Design for Space

The question of what happens in the heavens **has intrigued humanity since the earliest days**. It runs through history, making no distinction between civilisations, until taking a much more concrete form in the latter half of the 20th century. The significant efforts made by governments during **the Second World War massively mobilised scientists, industrialists and the military** to complete projects involving rocket-powered weapons systems, thus giving rise to major scientific progress towards the conquest of space, a subject that would fascinate humankind from then on.

Today, the advent of space tourism, the prospect of a mission to Mars and the boom in civil orbital aviation all invite us to radically **re-think the spaces and objects that enable us to live in space**. Like the maritime, automobile and aeronautical industries in their day, we will soon be witnessing a concomitant change in the space industry. A transition towards a **civilian Space Age**.

> ***« Designers have to come forward and to ask themselves questions about the potential of this huge field of opportunity, about a new way of looking at space, its needs and its unprecedented challenges, knowing that they are in possession of a considerable part of the answer. Indeed, the lack of privacy, conviviality, the isolation, the separation from Earth or the comfort on board are new decisive challenges that arise from cultural considerations, and not from scientific ones. To enter those still-undiscovered domains, to question our knowledge, our certainties, our habits – all this is an inseparable part of the designer's profession. »***

Since his first year of studies at ENSCI - Les Ateliers (The National School of Industrial Creation), Octave de Gaulle has been highlighting these new challenges as part of his Distiller One project. He is **one of the first designers of his generation** to explore this domain, which is still largely ignored by his fellow professionals.

Inviting Octave de Gaulle to exhibit this research, the Bordeaux Musée des Arts décoratifs et du Design introduces this experimental project to the public. This work was carried out during his graduation at ENSCI - Les Ateliers, and has, to this day, remained confidential.

On a marché sur la tête

The dissertation of Octave de Gaulle - **the starting point of all his work** - is not a pretensious publication about Space, although he writes about subjects like the most important steps of the construction of the Space history of the ancient Grece, the Alien myth or the Copernican Revolution. It is not a scientific essay neither, and don't count on finding there beautiful photographies of ... or Saturne rings. « On a marché sur la tête » is a **sincere and frank transciption** of an almost philisophical and antropological reflection about the relationship between the human and this sky so far away that fascinates him so much.

Fascination is also the reason why Octave de Gaulle chose to write about this subject, he also felt a necessity to confront himself to the untreated and non-exaustive history of the Space Age to provide some **objectivity** to his first sensitive approach.

> ***« I threw myself in this dissertation, in this quest, like a spationaute travelling for the first time in orbit : ready, but in the same time full of questions, enthousiast and worried about what will happen. My dissertation was an expedition, realized with limited means, to the unknown of the Space where science and fiction, phisical theories and fantasy stories, engineers and aliens are in contact! The aim wasn't to separate the real from the unreal, dreams from the reality, but quite the opposite. All those ways of apprehension of Space supplied my reflection and allowed me to question the relationship between the human and the celestial sky since the dawn of the civilisation. »***

All the **mythologies explaining the origine of the Universe** and all the scientific advances allowing to unveil first mysteries, have also the other side of the coin : the influence conflicts, the accidents, the failures, the re-assassements, etc. Octave de Gaulle took all the angles of the history to build **his own adventure** without taboos, and reveales thatwe are probably looking for our own reflection in the sky.

The dissertation of Octave de Gaulle was directed by Marine Royer and published at l'ENSCI - Les Ateliers (15 copies). It was recieved with a summa cum laude degree and reprinted on the occasion of the exhibition *civilizing Space*.

ESSOR is a **research program focusing on spacecraft interiors** and habitability. The study is exclusively conducted using **full-scale models** that allow both the **conception and representation** of the habitat of a space environment.

Disregarding the up/down order of things, i.e. leaving out verticality, turns out to be rather difficult using only hand drafting or 3D modelling. Indeed, when it comes to space, the residents don't live on surfaces: instead, **they occupy the entire volume of a habitat**. This means that they can move in any direction and reach any surface: there's no such thing as ceilings or floors, chairs or beds or the *right* or *wrong* **orientation**. And this is where full- scale models prove to be very helpful, since a model can be flipped, hung upside down and even explored from inside.

> « ***Using a full-scale model allows me to correct, resize or adjust objects and environments I've previously drawn. As an example, if I realise a handle is hard to reach from a certain point, I have to rethink its shape or position in order to guarantee its total usefulness. Once inside the model, you understand much better what is essential and well placed, and what is not. Actually, it is from inside the model that you're the most creative. In a way,*** **ESSOR** ***is a sort of gigantic sketchbook: first, I start with simple lines, building from cheap wooden battens. Then, I adjust, draw, set distances, draw again, fine-tune... and, little by little, the final shapes begin to appear as I layer the structure and the different elements of the habitat.*** »

ESSOR 2 introduces a **table as the pivotal point of the habitat**. More than just simple objects to lay things on, tables intend to structure the social life here on Earth. That is, tables can almost be considered as architectural elements: we dine, face each other, discuss, work on it. Men and women organise their entire lives around tables. Thus, when traditional bearings such as floors or walls disappear, **social markers** like tables become essential **to organise and orientate a space**.

ESSOR 2 is the second full-scale habitat realised by Octave de Gaulle. It follows his previous work *ESSOR*, carried out at ENSCI - les Ateliers, as a part of his graduation project. *ESSOR 2* was conceived and produced in 2015, as part of his artistic residency at CNES - Observatoire de l'Espace.

During the 70 years since the beginning of the space age, we have made space travel almost commonplace, we have succeeded in putting research laboratories in orbit and even in walking on the Moon. Yet all these devices created to take humans in Space are merely survival capsules. **Austere and functional**, they are designed to cater only to our **physiological needs**.

Since 2013, Octave de Gaulle has dedicated himself to the design and study of objects and environments that accompany humans in space. He measures the gap between how we imagine life in space to be and the crude reality of the existing installations. To this end, he has decided to create **his own 'space program'** that aspires to find the ideal forms that would allow us to really live in space, and not just to survive there. This program, named *Distiller One*, is the main project of his graduation.

> ***« The ambition of* Distiller *was to conceive forms that will allow human culture to express itself in space. At the moment, the stations in orbit and the objects at our disposal there were mostly conceived by military engineers. They make it possible for human beings to survive biologically, but they were not designed to offer comfort, or, indeed, any art-de-vivre. Yet, a human being is more than a sum of their biological functions! That's why the aim was to understand what makes rituals and experiences pleasant, enjoyable or convivial on Earth and to find the right forms to recreate it in space. The conditions of weightlessness radically change our relationship to objects! The direction, the weight of things or their capacity to stay where we put them disappear completely. However, weightlessness doesn't change our social nature, our need for conviviality or our sensitivity to beauty. »***

These questions gave birth to the desire to create a real, all-encompassing research program. This program contains not only documentation, but also drawings, prototypes, scientific evaluations and test procedures. Distiller One was a project to design and create a wine bottle and glass that can be used in zero gravity. It offers the possibility, through these two objects, of **rediscovering in space the pleasure and the conviviality** that charactarise the sharing of a glass of wine.

Alcohol has always been present in space stations, as a lot of documents in the archives show. Nevertheless, a plastic bag and a straw will never allow the true enjoyment of the gustatory or social qualities of wine which, together with gastronomy, are the symbols of French conviviality.

The myth of Capt. Haddock

The process of creation is the result of a variety of things: what's already out there, documentation and research, experiences, encounters… But there is always **a triggering factor** that is the result of the subjectivity of the person doing the creating: an element – insignificant for everybody else – but which has deep and particular meaning for them.

At the moment, the objects available to astronauts on board spacecraft are the same that we use on Earth, and that **we awkwardly try to adapt to the conditions in space**. So, we add a length of string, a hook-and-eye fastener, a strip of adhesive tape or a strap, in order to fight against weightlessness. This kind of approach assumes that we have to **counter its effects**.

> ***« We have to take the opposite approach and abandon the idea of adapting objects used on Earth to the conditions of life in space – that's a negative approach. We should think instead about how to transpose them, that is, how to create objects that fulfil the same functions but in the specific conditions of weightlessness. The absence of gravity represents as many constraints as it does formal opportunities and techniques, we just have to choose to make use of them! This realisation occurred to me as I was looking at a drawing in the comic book Tintin: Explorers on the Moon where you can see captain Haddock chasing after a bubble of whisky. This situation is funny, but also poetic and beautiful: this bubble that floats, rebounds, takes off… This is something we cannot recreate on Earth, but yet fascinates us. So why fight this beauty when we have the possibility of benefitting from it? »***

This is the course of action that Octave de Gaulle has taken: to create objects that **embrace the possibilities of life in Space**, the aim being to transpose our gestures and experiences on Earth. The forms he creates do not resemble anything we know, but they allow us to **regain the comfort of using**, ergonomics and an intuitive relationship to an object. This is why he designed his wine bottle and 'glass' around this particular state of a freely floating liquid.

HERGÉ, «On a marché sur la Lune», *Les Aventures de Tintin*, ed. Casterman, Paris 1954, page 5.

Raymond Loewy

The long and brilliant career of Raymond Loewy, the French-born American industrial designer, mirrored the history of the 20th century and its technical progress. Before being **appointed designer for NASA's Skylab space station** (1967-1973), Raymond Loewy gave form to anything that could roll, float or fly: transatlantic liners, streamline locomotives for the Pennsylvania Railroad, as well as Studebaker automobiles and the Concorde and Air Force One. We also owe him the design of certain domestic objects that became a symbol of the American way of life.

Thanks to his rich experience in the design of both means of transport and of everyday objects, Raymond Loewy was **the first designer in history to cooperate on the design of the interior of a space vehicle** and to introduce the idea of comfort, which had been all-but ignored up until then.

> ***« Between 1967 and 1973, Loewy's agency produced over 3000 drawings for NASA. They paid particular attention to the issues of hygiene, food, health and well-being in zero gravity. For example, he carefully considered the organisation of the very confined and constraining interiors of a space vehicle, so that you could have privacy in certain places, but also engage in social activities in others. He was also the first to suggest the idea of an on-board shower and to imagine a triangular table, so that no member of the crew would have the impression of dominating the others. His work has inspired me lot. »***

Raymond Loewy's take on these spaces and objects are not strictly functional, because he pays a lot of attention to the **symbolic character of the elements** his is working on. He highlights the **necessity of creating a dedicated design language for space**, and of not just being satisfied with a simple adaptation of what exists on Earth.

Raymond Loewy, *Saturn Five Space Station Habitability Study*, 1968, Collection Serge Aboukrat
Raymond Loewy, *Sur la Lune*, diptyque sans date, Collection Serge Aboukrat

Aquarium

How do you pass over **from myth to reality**? From the fantastical image of the bubbles of liquid that we imagine spinning around in Space, to a technical and functional solution? It is the designer's challenge: to find a form, a material, a gesture that matches the best with **this new expression of a basic need**.

That is where, intuitively, **the drawing phase gives birth to forms** that are able to interact with the new form of the liquid: rounded, spiral, planar objects with varying size. But **testing quickly become necessary** to find out how the drawing and the form influence the element. They are as essential during the conception phase of the project as for the validation of the final object.

> ***« The experiments in the aquarium were done in the very beginning of the project. At first, they were for understanding the spherical state of the liquid, rather than as an obligatory approval of every step of the project. From first assumptions to the final version, this test gave me a lot of information about what works and what doesn't work at all. The principle of this test is rather simple: I fill up a glass with oil, then I immerse it in a precisely measured mixture of water and alcohol. Oil is less dense than water, but more dense than alcohol. When my mixture of water and alcohol has the right density, the oil becomes a floating sphere, just like in space. Of course, simulation has its limits: the oil has its own weight, it doesn't have the viscosity of wine and moves a lot less easily in a liquid than in air, but it allows me to visualise how the liquid interacts with a form. »***

One of the first tests allowed the designer to not only demonstrate the **uselessness of the glass receptacle** as we know it, but also to comprehend the technical challenges of managing liquids in weightlessness. With help of his own drawings and of the demonstration videos made by astronaut Don Pettit, Octave de Gaulle carried out **numerous tests on different forms** and improved the designs of his glass, which would also be tested in the aquarium.

American astronaut Don Pettit stayed on board the International Space Station for six months, between 2002 and 2003, as a member of *Expedition ISS 6*. During his free time, he carried out a series of experiments on the behavior of liquids in microgravity. His video programme *Science off the Sphere* is still available online.

Reichelt

Setting off on the adventure that is space is no small undertaking. However, Octave de Gaulle's project shows us that space is accessible and, with a little ingenuity and a basic understanding of the laws of physics, this undertaking can be backed up by **the relevant scientific experiments**.

An example of the latter is the conception and design of a **free-fall device** that the designer christened *Reichelt*. Shaped like an artillery shell, this device was designed to be dropped from a certain height, thereby subjecting the objects that it contained to reduced gravity. On earth, weightlessness can only be achieved by using such a procedure, or during zero-gravity flights, where the aircraft's trajectory simulates free-fall. For several seconds, **an on-board camera filmed the behaviour of liquids** under reduced gravity, simulating the conditions in space.

> ***« Two versions of* Reichelt *were created, but the principle stayed the same: a housing equipped with a lighting system and a camera that filmed the prototype containers and the reactions of the liquids within them during free fall.* Reichelt 1, *which resembled a rocket, was first launched from the cliffs at Étretat. It was amazing, but the drop wasn't long enough. We then dropped it from the ninth floor of my apartment building in Paris, but a slight error of trajectory meant that it didn't survive the landing. At the time, I really had the impression that I was part of a real space adventure: my fist crash! Reichelt 2 was less pretty, but allowed us to capture some really good images that confirmed my hypothesis about the pinching of the toroidal bottle. »***

Just like the aquarium experiment, *Reichelt* saw the designer **through various stages of reflection** and consideration: first, it allowed the testing of various types of folds, just by putting simple tubes inside, then, later, the confirmation of the correct shape for the bottle that would give an **optimal interaction with the liquid**. Simple, efficient and a little crazy, *Reichelt* became the symbol for the *Distiller One* adventure.

Reichelt 1 and two are presented on the table *Clavex 680* produced by Maximum. These free-fall tests were named after Franz Reichelt, the 'flying madman'. In 1912, convinced that he had created a parachute suit that would prevent him from plummeting to his death, the French tailor jumped from the Eiffel tower wearing something resembling a large leather overcoat. The whole incident was filmed.

The corner effect

In the absence of gravity, it is not only the weight of objects that is affected. Weightlessness also reveals **forces that are largely hidden on Earth** by the force of gravity. Amongst these forces, surface tension – that is, when two surfaces meet, be they liquid, solid or gas – can produce some surprising phenomena. **Liquids, for example, have the tendency to form themselves into spheres**, reducing their area of surface contact with the air to a minimum. And, when in contact with certain shapes or materials, these same liquids can either spread out thinly over a surface or be repelled by them. The force of adhesion, the determining factor in this interaction, depends on the solid, liquid or gas involved. So, in space, it is essential **to take into account the parameters** that govern the behaviour of fluids in zero gravity, even though they are practically immeasurable on Earth.

> ***« Capillarity exists both on Earth and in space, and its strength doesn't vary between the two environments. It's a consequence of surface tension, and you can easily see it by plunging a small glass tube into some water: the level of the water rises slightly in the tube, since it prefers contact with the glass than with the air. It's the same phenomenon that makes the surface of wine rise up slightly where it comes into contact with the sides of a glass. It's only Earth's gravity that stops the water from climbing all the way up the tube, or the wine from creeping up the sides of the glass. In zero gravity, on the other hand, nothing holds this force back, so you have to work with it. A very interesting behaviour results from this physical phenomenon: the Corner Effect. The edges or folds that are impressed on the container increase its contact surface, permitting the retention of liquid, and even giving us the ability to control it! »***

The bottle that Octave de Gaulle has designed takes advantage of the Corner Effect, which is also used in the fuel reservoirs of satellites. the progressive narrowing of the bottle's wall, achieved using a steel mould, means that the wine always moves toward the bottle's opening and never collects anywhere else in the volume. So that it only presents this single edge, the bottle is toroidal (ring shaped). The bottle can, therefore, be stored and refilled lying flat on Earth, while in zero gravity, the ring shape makes it easy to grab on to and to manipulate. It can even be carried around an arm or shoulder or hung up using a strap.

Denis Louis Baralle's patent *EP0434554B1* for a shell capillary-effect reservoir inspired the first drafts for the design of the bottle for the project Distiller One, carried out at ENSCI - Les Ateliers in 2013.

Message in a bottle

It was after some **conversations with a submariner** that Octave de Gaulle realised the role of alcohol consumption in situations of confinement. A high-ranking Navy official confided in him **the importance of this matter** when men have to stay in confined spaces for several months, far from dry land.

Alcohol can be a **remarkable vector of conviviality**, but it can also turn out to be **a considerable problem**. It is the way that you consume it that will determine if it is a happy, social moment or, on the contrary, a sad and solitary one. If we take wine as an example, on Earth, there is a series of objects, gestures and rites that make its consumption **a sophisticated experience, a moment of sharing** and not simply a basic, mechanical activity of ingesting alcohol. But what about in space?

> ***« The question is: do we want to drink the wine straight from the neck of the bottle, everybody with their own plastic bottle and straw, or do we want to recreate this conviviality? The bottle is not simply packaging, its shape determines the gestures associated with the rite of serving it, the preservation of the wine's aroma – the whole tasting experience. It offers the possibility of sharing something: we open it, we serve, we close it, we serve again... It's the very opposite of an individual sachet: it carries with it a social dimension, while an individual sachet passes on the idea of rationing, or even a dose of medicine. »***

And let's not forget that a bottle – especially a wine bottle – has an aesthetic requirement and **responds to certain codes**. So the label, inseparable from the bottle, shows the vineyard, the vintage and gives you information about what you are about to drink, as well as about the wine's production methods. **Preservation of these identification** codes gives us the ability to break with the forms that we already know, all the while preserving **the spirit of the object**.

Octave de Gaulle's bottle is made of polycarbonate and silicone, materials known for their biocompatibility and used in baby's bottles. It was made in 2013 at ENSCI - Les Ateliers. It is presented here in between blown-glass bottles from the 18th century, made at Manufacture de Servanches, and glasses from several manufacturers dating from the 19th century. All these artefacts come from the collections of the Bordeaux Musée des Arts Décoratifs et du Design. The space water sachet (USA, 2009) is kindly loaned by the Observatoire de l'Espace, CNES.

Ceci n'est pas un verre

When we use **the word 'glass'**, we instinctively think of a certain type of container, one used for **containing liquid and transporting it to our mouths**. But, in zero gravity, liquids naturally form spheres and do not flow. The containers that we are used to using are ill-suited to this environment. At the moment, astronauts drink from **small sachets, sucking the liquid up through a straw**. This is a good enough solution for drinking water, for example, but it is diametrically opposed to the **terrestrial rituals and moments of conviviality** associated with the taste and appreciation of wine, which is what Octave de Gaulle wants to take into space.

> ***« These days, drinking on board space stations doesn't really represent any particular challenge. However, drinking alcohol from the current plastic pouches ruins everything that's good about drinking wine. To see this, you only have to look at present-day wine glasses, which are the product of centuries of refinement: they enhance the wine, and the balloon-shaped bowl, which has become larger and more open over time, is a testament to the importance of the sense of smell in appreciating wine. Today, we drink out of glasses that direct this bouquet directly to our noses... So it was necessary to find a form that, in contrast to the straw, preserves this olfactory aspect of wine consumption. On top of that, even if, on Earth, we confine our liquids to containers so that they don't spill everywhere, nothing really obliges us to do the same thing in Space. »***

This utensil, this 'glass', allows you **to capture, using a steel loop, a sphere of wine** that has just escaped from the bottle. The loop is enamelled, in order to remain taste-neutral and to simulate contact with glass. On one side of the loop , a stem allows the user to grab hold of the glass, and to move it, **raise it to the mouth**, inspect it or just let the wine breathe. On the other side are two thin, overlapping blades, where you can rest your lips (the blades are not sharp). The look and feel of this 'spout' recalls that of a woodwind instrument, **a familiar and comfortable form**. This spout has, furthermore, the property of channeling the liquid contained in the loop towards the mouth, allowing the consumption of every last drop.

The space "glass" is made from enamelled steel, polythene and tropical wood. A single example was forged at ENSCI - Les Ateliers, in 2013. It is part of the *Distiller One* project, Octave de Gaulle's final degree dissertation.

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Le dessin au verso a été réalisé pour le film *Le Voyage Cosmique* (Vassili Zhuravlev, 1935-1936) par Konstantin Tsiolkovski, le père et grand théoricien de l'astronautique russe. Le film, présenté dans l'exposition, ainsi que les dessins ont été gracieusement prêtés au musée des Arts décoratifs et du Design de Bordeaux par M. Claude Mettavant, amateur-passionné.

Illustrations of people in movement by Alberto Giacometti, 1948