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Chapter 3

SOME FEATURES OF LIFESAVING ROCKET DEVELOPMENT IN THE 19TH AND EARLY 20TH CENTURIES*

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The achievements of rocket technology in the 19th century were closely connected with the development and successful deployment of lifesaving rockets.‡ However, in the works published to date, their development has not received much attention [27, 3].

The noteworthy work on lifesaving rockets by M. R. Sharpe provides the most detailed information on the characteristics, the number of persons rescued, present state of lifesaving rockets and biographic information on their makers. However, Sharpe's work does not address the general technological problems associated with lifesaving rockets: the development of engineering technology, or how these problems were solved [3].

In the published works, a number of questions concerning lifesaving rockets are not thoroughly examined or are interpreted incorrectly. Especially those questions concerning the time and place of the construction of the first lifesaving rocket.** However, the best evidence makes it possible to credit the idea of lifesaving rockets to Ducarne-Blangy in France at the end of the 18th century [4]. His earliest models made successful flight tests in 1799 [4, p. 25].††

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‡ The so-called lifesaving rockets that were widely employed in the 19th century were used for rescuing the crews and cargo of shipwrecks not far from shore (500 meters). These lifesaving rockets were launched either from the ship to shore or from shore to ship. The rocket carried a thin wire rope that was used to haul a heavier cable to the ship. A rope chair then could move the crew off the shipwreck one by one to the safety of the shore.

** There are the following statements:

a) the idea of a lifesaving rocket was first put forward by Schaefer in Germany in 1784.
b) a lifesaving rocket was proposed by Trengrouse in Britain and tested by him in the late 1820s.
c) it was suggested that the idea of a lifesaving rocket was brought forward and tested in France at the end of the 18th century.

It is necessary to point out that the publications on this subject do not cite the source of the data obtained. Some researchers of Schaefer's works do not mention the lifesaving rocket among his accomplishments nor the source of the data.

Ducarne-Blangy did not limit his study to the idea of deploying lifesaving rockets. He addressed a wide range of problems associated with rocket design: launch pads, wire feeding devices, the influence of wind and the wire on the flight of the rocket, and the possibility of a wire delivery by one or more rockets. Ducarne-Blangy's creation, research and testing of flying rocket models was carried on for a long period of time.

The influence of other rockets of the period on lifesaving rockets is of special interest. It is necessary to point out that the employment of lifesaving rockets was the result of the evolution of various lifesaving devices, including projectiles whose development began in Europe in the late 1770s [5]. The specific features of lifesaving rockets that distinguished them from other rockets used in the 19th century included: the wire rope connecting the launch point to the moving rocket; the wire attachment brackets; and a thrust guard to protect the wire from the burning effects of the jet stream back flash. In addition, lifesaving rockets required [1, pp.4-5]: a gradual increase of thrust; a rocket motor working over the majority of the flight path; and a relatively slow acceleration of the rocket from the launch pad to prevent the wire rope from breaking away.*

The launch pad of the lifesaving rocket had a number of unique design features. It established the rocket's flight range and direction; a secure base to attach the rescue wire; and it fed wire to the rocket in flight.

The unique characteristics and requirements of lifesaving rockets allow us to consider the development of these devices as an independent direction of rocket technology in the 19th century.

Trengrouse proposed the idea of a lifesaving rocket in England [6]. He produced rockets of various calibers, complete with carton cases and lateral rocket tails. They were launched manually [2, p.290] or with the assistance of a musketoon [6]. When a rocket was launched from a musketoon, the tail was arranged along the barrel, and the rocket body was connected to a small metal structure attached to a bayonet shaped bolt.

Trengrouse tested his rockets in the late 1820s. The range of an 8 oz (0.226 kg) rocket was 180 yards (162 meters); a 1 lb (0.4 kg) rocket with a launch angle of 50° was 212 yards; and the launching of a 2 lb rocket failed because of wire rope breakaway [6; 2, p.290].

In the 1830s, Dennett, another British researcher, made further modifications on the lifesaving rockets: replacing the carton casing with a metal one and lengthening the tail up to 8 feet (2.5 m) [6]. Dennett's rockets were built from 3 to 32 lbs in caliber. A 9 lb rocket with the wire rope attached had a flight range of 107

†† It is of interest to note, that Ducarne-Blangy's ideas were known in Russia in the mid-19th century. In 1857, the Naval Committee examined a project of a lifesaving rocket. The author (only the first letter "T" of his surname is given) of the study stated that a lifesaving rocket was invented by Ducarne-Blangy in France in 1799.

* According to Tramble, a French artilleryman, the speed of a lifesaving rocket from the launch pad should not exceed 100-120 meters per second. For example, to increase the closely grouped fire of military rockets it was necessary to provide the fastest possible slide-off from the rails and short time motor propulsion.

to 124 sagenes (195 to 226 meters). The 12 lb rockets were considered the most effective for carrying the lifesaving cable [7].

Dennett's lifesaving rockets employed launch pads of a relatively simple design. The launching rack and elevating arc were mounted on the launcher body, which was provided with a tripod [6; 7, pp. 133-134, appendix].

The use of lifesaving rockets spread to other nations after their successful deployment in the early 1830s [7; 8]. Work on lifesaving rockets by Carte and Boxer in Britain [6], Tremblay in France [9], Bertinetti in Italy [10], Cordes in Germany [10], Amici in Denmark [9], Konstantinov and Nechaev in Russia [9] and others led to a wide variety of designs (see Table 1).

Table 1
DESIGN VARIETIES OF LIFESAVING ROCKETS

	Year	Maximum Range of Flight (According to source)	(in meters)	Launch Weight (in kilograms)	Source
Ducarne-Blangy (France)	1799	100* tuase	200	-†	[3, p.6; 24]
Trengrouse (Britain)	1818	212 yards	194	0.45	[2, p.290]
Dennett (Britain)	1832	-	-	-	[6; 7]
9 ft. single	-	124 sagenes	227	-	-
twin		171 sagenes	312	-	-
Carte (Britain)	1842	147 sagenes	267	-	[6]
Tremblay (France)	1848	500 meters	500	-	[9]
Boxer (Britain) double	1855	230 sagenes	418	-	[12]
Datch lifesaving rocket	1855	150 sagenes	273	6.4	[20]
Bertinetti (Italy) artillery piece and rocket	1855-1860	350 sagenes	636	-	[9, pp.70-73; 10, p.106]
Amici (Denmark)	1862	300 meters	300	-	[21]
Cordes (Germany)	1866	295 sagenes	537	20.4	[12; 22]
Manbi mortar and 3 lb rocket (Germany)	1868	1100 feet	335	-	[23]
Konstantinov two-hollows rocket (Russia)	1874	523 meters	523	-	[13]

* Based on Ducarne-Blangy supposition of possible lifesaving rocket range.

† No data available.

Despite the great number of lifesaving rocket designs, they all faced the same design problem: provide the maximum range possible without wire rope breakaway. The desire to achieve greater range led to the appearance of twin and double rockets, and rockets with two chambers.

Dennett designed a twin rocket that consisted of two single rockets of the same caliber with a tail attached. Though a rocket of such design had a range of 50-60 meters greater than a single one, it did not come into service because of a number of problems, such as simultaneous ignition of both rockets [6]. Rockets of this design were less accurate, since it was impossible to obtain the same thrust in each of the separate rockets.

Boxer's double rocket consisted of two cases coupled together at their ends with the help of a perforated tray. One end of the case was covered by a metal plank and the other end by a wooden hemisphere. Thus, the rocket had two tandem chambers, each with conical cavities filled with a combustible mixture. A rocket tail with a lifesaving wire rope passage was attached to the rocket case. The rocket had a two stage burn. The first burn lifted the rocket and the wire rope to the highest trajectory point. Then the second burn provided the rocket with further progressive forward motion. These double rockets allowed the lifesaving wire rope to be carried a relatively great distance (230 sagenes, 420 meters) while reducing the chance of breakaway [12].

K. I. Konstantinov designed a rocket with two chambers which had a performance analogous to that of a double rocket. The main difference between Konstantinov's design and a double rocket was the powder composition. The powder was pressed into one of the chambers and had two tandem charges with conical hollows. These two charges were separated by a powder inner layer, rather than a metal plank as within the double rocket[9, pp. 89-91]. This design allowed a 3 inch (76.2 mm) wire rope rocket to reach a range of 523 meters [13].

The manufacturing technology of double rockets and the two-hollow rockets was complicated and expensive. Nevertheless, these double rockets were widely employed.

Another important aspect of the lifesaving rocket concerned protecting the wire rope safety line while the rocket was in flight. Successful attachment of the wire rope to the rocket prevented its breakaway caused by burning, and adverse reaction to the rapid acceleration or thrust. A number of measures were taken to protect the safety line from breakaway: absorbers reduced the tension in the line from sudden pull; moving the safety line away from the motor nozzles by attaching it to the edge points on the rocket tail with a special device; protecting the safety line with water, or replacing it with leather or a length of chain.

Such measures reduced the possibility of breaking the safety line, but did not eliminate it altogether. Malfunction of the wire rope feeding (coiling, entangling, etc.) also led to its separation. Therefore, special attention was paid to the need to feed the safety line from the launch pad at a speed not less than the moving rocket.

Launching pads for lifesaving rockets used in the 19th century are distinguished by the means devised to feed the wire rope. The most common launch pads of the period were often simple expedients such as stone surfaces, slopes, and open ground; pads without special devices for wire rope feeding, or with simple devices such as blocks, rollers, and spools; pads used together with artillery (gun launchers); launching pads of carrier launching matrix type; launching pads with special devices for wire rope storage and feeding.

The most widely employed rocket launching pads were those with special devices for wire rope feeding [2, p. 288; 14]. The launch pads created in Britain and Germany during the mid 19th century led to the wide-spread utilization of rockets for lifesaving purposes. These pads had a number of features that solved the problems of rocket launching and safety line breakaway: gas conduit, impact lock, and wire release mechanisms.

As the lifesaving rockets improved, the transportation facilities for the rockets also improved. In the beginning of their employment, lifesaving rockets were carried to the launching point manually [7]. The necessity of rapid deployment of the rocket, crew and the accessories led to the development of the so called rocket cart in the mid 1800s [15; 16]. The rocket carts were designed with regard to the rockets' weight and dimensions, provided with rockets, launching pads, and the required servicing mechanisms.

Besides the development of shore-to-ship rockets, the 19th century saw the development of ship-to-shore rockets that could dispatch a wired anchor to shore behind the surf line.* These rockets possessed a more powerful propellant charge and carried a heavier disposable load, i.e. an anchor and a wire rope. Tests demonstrated that such rockets had favorable characteristics: a 2 inch (5 cm) rocket carried a 3 kg anchor to a distance of 50 sagenes (approx. 91 meters). A 4 inch (10 cm) rocket carried a 48 kg anchor a distance of 100 sagenes (approx. 182 meters) with a wire rope about 36 mm thick [17]. There is no information concerning the launching pads for these rockets, but it is probable that such rockets were launched from a ship by improvised means as well as from launching pads. These rockets did not require a very high accuracy and used a wire rope of relatively short length.

While European military leaders abandoned the use of combat rockets by 1875, the use of lifesaving rockets expanded. Many countries in Europe utilized these lifesaving rockets. By 1882, on sea and ocean shore (not counting ship board rockets),† there were 783 launching sites throughout the world [18] and about 14,000 lifesaving rockets. Between 1893-1895, there were about 630 launching pads [19] and 10,000 to 12,000 lifesaving rockets in Europe.‡ This is a considerable number of rockets, and it illustrates that the lifesaving rockets continued to fill an important need.

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* Using a wire rope, a lifesaving boat could get through the surf line to the open sea.

† Some sea-going vessels were equipped with six lifesaving rockets and one launching pad [29].

‡ The number of rockets is determined by the fact that there were approximately 18 rockets per launch site [30].

With advances in navigation instruments, improvements in ship building and the development of other lifesaving devices, the importance of lifesaving rockets began to decline. The last employment of lifesaving rockets took place during the 1920s [3, p.38].

Thus it is possible to conclude:

1. Lifesaving rockets were proposed and tested for the first time by Ducarne-Blangy in France at the end of the 18th century.
2. To solve the problem of a successful launch, special launch pads were developed to feed the wire rescue rope and prevent its breakaway during launch. At the same time, special transportation devices for rockets and launch pads were designed.
3. Lifesaving rockets were the first widely used flying vehicles with powder reaction motors. They were employed exclusively for peaceful purposes and practical tasks.
4. The development of lifesaving rockets can be defined in the following phases:
   - o the appearance of lifesaving rockets and their development until their first successful deployment from the late 18th century to the 1830s.
   - o the growth and increased use of lifesaving rockets in Europe from 1830s to the 1860s.
   - o the effective and practical deployment of lifesaving rockets around the world from the 1860s until the 1920s.

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