

Skyrockets and Flares as Aids to Our Fighters

Uncle Sam Had to Learn How to Make Fireworks When He Got Into the War, Because Telephones and Wireless Were Inadequate for Communication at the Front

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ONE of the problems which confronted the Ordnance Department of the army during the war and one which has provoked little comment was that of furnishing the American Expeditionary Forces in France with sufficient pyrotechnic devices for modern warfare.

At the entrance of the United States into the European conflict it was necessary to stimulate production of pyrotechnics on the part of the few fireworks manufacturers here and to create new manufacturing facilities in order to meet the requirements of our troops abroad.

It is hard to conceive what vast quantities of this type of material could be employed, and yet the cables were hot with calls for more. As an illustration the manufacturing program of the Ordnance Department called for:

25,000,000 Rockets.
28,000,000 V. B. Cartridges.
73,000,000 25-Millimeter Véry Pistol Signals.
200,000 Airplane Flares.
800,000 Wing Tip Flares.
37,000,000 Bengal Lights.
13,000,000 Hand Flares.
4,700,000 Smoke Torches.

These general types were subdivided in accordance with their different colors and effects. For instance, there would be a rocket with a parachute-suspended flare of red, green, or white. Another rocket would shoot out one, three or six fire balls of appropriate color. Some seventy-five distinctive types were included in the pyrotechnic code.

This enormous program was never met. The signing of the armistice was the signal for immediate stopping of production, but even then a producing capacity nine times greater than that existing would have been required in order to keep slightly ahead of the ever increasing demands.

Some conception of the problem which confronted the Ordnance Department with reference to pyrotechnics alone can be gained from the following:

The manufacturing schedule called for 19,000,000 yards of the finest Japanese silk, in order to manufacture those parachutes where Japan paper could not be employed.

The rocket sticks alone and without allowing for wastage amounted to 5,000,000 board feet.

The total boxed weight of all pyrotechnics involved in the program was 192,700,000 pounds.

The light given off by all the pyrotechnics actually manufactured and accepted would have developed continuously 27,000,000 candle power over a period of twenty-four hours.

While pyrotechnics have been known for centuries, the method of manufacture and the formulae have varied but slightly in two hundred years. The specifications whereby material might be judged as to its worth were lacking. Our allies had been rushed into the manufacture, and, in their haste, had not had time to prepare such standards. The Ordnance Department of the army prepared the first scientific standards for acceptance in the history of pyrotechny. These standards and specifications were based on performance, leaving to the ingenuity of the contractor how he should meet the requirements, but aiding him by suggestions based on the



Smoke Screen Made by a Phosphorous Shell Fired from a Mortar.

experiences in the department's research work.

In preparing these standards a lesson was taken from the illuminating engineer. The first standard established was that of candlepower. The result was surprising. Of samples submitted by various manufacturers, it was found that the candlepower of a certain type of flare varied from 400 to 40,000. Prior to this test each manufacturer had sworn by the efficacy of his own secret formula.

It was also noted that a high candlepower could be readily attained, but with an accompanying increase in the volume of smoke given off, which smoke, unless rapidly cleared away, cut down the illuminating power of the signal. The Ordnance Department thereupon devised an apparatus for measuring the quantity and translucence of the smoke given off. Standards for these features were then established.

Another standard which has only recently been satisfactorily established is that of color. It is little appreciated that no standard of hue exists. Color shade is purely a matter of personal opinion, and naturally the acceptance of material must be based on something more concrete. It would otherwise lead to indefinite argument. Since a distinctive color in the signal code has a definite meaning, the importance of removing all possibility of confusion becomes obvious. A green must not fade into white, nor a white show a tinge of red. These standards have been established in such a manner that the manufacturer will have a definite range of limits to which his product must conform.

The expansion of manufacturing facilities was not as easy a matter as in the case of the other types of munitions. The knowledge of the art was confined to a very few. Their efforts could not be diverted from actual production in order to assist in the creation of new facilities. It was therefore decided to establish an Ordnance School of Military Pyrotechnics, the graduates from which would form the nucleus of new Government plants. The students were sent to the operating plants and there appren-

ticed with a view to learning one or more specific phases of the manufacture.

The question naturally arises as to why pyrotechnics should in this day have again come into prominent use in military operations. The wireless and the telephone have undergone phenomenal development. The answer is to be found primarily in the unexpected intensity of warfare as was developed in "trench warfare," or "warfare of position" as it is more properly termed. It is essential that the military commander know everything that goes on behind the enemy's immediate front. The airplane has eliminated daylight manoeuvres. The airplane can detect night manoeuvres only if the terrain be illuminated. We therefore find many devices for either instantaneous or continued illumination of the ground. Reliefs were moved up at night, wounded were evacuated from front line trenches under a cover of darkness and ammunition supplies replenished. Only in an emergency were any movements within artillery range conducted by daylight. Where such was the case the toll from artillery fire was terrific.

Illuminating devices were the little white star shot from the Véry pistol, the white flares, suspended from the parachutes, fired from a special device attached to the rifle, (these were known as V. B. cartridges, named after the French inventor of the rifle attachment, namely, Vivian-Bessière,) the rockets with their parachute-suspended flare and the huge airplane flare. The last consisted of a flare which burned for six minutes and gave off an intensity of light of some 400,000 candlepower. This flare was suspended from a parachute made of the finest Japanese silk and eighteen feet in diameter. The flares were employed for the purpose of illuminating the terrain in order to detect manoeuvres at night or to facilitate bombing operations.

In this same connection an aviator can see better by moonlight than can an observer on the ground. Objects which are scarcely discernible at a quarter of a mile on the ground are clearly visible at a mile or more in the air. Tests which were made indicate that the flare when dropped from 5,000 feet illuminated the earth with an intensity equal to three times that of a most brilliant full moon.

While the telephone was extensively employed for communication purposes, absolute reliance was not placed on it, and the troops were profusely equipped with numerous methods of night signaling. The code was changed from day to

day, and great attention was paid to drilling the men in the use of pyrotechnic signals. The chief advantage lay in the rapidity of sending and receiving. There was no carrying of messages; there was no ambiguity of language, and there was no "listening in" on the part of the enemy.

For instance, on some special night, green might be the signal for gas. When the advanced positions detected gas, a green light was shot up from the Véry pistol, this signal was relayed from the trenches with V. B. cartridges, and eventually a rocket ascended high into the heavens, expelling at the height of its trajectory a little green light suspended from a paper parachute. More detailed information eventually found its way over the telephone communication. A similar signal the next night might call for the barrage.

A story is told of the early participation on the part of our colored troops in trench warfare. These troops were moved from training camp to a quiet sector in order to accustom them to the real thing. They were among the first of the American contingent thus honored. Their joy lacked adequate expression. They were moved up under cover of darkness and quietly instructed as to their duties by the French organization which they relieved. The American commander was naturally anxious that all should go well. From his position in the rear, he observed a lonely rocket climbing into the starlit heavens. Following its course with great anxiety he waited impatiently to see what signal might follow. There was a little puff of flame and a string of red lights became visible—the so-called "red caterpillar." His orderly had already the code at hand. A glance indicated, "We are being heavily attacked by tanks." The surprise of the General was complete. The terrain did not lend itself to the employment of tanks, nor did tactical considerations. Before he could reach the telephone another rocket ascended into the heavens. A beautiful green star slowly fell to earth—"Gas." Still another rocket soared upward and three red balls of fire fell earthward—"Lift the barrage." There was no barrage. By this time phone communication with the trench in question had been established and the interesting information returned: "We all's celebratin'."

Attempts were made by both sides to acquire the various signal codes used to confuse as well as to cause the artillery to open up needlessly and disclose its position.

Another employment of pyrotechnics relates to determining the advanced positions after some great movement where loss of contact and weakening of organization have resulted. When such a movement is contemplated each soldier is provided with a small flare called "The Bengal Light," which he puts in his pocket. During the night airplanes move over the terrain and at a prearranged signal the men ignite the lights and photographs are taken from the air. The airplanes return, the plates are developed, the pictures pieced together, and the new positions traced on the map. Isolated organizations are located and weaknesses or dangerous salients in the line discovered. This particular type of pyrotechnics was sparingly employed for this purpose in warfare of position, but found a greater value as open warfare developed.

Another type used in large quantities is the so-called smoke torch. When it became essential to undertake operations of a local nature in daylight, these torches were used in great quantity, forming an effective screen behind or within which certain movements could be made without fear of detection.