

THE RESTORATION OF THE PUIG-OLIVERO REPORT (THE FIRST STRATOSPHERIC ASCENT IN THE SOUTHERN HEMISPHERE)

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Abstract: Towards mid-2020, the situation of all human beings was governed by the various restrictions imposed by national governments as a result of the COVID-19 pandemic. A year earlier, we had accepted responsibility for beginning work to restore the San Miguel Cosmic Physics Observatory, a center for Astronomical and Technological Studies that had operated in Argentina since 1935 and was partially abandoned toward the end of the 20th century. At the time the restoration work began in 2019, all of the Observatory's buildings were completely abandoned and vandalized, their doors chained and padlocked, and the grounds were being guarded by the Argentine Air Force, its last user. We began opening and cleaning the buildings, suffering from lockdown and travel restrictions, and were only able to begin work at the beginning of 2022. During that time, we conducted an inventory and published various scientific outreach videos online, while we began the initial restoration work.

Keywords: Stratospheric Ascension, Astronomical Heritage, Restoration

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1. RESTORATION AND HERITAGE

1.1. WHY CULTURAL ASTRONOMY?

From the beginning of the restoration, we proposed a technical phase, working with the found materials and using different recovery techniques. We restored telescopes, astronomical and meteorological scientific machinery, and material obtained during the Observatory's years of operation, studying it on various photographic and film media. In these media, we have found a large amount of unpublished material missing from archives related to astronomical events. We have begun sharing it with a DOI code for unrestricted use, with credit to the authors. The question of whether the information obtained from the restoration and the subsequent dissemination of these data constitute Cultural Astronomy was a topic we addressed at the Warsaw meeting in 2023. In 2024, in Sicily, I presented a paper on previously unpublished solar eclipse images that are now part of the NASA archive. We published the progress on CERN's Zenodo platform and were delighted to welcome the formation of the SEAC Astronomical Heritage Committee, whose data can be consulted on the SEAC website. We have incorporated some findings from previously unpublished solar photographs taken at the Observatory during its years of operation. This second installment presents an unknown fact, based on a report found and restored at the Observatory. It will deal with a Stratospheric Ascension project around 1938, which will be the subject of my presentation.

1.2. BACKGROUND

In 1939, the world was at war, but the wisest human beings had no clear idea about what was happening in the stratosphere. They were almost a glimmer away from seeing the first rocket bombs and hadn't experienced enough to understand what was happening with such a significant ascent. In fact, reading this document through 21st-century eyes, we're more struck by the questions than the answers. According to the report by Jesuit Father Ignacio Puig, then Director of the San Miguel Cosmic Physics Observatory in Argentina, the research program to be carried out sought to investigate the level of cosmic radiation, secondary radiation, electrical potential, air ionization, electrical conductivity, ultraviolet radiation, meteorology, the solar constant, the solar spectrum, air composition, microorganisms, and polarized light. It made sense; these were unanswered questions after many experiments conducted around the world, and that's why this research work was cutting-edge. The report, published under the name Eduardo Olivero, an as pilot of the time, but undoubtedly under the direction of the Jesuit Father, is structured like a Jules Verne story: each chapter presents what is known and attempts to conjecture every aspect of the future flight to the stratosphere.



Figure 01 Observatory Aerial Picture

1.3. THE DOCUMENT

Found in terrible condition, it had to be restored and traces of dirt and animal droppings were removed, and some of its pages were stuck together due to humidity. A wet cleaning and air-drying process was carried out, which caused the stuck-together pages to separate. The mold and mildew were successfully eliminated by freezing. The document's pages are yellowed due to oxidation of the paper's original components but are perfectly legible and have been transcribed. The original document is under observation, although no new "latent" fungi have reappeared in recent months. It is ready for transfer to a preservation site in the collection of the San Miguel Museum under my direction. It is a linotype print on 52-gram cellulose paper, on 27 x 36 centimeter sheets. It consists of eight double-sided sheets with a blank back cover, totaling fourteen written pages. The document was published by the "Executive Board of the Argentine Stratospheric Ascension," printed at the now-defunct "Sarmiento Printing House" in Buenos Aires. Although not stated, there is a chronology that suggests the information contained in the document was prepared between 1937 and 1938. However, repercussions of its content can be observed in various international newspapers with this news item, which would have appeared between September and October 1940, I understand that these were given in response to the suspension of the project due to World War II and with the idea of reviving it once the conflict ended. It is worth remembering that invasion of Poland, began the war, occurred on September 1, 1939.



Figure 02 Restored Originals

1.4. PROJECT BACKGROUND

As early as 1862, the British Glaisher and Coxvell managed to ascend to an altitude of 8,838 meters, but their ascent was undoubtedly unsuccessful due to the poor instrumentation of the time and the limited laboratory equipment available. Many improvements were made. Belgian professor Auguste Piccard, the first to attempt a stratospheric flight, had built a balloon based on a weather balloon and reached 15,781 meters in 1931 and 16,201 meters in 1932. Both the balloon and the instruments suffered failures during the journey, so few scientific results were recorded, although the experience of experiencing an extreme ascent was evident. In the following years, Russia (1933) reached 22,000 meters, although the balloon crashed to the ground, killing all three crew members and losing all scientific results. While the Poles had unsuccessfully attempted their first ascent in 1938, and had been preparing their second attempt in 1939, all their equipment was destroyed by the explosion at the beginning of the war. In the United States, after two failed attempts, they finally reached 22,066 meters with the "Explorator II" balloon, manned by Stevens and Anderson, landing with a wealth of information. Returning to 1938, we see how the conditions were ripe: Belgian Professor Piccard, who, as we mentioned in 1931, had attempted the first ascent, would travel to the facilities of the San Miguel Observatory of Cosmic Physics, where its Director, Father Puig, a Jesuit and former deputy director of the Spanish Ebro Observatory, was preparing for the feat. The now Major Eduardo Alfredo Olivero would be his pilot, and the project was launched. Everything was enthusiastic about this project, from which we continue to recover documents and journalistic and scientific references. The document was edited by the "Executive Board of the Argentine Stratospheric Ascent," entitled "First Stratospheric Ascent in the Southern Hemisphere." (Paolantonio, 2015; Castelnuevo, 1988)



Figure 03 Mayor Olivero

1.5. WHAT DID THE SCIENTISTS OF THE TIME SAY?

It was understood that the planned balloon could perform a normal ascent up to 28/30,000 meters, taking into account not only the extreme barometric pressure but also the low temperature prevailing at that altitude. Previous experience was used in the selection of fabric, rope, and paint materials, and the selection of the cabin was the subject of careful study. While pure aluminum was used for the Belgian FNRS cabin, the Americans built it from Dowmetal, a very lightweight magnesium alloy. For the Star of Poland, the Poles adopted Hydroaluminum. Comparing the characteristics of each, the decision was made to use pure aluminum. While less resistant than electron or dural alloys, in relation to its weight, it offers the advantage of being much more expandable. Magnesium, on the other hand, is too delicate and dangerous. The lower resistance of aluminum compared to the other materials mentioned is compensated by increasing the thickness of the sheet to 4 millimeters, thus achieving a high safety factor. The system provided for detaching the cabin in case of an emergency is simple, safe, and easy to maneuver. With regard to the regeneration of the cabin's internal air, Draeger pumps (which operate with a piston) fully fulfill their purpose. The oxygen equipment used the number of injectors, tubes, and reserve liquid air cylinders to instantly compensate for any unexpected cabin air leaks, satisfactorily meet the required safety requirements. It is also extremely useful to calculate the crew's oxygen consumption, using basal metabolism, to ensure that the amount of oxygen delivered does not exceed at least 50% of the maximum consumption during the ascent. The system that harnesses the effect of solar radiation to maintain a bearable temperature inside the cabin, painting the lower part of the sphere black and the upper part white, has yielded satisfactory results in the ascents carried out. Although the adoption of this system was planned for the Argentine Ascent, the study being carried out to perfect it is interesting. Painting the sphere in vertical bands, alternating between black and white, should maintain a more balanced internal temperature and possibly prevent the inconvenience of rain due to air condensation caused by the crew's breathing. The ballast discharge system is simple in construction and easy to operate, allowing precise control of the discharged weight. While in principle similar to the one used on Prof. Piccard's FNRS, it is significantly

simplified. Although there is a valve control automatically actuated by compressed air, it is important to consider the provision of a second emergency control on the rope, as well as its placement through a mercury-filled passage tube to prevent air leakage. The ripcords and sleeve of the appendage are carefully designed and offer adequate safety in use. The support belt, which is planned to be attached around the entire perimeter corresponding to the equator and which, due to air pressure, will act as a parachute during descent, considerably reducing the descent speed. This has already been used in lower-capacity balloons with excellent results, will greatly facilitate landing. A parachute system will also be available. The radio station that will keep the balloon in constant communication with the ground must provide invaluable services, facilitating both the observers' work and the location of the balloon at the time of landing.(Olivero, 1938)



Figure 04 Restoration

1.6. THE MAIN OBJECTIVES

Pursued can be divided into two groups: The first involves the study of the quantity and quality of the energy received from the Cosmos before it is partially transformed or absorbed by the gaseous shell that surrounds us; the second involves the investigation of the physical, chemical, and mechanical conditions of the atmosphere, which currently hovers between 20 and 30,000 meters in altitude. The energy our planet receives from outside makes Earth's physical and organic evolution possible. Solar energy and the energy of those mysterious cosmic rays are the two types of extraterrestrial energy that are important to understand. So far, science cannot accurately determine the amount of energy received from the Sun, whether it is constant or experiences real variations, since we know in general that a certain portion of the ultraviolet radiation and part of the heat spectrum is absorbed by the atmosphere. Therefore, it is undoubtedly true that photography of the Sun's ultraviolet spectrum taken from the upper regions of the atmosphere using a quartz spectrograph, as well

as recording the heat received from the Sun at different altitudes using pyrheliometers and solarimeters, will shed light on these points.

As for cosmic radiation, it is perhaps the phenomenon of greatest interest to elucidate, since these penetrating rays, which pass through several meters of lead, are largely blocked by our atmosphere. There is a general belief that understanding its magnitude and variations will provide the key to its supposed influence, opening up an unlimited field of unsuspected applications.

Knowledge of the upper atmosphere, with regard to the chemical composition of the air, degree of electrification, and meteorological phenomena, should be emphasized as a matter of particular attention. Regarding the chemical composition of the air in the stratosphere, it is worth determining whether it differs significantly from that found in the lower layers, or whether the predominance of ozone, hydrogen, etc., is already beginning to be noticed.

It is interesting to note, regarding the degree of humidity, that there has been a notable surprise; manned ascents have revealed that it contains a greater proportion of water vapor than previously believed. The electrification of the atmosphere gives rise to various phenomena known as potential, conductivity, ionization, etc. These phenomena are much more pronounced in the upper layers than in the lower atmosphere; however, given the current state of our knowledge, it has not been possible to reach definitive conclusions due to a lack of data, especially in the Southern Hemisphere.

There were several international contributions: the visit of Eng. Van del Elst, from the University of Brussels, a student of Professor Piccard, who in 1934 climbed to 16,250 meters; Poland, through its Diplomatic Legation there, has provided technical data on the work for the upcoming ascent of the "Star of Poland," with input from Major Eng. Mazurek, Director of the Balloon and Parachute Production Company in Legionovo. (Puig, 1940)

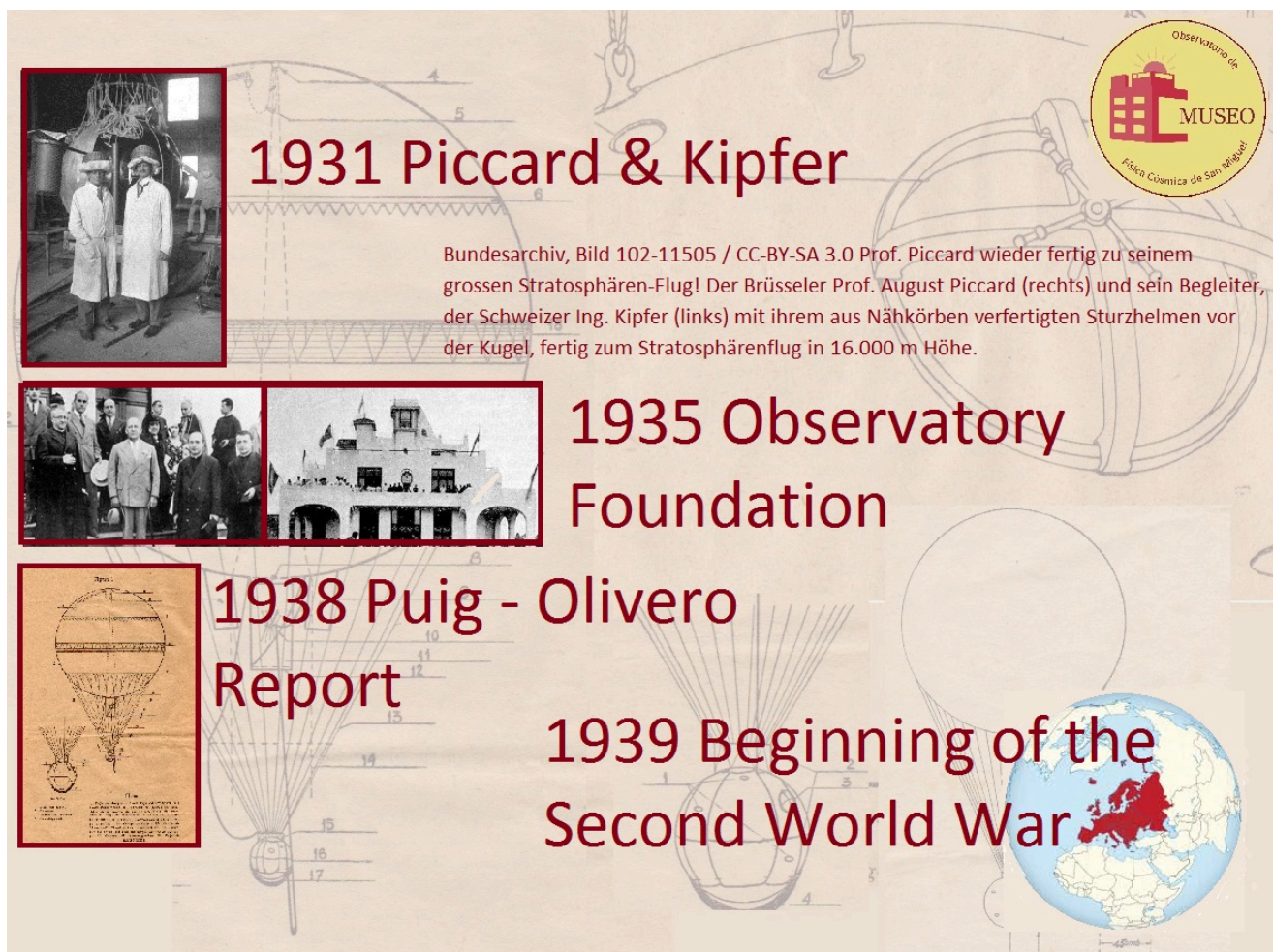


Figure 05: Background

1.7. SCIENTIFIC PROGRAM OF THE ASCENSION

1- Cosmic Radiation: Currently, these rays constitute one of the most actively researched natural phenomena. Much remains to be discovered, especially concerning its intimate nature, origin, and variations. These unknowns may be resolved only when abundant data collected in the upper atmosphere becomes available.

2. Secondary Radiation: When very short-wavelength radiation encounters matter, it splits into a series of longer-wavelength radiations, called secondary radiations. It is assumed, then, that cosmic radiation forms secondary radiation inside metallic enclosures, such as the spherical gondola of a balloon, a stratospheric aircraft, etc.

3° - Atmospheric Potential: The atmospheric potential in the highest layers of the atmosphere in this part of the American continent has not yet been determined.

4° - Air Ionization: It will be extremely important to understand air ionization at different altitudes, as well as the signs that affect the greatest number of ions.

5° - Electrical conductivity of air: At the same time as the previous determinations, air conductivity, disturbances from terrestrial magnetism, and solar phenomena will be recorded to determine the disturbances in the electrical ignition of a stratospheric aircraft engine.

6° - Ultraviolet radiation: It is very important to know its quantitative dosage in the various spectral ranges. This will be carried out by means of photoelectric cells, which would simultaneously lead to the spectral determination of the vertical presence of ozone and the evolution of oxygen, which, by filtering, protects us from the intensity of ultraviolet radiation.

7° - Meteorological phenomena: Observing the main meteorological phenomena from a manned balloon also offers notable advantages over those recorded by weather balloons, including measurements with meteorographs, devices that have the unique ability to simultaneously record atmospheric pressure, temperature, and humidity.

8° - Solar Constant: The Solar Constant designates the amount of energy that our planet receives at the upper limit of the atmosphere in one minute per square centimeter of surface. Determining the Solar Constant entails exact knowledge of the amount of energy lost to radiation as it passes through our atmosphere. This constitutes an extremely complex problem, to the point that science, despite the great advances made, is still unable to provide a fully satisfactory solution. Careful and continuous recording of solar radiation up to an altitude of 25,000 meters can contribute to the exact determination of the Solar Constant.

9° - The spectrum of the sun: There is no doubt that the composition of the solar spectrum varies with the height of the sun above the horizon and with the altitude of the observation site; the atmosphere absorbs a good portion of the radiation.

10° Air Composition: Another of the enigmas of the atmosphere involves the chemical composition of the air in its upper layers. It is commonly accepted that each of the gases that make up the air, such as nitrogen, oxygen, carbon dioxide, hydrogen, and rare earth gases, by not reacting with each other, each forms an atmosphere independent of the others.

11° Microorganisms: Their existence has not yet been sufficiently proven in the upper layers of our atmosphere, for which samples will be taken.

12° Polarized Light: The relationship between the amount of polarized sunlight and the purity of the atmosphere has been determined relative to date. Therefore, it is interesting to carry out a series of simultaneous measurements, both at the surface and at different heights, related to air density and weather changes.

1.8. INSTRUMENTATION AND CALCULATIONS

Scientific Instrumentation:

2 (Two) Geiger-Muller automatic cosmic ray counters

2 Special meteorographs

2 Recording solarimeters and their heliographs

2 Wulf electrometers and potential collectors

2 Quartz spectrographs (for studying the solar spectrum and ozone zones)

2 Air collection chambers

2 Ion Collectors (Special "Ebert" Model)

2 "Gardien" apparatus for air electrical conductivity

2 Photopolarimeters

2 Pyrheliometers

Special high-altitude meteorological instruments

Dry-cell batteries

Special motion-picture camera

Given the complexity of this task, which is much more difficult than common temperature, pressure, and humidity observations, it is essential to take the human element to the stratosphere so that the necessary tests can be carried out for the study of cosmic radiation; therefore, the weather balloon must be ruled out completely.

The Free Balloon and Calculations: It is, therefore, on the latter that all work must be based if success is to be assured, since it is the medium that most satisfactorily meets the needs. The balloon to be used in a stratospheric ascent must deviate from common balloons, both in its shape and construction. The weight of the envelope, cabin, crew, instruments, and ballast that must be preserved for the descent in one of these tests is approximately 2,000 kilos. With this load, it is necessary to reach a height where atmospheric pressure drops to about 7 millimeters of mercury, making it necessary to use a balloon constructed of extremely lightweight material and with a minimum volume of about 124,000 cubic meters. Filling a balloon of this size completely with hydrogen from the launch site, where atmospheric pressure is normal, would give it a lifting power of about 136 tons, but this power would require a material of such strength that it would greatly increase the balloon's weight. It is therefore necessary that the balloon be inflated with only a small amount of gas upon launch, leaving the rest of the balloon hanging in large folds. Under these conditions, the envelope will only gradually acquire its shape during ascent as a result of the expansion of the gas.

1.9. THE BALOON

Balloon: Constructed of double-sided rubberized fabric, using three different classes: Light drag 600 kg/m; Heavy drag 800 kg/m; Double drag 1000-1500 kg/m; Balloon capacity 124,790 cubic meters; Diameter 56.6 meters; Length 79.1 meters; Total balloon surface: 14,000 square meters; Gas load for launch: 4,500 cubic meters; Balloon weight: 1,403 kg. Weight of balloon, cabin, and instruments: 2,000 kg; Projected lifting power: 30,000 meters.

Cabin: Constructed with 4 mm thick aluminum sheets. Dimensions: 2.5 meters in diameter.

Involucre: The material for the construction of the involucre can be selected from varnished fabric or gummed cotton, but the most appropriate and safest is undoubtedly an involucre made of the highest quality, long-staple cotton. For the lower quarter of the balloon, the band up to the sleeves, a proportionally lighter fabric can be used than that used for the three-quarters of the balloon, extending from the valve to the suspension band. However, it is also important to keep in mind that while the stratospheric balloon will be subjected to minimal stress during its flight, if the material used is too weak, it will break during inflation or landing.

Color: The balloon is painted yellow with Claromine FF, a dye that does not harm cotton under the effects of ultraviolet light. As has been proven in experiments, with this color, after two hours of irradiation from a mercury vapor lamp, the cotton's breaking strength coefficient did not decrease at all. Cabin: The cabin is spherical with a diameter of 250 centimeters, formed by three 4-mm-thick aluminum sheets. The interior of the cabin is painted white for better visibility, and its lower section has a wooden floor approximately one meter in diameter. A special varnish is applied to neutralize the effects of mercury that could spill inside the cabin due to broken instruments. To prevent the force of the impact upon landing, a special shock absorber is installed on the underside of the cabin.

Access: For this purpose, there are two 55-centimeter diameter manholes, constructed with double covers. Visibility: The cabin is equipped with 10 portholes, each 12 centimeters in diameter, in appropriate positions. These are constructed of double-paned glass separated by a one-centimeter-thick rubber ring. This division between the two panes acts as an insulating field and reduces fogging. For greater visual safety for photographs, a small amount of sodium chloride is placed between the two panes of the porthole. Each

porthole has a metal cover, which allows it to be hermetically sealed in the event of a breakage, preventing depression.

Internal Air: The approximately 750 liters of air available inside the cabin, given its size, are insufficient for the journey, making it essential to continuously regenerate it during the ascent.

For this purpose, a special "Draeger-Werke" device has been installed, under normal conditions, it releases 2 liters of oxygen per minute from a pressurized tank, an amount that is surplus to replace the oxygen consumed by two people. It also performs the absorption of carbon dioxide. This device achieves this by drawing in 75 liters of air per minute, which it passes through a potassium filter. This air circulation is not produced by a pump; it is achieved by the fact that the oxygen leaving the tank sets an injector in motion, and thus, similar to the operation of a rotary pump, draws in the air. The flow of 75 liters of air produced per minute is large compared to the 2 liters per minute of oxygen supplied.

Cabin Temperature: It is known that the stratosphere has a temperature of about 60° below zero. First of all, it must be taken into account that the sun's rays are much stronger in the stratosphere. A closed cabin with two people inside is heated to a temperature 10° lower than the surrounding atmosphere, in fact, the air leaving the filter is approximately 70° warmer than the air entering. The sphere is painted in two colors, black and white, the latter color being used for the lower part up to 30° parallel to the equator. This color distribution considerably balances the temperature difference between the upper and lower parts of the sphere. **Commands:** The various ropes that allow the pilot to maneuver have been carefully considered, since during this ascent, the cabin remains hermetically sealed for much of the trip, thus preventing the ropes from being untangled or adjusted during the ascent, as can be done in a conventional basket balloon. **Lifting Belt:** To ensure a slower descent, the stratospheric envelope will be equipped with a lifting belt. This device is attached around the entire perimeter corresponding to the balloon's equator. **Cockpit Parachute:** The danger of lightning, although not present for the cockpit, should not be ruled out for the balloon. If we consider the losses suffered during the Gordon Bennett competitions, once the balloon has passed through the troposphere and entered the stratosphere, which is where it must remain for the longest time, it finds itself in a zone of almost absolute calm. **Radio:** communication with the ground base will be via AM shortwave.

Thus, abruptly, ends this final report by Major Eduardo A. Olivero, which, along with other reports from various interested groups, formed the content of this chapter. Those who have read it will have noticed that most of the reports lack dates, although our research and the mention of President Ortiz of Argentina and some of the scholars of the time in their scientific roles may allow us to date the reports between 1938 and 1939. Some comments have left me thinking, such as the similarity of Major Olivero's stories to those of Jules Verne. Indeed, I had to return to his book "From the Earth to the Moon," where each chapter explored the conditions of habitability and flight of the projectile—in our case, the stratospheric one—and I enjoyed a new reading in that regard. Verne's novels are an incredible source of scientific advances in the 19th and 20th centuries, and the article is a remarkable summary of international space knowledge at the beginning of the 20th century.

1.10. MEDICAL CLINICAL EXPLANATIONS (BY DRA. LUCIA ANTONELA BALBI)

Dr. Angel H. Roffo, Director of the Institute of Experimental Medicine and President of the Argentine Society of Cosmobiology, gives his opinion on the possible physiological disturbances that navigators may suffer. We must not forget the precedent of the Russian stratostat "Ossoaviakhin," manned by Fedesienko, Vasienko, and Uskin. In January 1934, they climbed to an altitude of 22,000 meters, but fell victim to a horrific catastrophe. This was due to the failure of the crew's breathing apparatus, resulting in death by asphyxiation and the balloon falling out of control.

The following tests were scheduled for the pilots:

1. Morphological and serological blood tests before and after the ascent.
2. Basal metabolism before and after the ascent.
3. Blood pH before and after the ascent.
- 4- General clinical examination before and after ascent.
- 5- Circulatory and electrocardiographic examination before and after ascent.
- 6- Measurement of the O₂ absorbed by the crew members.

- 7- Measurement of the CO₂ exhaled by the crew members and planning for its fixation
- 8- Chemical and bacteriological examination of air samples taken at different altitudes.
- 9- Radiographic examination of the sphere's welds. This is very important to detect cracks.
- 10- Testing of materials at the temperature and pressure at which they will operate
- 11- Possible survival in the event of the cabin opening at different altitudes.

Based on a current biomedical analysis (2025), the determinations prior to the stratospheric ascent were correct, considering their historical context and the available technology. An important point to mention is the calculation of the crew's basal oxygen requirements. Although it was anticipated that supplemental oxygen might be necessary, the method used to calculate this requirement is not mentioned. Today, oxygen consumption is measured based on the FickA principle, which establishes that the oxygen consumed in systemic cellular metabolism is exactly equal to that absorbed by the pulmonary capillaries. Thus, the volume of oxygen a person needs to meet life-sustaining requirements can be measured in three ways:

- 1) Closed-circuit volumetric rebreathing spirometry.
- 2) Open-circuit mixed-gas analysis.
- 3) Calculation of the difference in arteriovenous oxygen content multiplied by cardiac output.

Another relevant item is body temperature. Temperature changes during the ascent and how to maintain the crew's body heat at least 36°C were not properly assessed. It is also important to note that the decrease in body temperature slows metabolism, which leads to a decrease in the volume of O₂ consumed.

The biomedical analyses and studies performed on the crew are pertinent and sufficient, although more specific parameters could currently be obtained with more technological and sophisticated studies. In Appendix 2, which I will add to my subsequent written work, I will include several notes, reports, and newspaper articles from the time, highlighting the article from the prestigious "Astronomical Magazine" by Father Ignacio Puig, which is in perfect condition in the archives of the Argentine Association of Friends of Astronomy, the oldest Historical Observatory in Buenos Aires.



Figure 6: The Original

1.11. CONCLUSIONS

I have presented a previously unpublished restoration project that reveals the path stratospheric research has taken throughout the history of science. We will continue analyzing the documents and searching (which we have just begun) for parts of the balloon planned in 1938 in the remaining four unopened storage buildings of the San Miguel Cosmic Physics Observatory.

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