POLISH CONTRIBUTION TO SPACE RESEARCH

Piotr WOLAŃSKI
Institute of Aviation, Warsaw, Poland

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Author's address: P. Wolański, Institute of Aviation, Warsaw, Poland, e-mail: wolanski@itc.pw.edu.pl

INTRODUCTION

Space has always excited people. In the past Sun, Moon and stars were the subject of religious cults and fascinations, but as time went by, more mysteries of our universe were explained and scientists unveiled many previously mysterious phenomena. In this activity Poles have played a very important role. Nicolaus Copernicus was the first who understood planetary motions in our Solar System, Johannes Hevelius created the first moon map, while Kazimierz Siemienowicz [1] proposed stabilization of rocket with aerodynamic fins, multistage rocket and rocket clusters (Fig. 1). Later on general Józef Bem made further improvement of a rocket. In XIX century Ignacy Łukasiewicz developed a method of production of kerosene while Karol Stanislaw Olszewski and Zygmunt Wróblewski were the first to obtain liquid oxygen. Not many people knows that ideas of Siemienowicz, as well as discoveries of Łukasiewicz, Olszewski and Wróblewski are used in many space rockets, including the one that was used to launch the first Sputnik. Kerosene and liquid oxygen from the be-
ginning of the Space Era are the most commonly used rocket propellants. At the beginning of the XX century Franciszek A. Uliński drew the project of Interplanetary Spaceship. In this paper Poland’s contribution to space research and exploration over the last sixty years is briefly described.

SPACE-RELATED NATIONAL ACTIVITIES

Even before the launch of the first Sputnik in 1956, professor Kazimierz Zarankiewicz organized the Polish Astronautical Society (PAS). In 1958 UN Committee on Peaceful Uses of Outer Space (COPUOS) was created and Poland was among the first members of that significant Committee. We also participated from the very beginning in the work of the Committee of Space Research (COSPAR). Professor Włodzimierz Zonn, the first Polish representative to those Committees, organized in Warsaw two very important meetings of those organizations: in 1963 COSPAR Congress and in 1964 Congress of the International Astronautical Federation (IAF). In 1968, Polish Academy of Sciences created Committee for Peaceful Uses of Outer Space which since 1990 has worked under the name of Committee on Space Research of the Polish Academy of Sciences. The Committee is affiliated with the Presidium and consists of 35 members nominated by the President of the Polish Academy of Sciences. It has five Sections: Astronautics and Space Technology, Astrobiology and Space Medicine, Physics of outer Space, Satellite’s Geodesy and Teledetection. Committee represents Poland in UN COPUOS, COSPAR and IAF.

In the seventies of the last century, space-related scientific activity of Poland was basically confined to Interkosmos program coordinated by the Soviet Union [3]. Under that program, many instruments were developed and constructed in Poland and later launched into space on board of the Soviet rockets. The first Polish instruments were launched into space aboard the Vertical rockets. They were designed to study the Sun in the X-ray spectrum. Those instruments were designed by Professor Jan Mergentaler from Wrocław.

Another important instrument which was launched into orbit on board of “Interkosmos-9 – Kopernik 500” was radio-spectrograph RS-500 K (Fig. 2). That instrument was designed and built in the IA by Zygmunt Krawczyk, MS PhD, under scientific supervision of Professor Jan Hanasz from Nicolaus Copernicus University in Toruń.

In 1965-1973, under the direction of Jacek Walczewski and Jerzy Haráźny from the National Institute of Weather and Water Management in IA, about two hundred “Meteor” rockets were built and launched [23]. Those rockets were designed to study the upper layers of the atmosphere at altitudes between 30 km and 100 km (Fig. 3).

Also in 1976, the Institute of Geodesy and Cartography created Remote Sensing Center “OPO-LIS”. Activities of the Center encompassed a broad...
range of research related to the use of various satellite images and products for agriculture, which included: forecasting of yield, drought detection, crop recognition and crop condition assessment, estimates of heat and carbon fluxes between surface and air, detection of soil moisture changes in wetland areas, hydrological aspects, bioenergy, forests, natural hazards: floods, forest fires and landslides as well as land cover and land cover changes.

In February 1977, SRC of PAS was established. This Institute is engaged in a wide range of research topics including: physics of the Sun (a division in Wrocław), study of planets and small Solar System bodies, interplanetary space physics and astrophysics, plasma physics, planetary geodesy and geodynamics (a division in Borowiec).

In 1978, on board of the Soyuz-30, Mirosław Hermaszewski, the only Polish cosmonaut, was launched into space with a Russian cosmonaut Piotr Klimuk (Fig. 4). Their spaceship docked later to the Salyut-6 space station. During an 8-day mission, 11 experiments were conducted. Medical experiments conducted during that flight were prepared at MIAM under the supervision of professor Stanisław Barański. Technological experiment “Syrena” (“Siren”), devoted to material study under microgravity conditions, was prepared by the Institute of Physics of the Polish Academy of Sciences under the supervision of professor Robert Gałązka. It should be also mentioned that the selection of candidates for a cosmonaut was conducted at MIAM. For a long time in the 1970s and 1980s that Institute was involved in intensive research in the field of medical aspects of space flights, astrobiology and aeromedicine, including psychological aspects of long-term space flights. Also for a long time, the activities of PAS were closely connected to that Institute.

After the change of the political system in Poland, Polish space activities were widened to include international cooperation with ESA members, NASA as well as with India, Japan, China and other countries. Instruments designed and built...
information from meteorological satellites for more than 45 years.

Before the end of the last century, Poland signed cooperation agreements with ESA which resulted initially in PECS agreement and later on in a full accession to ESA. That was possible owing to a strong and continuous support of the Polish Government and especially the Ministry of Economy, the Ministry of Science and Higher Education, the Ministry of Foreign Affairs, the Committee of Space of the Polish Academy of Sciences and the Parliamentary Group for Space Research. At the beginning of November 2012 both chambers of the Polish Parliament accepted unanimously the ratification of our accession to ESA and as a result Poland became the 20th full member of ESA on 19 November 2012.

The education of space science is constantly evolving in Poland. This includes special educational programs for primary and high schools. Special programs dedicated to space education exist at the Warsaw University of Technology and other universities. ESA granted special projects for supporting educational activities of students at the Warsaw University of Technology and Wroclaw University of Technology. Students from the Warsaw University of Technology from the Astronautical Group were involved in many projects related to space activities such as: microgravity flights, Mars Rover Competition with Skarabeusz, REXUS/BEXUS, European students’ satellite SSETI Express, Yes-2, ESEO, ESMO. With the help of SRC of PAS, they also built the first Polish satellite PW-Sat, which was launched into orbit on 13 February 2012 by VEGA. Currently, the students from the Warsaw University of Technology are involved in many other projects such as development of experimental two-stage rockets, second cubesat “PW-Sat-2” as well as NASA Fourth Annual Lunar-botics Mining Competition, in the project dealing with design of a digging robot called “Huzar”.

In 2005, a degree of Msc in “Aerospace” was established by the Ministry of Science and Higher Education. Since that time, the number of students interested in space education has been continuously growing in Poland and there is a necessity to create a new course of studies i.e. “space technology”.

The Polish space industry companies are beginning to cooperate in the field of development. In 2012, companies in Poland established the first Polish Space Industry Association. Now it includes more than 25 companies but many other are considering membership.
In November 2013, the Polish scientific satellite “LEM”, named after a famous Polish science fiction writer, is to be launched into space. The satellite is a part of a constellation constructed jointly by Austria, Canada and Poland. This constellation, called “BRITE” is designed to study the dynamics of bright stars (Fig. 5). The next Polish satellite in the “BRITE” constellation is named “HEWELIUSZ”, after the famous Polish astronomer, and will be launched soon on board of the Chinese rocket Long March 3C. Both Polish satellites of “BRITE” constellation were built by SRC of PAS.

In the IA, similarly as in the 1970s, space technology is gaining momentum. A unique technology of purifying hydrogen peroxide to approx. 98% of purity was developed (Fig. 6). This technology is unique in Europe and Poland and soon IA should be the largest producer of such substances for space technology and chemical industry. Moreover, in this institute, green propellants for rocket propulsion were successfully tested, including hybrid and bipropellant rocket engine for satellite propulsion. It is also possible to develop a rocket launcher for small satellites, as Romania is doing, or to joint Romania and other counties in such undertakings. Since the rapid development of miniaturization technology, the creation of mini-, micro- and nano-satellites with similar performance levels as the large ones currently in service, will soon become a reality. Additionally, they will become less expensive. Therefore, building a small satellite launcher will be necessary, especially if Europe wants to be an independent partner in space exploration (Fig. 7). We cannot lose the chance to be independent in having access to space. Without access to space no one can build a strong space program and a strong space industry.

It is now discussed to establish a Polish Space Agency, which as in other countries would be responsible for management and coordination of Polish space activities and represent Polish government in ESA. In my opinion, such a body is needed and would further boost space technology as well as enhance the competitiveness of Polish space industry and academia on the international market.
Fig. 5. The first Polish Satellite PW-Sat.

Fig. 6. Rocket engine tests at the Institute of Aviation in Warsaw. a) bipropellant engine (98% H₂O₂ + kerosene), b) hybrid rocket (98% H₂O₂ + HTPB).
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similarly to Romania. When examining all invest-
ments in space technology in the world, we may 
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cated to purely scientifi c missions and the rest is 
spent on diff erent technological and application 
aspects of space exploration.

CONCLUSIONS

Poland has always been active in the fi eld of 
space research, but recently these activities have 
accelerated. This is mainly due to our recent ac-
cession to the ESA. The accession should stimulate 
activities in all possible aspects, but basically in 
research and technology development. To date, 
our biggest contribution to space research has 
focused on scientifi c aspects of space explora-
tion. However, to secure the highest returns from 
investments in space, our activities should be redi-
rected towards technological aspects. The biggest 
return of our money spent on space will be from 
development of new technologies. Poland should 
be more actively involved in two biggest Euro-
pean space programs, such as Galileo and GMES, 
but also develop small satellites. If we invest only 
in space science, our return from the investments 
will be much lower than in case of the invest-
ments in new space technologies. Poland should 
also invest in the development of new launches, 
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