AN EXPERIMENT PROPOSED AND SET UP BY THE READERS WILL BE FLYING ON BOARD THE SHUTTLE - THESE ARE THE RULES OF THE GAME - THE EXPERIMENTS OF OTHERS

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Translation of "Volera a bordo della Shuttle un esperimento proposto e realizzato dai lettori - Queste le regole del gioco - Gli experimenti degli altri" Scienza & Vita Nuova, No. 18, 1982, pp. 1-6.

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attention of the NASA personnel, the journalists and of the entire scientific world was drawn to the series of scientific experiments connected with the third flight of the Columbia. Of course, the importance of the performances of the spacecraft and the two courageous astronauts Jack Lousma and Gordon Fullerton during their one week mission (which was then extended by another day because of the poor meteorological conditions on the landing field of the desert of New Mexico) was not disregarded, but the real novelty was represented by their scientific work.

The third mission of the space shuttle, while it maintained its main purpose as Test-Flight and therefore the testing of the different instruments as well as the spacecraft as a whole, had an extremely ambitious and important "scientific payload". Now, while the Cape Canaveral technicians are restoring the Columbia for its take off once again the most qualified laboratories attached to NASA are analyzing with considerable labor the precious scientific data gathered by Jack Lousma and Gordon Fullerton.

The complex of scientific experiments designated as OSS-1 (Office of Space Science No. 1) assigned to the third mission of the Columbia included experiments concerning not only the acquisition of new data in the sectors of astrophysics, geophysics, biology and bio-medicine, but also experiments which may give rise to technological and industrial applications. This is also with a view to the creation, no longer in the remote future of permanent bases in orbit around the Earth. For example, they studied plants and insects to know whether it would be possible to cultivate plants and establish bee hives for the future residents of space platforms to limit supplies from the Earth.

But let us proceed in an orderly manner starting from the studies of the Earth's ionosphere and solar physics. The Columbia carried into space instruments which allowed the measurement of interaction in orbit (the shuttle itself) and the Earth's iono-

patriotic historical precedent: the first experiments of the artificial formation of crystals of snow were actually conducted by a Japanese physicist: Ukichiro Nakaya in 1936.

A Ticket For You

When their Get Away Special (GAS for short: that is the term by which NASA defines this type of payload) is in orbit, for the first time crystals of snow will be produced artificially in an ambience of weightlessness, a process very similar to the one occurring in the tail of a comet which is drawing away from the Sun.

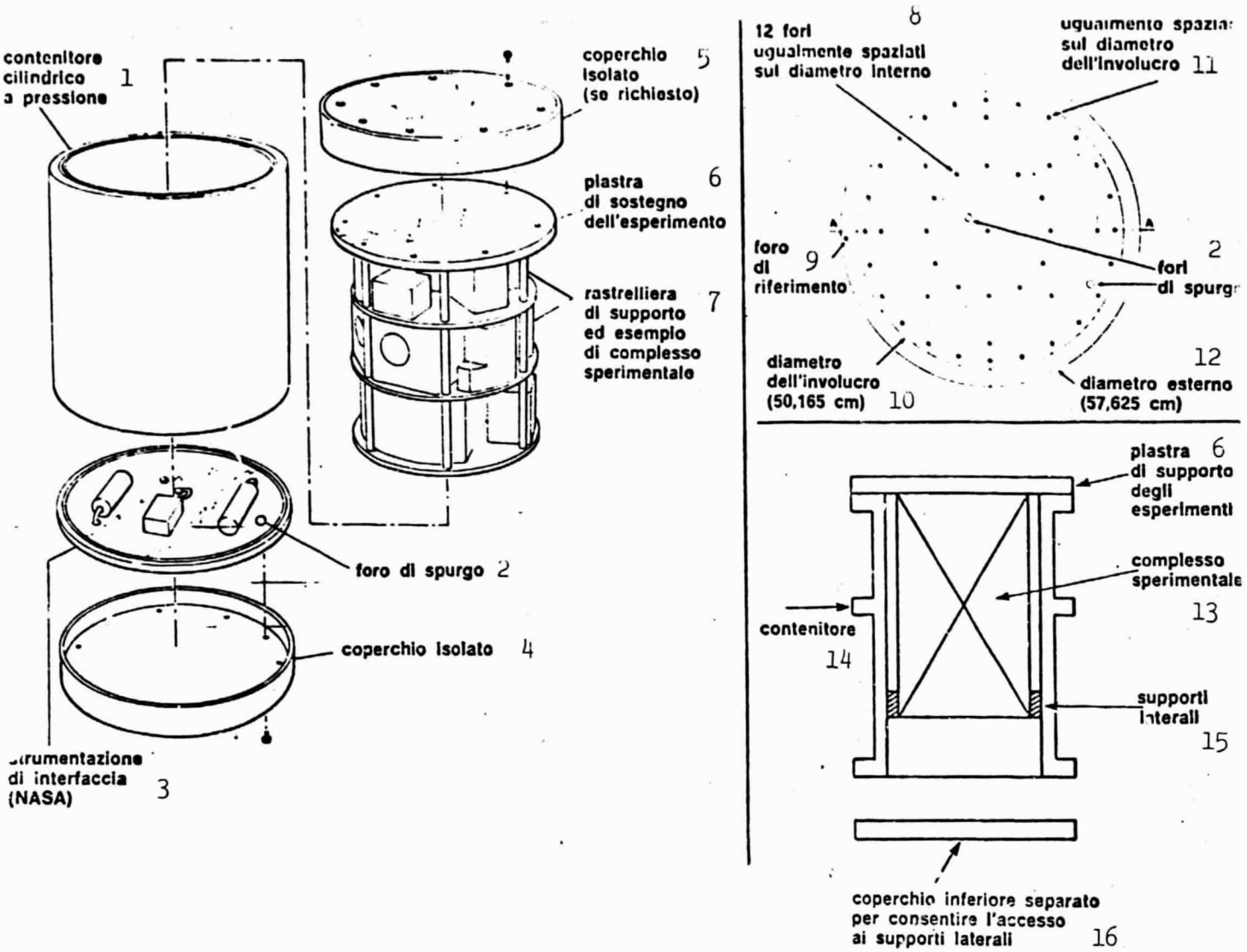
Since 16 February 1982, a round ticket to space via the Space /2 Shuttle has been booked in the name of Scienza & Vita Nuova; it is the 400th ticket booked at the offices of the GAS project, which continue meanwhile to receive bookings on the principle of first come, first to travel in orbit. In a few month's time, the name of the publication will be replaced by the name of the readers who will be chosen by a selection commission among those who have sent proposals for experiments, and the booking will be converted to a definite commitment according to the modalities which we publish in the Regulations in the inset on this page.

What do the users of the GAS propose to have in the hold of the Shuttle? We have spoken of two experiments; we shall speak of others in the next issues, along with the description of the first projects to be sent in by the readers.

Probably not all are planning to carry out absolutely original experiments, without precedent in the history of science. Certainly, many intend to make use of the special conditions of flight in space under conditions of microg vity to learn something more about the studies already accomplished, both in the area of pure science and in the many sectors of application, from the mechanical industry to electronics, from pharmaceutical chemistry to genetic engineering.

For most of the experimenters, it will be the first experience of management of a space load. We who have always sought to describe in Scienza & Vita Nuova how scientific research originates, takes place, and is applied are highly interested in this aspect. We too will accomplish a very stimulating experiment: we will have the opportunity of following and describing a scientific experiment "from the inside" in all its phases of planning, implementation, and analysis of the results.

This will probably be a unique opportunity in Italy to describe step-by-step how the work of a scientific team develops while they adjust an experimental complex which will be flying in space. This the anticipation, certainly limited and very particular but complete, of a method of working which may become very common in about a decade when the "space factories" begin to operate in orbit.



These sketches furnished by NASA give an idea of the dimensional characteristics to be kept in mind in the definition of the project. Above we see the pressurized cylinder, the corresponding insulating covers and an example of rack with the experimental assembly arranged by the experimenters. Top right, the plate of the upper cover which also provides the support for the experimental complex. In the bottom, the cross section of the container with the lateral supports.
1. container pressurized cylinder; 2. drainage hole; 3. interface instrumentation; 4. insulated cover; 5. insulated cover (if needed); 6. plate for support of the experiment; 7. support rack and example of experimental complex; 8. 12 holes at equal intervals on the internal diameter; 9. reference hole; 10. diameter of the envelope; 11. at equal intervals on the diameter of the envelope; 12. external diameter; 13. experimental complex; 14. container; 15. lateral supports; 16. lower cover separated to allow access to the lateral supports.

Artificial Comets

There will therefore be experiments which teach something about phenomena difficult to isolate and study under terrestrial conditions, such as crystal growth. A NASA technician said: "For the first time, thanks to the Space Shuttle we will be able to study the structures of perfect crystals and perhaps find out how to produce them better on our planet."

Indeed here when the solid crystal is formed starting from a melted mass, by the effect of gravity vortical parasitic and microscopic currents are generated which render it not totally uniform.

Or we would have slightly crazy experiments, such as the one proposed by a group of American artists: they would like to release from the Shuttle a sheet of reflecting material 3.2 km long. The sheet left to itself would unroll slowly assuming the shape of the tail of a comet due to the effect of radiation coming from the Sun, and would probably be visible to us on starry nights. /4

This experiment would not be accepted within the framework of the GAS project, which provides for the exclusive use of suitable aluminum containers. This is how NASA puts it: "The standard container of the GAS project provides a means for installing small experiments in the hold of Orbiter, and it is intended at the same time to isolate them from the crew and other loads. The container may have its own internal pressure vary from a point close to zero (vacuum) to about 1 atmosphere and also guarantee a certain thermal protection for the experimental equipment. The standard container of aluminum has lateral sides 5/8" thick (about 1.6 cm) insulated thermally; the cover consists of the mounting plate of the experiment and may or may not be insulated; a 3" (about 7.62 cm) layer

from the bottom of the container must not be occupied by the experimental equipment, because it will be taken by interface instruments provided by NASA such as the pressure regulating systems."

Inside the cylinder and taking into account the dimensional limitations, the experimenters can place whatever they need for the purpose of the experiment: from the structural support which can in its turn be subdivided into compartments, to the recorders of measurements which may characterize the different phases of the experiment, to the batteries feeding it, besides obviously the actual experimental system. For all these components and for many others which may be considered, NASA furnishes exact instructions for assembly and tolerances which cannot be summarized on this page. We shall mention them in part in the next issues, and will send the original documentation to those who get through the first selection phase. Finally the winners can have direct access to the data bank which the Space Organization has organized precisely to satisfy the requirements of users of the GAS project.

The first race for a passage in orbit has begun: we await your proposals!

THESE ARE THE RULES OF THE GAME

Scienza & Vita Nuova collaborating with NASA within the framework of the Get Away Special Program offers Italian students a flight on the Space Shuttle for a scientific experiment which satisfies the following basic principles:

1. Weight (not more than 60 pounds) = 27.21 kg
2. Volume (2.5 cubic feet) = 70 liters
3. Diameter (19.75 inches) = 50.16 cm
4. Height (14.13 inches) = 35.89 cm

On board, the experiment will be enclosed in a standard aluminum container provided by NASA, insulated thermally on the outside. The upper part may be insulated or not, according to the needs of the experiment and/or the flight of the Space Shuttle.

The pressurized container must be able:

a. to be placed under vacuum conditions before the launch, or:
b. be placed under vacuum conditions during the launch and repressurized during the re-entry or:
c. maintain a constant pressure in all phases of about 1 atmosphere, or:
d. be evacuated and repressurized in orbit if the experimenter provides a system of ventilation and gas for repressurization.

The experiment must be self-sufficient, in the sense that no interventions are planned by the Shuttle crew, and be equipped in case of need with an adequate source of energy (battery) which satisfies the safety standards required by NASA. As an example, we may say that lithium cells are not accepted.

The flight already booked by Scienza & Vita Nuova on 16 February 1982 bears the order number 409. This means that the proposed experi-

ment will fly with the Shuttle after all those with prior bookings have been completed. Purely as an indication it may be said that it is presumed that the proposed experiment could fly before the end of 1986 unless otherwise decided by NASA.

The investigations could concern any field of science and technology. They will preferably be set up in the areas of physics, chemistry, biology, medicine and technology.

A commission consisting of personalities of the Italian scientific world, which will be announced later, will evaluate the proposals which come to the editors and will consider the originality as well as the correct organization of the research and the fulfillment of the principles required for the flight.

The competitors, of Italian nationality can be individuals, industrial companies, universities, schools, research laboratories.

The interested parties must send the editors before 31 July a letter of intention describing briefly the type of research it is proposing. By October 30, the applicant will receive from the periodical a communication on whether his proposal has or has not been accepted for further selection.

In case of acceptance, the party concerned engages to send the editors not later than 31 December 1982 a detailed project of the experiment with all the elements needed to allow the selection Committee to make the actual uncontestable choice of a proposal which shows all the required characteristics. The selection will be made according to the undisputable criteria which the Commission will decide to adopt. The choice will be final when the competitor

receives the communication on the positive evaluation of the project proposed; the competitor will be accredited to the Goddard Space Flight Center of NASA (Greenbelt, Maryland U.S.) and will assume for this the designation of "Assignee" and the position of "Payload Manager" pursuing autonomously all the subsequent contacts with the American Space Agency and accomplishing personally the necessary technical duties.

From that time to the approximate date of flight, the author (or authors) will be able to set up in final structure the scientific experiment to be installed on the Shuttle.

The date by which it must be handed over to NASA will be communicated directly to the Payload Manager.

In the promotion of this, the periodical Scienza & Vita Nuova engages to bear only the costs relative to the agreement signed with NASA in terms of weight and use of the container according to the above indicated norms without providing any other variant. Possible additional specific needs must be negotiated directly with NASA and if they are considered acceptable the corresponding financial costs must be borne.

Therefore the author (s) of the selected experiment must bear all the costs inherent to the implementation of the experiment, and the insurance if needed for transport in the United States and return to Italy.

Remaining in its own area of journalistic activity, the periodical will give news of the developments of the initiative through suitable columns in its own pages and other possible channels of information it may choose (daily newspapers, weekly periodicals, television).

The author (s) of the project chosen, by the very fact of participation, yields to Scienza & Vita Nuova the exclusive rights of publication of texts and photos inherent to the research which is the object of the project declared as the winner.

THE EXPERIMENTS OF OTHERS

Giancarlo Masini

The Space Shuttle Columbia is now on the eve of its fourth /4 and last test mission before it can be declared operational. Its first "Commercial" mission will take place next November. Then, just as for airline aircraft, the "round trip" missions in space can be conducted on a monthly or perhaps even bimonthly basis; all will depend on the American or multi-national programs, such as, for example, the European Space Laboratory. On the whole, there will be the practical implementation of the actual industrial use of space: the new era of astronautics, the proper inauguration of the new system of space transport of the shuttle which as we may recall is both an aircraft and spacecraft. This system of transport has made at one blow the large "lost rockets (that is to be used only once) outdated, which only yesterday seemed material for science fiction and which allowed among other things, man's conquest of the Moon. At that point, the space missions will not cause more emotions than those arising nowadays at the take off and landings of jet aircraft at airports.

Instead of the wonder which greets today the deafening noise and infernal furnace of the motors of the Space Shuttle at the time of take off from the launch pad of CapeCanaveral and at the /5 time of its silent return, a glider without wings weighing 85 tons on the landing runway, there would be a more rational evaluation of the scientific results and the technological and industrial applications which may be derived from human activity in outer space.

A precious "Scientific Load"

For the rest we were able to verify already something of this kind during the third test mission of the Columbia. Most of the

attention of the NASA personnel, the journalists and of the entire scientific world was drawn to the series of scientific experiments connected with the third flight of the Columbia. Of course, the importance of the performances of the spacecraft and the two courageous astronauts Jack Lousma and Gordon Fullerton during their one week mission (which was then extended by another day because of the poor meteorological conditions on the landing field of the desert of New Mexico) was not disregarded, but the real novelty was represented by their scientific work.

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But let us proceed in an orderly manner starting from the studies of the Earth's ionosphere and solar physics. The Columbia carried into space instruments which allowed the measurement of interaction in orbit (the shuttle itself) and the Earth's iono-

sphere, that well-known region of space surrounding our planet in which the particles of the upper atmosphere are ionized (that is, become atoms deprived totally or partly of their electronic envelope). Among other things, the phenomenon of the reflection of electromagnetic waves of certain frequencies depends on it.

The experiment was conducted in the following manner. A special equipment housed in the hold of the Columbia emitted beams of electrons, while a measurement equipment supported at a distance of about 10 meters outside the shuttle by means of the now famous "satellite-catching" robot arm with which Columbia is equipped (and which operated in a regular manner) measured the propagation in outer space of these electron beams with regard to the lines of force of the Earth's magnetic field and the subsequent ionization caused by the movement of Columbia itself in the passage through the ionosphere.

As regards solar physics, the experiment was a passive one, simply the observation of the emission of ultraviolet radiation and polarization of the X-rays emitted by the heavenly body. As we know, the zones of solar flares emit, among other things, powerful beams of high energy electrons. We wished to know whether and to what extent the X-rays are polarized by such electron beams. Both these investigations are of enormous interest both of the speculative type, as regards knowledge about the stellar mechanisms, and of a practical value as regards the better use of solar energy.

Another very important experiment for astrophysics was aimed at the measurement of the cosmic dusts circulating in the interplanetary space. Moreover, we wished to know the degree of interference in the observations of the light of the stars as well as their interaction with the particles emitted by the shuttle itself. On a special aluminum plate they also collected specimens of these interplanetary dusts.

The astronaut Jack Lousma "swims" in the hold of the Columbia in the absence of gravity to move some containers of experiments. The photo was taken by G. Fullerton. /6

Inside of the hold of the Shuttle taken during the second mission: in the background you see the experimental complex set up by the Office of Ground and Space Applications of NASA.

And now we come to the science of life. In a suitable container with soil, various types of plantlets were placed to establish the effect of the absence of gravity on the formation and growth of lignite. As we know, this is the compound which constitutes one of the support structures for tree trunks. The estimates were obtained by comparing the speciments sent into outer space with identical specimens allowed to grow on our planet in pots with soil identical to those carried in the Columbia.

Life Without Gravity

Then experiments on electrophoresis were carried out. This word means literally the transport of particles by means of electricity. It is used among other things to determine the separation of different types of cells present in the human tissues. In the case of Columbia 3, they were kidney cells and red corpuscles of the human blood. In the laboratories on Earth, the phenomenon of electrophoresis is disturbed by the inevitable factor of gravity. In outer space, this interference is eliminated, and therefore the electrical forces involved can exert their effect fully. The investigations carried out with Columbia 3 will be useful to allow us to understand better the immunity processes of our organism as well as the morbous processes. Moreover, there was another experiment of great interest to the pharmaceutical industry: the formation of microspheres of polystyrene. These are extremely small balls, all equal (their radius is in fractions of hundredths of millimeters), which they are not able to produce on Earth and which tomorrow may be used to carry directly radioactive drugs in diseased cells to destroy them without doing any damage to healthy ones. These are the foreshadowing signs of the implementation of the dream of an industrial technology to be implemented in outer space.

Then we have the study of the behavior of insects, including bees and centipedes under space conditions. This experiment was actually conceived by a student who immediately became famous. This is Todd Nelson, a resident of a remote district in Minnesota, Rose Creek. He designed a miniature laboratory: a plastic box marked into quadrants in which the insects were able to live and move freely while special moving picture cameras photographed every movement from moment to moment. The coupling of queen bees and drones took place in space also. Nevertheless it seems that in re-entry to Earth, the bees were found dead, while the centipedes were unhurt.

For the purpose of building beehives in space, the observations carried out should give positive answers, but the problem will be studied more deeply. It will be accomplished in the next missions of the shuttle. Meanwhile the two astronauts assigned to the Columbia 4 mission are already ready to leave. They are Thomas Mattingly, a veteran who flew around the Moon in 1972 with Apollo 16 and a freshman in space, Henry Hartsfield. There will also be a first payload for the Defense Department which as we know is paying for one third of the expenses of the Shuttle, acquiring this right until the first military shuttles are put into action. This last fact will depend on the attitude and the moves of the Russians. As regards the NASA Space Shuttle, now and later the space reserved for scientific experiments will increase constantly.