EXPERIMENTAL 3D DOCUMENTARY AT THE IRON GATES REGION MUSEUM PLANETARIUM

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Abstract: This scientific documentary, produced in 2024 for the Planetarium of the Iron Gates Region Museum, explores the evolution and technical features of the Apollo A7L space suit. Essential for astronaut protection during the Apollo missions, the suit embodied a synthesis of engineering innovation and material science. Presented as a stereoscopic 3D projection, the film highlights the technological breakthroughs that enabled humankind's first steps on the Moon, while testing new methods of communicating scientific heritage in a museum planetarium environment.

Keywords: 3D documentary, Planetarium education, Space history, Apollo 11, Lunar exploration, Space suit engineering, Apollo missions, Apollo A7L space suit

Introduction

The film was conceived as an experimental project that combines historical research with immersive visualization. The film narrates the story of the Apollo A7L space suit – its design, development, and role in lunar exploration, through a carefully structured short documentary script. The production was prepared for stereoscopic 3D projection, designed to be viewed with special glasses in the dedicated 3D area of the planetarium. This required adjustments such as stereoscopic rendering, depth calibration, and synchronization of narration with visual sequences. By using this format, the museum tested the educational potential of 3D projection technology as a medium for presenting scientific and historical content. The result is both a tribute to the ingenuity of space engineering and a pilot experiment in innovative museum communication.

Having outlined the technical framework and the experimental context of the 3D projection, the article now turns to the scientific core of the documentary: the

Apollo A7L space suit. The following section presents its history, structure, and technological innovations, as narrated in the film.

The Apollo/Skylab Space Suit

On July 20, 1969, humanity took a giant leap in space exploration. Neil Armstrong became the first man to walk on the Moon during the Apollo 11 mission *(NASA, 1969; NASA Moon Portal, n.d.).* But how did he manage to survive the extreme conditions on the lunar surface? The secret lies in his space suit, a masterpiece of engineering and design.

The lunar suit, or A7L model (Fig. 1), was specially designed to protect astronauts from extreme lunar temperatures (which can reach 121°C in direct sunlight and a minimum of –133°C at night), solar radiation, micrometeoroids, and lunar dust. The suit consisted of several layers of resistant and flexible materials that provided thermal insulation, pressurization, cooling, and ventilation (*McBarron, 2015; ASME 2013*).

These suits were complemented by backpacks, together forming the Extravehicular Mobility Units (EMUs). The suit was called the Pressurized Suit Assembly (PSA), and the backpack was called the Portable Life Support System – PLSS (Fig. 2). This suit was an essential part of the Apollo 11 mission, which marked a historic achievement for mankind. It proved to be the main pressurized suit worn by NASA astronauts during the Apollo Project. (*NASA, 1969; Thomas, 2016*)

Starting in 1969, the A7L suits were designed and manufactured by the International Latex Corporation – now ILC Dover (Fig. 3), a company that owed its reputation to its line of women's underwear sold under the Playtex brand (*ILC Dover, n.d.; Fast Company, n.d.*).

The company had won a competition organized by NASA in 1965, in which eight companies presented their solutions. The A7L is an evolution of the original A5L and A6L suits, which introduced thermal and micrometeoroid protection coatings. After the devastating fire on Apollo 1, the suits were improved with a fire-resistant coating that could be removed for repair and inspection, and were renamed the A7L *(De Monchaux, 2011; McBarron, 2015; ASME, 2013)*.

The A7L was a one-piece suit with synthetic and natural rubber joints at the shoulders, elbows, wrists, hips, ankles, and knees. Six life support connectors were placed in two parallel columns on the chest. The four lower connectors provided oxygen, the upper right connector was for electricity, and the upper left connector was a two-way connector for the cooling system water. The quick-release system at the neck and forearms allowed for the connection of pressure gloves and the famous Apollo "fishbowl" helmet. All A7L suits had a vertical zipper that started at the helmet release (the ring at the neck) and continued down the back (*Lutz, Stutesman, Carson, & McBarron, 1975; Heroic Relics, n.d.; ASM, 2013).*

The extravehicular pressurized suit assembly

The A7L space suit consists of several layers. The outer layer conceals three overlapping inner space suits: The three-layer liquid cooling and ventilation garment – LCG (Fig. 4), also known as the "unified suit," had tubes that circulated water to cool the astronaut, minimizing perspiration and helmet fogging. Water was supplied from the PLSS backpack, where it was cooled to a constant, comfortable temperature by a sublimator.

Although initially developed for space exploration, LCG suits have been adapted for a variety of applications on Earth, such as the military, sports, and various medical fields. Outside the LCG, a pressure layer, and a retention layer, which supported the pressure layer and prevented its deformation, there was a thermally integrated micrometeoroid layer – ITMG. This was made of several resistant materials (*Lutz et al., 1975; McBarron, 2015; Thomas, 2016*).

The first layer inside the ITMG was made of ripstop nylon covered with neoprene, which is particularly resistant to mechanical stress for protection against micrometeoroids. Next, protection against thermal radiation was provided by five layers of aluminized PET foil (Mylar), alternating with four layers of nonwoven Dacron, which provided thermal spacing, followed by two layers of Kapton foil and Beta cloth, which consists of finely woven silicon fibers. The outer layer was made of Beta cloth, covered with Teflon, was non-flammable, and provided protection against abrasion caused by lunar dust. This layer was supplemented with Teflon patches against abrasion on the knees and other areas of the body *(National Air and Space Museum, n.d., Ross, 2016; ASME, 2013)*.

The boots were manufactured in the same way, consisting of 25 layers of ultra-light insulation. They had a fastening system with a fabric buckle and cord. A Teflon reinforcement around the ankle was added to prevent premature wear of the area due to friction. The entire boot is secured with laces and ratchet fasteners (Fig. 5).

The gloves were among the most challenging components to design, as they had to combine fine dexterity with extreme durability. The pressurized extravehicular gloves were reinforced with metal fabric and contained an inner lining of rubber and neoprene for insulation and flexibility. Their outer layer was made of Beta cloth with additional protective patches, while the fingertips were textured to improve grip and allow astronauts to handle tools and collect samples effectively (*McBarron, 2015; ASME, 2013; Apollo11Space, n.d.*).

The detachable helmet is made of Lexan, a polycarbonate with excellent mechanical strength and thermal resistance, capable of withstanding continuous use at ~115–125 °C according to manufacturer data (*SABIC, n.d.; A&C Plastics, n.d.*). The helmet incorporated an internal ventilation duct and a padded headrest element, designed both to stabilize the astronaut's head and to direct oxygen flow toward the face (Fig. 6).

In total, each space suit is made up of 21 layers of materials (Fig. 7), most of which were developed by DuPont (*De Monchaux, 2011; ASME, 2013*).

Intravehicular pressurized suit assembly

The command module pilot (CMP) used an intravehicular pressurized suit assembly, a simplified space suit adapted for wear inside the spacecraft. It consisted of a torso and limb suit (TSLA), which had fewer connectors, over which was an intravehicular cover layer (IVCL), made of Nomex and beta cloth for thermal and mechanical protection, and a constant wear garment (CWG), made of cotton, instead of the liquid cooling and ventilation suit. Cooling came directly from the suit's oxygen flow via a connection to the spacecraft's environmental control system (*NASA, 1969; Lutz et al., 1975; Thomas, 2016*).

The Apollo 11 A7L suit was an extraordinary piece of equipment (Fig. 8) that allowed humans to explore the lunar surface for the first time in history (*NASA, 1969; De Monchaux, 2011; ASME, 2013*). This space suit was the result of years of research and development, and combined functionality, safety, and comfort. It was used in several Apollo, Skylab, and Apollo-Soyuz missions, demonstrating its adaptability and reliability (*TIME Magazine, n.d.; ABC News, n.d.; NTD News, n.d.*).

Conclusions

The 3D documentary on the Apollo A7L space suit marked the beginning of a new direction in the Planetarium of the Iron Gates Region Museum: using immersive technologies to communicate scientific and historical knowledge. By combining rigorous research with innovative projection methods, the project demonstrated how complex technical subjects can be made accessible and engaging for diverse audiences.

Following this experiment, the museum expanded its 3D documentary program with new productions, such as "*Planets, Myths and Gods*", which explores the enduring connection between astronomy and mythology. Together, these initiatives confirm the museum's role as a pioneer in integrating cultural heritage, scientific accuracy, and technological innovation, inspiring curiosity and learning across generations.

Alongside technical documentation, media sources were cited to illustrate the cultural resonance of the Apollo suit in public perception.

All figures included in this article are extracted from the original documentary presented in the Planetarium of the Iron Gates Region Museum, in 3D format, as referenced throughout the text.

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Fig. 1. The Apollo/Skylab Space Suit

Fig. 2. Portable Life Support System

Fig. 3. International Latex Corporation (ILC Dover) label on the Apollo suit

Fig. 4. The liquid cooling and ventilation garment

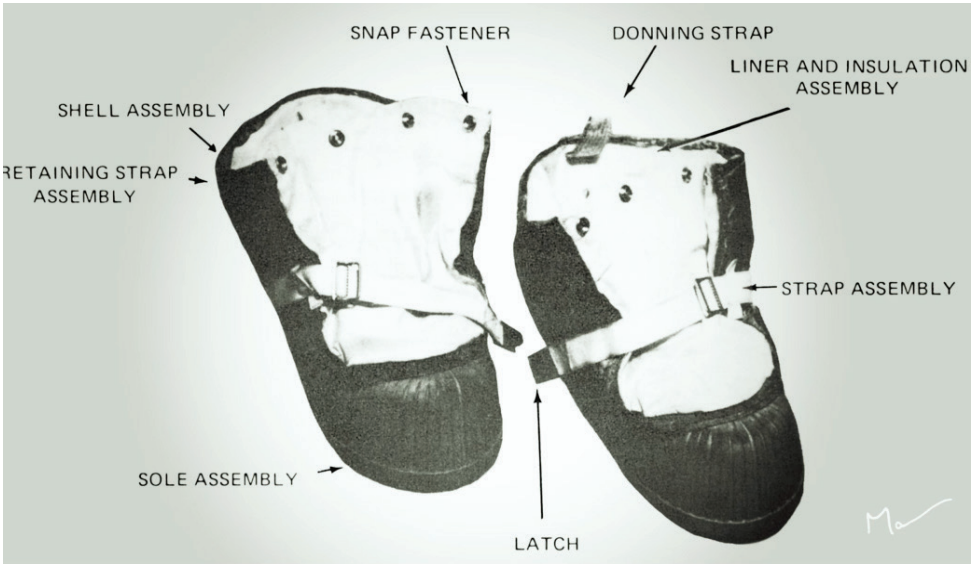

Fig. 5. The lunar boots

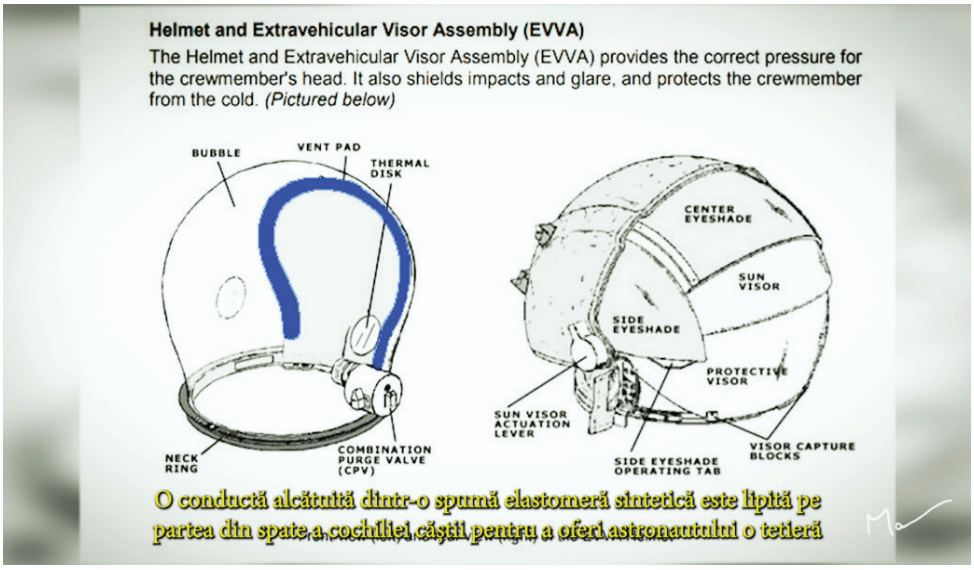

Fig. 6. The lunar helmet and Extravehicular visor assembly

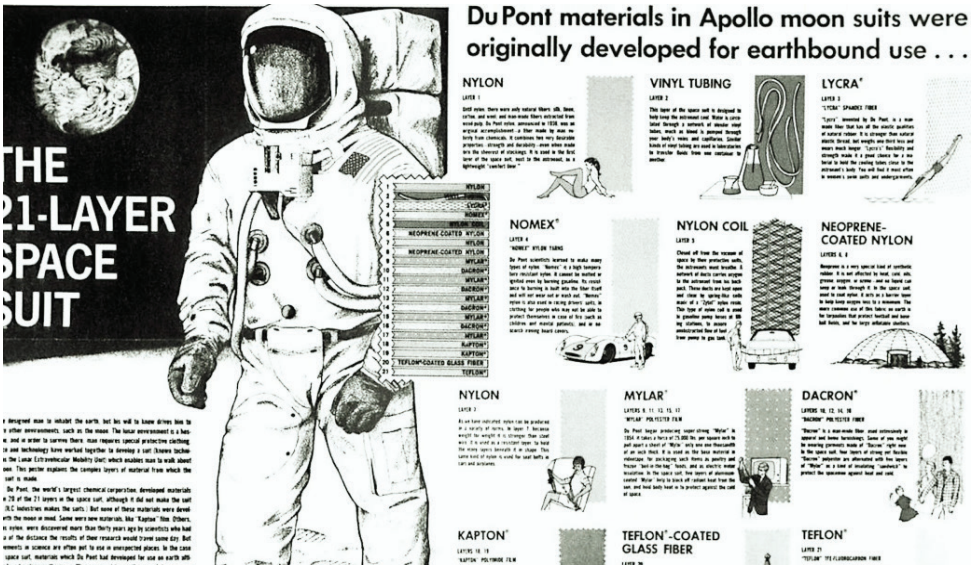

Fig. 7. Picture of article on the materials used in the lunar suits

Fig. 8. Structural overview of the Apollo A7L suit and its components