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Robert Le Ricolais (1894–1977) “Father of Spatial Structures”

René Motro

1. LE RICOLAIS: “ZERO WEIGHT, INFINITE SPAN”

Considered as “the father of Spatial Structures”, Robert Le Ricolais (Fig. 1), a native of La Roche sur Yon received the Architectural Study Circle prize in 1962, presented by André Malraux. This late recognition came almost ten years after his departure for Philadelphia, where his versatile mind had worked such wonders. Engineer, mathematician and poet, Robert Le Ricolais sowed the seeds of a harvest that others are still reaping today. Yet he used to say that “to some extent, his main preoccupation was making holes”. One more pirouette for this man of paradoxes.

Engineer, mathematician, poet, so many epithets that apply to a man whose research went against the discursive or linear trend so typical of the land of Descartes. Robert Le Ricolais is one of those men you can’t classify, who don’t fit into a convenient category, whether, as in his case, that of architect, engineer or artist, poet or painter. He didn’t exert any one of these functions, per se, but had all the qualities needed to exercise each of them—and he did exercise them all.

He studied mathematics and physics, and then turned to the study of hydraulics; indeed, how can you not have a special interest in fluids, when you first saw the light of day in La Roche sur Yon? Because that is where he was born, in 1894 a few cables’ length from the ocean.

2. A MAN IN SEARCH OF HIMSELF AND THE WORLD AROUND HIM

He began his career as a Hydraulics Engineer at the firm of Air Liquide. It was during this first phase in the quarter century from 1918 to 1943, that he wrote an article in 1935 on composite sheets (“Composite sheets and their application to lightweight metallic structures”) which earned him the medal from the French Civil Engineering Society. It was actually a study of what is commonly known as “corrugated

iron”, but already Le Ricolais allowed himself the scope in this study, to turn this undulation, this rigidity acquired by the shape, into a light structure. To do so, he made clever use of the crossing undulations of two layers: observe, understand, invent, experiment, these are some of the keys to the approach of this tireless researcher. He related their connectivity to a truss connectivity (Fig. 2). His firm was thus able to take advantage of the invention, referred to as “isoflex tubes” (Fig. 3). It consists of superimposing components that are bent according to the orthogonal directions, creating high rigidity while considerably reducing vibratory problems. “It’s the search for the decomposition of fundamental vibrations in their harmonics” he wrote. This man of paradoxes designed a material object by working on immaterial sound, and did so with success. He stressed the primacy of experimentation in studying chord vibration, for which, as a mathematician, he considered the process of integrating differential equations to be longer and less certain than listening to them vibrate. This period was also marked by the publication in 1946 of an article dealing with spatial partitions, a historical article in the world of metallic structures, a founding article if ever there was one. It was the outcome of research undertaken in 1940 (“Research on three dimensional Network Systems”) (Fig. 4). Robert Le Ricolais had drawn on his meticulous and continual observation of nature, particularly of radiolaria: “Radiolaria, the phenomenal vocabulary of shapes, belongs to this ancient era of creation, when highly geometrical structures prevailed. The reason for such economy of matter is no doubt one of the mysteries of Nature. Their strange and delicate structures are like scaffolding networks. The architecture of radiolaria suggests problems of major interest. They are triangular three-dimensional structures that respect the hexagonal grid framework and herald geodesics”.



Figure 1. Robert Le Ricolais.

3. ENGINEER, BUT ALSO ARCHITECT, ARTIST AND POET

The second half of the twentieth century saw the birth of what are referred to as spatial structures, made up of metallic elements, covering very wide spans with no need for intermediary points of support. These structures respond to numerous architectural programs ranging from large entertainments sites to the field of aviation. All the important designers of these structures have paid homage to Robert Le Ricolais for the interest of his work and the benefits they have derived for their own work. And so it was this man, who wasn't an architect, like his American alter ego Richard Buckminster Fuller, a designer among other things of magnificent domes, who received the 1962 prize from the French Architectural Studies Circle. On this occasion André Malraux addressed him, stating that the French State needed his

audacity and vision. The newspaper, *Le Monde* even referred to him as “the father of spatial structures”.

But this again confirmed the notion that no man is a prophet in his own country, since Le Ricolais had meanwhile moved on to Philadelphia. But we'll come back to that. Parallel to this activity, he devoted himself to poetry and painting. As from 1928 he studied art at the Grande Chaumière Academy in Paris. Some of his oil paintings are in the constructivist vein which also had a very marked effect on “structures”. Exhibitions of Le Ricolais' work have been held in France. Some of it has enriched private collections. His work features in the collection of the Fine Arts Museum in Nantes.

Doubting his manual dexterity, he sometimes resorted to using a spray. He used this technique as he was unsure of his hand in making the transitions from white to black, but he was far when it came to his eye judgment. This was what he called the notion of compensation, which meant that at a certain point, we end up loving what we lack. He went on to add that “everyone has their own references... you cannot only appropriate and fully own what you have discovered by yourself. You have to look at things, and experiment with them so that your eyes assist your thinking... there are phases of reflection where, what you discover on the way is often more interesting than what you set out to do initially...”. These words contain the basis of Le Ricolais' experimental approach and the lessons he drew from it—he who made experimentation one of the pillars of his research work.

Engineer, artist, but also builder and, as such, he carried out several projects between 1948 and 1958: a school, a summer camp, an aviation hangar, a covered market, a factory, two exhibition halls, a weather station, an experimental house and a church (Fig. 5). Some of the models have been conserved at the Pompidou Center, others by private individuals, like Monsieur Thomas, who organized an exhibition in Nantes in 1968 entitled “Space, movement, structures” which followed the one held in 1965 at the Palais de la Découverte. Moreover it was on this occasion that our subject presented his concepts in a lecture on “the mechanics of shape” that stands out in history.

3.1 Philadelphia

Meanwhile, in 1951 at the age of 57 he left France to continue his research in the United States: first of all in the universities of Illinois at Urbana, North Carolina, Harvard, in Pennsylvania and in Michigan. He settled in Philadelphia in 1954. In 1974 he took the Paul Philippe Cret chair in architecture at Pennsylvania University.

Member of the American Institute of Architects in 1973, he was awarded the medal for Research by this

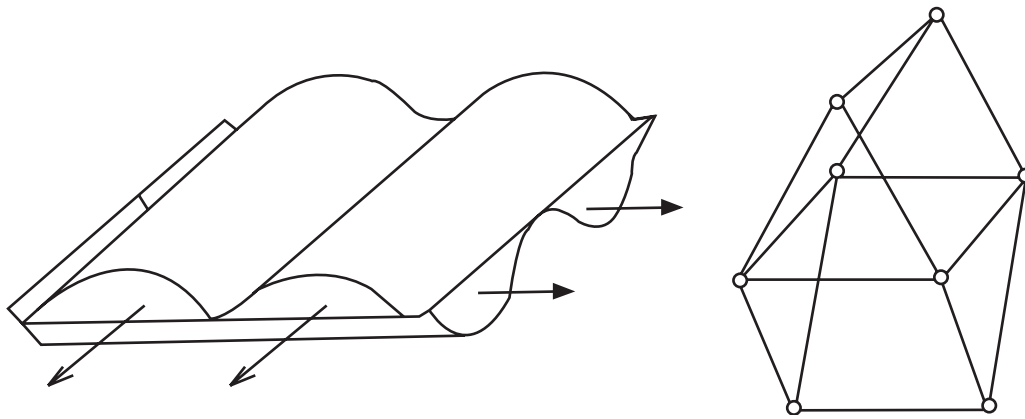


Figure 2. Identical connectivity of crossing tubes and associated truss.

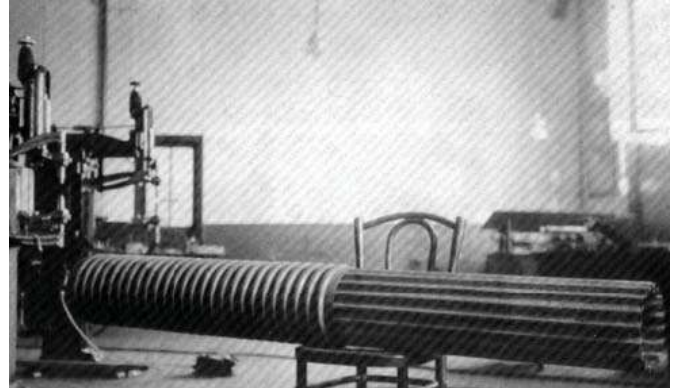


Figure 3. Isoflex tubes.

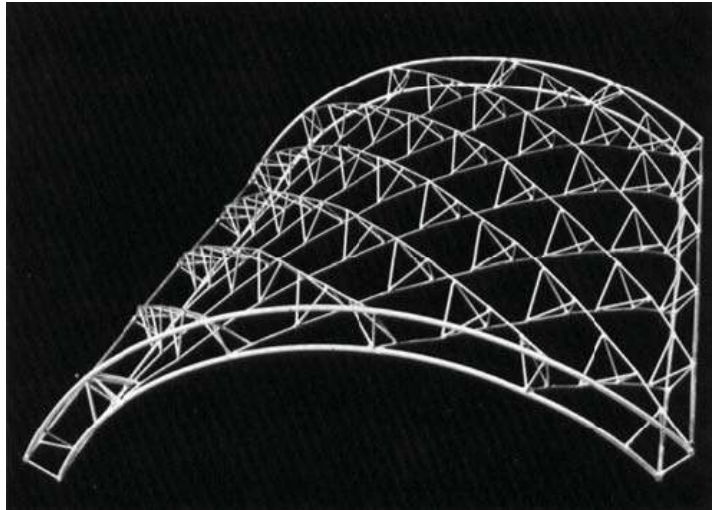
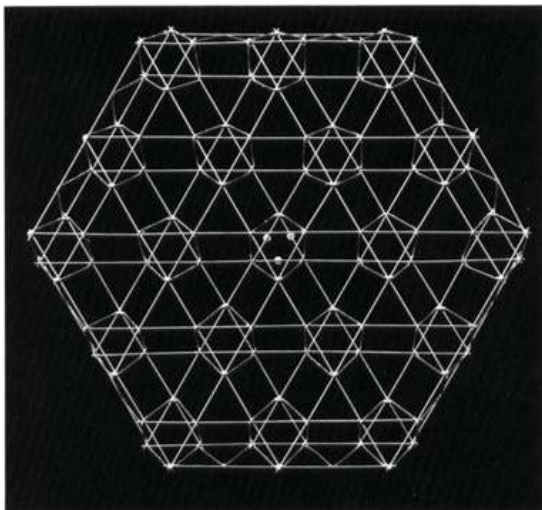


Figure 4. Network Systems.

same association. For almost twenty years he devoted his time to teaching and research. He supervised the making of over two hundred models during this period. It has not been possible to ship these to France, to date. Several of the models have been reproduced at the Nantes School of Architecture, under the supervision of P. Dudon and A. Chassagnoux. The “Le Ricolais” chair which was donated to the Montpellier School of Architecture on the occasion of the 1992 exhibition in

his honor, is not to my knowledge one of his own models, but a homage representing some of his works.

It is impossible to summarize Le Ricolais’ research, moreover this is not the aim of the present article, but it is important to emphasize his progression, and the voyage of this inquisitive mind. Because he, who incited engineers to produce lightness with heavy materials, in yet another paradox, was able to sail a “stone vessel”, as evoked by Sylvain Chiffolleau at the



Figure 5. Le Ricolais “on site”.

1968 Nantes exhibition. “A word or two about Nantes: You left your town, in fact, after the last war had piled up its destructions ... but you love it and you want Nantes, true to its coat of arms, to be this stone vessel, traveling through the seasons with the wind in its sails.” One thing’s for sure, Le Ricolais knew how to be the skipper, and the adventurer.

3.2 Researcher: An Adventure

The wealth of his ideas and work no doubt owes a lot to his multiple modes of thinking: analogical, logical and experimental. His taste for observation may have come from his mother, a natural history teacher, while his taste for the paradoxical may well have come from his father, who was a lawyer.

Curious about life that cannot be grasped by reason alone, he let himself be guided by a number of seminal ideas in his research on “the Mechanics of Form”. Relying on the concept of “duality”, duality between compression and traction, matter and holes, between forms and stresses, he sought out the paradox and whenever he found it, it related to life:

“... however strange it appears, despite the diversity of our pursuits and the variety of objects, our main preoccupation was, in a way, making holes ...”.

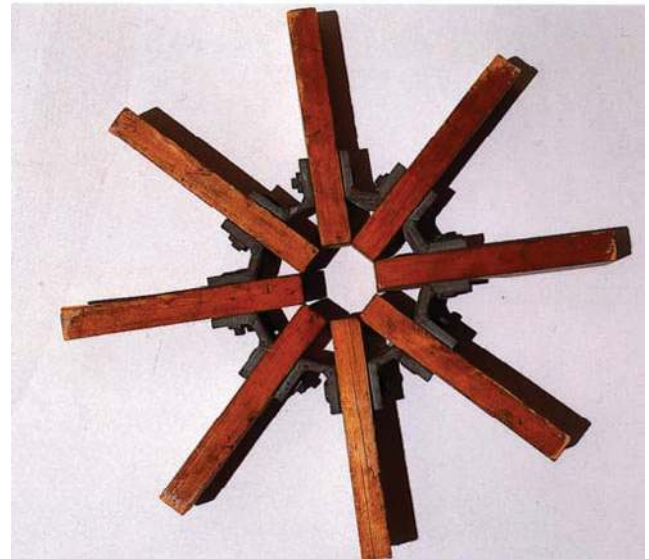


Figure 6. Wooden node.

“...from a principle which may seem paradoxical at first glance, but which is dear to me, i.e. that of contradiction, whereby the contrary of any evoked principle is also acceptable; ... thus after studying compressed systems, it became fascinating to explore tensile systems, according to the principle that by turning a holey jacket inside out, the holes remain, the conservation of these holes being the essential question”.

“... the constant in our universe is change. Our only hope of understanding it: to study what remains invariable in the course of this change”.

“...habit has desensitized us to the miracle of the phenomenon of solids and the paradox between molecular chaos and the stability of a body which is actually a diagram of forces in equilibrium ...”.

“... The book of nature is so big that sometimes you find the answer to a question you had not even asked yourself”.

These are a few of the items of reflection that some of us draw on in our own research. We have been able to benefit from these through publications and public lectures, as well as private exchanges until the very end of his life (Fig. 10).

3.3 Le Ricolais Institute

Robert Le Ricolais was unable to further his research in France, but many of his devotees endeavored to help him to do so, unfortunately with little success. Reference must be made here of the action of David Georges Emmerich

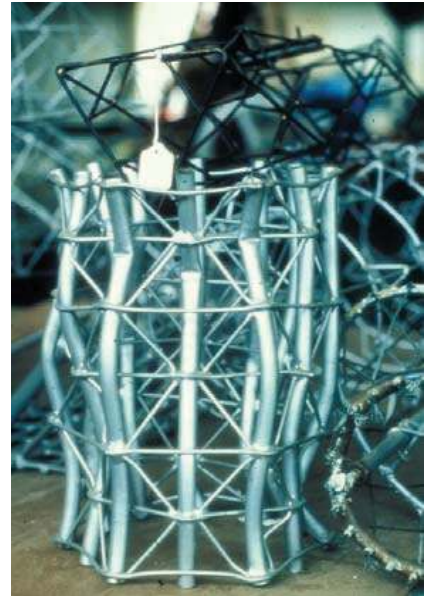
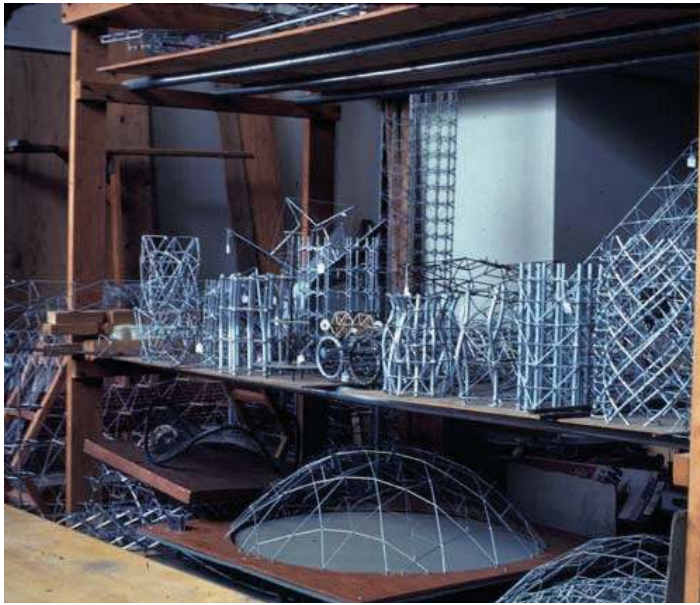


Figure 7. Models in Pennsylvania University.

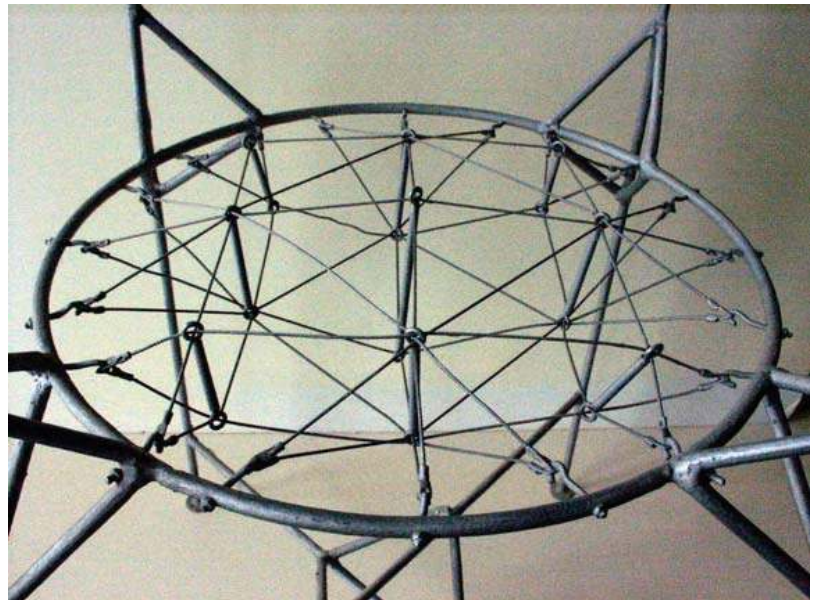


Figure 8. Le Ricolais's chair.

who tried to set up a Structural Research Workshop that could have welcomed Le Ricolais. He gives a detailed account of his efforts to do so in a polemical document he was a secret party to. Stéphane Du Château Chairman of the Institute for the Research and Application of Spatial Structures made every effort to get France to recognize the works of Le Ricolais, beyond simply awarding him medals. The last time he participated in this fervent group of followers he spoke in these terms, as related by Henri Drevon in January 1977:

“Le Ricolais, who had taken two of his students with him, reported on the missions always assigned to him in the USA. He regrets that the

doctors do not allow him to do more and that he has been unable to find an organization in France that would enable him to pursue his task. This entails, among other things, repatriating the impressive set of models made with his students Philadelphia, which would put up a very good show in the Pompidou Center”.

Further on he writes ...“The proposal to honor Le Ricolais by transforming the IRASS into a Le Ricolais Foundation is adopted unanimously and with an ovation...” This was a testimony of our friendship, expressed to him shortly before his death on June 4th.



Figure 9. Le Ricolais's notes.

3.4 His Range of Influence

Two years earlier in 1975, he had once again demonstrated his knowledge of structures. This was at the second International Conference on Spatial Structures organized in Guildford by Zygmunt Makowski, another great name in this field; on the fringes of the conference, in a backroom, in the presence of a few privileged people he once again did his “number” about “King posts and Queen posts”. He spoke to us about the many interests to be derived from separating traction and compression and gave free rein to his ideas about some very un-mechanical interpretations of the names of these two supports taken from what is known, in France, as the “Polonceau System”. This also gave him an opportunity to remind us that the quote “zero weight, infinite span” was simply a joke in response to a speaker who had asked him about the aim of his research. Because how do you in fact explain that it was simply the path itself that intrigued him, with its surprises and difficulties and the joys that led him to assert that the whole art of structures is knowing “where to put the holes”, while others pride themselves in knowing where to put the matter. How can you explain in a single formula that according to

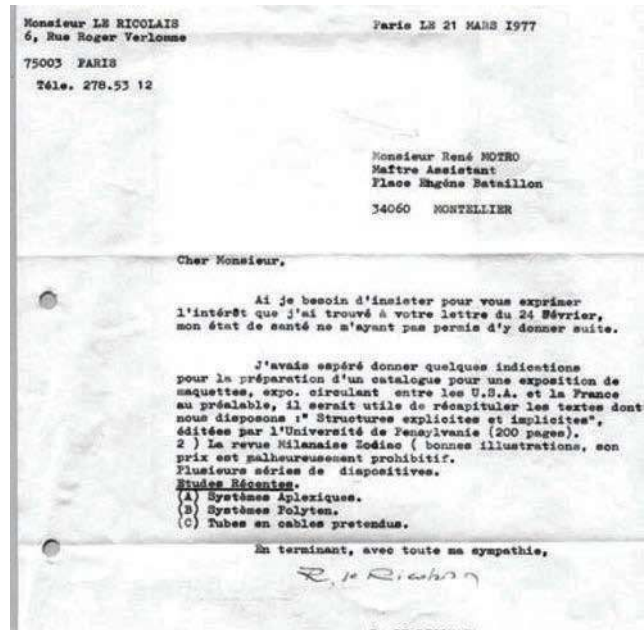


Figure 10. Private correspondence.

his terms, it is the relationships that are important and that mathematics can shed light on the invariants by using topology.

“Topology: a new method of mathematical reasoning in which the shapes and magnitudes of configurations are of no importance. In its relationship to architecture, at least for problems of circulation, topology plays a role not only in terms of economizing partitions, but for a far more important consequence, that of predicting the economy of displacements (movements), i.e. of time”. We find him once again, moving on from matter to the question of circulation, with the same notion of opposites, working on the concept of a “hollow rope”.

Engineers and architects still have a long way to go before exhausting the treasure left to them by Robert Le Ricolais, especially if they agree to become adventurers themselves.

Perhaps we should leave the last word to Pingsusson, the well-known architect, in his evocation of Robert Le Ricolais:

“We love those among us who convey an elevated idea of humanity, those who we feel burn with a passion for knowledge, utter devotion to a grand design, humble in the face of the unknown. Through them we embrace a form of the absolute, this absolute, which we may or may not be aware of, this deep need, because we all yearn for a life of dedication.”