas persisted longer there than elsewhere and built up a tidy concentration which caused a lot of trouble.

The gunners were among our chief sufferers from these gas shell, as their guns were so frequently placed in sunken roads and folds in the ground for protection against explosive shell and aerial observation, and these were just the kind of places that held the gas longest. In the open much less damage was done. I remember one night the first-line transport of a battalion of the Black Watch ran into a patch of country into which the boche was raining 77-millimetre Green Cross Shell, and came out with only three casualties, two of which were from a direct hit on one of the wagons, the driver being killed instantly.

It seems particularly bad luck to be killed by a direct hit from a gas shell, for the bits

of shell that fly about don't do much damage in the ordinary way and don't travel great distances. Indeed it is remarkable, even in the biggest gas-shell bombardments, how very few men are hurt by the fragments.

The first week or two after the advent of the Green Cross the toll of gas-shell casualties was considerable if not alarming, but steps were immediately taken to get the situation in hand. It is in a case like this, where a surprise had been brought off, that Discipline, with a very big "D," counts for so much. Fortunately the gas discipline of the British Army was pretty good, and it was not difficult to get new instructions carried out and orders obeyed. Once they got going their effect was most apparent and the gas-shell casualties dropped from week to week until they approached a minimum.

Among the important steps that were taken were a revision of the methods of spreading the alarm, and the protection and clearing out of dugouts into which the gas had penetrated.

Mention has already been made of the slight noise caused by the explosion of the gas shell, and instructions were accordingly

issued that all shell that sounded like duds were to be regarded as gas shell, and the respirators adjusted accordingly. This got over one of the elements of surprise.

A great many men, especially those in battery positions, had been gassed in their dugouts before warning of the gas bombardment had been spread. Numbers of these men were actually gassed in their sleep and were awakened too late by the choking fumes themselves. What was done was to post a gas sentry at every battery in just the same way that it was done in the trenches. Special local-alarm signals were arranged so that the sentry could wake every one in the neighbourhood without having the alarm spread beyond the limit of the gassed area. These alarms generally took the form of bells or of gongs made from big shell cases; but later on policemen's large rattles were found to be the most effective "weapon" for the purpose, and numbers of these were distributed up and down the line and in the battery positions. It was feared at first that the noise of the rattles would be mistaken for machine-gun fire and no attention be paid to it, but this did not ma-

terialise and the rattles have done good service.

The only thing about them is that they are made of wood—and nicely pickled, easily burning wood at that. In the trenches kindling chips of any kind are eagerly sought after to make a miniature fire to warm tea or cook an egg. When men will go the length of shaving the handles of their entrenching tools to obtain dry wood it could hardly be expected that policemen's rattles would always be respected. I am afraid a number of them disappeared. With the artillery things are not so bad as fuel is easier to obtain and the rattles are therefore less liable to get lost

## CHAPTER VIII

The gas-proof dugout—First-aid methods of alarm—Von Buelow improves German gas tactics—Popular errors about gas—Effectiveness of new British respirators—Vomiting gas—Germans speed up their manufacture—Gas as a neutraliser of artillery fire—As a neutraliser of work behind the trenches—Raw recruits ashamed to wear the mask—Casualties resulting.

PROBABLY the most important thing that was done as the result of the Somme Battle experience was to insist on there being at least one protected or gas-proof dugout at every headquarters, battery position, signal station, aid post, or wherever gas shell were particularly likely to drop.

I have deferred describing these protected shelters until now, but as a matter of fact they had been devised and adopted nearly a year previously, though not many of them had got into actual use. The protection consists essentially of a damp blanket fitting closely over the entrance to the cellar or dugout or emplacement, which-

battalion was going to be relieved that night and they took off their webbing equipment for the purpose of fastening on the haversack and pack. Absolutely against orders they also removed their box respirators, and of course it was just that moment that the boche chose for dropping in half a dozen small trench-mortar bombs filled with phosgene. These vicious little guns are very accurate and most of the shell landed on or near the parapet and filled the fire bay with gas. Both men dived at once for their respirators and in so doing upset three other men in the bay. All five were gassed and three of them died later.

## CHAPTER IX

Mustard or Yellow Cross gas—Not deadly but a dangerous pest—Its troublesome persistence—Cleaning it out by fires—Sneezing or Blue Cross gas—Another pest—Its violent effect—The limit of gas shell effectiveness—The need for constant vigilance and disciplinary training.

THIS was pretty well the position of things in July of last year, when the German use of gas shell underwent a radical development due to the advent of the so-called mustard gas. So much has been written about this gas and so many mis-statements have been made concerning it that it is as well for the public to understand what mustard gas is, what it can do and what it cannot do. On the one hand, it has been credited with such impossible potency as would make it wonderful that any Allied soldiers remain at all. On the other hand, it should be realised that in mustard gas the Germans possess a very powerful weapon of war and one which they are using to a very considerable extent.

In the first place let it be said that mustard gas is not a killing gas like Green Cross, but that it is of the persistent type, like the older lachrymators. Unlike the lachrymators, however, its effects are not transitory and a man put out of action by mustard gas is going to be a casualty for several weeks and perhaps longer. Mustard gas principally affects the eyes and the lungs, but in a very strong vapour or in contact with any of the actual liquid from the shell a man's skin may be burned very severely—even through his clothes. More attention has been turned to this blistering effect of the gas than to anything else, but as a matter of fact the blistering is of secondary importance and in itself does not result in the loss of many men to the line. Of course one has to be very careful. It is foolish, for example, to lean up against sandbags that have been spattered with the liquid or to sit in a mustard-gas shell crater. Sooner or later the skin underneath will develop a severe and possibly extensive blister, which is very painful and certain to last some time.

These burns are not dangerous, but they are most uncomfortable, to say the least,

especially as they are most easily produced on the more tender parts of the skin.

Great excitement was caused at first among the Highland regiments because the story was spread about that the Scots were particularly susceptible to the mustard gas because of their attenuated clothing. As a matter of fact the kilt doesn't seem to be a source of danger at all, and Highlanders are burned no more frequently than others. Possibly the continued exposure of their legs hardens them.

The chief effects of the mustard gas are on the eyes and lungs. The first thing you notice is the smell—which is slightly of garlic or mustard—and irritation of the nose and throat. Neither effect is enough to make you feel gassed, and the chief symptoms develop later on. When the gas is strong it is apt to cause sickness and sometimes actual vomiting. Later on the eyes inflame and get very sore, the lids swell and blister, but no permanent injury to the eyes takes place, though the victim may be temporarily blinded. The effects developed in the lungs are equally painful and consist of severe inflammation and bronchitis, which

may take some time to get better and if not well looked after may develop into pneumonia.

It will thus be seen that for a persistent gas, though not deadly poisonous, mustard gas is a nasty proposition. First the gas does not of itself force a man to protect himself. With the old lachrymators a man either put on his mask or his eyes would smart and water so badly that he could not keep them open. With the Green Cross and similar gases a man either protects himself or dies. But with the mustard gas, though the smell and irritation may be perfectly apparent, the effect is not such as to force a man to don his mask. Yet if he does not do so and continues to live in the vapour unprotected he will certainly become a casualty. It may take half an hour, it may take several hours to come on, but come on it will.

Another particular disadvantage of the mustard gas is its persistence. It will hang about in shell holes for many hours and even for days. If it gets into a dugout it is very difficult to get rid of it, and as long as there is enough to produce the faintest smell or irritation of the nose there is enough to bring

on serious symptoms eventually. This means that when it is used our fellows are forced to wear their masks for very long stretches of time.

The mustard gas is known officially by the Germans as Yellow Cross gas, and the shells are marked on the sides with bright yellow crosses and bands. The paint used for these bands changes colour in contact with the mustard-gas liquid, so that if a shell should leak it at once becomes apparent and can be taken away and buried.

The Yellow Cross gas was first used at Ypres and bombardments there were quickly followed by similar ones at Nieuport and Armentières. Enormous numbers of shell of all calibres were employed, including a new and larger size—the 8.3-inch howitzer shell, which holds nearly three gallons of the liquid and can be fired a distance of six miles.

At Nieuport more than fifty thousand shell were fired in one night, and equally large numbers were used in deluging the other towns. Since then the numbers used have continually increased, especially when

the boche was preparing for an attack or expecting one of ours.

Duds that were collected showed that the mustard-gas liquid was a chemical called dichlorethyl sulphide, a liquid that gives off its vapour only slowly. The shell themselves were similar to the previous gas shell except that the small one have a new type of fuse—a very simple and quick-acting fuse which bursts the shell before it can get into the ground, and consequently produces a very little crater. This of course helps to spread the gas round more than if a big hole were formed. The respirators keep out the Yellow Cross gas completely, and the blanket protection of dugouts will also keep out the gas splendidly. Of course if a dugout gets a direct hit with a mustard shell there is nothing for it but to leave it empty for some days, as the liquid cannot be removed by ventilation with either fans or fires.

A case that will illustrate what I mean was one in which a three-inch mustard-gas shell got a direct hit on a doctor's dugout and gassed him and his orderlies. Some time afterward the remaining orderlies thought they ought to send the doctor's things down

the line and went in and got them out of the dugout. They noticed a faint smell but did not worry about it, and soon afterward found themselves gassed in consequence.

A fire was then placed in the dugout to clear it. In the meantime the medical sergeant secured another dugout by clearing out some infantrymen. In the evening the infantry felt soul-sick and wanted somewhere to sleep, so they went into the original gassed dugout and slept there. In the morning they all went down, gassed.

Where there has been no direct hit and the mustard-gas vapour gets into the dugout, it can be cleared out just like ordinary gas, by ventilation either with fans or by means of fires. For clearing dugouts a great deal of reliance is placed nowadays on building small fires inside. A dugout with two entrances can be very quickly cleared by means of fires, as a through draft is produced, which carries the gas away with it; but difficulty is frequently found in getting the necessary fuel for the fire and in keeping the stuff handy. Bundles of firewood and kindling material are supposed to be kept in the dugouts ready for use; but, as has

already been explained, the Tommies are always on the lookout for combustible materials for their own fires, and continual inspection has to be made to see that the special supplies for ventilation are kept available. One officer told me that he always had the supplies of wood, paper and kerosene kept in an army-biscuit tin which was closed and sealed; because, as he said, no Tommy would ever investigate the contents of a biscuit tin unless absolutely forced to do so for lack of other food.

It should be realised, however, that properly protected dugouts have given perfect immunity from the mustard gas as long as the protection has remained intact, and a great deal of attention is being paid to increasing the number of the protected shelters in order to give the men the necessary rest from wearing their respirators occasioned by the extensive use by the boche of his Yellow Cross Shell. In Nieuport a special gas patrol was instituted for going the round of the town to see that blanket protection of cellars and shelters was kept in good condition, as there was always a chance that they would not be well looked after or that the

blankets had been taken down by some enterprising Tommy for his own personal use.

Round about battery positions the most annoying feature of the mustard gas is the length of time it persists. In the shell holes it can at any rate be partly destroyed by sprinkling with chloride of lime. It is rather interesting to find that in some captured German instructions great secrecy was laid on the use of chloride of lime for getting rid of the effects of mustard gas. The boche kept boxes of chloride of lime in all positions where the gas shell were stored, and issued instructions to his own troops that "the use of chloride of lime for the protection of our own troops against Yellow Cross liquid must not become known to the enemy. Observation of the strictest secrecy is a matter of duty just as much now as it was previously. The troops will be thoroughly instructed in these precautionary measures, but nothing will be taught them as regards the nature or composition of the antidote employed."

During the present offensive the Germans have used very large quantities of mustard gas, generally for holding purposes and

against our rear lines, battery positions, communications and reserves. This is kept up for many hours in order to wear out the patience of our fellows and weaken them for the coming assault.

Strong points that the boche does not wish to attack are also swamped with the gas, and when Armentières were evacuated by the British, Yellow Cross liquid was actually running down the gutters. But in places that he intends to assault he will complete the mustard-gas bombardment against our troops some considerable time before he advances; otherwise his own troops would run into it and be forced to don their respirators.

The quantities of shell used in this preparation are enormous and supplies of the mustard gas must have been accumulated during the winter to an unexpected extent and their manufacture proceeded with to full capacity.

Take it altogether, Yellow Cross gas is very much more than an annoyance, but there is no question that good discipline and thorough appreciation and carrying out of the orders laid down for the protection of troops have reduced the losses in very much

the same way that the screwed-up discipline reduced the losses after the first introduction of Green Cross Shell. One of the most objectionable features of the mustard gas is the continual care that has to be exercised to prevent casualties. It is so easy for a man whose clothing is slightly contaminated with gas to enter a dugout and contaminate the whole of the interior and all its occupants. Sentries also have to be posted to warn troops passing through or into an area that has been bombarded with mustard gas, so that respirators can be put on. After a cold night the officers must be continually on the watch to see whether the vapours that rise from the warming of the earth by the morning sun are charged with mustard gas, and to take the necessary precautions on the slightest detection of the characteristic smell. This smell to my mind is much more like garlic than mustard, and the use of the term "mustard gas" is purely the origination of the Tommies themselves. As a matter of fact, so as not to confuse the Yellow Cross liquid with true mustard oil, efforts were made at first to prevent the stuff from being called mustard gas. But

once the British Tommy decides on a name for anything, that name it is bound to have, and as he adopted the name "mustard gas" for it mustard gas it will remain for all time.

The other new material that was introduced by the Germans in the summer of 1917 and which, like mustard gas, has been in use ever since is the German "sneezing gas." For a long time high-explosive bombardments were reported on many occasions to be accompanied with violent sneezing, which at the time was laid down to the presence in the air of undecomposed explosive from the shell. As a matter of fact the sneezing was due to the presence inside the high-explosive shell of bottles containing chemicals the chief effect of which is to cause violent sneezing when small quantities get into the air. This sneezing material, or sternutator, to give it its scientific name, in this case was a solid which is atomised into tiny particles when the shell bursts. Chemically speaking, it is called diphenyl-chlorarsine. This material is used embedded in the trinitrotoluene of the explosive shell in most cases, and such shells are called Blue Cross Shell, and are marked accord-

ingly. This is the third of the present trilogy of the German coloured-cross gas shell. The sneezing gas is also sometimes mixed in with the contents of the Green Cross Shell in considerable proportions.

The idea underlying the use of this sneezing gas by the Germans was apparently partly that of getting a gas which they thought might go through our masks. In this of course they were disappointed, as the respirator keeps out sneezing gas perfectly well. The other idea underlying its use was apparently to cause such violent sneezing as to prevent men from getting their masks quickly adjusted or to cause them to sneeze them off if they had been put on.

This and all sorts of other tricks of the gas-shell business have been tried out at various times by the Germans. While putting over Green Cross or Blue Cross Shell, or both, they will suddenly accompany them with violent bursts of shrapnel, the idea being that men will be so busily occupied in putting on their masks or in sneezing that they will not take the usual care in finding immediate cover from the shrapnel; or that, on the other hand, in taking cover from the

shrapnel they will not get their masks on in the minimum time or will displace them in their efforts to get away.

The sneezing caused by the Blue Cross Shell is a most peculiar and violent kind. If you get the smallest dose of this stuff into your lungs you start sneezing at once. You seem to sneeze from the very bottom of your stomach upward, and feel as if the whole of your chest were going to come out with it. This may continue almost continuously for a short time; but there are apparently no after effects unless the gas has been very strong indeed, in which case there is very painful irritation of the whole of the throat and lungs which will produce bronchitis.

This is the present stage of development of the German gas shell. Whether they will add another colour to their lot of Green, Yellow and Blue Cross Shell we do not know, but we are prepared for it when it does come, and in the meantime he is getting as good as he gives.

It will be news to most people to realise how the gas shell are gradually dominating the field. Some bombardments are composed entirely of gas shell. As many as a quarter

of a million have been fired on the attacking front during twenty-four hours, and probably at least one-quarter of all German shell of all calibres are gas shell.

It must be remembered that there are certain things that gas shell cannot do. They cannot replace high-explosive shell for the demolition of fortified works, for example. Nor can they be used for cutting barbed wire previous to an advance; and the creeping barrage that preceded the assaulting infantry cannot be made up by gas shell. An S O S barrage in No Man's Land, to cut up an attack, also would have to be shrapnel and H. E. so as not to gas the defending troops. When all these are cut out it will be realised that the proportion of gas shell that are used against living targets must be very big indeed. It is hardly too much to assert that at the present day, of the actual methods of attacking men direct gas is the most important. It must be realised also that it can become, and is likely to become, still more important, and that the fight between the offence and the defence on both sides will continue until the end of the war.

Since December of last year the boche has

been copying a method invented by the British for firing a large number of big drums of gas simultaneously. These drums are used chiefly against the front-line troops and are generally filled with pure phosgene. As each bomb contains a gallon and a half of liquid and many hundreds are fired at the same moment a good high concentration of gas is produced. Warning is given by the tremendous roar from behind the German lines when the flock of canister or rum-jar bombs starts on its way. Every man who hears the noise gets his mask on at once, even before there is any sign of gas; and if he does this there is little danger, as the respirators are quite capable of dealing with even the very high concentrations of phosgene produced. If a man keeps his head and obeys orders there is little to fear from gas. But discipline must be high. As one Tommy said: "You must be so well disciplined that when the gas alarm goes you will even drop the rum ration so as to get your respirator on in time." Beyond that it is simply a question of carrying on the work in hand while wearing a respirator, and this is entirely a matter of practice.

## CHAPTER X

**Liquid Fire**—First used by Germans in July, 1915—A great surprise and success—German hopes from it—Construction of a flame projector—Flammenwerfer companies—Their perilous duties and incidents of desertion from them—Improved types of projectors—Co-operation of machine-gun fire—Failure of liquid fire—Its short duration and short range—Ease of escape from it.

WHEN the German Army entered on its policy of frightfulness there was none of its new and unprincipled methods which had more immediate and striking success than the use of liquid fire. And there is now none of all its methods of frightfulness which has fallen more into disrepute, and which has had less success when once the first surprise was over.

A great deal of attention has been drawn in the newspapers to the use of liquid fire, but the average man, even in the fighting forces, knows very little about the German methods and the appliances for its use. Yet Germany still has special troops trained in

the use of liquid fire, and seeks continually to alter and develop the fire weapons and their tactical employment in order to take advantage of the undoubtedly terrible appearance and destructive power of the high temperature flames which can be emitted. This article is intended to show the stage to which the development has attained and the reasons for the relatively innocuous character of what is probably the most terror-inspiring method of modern warfare.

Throughout 1915 England was pouring new divisions of its National army into France. As with all new troops the procedure adopted at the time was to bring these divisions by easy stages to within a short distance of the front line, and then send them in by companies for a four day "instructional tour" in the trenches to pick up all the wrinkles and habits from the seasoned troops holding the line. After the whole formation had been put through it in this way the division would be allotted a definite part of the line, taking it over possibly from the troops with whom it had been in for instruction and allowing the latter to get out for a much needed rest, or to get

"fattened up" for some impending or progressing show elsewhere.

One such new division, absolutely fresh from England and with no war experience whatever, was the target selected by the boche for his new deviltry. The portion of line allotted to this division was on the outermost part of the Ypres salient and included the ruins of the little village of Hooge right at the point of the salient. This position had always been a hot corner—"unhealthy" in the British army parlance—and had changed hands several times. The trenches there were poor as it was almost impossible to get effective work done on them owing to their exposed position. Indeed there were many parts of the line where no movement was possible by day and the men on the posts had to lie "doggo" until night. The two lines were very close together—in many places less than twenty yards—and it was quite possible to hurl hand grenades from one set of trenches to the other. It was on this position of the line, over a front held by two battalions, that the attack was made.

After a bombardment of several days, a mine was exploded under the front line and

then immediately afterward, at 3:20 A. M. on the morning of the 29th of July and without the slightest warning, the front line troops were enveloped in flames. Where the flames came from could not be seen. All that the men knew was that they seemed surrounded by fierce curling flames which were accompanied by a loud roaring noise and dense clouds of black smoke. Here and there a big blob of burning oil would fall into a trench or a saphead. Shouts and yells rent the air as individual men, rising up in the trenches or attempting to move in the open, felt the force of the flames. The only way to safety appeared to be to the rear. This direction the men that were left took. For a short space the flames pursued them, and the local retirement became a local rout. Then the flames stopped and machine guns began to take toll of the fugitives. Only one man from the front trenches is known to have returned. German infantry following up, poured into the breach in the line, widened it, took our positions as far back as Sanctuary Wood, and then consolidated.

Ten days afterward we counter attacked and won back the whole of the line concerned

but at very considerable cost. Incidentally, we captured two of the German flame projectors, one of them complete, and they proved to be of the greatest possible use to us subsequently for educating the army in the new warfare, and for inspection by our own experts with a view to their duplication for retaliation.

Any one attempting to blame the troops attacked for their retirement can hardly appreciate the circumstances, and, I am convinced, over-estimates his own capacity for resistance. This attack was an utter surprise—the kind of warfare was unknown and unheard of. Imagine being faced by a spread of flame exactly similar to that used for the oil burners under the biggest boilers, but with a jet nearly sixty feet in length and capable of being sprayed round as one might spray water with a fire hose. Personally, I am pretty sure, had I been there, that I should have hopped it if I had not been fried by the heat or frozen with terror. Later, when we knew the limitations of these things it was different, though even then it is a pretty good test of a man's nerve.

The flame projectors taken by the 14th Division in the counter attack were simple but very interesting in construction. The main part was a cylindrical vessel of steel about two feet in height and fifteen inches in diameter provided with straps so that it could be carried on a man's back. At one side about two-thirds of the way up was a filling hole for oil, closed by a screw cap. Near the top was a pressure gauge attachment and toward the base was a lock closed by a lever handle and to which could be attached a long length of flexible hose ending in a peculiar shaped nozzle.

On examination it was found that the body of the projector was divided internally into two compartments which could be connected by opening another tap. The upper compartment was the compressor and the lower the oil reservoir. The compressor chamber was filled to a pressure of twenty-three atmospheres with deoxygenated air or nitrogen. Air itself cannot be used because of its oxygen content forming an explosive mixture with the vapours from the oil, and any heating on compression, or back-flash from the flame or fuse, might make things

very unpleasant for the operator. The nitrogen required for the flame projectors is carried into the field in large cylinders about 4 feet 6 inches in length and 6 inches in diameter. Several of these cylinders have been captured from the enemy since. These cylinders are actually taken into the trenches and the flame projectors charged from them there.

The combustible liquid used in the flame throwers has varied in source and composition from time to time, but it invariably has one characteristic which appears to be essential for good results—it must have light or easily volatile and heavy and less volatile fractions mixed in carefully graded proportions. The heavy oil has sometimes been a petroleum product and sometimes a tarry residual oil from the distillation of wood. The light portion, which insures the jet's keeping alight was originally a light gasoline, but at one period, whether from shortage of petrol or not I do not know, the place of the latter in the mixture was taken by ordinary commercial ether.

The lighting device, fixed at the end of the flexible hose, is the most ingenious part

of the whole contrivance and is so made that the oil ignites spontaneously the minute the jet is turned on, and is kept alight by a fiercely burning mixture which lasts throughout the discharge.

The nozzle is about 9 inches long and detachable so that replacement is easy. It clips into the end of the tube and is held in position by an annular ring. When the oil with its twenty-three atmospheres pressure behind it is rushed out of the jet, it forces up the plunger of a friction lighter and ignites a core of a fierce burning fuse mixture which fills the whole of the space between the central tube and an outer casing. The latter consists of a thick wick soaked in paraffin wax and fitting loosely into a thin brass case.

When the nozzle is in position all that is necessary is to turn on the tap, and the stream of flame issues from the tube and can be directed at will.

The official name for this instrument we discovered was the "*Flammenwerfer*" (flame thrower) and it is now never known in the British army by anything else than its German name. Indeed this is one of the

very few German words we have adopted as an outcome of the war, the only others I can remember being "*strafe*" and "*Kamerad*."

Flammenwerfer attacks are made by the 3rd and 4th Guard Pioneer Battalions and by the Guard Reserve Pioneer Regiment—all of which troops are specially trained in flame tactics. Each battalion is composed of six companies and each company is equipped with 18 small or portable projectors similar to that described above, and with 20-22 large projectors of greater range. The latter larger flammenwerfer are built on the same principle as the former, but are too heavy to be used as mobile weapons. They are consequently built in to the trenches at about 27 yards from the opposing lines, and, if the trenches are not close enough together for the purpose, special saps are pushed out and the flammenwerfer installed at the end. The range of these large projectors is 33-44 yards and they can cover a front of 55 yards with flames.

It is probable that in the attack at Hooge that both large and small flammenwerfer were employed.

It is possible with the above equipment for a flame company to cover a total front of 1100-1600 yards.

Service in the Guard Reserve Pioneers is apparently a form of punishment. Men convicted of offences in other regiments are transferred either for a time or permanently, and are forced under threat of death to engage in the most hazardous enterprises and carry out the most dangerous work. The following incident will serve to show how the German soldiers are hounded to their death in these engagements.

In the summer of last year a small flammenwerfer attack was made against our line at a point near Monchy, south of Arras. Two boches armed with flame projectors of a modified pattern were instructed to attack one of our advanced posts which was at the head of a sap running out toward the German trenches. In broad daylight and with no covering fire worth talking about these two poor devils were forced over the top with revolvers pressed into their backs. One was shot down immediately. The other managed to get clear of his own barbed wire and then discarded his apparatus, with the intention

of crawling over to us and deserting. By this time, however, he had been badly shot up—whether by his own people as well as by us, I cannot say. His left arm and his right thigh were both smashed, and he had two bullets in his abdomen. Nevertheless this man managed to crawl into our lines and was taken care of. He was sent down to a Casualty Clearing Station in a perilous condition, but despite his terrible injuries I understand the doctors managed to patch him up, and that he recovered completely.

The portable flammenwerfer used in the attack just described was brought in by our patrols the following night, the spot where he had left it being accurately described by the wounded prisoner. It was found to be of a new pattern and other specimens of the same construction have since been captured, chiefly in the neighbourhood of Lens where they were employed by the boche in the course of abortive counter attacks against the Canadians.

In this pattern, which is shown in detail in the photograph, the compressed nitrogen is contained in a spherical-vessel which is contained inside a ring-shaped oil container.

The whole thing looks like a life preserver and is mounted on a light frame so that it can be comfortably carried on the back. For a man who may suddenly have to get down on his stomach and crawl, the apparatus is much more compact and better fitting to the body than the original type, but it has no advantage over the older varieties as regards range or duration.

The flexible hose which carries the lighting nozzle is made of canvas and rubber, and enemy documents which have been captured show that only one tube is provided for each three reservoirs. After the discharge of one apparatus the long tube is supposed to be fitted with a new nozzle and handed on to the others in succession.

The flammenwerfer companies are divided into squads. Following the German army habit of adopting contractions—a habit presumably forced on them by their cumbersome word-building language, the squads are designated *Großtruppe* or *Kleiftruppe*, according as they are armed with large or small projectors. The former is a contraction for *Grosser-flammerwerfertrupp* (large flame projector squad), and the

latter for *Kleiner-flammenwerfertrupp* (small flame projector squad).

In the case of attacks with the large projectors, or a combined attack with both sizes, the chief thing is secrecy of installation in the trenches. If it was ascertained or suspected that flammenwerfer were being put in, our gunners would open on the position in no time and blow the apparatus sky-high. As it is necessary to sap out to within 27 yards of our lines in order to get in a "shot," it can readily be seen that the possibilities of using the large projectors are very limited, and as a matter of fact little use has been made of them.

Attacks with the portable projectors are more possible owing to their greater mobility. But here again the essential part of the tactics and the most difficult thing to do is to get near enough the target to make the shot effective. The range is only fifty to sixty feet. The German idea is to cover the advance of the "*Kleif*" men by protecting machine gun fire.

In an attack, the advance of the company is covered by machine gun fire from each side, converging at a point on the opposing

trenches. In the triangle thus formed the attacking force, the "*Kleiftruppe*" in front, then a party of bombers, and finally the raiding or attacking party take up their positions in No Man's Land and crawl as far forward as possible in the "protected area." As soon as the flame projectors are within range, the machine guns switch outward to each side, the flame is discharged and the bombers rush in and try their luck in the trench. If things go well, the infantry follows the bombing party and proceeds to its objective.

In an attack of this kind, or a less well-supported attack such as that at Arras, mentioned above, the attackers suffer from two such severe disadvantages that against well disciplined troops they stand little chance. These disadvantages are (1) the flammerwerfer carriers have to get so near their objective that they are almost certain to be shot, and they then become a source of danger to their own side; (2) men in trenches know they are perfectly safe from frontal flame attack if they keep well down and hug the parapet side of the trench. The reason for this is that the flame will not sink

down into a trench, but having little force behind it at the end of its journey is curled *upward* by the rising currents of hot air. The result is that any sort of head cover (unless made of wood) makes perfect protection, and a man crouching in a trench or even lying prone in a shell hole, is very unlikely to be more than slightly scorched at the very worst. I can vouch for this, for I have lain at the bottom of a trench with the flames playing over my head and have not been injured in the slightest, though I confess to being very much relieved when the flame stopped. The only danger in trenches to men who keep their heads is that of "blobs" of burning oil falling from the end of the fiery stream, but this is not a very serious chance.

Another serious disability in the German liquid fire is its *very* short duration. The stream of flame from the portable flammerwerfer lasts rather less than one minute. It is impossible to charge up again on the spot, and the result is that once the flame stops the whole game is finished and the operators are at our mercy. Without making the apparatus of a prohibitive weight, the duration

of the flame cannot be increased. Even the heavy projectors give only a flame lasting at the best one minute and a quarter.

It must be realised that it is discipline and coolness (if one may use the word) which count, and that the moral effect on unsteady troops, unaware of the fact that the appalling flames have little destructive value, may be very great indeed. When men have bolted from the trenches into the open they are an easy prey.

An enfilade attack, i.e., one made from a flank, would be much more dangerous were it not for the difficulty of approach and the fact that the traverses of a fire-trench are as good protection against flame as the parapet. Only where the "*Kleif*" squad can approach under cover and get in its shot at an exposed target is the flammenwerfer likely to have much success nowadays.

A certain amount of value was obtained from their use in this way in the attack on Verdun for reducing isolated strong-points, notably fortified farmhouses and broken down cottages in the ruined villages. In certain cases the flame projector carriers were enabled to approach under cover or by crawling among the ruins and heaps of

debris, to within striking distance of the otherwise well protected machine gun emplacements and positions. By suddenly playing the fire jet into the loopholes, enough flame penetrated into the interior of the emplacement to put the machine gun and its crew out of action—either temporarily or permanently. This was the opportunity awaited by the covering party of bombers who would rush the post the minute the flame ceased, having made their approach while the projectors were in action.

But even for special cases like these the circumstances must be so favourable and the inherent disadvantages are so great that the flammenwerfer cannot be counted on to attain the required result.

The low value placed by the Allies on the German flame attack can be realised from the fact that no special form of cover is provided against it. There is no special form of fireproof clothing or other protection issued to the troops, and the instructions for meeting the attack may be summarised as "Shoot the man carrying the apparatus before he gets in his shot if possible. If this cannot be done take cover from the flames and shoot him afterward."