Chapter 8
Vittorio Giorgini's Architectural Experimentations at the Dawn of Parametric Modelling

Denise Ulivieri, Marco Giorgio Bevilacqua, and Filippo Iardella

Abstract Vittorio Giorgini (1926–2010) grew in Florence, Italy, where he attended the School of Architecture. From the earliest years of his academic studies, Vittorio Giorgini showed interest in developing research on natural models with the aim of applying them to architecture. Starting from the 1960s, his studies focused on the analysis of membrane structures, tensile structures, and on the elaboration of tetrahedral and octahedral structural meshes. He experimented spatial meshes in an intuitive way, even if he understood, at the end of his career in the late 1990s, that only with the help of technology and electronic instruments it would be possible to obtain a mathematical control of meshes.

Based on an in-depth analysis of Giorgini's projects, drawings, and documents collected in his private archive, the aim of this paper is to demonstrate how pioneering Giorgini was anticipating several years of recent investigation in the field of parametric modelling and computational design.

Introduction

Vittorio Giorgini (1926–2010) was born in Florence. His father, Giovanni Battista, was a pioneer in promoting Italian high fashion around the world. Vittorio Giorgini grew up in Florence, where he attended the School of Architecture. After his graduation in 1957, he worked in Italy up to 1969; then moved to New York City, where he worked as a professor of Architecture and Planning at the Pratt Institute until 1996, when, going blind, he was forced to end his professional activity and return to Italy, where he died in 2010 with the age of 84.

D. Ulivieri (✉) · M. G. Bevilacqua
University of Pisa, Pisa, Italy
e-mail: denise.ulivieri@unipi.it; marco.giorgio.bevilacqua@unipi.it

F. Iardella
BIM and Digital Engineer, Milano, Italy

V. Viana et al. (eds.), *Polyhedra and Beyond*, Trends in Mathematics,
https://doi.org/10.1007/978-3-030-99116-6_8

From the earliest years of his academic studies, Giorgini was fascinated by the natural world, which he considered not as a mere repertory of formal solutions, but as an enormous catalogue of building techniques and functions (Fig. 8.1). Based on the direct observation of natural structures, his intellectual and design studies focused on building systems for the design of functional houses. He showed great interest in the study of curved systems, such as shells and membranes, passing on to tensile structures and organizing his ideas in the elaboration of tetrahedral and octahedral structural meshes. He worked on symmetrical and asymmetrical shell beams, and further explored the issues dealt with by topology. At the same time, Giorgini developed a series of projects that, to use his own words, belong to those conventional techniques, diagrams of straight lines and planes, relating to polygons and polyhedra [1].

Until the first half of the nineteenth century, Euclidean geometry was the only instrument used for describing nature, but the advent of non-Euclidean geometry led to what Marcos Novak defines a fundamental re-thinking of the meaning of space-time, matter and energy, information, and noise [2], which inevitably led to the study of new ways of conceiving and materializing architecture. In this context, Giorgini fully understood, along with a few others, what Thomas S. Kuhn (1962) in his own words, defines, as a *new paradigm* [3]: the transition to a new vision of the physical universe in which instability and fluctuations are at the origin of the incredible variety and richness of forms and structures that could be seen all around us [4]. He thought about a different way of understanding architecture, based on the search for integration with nature, which, however, is not achieved by the simple imitation of the forms of the organic world, but in the design of spaces suitable to the needs of everyday life and economic viability.

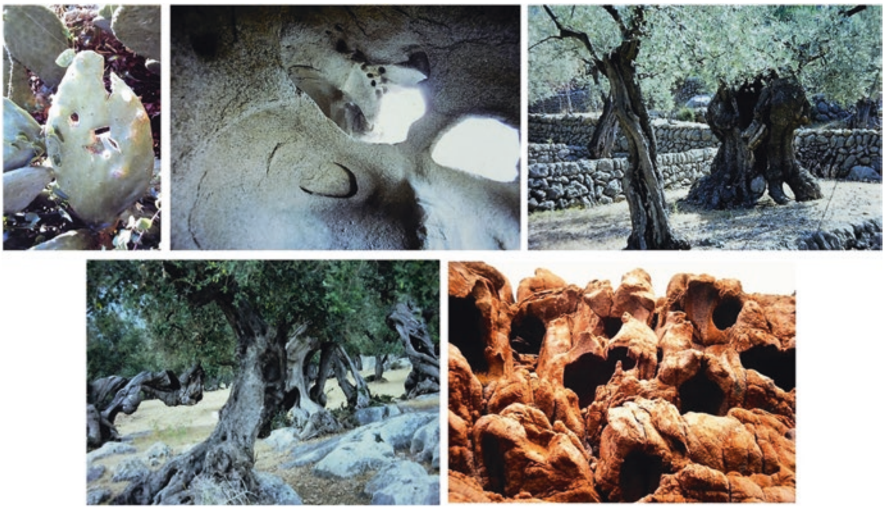

Fig. 8.1 Photos by Vittorio Giorgini of natural shapes (Courtesy B.A.Co. – *Vittorio Giorgini Archive*)

According to Giorgini, geometry is an analysis, verification, and operational tool [5, p. 193] and he considered its study as the basis of static and structure. In Giorgini's words, that we translated from the Italian, Geometry has acquired the same significance possessed by math, physics, and chemistry and has become the support of taxonomy. Like taxonomy itself, geometry can be said to have become a tool of analysis, verification, and operational methods. Geometry seems to have become a common denominator of all the above, rendering them common and interdependent [5, p. 19]. Giorgini continues, denoting that Geometry is the basic order from which models are developed, in his attempt to approach models of nature with efficient mechanisms of self-control. Giorgini's world is, therefore, *post-Euclidean,* within a complex and continuous reality where natural evolution proceeds, as he puts it, systematically with dynamic transformations, adaptations, and continuous retroactions [6, p. 6], a dynamic and interrelated reality that, from the 1950s onwards, he investigated through topological geometry.

Based on an in-depth analysis of Giorgini's projects, drawings, and documents collected in his private archive and in the outcome of a lecture we presented at the *Nexus Conference* in Pisa in 2018 [7], the aim of this paper is to demonstrate how pioneering Giorgini was and how he anticipated, in several years, recent investigations in the field of parametric modelling and computational design. In particular, our current research focuses on the case study of symmetrical geometric meshes, which, through dynamic transformation, change into asymmetric meshes, as it happens in nature.

Giorgini as a Morphologist-Spatiologist Architect

Giorgini defined *Spatiology* as the research he developed based on the study and observation of natural structures to achieve efficient and flexible building models similar to nature itself. In his approach, he used the morphological and geometric suggestions derived from natural elements to create a *free* design, meant as rich in formal spatial solutions, and economically convenient. Giorgini establishes that *t*he *scientificization* of design neither cramps nor sterilizes the art of which it is a part, quite the contrary, it enriches art greatly and widens art's horizons on the ground it claims. The success of the *scientificization* of design, however, depends on bravely accepting the increased difficulty of the challenge it poses. For this reason, Giorgini chose the word *spatiology* to describe the study of geometry as the mathematical discipline and *backbone* of statics, (systemic) taxonomy, and technology [5, p. 193].

As a morphologist-spatiologist architect, in 1962, Giorgini created the *Saldarini House* in the Gulf of Baratti (Tuscany), later known as *Casa Balena* (Whale House) or *Casa Dinosauro* (Dinosaur House), a *fanciful morphology,* in Del Francias's words [8, p. 26] where the topology of transformation and continuity is linked to the architectural concepts of flexibility, fluidity, and dynamism [9, p. 130].

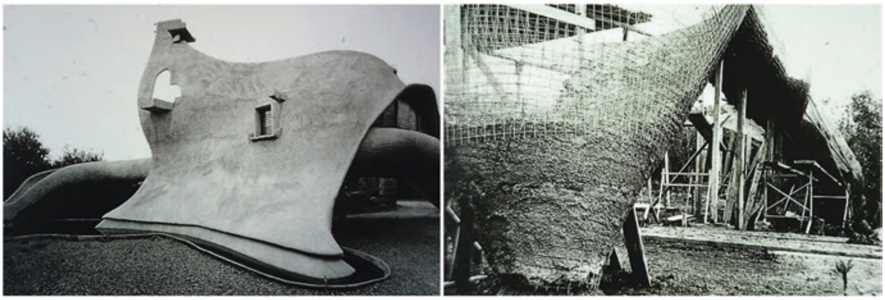

Fig. 8.2 *Casa Saldarini*, Gulf of Baratti, Livorno, 1962. On the left, view of the house; on the right, detail of a foundation plinth (Courtesy B.A.Co. – *Vittorio Giorgini Archive*)

The *Saldarini House* represents Giorgini's first real opportunity to study curved surfaces as generative elements of the space (Fig. 8.2). The project reflects Giorgini's interests in the studies of the Swiss natural scientist Hans Jenny. In those years, Jenny was involved in Cymatics: subjecting some materials, such as sand and liquids, to vibrations, which results in an infinite range of morphologies similar to natural configurations [10]. The exploration of natural geometries in the dynamics of growth and physical processes by the British biologist and mathematician D'Arcy Wentworth Thompson was also fundamental for Giorgini [11].

In the *Saldarini House*, Giorgini experimented for the first time his *isoelastic structural membrane*, that is, an asymmetrical and non-orientable *shell* beam, characterized by a double curvature, to better absorb deformations. Using common materials, such as wire meshes and concrete, he experimented with a new and personal building technology, conceiving a house characterized by topological surfaces and static efficiencies, like those of natural structures. The house lies on a continuous curvilinear foundation and on two original reinforced concrete plinths, where the 3 mm-thick galvanized electro-welded mesh with a pattern of 5 × 5 cm, covered by a layer of concrete, is fastened. The 8–10 cm thick continuous membrane makes the building profile similar to an ingenious zoomorphic morphology.

From the earliest years of his academic studies, Vittorio Giorgini showed interest in developing research on natural models with the aim of applying them to architecture, in order to obtain more efficient complex systems. He committed to the systemic vision of contemporary scientific thought, aiming to determine *the structure of a system as the order in which the elements are organized* [5, p. 211], thus developing a dynamic, articulated, sophisticated architecture, open in all the directions, where geometric principles, structural, and functional needs are perfectly integrated.

Giorgini as a Pioneer of Parametric Design

For the last several years, we have been watching, in several design practices inspired by natural phenomena and organisms, digital modelling that is based on computational logic, guides projects focused on the evolutionary aspect of the shape and on its optimization based on specific criteria. The first experiments for the parameterization of shapes and surfaces are conventionally traced back to the embryonic work of Steve Coons in 1967 [12], who was among the first to introduce a method to describe curves through parametric equations, although several scholars agree in identifying the formulation of the concept of parametric architecture in the 1940s, in the writings of the Italian architect Luigi Moretti [13, 14, p. 21, [15]]. A few years later, in 1986, Gross [16] was the first to understand the potential of the parametric approach in the elaboration of complex forms in architecture. From the 1990s to the present day, numerous experiments in parametric modelling and generative design have multiplied and spread; and among these, a few deserve special mention, the work of Serrano in 1993 [17] and certainly that of Dennis Shelden in 2002 [18], who documented in an organic and systematic way the potential of parametric design in architecture.

In the same years of Coons's research, and in advance of those of Serrano and Shelden, Giorgini started his experimental works on spatial meshes and their formal deformation under the action of forces in order to adapt them to tensions. In agreement with the statement by D'Arcy Wentworth Thompson, that the shape of an object is a diagram of forces and applying Thompson's *theory of transformations* to symmetrical and asymmetrical meshes alike [11, pp. 1026–1095], Giorgini analysed their structural behaviour and tried to quantify the forces that modify the original model, having concluded that the transitions from the linear (the straight line), to the bent (broken) up to the curved, both for lines and for surfaces and meshes, are generated by different geometries and are transformed, symmetrically and asymmetrically, according to the forces action [5, p. 199] (Fig. 8.3).

Vittorio Giorgini's studies, as much as Le Corbusier's research on hyperbolic geometry or the technological and formal solutions of Richard Buckminster Fuller and Frei Otto, coming out of the renaissance static perspective approach, moved towards Einstein's curved space, Gilles Deleuze's folded space, or the topologically deformed space theorized by René Thom [19, p. 55].

The structure of a system can be attributed to a geometrical configuration and to the action of forces. Through the transformations of the models, Giorgini investigated the structural organization of the systems, the aggregation relationships between the parts, coming to quantify the resultant forces and understand the causes of the model's transformation [7, p. 13]. In some notes and sketches, he explained that the point and the force are the first generators of systems which have a certain degree of complexity, which is developed from the dynamic interaction between the point (sign) and the forces themselves by adding to the three dimensions of geometry (space), the force—potential energy as a fourth physical dimension. The latter is understood as *the virtual* (potential) force which generates systems when applied

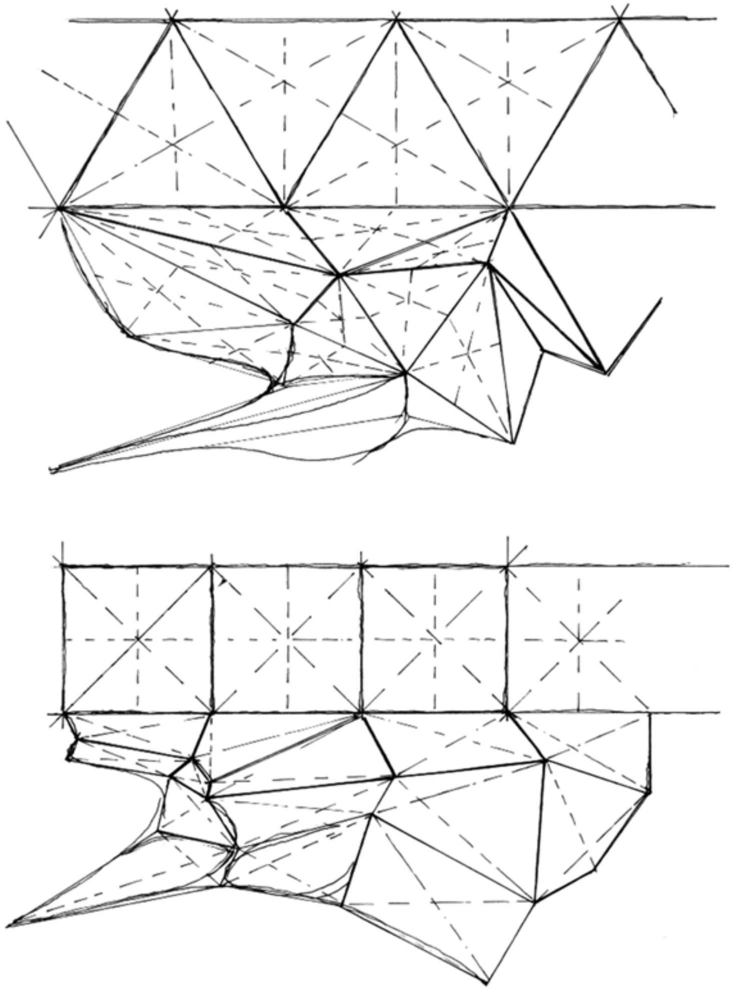

Fig. 8.3 Studies for the deformation of a mesh (Courtesy B.A.Co. – *Vittorio Giorgini Archive*)

according to a certain norm (Notebook sketches, B.A.Co. – *Vittorio Giorgini Archive*).

In a way, Giorgini seems to apply the same method illustrated in Fig. 8.4: *The Kangaroo workflow*, developed in the Grasshopper-Rhinoceros 3D plug-in software created by Daniel Piker for interactive simulation, form-finding, optimization, and constraint solving. The workflow relies on the same set of rules and operations for low-nodal models, such as single digital chains, as for high-nodal models, such as multi-supported membranes. In a digital environment, the organic forms are discretized by meshes; Giorgini used the same method in the pre-digital age. He

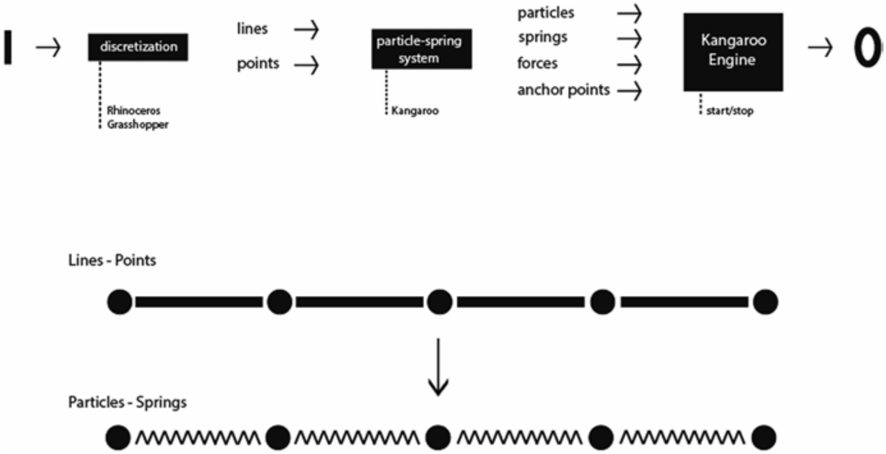

Fig. 8.4 'The Kangaroo workflow' (graphic elaboration by Filippo Iardella)

understood the *discretization technique,* but he did it in a traditional way. In a certain sense, we can say that he demonstrated to possess a *parametric mentality*.

Giorgini Parameterized

To simulate a membrane the same way as in Giorgini's meshes, a grid of springs was defined in Fig. 8.5, that shows the behaviour of two cable networks, one with a square mesh, the other with a triangular mesh, subjected to three external forces and anchored on one of the smaller sides. Giorgini modelled his meshes in an intuitive and experimental way, as in the case of *Saldarini House* or the unfinished project for the *Liberty Rural Community Centre* placed in Parksville (1976–1979), near New York City, where meshes were modelled manually, in order to obtain the desired curvature. In the same way, the wire mesh structure was moulded to the shape required with the support of wooden poles (Fig. 8.6).

Giorgini's approach to design was experimental and intuitive. During the construction of the *Saldarini House*, he confessed to not being fully aware of the topological characteristics of his creation, and that its static behaviour was a riddle to solve [5, p. 245].

Giorgini's investigations have been developed in current software of parametric modelling, in order to elaborate a critical analysis of his work, verifying, in particular, the limits induced by the lack of specific software. The experimentation focused on the modelling of double-curved asymmetric surface systems with topological morphological characteristics, such as the *Saldarini House* and the unfinished *Liberty Project*. Like Giorgini in his *Liberty Project*, we simulated, thanks to our

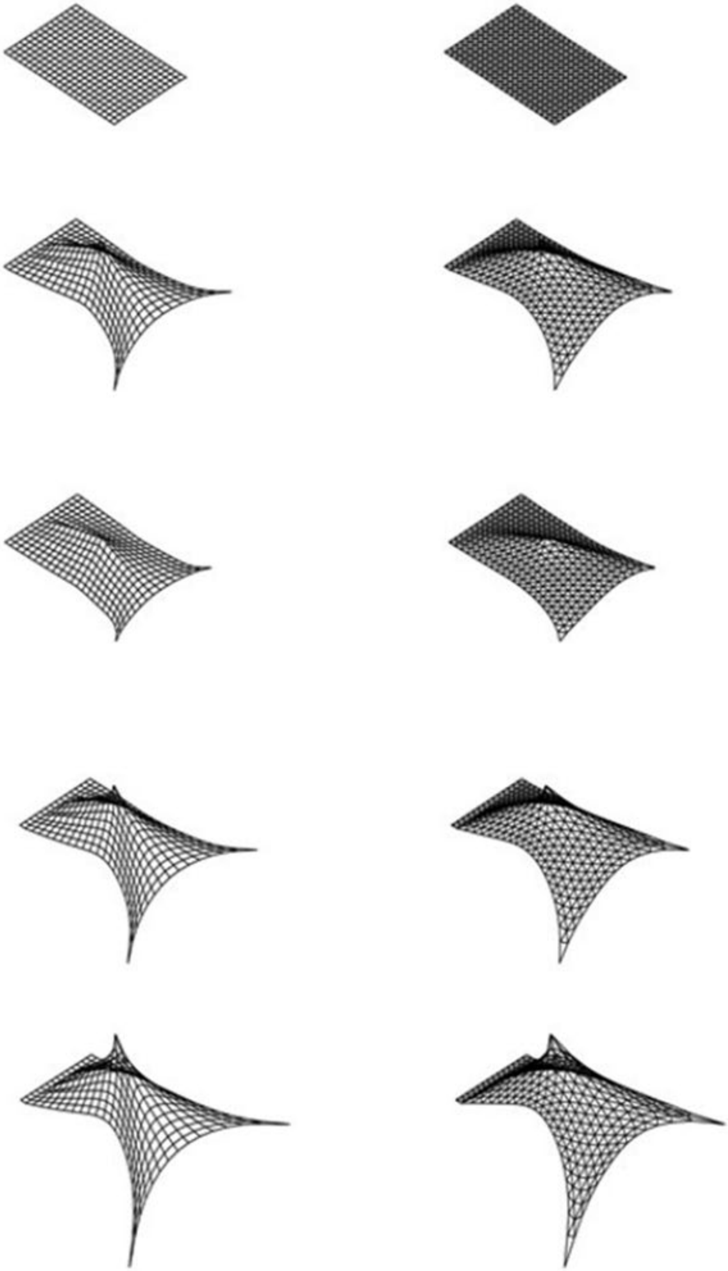

Fig. 8.5 Membranes' simulation. The figures show the behaviour of two cable networks, one with a square mesh, the other with a triangular mesh, subjected to three external forces and anchored on one of the smaller sides (graphic elaboration by F. Iardella)

Fig. 8.6 *Liberty Rural Community Centre*, Parksville (1976–1979). On the left, view of the structure; on the right, Giorgini walking on the structure for manually modelling the meshes (Courtesy B.A.Co. -*Vittorio Giorgini Archive*)

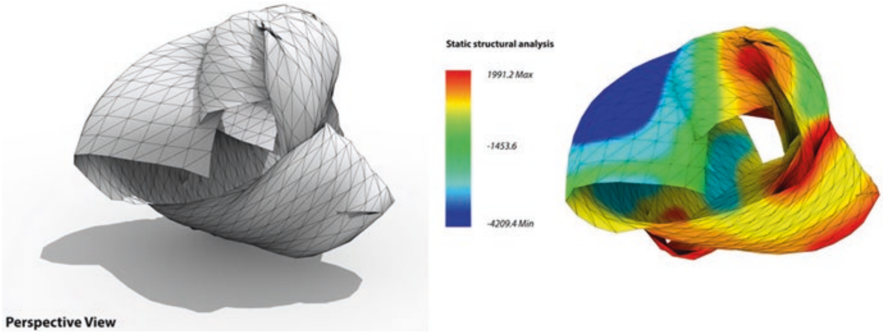

Fig. 8.7 On the left: like Giorgini in his *Liberty Project*, digital simulation of a deformed cables-net, defining the right elastic behaviour (Hooke's Law), the probable anchor points and the forces to be applied. On the right: Finite Element Method analysis of the mesh (graphic elaboration by Filippo Iardella)

digital tools, a deformed cables-net, defining the right elastic behaviour (Hooke's Law), the probable anchor points, and the forces to be applied.

Giorgini attempted to define static diagrams to quantify the forces that transformed the original symmetrical model, with the aim of investigating more efficient and economical design techniques. However, he pointed out that, while in nature, it is simple for a mesh to become asymmetrical, but that, with our techniques, it is difficult and expensive [5, p. 214]. But the most important tool that Giorgini could not use was the *Finite Element Method* analysis software. It is a numerical method for solving problems of engineering and mathematical physics, and typical problem areas of interest also included structural analysis (Fig. 8.7).

But Giorgini firmly believed in innovation and technology as tools for reducing the distance between Man and Nature. He understood that only with the help of technology and electronic instruments, it is possible to obtain a mathematical control of meshes. In 1978, during the 38th edition of the *Venice Biennale*, where Giorgini participated in the section dedicated to *Topology and Morphogenesis*, he declared that the Euclidean geometry is not the only and most appropriate tool available, but the only one that, until then, he had been possible to exploit. He was convinced, in fact, that new tools, introduced by the developments of genetics, electronics, and information technology, would pave the way for more structurally efficient building techniques [20, p. 131] and in the 1980s, he began performing experiments with computers.

Leaving aside the orthogonality of the usual space, Giorgini developed an *ante-litteram* morphing process, based on the rectification—a sort of discretization—of curved lines. Starting in the 1970s, he developed a series of projects that belong to those conventional techniques. In his USA period (1969–1996), he began a far-reaching design phase in which the formal interpretation of natural organisms consisted of tetrahedral and octahedral meshes.

Giorgini's design is the result of a continuously generative process based on a system of parameters and relations; this process guides the result, which is almost always unknown to the architect. Giorgini's mindset is dominated by the concept of the diagram (process); the form is meant as a dynamic of transformation, in which the complex system of relations of the parts, and the internal and external forces that define the form itself must be investigated and interpreted. Giorgini realized that nature offers models set on a triangular-tetrahedral structure, such as in bone tissues, and asserts that, in nature, geometry is generally only a model and never appears as we know it or according to what we call symmetric models, such as the square or the equilateral triangle, and their transformation into rhombuses and isosceles triangles. In these transformations, Giorgini concludes that the triangle is always the basic element of such structures [1].

Natural structures, however complex, composed, and asymmetrical as they can be, are reduceable to recognizable models, in other words, to conventional systems, identified by the straight line, the flat surface, or polyhedrons. For Giorgini, a curve is a shape born under the action of multiple forces, whose conventional representation is nothing but a straight line. Applying the notions of graphic statics, he transformed curved systems into conventional systems, obtaining symmetrical geometric meshes then transformed into asymmetrical meshes through the application of forces. Giorgini's aim was to arrive at the definition of static diagrams capable of explaining forces and tensions of a given spatial conformation.

The ideational-design process of Giorgini was as parametric as the approach of Luigi Moretti or the intuitions of Sergio Musmeci; for whom, as for our architect, the concept of the diagram was central and preceded the introduction of the computer in the design practices. Giorgini's American projects represent the key to understand the application in the architecture of the models and diagrams of static forces that he studied in theory.

Our investigation focused on the modelling of the unrealized projects designed for Manhattan, like *Hydropolis* (1981–1982) and *Genesis* (1984), based on Giorgini's *Octa-Frame System*, a self-bearing octahedral-tetrahedral base-module. Giorgini explained that, given its geometric stability, the regular tetrahedron is the most statically efficient figure.

Simplification and standardization were his response to the lack of specific software. We tried to re-create a modular structure like those designed by Giorgini. When the shape was defined through the application of external forces, the closed volume was found in this step; a certain degree of approximation was taken into account to avoid calculation problems by the computer. Once found, the volume was discretized with the least number of bounding boxes with the tools of *Grasshopper* and *Pufferfish* (useful for working on Shape Changing) plug-ins. Within these boxes, the modules used by Giorgini were inserted, thus creating a modular structure (Fig. 8.8).

In 1981, Giorgini designed *Hydropolis*, an unusual neighbourhood on the East River. In *the Octa-Frame System,* the basic module defines a self-supporting structure: a bridge over the river composed of octahedral structures, displaced as interdependent modules, which form a system of self-supporting beams laid on inverted tetrahedrons that rest on truncated pyramidal plinths by means of spherical metal nodes (Fig. 8.9). Scaling the module established by the proportions of the bounding boxes, it was possible to model 3 support points—foundations, as can be seen in the Giorgini *Hydropolis* project (Fig. 8.10). The node is the most technologically complex element in which three or more metal tubular elements of variable sections converge.

Giorgini tested and revised the nodes many times during his work, before arriving to the most complex version, described as *universal connective nodes*, the *Octa-Frame System* [7].

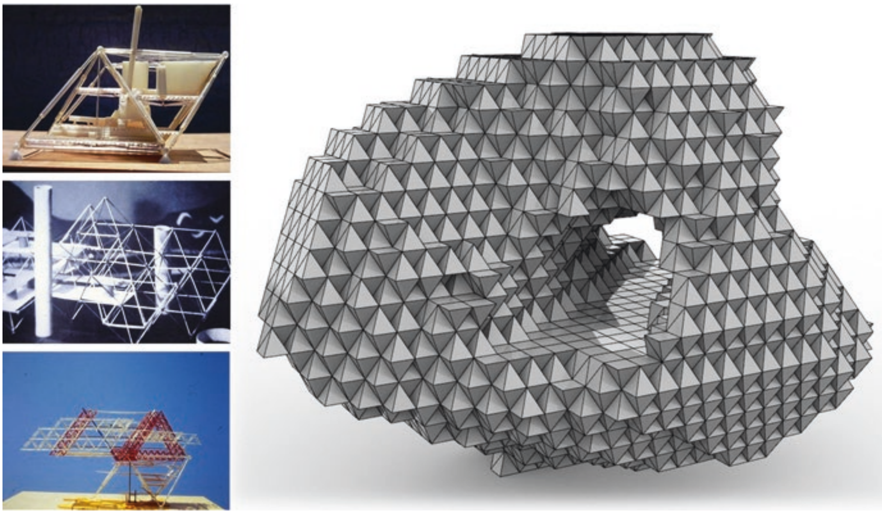

Fig. 8.8 On the left: Giorgini experimental models of structures based on the tetrahedron. On the right: digital elaboration of a modular structure like those designed by Giorgini (graphic elaboration by Filippo Iardella)

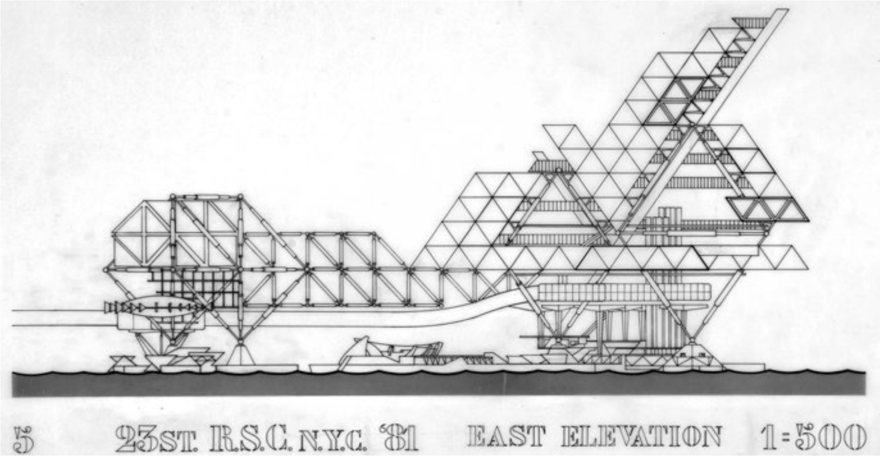

Fig. 8.9 *Hydropolis*, Manhattan, New York, 1981–1982 (Courtesy B.A.Co. – *Vittorio Giorgini Archive*)

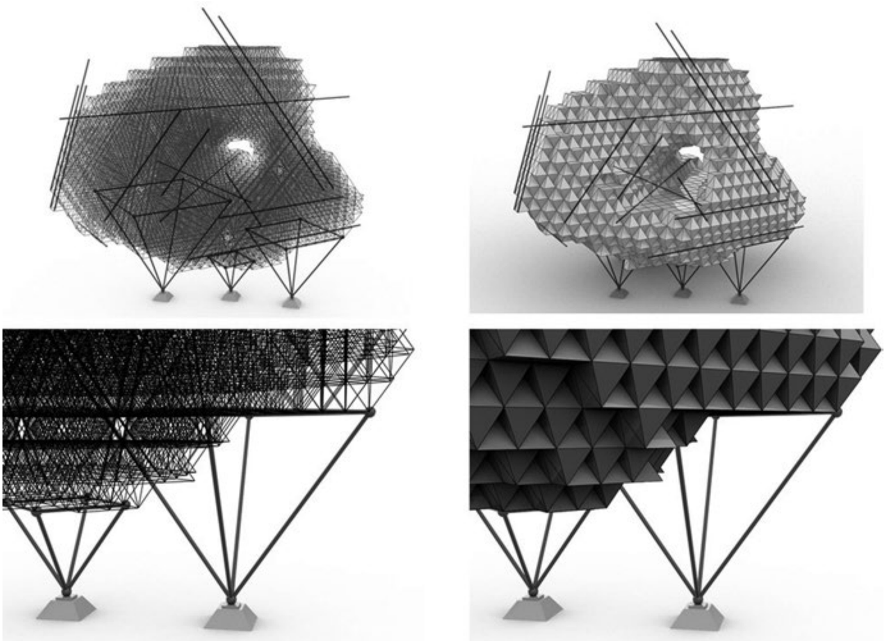

Fig. 8.10 Scaling the module defined by the proportions of the bounding boxes it was possible to model 3 support points—foundations as it can be seen in the Giorgini ‘s project called *Hydropolis* (graphic elaboration by Filippo Iardella)

Conclusions

In the end, Giorgini continues to surprise us for his cultural and social relationships; he was a friend of André Bloc and of the sculptor Isamu Noguchi; he knew the work of Frederick Kiesler; he met Richard Buckminster Fuller to discuss architecture; he was also a friend of Sebastián Matta, and a good friend of John M. Johansen. Giorgini met many times with Peter Eisenman at the Pratt Institute. In 1979, Giorgini took part in the exhibition *Transformations in Modern Architecture* at the Museum of Modern Art of New York, that gave rise to a book (with the same name) edited by Arthur Drexler. The *Whale House* was exposed in the section titled *Sculpture: Organic Form,* next to Frederick Kiesler's *Endless House* (1960) [21].

Giorgini foresaw the enormous creative possibilities offered by digital language, demonstrating, in a certain sense, to have a *parametric mentality*, which he could not develop due to the lack of tools and other personal reasons. In 1995, a serious eye disease affected the last part of his life.

On the one hand, Giorgini's projects related to curved systems were mostly misunderstood and labelled as informal while, on the other hand, his pioneering and unrealized projects of the American period, mostly characterized by the use of tetrahedral and octahedral meshes, were branded as utopian and absurd.

Since the beginning of the twentieth century, the observation and investigation of nature, as a resource for architecture, unite the intellectual and design paths of some of the most innovative and lively architects, engineers, and artists of the time. Certainly, Giorgini should be considered in the eminent company of other personalities, such as Nervi, Candela, Otto, Gaudí, Fuller and Wachsmann, Le Corbusier, and with the liveliest minds of that time, like Andrè Bloc and Roberto Sebastian Matta, whom Giorgini knew personally, as well as Frederick Kiesler.

During the last years of his life, he declared, with profound bitterness, that he had been left very alone and that his work had never generated great interest from critics. In his own words, that we translate from the Italian: *My research has remained fruitless to this day. What remains is only an intention, a concept, a supposition, but no confirmation* [1].

Nowadays, digital modelling has made possible rereading, analysing, and critically evaluating Vittorio Giorgini's design thinking, highlighting the modernity of his investigations full of intuitions, which, however, did not mark their time, but nevertheless persist.

Acknowledgments The authors wish to thank Architect Marco Del Francia for his support and for making available the *Vittorio Giorgini's Archive* (B.A.Co. – Follonica (GR), info@archiviovittoriogiorgini.it).

Authors' Contributions The paper shows the results of a research coordinated by Denise Ulivieri.

The contributions of Denise Ulivieri (D.U.), Marco Giorgio Bevilacqua (M.G.B.) and Filippo Iardella (F.I.) in the elaboration of the paper were: Introduction (D.U.); Giorgini as a morphologist-spatologist architect (D.U.); Giorgini as a pioneer of parametric design (D.U. and M.G.B.); Giorgini Parameterized (D.U. and M.G.B.); Conclusions (D.U. and M.G.B.).

All the digital and graphical elaborations were developed by Filippo Iardella, under the supervision of Denise Ulivieri and Marco Giorgio Bevilacqua.

All the English translations of cited texts in Italian are by the authors.

References

1. Giorgini, V. (2006). *Storia di uno stronzo*. Audio cassette tape (unpublished biography).
2. Novak, M. (2007). Babele 2000. Retrieved March 22, 2019, from http://www.trax.it/mar-cos_novak.htm.
3. Kuhn, T. (1962). *The structure of scientific revolutions*. University of Chicago Press.
4. Nicolis, G., & Prigogine, I. (1991). *La complessità. Esplorazioni dei nuovi campi della scienza*. Einaudi.
5. Giorgini, V. (1995). *Spatiology: the morphology of the natural sciences in architecture and design. Spaziologia. La morfologia delle scienze naturali nella progettazione*. L'Arca Edizioni.
6. Del Francia, M. (2006). *Vittorio Giorgini architetto. Morfologia, Topologia, Spaziologia*. Generazioni in Arte.
7. Ulivieri, D., Giorgetti, L., & Tognetti, B. (2019). Vittorio Giorgini Spatiology–morphology architect. *Nexus Network Journal, 2020*(22), 191–210. https://doi.org/10.1007/s00004-019-00453
8. Del Francia, M. (Ed.). (2000). *Vittorio Giorgini. La natura come modello*. Angelo Pontecorboli Editore.
9. Di Cristina, G. (2005). Architettura come topologia della trasformazione. In M. Emmer (Ed.), *Matematica e cultura (129–141)* (p. 4). Springer.
10. Jenny, H. (1967). *Cymatics. A study of wave phenomena and vibration*. Basileus Press.
11. Thompson, D.'. A. W. (1945). *On growth and form*. Cambridge University Press.
12. Coons, S. (1967). *Surfaces for computer-aided design of space forms*, MIT Technical Report, Cambridge.
13. Stiles, R. (2006). *Aggregation strategies (masters dissertation)*. University of Bath.
14. Bucci, F., & Mulazzani, M. (2000). *Luigi Moretti: Works and writings*. Princeton Architectural Press.
15. Palestini, C., & Basso, A. (2019). Parametric architecture and representation, the experiments of Luigi Moretti. In C. Marcos (Ed.), *Graphic imprints*. EGA 2018. Springer.
16. Gross, M. (1986). *Design as exploring constraints (doctoral dissertation)*. MIT.
17. Serrano, J.G., Coll, J., Melero, J.C., Burry, M. (1993). *The need to step beyond conventional architectural software*, eCAADe Conference Proceedings Eindhoven.
18. Shelden, D. (2002). *Digital surface representation and the constructibility of Gehry's architecture*. (Doctoral dissertation). MIT.
19. Capanna, A. (2000). *Le Corbusier. Padiglione Philips, Bruxelles*. Testo&Immagine.
20. Vinca Masini, L. (Ed.). (1978). *Topologia e Morfogenesi*. La Biennale di Venezia.
21. Drexler, A. (1979). *Transformations in modern architecture*. The Museum of Modern Art.

Denise Ulivieri is Associate Professor of History of Architecture at the University of Pisa. Her research interests are in the field of historical-architectural heritage, with particular attention to the history of the Tuscan built environment, the analysis of vernacular architecture and local building tradition. Her research is also focused on biographical studies of architects and engineers of the nineteenth and twentieth centuries, almost forgotten by critics or only marginally studied.

Marco Giorgio Bevilacqua is Full Professor of Architectural Representation at the University of Pisa. His research interests are in the field of valorisation of the historical architectural heritage, with particular attention to historical military architecture, architectural and urban survey and digital technologies for the communication of historical architectural heritage. He currently teaches Architectural Representation and Methodologies for Architectural surveying in the master's degree program of Architecture and Building Engineering at the University of Pisa.

Filippo Iardella is an engineer specialized in Building Information Modelling and in programming environments for computational BIM design that allow to design workflows and automate tasks. He has a master's degree in Building Engineering and Architecture from University of Pisa and an II level master specialization in BIM Management from Polytechnic University of Milan. Currently, he works as BIM and Digital Engineer at Lendlease Italy. His tasks include BIM coordinating and assisting BIM Manager using a fully integrated BIM approach based on the digitalization of projects and data management.