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Author: Mr. Tal Inbar

Head, space research center, Fisher Institute for Air and Space Strategic Studies,
Israel, talinbar@fisherinstitute.org.il

**AIMING HIGH - FIRST STEPS OF ISRAELI RESEARCH ROCKETS IN
THE LATE 1960'S**

IAC-14 E.4.2.5

Abstract

During the late 1960's, a sudden interest in practical rocketry at Israel's Technion technical institute and at the Bosmat technical high school, affiliated to the Technion rose, and the result was a series of original rockets that launched and reached several kilometers into the skies. The paper described these "days of Genesis" in the rocketry projects, inspired by a small group of enthusiast engineers from Israel's society of astronautics. Those small rockets were a very humble beginning of Israel quest for space, culminating 20 years later, Israel loft its satellite to space by its indigenously designed "Shavit" launch vehicle.

Early Rocketry in the 1960's

Rocket building and flying was a very common way serving scientific and educational purposes. ESTES industries, a company based in Penrose, Colorado, USA that designs and builds model rocket and rocket engines, was the major player in the field of model rocketry during the "golden age of rocketry" in the 1960s and early 1980s. Millions of launches conducted during decades, and the youngest rocketeers were in elementary school. But the situation was very different in Israel in the 1960's. The import of rocket kits and engines was prohibited (as it still is today). The literature on propellants, aerodynamics of rockets and the

technical issues of launch pads etc. was scarce, and usually not available to the general public.

It was in the late 1960's, when the rocketry project begun to take shape in educational institutes in Israel, and it toll a very different path from similar projects in US. Since there were no available rocket motors on the free market, the rocketry enthusiasts were cooperating with the military - either the Israeli Air Force – or the military industries such as RAFAEL and TAAS. The Air Force provided engines from its arsenal of non-guided air to ground rockets (typically French made MATRA SNEB 68 mm rockets and later on the US made "Zuni");

Rafael (then the national authority for the development of weapons, under the auspices of the ministry of defense) agreed from time to time to cast the propellants needed for the rocket motors. Rafael gave the students permission to use its test range – usually the rockets were fired to the sea, and were not recovered after flight. The Israel Defense Forces (IDF) also provided proving ground for the launches, and also gave the students smoke grenades, that were inserted in several rockets, as a mean of tracking them.

“Nachshon” – the first student rocket in Israel

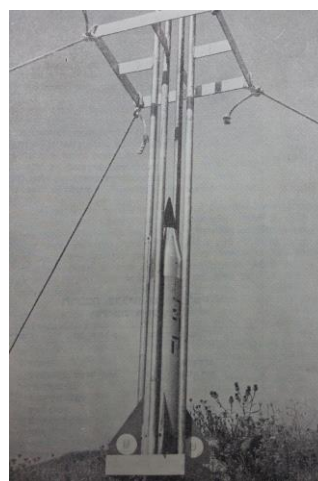
The first Student built rocket on the records is “Nachshon”, designed and built by Technion students and launched in June 1966. It was a tiny rocket, measured only 40 centimeters in long, with a diameter of 3 centimeters. The height reached was 500 meters. The rocket was the result of a special rocketry course led by engineers from the Israel Society of Astronautics, and it was conducted as an ex-curriculum course for a small group of students.

“Lightning” from the Technion

The second Student built rocket on the records is “Barak” (Hebrew for Lightning), was built by the Technion students, and launched on July 14, 1967, to a height of 6 kilometers.¹ The design of the rocket was almost

¹ The detailed information on the launch was published on “MADA (Science), a science quarterly published by the Weizmann institute of science, on July 1967.

identical to a series of other student built rocket that were built at BOSMAT technical school, affiliated to the Technion, a year after. The Barak rocket contained two smoke grenades as a mean of visual tracking. The instructors from the Israel society of astronautics then opened a second rocketry course at Bosmat, and brought the design of Barak to the technical school. The launch postponed due to the 1967 Six Days war, and the first Bosmat rocket launched in 1968.



Barak (Lightning) rocket is seen on its launch pad, April 14, 1967.

The design of Barak is relatively sophisticated for the time – as a student project – and it included a graphite nozzle for the rocket motor. The propellant was solid, with a weight of 3.1 kilograms, producing a 270 kg thrust for a duration of 2.5 seconds.²

BOSMAT Technical School

In 1933 a 4 years technical high school was established in Haifa, under the auspices of the Tehnion, Israel’s leading technical university, in order to train skilled workers for industry and

² Ibid

prepare students to study at the Technion. The BOSMAT (Hebrew acronym for professional technical high school) was the first of its kind in the country, which included various departments and disciplines: machinery, electrical, architecture, chemical engineering, carpentry, refrigeration and air conditioning, auto mechanics, radio (which has become the trend of electronics) and other that were added and changed over the years depending on the requirements, such as equipment and control, telecommunications, and electronic data processing.

During the British Mandate, Technion building in Hadar, including professional school buildings, were the center of the Haganah (leading Jewish resistance organization and the herald of the IDF) in Haifa and in the region. Workshops, underground, create hand grenades, machine guns carved cane give Stan, signaling devices (Morse) and Heliographs during the War of Independence and the establishment of facilities for guns brought down without proper facilities. Even before World War II, were produced at the school for aircraft spare parts of British aviation corps because they could not fly them from England.

Until 1958 the school had only boys. Number of girls at school did not exceed 25% even in his later years. Girls fit any trends but trends were auto mechanics like that is not embedded in girls and focused on

trends such as chemicals and construction. During the 80s onwards began to close due to lack of demand trends by the students.

The school was finally closed on 2004.

In 2007 the historic building of the school became part of the Israel's National Museum of Science, Technology and Space.

Rocketry at BOSMAT technical School

The staff and students were very creative and a special course for inventors was one of the schools attractions. One of the inventors won a gold medal at the 1968 International Inventors Exhibition in New York.

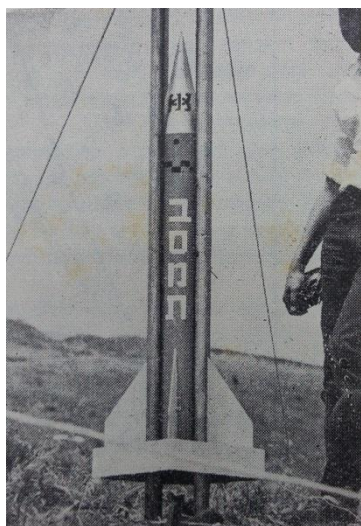
A BOSMAT there was an activity devoted to solar energy and in the line of excellence in learning, innovation in spirit, and hands on learning involving technical training, the special rocket course was established in 1967.

Partial support for the rocketry class was provided by the Israeli ministry of education, through its youth activities in science program, operated at all academic institutions since early 1960's.

BOSMAT 1

The Technion (Israel's leading technical university) students already launched a rocket in 1966 and 1967, and the Technion affiliated Bosmat technical high Scholl designed its own

rocket immediately after. But it took two unsuccessful launches (the exact dates are unknown) before the first successful launch of Bosmat-1. The rocket was a one meter long, single stage, solid propelled rocket, with four large stabilizing fins.



The first rocket in the line: BOSMAT-1 on the launch pad

The design of the rocket was very rudimentary – it was made of steel, and weighted 14 kilograms upon launch.³ Its velocity on launch was 30 m/s⁴ and terminal velocity about 500 m/s. It reached an altitude of 6 kilometers, and fell downrange at a distance of 1800 meters from the launch pad.⁵

³ The technical data was published on "MADA" (Science in Hebrew), a quarterly magazine published by the Weizmann Institute of Science, on April 1968.

⁴ Ibid

⁵ Note that this rocket was launched from a military proving ground near the coast of the Mediterranean near Haifa. Later student built rockets were fired towards the sea, since they got more energetic and possessed danger to nearby population in case of malfunction – these rockets were not equipped with flight termination apparatus.



Note the size of the rocket – about one meter in length.

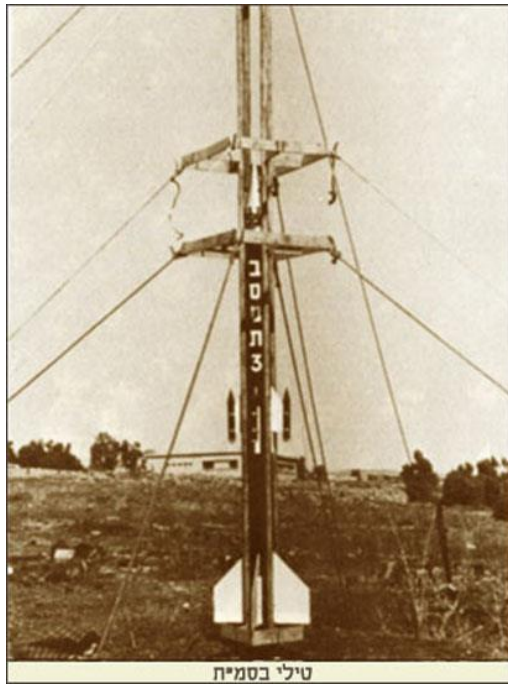
BOSMAT 2

On April 17, 1969, the students launched the second rocket, named "Bosmat 2 Alexander Konoff"⁶. The design was identical to the first rocket of April 1968. The one year interval between the launches indicate that Bosmat-2 was the outcome of a second group of students, that stated learning rocketry after the successful launch of the first rocket back in 1968. The rocket performance was similar to the Bosmat-1.

BOSMAT 3

Bosmat-3 was an improvement over the design of the first two rockets, as it was a two stage rocket, and a separation mechanism was have to be designed, built and tested. Two pyrotechnical tracing devices were included in the wing tips of the second stage, to improve visibility of the rocket.

⁶ Alexander Konoff was a donor of the Bosmat School and naming the rocket after him was not only an act of gratitude, but a hope of the school that he will support the rocketry activities as well.



“BOSMAT 3” rocket on its launch pad. The rocket has two stages. Note the pyrotechnical tracers at the end of the second stage fins.

BOSMAT 4

Until September 2014, no data was available on BOSMAT-4, regardless of the author’s interviews of the school’s graduates. There is no data on the rocket at the Municipality of Haifa archives either.⁷ It is the authors belief that the rocket was either a two stage similar to the previous rocket, or a simple, one stage rocket, but longer and capable of reaching higher altitude, similar in the design of the Bosmat-5.

BOSMAT 5

⁷ All the records from Bosmat school, starting from 1933, were moved to the Haifa central archive, but a lot of material on the rocketry classes was lost and currently not available.

BOSMAT 5 was probably the last in the series of rockets designed and built at BOSMAT technical high school. It was also a rocket that worried the Egyptian armed forces. It was a single stage rocket that reached an altitude of 18 kilometers, making it the highest altitude rocket in the series. It is worth notice, that Egyptian intelligence wrote a classified report on the rocket, and concluded that the launch was a stage in the development of an operational weapon system.⁸ It is kind of an anecdote, but one could learn about the tension between Israel and Egypt, that gave room for such an interpretation of a student made sounding rocket.⁹ The Egyptian analysis of this particular rocket was a product of imagination, rather than facts. For example, it stated that Bosmat-5 reached an altitude of 18 km and a speed of 3000 kilometers per hour (those figures are correct and were taken from Israeli newspapers). But the report stated that the purpose of the rocket was to test an anti-personnel rocket system, which was supposed to be fired in salvages.¹⁰

⁸ See "wings over Cairo", Shalom Dani, available online at : http://www.fisher.org.il/DLFlippingBooks/Biography/Cairo_A/files/assets/common/page-substrates/page0182.jpg

⁹ It is also of interest to see the reaction of Israel, when in 1961 it learned that Egypt is about to launch a US made sounding rocket, and embarked on an emergency rocket project of its own. And see the article by the author, "Reaching for the Stars? 50th anniversary of Israel’s Shavit-2 rocket", IAC-11, E4.3.5

¹⁰ See "wind over Cairo", SHALOM Dani, BAAVIR publishing house.



Continuation of educational rocketry in the late 1960's and early 1970's

The rocket building endeavor at both the Technion and Bosmat technical high school continued for a short period of time. Technion made rockets were flown from 1967 till 1972 on a semi regular base, and then it became more sporadic. A dedicated article on Technion developed rockets of the 1970's will be presented by the author in a future IAC.

“BOSMAT 5” rocket on its launch pad. This was the LAST in the series of BOSMAT rockets.

Reaction to the rocket launches – in national and international media

The rocket launches for civilian and educational purposes were scarce in 1960's Israel, and naturally they attract a lot of public attention on newspapers.¹¹

¹¹ There was no TV broadcast in Israel until 1968, and there are no records of these launches in national TV archives in Jerusalem. The material – if it was on tape – was lost forever, since at the early days of the television a re-use of video materials was the common practice.