History of Rocketry and Astronautics

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

Bremen, Germany, 2018

Hannes Mayer, Volume Editor

Rick W. Sturdevant, Series Editor

AAS History Series, Volume 51

A Supplement to Advances in the Astronautical Sciences

IAA History Symposia, Volume 38

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AMERICAN ASTRONAUTICAL SOCIETY

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 2021

ISSN 0730-3564

ISBN 978-0-87703-677-7 (Hard Cover Plus CD ROM)
ISBN 978-0-87703-678-4 (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 16

Félicette, the Only Space Cat*

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Abstract

On 22 February 1961, France became the third country to launch an animal into space, the rat *Hector*, on *Véronique* AGI V24. This was a rather elaborate experiment as, under the dynamic guidance of Professor Robert Grandpierre, founder of CERMA (*Centre d'Enseignement et de Recherche de Médecine Aéronautique*), the electrical activity of the brain and the muscles of *Hector* were measured.

But amid the space race, Grandpierre also quickly went for bigger animals, with the successful flight of the cat *Félicette* on 18 October 1963, on *Véronique* AGI V47.

This chapter tells, for the first time, the full story of this flight, thanks to the actors themselves, including Chief Medical Doctor Gérard Chatelier.

This chapter is particularly opportune, as an impressive crowdfunding campaign was highly successfully concluded within a few weeks by British Matthew Guy, thus allowing the realization of a monument dedicated to what turned out to be the only space cat!

The Chapter will conclude with an amusing feline coincidence.

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* Presented at the Fifty-Second Symposium of the International Academy of Astronautics, October 1–5, 2018, Bremen, Germany. Paper IAC-18-E4.2.09.

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Acronyms

AGI	*Année Géophysique Internationale*
CEAM	*Centre d'Expériences Aériennes Militaires*
CEBA	*Centre d'Etudes de Biologie Aéronautique*
CERMA	*Centre d'Enseignement et de Recherche de Médecine Aéronautique*
CEV	*Centre d'Essais en Vol*
CIEES	*Centre Interarmées d'Essais d'Engins Spéciaux*
CNES	*Centre National d'Etudes Spatiales*
CNET	*Centre National d'Etudes des Télécommunications*
CRS	*Comité des Recherches Spatiales*
DMA	*Délégation Ministérielle pour l'Armement*
DTIA	*Direction Technique Industrielle de l'Aéronautique*
ETAG	*Etablissement d'expériences Techniques des Autopropulsés Guidés*
GTC	*Groupe Technique de Cannes*
IFHE	*Institut Français d'Histoire de l'Espace*
IGY	*International Geophysical Year*
IRBA	*Institut de Recherche Biomédicale des Armées*
IRIG	*Inter Range Instrumentation Group*
LAMAS	*Laboratoire de Médecine Aéro Spatiale*
LEMP	*Laboratoire d'Etudes Médico Physiologiques*
LPA	*Laboratoire de Physique Appliquée*
LRBA	*Laboratoire de Recherches Balistiques et Aérodynamiques*
NASA	*National Aeronautics and Space Administration*
ONERA	*Office National d'Etudes et de Recherches Aéronautiques*
SFIM	*Société de Fabrication d'Instruments de Mesure*
STAé	*Service Technique de l'Aéronautique*
STSSA	*Section Technique du Service de Santé de l'Armée*
UCLA	*University of California, Los Angeles*
3AF	*Association Aéronautique & Astronautique de France*

I. Context

Man's conquest of the third dimension always has been preceded by animals. Thus, on 19 September 1783, in front of Louis XVI, a sheep, a rooster and a duck were lofted in a *Montgolfière* (hot-air balloon) in Versailles, opening the way for Man's first flight the following 21 November, when pilot Jean-François Pilâtre de Rozier and Marquis d'Arlandes ascended over Paris in a *Montgolfière*. Similarly, using a bundle of black powder rockets Claude-Fortuné Ruggieri

launched in 1830 a sheep in Marseille, which was recovered after peaking at about 200 m.

The first living creatures in space were flies launched from White Sands Proving Ground to an altitude of 109 km, and recovered, on 20 February 1947. They were aboard US Air Force General Electric V2 n° 20, as part of the *Hermes* program. However, the following *Blossom* flights of monkeys *Albert I* to *IV*, reaching altitudes up to 134 km between 11 June 1948 and 8 December 1949 were failures, although *Albert III* could be recovered, dead, after the explosion of the V2 at 4,800 m. After some pause, success was finally achieved, however, with V2 n° 51 on 31 August 1950, when mice were recovered. The Air Force then switched to the new Aerojet RTV-A-1 *Aerobee*, an initial failure on 18 April 1951 being followed by the recovery on 20 September of monkey *Yorick/Albert VI* and 11 mice after a flight reaching 61 km altitude.

In the meantime, the Soviet Union had begun a string of successful dog launches, with *Dezik* and *Tsigan* becoming the first animals to have flown into space and back on 22 July 1951 on board an OKB-1 Korolev R-1B rocket (a Soviet V2) that reached 100 km altitude: only 3 of the 15 launches with R-1B, R-1D and R-1E rockets failed, with 21 dogs recovered alive. Seven dogs even flew twice (one was *Albina*, from the *Sputnik 2* team), and Lisa[2] and Ryzhik flew three times.

With the introduction of the improved Korolev R-2A on 16 May 1957, *Damka* on its third flight (and a 4th flight on 31 August) and *Rizhaya* reached 212 km.

Barely one month after the beginning of the modern Space Age, the Soviet Union put the dog *Laïka* in orbit with *Sputnik 2* on 3 November 1957. She, of course, could not be recovered. Soon after, a powerful Korolev R-5A rocket was launched on 21 February 1958, allowing climbs to 473 km altitude. However the two dogs on board—*Palma* and *Pushok*—died in flight. One of two other flights also failed.

The Americans went back with the MIA (Mouse-In-Able) program, using *Thor-Able* launchers: all three failed between 23 April and 23 July 1958, although physiological telemetry was retrieved from the last two flights. However, after a failure with the new *Jupiter* missile on 13 December, the next big step occurred on 28 May 1959 when monkeys *Able* and *Baker* were recovered 2,574 km down range after peaking at 483 km, a true suborbital flight. The space race was on! NASA had been created on 1 October 1958 and *Project Mercury* was announced on 7 October, followed by the famous *Mercury 7* astronauts on 9 April 1959. As soon as the following 4 December, the monkey *Sam* became the

first *Mercury* passenger on board a boilerplate capsule, launched by *Little Joe* n° 2 to an altitude of 85 km.

The Soviets did not react immediately, probably due to over confidence: it was not until 13 March 1960 that they selected a large team of 20 cosmonauts. A crash program then adapted the Korolev 11F61 *Zenit 2* spy satellite (which eventually only flew on 11 December 1961 and was a failure) into the manned 1KA *Vostok*. Dogs were naturally selected as test subjects. Alas *Chaika* and *Lisichka* died on board 1KA n°1 in the explosion of the R-7 launcher on 28 July 1960.

In an incredible scenario, the Americans became the first to recover a satellite, *Discoverer 13* on 11 August, followed nine days later by the Soviets with 1KA n° 2: *Belka* (on her 5th flight!) and *Strelka* were the first animals recovered from orbit, together with a rabbit, 42 mice, 2 rats and flies.

Some R-2A launches had continued up to 22 September 1960, but disaster struck in December with 1KA n° 3 and 4 both failing. While on the following 31 January 1961, the monkey *Ham* qualified the *Mercury* spacecraft on a suborbital flight, opening the way for Alan Shepard to become the first American in space.

Later, animals also preceded humans to the Moon, when *Zond 5* was recovered on 21 September 1968 after a circumlunar flight: its crew of turtles, flies and worms, survived a 20 g deceleration. After the *Zond 6* failure, no cosmonaut followed.

II. Enter France

As explained in previous papers by one of the authors about the "Furia Francese" on rocket matters during the 1950s,[1] it came as no surprise that France was the third country to launch animals into space, with the rat RC 139 *Hector* on LRBA *Véronique* AGI V24 on 22 February 1961. The recovery was quick, thanks to the first use of helicopters in Colomb-Béchar in the Sahara. This may have been a small beginning for France, but the live transmission of brain activity during the flight was a world first.

The roots of these flights went back to 11 December 1944 when STSSA (*Section Technique du Service de Santé de l'Air*) was created within STAé (*Service Technique de l'Aéronautique*). On 6 January 1945 CEBA (*Centre d'Etudes de Biologie Aéronautique*) was established at the *Cité de l'Air* in Paris, with *Médecin-Général* Robert Grandpierre its director from 25 February. He was a physiological professor in Nancy. CEBA was attached to STSSA in April 1946, the very month future IAF founder, Alexandre Ananoff created a special session during the 2nd *Congrès de l'aviation française* on navigation in the upper atmosphere, which included papers on human physiology.

As the *Armée de l'Air* was operationally testing its aircraft in CEAM 330 *(Centre d'Expériences Aériennes Militaires)* in Mont-de-Marsan, south of Bordeaux, a *Laboratoire d'Etudes Médico Physiologiques* (LEMP) was created there in 1948, under CEBA, initially specialized in oxygen issues. There Dr Gérard Chatelier started working on sensory isolation. On 12 January 1955, STSSA and CEBA were merged into CERMA (*Centre d'Enseignement et de Recherche de Médecine Aéronautique*), with an added education mission, Grandpierre being its director.[2] In May 1957, to study the biological effects of accelerations and vibrations, CEV (*Centre d'Essais en Vol*), the French aircraft test center, established in May 1957 a *Laboratoire de Médecine Aéro Spatiale* (LAMAS) at its Brétigny center, near Paris. Among others, it was equipped with a centrifuge.

On 7 January 1959, the *Comité des Recherches Spatiales* (CRS) was created to foster space research. It revived the *Véronique* flights in March 1959 (which had ceased in 1954), with a new International Geophysical Year (IGY) version (*Année Géophysiqe Internationale*, or AGI in French), now equipped with a telemetry system, a VHF beacon and a radar transponder.[3] In November, Chatelier managed to surgically implant electrodes on the skull of a rat to record the activity of the brain's cortex and reticular area. Other probes recorded the body temperature, heart rate, respiratory frequency, and the activity of the muscles of the diaphragm and the nape of the neck. Grandpierre could then propose to CRS flying rats on *Véronique* rockets, with an agreement being signed in August between CERMA and CRS.

After *Hector*, two further rat flights took place, now under the aegis of CNES, which had been created the previous 1 March, the world's second space agency after NASA. RC 271 *Castor* and RC 268 *Pollux* were launched on 15 and 18 October 1962. *Pollux*, however, could not be recovered.

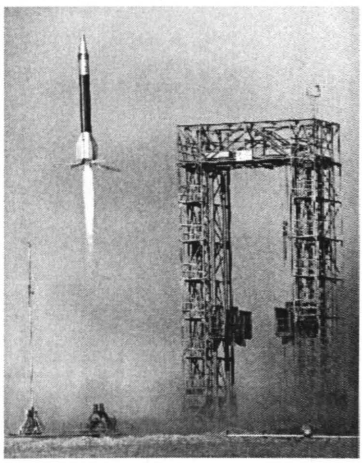

Figure 16–1: V36 launch with *Pollux* the rat. [CERMA].

III. Switching to Cats

Grandpierre now decided to switch to larger mammals, cats being selected as they were the most used in neurophysiological science.[4] The aim was to study the performance of the central nervous system in zero-g. In addition to the measurements already performed on the rats, the reaction of the sensory system to a leg stimulus would be analyzed.

This led to a rather elaborate experiment,[5] using the LRBA *Véronique* AGI. Its safety destruct telecommand system also was provided by LRBA.

Jacques Seince, was in charge of the nosecone development, which included:

- at the bottom, a pressurized container with a special dolly holding the cat in a horizontal position, so that its body axis was perpendicular to the rocket main axis. There was a cartridge to absorb carbon dioxide below the dolly. The movements of the cat's head were limited. Trained to be in the container, it was not given any drug
- IRIG telemetry provided by Sud Aviation LPA in Suresnes (headed by Teissier). Its low-level amplifiers were located above the cat container
- radar transponder (Sud Aviation)
- directional beacon (Sud Aviation)
- homing beacon (Thomson)
- parachute system (Sud, but with which drogue and main?)
- SFIM A.15 recorder,* above the amplifier.

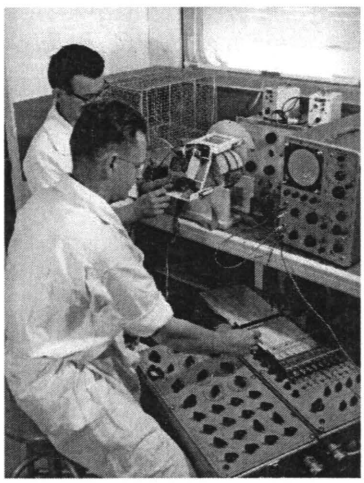

Figure 16–2: Ginet checking the leg stimuli of a V47 cat. Fondanesche to the left. [CERMA].

* It converted electrical current into an optical beam, recorded on a photographic tape.

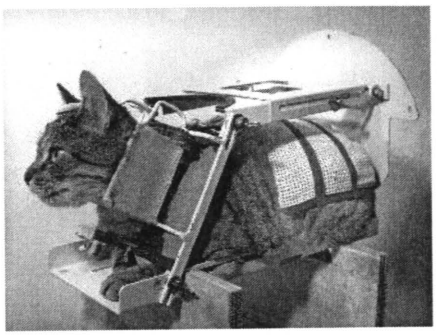

Figure 16–3: Cat with its restraining device.

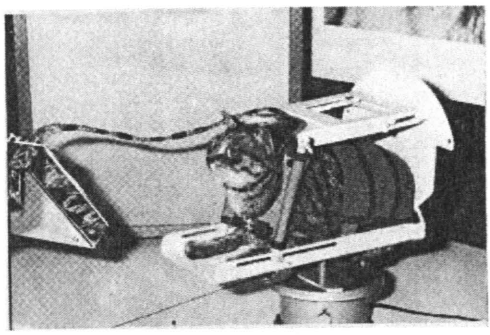

Figure 16–4: Cat dolly. [*Air & Cosmos* n° 28, 28.10.63].

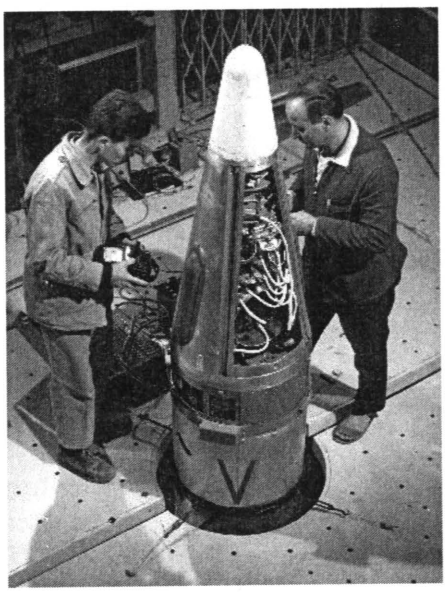

Figure 16–5: Left Michel Calvy, right Bernard Cailler. [CERMA].

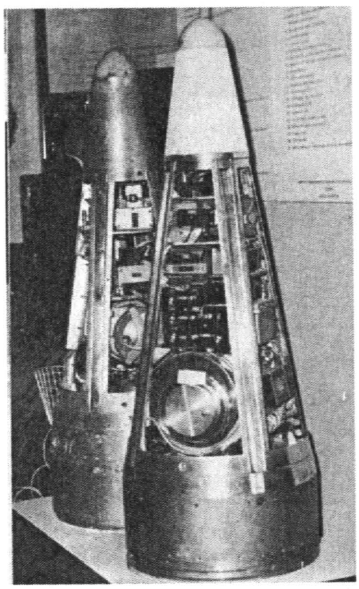

Figure 16–6: The new Sud Aviation V47 and V50 nosecones in the June 1963 Paris Air Show. [*Air & Cosmos* n° 8, 28.10.63].

Stimulation

The leg stimulation was implemented via two electrodes glued on a fore-leg. The benign shocks lasted .5 ms, spaced according to a repetitive sequence 10 s—.5 s—.1 s, 10 s...

Responses were recorded in the somatic area.

Recordings

No less than 9 electrodes were located in the brain:

- 2 in the frontal sinus, SF (n° 1 & 3)
- 1 in the somatic area I, SI (n° 4)
- 2 in the associative areas, A (n° 5 & 6)
- 2 in the ventral hippocampal, H (n° 7 & 8)
- 2 in the reticular area, R (n° 9 & 10).

Heart activity was recorded via two electrodes located in the forward left and the rear right legs. Breathing was recorded by a microphone on the chest (plus another in the nosecone).

After amplification, the signals were transmitted in real time via the Sud Aviation telemetry system.

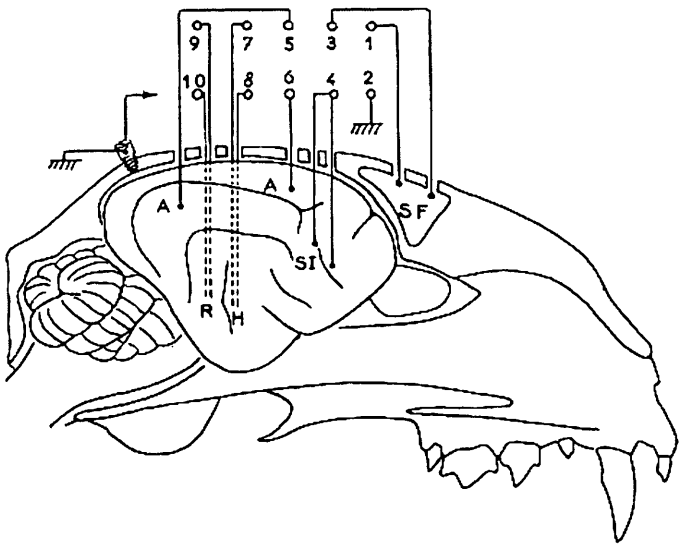

FIG. 1. — *Schéma des électrodes avec leurs connexions sur le crâne du Chat.*

SF : Sinus frontal
A : Cortex associatif
SI : Cortex somesthésique primaire
R : Formation réticulée
H : Hippocampe

1-3 : Électrodes indifférentes
2 : Masse
4 : Électrode corticale somesthésique
5-6 : Électrodes corticales associatives
7-8 : Électrode hippocampique
9-10 : Électrode réticulaire.

Figure 16–7: Diagram showing placement of electrodes in the cat's skull [5].

There was a special exhibit by CNES during the 25th Paris Air Show in Le Bourget (7 to 16 June 1963), as shown in Figure 16–8.

Figure 16–8: Left to right: *Vesta* nosecone, 3-axis chair, cat dolly, rat dolly, recording rack, screen rack, V47 &V50 nosecones. [CERMA].

IV. Félicette's Historic Flight

After being purchased from a pet dealer, cats with calm temperaments were selected: all were female as they were more docile than male cats. The selection criteria were the ability to withstand the restraint harness, container, accelerations, electrodes…: after implantation of the electrodes, recordings were performed every day, and the quality of the latter ones were given a note on a scale of 10.

Fourteen cats were selected, which trained for up to 2 months (before the electrodes polarized). They spent periods of 1 to 2 hours, on a 3-axis chair, in a centrifuge, and were subjected to simulated rocket noise. While the cats tended to urinate before entering the container, *Félicette* was made not to! They were not given names to prevent personnel to become too attached to them, with possible impact on the experiments: the future *Félicette* thus was cat CC 341. In addition, one cat which had been found with the then-popular "scoubidou" braid around his neck was one of the first to have electrode surgery. The latter having deteriorated after a few months, they were removed, and the cat was adopted as the CERMA mascot, with the name *Scoubidou*.

Figure 16–9: French astrocat candidates, *Félicette* to the far right, with the V50 cat next to her. [via Gérard Chatelier].

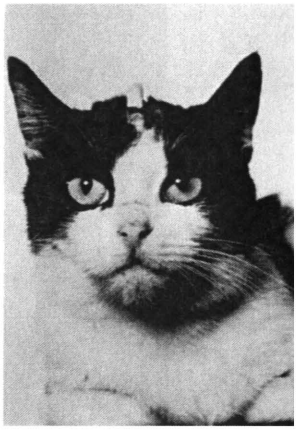

Figure 16–10: *Félicette.* [Captain Perroche, CERMA Technical services photographer].

CNES organized a "Space" campaign at the CIEES 343 launch range from 4 to 31 October 1963 for a Dragon technological flight for DMA and two *Véronique* launches for the CERMA cats.[6]

A team of 60 persons was assembled, consisting of:

- 26 Sud Aviation personnel
- 12 from CERMA including Grandpierre; Commander Brice, head of technical systems, and his technician Vergnol; Bernard Cailler, head of the measurement laboratory, with his technician Michel Calvy and Fondanesche; Commander Doctor Angiboust and Captain Doctor Ginet, Jean-Paul Gicquel. Chatelier was not present, being on a research period at UCLA related to primate neurosurgery
- 10 LRBA personnel
- 7 CNES staff including J-C Renou
- 4 ETAG personnel
- 1 for weather duties.

All the cats were sent to the Hammaguir area. As it was not possible to take a commercial flight, a cargo plane, at the time unpressurized, was required. Then a common workhorse in France, the Bristol 170 *Freighter* was very noisy. For Calvy, in charge of the troop, it was a long and slow trip from Le Bourget to Perpignan, then Hammaguir. He had been hired in September 1961 by Seince, working on the *Bélier* and *Centaure* sounding rockets launched from Ile du Levant and Reggane, for CNES and CNET. When called up for his mandatory military service, he happened to be hired by CERMA in November 1962, as they

needed an experienced technician. He was given the rank of Captain, necessary to use a car to commute between the *Cité de l'Air* and Suresnes.

Véronique V47 was prepared in Hammaguir on pad B"2 *Blandine.*

Figure 16–11: Hammaguir scene with a typical French Citroën *2 cv*. Note PARCA ramp at right. [Michel Calvy].

The CNES, CERMA and Sud Aviation teams arrived on 5 October. The cats were housed in Saharan cabins at *Blandine*. The following day was spent installing the teams and material. A meeting on 8 October allowed the mission chronology to be established, while CIEES prepared for the recovery. The next day the telemetry antenna was deployed, and the receivers were tested. On 11 October, the heading beacon was tested, with a Sud Aviation *Alouette II* helicopter flying along a 200 km circuit, being duly followed by four ground stations. Telemetry was tested, unsuccessfully, on the 12th with the nosecone carried under a Piasecki H-21 helicopter. New tests were made the following day, with the nosecone near the launch pad. On the 14th and 15th, there were unsuccessful tests of the homing beacon using a Douglas C-47, while another set of tests of the nosecone under the H-21 were partially satisfactory this time, with bad modulation on the 40 kHz channel. Everything finally worked on 16 October: the C-47 could be located 50 km away with an accuracy of 50 m, and the H-21 went as far as 100 km at an altitude of 1,160 m. Thus, that evening, the 60 kg mass nosecone could be prepared. The 2.5 kg cat CC 341 was selected for the flight, because she was the best of the eight finalists from the previous day, along with a back-up. The *Véronique* was weighted and balanced, before being mounted on the four arms of the launch table.

On 17 October the telemetry chain was calibrated and the CERMA amplifiers were adjusted using a cat in its container. The nosecone was mounted on the rocket. There was some static on the 40 kHz channel, which was corrected by changing the routing of a cable between the container and the amplifiers. This delayed the general rehearsal to the following day.

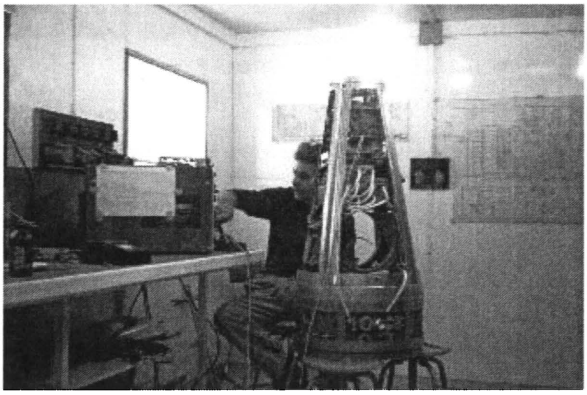

Figure 16–12: Gicquel checking in the mobile. [CERMA].

Figure 16–13: V47 rehearsal with the V50 cat, with Fondanesche & Ginet [CERMA].

On 18 October 1963, launch had been planned early, at 7 h 00. However, the external NiCd batteries had to be replaced, and there were difficulties with closing the container valve.

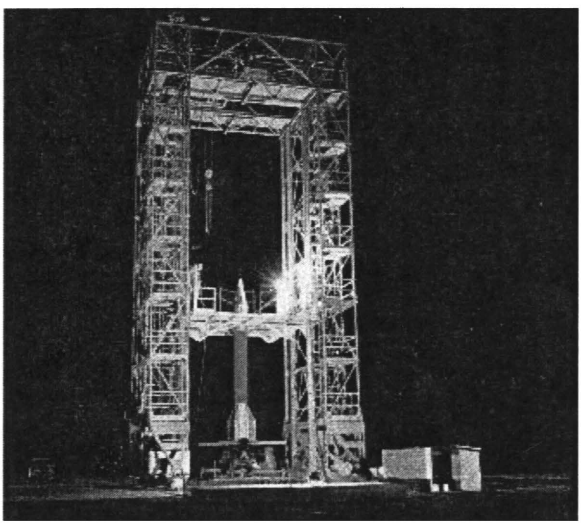

Figure 16–14: V47 on launch pad B2 *Blandine.* [Paris-Match 16 November 1963].

Data recording began 30 minutes before launch, with V47 lifting off at 08 h 09. Everything went smoothly. Propulsion lasted 42 s, with acceleration building up to 9.5 g, followed by a 0 g coast up to To+5 min 52 s, during which the nosecone separated at To+2 min 57 s before peaking at 157 km at To+3 min 30 s.

Some turbulence began at To+7 min 20 s, with vibrations, pitch and roll, to an overall value of 7 g. Parachute deployment followed at To+8 min 55 s (creating a 9 g deceleration) and landing at To+10 min 36 s.

Thanks to the H-21 helicopter, recovery quickly occurred at To+13 min 13 s, as the downrange distance travelled only was 2.5 km instead of 65 km planned, while the altitude was nominal (160 km required). The flight heading was 350° versus 140° planned, but this had no effect on the experiment.

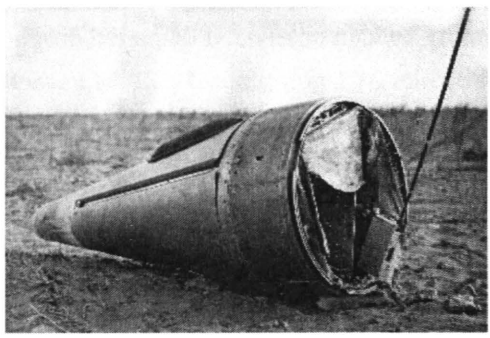

Figure 16–15: Nosecone recovery. [CERMA].

Figure 16–16: *Félicette* just after recovery! Left to right, front: Brice, Ginet, Vergnol, mechanics, Fayol, Gicquel, Cailler; back: ?, Fondanesche, Angiboust, Calvy. [CERMA].

In the evening, a celebration was duly organized by Grandpierre.

It is now known that *Félicette* was lucky to achieve her pioneering status, as Brazilian Army Colonel Manuel dos Santos Lage had planned to launch, on 1

January 1959, the tomcat *Flamengo* to 110 km with rocket 360BD named...*Félix I*! However, following protests by US cat lovers, the flight was cancelled.[7]

V. Results

The biological data was retrieved on 19 October, and the flight parameters were analyzed.

At equipment level, a few discrepancies without consequences were a bad deployment of the homing beacon antenna, a damaged drogue chute and one torn panel for the main chute.

Except during the turbulence period, recordings were of good quality, although the reticular measurements were not. The only significant hitch was at the level of the stimuli, which were done at a higher frequency than planned, as well as randomly.

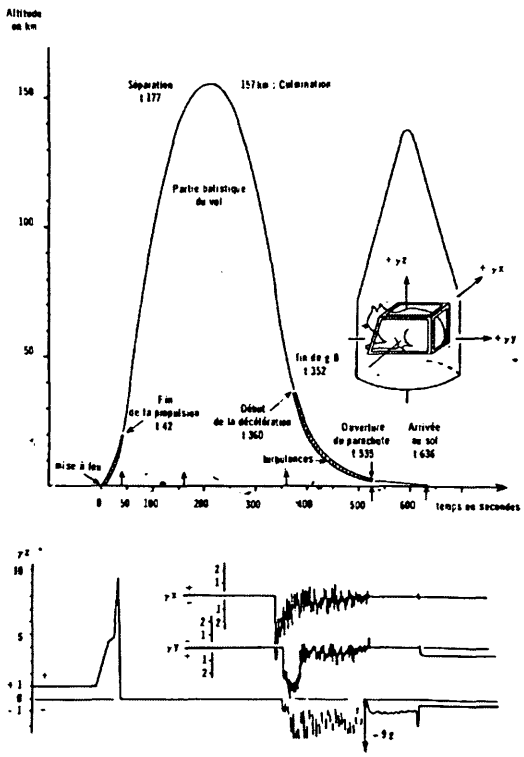

FIG. 2. — *Courbe représentative du mouvement de la fusée V 47*. En regard de l'axe des temps, ont été figurés les tracés des accéléromètres donnant la valeur des vecteurs accélération selon l'axe de fusée (γz), et dans le plan perpendiculaire, selon γx et γy. Noter entre 150 et 1330 l'annulation de γz. Pendant cette période γx et γy sont également nuls. Le schéma en haut à droite figure la position de l'animal dans la tête de fusée et les trois directions de mesures de γ. Les accéléromètres étant sensibles à l'inclinaison statique, les valeurs lues postérieurement à l'arrivée au sol traduisent la position du cône avant récupération.

Figure 16–17: V47 trajectory. [5].

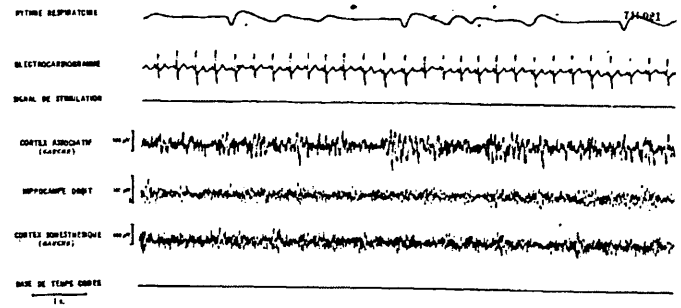

FIG. 3. — Tracés électrophysiologiques obtenus 2 mn avant le départ.

Figure 16–18: Recordings at To-2 min. [5].

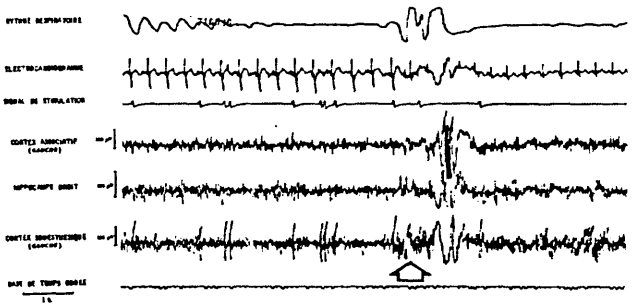

FIG. 4. — Tracés électrophysiologiques obtenus à la fin de la propulsion (42e sec).

Figure 16–19: Recordings at burn out at To+42 s. [5].

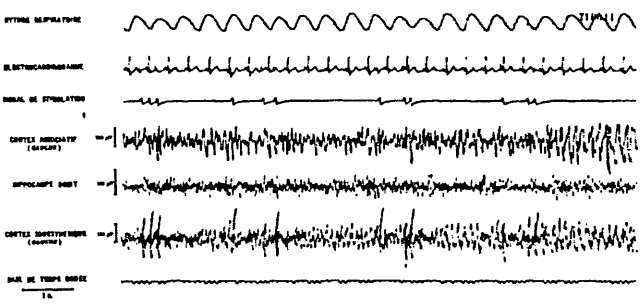

FIG. 5. — Tracés électrophysiologiques obtenus en gravité zéro (entre la 110e et la 120e sec).

Figure 16–20: Recordings during zero g at ~To+115 s. [5].

FIG. 6. — Tracés électrophysiologiques obtenus à la fin de la période de gravité zéro (entre la 320e et la 330e sec).

Figure 16–21: Recordings during zero g at ~To+325 s. [5].

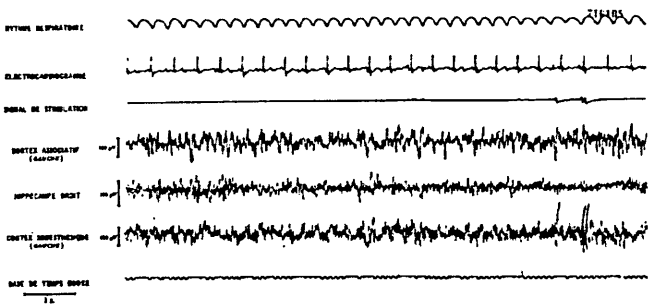

FIG. 7. — Tracés électrophysiologiques obtenus au sol après la fin du vol.

Figure 16–22: Recordings after landing. [5].

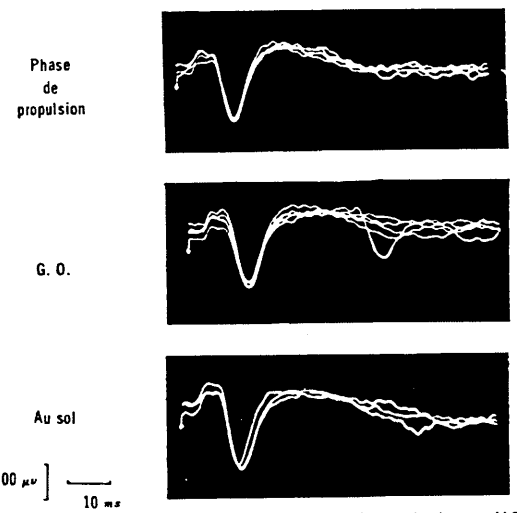

FIG. 8. — Absence de modification des réponses évoquées somatiques primaires. — A) Réponses recueillies pendant la phase de propulsion ; B) en gravité zéro ; C) au retour au sol. Chaque tracé représente la superposition de 3 à 5 réponses successives.

Figure 16–23: Somatic responses during propulsion, 0 g, after landing. [5].

VI. Analysis

The biological results showed that, during propulsion, the cat displayed a high level of alertness, linked to the noise and the increasing acceleration. Conversely, during weightlessness, *Félicette*'s rhythms became very slow, without any variations at the vegetative, cardiac, or respiratory levels. Her breathing was noted as remarkably regular, indicating a peaceful zero-g flight...

Reentry was the worst phase for *Félicette*, with heart trouble, probably due to significant turbulence. This however could not be analyzed because of the poor quality of the recordings, but the amplitude variations remained at a minimum level.

To summarize, during the whole flight, no abnormal behavior was noted.

After two months of tests, she had an autopsy to perform a histological analysis of the electrode areas.

VII. An Unlucky Cat

The success of *Félicette*'s flight unfortunately was marred by the failure of the second flight of the campaign.

On 24 October, after two scrubs on the 22nd and the 23rd, due to winds higher than 10 m/s, ignition was right on schedule at 6 h 30. However, one of the explosive bolts did not work and the arm holding the separation timer disconnected, while one of the four stabilizing cables ruptured. *Véronique* V50, thus unbalanced, took a northerly heading at 46°, traveling 160 km downrange after peaking at only 88 km. The radar transponder also stopped working on the pad at switch over to internal power, and the homing beacon did not work. Telemetry started working intermittently from To+128 s.

An *Alouette II* located the parachute in Djebel Béchar but could not land. Later, land vehicles were prevented from accessing the site by barbed wire. The next day, it was the turn of the helicopter to develop a fault! A second *Alouette II* then took off from Béchar, and this time managed to land. The nosecone was found to be badly damaged, its attachment to the parachute system having apparently broken before touchdown. The drogue chute also was torn. Unfortunately, the nosecone's feline passenger had not survived.

Even the successful flight of *Dragon* D05 on 30 October[8] was to be followed by yet another unforeseen problem, when the Algerian government impressed the whole Air Algérie fleet and the CNES team had to return to France the following day on two CIEES C-47s.

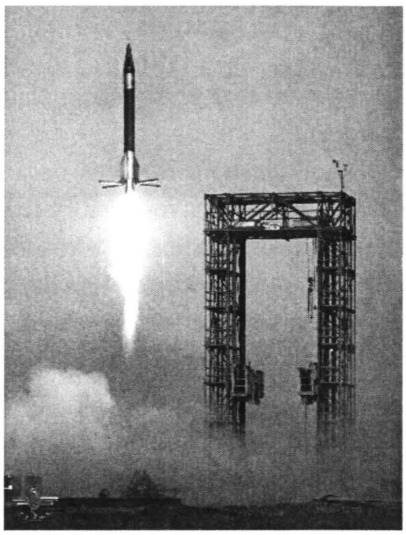

Figure 16–24: V50 launch: note the broken wire. [CERMA].

As could be expected, CNES required modifications to the launch table (which experienced one incident every five launches), particularly moving the separation timer onto the rocket itself. Somewhat surprisingly, while the homing beacon indeed never worked, there was a request to completely change the recovery system! If there had been damage without consequence to the V47 chutes, the problem with V50, according to Calvy, was that the wrong trajectory led to a crash on a summit at 1,500 m altitude, instead of the 750 m of the range...Being in charge of the equipment, he managed to recover the damaged recorder and extract the intact tape in full darkness. He remembers that on one of the flights, a wrench used to close the nosecone panel fell inside *Véronique* and could not be recovered; the microphones recorded not only the cat's meows, but also the noise of the wrench colliding against the *Véronique* structure!

Interestingly, after its flight, cat CC 341 was duly presented to the media, which christened it *Félix* (because of the famous cartoon *Félix the Cat*), as reported by the famous Albert Ducrocq[9] in *Air & Cosmos* 28 October 1963! This was adopted by CERMA, but with the necessary switch to *Félicette*.

Félicette was therefore honored around the world with several stamps (though none were issued in France), all incorrectly labelled as "*Félix*"! A "Cinderella" stamp was created in the US to mark the 10th anniversary of the flight in 1973, while the Comoro Islands issued a stamp in 1992, Chad in 1997, Niger in 1999.

Figure 16–25: *Alouette II*. [via Gérard Chatelier].

Figure 16–26: Comoro stamp. [7].

Figure 16–27: Chad stamp. [7].

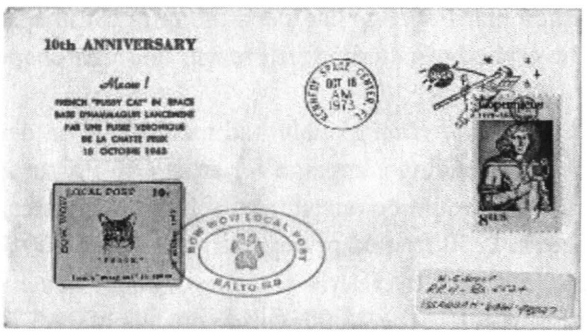

Figure 16–28: US Bow-Wow Local Postal cover. [7].

Of the 14 cats originally selected, two made spaceflights and ten were reportedly decommissioned at the end of the program, which leaves a question mark on the fate of one of them.

VIII. Monkeys before Man

With three successful animal flights under its belt, and the availability of *Vesta*, a more powerful derivative of *Véronique*, CERMA now could switch to monkeys for its biological research. Two successful flights were made, with *Martine* and *Pierrette* being recovered on 7 March and 13 March 1967 respectively, after peaking at 243 km and 234 km with *Vesta* n° 4 and 5. *Pierrette* however stayed apathetic during the whole flight, a response which sometimes occurred on other simian experiments.

Following these flights, Grandpierre left CERMA to take up a position at the University of Bordeaux. However, no agreement could be reached between two new competing research proposals from CERMA and Bordeaux, leading CNES to end national biological flights—the agency even completely gave up sounding rocket use to the benefit of satellites around 1973.

The first country in the world to cooperate in space with Soviet Union from 1970, France returned to biological research with the *Bion* satellites (commencing in 1975 with Cosmos 782). This was followed by experiments on Soyuz 27/Salyut 6 in 1978 and finally with Jean-Loup Chrétien, the first Western non-American astronaut, on Soyuz T-6/Salyut 7 in 1982.

IX. Fascinating Commemoration

Early in 2017 Matthew Serge Guy, a Creative Director at *Anomaly London*, chanced upon a tea towel celebrating the 50th anniversary of the flight of a cat in space. Thinking it might have been a Russian mission, he carried out some research that revealed that *Félicette* had been the only cat in space: a distinction that had escaped everybody, including in France, and this chapter's French authors!

Noting that *Laïka* and *Ham* already had memorials, he decided to launch, on 18 October, a crowd funding campaign for artist Gill Parker to create a 1.5 m tall bronze statue. Funds would be raised from selling £10 postcards, £25 badges, £40 bags, £65 posters, £250 framed prints and plaques, £6,000 30 cm replica of the planned statue. Informed by Kerrie Dougherty about this endeavor, P. Jung transferred this information to the 2,000 world contacts of 3AF *Commission Histoire*.

There was an amazing reaction to the campaign. By mid-November, the necessary £43,000 had been donated by 1,141 persons from Australia, Canada, the Caribbean, Chile, China, Croatia, France, India, Indonesia, Italy, Japan, Mexico, Peru, Poland, Portugal, Russia, Slovenia, Netherlands, South Africa, Spain,

Turkey, the United Kingdom, and the United States! The only remaining step was finding an appropriate location for the statue. P. Jung specifically contacted CNES *Observatoire de l'Espace* in Paris, already on his list, as the latter is a cultural laboratory to promote space to the public.

Also contacted, Chatelier, who had presented his work during a memorable 3AF *Commission Histoire* "History Saturday" at the *Musée de l'Air et de l'Espace* in Le Bourget on 15 December 2001 with astronaut Jean-François Clervoy, informed us that all his archives had been transferred to the *Institut de Recherche Biomédicale des Armées* (IRBA) in Brétigny. He suggested *La Cité de l'Espace* in Toulouse for the statue.*

X. A Feline Postscript

Much later, in the Cannes plant, now belonging to Thales Alenia Space, a stray black and white cat was found quietly roaming near the company restaurant. It eventually was adopted by the personnel and nicknamed *Félix*, while of course nobody remembered the story of *Félicette*! He now appears from time to time in the local media on some special occasions, as *Félix* the Space Cat.

* Eventually the statue of *Félicette* found an appropriate home in France, when it was installed in the Hall at the International Space University (ISU) in Strasbourg, the president of which had contributed to the funding. On the occasion of the 25th anniversary of ISU's Master of Space Studies program, it was unveiled on 18 December 2019, in the prestigious presence of astronauts Helen Sharman (a cat lover), Reinhold Ewald, Paolo Nespoli, while Matthew Guy was represented by Philippe Jung (who summarized the story).

Figure 16–29: *Félix* the Space Cat during a Cannes plant visit on 15 April 2017. [Michel Calvy].

Acknowlegments

With thanks to Michel Calvy and Christian Lardier.

Date	Launcher	Bio Payload	Result	Responsible
20.2.47	V2 Hermes n°20	flies	109km, recov	AF AMC
11.6.48	V2 Hermes n°37	monkey Albert I (Blossom)	63km, fail	AF AMC CRL
14.6.49	V2 Hermes n°47	monkey Albert II (Blossom)	134km, F	AMC
16.9.49	V2 Hermes n°32	monkey Albert III (Blossom)	explos 4.8km, R (d)	AMC
8.12.49	V2 Hermes n°31	monkey Albert IV (Blossom)	127km, F	AMC
31.8.50	V2 Hermes n°51	mice	137km, R	AMC
18.4.51	RTV-A-1 Aerobee USAF-12	monkey Albert V	61km, R (d)	ARDC
22.7.51	R-1B	dogs Dezik, Tsigan	100km, R	USSR
29.7.51	R-1B	dogs Dezik (2), Lisa	100km, crash	USSR
15.8.51	R-1B	dogs Chizhik, Mishka	100km, R	USSR
19.8.51	R-1B	dogs Ryzhik, Smelny	100km, R	USSR
28.8.51	R-1B	dogs Chizhik (2), Mishka (2)	100km, d in flight	USSR
3.9.51	R-1B	dogs Neputevy, ZIT (replacing Bolik missing)	100km, R (Bolik escape!)	USSR
20.9.51	RTV-A-1 Aerobee USAF-19	monkey Yorick/Albert VI, 11 mice	71km, R (d after 2h)	ARDC
21.5.52	RTV-A-1 Aerobee USAF-26	monkeys Mike & Patricia, mice Albert & Mildred	26km, R	ARDC

26.6.54	R-1D	dogs Lisa², Ryzhik (2)	100km, R	USSR
2.7.54	R-1D	dogs Damka, Mishka²	100km, R Mishka dead	USSR
7.7.54	R-1D	dogs Damka (2), Ryzhik (3)	100km, R Ryzhik d	USSR
25.1.55	R-1E	dogs Lisa² (2), Rita	100?85km, R Rita d	USSR
5.2.55	R-1E	dogs Bulba, Lisa² (3)	100km, d in flight	USSR
4.11.55	R-1E	dogs Knopka, Malyshka	100km, R	USSR
31.5.56	R-1E	dogs Linda, Malyshka (2)	100km, R	USSR
7.6.56	R-1E	dogs Albina (Sp2 team), Kozyavka	100km, R	USSR
14.6.56	R-1E	dogs Albina (2), Kozyavka (2)	100km, R	USSR
16.5.57	R-2A	dogs Damka (3), Ryzhaya	212km, R	USSR
24.5.57	R-2A	dogs Dzhoyna, Ryzhaya (2)	212km, decompress	USSR
25.8.57	R-2A	dogs Belka, Modnitsa	212km, R	USSR
31.8.57	R-2A	dogs Belka (2), Damka (4)	212km, R	USSR
6.9.57	R-2A	dogs Belka (3), Modnitsa (2)	212km, R	USSR
3.11.57	Sputnik 2	dog Laïka	orbit	USSR
21.2.58	R-5A	dogs Palma, Pushok	473km, d (decompress)	USSR
23.4.58	Thor-Able	mouse MIA	explos. Mouse-In-Able	US
9.7.58	Thor-Able	mouse MIA II	F	US
23.7.58	Thor-Able	mouse MIA III Wickie	F	US
2.8.58	R-2A	dogs Kusachka, Palma (2)	R	USSR
13.8.58	R-2A	dogs Kusachka(2), Palma (3)	R	USSR
27.8.58	R-5A	dogs Belka (4), Pestraya	R, 450km	USSR
31.10.58	R-5A	dogs Knopka (2), Zhulba	415km, crash	USSR
13.12.58	Jupiter AM-13	monkey Gordo	F, 550km, d at landing	US
28.5.59	Jupiter AM-18	monkeys Able, Baker	R, 483/2.574km	US
3.6.59	Discoverer 3	4 mice	(orbital, d in flight)	US
2.7.59	R-2A	dogs Otvazhnaya & Snezhinka, rabbit Marfusha	R	USSR
10.7.59	R-2A	dogs Otvazhnaya (2), Zhemchu-zhnaya	R	USSR
16.9.59	Jupiter AM-23	14 mice	F	US
4.12.59	Mercury LJ-2	monkey Sam	85km, R	NASA
21.1.60	Mercury LJ-1B	monkey Miss Sam	14km, R	NASA
15.6.60	R-2A	dogs Malek & Otvazhnaya (3), rabbit Zvezdochka	R	USSR
2.7.60	R-2A	dogs Malek(2), Otvazhnaya (4)	R	USSR
28.7.60	Vostok 1KA n°1	dogs Chaika, Lisichka	explos	USSR
19.8.60	Sputnik 5 (1KA n°2)	dogs Belka (5), Strelka, rabbit, 42 mice, 2 rats, flies	R (orbital)	USSR
16.9.60	R-2A	dogs Malek (3), Palma (4)	R	USSR
22.9.60	R-2A	rabbit, mice	R	USSR
13.10.60	Atlas 71D/RVX-2A n°423	mice Ay, Moe, Sally	R 1,050/8,121km	USA

1.12.60	Sputnik 6 (1KA n°3)	dogs Mushka (Laïka back-up), Pchelka	F (orbital)	USSR
22.12.60	Korabl 1KA n°4	dogs Alfa, Zhemchuzhnaya (2), mice	F but R, mice d	USSR
31.1.61	MR-2 S/C n°5/MR-2	monkey Ham (n°65 Chop Chop Chang)	253km	NASA
22.2.61	Véronique AGI V24	rat Hector RC 139	110km, R	France
9.3.61	Sputnik 9 (3KA n°1)	dog Chernushka, mice, guinea pig, insects	R (orbital)	USSR
25.3.61	Sputnik 10 (3KA n°2)	dog Zvezdoshka	R (orbital)	USSR
10.11.61	Atlas 32E	monkey Goliath/SPURT	F	US
29.11.61	MA-5 S/C n°9/Atlas 93D	monkey Enos	R (orbital)	NASA
20.12.61	Atlas 6F	monkey Scatback	F	US
15.10.62	Véronique AGI V37	rat Castor RC 271	R, d	France
18.10.62	Véronique AGI V36	rat Pollux RC 268	F	France
18.10.63	Véronique AGI V47	cat Félicette CC 341	157km, R	France
24.10.63	Véronique AGI V50	cat CC 333	bad traject:h=88km, d=160 km, d at impact	France
22.2.66	Cosmos 110	dogs Veterok, Ugolek	R (orbital, 22 days)	USSR
15.7.66	T-7A(S2)	dog Xiao Bao, rats, mice	R	China
28.7.66	T-7	dog Shan Shan, rats, mice	R	China
14.12.66	Biosatellite 1	insects	F (orbital)	NASA
7.3.67	Vesta 4	monkey Martine	R	France
13.3.67	Vesta 05	monkey Pierrette	R	France
5.67	Orion II	rats		Argentina
7.9.67	Biosatellites 2	insects	R (orbital)	NASA
15.9.68	Zond 5	turtles, flies, worms	R (Moon flyby)	USSR
10.11.68	Zond 6	turtles, flies, worms	F (Moon flyby)	USSR
28.6.69	Biosatellite 3	monkey P-470 Bonny	R(orbital)	NASA
23.12.69	Canopus II	monkey Juan	(orbital)	Argentina
9.11.70	Orbital Frog Oto-lith	frog	(orbital)	NASA
28.7.73	Skylab II	spiders Arabella, Anita	(orbital)	NASA
31.10.73	Cosmos 605/Bion	tortoises, rats, insects	(orbital)	USSR
25.9.79	Cosmos 1129	rats	(orbital, no coupling)	USSR
14.12.83	Cosmos 1514/Bion 6	monkeys Abrek, Bion	(orbital)	USSR

AF = Air Force, D = dead, F = fail, R = recovered

Table 16–1: Animals flights. [IFHE *Espace & Temps* n° 7, December 2010; Animals & Man in Space->1960, ONR; https://history.nasa.gov/animals].

Chrono	Phase	Area SI	Area A	Area H	Somesthetic Potential	Remarks
	before launch	normal: fast phases (30-35 Hz) slow phases (8-12 Hz)	normal: fast phase (30 Hz) ample puffs (9-15 Hz)	fast (28-35 Hz)	latency 3.5-4 ms	see Figure 2
To T+42s	propulsion	sustained activity (35-40 Hz)	sustained activity	fast	reduced variability	see Figure 3
T+42s T+352s	0 g	fast phases (30 Hz) slow ample phases (8-12 Hz)	fast phases (20-25 Hz) slow ample phases	slight slowdown	higher variability max amplitude during slow waves	heart & breathing constant. See Figures 4 & 5
T+360s T+636s	reentry	activated	activated, then slowdown	fast		much static, turbulence
	ground	normal		normal, then slow		in polypnoea. See Figure 6

Table 16–2: Flight events summary.

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