History of Rocketry and Astronautics

Proceedings of the Fifty-Third History Symposium of the International Academy of Astronautics

Washington DC, USA, 2019

Otfrid G. Liepack, Volume Editor

Rick W. Sturdevant, Series Editor

AAS History Series, Volume 52

A Supplement to Advances in the Astronautical Sciences

IAA History Symposia, Volume 39

AAS Publications Office
P.O. Box 28130
San Diego, California 92198

Affiliated with the American Association for the Advancement of Science
Member of the International Astronautical Federation

First Printing 2022

ISSN 0730-3564

ISBN 978-0-87703-681-4 (Hard Cover Plus CD ROM)
ISBN 978-0-87703-682-1 (Digital Version)

Published for the American Astronautical Society
by Univelt, Incorporated, P.O. Box 28130, San Diego, California 92198
Web Site: http://www.univelt.com

Printed and Bound in the U.S.A.

Chapter 22

French Contribution to Apollo 11, Plus: I Was There on July 16, 1969![*]

Philippe Jung[†]

Abstract

While it is generally well-known that famous French astrophysicist Audouin Dollfus, a distinguished IAA Trustee, was involved in the Apollo landing site selection, France also was present, directly and indirectly, at hardware level.

Thus the cameras used for the Moon programs incorporated *Angénieux* optics, from *Ranger 6* to the Apollo Lunar Rover Vehicle on the last three landings.

Interestingly, the Apollo structure was welded with *Sciaky* machines.

It even could be pointed out that, before being selected as an astronaut, Michael Collins had been a 72th FBS fighter pilot in the NATO Chambley air base in Lorraine, not far from Metz, from 1954 to 1957.

This chapter will detail such French contribution to the Apollo program.

It will conclude with a personal recollection of how this author, then a student, not only watched the iconic *Apollo 11* launch, but even managed, by a sheer stroke of luck, to be there as a VIP! To this day, his recording, of astonishing quality, still makes him shivering…

---

[*] Presented at the Fifty-Third Symposium of the International Academy of Astronautics, October 21–25, 2019, Washington, DC, United States. Paper IAC-19-E4.3.04.

[†] Airbus AIRitage, GREFF Groupe de Recherches sur les Engins et Fusées Français, France.

Acronyms

AFN *American Forces Network*
ASSB *Apollo Site Selection Board*
CEA *Commissariat à l'Energie Atomique*
CEV *Centre d'Essais en Vol*
CM *Command Module*
CNES *Centre National d'Etudes Spatiales*
CNET *Centre National d'Etudes des Télécommunications*
CRS *Comité des Recherches Spatiales*
DGRST *Délégation Générale à la Recherche Scientifique & Technique*
EBAM *Electron Beam Additive Manufacturing*
FBS *Fighter Bomber Squadron*
FBW *Fighter Bomber Wing*
FIT *Florida Institute of Technology*
GTA *Gas Tungtsen Arc*
IAA *International Academy of Astronautics*
ISU *International Space University*
IRT *Institut de Recherche Technologique de Toulouse*
JPL *Jet Propulsion Laboratory*
LEM *Lunar Excursion Module*
LM *Lunar Module*
LRV *Lunar Roving Vehicle*
MSFC *Manned Space Flight Center*
MSN *Manufacturing Serial Number*
NASA *National Aeronautics and Space Administration*
NATO *North Atlantic Treaty Organization*
NTSC *National Television System Committee*
PDT *Pacific Daylight Time*
PI *Principal Investigator*
RCA *Radio Corporation of America*
SEC *Secondary Electron Conduction*
SAGEM *Société d'Application Générale d'Electricité et de Mécanique*
SFIM *Société de Fabrication d'Instruments de Mesure*
SM *Service Module*
TIG *Tungsten Inert Gas*
VAB *Vertical Assembly Building*
WW *World War*

"*The Moon plays the same role in our space program that the city of Paris played in Lindbergh's memorable flight.*" W. von Braun, 1964.

I. Context

Aerospace ties between France and the USA can be traced very early, with the correspondence between the Wright brothers and Polytechnician Ferdinand Ferber. WWI saw the decision on April 18, 1916, to incorporate thirty-six American pilots in the French N 124 squadron, flying Nieuport XI and XII fighters in Luxeuil, in northeastern France. On December 2 N 124 became the glorious *Escadrille La Fayette*.

France similarly cooperated early with the USA in space, when an agreement was signed on March 21, 1961, by Hugh Dryden for NASA, Pierre Piganiol for DGRST (*Délégation Générale à la Recherche Scientifique et Technique*) and Pierre Auger for CRS (*Comité des Recherches Spatiales*) [1]. It was a long term accord, for a French satellite to be launched by an American rocket (the future FR-1), but also for training French personnel in NASA centers. CNET (*Centre National d'Etudes des Télécommunications*) was put in charge, but with the creation of CNES (*Centre National d'Etudes Spatiales*) on March 1, 1962, the latter took over, initially planning an ionospheric research program. Twelve CNES engineers thus were sent to the Goddard Space Flight Center for one year.

II. French Optics on the Moon

The French industry also was active. The quality of French optics meant they were selected early in the American space program.

II.1. Ranger

This is the story of a great optical engineer, Pierre Angénieux (14.7.1907 Saint-Héand-26.6.1998), who graduated from *Arts & Métiers* in 1928 and *Ecole Supérieure d'Optique* in 1929. After working for *Pathé* in 1930–1931, he eventually created *Etablissements Angénieux* in Paris on September 20, 1935, with production in his home village of Sain-Héand, north of Saint-Etienne, from 1937. He met the great filmmakers of the time, such as Jean Renoir, and patented the *Pictographe* in 1937 with Abel Gance, improving depth of view. He revolutionized optical computations, dividing by a factor of ten the time to design optics.

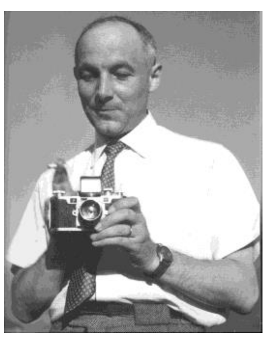


Figure 22–1: Pierre Angénieux [2].

Figure 22–2: The Angénieux logo in 1947 (left) & 1958 [2].

A second major progress came in 1950 with the *Rétrofocus*, soon to become a household name, allowing use of optics of focal length smaller than 40 mm.

Yet another significant step was achieved in 1953 when he invented the wide angle optics, doubling the amount of usable light, from f/1.40 to f/0.95. As a consequence, a 35-year long agreement was signed with Bell and Howell for use of these optics on the latter BH 70 16 mm cine camera.

But the best was to come, when Angénieux invented today's zoom in 1956, by modernizing and simplifying it. The initial ratio of 4 (17–68 mm) increased in 1961 to 10 (12–120 mm). Bell& Howell adopted it in 1957. This gave him a Scientific and Engineering Award in 1964, followed by another one from the Academy of Motion Picture Arts and Sciences for his contribution to cinema in 1989 [2].

Portending the future, the company also started to work with RCA on television cameras from 1958.*

With the space race ignited by the Soviet Union, a program to launch five *Jet Propulsion Laboratory* (JPL) probes to the Moon, with emphasis on high resolution pictures before impacting, was decided on December 21, 1959, named *Ranger* on May 4, 1960 [3]. Jim Burke became the program manager in the fall. On February 1, 1960, it was decided to launch initially two Block I test *Rangers,* followed by three Block II scientific ones with a television camera and a jettisonable impact capsule. JPL built the camera's f/6 aperture telescope of 102 cm focal length and 1° field of view, while the contract for the 200 lines vidicon sensor was awarded on August 25 to RCA Astro-Electronics Division, the only company experienced in this field through its experience on TIROS, the historical first weather satellite. But in the wake on the announcement by John Kennedy of a manned Moon program on May 25, 1961,† it became very urgent to better know the surface of our natural satellite, via a high-resolution television camera system. Thus was born *Ranger* Block III, with a battery of six high-resolution cameras replacing the impact capsule of the Block II's, with RCA readily sole source contracted on June 20, again because of its experience, to provide six cameras, two full scan ones and four partial scan ones.

Four more *Rangers* were correspondingly ordered on August 29, *Ranger 6* to *Ranger 9*. Quite naturally, RCA contracted with a company they had been with for several years, and the inventor of the f/0.95 wide angle optics, Angénieux.

While the Block II *Ranger 3* to *Ranger 5* all failed to various degrees in 1962 before reaching the Moon, although the camera on *Ranger 3* did work, but the probe had gone out of control. Soon after, RCA hit problems with the vidicon

* RCA invented the 525-line NTSC standard.

† NASA had begun working on a manned Moon landing program as soon as May 1959, named Apollo on July 25, 1960.

tube, the design of which was changed in the Spring of 1963. Arcing also affected the amplifiers.

This new design, to improve at scientist request the Moon pictures, probably was the time the field of view for three of the cameras was increased, thus bringing in Angénieux with its f/0.95 lens:

- Two full-scan 1,132 lines cameras, FA & FB: wide angle FA 25 mm f/0.95 [4] with a field of view of 25°, FB 75 mm [5] f/2 with a field of view of 8.4°
- Four partial-scan 290 lines cameras, P1 to P4: two wide angle 25 mm f/0.95 with a field of view of 6.2° (including P3), two telephoto 75 mm f/2 with a field of view of 2.1° (including P1).

Then the first Block III, *Ranger 6,* had a perfect flight in January 1964, but the TV cameras never went to full power during the final thirteen minutes before impact. Three 25 mm f/0.95 aperture French Angénieux lenses thus crashed on the Moon Sea of Tranquility on February 2, 1964* (the three others were RCA cameras with 75 mm f/2 *B&L Super Baltar* lenses). A thorough review of the whole camera subsystem was performed, leading to modifications and more testing. Interestingly, French Maurice Piroumian, an electrical engineer who had emigrated to the United States after WWII, was put in charge of checking the possibility that the problem had been at the level of the *Agena* umbilical. It later was found that spilled propellant at booster separation had probably ignited, causing shorting of the pins behind the umbilical door.

So, when *Ranger 7* was launched on July 28, 1964, it had to succeed: the Lunar Excursion Module (LEM) design was urgently depending upon it, and the *Surveyor* and *Lunar Orbiter* programs were upcoming. On July 31, seventeen minutes before impact in the Sea of Clouds, full power came to the two full-scan cameras, followed two minutes later by the four partial-scan ones. At 6:25 PDT, only the second time the Moon had been photographed after the crude belinograms of *Luna* 3, the last of 4,316 high-resolution pictures was received.

The Sea of Tranquility and Alphonse Crater were afterwards successfully surveyed by *Ranger 8* and *Ranger 9* on February 20 and March 24, 1965, for an impressive total of 12,267 photos.

* Angénieux says they were on board from *Ranger 7*, but is now checking their presence on *Ranger 6,* which is highly probable.

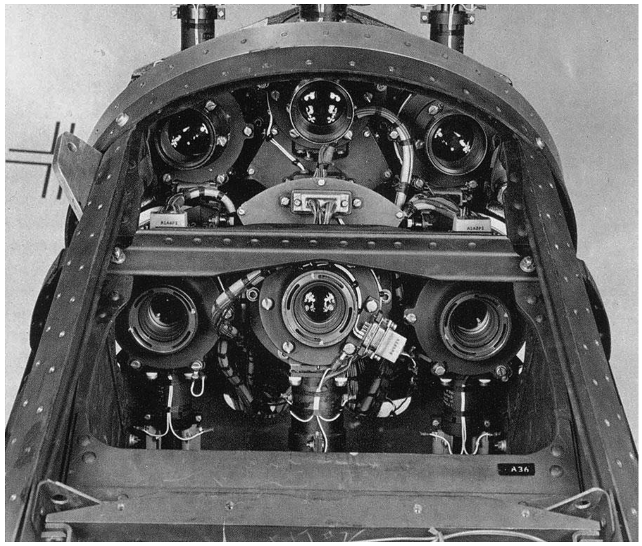


Figure 22–3: The three lower RCA cameras with Angénieux 25 mm lenses (FA in the middle). The upper cameras have B&L Super Baltar lenses [2].

Figure 22–4: 1953, f/0.95 achieved with the 25 mm M1 Angénieux lens [2].

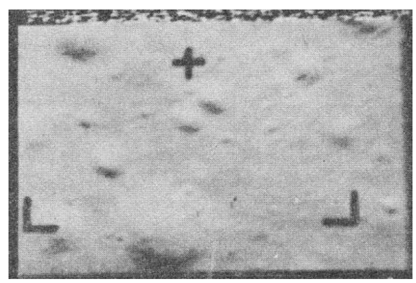


Figure 22–5: *Ranger 7* last Moon picture, taken at 300 m altitude, by 25 mm camera P-3. The area is 18x30 m [*Air & Cosmos,* December 26, 1964].

II.2. Gemini

Following a call for tender in 1961 for the *Apollo* program, Angénieux became a member of the JA Maurer and RCA Astro Electronics teams.*

But with the incredibly ambitious *Apollo* program decided when only fifteen minutes had been spent in space by Alan Shepard, it was quickly realized that an intermediate technological program had to be launched. Thus, the corre-

* https://blog.angenieux.com/apollo-11-mission-destination-moon-for-angenieux.

sponding 2-man *Mercury* project was approved on December 7, 1961, given the name *Gemini* on January 3, 1962 [6].

Angénieux again was present, with several optics for the 16 mm Maurer TV camera: 25 mm f/0.95, 18 mm f/2 and 75 mm f/2.5. The use of the Maurer thus probably started with *Gemini 3* launched on March 23, 1965. It was used by James McDivitt on June 3 when Edward White performed man's first fully successful space walk outside *Gemini 4,* together with the spectacular first good pictures of such an event. The 25 mm lens was used during *Gemini 12* observation of the Sun eclipse on November 12, 1966. But two days later the release of sodium clouds by Sud Aviation *Centaure* C105 and C139 sounding rockets launched from Hammaguir could not be observed [7].

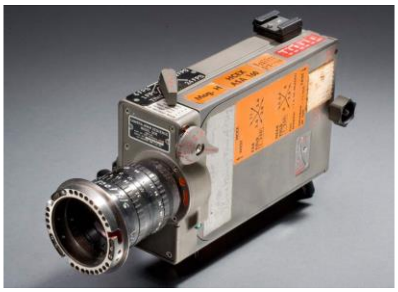


Figure 22–6: The 16 mm Maurer 308 camera with a 75 mm Angénieux fixed lens [Angénieux].

Figure 22–7: Angénieux optics giving the first good pictures of an EVA [Petersen's *Book of Man in Space,* Vol. 2].

Figure 22–8: Conrad pictured by the Maurer camera with an 18 mm f/2 Angénieux lens during the *Gemini 5* mission in August 1965 [2].

Figure 22–9: Collins checking the Maurer camera for *Gemini 10.* Note Donald Slayton in the background [Angénieux].

II.3. Apollo

As soon as the *Apollo* program had been decided, NASA issued in 1961 a call for tender for a camera allowing live transmissions, with many attributes: use in space/lunar environment, small, low consumption, easy to handle by astronauts.

RCA Astro Electronics was selected with a black & white TV camera, for live transmission, using two types of optics:

- a wide angle fixed lens by Taylor Hobson for lift-off and cruise
- an Angénieux *Cinéma 6X* 6x12.5 zoom* for in-orbit CM Block I activities and outside views.

Figure 22–10: The RCA camera with its Angénieux 6x12.5 zoom during *Apollo 1* ground testing [2].

It originally had been planned that RCA would provide the television camera for the LEM to Grumman. But delays due to a complex industrial arrangement [8] led NASA to contract directly with Westinghouse Electric on September 3, 1964. In the end of the month, it was decided that this camera also would be used on the Command Module CM Block II, whereas RCA still was providing it for the Block I [9].

However, the dramatic *Apollo 1* fire on January 27, 1967, led to a deep analysis of the whole *Apollo* program. Live transmission also became secondary behind safety.

For the new CM Block II on *Apollo 7, 8,* and *9*, black and white 16mm Maurer cine cameras used Angénieux 18 mm f/2, 25 mm f/0.95 and 75mm f/2.5

* Magnification ratio of six times 12.5 mm focal length, an Angénieux designation which became a standard.

optics (simplified RCA TV cameras also were used, with optics from Fairchild and Argus Optics).

Color appeared in the *Apollo 10* CM-106 with the Westinghouse camera, using a new single SEC (Secondary Electron Conduction) tube, instead of the previous three tubes. It had a 16 mm Angénieux zoom, 6x25 f/4.4 (actually a 6x12.5 zoom with a doubler, from a cinema 16 mm camera). Success was there, with the first live color broadcast TV around the Moon. The Maurer camera also was used in the CM.

Figure 22–11: Angénieux 6x12.5 zoom no. 1002 [2].

Now came the historical *Apollo 11* flight, for which, to limit transmission risks, a black and white Westinghouse TV camera with Fairchild optics was used on LM-5. CM-107 used the color Westinghouse camera, and a 16 mm Maurer one with Angénieux 75mm optics.

Figure 22–12: Westinghouse camera mana ger Stan Lebar, holding in his right hand the color camera, and the black and white one in his left hand [2].

Figure 22–13: Collins shooting with the Maurer camera with an Angénieux 75 mm lens the LM-5 Eagle Ascent Stage about to rendezvous with *Columbia* on July 21 [NASA EP-100].

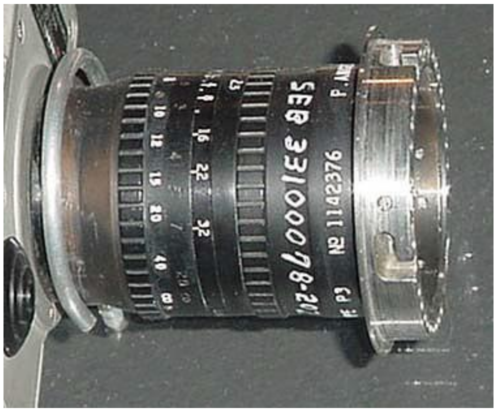


Figure 22–14: The 75 mm Angénieux optics [Angénieux].

Figure 22–15: The entire Angénieux staff watching *Apollo 11* on July 21, 1969 [https://blog.angenieux.com/apollo-11-mission-destination-moon-for-angenieux].

Figure 22–16: The Angénieux director and his team [www.leparisien.fr/societe/premiers-pas-sur-la-lune-comment-une-pme-de-la-loire-a-permis-la-reussite-d-apollo-11-20-07-2019-8120718.php].

For *Apollo 12*, the Westinghouse color camera also was on board LM-6, inside the equipment bay of the Descent Stage, thus allowing viewing the astronauts climbing down the ladder. To withstand the lunar environment, plastic elements were replaced by aluminum ones, and the zoom (and camera) was painted in white. Unfortunately, Conrad fortuitously aimed the camera at the Sun, damaging the tube and preventing any picture to be sent.

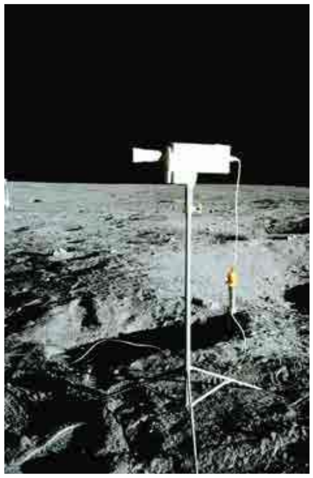


Figure 22–17: *Apollo 12* and the first color camera on the Moon, with the Angénieux 6x12.5 zoom and doubler [2].

For *Apollo 13*, Westinghouse thus added a lens cap, as well as switches allowing disconnecting the camera while it was running. Alas, as is well known, the explosion of an oxygen tank in Service Module SM-109 on the way to the Moon resulted in an extraordinary rescue, thanks to LM-7 being used as a safe haven and tug. The Westinghouse camera also had been mounted on the top of the launch tower, duly protected, to record the launch of *Saturn V* AS-508.

For *Apollo 14*, Jacques Debize developed a special, dedicated and shorter, 6x25 zoom, limiting the risk of shocks against the astronaut helmets. A new lubricating grease limiting outgassing and a new protection against solar radiation were developed. It thus was possible for the first time to see men in action on the Moon in color.

Figure 22–18: Angénieux 6x25B zoom no.1266082 in 1970 [2].

In the wake of the highly successful previous flights, the LM was beefed up, allowing the carriage of the first manned car on the Moon, the Boeing LRV (Lunar Roving Vehicle), on *Apollo 15, 16,* and *17* (the J-series missions). It marked the return of RCA, with a color camera with the Angénieux 6x12.5 zoom and its doubler. The Westinghouse camera still was used in the CM.

One of its salient features, besides a 16 mm camera, was the use of the RCA color TV camera, as it could be operated from Houston. It thus allowed geologists to cooperate with the astronauts. An added, spectacular bonus, was the live transmission of the lift-off. Its optics were a 6x12.5 Angénieux zoom.

Its dimensions were 41.8 x 10.1 x 18.5 cm, with a 13 W power consumption. It used the US standard of 525 lines, with a thirty images/s rate. Fourteen movements were possible, including left-right, up-down, and zooming between 42 cm (f/22) and 122 cm (f/2) [10].

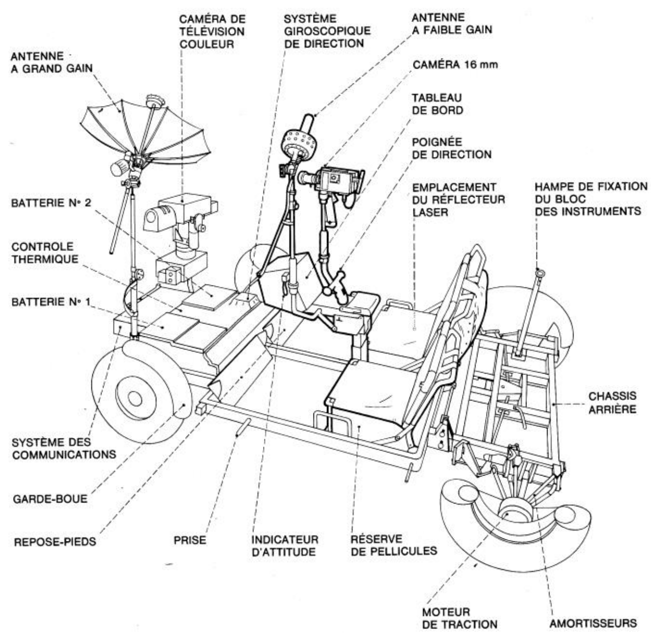


Figure 22–19: The LRV [Cosmos Encyclopédie Vol. 5].

In addition, a Westinghouse camera with an Angénieux 6x25 zoom was used on the Moon surface, mounted on a tripod.

Figure 22–20: The RCA camera in the front of the LRV [2].

Figure 22–21: The 6x12.5 Angénieux zoom on the LRV RCA camera [2].

Figure 22–22: *Apollo 15,* the historic first live transmission of a Moon launch, courtesy the Angénieux 6x25 zoom, on August 2, 1971, by the LRV parked 100 m away [NASA EP-94].

III. Yet Another French Optics Company, Kinoptik

Another French company working on optics, Kinoptik, has only now been found to have been involved on the Gemini and Apollo Program. Created in 1932 in Paris, it developed optics for air photography in 1939, before switching in 1944 to optics for 35 mm cine cameras. In the 1950’s it built optics for 16 mm and 35 mm cinema cameras [11].

Their 18 mm optics were used on the Maurer cameras during the *Gemini* program, essentially when filming through the spacecraft windows.

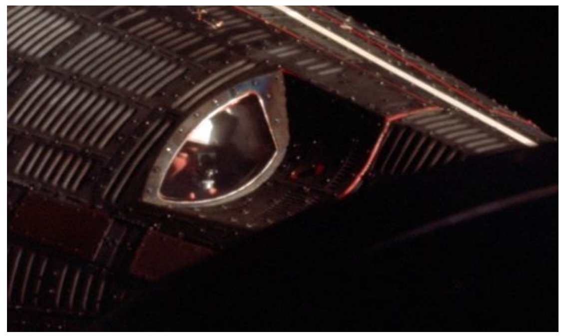


Figure 22–23 (left): The Maurer camera with Kinoptik optics [via Angénieux].
Figure 22–24 (right): Historic rendezvous: Lovell in *Gemini 7* shooting *Gemini 6* with a Maurer camera with the 18 mm Kinoptik [via Angénieux].

It again was on board the CM of *Apollo 7* to *Apollo 11*. Its 18 mm optics had been planned for LM-5 *Eagle*, but only was used in CM-107 *Columbia*. The former actually had 10 mm Kern Switar optics, according to the *Apollo 11* stow-age list.[*]

IV. Great Astronomer Audouin Dollfus

Audouin Dollfus (12.11.1924-1.10.2010) started in *Observatoire de Paris-Meudon* in 1946. The son of Charles, balloon pioneer, historian and first director of the Chalais-Meudon Museum†, he made the historical first use of a telescope from a balloon with his father on May 30, 1954, observing Mars from an altitude of 6,400 m. Having failed to detect the presence of water on Mars, he concluded he had to climb twice higher, into the stratosphere [12].

---

[*] Kinoptik was later taken over by SFIM, an aerospace equipment manufacturer, later by SAGEM, which became Safran.

[†] Now *Musée de l’Air et de l’Espace* in Le Bourget.

To this end, he devised a very ingenious architecture with no less than 105 small Beritex balloons, attached along a central cable, over a length of 450 m, each with an explosive charge. It was thus possible to control the rate of climb and descent. On April 22, 1959, he reached 13,720 m, to analyze Moon and Venus atmospheres, as well as the surface of Mars. This was the highest manned balloon-borne telescope flight at the time. He thus confirmed our natural satellite had no atmosphere. Among many other discoveries by Dollfus were Janus, a Saturn satellite, in 1966. He was elected in 1962 to the IAA, in Section 1 (Basic Sciences), later becoming a member of the Board of Trustees from 1975 to 1981. He received many awards, including *Prix Galabert*/*Prix International d'Astronautique* 1972. Asteroid 2451 is named after him. He also was member of the jury of the *Prix Albert Ducrocq*, honoring the greatest space popularize ever,[*] a friend of him.


Voyageurs de l'espace

Un tel exploit est célébré par un cercle restreint de spécialistes qui des années plus tard le font collaborer au programme Apollo. Pas question de s'en prévaloir auprès de ses collègues de la Commission dont beaucoup n'ont connu de l'altitude que celle à laquelle les avions volent. Par la suite il est présent chaque fois qu'une éclipse est visible de la terre, au Chili ou ailleurs, et il entraîne dans son sillage des amateurs qui profitent de son expérience.

De tout cela il n'en souffle pas un mot lors des réunions de la Commission. Parler d'un collègue dont la préoccupation majeure fut de rester simple et strict comme son apparence est une gageure. Il fut chaleureux avec tous les membres de la Commission, attentif à leurs problèmes et souvent de bon conseil. Son dernier gros souci était de réussir à transformer le hangar Y de Chalais Meudon en Musée de l'aérostation ouvert à tous. Il le voulait assorti d'un parc où les enfants pourraient s'amuser entre deux passages instructifs en un lieu où s'inscrivent les progrès de générations de chercheurs et d'amateurs obstinés à découvrir l'espace.Lors de l'inauguration officielle de ce conservatoire, il serait judicieux de donner le nom d'Audouin Dollfus à l'un des bâtiments, si ce n'est à l'ensemble car il l'a bien mérité. Si « la mort d'un homme est une bibliothèque qui brûle », celle d'Audouin équivaut à l'incendie de toute une Université. □

44

45

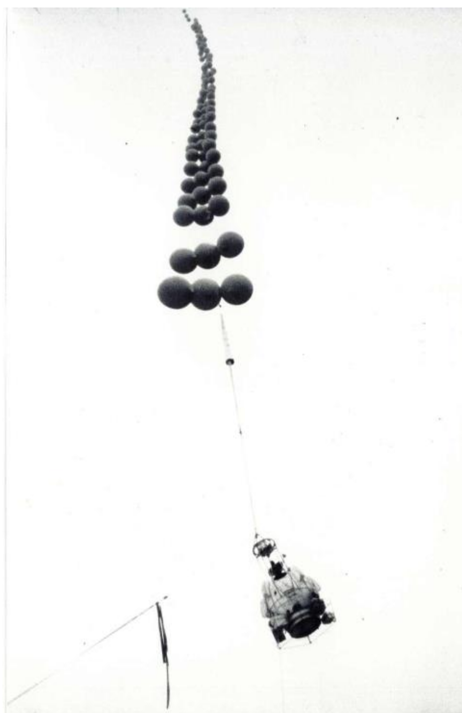
Figure 22–25: Audouin Dollfus decorated by astronaut and minister Claudie Haigneré [Aérofrance no. 117 (2011)].

He was the world specialist in the analysis of reflected polarized light: in 1955 he already discovered water and iron oxide on the Red Planet, contradicting the hypothesis of Gerard Kuiper.[†] He then found in 1956 that the Moon had a thick layer of dust made of pulverized basalt [13]. This was used for the landing

[*] His yell on the *Europe 1* radio station when *Apollo 11* landed is legendary. I created this *Prix* in 2013, with minister and CNES president Hubert Curien as the president of the jury.

[†] He also was involved with the Soviet *Mars 5* orbiter, analyzing in 1974 its polarimetric results.

selection of *Apollo 11* by the Apollo Site Selection Board ASSB [14]. The ASSB had been established in July 1965 by George Mueller, to decide on recommendations by Bellcom, created in March 1962 as a subsidiary of AT&T. Chaired by Samuel C. Phillips, its members came from the Office of Space Science & Applications and the three NASA manned spaceflight centers. It first met on March 16, 1966. Actually, NASA already had created in September 1962 a Joint Working Group, led by Eugene M Shoemaker, from the US Geological Survey Astrogeology Branch. Dollfus analyses of the Moon surface also were used in the design of the astronaut boots.



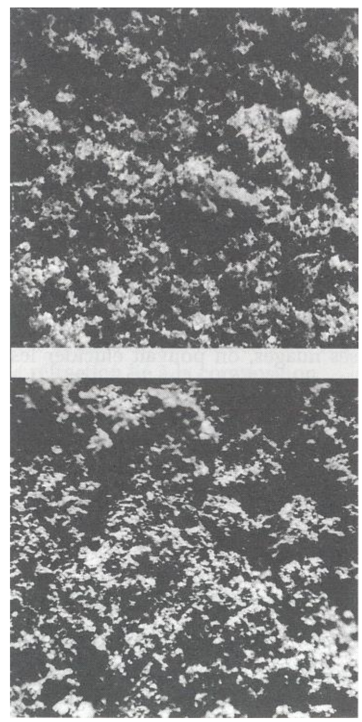


Figure 22–26 (left): Audouin Dollfus and his extraordinary balloon assembly on 22 April 1959 [www.astropolis.fr/Biographies-des-grands-savants-et-astronomes/Audouin-Dollfus].

Figure 22–27 (right): 1956 prediction (top) and *Apollo 11* sample (bottom) [13].

After the samples became available, he naturally became a NASA Prime Investigator for their analysis, from 1970 to 1995. He thus was provided samples in 1970, and participated later to the first Lunar Science Conference in Houston in January 1970 to compare results from the various PI's in the world. The *Apollo* and *Luna* Moon landings proved he had been amazingly right: it just became impossible to distinguish any difference between the signatures of the actual samples and his polarimetric predictions!

Figure 22–28: Audouin Dollfus NASA diploma, dated March 19, 1979 [Ariane Dollfus].

A fascinating story is that Dollfus also was offered Soviet samples, although only 326 g had been recovered by *Luna 16*, *Luna 20,* and *Luna 24*. There were no constraints attached to what was a personal gift, contrary to the very strict documentation and reporting imposed by NASA for their total of 381 kg of samples!

V. Sciaky Welding Apollo

I remembered having read in a magazine at the time of the Apollo program that French company Sciaky had welded the Lunar Module. During the Paris Air Show 2017, I found an American Sciaky booth, but could not progress further, until the next Paris Air Show in June 2019, when I had the luck to meet the *Président Directeur Général* of Sciaky Welding Electric Machines Ltd of Slough in the United Kingdom, Louis A. Kunzig, IV, the grandson of Mario Sciaky!*

Then, recently discussing about my research in one of my preferred restaurants in Mandelieu, besides Cannes, *La Voile Bleue du Bistrot du Port*, the owner told me that David Sciaky had been a nice customer! She precised that he was a spot welding specialist from Chicago.

* He was chairman of Sciaky from 2003 to 2007.

There were four Sciaky brothers, who became specialists in welding, managing a worldwide organization. It all started in 1929 with Sciaky SA in Paris and Vitry-sur-Seine. David Sciaky was its president from 1934 until his death in 1987, when he was its chairman.* Sciaky Welding also was established in Slough in 1932. A worldwide expansion continued in 1939 with the founding of Sciaky Bro*s* in Chicago (with David Sciaky as president and Maurice Sciaky as vice-president), and a research plant in Los Angeles.†

Fusion welding at near melting point of metal parts was used during the industrial revolution (~1750 to 1850), until resistance welding was patented by Elihu Thomson in 1886. While ships were commonly using fusion welding in Europe at the end of WWI, David Sciaky took the first of several patents in 1919, to improve welding, and use it for other metals than steel, with aeronautical and automobile applications. Aluminum welding thus allowed the French Nieuport-Astra company to develop in the mid-twenties, with the help of Sciaky, a metallic fighter—so far not identified—for use in the colonies and their adverse tropical weather [15].

The youngest Sciaky brother, Mario, was born on September 19, 1909, in Salonique. An *Ecole Breguet* graduate, he started as an engineer in Sciaky France in 1932, becoming its *Président Directeur Général* from 1952 to 1991, as well as of Sciaky in Slough. He also was an administrator of Uaya Hind Sciaky Ltd in India [16]. He retired in 1988, selling the company, then specialized in automatic welding for the automobile industry, to Dominique Georges Akel. Morgan Stanley took over in March 1997. The company went into receivership on December 3, 1998, and was taken over by Comau Italy, still with Akel as president. The factory was closed in 2000, and an office kept in Paris until December 28, 2004.

Besides resistance and fusion welding, Sciaky was licensed in the USA for the patent of *Commissariat à l'Energie Atomique* (CEA)‡ on electron beam welding. They were early contributors to the American space program: they improved the spot welding technique (already used on the Douglas F4D-1 *Skyray* in 1951) into resistance welding, used on the Army/Chrysler *Juno II* which launched *Pioneer IV* on March 3, 1959, the first United States space probe [17]. This technology was also used on the Lockheed *Polaris* and the De Havilland *Blue Streak* [18]. TIG (Tungsten Inert Gas) fusion welding was later used on the Raytheon *Hawk* and the Martin *Titan II/III* [19], and spot welding by TRW for its OGO satellites [20].

* He was succeeded by his brother Mario, until 2003.

† Sciaky Australia Pty Ltd also appears by 1963, disappears by 1969, when Sciaky/Tafer SRL appears in Argentina. Sciaky USA was sold in 1983 and now belongs to the Phillips group.

‡ It was created on October 18, 1945.

Sciaky also has been involved, since its beginnings, with the American manned spaceflight program: resistance welding was used on the McDonnell *Mercury* spacecraft. It logically continued with its derivative, the McDonnell *Gemini* structure, which was built using resistance, spot and seam welding [21].

Sciaky then was heavily involved in the *Apollo* program, including TIG welding on the North American S-II second stage of the *Saturn V*. With the latter company in charge of the CM, TIG and electron beam welding were used for it, with the following toolings:

- 17 GTA skate welders (fusion welding with Gas Tungsten Arc)
- 1 Special Head and Tailstock Positioner (for welding & machining at 1 to 20 RPM)
- 2 Special Trunnions Positioners on a rotating turntable
- 13 ½ HP Sciakydyne Units (welding & machining at 0.01 to 0.6 RPM)
- 1 Electron Beam Welder Type VX-50x30x42

In charge of the LM, Grumman decided as well to use TIG welding for its spacecraft [22].

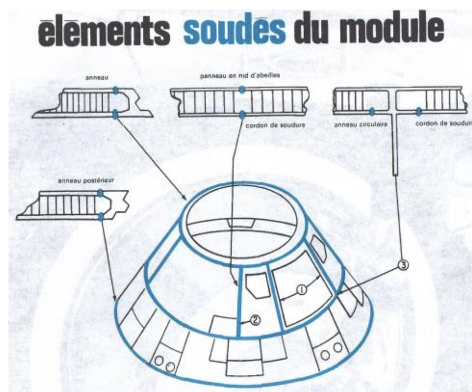


Figure 22–29 (left): Visit of Sciaky SA in North American Rockwell Downey on March 12, 1969: from left to right, engineer J. Gauthier, PDG Mario Sciaky, engineer G. Moressée, Maurice Sciaky (VP Sciaky Bros). Note behind them the recovered *Apollo* CM-101 [Sciaky at Work Vol. 8 no. 10].

Figure 22–30 (right): CM welded elements [Sciaky at Work Vol. 8 no. 10].

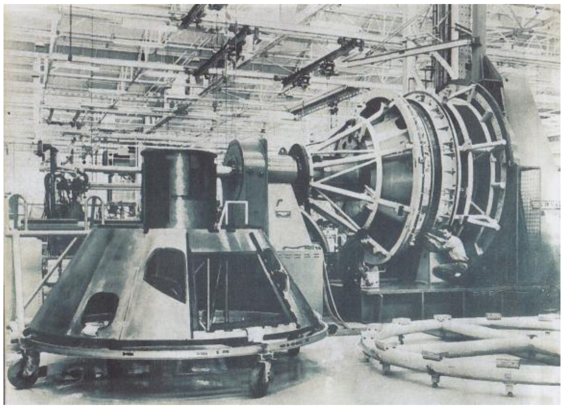


Figure 22–31 (left): CM positioner [Sciaky at Work Vol. 8 no. 10].

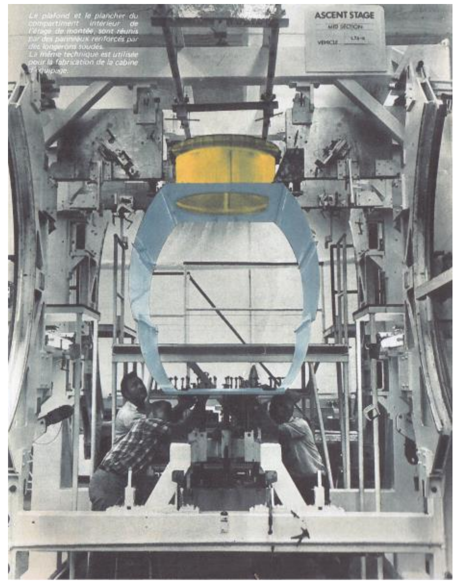
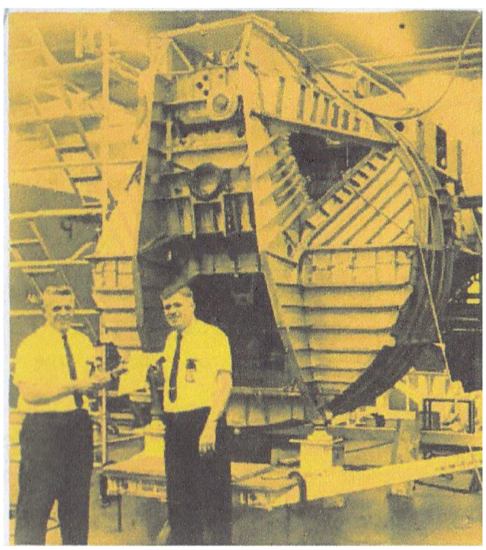


Figure 22–32 (right): LM Ascent Stage LTA-8 inner structure welding [Sciaky at Work Vol. 9 no. 2].



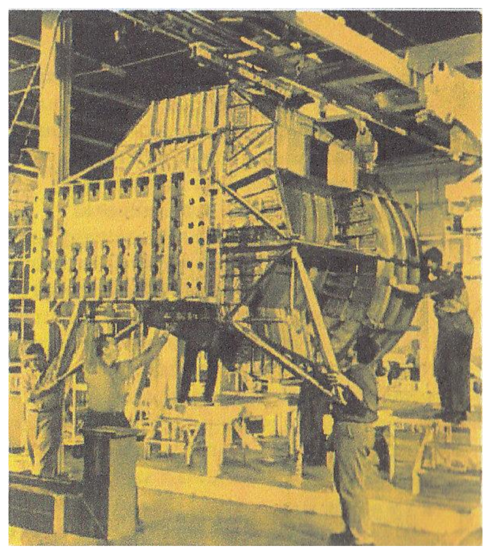


Figure 22–33 (left): LM Ascent Stage (front) welding [Sciaky at Work Vol. 9 no. 2].
Figure 22–34 (right): LM Ascent Stage (rear) welding [Sciaky at Work Vol. 9 no. 2].

Concerning the actual participation of Sciaky France to *Apollo*, it has not yet been possible to ascertain and detail it. Some elements of tooling design, and possibly fabrication, may have been done in Vitry.

VI. Apollo 11 Crew and France

It all started very early, when Michael Collins, a US Air Force North American F-86F-35 *Sabre* pilot, was part of the *Fox Able* cold war transfer of the 21FBW Fighter Bomber Wing and its No. 72, No. 416 and No. 531 Squadrons, seventy-eight aircraft in all, from George Air Force Base to Chambley-Bussières, near Metz, from December 12, 1954. Flight operations began on January 27, 1955 [23]. He belonged to the 72FS. He ejected on August 16, 1956, near Chaumont due to cockpit fire of MSN 191-940, serial number 52-5244 [24]. He came back to the USA in 1957.

France hosting every two years the Paris Air Show in Le Bourget, the first and biggest such event in the world since 1907, astronauts regularly come to it, like in May 1967 Collins and David Scott, who had flown the previous year on *Gemini 10* and *8* respectively. Collins thus had afterwards the occasion to visit the big Metz-Frescaty military airbase* and nearby Chambley. He was accompanied by his wife, he had married in the latter town ten years before, where they became honorary citizens, with a special re-enactment of their wedding… [25].

Figure 22–35 (left): Re-enactment of the wedding of Collins in Chambley [25].

Figure 22–36 (right): Aldrin, Armstrong & Collins in front of the USA Pavilion in the Paris Air Show June 9, 1989 [P. Jung].

The *Apollo 11* crew naturally was present in the Paris Air Show on June 9, 1989, for the twentieth anniversary of their historical flight.

Armstrong already had visited famous *Centre d'Essais en Vol* (CEV) in Istres on March 15, 1972, where he was shown the variable geometry Dassault *Mirage G8* no. 01. He later flew SOCATA TBM700 N700PW with the company chief pilot, Christian Briand, on August 3, 2003, in Oshkosh.

---

* Where I met him.

Figure 22–37 (left): Armstrong shown the prototype Mirage G8 [Fana de l'Aviation July 2019].

Figure 22–38 (right): Armstrong and TBM 700 no. 211 [via C.Briand, right].

Aldrin had preceded Armstrong in Istres, where he went on September 24, 1971. He however has a true love affair with *Côte d'Azur* ever since he inaugurated the first European *Space Camp*, in Cannes-Mandelieu, on July 6, 1989. It used as a model the *US Space & Rocket Center*, inaugurated in Huntsville by von Braun on August 5, 1968. He regularly comes to Sainte-Maxime on the occasion of the *Free Flight World Masters*.

Figure 22–39: Sevastianov, Baudry, Aldrin & Al Saud on the inauguration of the Cannes Space Camp [P. Jung].

Interestingly, two full-scale LM mock-ups have been built in France, one in *Cité de l'Espace* in Toulouse, and one in *Base Aérienne* BA 110 in Creil, north of Paris. During the C'Space launch campaign July 15 to 19, 2019, by rocket enthusiasts, a commemorative *Apollo 11 Saturn V* model was launched near Tarbes (and the Daher, ex-SOCATA, plant).

Figure 22–40: The LM mock-up in Toulouse [Cité de l'Espace].

Figure 22–41: The LM mock-up in Creil [via Jean-Michel Borde].

Figure 22–42: C'Space *Saturn V* model launch [*Air & Cosmos* August 2, 2019].

VII. Unexpected French Connection

The highest pole vaulter in the world today, Renaud Lavillenie, is French. But many years ago, a French vaulter, who had emigrated to Canada, published a pole vaulting Who's Who. I discovered there a world class jumper, E. Aldrin. The year could fit with Buzz, which the later duly confirmed to me. At the time in the university, he only could remember that his metallic pole was made in Sweden. Shortly after, the world record for metallic poles, before the switch to fiberglass, was established with a new Californian maker, named *Apollo*! So, I told Buzz he narrowly missed being a double Apollonaut…

Also, Jim Burke, the *Ranger* manager until December 18, 1962, became a prime teacher in the ISU (International Space University) Summer Space Programme, before ISU came permanently to Strasbourg with the creation of the Master of Space Studies. Buzz Aldrin became the ISU Chancellor in 2015.

VIII. Hitchhiking to the Cape

I was following live all *Apollo* flights from my hometown of Metz, listening to American Forces Network (AFN) in Germany and Voice of America. I had for long planned to be there for Man's departure for the Moon. But the dilemma was, *Apollo 8* and the first true "astronauts" fulfilling Tsiolkovsky dream that Man cannot stay forever in his cradle, or the first landing, at the time planned after *Apollo 10*? As a young student in the *Université de Metz,* with limited money, I had to make a hard choice, and the priority was to be Man's first landing on another celestial body.

Thanks to money earned harvesting grapes in Champagne, I could buy a charter flight ticket in a Paris agency selling them cheaply to young people. So I hitchhiked 300 km west to the capital, seizing the opportunity of the Paris Air Show May 29 to June 8, 1969, to take my ticket. I thus again hitchhiked from Metz to Paris early in July, with the necessary big margin…

Charter flights being forbidden in France at the time, we were bussed to Brussels, from where I could board a DC-8 of … Saturn Airways! After a refueling stop in Bangor, I had a wonderful arrival by night in JFK airport for my first trip to the Americas, with New York gleaming like an enormous jewel. After a strong interpellation by a policeman at a toll bridge exit in the area, I could begin my long trek to Florida. An incredible stroke of luck saw me taken by Bill Plummer, a veterinarian student near Goldsboro, North Carolina: he happened to be a nephew of Robert Saidla.

When Kennedy wanted to see the Moon hardware he had set rolling on, he began at its heart, the Marshall Space Flight Center and Rocket Man, Wernher von Braun. It was hard to convince the Secret Service, but the highlight would be a full duration static test of a *Saturn I* first stage. As JFK drove to the test stand on September 11, 1962, after the firing, he stopped and asked for the test conductor: as young Bob Saidla was presented to him, he congratulated him on a most impressive firing, shaking his hand! [26].

Figure 22–43: Kennedy's visit in Huntsville [26].

I soon was welcomed in Bill's home, provided with his badge for the launch, and taken care of during several days by his parents, waiting for his friends to go to the Cape with their station wagon! After a short nap in a motel in Daytona Beach, we departed in a quiet and fresh night, thus being among the first to enter the mythical base, riding along the coastal road, passing by the famous VAB (Vehicle Assembly Building), and parking on a road which quickly filled up.

Figure 22–44: How my numbered badge looked [*Man in space volume 4 - A giant leap for mankind* (Petersen Publishing, 1974)].

Waiting for the launch, I started walking toward the VAB. But after several minutes, the huge building looked no closer, his cubic shape giving no good perception of distance… So I turned back not to risk missing the historical lift off.

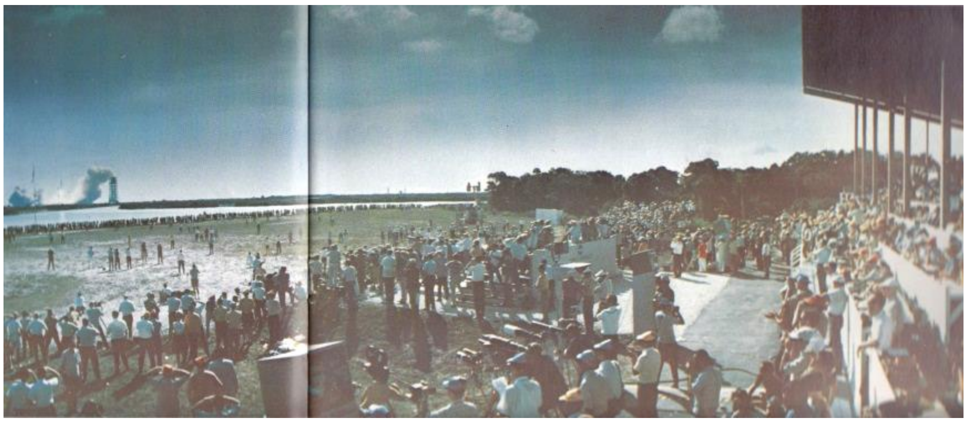


Figure 22–45: The crowd on the shore road. I was farther to the left [NASA EP-100].

Loudspeakers all along the road gave us NASA voice, with updates on the countdown, interspersed with warnings about alligators on the ditch on the roadside—KSC being a natural reserve. It was a glorious, hot, summer morning, with a beautiful blue sky and no wind—perfect weather conditions. I just put my—then new—cassettophone on the roof of the car, with the mobile mike besides, ready to be opened. *Apollo 8, 9,* and *10* had all lifted off at the planned second, but would the incredibly complex assembly do it again? Would my 7,500 km gamble succeed, watch my first rocket launch, and what a rocket, as the T- 1 minute mark approached, in the midst of an incredible tension all around?

"T-60 s and counting … 12 … 11 … 10 … ignition sequence starts," again the marvelous *Saturn V* ignited at T-9 s, without a single countdown hitch—for my first, totally unexpected, shock which sent me jumping: although 5 km away, the closest allowed, the flames, about 300 m long on each side of the launch table, were next to blinding, despite the full Sun! The five F-1 engines ignited in sequence, so as not to overload the S-IC thrust structure. "Zero all engines running." In a dramatic complete silence, the 111 m long pencil started climbing excruciatingly slowly, slightly diverging from the tower. T+12 s "Tower cleared." T+14 s "Pitch and roll program" Armstrong announced.

Then it came at T+16s, as expected this time, the noise and rumbling started reaching us, growing and growing. Now 3,500 t of thrust were pounding on our chests, at T+37 s crackling began hitting our ears, reaching its maximum at T+47 s, for about thirty seconds.

The sound slowly faded away, silence came back at T+1 min fifty s, preceding yet a second unexpected incredible vision, again in deep silence: I looked up with awe, as a man-made object, thousands of meters high in the Earth atmosphere, just was splitting the sky in two halves, quiet blue left and right skies, and in the middle a huge wide and kilometer long turbulent wake. Not from a nearby ocean liner at slow speed, but a rocket travelling at supersonic speed. This was just the expression of the most powerful and peaceful human technology, besides the atomic bomb, at its best.

Again, thanks to Bill, I was hosted for free in the Florida Institute of Technology (FIT), where I could follow the whole flight live—I vividly remember Wally Schirra weeping when the historical "Houston, Tranquility Base here, the Eagle has landed" came.

I had planned a grand finale by watching the night launch of Long Tank Thrust Augmented Delta 71 on July 25 with *Intelsat 3E*, but was told it had been cancelled. So, after a short sleep, I was on the road again … only to learn that it had taken place! My next stop again was courtesy Bill, since I was warmly welcomed in Robert Saidla family in Huntsville. A director in MSFC (Manned Space Flight Center), Robert house was full of trophies for his many achievements. So I was regaled by a visit of the MSFC, where I could have a very close look at a S-IC stage on its test stand. I learnt there that a decision had just been taken to go for the dry Skylab, not the wet one. As they were going in vacations in the Appalachians, I then was offered to join the family in their camper—another long free ride…

Having had such an incredible experience, I later applied to the FIT, and was accepted, as their first French student. I however cancelled at the last moment, when a new engineering course was created in my hometown of Metz.

IX. Conclusion

Angénieux went on providing NASA with its optics for *Apollo-Soyuz*, *Skylab*, the *Space Shuttle*, *Spacelab* and the *Dawn* probe. It was taken over by Thomson-CSF in 1993, now named Thales.

Sciaky is still very active in welding, like for *Ariane* 1 to 4, although the French branch, after concentrating on the automobile industry, has now disappeared. Sciaky has been using electron beam welding under vacuum since 2009. It is part of a R&D program on electron beam additive manufacturing (EBAM) for titanium, with Airbus and the *Institut de Recherche Technologique de Toulouse*, IRT Saint Exupéry. It is a regular participant to the Paris Air Show—which helped a lot for this chapter.

With thanks to Alain Broc, Jean-Marc Bouchut (Thales Avionics/Angénieux), Ariane Dollfus (daughter of Audouin), Louis Kunzig.

References

[1] Claude Carlier, Marcel Gilli, "Les trente premières années du CNES" (La Documentation Française).

[2] "Angénieux et le Cinéma: de la Lumière à l'Image."

[3] R. Cargill Hall, "Lunar impact: a history of project Ranger" (NASA SP-4210).

[4] *Air & Cosmos* no. 80 (21 November 1964).

[5] *Air & Cosmos* no. 59 (30 May 1964).

[6] Barton C. Hacker, James M. Grimwood, "On the Shoulders of Titans—A History of Project Gemini" (NASA SP-4203).

[7] Philippe Jung, Jean-Jacques Serra, "Bélier, Centaure, Dragon" (02-IAA.2.2.03, AAS History Series, Volume 33, IAA History Symposia, Volume 22).

[8] Courtney G. Brooks, James M. Grimwood, Loyd S. Swenson, Jr, "Chariots for Apollo—A History of Manned Lunar Spacecraft" (NASA SP-4205).

[9] Mary Louise Morse, Jean Kernahan Bays, "The Apollo spacecraft—A chronology—Volume II" (NASA SP-4009).

[10] Pierre Garaud, Guy Giami, "Cosmos Encyclopédie—Volume 5—La Lune monde fantastique" (Science & Avenir).

[11] https://fr.wikipedia.org/wiki/Kinoptik.

[12] www.astropolis.fr/articles/Biographies-des-grands-savants-et-astronomes/Audouin-Dollfus.

[13] Audouin Dollfus, "50 ans d'Astronomie—Comprendre l'Univers!" (EDP Sciences).

[14] William David Compton, "Where no man has gone before—A history of Apollo Lunar Exploration Missions" (NASA SP-4214).

[15] Sciaky at Work, Volume 7, no. 4 (December 1969).

[16] Who's Who in France.

[17] Resistance Welding, Volume 5, no. 6 (Sciaky).

[18] Resistance Welding, Volume 5, no. 8 (Sciaky).

[19] Sciaky at Work, Volume 6, no. 4.

[20] Sciaky at Work, Volume 7, no. 1 (August 1967).

[21] Sciaky at Work, Volume 6, no. 6 (March 1965).

[22] Sciaky at Work, Volume 9, no. 2 (June 1970).

[23] Ray Wagner, "The North American Sabre" (Macdonald).

[24] www.joebaugher.com.

[25] Philippe Buron Pilâtre, "Lorraine, fille de l'air" (Serpenoise).

[26] Ed Buckbee & Wally Schirra, "The real space cowboys" (Apogee Books).