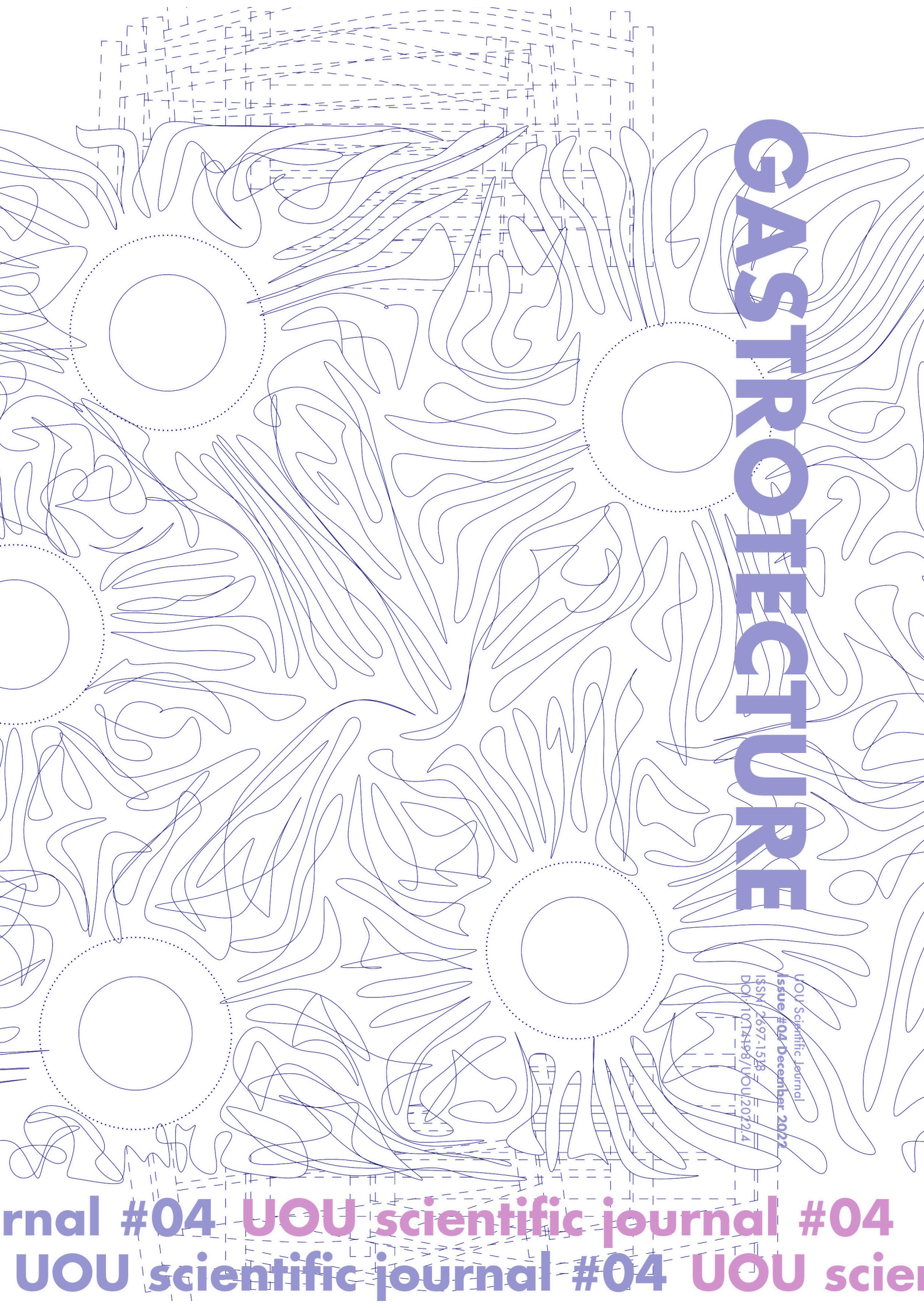
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Fig. *Andreas von Foerster (1943), Spaghetti with Meatballs: cross section, three times full size, 1972.*

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GASTROTECTURE

UOU4EUROPE Project: A Teaching Model for the UNIVERSITY of EUROPE

Letter from the director

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NEEDS, RELEVANCE, AND FEASIBILITY OF A STEP BEYOND

Last October the University of Alicante (UA) was represented at the TRANSFORM4EUROPE International Conference: “Innovative Teaching and Learning Methods in Higher Education (INNO-METHODS)”, held in Kaunas (Lithuania). Our participation was decisive in consolidating two points that justify the present proposal and the need for this teaching model:

A) In the first place, after the presentation of our paper “Enhancing students’ critical thinking at UNIVERSITY of Universities”, it became clear that the hybrid teaching experience we are developing in the Architecture Degree with numerous European universities, is putting numerous teaching innovations into practice.

The comments made by the audience, most of them experts in education, valued the results obtained from the incorporation of different types of Blended Learning Models:

The Flipped Classroom Model, the Enriched Virtual Model, the Individual Rotation Model, the Flex Model, the A La Carte Model, Inquiry based learning, Object based learning, Collaborative learning.

Our initiative, known as UNIVERSITY of Universities (UOU), is an educational program consisting of fortnightly workshops exchanged between international architecture schools. Originated during the pandemic with six universities, the success of the program is evidenced by its rapid growth, with forty-two universities currently participating:

All of them are totally committed to the organization of workshops that are carried out in parallel, in such a way that multiple options are offered to the students, thus enabling the personalized learning that they wish:

https://uou.ua.es

Each workshop is directed by an academic expert from one of the schools involved, and all students participate in it. This is organized in international work groups through the MOODLE learning platform. The techniques involved adopt a learning model centred on the student, making use of the flipped classroom, and inquiry-based learning and collaborative engagement.

An important part of **UOU** is the interdisciplinary and intercultural nature of the workshops, combining architecture, urbanism, and art.

This teaching experience is only possible thanks to the use of Learning and Communication Technologies (TAC); it is multilingual, developing a horizontal, inclusive, participatory teaching-learning process that engages with the gender perspective in the design processes. In addition, it strengthens the student's commitment to their education.

In addition to the fundamental use of MOODLE resources provided by the UA Vice-Rector for Digital Transformation over the past five academic semesters, and the Publications Service offered by the UA Vice-Rector for Research and Knowledge Transfer for the dissemination of the work developed, it is also necessary to mention the work carried out by the UA research Network last year; the "**UNIVERSITY of Universities**", which served to define the 21st century classroom, a space that goes beyond its materiality.

With all this great help we have achieved, from a realistic

perspective, and building with imagination - as if it were a building - a revolutionary learning structure based on the idea of exchanging intercultural techniques and methods: a whole innovative model for the **University of Europe**.

B) However, the recognition from the Kaunas Conference has provoked an important reflection: it is no longer enough to work only from intuition.

From now on, it is essential to identify the different methodologies used in the teaching practice among the different universities participating in this international network. In addition, it is necessary to be able to evaluate the knowledge and attitudes acquired, not only by the students, but also by the teachers participating in **UOU**.

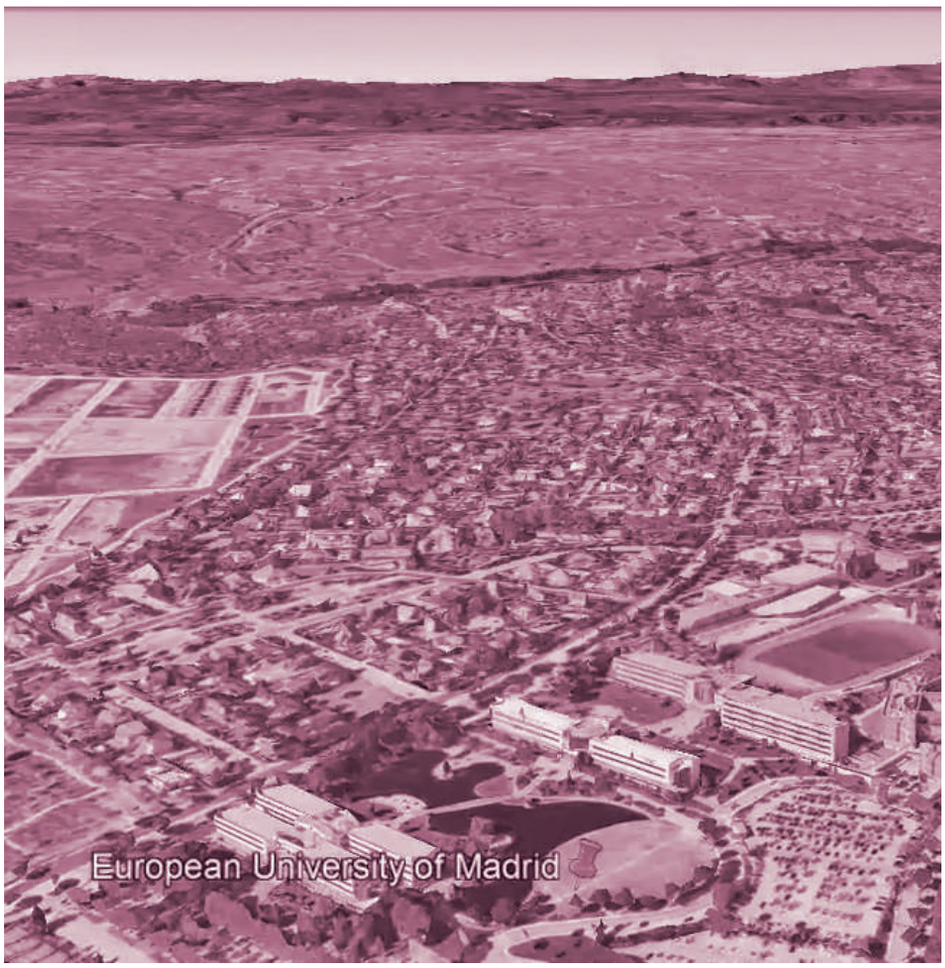
The viability of the proposal is taken to be indisputable, evidenced by the **UOU** teaching in the module of Architecture Design Studio (International Group) of the Degree of Architecture at UA and, of course, the continuously growing number of students and professors from universities that are part of **UOU**.

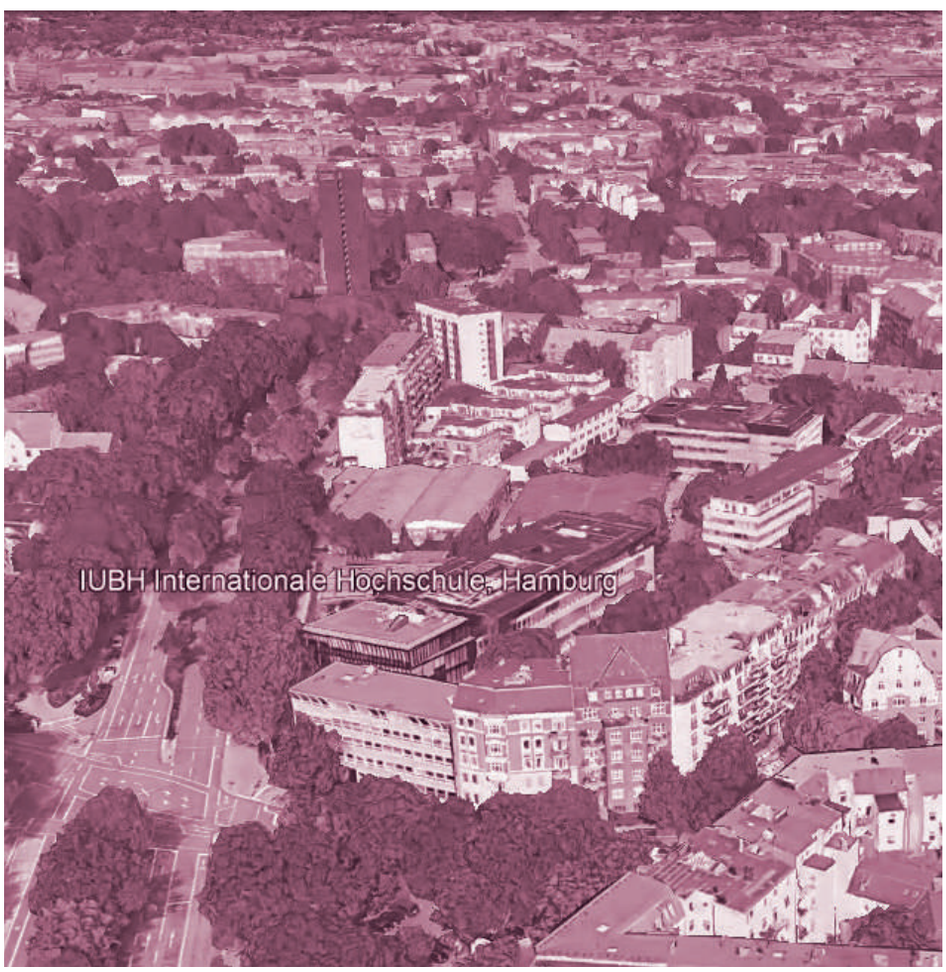
BRIEF DESCRIPTION AND PURPOSE OF THE PROJECT

UOU4EUROPE is a two-year Project, each year having well-defined goals:

- The first year consists of identifying the different methodologies used in teaching practice so that they are included in the guide for the module Architecture Design Studio offered in the **UOU** program.

- The second year of work focuses on evaluating the knowledge and skills acquired by the students who participate, as well as the attitudes developed by them in comparison to the





groups taking this degree who do not participate in **UOU**.

The attitudes developed by the teachers will also be evaluated.

In the methodology section, it will be detailed how each of the phases is carried out.

OBJECTIVES TO ACHIEVE

By putting into practice the teaching innovations valued at the international conference in Kaunas, the **UOU4EUROPE** Project aims to identify the teaching methodologies that are used in the different universities that participate in **UOU**, and make an evaluation of the knowledge and attitudes acquired by students (as well as attitudes acquired by teachers).

In conjunction with this, other objectives from **UOU** will also be achieved in parallel, which involves the incorporation of the following notions:

- Interculturality as defined by UNESCO: Refers to the existence and equitable interaction of diverse cultures and the possibility of generating shared cultural expressions through dialogue and mutual respect.

- The immediate response of the university will have the effect of exploding the bubble that can isolate us from society. It is about the capability of response to emergencies and other important facts; (one still gets emotional when reminding **UOU** professors and students to design reception areas for Ukrainian war refugees upon arrival in Poland), an attitude that in turn promotes the employability of the students.

- The incorporation of new advances that transform the role of the architect, such as Artificial Intelligence and the Metaverse.

- To solve family reconciliation problems, thanks to this teaching innovation that transcends space and time.

- Sustainability; for example, not only by saving on transportation, but also on air-conditioning, avoiding economic difficulties in increasingly long hot periods, and aggravated by the sharp increase in the price of electricity.

- The possibility of "breaking borders in education".

Speaking of the Mediterranean, for example, only the upper part of it is usually mentioned from the European perspective.

From now on, the existing asymmetry, both political and economic, with North Africa will begin to fade as students from there study in Europe.

METHODOLOGY

A framework of assessment is established that includes internal factors:

Existing curricula, cultural expectations, language skills, design skills base, accreditations, etc.

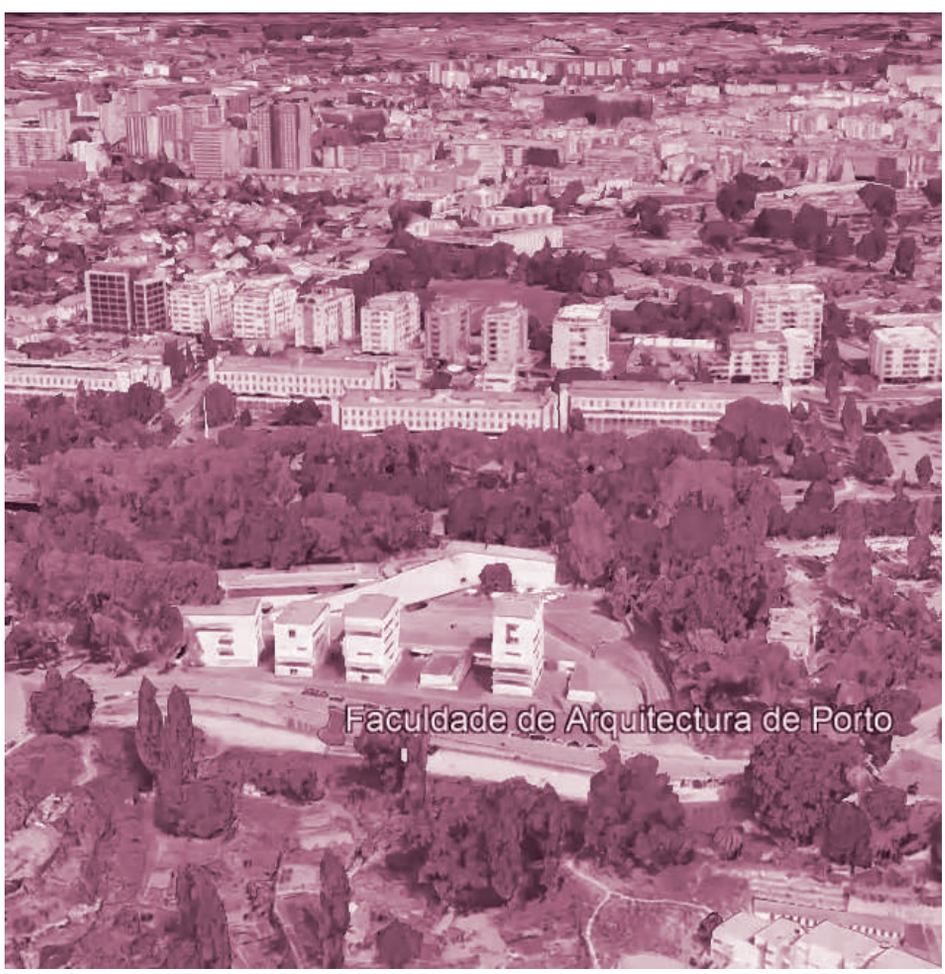
And external factors:

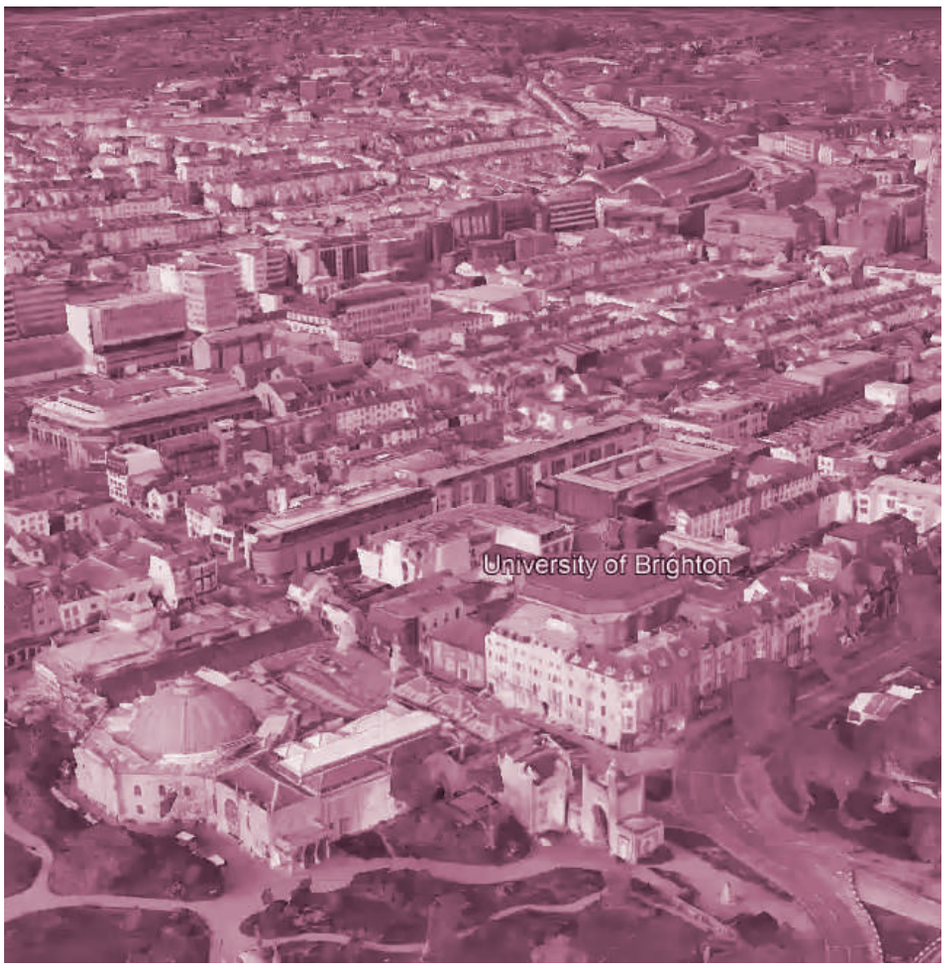
A vision of an increased online learning, evolution of the pedagogical thinking, economic viability of the campus in the future, sustainability, and climate change, etc.

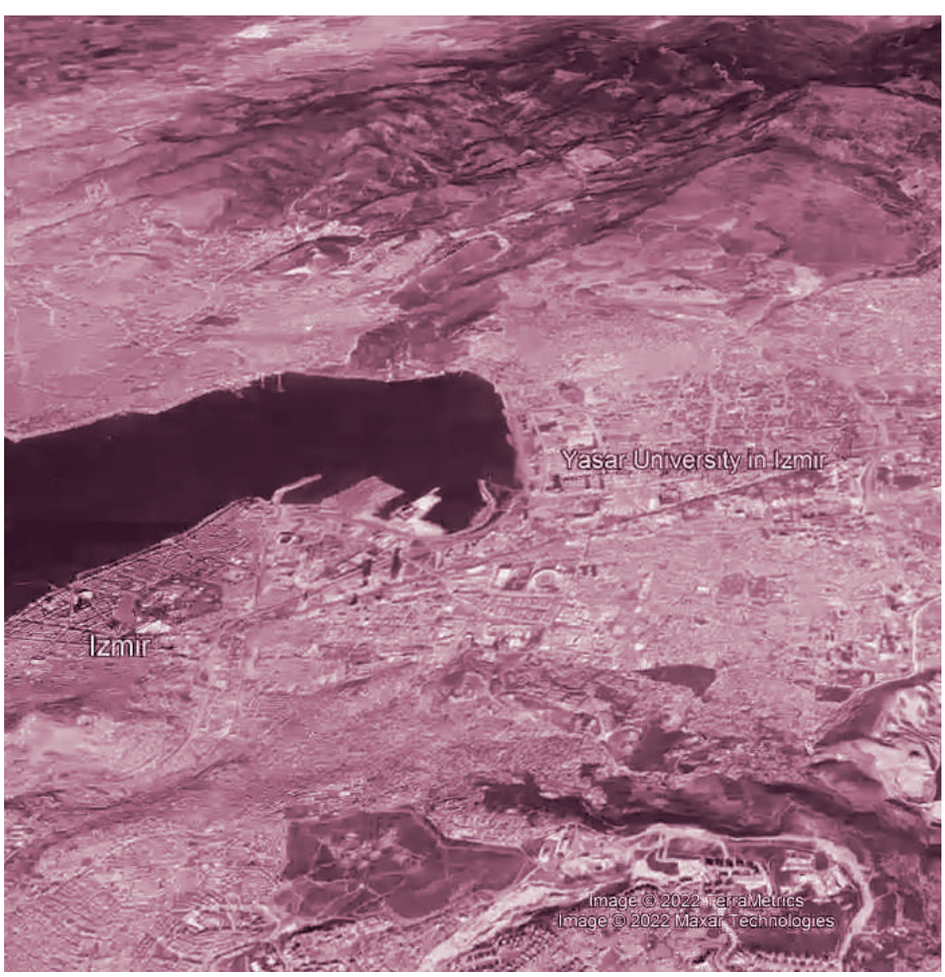
Which provides a solid reflection upon the last three years of **UOU**.

To this end, the following series of actions a to be carried out in the following two years of the Project are proposed:

- All the participants from the 42 schools of architecture will be organized into international research groups, each group coordinated by one of the members of this Project.







- During the first semester of the first year of the Project, each group will identify the methodologies, as a taxonomy.

- In the second semester of this first year, questionnaires will be designed that function as authentic quality indicator tools to improve the **UOU** teaching innovation experience.

In this way, Indicators will be established demonstrating the acquired Knowledge, and Aptitudes that evaluate the experience, and Skills.

In this phase, three questionnaires will be prepared:

- One to measure the knowledge acquired by the students in the module Architecture Design Studio.

- A second one to measure the attitudes developed by the students.

- And a third for the attitudes of the teachers participating in **UOU**.

But before being able to use these questionnaires for the purpose for which they have been designed, they will have to be validated by experts and through the Pilot Test.

Therefore, the next step will be, during the first semester of the following course, to formulate and elaborate a Pilot Test, concluding in the fourth semester of this Project, with a comparison between the students of the **UOU** Experimental Groups and those of a control Group.

Once the questionnaires have been validated, they will be used to assess the knowledge and attitudes of students and teachers in the Experimental Groups. Here, the number of Experimental Groups that participate will be indicated by comparison with the Control Group following the same subject, although taught in a traditional way.

The collected data will be analysed using filters that direct the focus to a particular subgroup, for example, of gender, cultural, or entrepreneurship.

This working plan is accompanied by seminars, held every six months at a UA partner university, which will serve to disseminate the advances of the Project internationally, all of them accompanied by their publication in the **UOU scientific journal**.

The series of 4 seminars along with the corresponding publications in the two years of the Project will, in turn, have an impact on the UOU's teaching strategies and methodology.

Among the 42 participating universities, 4 colleagues with innovative experience will be in charge of coordinating each research work group, and preparing minutes of the meetings that allow monitoring of the work of this first phase:

- Maria Luna Nobile: Associate Professor / Umeå University, Sweden.

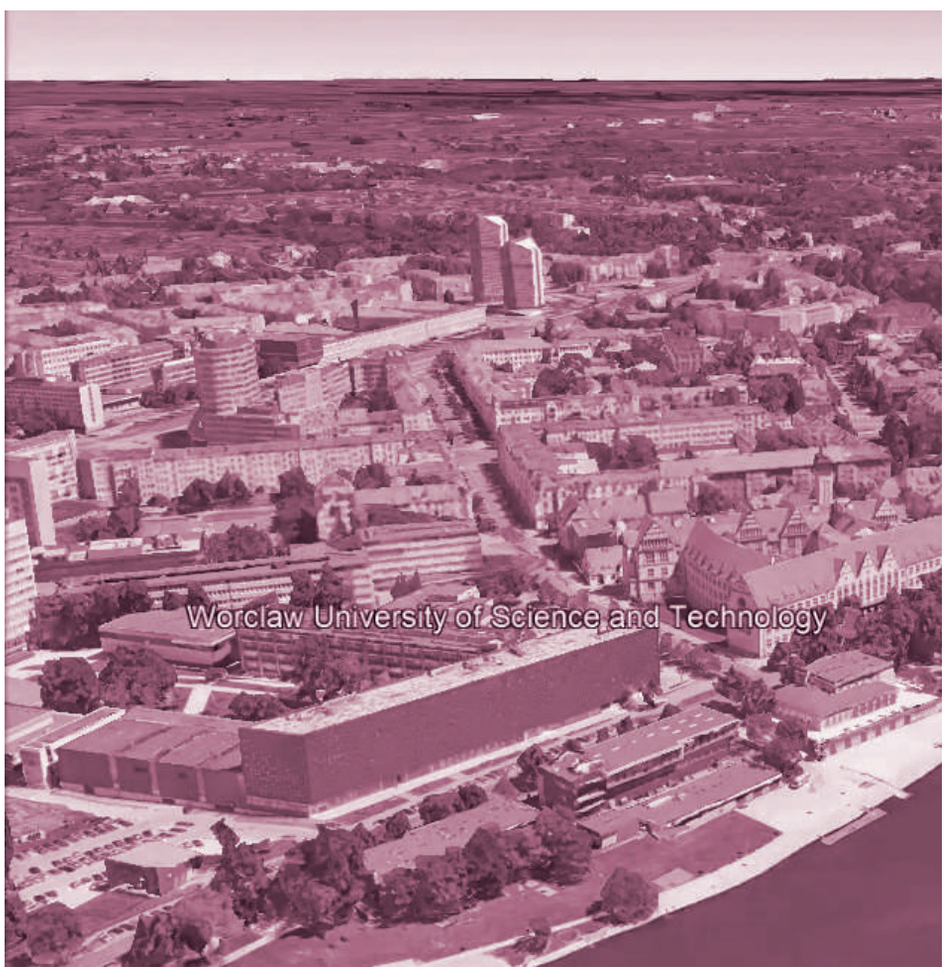
- Markella Menikou: Associate Professor / University of Nicosia, Cyprus

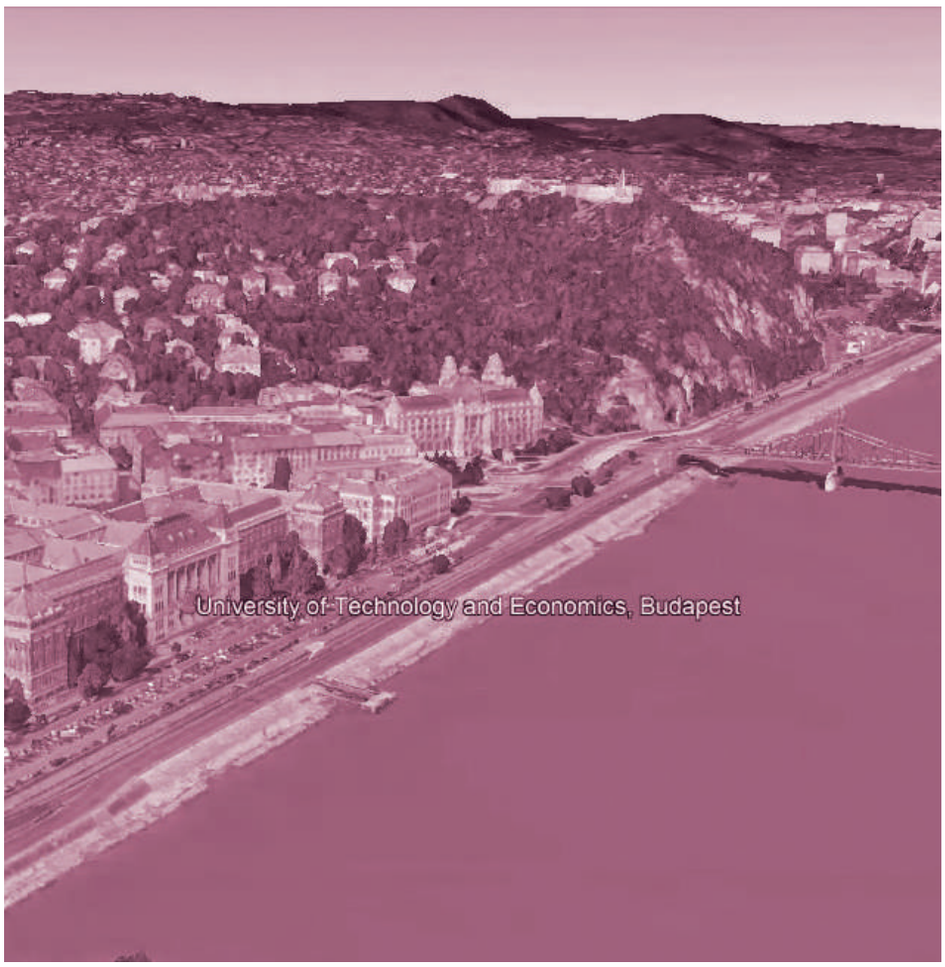
- Sofia Aleixo: Assistant Professor / University of Évora, Portugal.

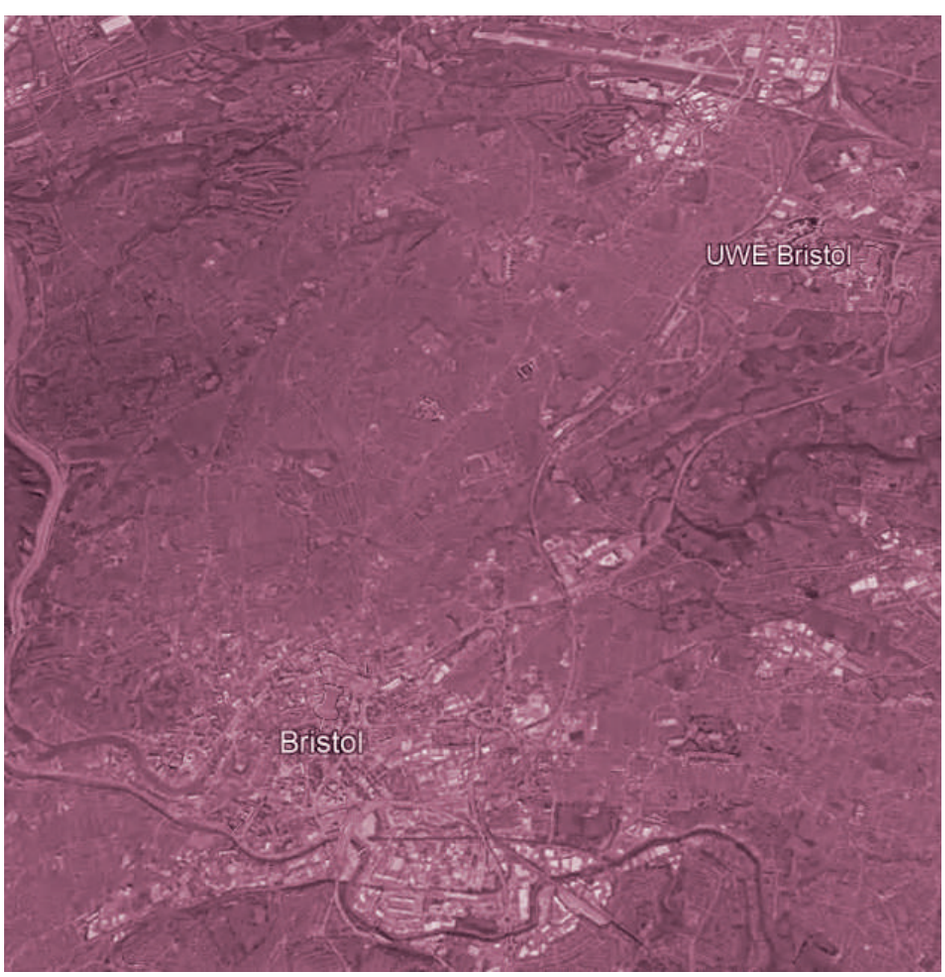
- Jerzy F. Łątka: Assistant Professor / Wroclaw University of Science and Technology, Poland.

- They are joined by a collaborator from another degree at the UA, in the Area of Didactics of Experimental Sciences: Asunción Menargues Marcilla is the professor in charge of supervising the identification of methodologies and the design of questionnaires.

- The Project is completed by the professors from the UA, Joaquín Alvado Bañón and







Javier Sánchez Merina. They will oversee the publications and seminars, as well as the dissemination of the work developed.

The second year ends with the full exposure of **UOU** as a UA Teaching Model for the "**UNIVERSITY of EUROPE**".

IMPACT, EXPECTED RESULTS AND SUSTAINABILITY OF THE PROPOSAL

The final document of the **UOU4EUROPE Project** is necessary for the consolidation of such an ambitious and exciting teaching proposal that is **UOU**.

Firstly, this is due to its continuous growth, which presents it as an international model for the "**UNIVERSITY of EUROPE**".

But, in addition, and focusing specifically on architecture schools, it is urgent for them to take the step from a teaching carried out by the intuition of architects to a solid educational program that contrasts with, and complements, its more typical outcomes.

This is the real impact to be achieved as a result of the objectives of this Project, and that will ensure the sustainability of the proposal over time:

The conclusions of the Project will enable us to analyse and reason the evidence of success:

A growing model, an international and cultural development of the future architect.

It embraces 'personal responsibility' in education, multidisciplinary learning, expansion of the skills base, employability, etc., at the same time as acknowledging challenges such as: national accreditations, campus versus the agendas and

pressures of online learning, the need for an element of co-management, and the 'formalisation' of what, up to now, has been a voluntary agreement for the advancement of the learning of architecture.

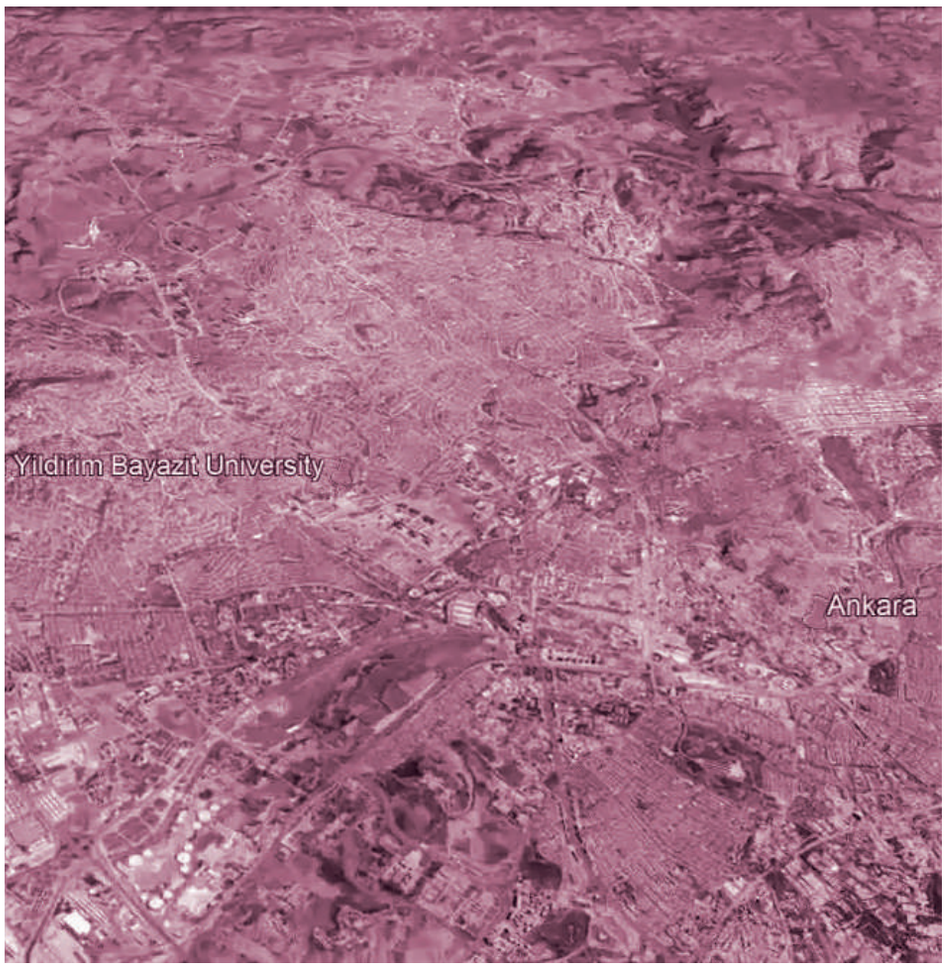
This international teaching approach in shared studios has rethought the learning space.

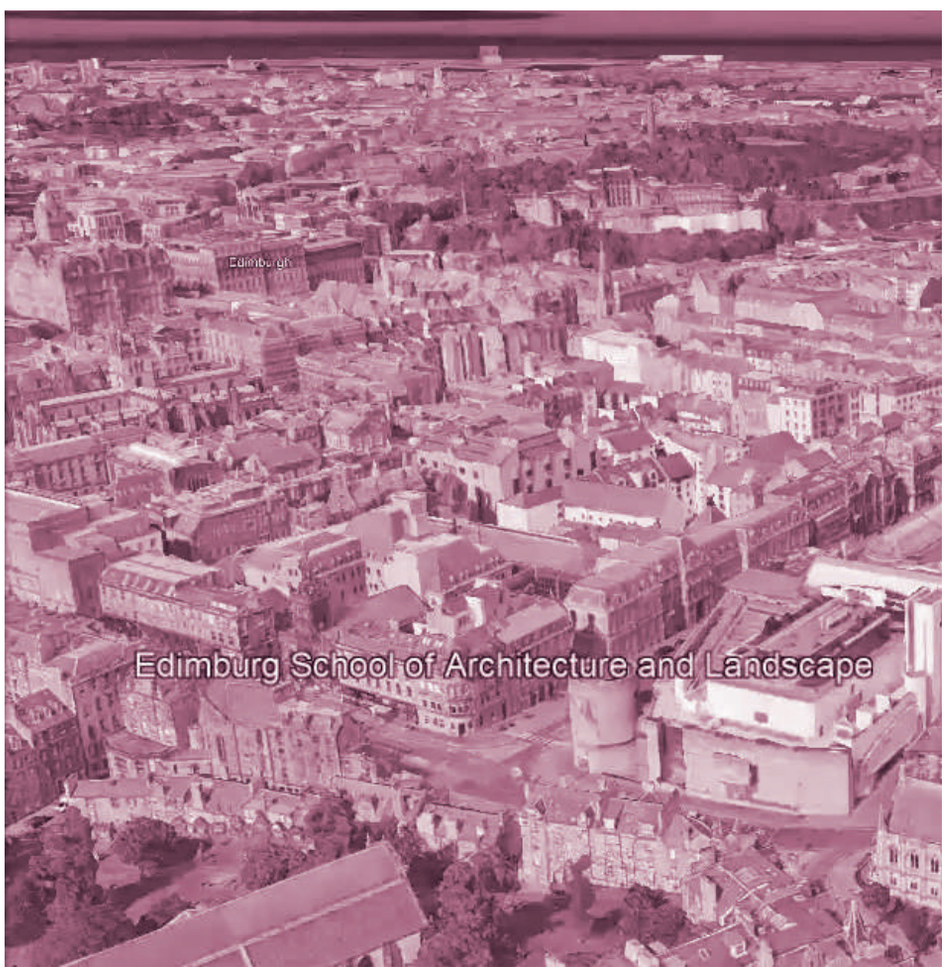
The commitment of so many academics and practitioners has enabled a timetable that sequences learning and skill development and, crucially, allows students to create their own curriculum. It is noteworthy how, being voluntary and not too institutionalized, it allows for immediate architectural responses to contemporary problems, much faster than traditional curricula.

As already mentioned, examples include responding to advances in artificial intelligence and the Metaverse or allowing students from across Europe to jointly design welcome areas in Poland for Ukrainian war refugees.

The Project will also identify how **UOU** seeks to engage beyond Europe, breaking boundaries in education by actively encouraging participation from other continents.

Participants now include, for example: university schools of architecture in Cairo, Reunion Island, Dubai and Izmir.





EDITORIAL

Digesting Gastrotecture

A constellation of associations between Architecture and Gastronomy

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CONTEXT

This fourth issue of the UNIVERSITY of Universities Scientific Journal, titled Gastrotecture, aims to achieve a broader understanding of the intertwined relationships between architecture and gastronomy, expand the limits of both disciplines and register the emergence of new practices supported by innovative and unconventional approaches from design and technology. Gastrotecture has invited academics, researchers, designers and students to contribute with their works that broadly converge architecture and gastronomy and openly understand their borders.

The UOU scientific journal, has experienced several transitions since its birth in Sweden in November 2020 in the framework of a research seminar on the topic of International Research hosted by the Umea School of Architecture (1). Gastrotecture collects works and projects developed during the pandemic and also incorporates contributions and face-to-face experiences of this post-pandemic period in which we find ourselves. However, the singularity of this issue would not be "coming back to normality" but having invited a discipline other than architecture to reflect on the need for interaction between different fields and their visions of the future. It allows architecture and gastronomy to expand their applications within the contextual urgency to acquire new skills for having a global idea of our realities. Gastrotecure seeks to holistically offer a more comprehensive picture of today's education and research and presents works aiming to inspire educators, students, professionals and researchers.

In *Atlas of emerging practices, being an architect in the 21st century*, the project New Generations, developed by Itinerant Office in 2013, was presented by Gianpiero Venturini. The project looked at how the architecture industry changed after the financial crisis. It examined the careers of selected 95 young, emerging architects from 22 European countries to give architecture students, recent graduates, and emerging firms essential tools and information in the early phases of their careers. Other architects like Alejandro Zaera-Polo also did a sweep on the state of the profession. In his article *Well Into the 21st Century. The Architectures of Post Capitalism*, published in the 187 issue of El Croquis magazine, mapped and categorised architecture studios based on their emerging ways of practising and understanding the profession. The architect and academic Juan Herreros, in conversation with Nikolaus Hirsch and Nick Axel spoke about the obsolete vision of the architect as an orchestra conductor, which he classified as unsustainable in our times. He proposed instead that *"Our work today is closer to a DJ, using fragments, identifying moments, confronting inputs and information from very different people and knowledges"* (2).

The pandemic outbreak in 2020 once again forced the need to reinterpret architectural design and practice radically. The shortcomings of our built environment were highlighted during confinement and social isolation, and, the university education had to reinvent itself. UNIVERSITY of Universities is a novel alternative to the current options of remote teaching, which are similar in most schools in the European context. Likewise, the UOU scientific journal represents this singularity as a great opportunity. Gastrotecture has sought to be a call to show diverse works representing multidisciplinary practices that facilitate innovation. Innovation has been framed lately as the constant to be fully incorporated into our work routines, becoming today one of the critical factors for the survival over time of any company in an era of ever-changing professions.

Delving into the pairing of architecture and gastronomy, Samantha L. Martin-McAuliffe discusses the shared attributes between eating and building and how food studies and architecture can learn from each other in her book *Food and Architecture at the table*, Bloomsbury Academic, 2016. It is the first book that explores, interrogates and illuminates the reciprocity between the vocabularies of these two fields in the present day, focusing on the four most repeated and debated shared terms: regionalism, sustainability, craft and authenticity. (3) Gastrotecture intends, more than making a terminological classification, to bring a diversity of voices that illustrate new multi, inter and transdisciplinary[1] bridges that are relevant today through dyads or "bigamies" understood as seemingly improbable pairings that result in new genres. The range of voices contributing to this issue and finding an intersection between architecture and gastronomy in their work goes from Architects, Professors and Students of Architecture to Physical Biochemists, Gastronomic Scientists, Experimental Psychologists, Sociologists, Experts in Future & Virtual Environments and Food Designers.

THE CALL

"Architects, like chefs, turn the raw into the cooked, transforming basic materials into an end product. In both cuisine and architecture, a sensory and social world opens up from the perfect combination of elements brought together in time and space. The two practices answer the mere necessities of life, shelter and food, but both can transcend the prosaic to reach a higher level of culture" (4)

Gastrotecture presents itself as

the hybrid between gastronomy and architecture. Gastronomy means the art of eating, from the Greek gaster 'stomach', and nomos 'law'. (5) Architecture means the art of building, from the Greek *arkhitéktōn* (architect), *arkhi* 'chief' and *tekton* 'builder' (6). Both gastronomy and architecture are part of our everyday life, as an expression of cultures, as an interdisciplinary practice involving senses, combining materials, defining structures and forms of living together involving a social dimension.

On the one hand, the architect Bjarke Ingels names these hybridizations "bigamy" and describes it as *"taking multiple designable elements that may not seem fit together, and merging them to create a new creation or genre."* (7). This thinking allows us to step out of the accepted parameters of any field, such as architecture or gastronomy, and in doing so, bring life to new ideas that previously seemed impossible or unheard of. On the other hand, Daniel H. Pink speaks of the end of the "Knowledge Age" and the beginning of a new era, the "Conceptual Age", where the future belongs to a type of person with a global and creative vision. That seeks transcendence instead logical, linear and computational capabilities, typical of the information age. (8)

Gastrotecture aims to achieve a broader understanding of the intertwined relationships between architecture and gastronomy, expand the limits of both disciplines and register the emergence of new practices supported by innovative and unconventional approaches from design and technology. Gastrotecture invites authors to converge architecture and gastronomy, understanding their borders broadly. Multi, inter and transdisciplinary expressions and research through the proposed but not limited "bigamies" and keywords listed below:

Time, Space & Food

Relationships between food elements, ways of cooking, presenting, serving and tasting rituals, and food to human body relation, context and space surrounding it. Unconventional culinary spaces. Scenographies and artistic approaches to gastronomic spaces and table settings. Cum-edere "to eat with", unprecedented visions of gatherings around food. Atmospheres / Symbolisms / Time / Spaces for food

Cities & Food

Architectural and urban solutions bearing food industry issues and facing the challenge of how to feed a growing population without destroying its natural resources. Conciliation between food production, habitat, environmental impact, health, consumption and waste management. Circular gastronomy and sustainable cycles in the food industry. Living architectures: building with organic products and materials derived from food. Architecture defined by farming and its processing. Form follows food

Farming & Space Food

Food and farming systems for outer space. Farming solutions on sites with extreme environmental conditions

Sci-Fi & Food Design

Food that brings us the future. Culinary outputs where food, hardware and software intertwine cross methodologies and visionary settings. Kitchens as Fab Labs. Advanced food design. Food & Algorithms: Parameterization and computational design applied to food. Food genotypes, evolutionary optimization. Gastrophysics. Food tech. Future's food

Graphics & Food

Graphic expressions of food, from analog representations to open forms. Food & geometry. Food graphics & codes. 2d, 3d, 4d, 5d representations. Visual narratives. Drawings / Notations / Mappings / Models / Collages / Montages / Diagrams / Simulations /

Future Environments & Food

Emerging practices of architectural design entering the field of future environments and Metaverses, proposing unseen forms of creation and experimentation of food and space. Virtual-Mixed-Augmented-Extended Realities advancing the Human-Food interaction (HFI) that will play a significant role in future human behaviors, gastronomic experiences, socializing and finance. VR / MR / AR / XR / Metarverses / Metafood / NFT / Web 3.0

Multisensorial Experiences & Food

Natural and artificial multisensory creations around food. Neurogastronomy. Psychological comfort. Sensory disturbances. Food Pairing / Food Bridging. Tools and tableware as sensorial stimuli

"*All the senses, including vision, are extensions of the tactile sense; the senses are specialisations of skin tissue and all sensory experiences are modes of touching and thus related to tactility. Our contact with the world takes place at the boundary line of the self through specialised parts of our enveloping membrane*." (9)

Twelve articles and an atlas of student works are presented in this edition of UOU Scientific Journal to introduce you to the realm of Gastrotecture. The contributions touch on more than one of the aforementioned keywords. As the issue's editor, I opted to structure the sections as "bigamies" of linked ties between gastronomy and architecture. Following this classification, you

will read one article related to Time, Space & Food, four articles related to Cities & Food, two articles related to Farming & Space Food, one article related to Sci-Fi & Food Design, one article related to Graphics & Food, two articles related to Future Environments & Food, and one article related to Multisensorial Experiences & Food. Of course, this structure presented here is not the only one possible, nor is having used the notion of bigamy to relate fundamental aspects or terms of architecture and cities with food and gastronomy. Still, it is a structure of its own with which I have tried to echo the richness of relationships and ties between the two.

Time, Space & Food

The first article, **"Building bridges: A transdisciplinary view on gastronomy"**, is a conversation between a food open scientist and a sociologist about the diverse range of areas naturally embraced by gastronomy and that can be used to explain specific characteristics of food and the act of eating. In this dispersion of areas, the authors reflect on the great challenge that gastronomy means for science and the need to build an overall vision and common language, what they called an "archipielago of knowledge" or "gastrology" that leans on transdisciplinarity and what sociology states as the science of associations, to approach that goal. They share the variety of definitions when the same object is analysed from different disciplines and the loss of possibilities if all these definitions are not first deconstructed and then connected with bridges. One way to deconstruct the kitchen is to blow it up by moving its parts to the periphery and allowing other outside thinkers to position themselves in the centre. That look from the outside is what the Kitchen Dialogues (Diálogos de Cocina) congress offers, organised by the restaurant Mugaritz, Euro-Toques and the Basque Culinary Center, and where the authors have been and are participating. From my perspective, a holistic vision of gastronomy and architecture forces chefs and architects out of the centre of their disciplines. This move may allow us to solve shared challenges such as feeding and housing the overpopulation while dealing with climate change, and using gastronomy and architecture as educational tools.

Cities & Food

In the second article, **"EDIBLE, or, the Architecture of Metabolism"**, the head curators of the 2022 Tallinn Architecture Biennale, presented food as the tool for imagining scenarios for alternative futures. They discuss the unsustainability and fragility, further accentuated by the pandemic, of the current global food systems and raise awareness about the journey of food that reaches our tables and its impact. In the same way, it is intended to reveal how architecture builds, feeds on materials and discards them. They addressed three scales: the micro-scale of materials –from brick to soil-, the macro-scale of large-scale territories – food and geopolitics- and the meso-scale of habitation -the metabolic home-.

In the micro-scale of materials, the results of the investigation contemplated in the eighth article of this Journal "RootSkin - from soil to soil" and the fourth article "Can We Eat Earth Buildings? The mineralogical common of earth building and edible earth practices" were presented and exhibited. In the meso-scale of habitation -the metabolic home raises the question: how can architecture radically intervene in these metabolic processes? One of the first modern attempts to construct the architecture of metabolism was Grahame Caine's Eco-House, featured in the sixth article of the Journal, which I recommend cross-reading along with the "The Metabolic Home" Biennale program.

In the third article, **"Food as a City Masterplan: Three Visions"**, the author proposes three hypotheses for designing and alter a city using a diet as an agent of urban and social planning. The first proposal exposes the consequences on the body, the home and the city of taking advantage of the "Lightnahrung" diet, feeding exclusively on the light. The second proposal values the local product, the second life of food that is not fit for sale but can be processed. Being a 2008 project, he revisits and updates it today, advising linking organic farming with the new collaborative economy systems managed by DAO, blockchain, tokens and gamers that would help engage the younger community. In the third, a more speculative proposal, the author revisits the Paleolithic, the golden age of humanity, according to Jean Chavaillon. It proposes the denial of agriculture to sponsor and free food from the property, from the act of cooking and consuming to become a relational platform. In this high degree of technology, the author transfers architecture to food and choreography to the city of leisure; there is no longer production but consumption. These three projects carry new architectural typologies and urban models, as seen in the previous article.

In the fourth article, **"Can We Eat Earth Buildings? The mineralogical common of earth building and edible earth practices"**, the authors present one of the most distinctive bigamies where the mutual dependencies between humans and their surrounding natural resources are revealed. Through this pioneering research, the authors analyse, compare and contrast soil as a building material and food, something more commonly found in other

animal species. It is a theoretical and experimental research-by-design investigation into the mineralogical content within earth materials and its role in building and human metabolism. The Results of the research-by-design process of creating buildable and edible earth artefacts were presented in a public [EAT ME BUILD ME] installation as part of the 2022 Tallinn Architectural Biennale. A significant project and its potential circular value of using earth-based materials as a healthy building material, food and local resource.

In the fifth article, **"Architecture for Fermentation and vice versa: A review of the passive-cooling strategies they may share to combat the rising temperatures due to climate change using Iberian pork slaughterhouse as hypothetical model where both disciplines converge"**, the author proposed that the contamination of fermentative techniques and spaces through architecture - and vice versa - are a form of biomimicry that generate results more adapted to the environment, economy and social functioning. We see that, like many of the articles in this journal, the vernacular architecture, construction techniques, materials and local products are necessary conditions to guarantee more sustainable cycles. The Iberian pork slaughterhouse and the amphoras for fermentation are examples where form follows function, and food production is the leading agent that shapes the space. This study links to the next chapter since the conclusions drawn from these processes in extreme global warming can inform solutions to other extreme situations, such as those created in outer space.

Farming & Space Food

In the sixth article, **"Junk Food: Radical approach to sustainability in Grahame Caine's Eco-House"**, architecture and food production are not introduced in the context of extreme environmental conditions, which does happen in the fifth and seventh articles. Instead, architecture proposes an extreme performance to align with a radical approach to food production and the waste recycling cycle. It is an example where two basic needs stand out: the construction of a shelter and food preparation. It reveals the cohesion of the energy cycle that humans and architecture need and can produce. Architecture, tightly associated with science, technology and its environment, looks back to its origins and becomes a social and political agitator in this "inhabitable housing laboratory". It reformulates the idea of "house" and its design processes as well as the physiology and psychology of living where the inhabitant makes the diagrams and the house works.

In the seventh article, **"From being Consumers to becoming Producers: DESIGNING CYCLES AT 64° Interior Urban Landscapes and the Water-Energy Food Nexus / PHASE 0"**, authors present the challenge of growing food in the sub-artic climate, at 64° latitude, where agricultural land is minimal, and the built-up area as an untapped opportunity for food production by exploring greenhouse extensions and building envelopes as local passive architectural solutions. Using the city of Umeå as an example, they introduce phase 0 of a living lab set-up, similar to Grahame Caine's Eco-House presented in the sixth article, and the need to test this research through a prototype "safe-to-fail", reflecting on the idea of a new vernacular for local food production reconnecting food with the soil and specific conditions required to produce it. With this model, academia and applied research built productive interfaces between the private and public sectors, involving architects, urban planners, students, NGOs and the general public to develop models that connect transdisciplinary knowledge in a holistic system. Authors reflect on these critical approaches by analysing precedents, even from different latitudes, that try to extend the growing seasons, and balance energy consumption and resources. These references are already addressing the world's expected population by 2050 and the current segregation, dehumanisation and globalisation of food production. The social implications of the project would also help to reconduct the phenomenon of increasing loneliness in Northern countries. Food production is presented as a tool to reconnect people by defining new housing and living layouts.

Sci-Fi & Food Design

In the eighth article, **"RootSkin - from soil to soil"**, the authors portray a living architecture that is both responsive to and harmonious with nature by recycling plants into architectural applications, specifically biodegradable textiles from plants supporting food growth. It intends to restore the environment's equilibrium through multispecies (humans, plants and bacteria) cooperation embedded in the design. It incorporates robotics and digital fabrication, allowing them to generate patterns that guide plant growth. Rootskin was also presented at Tallinn Architecture Biennale 2022. This article could be hosted together with "Can We Eat Earth Buildings?" article within the framework of building materials from the soil, multiple applications for architecture and food, and circular cycles. Nevertheless, this high degree of technification incorporating robotics in construction and manufacturing via computational design gives it another condition. Its lower temporality distinguishes it compared to bricks since when

the membrane biodegrades, it returns the roots back to the soil to provide, through bacterial decomposition, the nutrients for the next plants to grow. Finally, as an interdisciplinarity approach to design, analytical work was carried out to develop the moulds by studying other artists and designers who work with roots.

Graphics & Food

In the ninth article, **"The disorder of the dining table"**, the author takes us into the context that hosted the elaboration of the drawings that precede The plan of the house at Stock Orchard Street, 2001, colloquially known as the Straw Bale House. The drawings explore the relationship between diners around a table compared to the interactions between occupants in the home. Since table settings dictate people's behaviour during a meal as pillars, walls and stairs dictate the user experience, interactions and movement. The drawings illustrate a set of a meal for eight people at different times of the evening. They serve to record the wealth and enjoyment that springs from people's daily lives when they are not tied to pre-established behaviours, regulations or protocols, and are also more faithful to what happens instead of what had to happen, something that causes discomfort in architects and that we use to forget when planning. This sequence of drawings helped the author and architect Sarah Wigglesworth build a house that was unprejudiced in its distribution and in the incorporation of local construction materials. The resulting architecture accommodates the growth of food and the freedom to combine the ingredients to generate new recipes, understood as distributions of use, daily scenes, adaptations to changes and the incorporation of the Everyday. Analogically, the house has thatched walls that make the connection between architecture and food explicit.

The cover of the UOU scientific journal issue #4 is inspired by the drawings of Sarah Wigglesworth. It represents an intermediate state where the crossing of aromas and flavours stemming from the different dishes is perceived. As well as the different cultures, origins and nationalities that are in tandem with the open and transdisciplinary character of this call. (See Figure 1).

Future Environments & Food

In the tenth article,**"VIRTUAL PHENOMENOLOGY: A Critical Essay about the Relationship between Virtual Environments and the Senses"**, the author brings to the surface one of the most considerable challenges that the new media and associated controllers face: the stimulation of the senses in virtual environments. In the particular case that concerns us, the sense of taste brings together the most significant hardships for both the design of a tasting space and sensory experimentation. However, a cross-reading of the twelfth article, "The form of taste: On the origins, implications, and applications of shape-taste crossmodal correspondences", may shed light. The author presents the results of the DDFT 473 – Virtual Environments course at the American University in Dubai. It addressed the relationship between the virtual realm and the senses using virtual reality, allowing students to create virtual spaces associated with food inside virtual reality.

In the eleventh article, **"The Blur Table: An investigation of the**

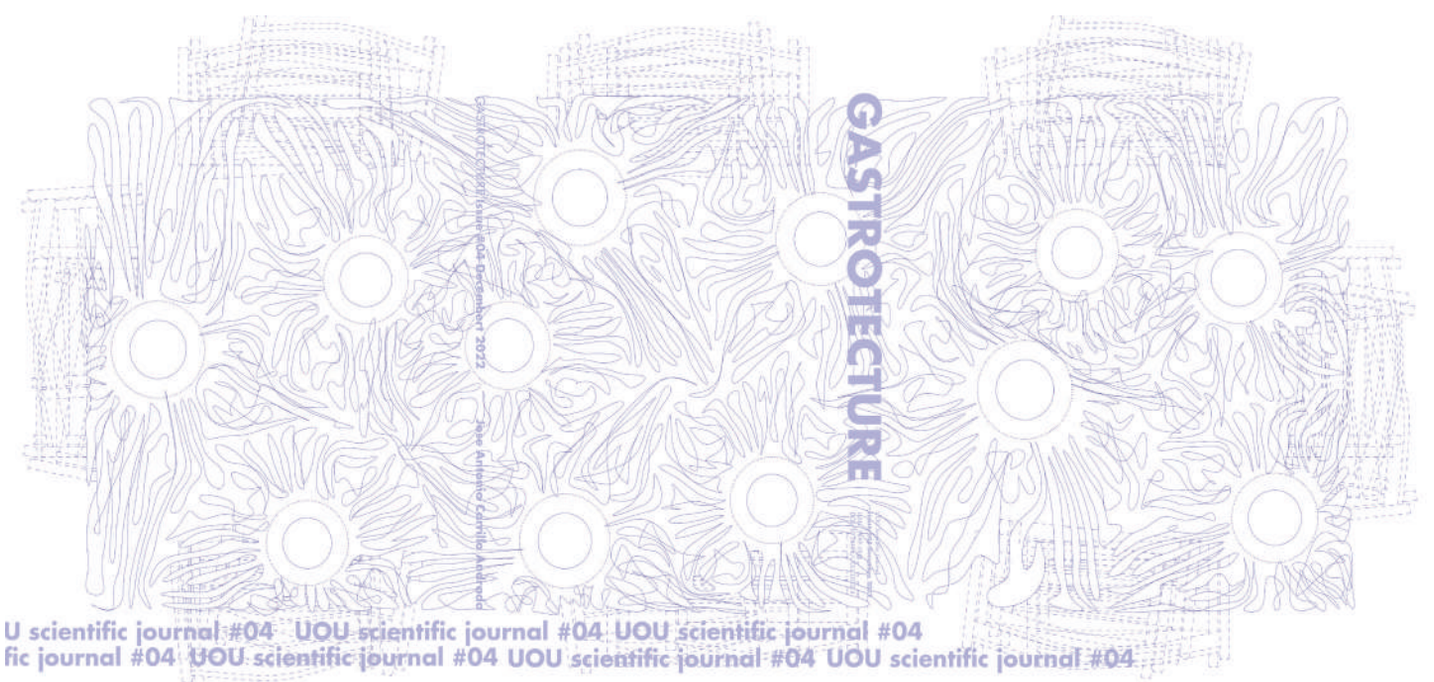

Fig. 1 - UOU scientific journal issue #4 cover inspired by The disorder of the dining table's drawings of Sarah Wigglesworth.

virtual experience through the social act of the meal" the author investigates the relationship between virtual space, physical objects, and the user in a domestic context in the context of the Covid-19 pandemic. At the core of the study is the social act of eating as a phenomenology of the social and as a connector between the virtual and the physical. This phenomenology is graphically recorded with digital and synthesised architectural tools in The Blur Table or, as the author calls it, "the borderless furniture". The representation directly parallels the Sarah Wigglesworth drawings presented in the ninth article. The article discusses the symbolisms and the constructions of virtual spaces that come with us, personal relationships, and the sense of reality in relation to the virtual. The final step was materialising the investigated notions into The Blur Table furniture that manifests the virtual experience in space and time.

Multisensorial Experiences & Food

In the twelfth and final article, **"The form of taste: On the origins, implications, and applications of shape-taste crossmodal correspondences"**, the author presents us with a historical narrative and a structured review of the affinities that an emerging body of crossmodal correspondences research has found between form and taste. Shapes that condition preferences and behaviours range from food to plateware, packaging, furniture and the servispace or dining environment. The insights have been attempted to apply in the fields of design, immersive virtual reality and experimental marketing and the results are associated with neurologically-normal individuals.

This last article allows me to connect with the archEatable academic course I have been directing since 2018 at the Architecture School at the American University in Dubai. The course explores Food and Gourmet Pastry Art as a vehicle for teaching Digital Design and Fabrication lessons in Architecture. Students design and manufacture a consumable product from beginning to end in collaboration with professional chefs in the region. They study in depth the cooking philosophy and sources of inspiration of their partner chef, as well as the culinary culture and brand identity of the chef's restaurant. Students design unique pieces that formally synthesise and reflect the brand identity aspects and the servispace. The edible creations are incorporated into the chef's menu and the restaurant's special events. Professor and students delve into the powerful collaborative synergy built with the chefs, learning from them which techniques and ingredients are more suitable to make the designs come true. The results are by no means possible without this cross-knowledge. Students and chefs jointly create a final product that responds to a transdisciplinary perspective.

This edition of the UOU Scientific Journal provides a constellation of associations between architecture and gastronomy through the 12 articles, allowing readers to reevaluate and discuss gastronomy in the context of architecture and vice versa. The "Atlas" section with student contributions, is meant to further the topic and provide examples. We hope your reading experience is enjoyable and stimulates unprecedented associations, new bigamies, and imaginative thinking.

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NOTES

[1]According to Lakehead University's "Essential Guide to Writing Research Papers," multidisciplinarity contrasts disciplinary perspectives in an additive manner, meaning two or more disciplines each provide their viewpoint on a problem from their perspectives. Multidisciplinarity involves little interaction across disciplines. Interdisciplinarity combines two or more disciplines to a new level of integration suggesting component boundaries start to break down. Interdisciplinarity is no longer a simple addition of parts but the recognition that each discipline can affect the research output of the other. Transdisciplinarity occurs when two or more discipline perspectives transcend each other to form a new holistic approach. The outcome will be completely different from what one would expect from the addition of the parts. Transdisciplinarity results in a type xenogenesis where output is created as a result of disciplines integrating to become something completely new. CALDWELL, Willie. Official Grad 5104 blog: https://blogs.lt.vt.edu/grad5104/multiintertrans-disciplinary-whats-the-difference/

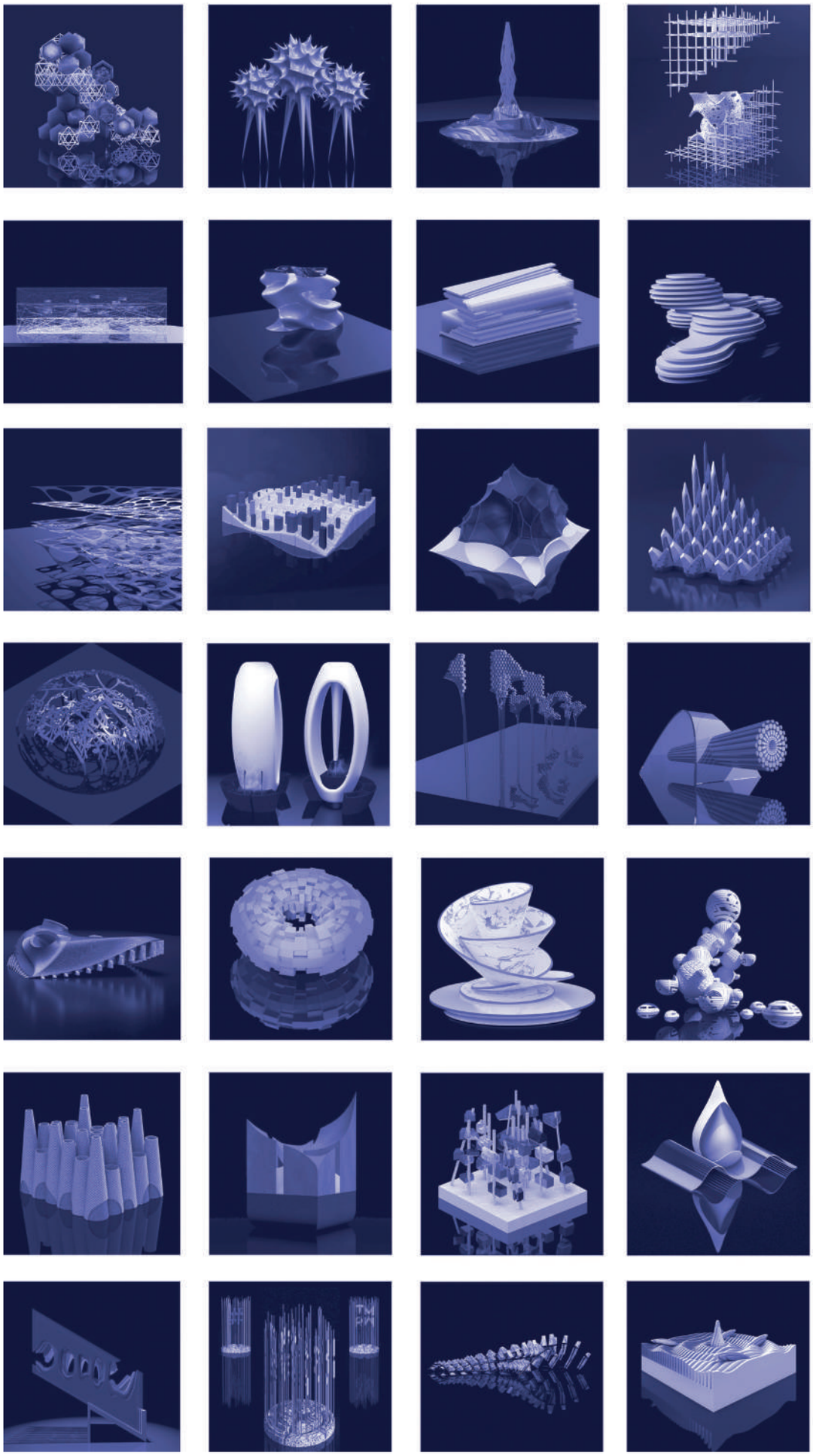

Fig. 2 - archEatable student's work. Editions 2018, 2019, 2020. Professor José Antonio Carrillo Andrada. School of Architecture, Art and Design. American University in Dubai. https://www.instagram.com/archeatable/

The human act of eating as the birth of the digital architecture

A conversation between the Editorial Committee members

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MATTER MATTERS

LN The time and space in which this conversation is taking place speaks to the space of architecture in the contemporary society. 'Post-catastrophes', 'post-human', 'post-pandemic', are some of the words used by researchers and commentators in the architecture field. The notion of post is referring to the present of a past and a future, and it is mainly directed towards a definition of a space that is not considered to be present at the moment. Placing us as human beings in the post-contemporary society we are dealing with a potential gradual dissolution of the everyday space, and the act of occupying this space that has been the most pertinent topic in architecture together with the notion of matter.

JA What it is relevant in Architecture and Art? Talking about objects is the matter. Matter as a physical substance that creates atmospheres, relations and light.

MD Matter surrounds us – a picnic in the countryside, surrounded by vegetation: barbecue at the beach, surrounded by water; and dinner at home surrounded by friends. All evoke and provoke. Architecture does that. Matter matters.

JA To understand the presence of matter in our projects we must refer to the writing of Toyo Ito about "Vortex" . Architecture creates matter as a human act of meeting and eating. An atmosphere as an immaterial envelope for the cherry blossom tree festival. 'Vortex' in currents of air, light and sound, being carried away by the current. This natural scenario for a lunch is a dynamic atmosphere that represent the birth of the Japanese architecture.

LN Is this still possible in a post-contemporary condition where matter and space can be dissolved and transformed by technology? What if we would be asked to re-write 'Vortex' in the current digital era?

MD The Japanese tea ceremony brings tradition, rituality and atmosphere to the place of drinking. Without the tea what would the room be? A void? I argue that the act of eating, and in this case drinking, makes the space a place. But can we replicate this experience? Do we need to be in Japan, in a purposefully designed room? Can we be far away? Does replicating the ceremony bring the place to us. We create heterotopias as we eat and drink. The 'French' restaurant in New York, the 'Spanish' restaurant in Berlin, the Italian restaurant on a cruise ship that moves across time and space as diners 'enjoy' the meal. And, even trying to recreate a holiday meal at home.

JA In this piece of writing, I want to discuss the future of the dynamic envelope by talking about SUSTAINABILITY AND DIGITALIZATION. Sustainable spaces as a physical and digital substance that create new environments, relations and horizons. Nowadays the new layer of the digitalization reformulates the design, adding virtual information to environmental conditions.

BEYOND THE EXPERIENCE

MD Architecture has been creating these physical (material) spaces for eating for a long time, but now there is a challenge. In the world of digitisation and virtual reality do we need to take ourselves to such places? Is the atmosphere, the experience, the occasion the same?

JA Last year, we start working in University of Universities UOU with Intelligence Artificial and Metaverse as new scenarios for the experience of eating. The reflection about the human act and its natural dynamic envelope was transferred to the internet. Zoom meals all over the world, virtual food, learning engines for future meetings, windows of windows as contemporary space for dinners. The projects start our thinking about the new environment produced in virtual relationships and the design of this digital dynamic act.

LN We are working in parallel paths researching possible conditions and contributing to the open debate in architecture as a way for integrating our teaching with these findings. In order to make sure that we can talk about artificial intelligence and metaverse we need to go beyond the common definition of this terms and go more in deep, and in order to do that we, as architects, need to learn from other disciplines and formulate a research question that can bring us to a next step where we would be able to use these words and reflect on them it. I feel the need as a researcher to have the time to elaborate and translate this subject into the notion of space and matter. The Dutch Pavilion curated by the Het Nieuwe Instituut in the 16th Venice Architecture Biennale presented the research “Work, Body and Leisure” as a journey through a series of architectures in the Netherlands and beyond in which bodies are categorized and transformed: offices, playgrounds, farms, factories and virtual spaces, windows, beds, and doors. Starting from this contribution, the Institute has opened a transnational research program focusing on how the field of architecture can be influenced and react to the emerging technologies of automation and how the notion of built environment and space can be reconsidered. And, this is just an example on how we can imagine architecture dealing with a non-physical experience. But can this really be considered as the future of our discipline?

MD And this is where I struggle to see how the architecture of the physical (material) space can be truly replaced. Until we genuinely share the whole experience we are only bit-players. Sharing online means we miss out on everything intangible associated with the occasion: shared smell, shared texture, feelings only to be replaced with an ersatz, and for now at least, poorer substitute. Eating needs a shared architectural space. So the challenge for the digital future is how to design such. Convince me it can be done!

JA Flavour, smell, texture as well as social relationships, boundaries and digital biotopes must be redesigned to establish this future scenario.

LN Are we really sure that we have the tools to redesign the future scenario?

JA Along the design journey, we used irony as a particular process of thinking. There was a strategy about the subject to change and the contingency and fragility of the final vocabulary to describe the change. In the book “Contingency, irony, and solidarity” (Rorty, 1989) Rorty defines an “ironist” as someone who fulfills three conditions:

"He/She has radical and continuing doubts about the final vocabulary she currently uses... he/she realizes that argument phrased in his/her present vocabulary can neither underwrite nor dissolve these doubts ... he/she does not think that his/her vocabulary is closer to reality than others...". The opposite of irony is common sense. During the year, we were not trying to dissolve doubts; we were trying to think about a new reality and to find ways to describe the vocabulary of a fiction. Architecture and gastronomy, in this fictional scenario, reinforces the natural presence of the human act as the birth of the contemporary architecture.

MD Would you prefer to drink tea with Toyo Ito on zoom, or in person? I know my answer.

LN I know my answer too. But is it just about converting the experience using a digital platform for communication or is this conceived as a totally different experience? I still don´t know the answer.

REFLECTIONS

SA On this idea of discussing the human act of eating, in the space of architecture, as the birth of Digital Architecture in the contemporary society, I argue that the ironic image below (Fig.1) encapsulates the representation of what we were sixty years ago and what we still are today: constraining food-for-thoughts within architects' blue boundaries, or a blue box where the representation of food makes claims for order within the real world boundaries that surround us. And, breakfast remains the same today.

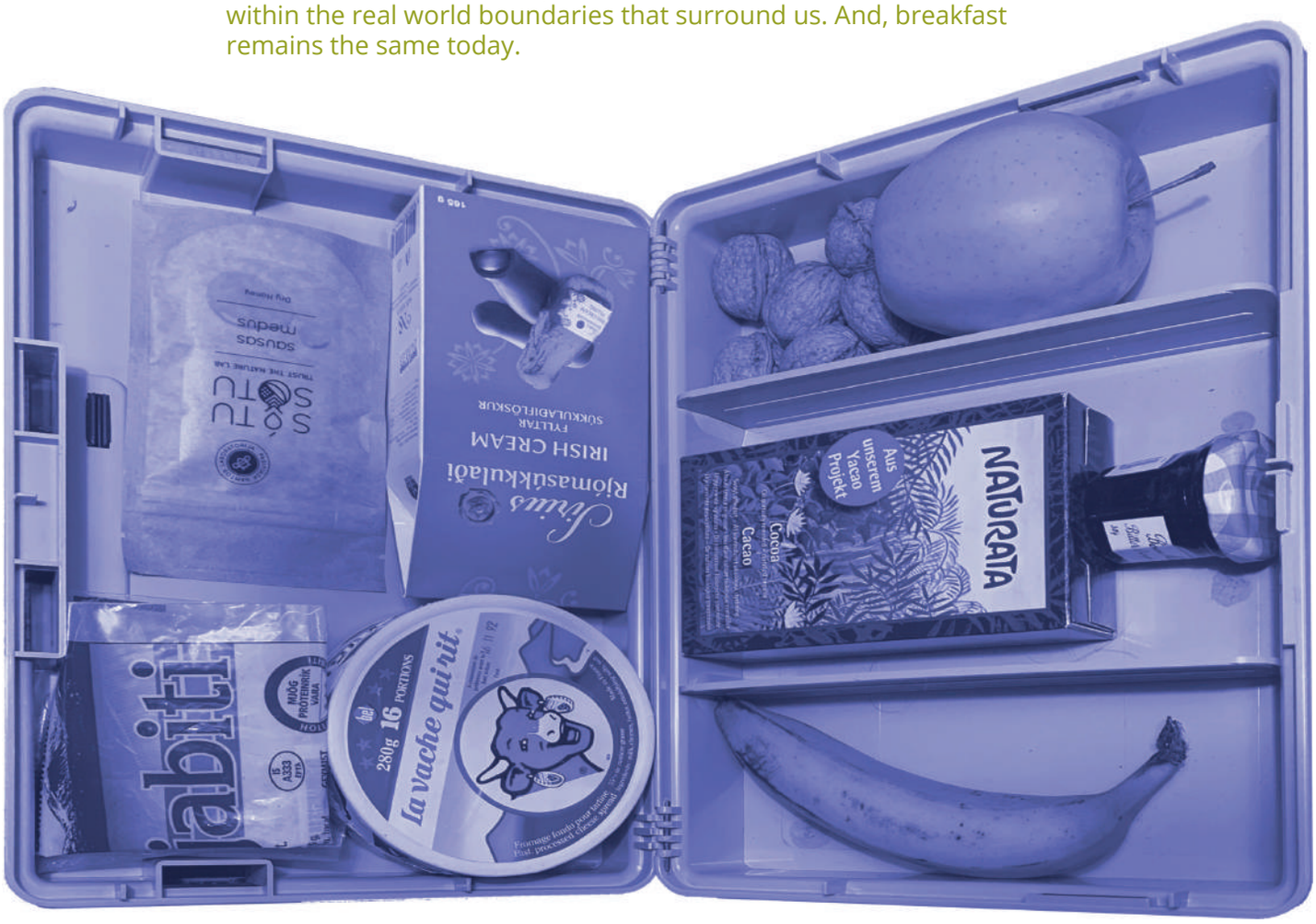

Fig. 1 - Breakfast Kit by Javier Sánchez Merina, based on *False Food Selection, 1965,* Claes Oldenburg. Getty Research Institute, Los Angeles

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TIME, SPACE & FOOD

Building Bridges

A transdisciplinary view on gastronomy

transdisciplinariedad
gastronomía
disciplinas
interacción
alimentación
ciencia
sociología
transdisciplinarity
gastronomy
disciplines
interaction
food
science
sociology

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La gastronomía es un espacio compartido que abarca con naturalidad diferentes disciplinas o áreas de conocimiento. La cocina, la sociología, la antropología, la historia, la arquitectura, la química y la biología son algunas de las áreas que se pueden utilizar para explicar las características específicas de los alimentos y el acto de comer. Sin embargo, las disciplinas normalmente trabajan por separado, provocando la mayoría de las veces una pérdida de información interesante. El concepto de transdisciplinariedad se utiliza entonces para considerar todas las dimensiones de la gastronomía para encontrar soluciones reales que van más allá de las disciplinas.

Este diálogo entre un científico alimentario y un sociólogo no pretende ser más que una conversación entre dos colegas de distintas disciplinas que suelen colaborar en algunos proyectos de investigación alimentaria. A través de esta experiencia colaborativa, ambos expertos destacan algunas ideas que pueden ayudar a construir puentes entre disciplinas. Al final, la gastronomía puede ayudarnos a entender todo el sistema alimentario.

Gastronomy is a shared space that naturally embraces different disciplines or areas of knowledge. Cooking, sociology, anthropology, history, architecture, chemistry, and biology are some areas that can be used to explain specific characteristics of food and the act of eating. Nevertheless, disciplines usually work separately, causing most of the time a loss of interesting information. The concept of transdisciplinarity is then used to consider all dimensions of gastronomy to find real solutions that go beyond the disciplines.

This dialogue between a food scientist and a sociologist does not expect to be more than a conversation between two colleagues from different disciplines that usually collaborate on some food research projects. Through this collaborative experience, both experts highlight some ideas that can be helped to build bridges between disciplines. In the end, gastronomy can help us to understand the whole food system.

THE SCIENTIST

I would say that Gastronomy is a common space that naturally embraces different disciplines, and different areas of knowledge. Gastronomy is a cosy house built during centuries. The atmosphere is impregnated by Cooking, all sort of cuisines from all over the world. In that house are rooms for so many disciplines: sociology, anthropology, history, architecture, chemistry, biology... the list is so long. However, the rooms are separate, and each discipline occupying its own room, consequently is not aware that it is in the same house as the others. At least in that house, each discipline exists for the sake of Gastronomy and Food.

Some years ago, I realized, as a food physical chemist, that I could perfectly understand the micro-structure of multiple foodstuffs, but I did not know anything about the social and cultural implications of that foodstuff. And that seemed to be fine. I was just applying science to understand different mechanisms at the molecular level. Science must follow the scientific method. You have a question, make a hypothesis, define a method, and have some results and conclusions. That is completely fine if we forget that that particular food is just one of the different actors that form the act of eating. Traditional cooking is more empirical. It is based on trying and observation (observation is also used in science). Chefs are more open to consider other factors like intuition and creativity.

But what is an apple? Is it a gastronomic product? Yes, it is. But it would be silly to think it would be just gastronomic. Food Science and Agricultural Engineering can also help to understand the meaning of an apple.

We can clearly see connections between disciplines in a single apple. But most of the times, disciplines tend to work in a separate room. They belong to the same house but they do not know or they do not want to know.

If we then do not act to build bridges, to have a broader vision of Gastronomy and Food, how could we think about topics like Gastronomic Sciences? If we try to simplify what is Gastronomic Sciences, we could say that Gastronomy becomes a Science. We could say that Gastronomic Sciences could fill that gap between Science and Gastronomy.

But is it that simple Iñaki?

THE SOCIOLOGIST

Let's continue with the apple. That apparently banal object is an object that has multiple dimensions and scales of observation. Those different forms of knowledge that we call disciplines, from the science dealing with the molecular analysis of the apple, to, say, the science that analyses the symbolic or sacred meaning of an apple in religious texts, between them cover the multiple dimensions of an apple. If we put all these dimensions together, we would have a kind of "archipelago of knowledge":, islands in a sea that separates them.

There is a more interesting definition of archipelago: a set of islands separated by the same thing that unites them. This will have to be the definition, Juan Carlos, not of gastronomic sciences, which continue to be separate islands, but of a Science of Gastronomy (I like naming it "gastrology"). The islands are the disciplinary positions, because each discipline needs a position, that is, its own perspective, concepts and methods, components through which it distinguishes itself from the other "sciences", otherwise the knowledge would be confused and would only generate confusion. But the fact that they are islands does not mean that they cannot collaborate in the knowledge of that sea that separates as much as unites them.

If we aspire to a Science of Gastronomy, for gastronomy to be a science like any other, with its own point of view, its methods and its analytical tools, an apple has to be a boundary-object. As Susan Leight Star has said, a boundary-object is robust enough so that it remains an object and does not lose its distinctive profile, but at the same time plastic enough so that it can be shared, analysed, interpreted by different disciplines, without any of them monopolizing it.

There is a very illustrative parable about a group of blind men who heard about an animal called "elephant". When they approached this animal for the first time, the elephant was for each one the part they felt (ear, trunk, leg, tail...). None of them had the whole picture of the elephant. The same thing happens with our apple and the blind disciplines, which only observe what they consider "their object" when it is actually "their approach to an object". The Science of Gastronomy is the attempt to convert relative blindness into a comprehensive and transdisciplinary vision (disciplines working together for the sake of all of them) of what we understand by food, eating and cooking as boundary-objects.

The paradox is that an apparently banal object such as gastronomy, which had always been left behind in the shadow of kitchens, traditionally considered as black boxes (we knew what was the input –food- and the output –dishes-, but not the transformation processes, the algorithm ruling inside), or in the short-range lights of a dilettante elite that used gastronomy to build social walls, the paradox, I was saying, is that gastronomy is a very complex analytical object due, firstly, to the fact that it has

never been considered worth analysing, and secondly because of the multiple dimensions it has once we observe it without prejudice. Gastronomy supposes a greater challenge for science and an opportunity to overcome what C. P. Snow called the two cultures; the huge abyss between natural sciences on the one hand, and the humanities on the other.

As a sociologist, I see my discipline as a sort of a matchmaker, a gathering-point where these two cultures can begin to talk and seduce each other, not to appropriate the object to the point of monopolizing it and disavowing each other, but to be able to work together in the narrow but stimulating space of the limits of each discipline. Sociology is a science that has put at risk its own object: society. It is no longer a science of society, a notion that has become controversial. I am not referring to that famous Margaret Thatcher's "ideological" claim: 'there is no such thing as society'. Sociology is the science of associations; it is focused on how things associate; how they form an ensemble. Sociology, therefore, could be useful to promote contact between these separate islands of knowledge; it could build bridges between disciplines.

Is it challenging for a "pure" scientist as you, Juan Carlos, - In this dialogue you called yourself "the" scientist - working with a representative of such a dubious knowledge?

THE SCIENTIST

... please let me correct myself...

AN OPEN SCIENTIST

Sure. It seems to me that a dialogue about building bridges among disciplines is extremely challenging, but not because I consider myself "a pure scientist" (what would that be?). It is especially challenging because of the current lack of associations and interaction among disciplines. The current structure of Sciences makes natural barriers with a low possibility of interaction or unity. This isolation, in a way, was needed for the progress of the different knowledge that represents disciplines.

According to Thomas Kuhn, Science enjoys periods of stable growth punctuated by revisions and revolutions. I enjoy imagining that we are close to a change of paradigm in Science and that of necessity. Science would build bridges to understand the world, the universe as a whole, like the bridge needed to connect psychology with neurophysiology or quantum and classical physics.

Why would a "pure" scientist feel that discussing with other specialists is challenging? A representative of a dubious knowledge? the sociologist or the chef?

This is a good point, Iñaki. We are discussing about how we could build bridges among disciplines. But those bridges are built by humans, by individuals (with their beliefs, fears, culture and so forth) that represent a discipline with lower or higher social status, and the individual response for that status. This fact makes a big initial barrier for the bridging proposal.

We need then, firstly, to break down those social and professional barriers, as well as to take a friendly approach with the language used. That archipelago, that set of islands are now separated not only by the sea, but also for a huge lack of communication between islands (disciplines).

Even if we break those barriers and we open the paths for communication, communication does not necessarily have to exist. We would need to create new rules for the game, how to interact, how to mix different knowledge, how to associate disciplines into a big house called Gastrology.

THE SO-CALLED SOCIOLOGIST...

Juan Carlos, let me tell you a little story. In 2013 I began to collaborate with Mugaritz Restaurant and the Basque Culinary Center in the content design of a congress that had (and still has) a very promising name: Kitchen Dialogues [Diálogos de cocina].

As I was a sociologist, and my discipline lacks a clear definition – and this is what makes it interesting and challenging - the promoters of the congress invited me to discuss the ability to talk about those things that are on the margins of gastronomy. They asked me to talk about the social and anthropological implications of eating and cooking. I did not feel very comfortable going as a representative of my discipline, because surely there would be people much more qualified than me to do it, so I took advantage of the occasion to promote as much as possible the encounter between "differents": different people, different methods, different ideologies and cultures, different origins, different sciences, different tastes, different backgrounds... of the people gathered there.

Up until then, the congress was dedicated to making chefs aware of disciplines that could be related to cooking. It was a congress designed "against" - a contra-model of the more conventional gastronomic congresses - in which the chefs showed their latest dishes and their technical findings in front of their colleagues. Kitchen Dialogues aimed to show that the cooks, instead of being the protagonists, those who had the singing voice, would sit in the auditorium to listen and be "disciplined" by what scientists and thinkers from multiple disciplines had to tell them about

what they did. Every two years we incorporated another perspective, a new topic, an unknown scientific discipline (chemistry, neuroscience, art, whatever). The congress functioned by "accumulation of knowledge", as if the cooks were enrolled in a university faculty.

One day, we realized that in the congress as such there was little dialogue. The different disciplines kept turning their backs on each other when they spoke from the stage. Each one was going to "talk about his book" as we say in Spanish. Seeing it on stage made it even more visible that the sciences inhabited a Tower of Babel, in which, each one spoke a language that was untranslatable for the others. The cooks, meanwhile, took notes very carefully and were surprised by the multiple dimensions of what they used to do intuitively.

But curiously, what happened in the backstage of the congress was very different, when we gathered together the guests, representatives of different scientific disciplines, at a table to eat. There, while they ate, their discipline ceased to be the center and they talked about what they were eating. You can imagine that the food that was served was, in addition to delicious, very challenging for the senses and for the intellect also: food for thought. The food that they were eating was a shared object that inspired all of them to use their knowledge as a means and not as an end.

In short, at conferences, scientists tried to defend and even promote their discipline, but at the table, aided by food and drink and the good atmosphere, they became "undisciplined" and spoke on equal terms, conversing unapologetically and without secrecy with their colleagues from other disciplines. Sometimes I have come to see in these tables how multidisciplinary collaboration and research projects arose. The real "kitchen dialogues" took place backstage: they were after-meals (in Spanish we call them "sobremesas") in which the table served as an improvised laboratory in which transdisciplinarity ceased to be a chimera.

I draw two lessons from this, Juan Carlos. In the first place, food itself is a factor for building bridges between disciplines, but not only because it is a boundary-object with its multidimensionality that increasingly interests more scientific disciplines due to or, why not say it, its complexity. It is a bridge-building factor because, secondly, it generates an environment of collaboration: because it is a social cement from which to build social as well as scientific bridges. Where scientists really get to know each other is not in the congress hall; in the congress, everyone makes their speech and leaves the room when their colleagues begin their speech. Where scientists really get to know each other is around a table, where they have to talk about an object such as food, cooking or gastronomy, and none of them "represents" exclusively or monopolizes the conversation. They have no choice but to listen what the others say.

The good news is that Diálogos de cocina has gone a step further: it has shown that that, over time, gastronomy has already reached such a level of complexity as an object of analysis that it is worth turning it into the subject to be addressed. Consequently, more and more chefs are taking the stage in a colloquium format. In addition, the willingness of experts in the audience to listen and learn from what chefs say about their work is becoming more and more evident. Gastronomy has acquired the status of an interesting topic. Probably not a scientific status yet. But everything may come to pass.

I dream that Diálogos de cocina will one day be a gastrology congress; a meeting in which there is no distinction between science and gastronomy; between brainy knowledge and gastronomic pleasure; a huge table where you eat and talk at the same time; in which the experience is known and enjoyed simultaneously; in which those gathered there have to do with their knowledge the same as they do with food, sharing it equitably so that no one leaves hungry. Food and knowledge served on the same plate. The knowledge of pleasure and the pleasure of knowledge working together.

AN OPEN SCIENTIST:

A good dream indeed, Iñaki. The problem here is when the scientist sits down around a table, she/he forgets that she/he is a scientist, and the full person arises. The knowledge may be shared but I think we are not yet prepared to do a serious work in those circumstances. Scientists want to control the objectivity and they become uncomfortable in the space of subjectivity. But Gastronomy is both objective or subjective at the same time. That is part of its complexity. It is true that Gastronomy has acquired the status of an interesting topic in the last few years. A scientific status would be one of a big list because Gastronomy naturally mixes disciplines like chemistry, physics, biology but also anthropology, history and much more.

Everything is in the melting pot already, but we don´t know how to deal with it. We don´t know how to integrate all disciplines to get a better understanding of the food system as a whole. After all, chefs inhabit the space of Gastronomy as the main representatives and they can play a key role to build bridges between disciplines, helping individuals (disciplines) to transgress the barriers of other disciplines.

In extreme conditions, barriers

between disciplines can vanish. I have been involved for a while in a project about space food. Humanity is facing the situation of having human beings living on the moon or travelling for three years to Mars. In that situation, the astronauts can´t only be fed by gels and lyophilized food as happens at the moment. They would be fine from a nutritional point of view. But we know that it is not enough. We can design much more interesting products from a culinary point of view. That would be a good step forward. Still not enough. In that extreme condition, the act of eating, the act of sharing and socializing become precious. Every detail is important. The food microstructure of the served bread, the yeast properties from a microbiological point of view, the room where they eat, the ritual around the table, the cultural background of that people. Everything would work only if it were studied as a whole. Otherwise, we will lose important information and therefore we could have an unpleasant situation.

At this point, Iñaki, we can agree, just between you and me at least, that building bridges among disciplines could cause a paradigm shift. What for? And how?

It is clear to me that Research and Development would be much more effective and assertive. We live in a complex world with so many difficult challenges. In thirty years, world population will be around 9 billion people. Climate change is already here (floods, droughts, less harvests), increasing food prices, fuel shortage, having less water, creating political and social instability. Food will become (is becoming) a commodity. We really need to change our minds for a more sustainable consumption. Go to a market, anywhere in Europe. You can find quite a lot of food from the other side of the world. Why? Because we demand it. Policy makers have a big role here, but the battle starts from our own standpoint. We need to think about how we grow food. How we eat it? What we eat? How much I am prepared to pay for it. It will a big issue of availability, quality and price of the food.

It seems not such a great scenario, doesn't it?

At the same time, human knowledge is exponentially increasing day by day. AI, eating sensors, robotics, VR systems are a reality already and it will affect our way of eating. We already have an overload of information. Algorithms are doing the job of correlating information but is this enough? or is this right? Do algorithms solve all our problems? I don´t think so.

We need to be more focused on correlating different sources of knowledge rather than learning a singular body of knowledge. We will have more time to understand the whole picture. We humans are incredible creatures, full of knowledge, ambition, power, pains and joys, love and hate. We are more than knowledge, more than science or technology. Science and technology do not give us all the answers we need. We need to see the big picture. That is why we need to humanize Science.

How? You know Iñaki. I am always looking for the way to organize this. The way of interaction among disciplines.

From our first interactions between food science and gastronomy, we managed to design mega-resistant foams capable of withstanding a syringe passing through them to include aromas that the diner would fortuitously encounter in his sensory experience. A complex scientific challenge that allowed us to reflect on concepts as intangible as vanity. At the beginning of this journey, we were happy to observe how two very different disciplines complemented each other and created a much richer mosaic, providing more useful information for a better understanding of the food world. This juxtaposition of perspectives and models from Science and Gastronomy began to approach the definition of multidisciplinarity.

We have been evolved in our way of working and now, at least, we have a same space where different academic profiles cohabit: chemists, biologists, food engineers, nutritionists, chefs,... In this space, people work in multidisciplinary teams on a common theme. In practice, this is achieved through the transfer of models, methodologies and tools that work for the common good of the project and never from the discipline itself. This way of working, called interdisciplinarity, has the capacity to generate new disciplines, such as quantum cosmology (generated from the confluence of cosmology and quantum physics), archaeological chemistry (generated from the interaction of chemistry and archaeology). Gastronomic sciences too?

From this point, and with enough sensitivity, it would be relatively easy to place ourselves into a transversal vision. However, it would be crucial to design a new way of working in a transdisciplinary frame. In this transdisciplinary adventure, no discipline should take control of the space. We should pursue dialogue. Consensus and mediation will thus be an important goal. Rather than reproducing fragmented models from a particular discipline, the different realities that exist at the same time should be considered.

I wonder, what would be the architecture of our dream space?

THE SO-CALLED SOCIOLOGIST

Juan Carlos, it is very interesting that your last question points to

the tangible. How to conceive an architectural design for that dream space, to be able to share an object of analysis (gastronomy or the food system) just as we share, on a table, food or a gastronomic experience?

Normally, to analyse something, science isolates it and puts it in a laboratory. As absurd as it may seem, analysing something happens by stopping its practice. We stop eating to analyze how and what we eat; we stop cooking to reflect on how we cook. To close the door of a laboratory is to lay the first stone of the building of a scientific discipline.

Why don't we make tables in those dream spaces to experience first-hand the complexity of the object we are facing? Why not make the table the laboratory of the Science of Gastronomy? A table where scientific data is processed, discussed, food is eaten, people socialize...

There was a system sociologist who claimed that the only way to deal with complexity is to create even more complexity. Putting an object such as food, the food system or gastronomy in a laboratory and isolating it is an attempt to reduce complexity. It is like looking for the key in the lighted area knowing that it is not there.

The table is, apparently, something not very complex, a space designed for commensality, for understanding each other. I like to think that setting a table properly, which is very often left in the hands of children, is something extraordinarily difficult. Why not think about how to set a table for science?

Commensality is to the table what transdisciplinarity is to science. Being transdisciplinary is wanting to eat with others who are different at the same table, something that is not known what it is, but that will satisfy all parties. Not for the same reasons though.

How we eat depends, therefore, largely, on how the table that we are preparing to eat is designed. Whether it is a table designed to gather or to separate. If it is designed to gather, it will generate harmony and the result of the conversation will be cacophonous. If it is a table to separate, like that huge white table where Vladimir Putin receives the leaders of other countries, it will generate conflict and therefore a feeling to be lost in translation.

I have known tables in prestigious congresses that

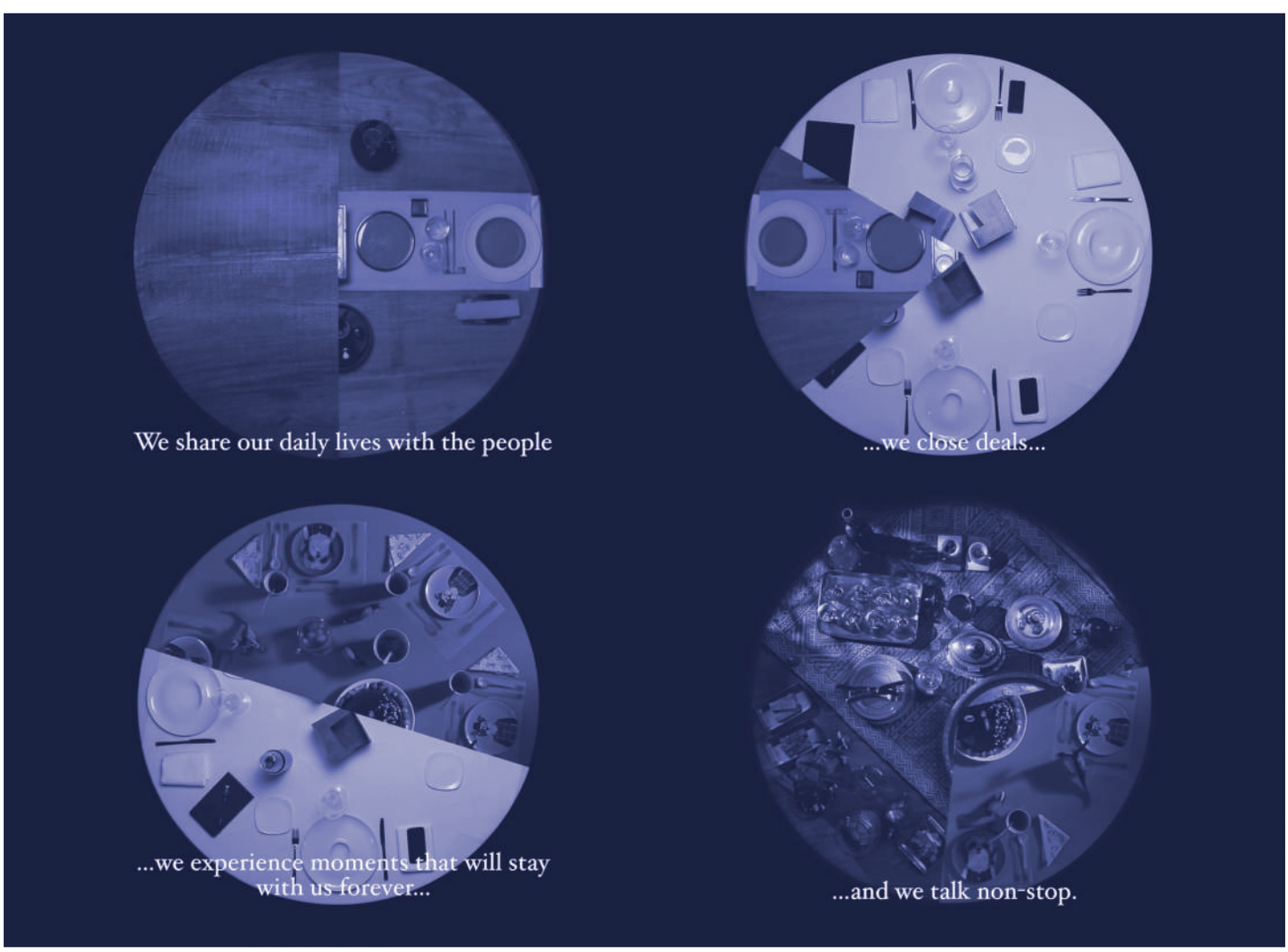

Fig. 1 - Gastroarquitecture of a table. Diálogos de Cocina 2017. Basque Culinary Center. https://www.youtube.com/watch?v=yWF7TNf51Ic

followed that same separating pattern. Whereas, on the other hand, there will have been unstable picnic tables where visionary theories have been formulated. A picnic table can cross borders, as artist and photographer JR did on the US-Mexico border. Tables that serve for eating the borders that try to split them. There are apparently friendly, inclusive tables, in which those gathered to eat are precisely the borders, which are indigestible with everything that is served because they are not going to eat, but to remain what they are, borders.

A stimulating table from the point of view of its design is the one that generates the possibility of understanding out of conflict and controversy; the one that unites and separates at the same time; that unites what separates and separates what unites. A table is an archipelago in which water is shared.

But at the tables there is a double conversation, the public one, the one that takes place on the table; and the one below, which is less audible. Above are the public agreements, below the small print, the backstage that makes those agreements possible. You talk about building bridges, Juan Carlos, but under the bridges, there are links that also serve to unite, although they do it in a silent way. Many translators and go-betweens are needed in transdisciplinary strategies. Not only bridge-builders.

So, following this interesting logic you propose that what brings us closer to design and architecture, to the so call useful arts, are what we need is to design experiences that produce a certain discomfort in scientists. A discomfort that takes them out of their comfort zone, that activate their subjectivity, but instead of paralysing them, help them break the glass ceiling of their discipline.

Finally, I would like to speculate on the possibility that these experiences could be gastronomic experiences. The Science of Gastronomy is a science that articulates associations or assemblages of social, scientific, technical and material elements, that activates in scientists a subjectivity, which makes possible collaboration with other disciplines beyond the cognitive limits of their discipline, that is, beyond the world of certainties in which their scientific socialization has taken place.

I would like to raise two questions in this regard: is it possible to design a space, a kitchenatory, in which scientists and chefs can work under equal conditions, without inferiority complexes or arrogant and contemptuous attitudes towards those who are different? Can this collaboration conclude, as it normally does in a scientific article, in certain dishes, designed by scientists and chefs, that make us think about how to face the great challenges that you mentioned in your last intervention, those technical, social scientific challenges, such as climate emergency, leading us inevitably to collapse? Can a dish be an epistemological device? Can it make us think, beyond producing sensory sensorial pleasure or protection (comfort-food)? Can they teach us something about how we are transforming our environment? To recall a core idea: commensality is to society what transdisciplinarity is to knowledge. Can a dish work the miracle of challenging and intriguing scientists from different disciplines and chefs in the same way, so that they have to collaborate to eat it and thus embrace its multiple dimensions?

These epistemological dishes would bring us closer to the most complete, multidimensional and multi-scale vision of the food system that you speak of, Juan Carlos. This possibility has an enormous poetic power. The truth is right under our noses, on the plate. A dish that shows us, first, that when we cook, we cook the world; and, secondly, that we should build the world as if we were cooking a dish, a delicious, sustainable, affordable and healthy dish.

What I am trying to say, Juan Carlos, is that beyond the intentions of the subjects, the will of individuals, laudable as they may be, gastronomy can help us to understand the food system by creating small experimental devices that make us be reflective on how what we eat and what we cook contributes to shaping the world. That we are what we eat; that we are how and with whom we eat; that we eat what eats what we eat; and that we eat what our senses perceive and what the micro-organisms that inhabit our second brain, the intestine, eats. This knowledge has to travel from scientific articles to kitchens; from laboratories to dishes. From science, to society.

CITIES & FOOD

EDIBLE, or the Architecture of Metabolism

πλανητικά συστήματα τροφής
συμμαχίες ανθρώπινων και μη- ανθρώπινων ειδών
Υποπροϊόντα και περιττώματα
ανακύκλωση
μεταβολισμός δομημένου περιβάλλοντος
πεπτικά συστήματα

planetary food systems
interspecies alliances
excremental processes
recycling
metabolism
digestive systems

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Πώς μπορούμε να ορίσουμε την αρχιτεκτονική του μεταβολισμού; Αυτή η ομιλία ερευνά πώς η αρχιτεκτονική κατασκευάζει, διανέμει και μετασχηματίζει μορφές εξουσίας μέσω της ανακύκλωσης υλικών, της κατασκευής συμμαχιών ανάμεσα σε διαφορετικά είδη -ανθρώπινα ή μη-, και της βιοπολιτικής που σχετίζεται με τη διαχείριση περιττωμάτων. Νέα δομικά υλικά θα παρουσιαστούν μέσα από την χαρτογράφηση και τον επανασχεδιασμό συνασπισμών στο δομημένο περιβάλλον, ως προϊόν πολλών δυνάμεων, που μεταφράζονται στις εντάσεις μεταξύ προϊόντων και υποπροϊόντων, παραγωγής και κατανάλωσης και, τέλος, δημιουργίας και αποσύνθεσης.

How can architecture produce food, and be eaten away? How can we define the architecture of metabolism? This paper seeks to reveal how architecture constructs, distributes, and leverages power via material upcycling, interspecies alliances, biopolitics and excremental processes. It maps and redraws the affinities of the built environment as a product of many forces, translated in the tensions between products and by-products, production, and consumption and, finally, creation and decomposition.

Fig. 1 - Tallinn Architecture Biennale 2022 graphic identity by stuudiostuudio.

When we consider something edible, we understand its capacity to be eaten, consumed, or ingested, independently of taste. If our contemporary relationship to the built environment registered these processes, what could our cities and constructed environments become?

During the COVID-19 pandemic, the question of where our food comes from became eminently important. The fragility of our production processes and the mobility networks that transport commodities and food, new forms of localization and the design of circular economies.

In the 2022 Tallinn Architecture Biennale --EDIBLE, or, the Architecture of Metabolism—we approached food both literally and metaphorically. On the one hand, we explored food via architectural strategies of local production and self-sufficiency —like urban agriculture and renewable energy (Fig. 1). On the other, we analysed the by-products of urban life—namely livestock, agriculture, and forest residues—as resources, and in ways that limit material loss and explore alternative pathways. The material and existential entanglements between architecture and food surface at different scales: from the gut of our bodies to the ecology of territories and the technology of building systems. They bring together the farm, the city, environmental inequality, and the stomach.

Currently, the global food system—from the overgrowth of chickens to the entirety of the agri-food industry—is the world's second largest emitter of greenhouse gases. As the need for food continues to grow in response to an increasing global population, the alienation between people and their sources of provisions also grows. We continue to produce and consume our edibles by growing carbon dependency, often unaware of the links between the sourcing, production and distribution of food, and the ways in which we consume it. In many ways, we are estranged from the journey of the edible arriving to our table. Returning to poultry for a moment, if we consider that the volume and weight of chicken breeds between 1957 to 2005 grew about 4 times larger, it becomes evident that our food systems are deeply mired by continuously unfettered growth. This rapid enlargement of chickens, for instance, has had a significant impact on their health and well-being, including in some cases the inability to move or support their own weight. We not only raise and alter chickens to be turned into a food source as quickly and efficiently as possible, but also have developed food systems that require the physical alteration of living beings to support the insatiable logistical machine of industrialized agriculture.

The overuse of fertilizers, the excessive reliance upon antibiotics in animals, the destruction of natural habitats through processes like deforestation, and the loss of biodiversity are only some of the many practices that massively "infect" human and non-human species on our planet in order to support our unsustainable food systems.

Fig. 2 - "The Metabolic Home" curated by Lydia Kallipoliti and Areti Markopoulou and designed by kse studio (Sofia Krimizi & Kyriakos Kyriakou). Tallinn Architecture Biennale 2022. Photograph by Petros Pattakos.

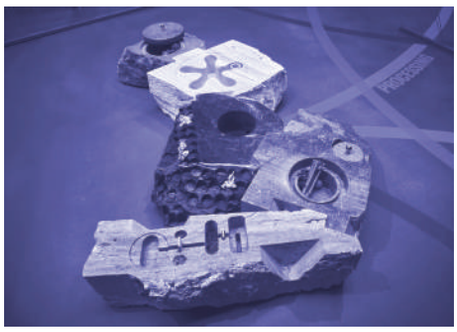

Fig. 3 - "Post-Industrial Zymological Kitchen" by Andrés Jaque (Office for Political Innovation) with M-Marble Project. Tallinn Architecture Biennale 2022. Photograph by Tõnu Tunnel.

Fig. 4 - "Everything's on the Table" by Hayley Eber and Mae-Ling Lokko. Tallinn Architecture Biennale 2022. Photograph by Petros Pattakos.

Fig. 5 - "From Brick to Soil". Tallinn Architecture Biennale 2022. Photograph by Tõnu Tunnel.

Envisioning an architecture that produces resources, digests its waste, and decomposes, could radically intervene, and recompose the extractive, consumptive, and contaminating logic and processes of the built environment. Within the context of interconnected global crises today, namely that of climate emergency, public health, and social inequity, the idea of a world where resources are recirculated is vital for planetary habitability.

Crucially, such an idea needs to be posed as a creative, multidimensional design problem that reflects the aesthetic and cultural qualities of spaces as productive environments in their full life-cycles: from the moment of extraction to the moment of demolition. How can architecture produce food and be eaten away?

It is with this in mind that EDIBLE urges architects, planners, and environmental designers to re-imagine planetary food systems along with architecture's expressive capacity to metabolize, digest, and generate resources.

How can we redefine traditional practices upon which the global food systems have been operating for the last decades and urge new forms of localization and production? How can we explore alternative pathways between production and consumption? How might we foster circular processes and economies through design?

The production of food organizes and establishes territorial sovereignty and political struggles, which are largely hidden behind power regimes that maintain aesthetic and lifestyle desires while changing the earth. The appearance of edibles, as well as the ways in which they are ingested and then wasted, are entangled with political protocols that manufacture and empower desires. These very political protocols also define the modes of reproduction and prefigure the modes of discourse through which food is envisioned, sourced, and distributed. Through this lens, we use food as the tool for imagining scenarios for alternative futures.

THE ARCHITECTURE OF METABOLISM

As the authors of Black Almanac—and participants in TAB 2022—wrote, "we incorporate the world, not only by acknowledging and recording its geochemical and socio-political manifestation, but also by eating it." By eating, we ingest the planet, and the planet in turn becomes the repository of our excretions. This reciprocal and primeval relationship of interdependency can be sensed via architecture, itself a medium wherein resource consumption and decomposition, as well body sheltering and micro/macro-climate change, is registered.

During the pandemic, we have all become witnesses to the fact that the human body is the most powerful instrument of biopolitics. When there is an immediate and abrupt change in the reality and canons of physical encounters, and in the ways that bodies relate and form spatial protocols, our understanding of larger questions—planetary habitability, climate justice and environmental ethics— become painfully present. Food uncertainty and the impact of the pandemic on industrial food production have foregrounded the urgency for a united reflection on the fragility of our production and distribution processes, the significance of the geolocation and mediums of such processes, our hubris in the pursuit of ceaseless growth and endless mobility, and finally, our accountability for how we occupy our planet.

Like a filter, architecture receives the evolution of territorial networks and geopolitical power struggles, and transfers it to the body. Historically, the body's physiology has gradually been removed from the processes wherein ecological concerns are translated into sustainability criteria. Buildings have been primarily conceptualized as systems equipped with devices, performing or operating in particular ways in order to achieve certain standards. As such, the literal and corporeal ramifications of occupation, maintenance, and care have been marginalized. While ecological systems of the postwar period portrayed the inhabitant as an indispensable part of building ecology,

currently this image is dismissed. Environmental concerns register in a framework that promotes conservationist ethics all the way down to lists for cautionary daily practices in face of scarcity.

Against this constellation, the metaphor of metabolism—which manifests most prominently in TAB 2022's main program entitled "The Metabolic Home"—presents the archetypal program of the house, conceived, however, as a living experiment and stage set where humans and other species, and their physiology of ingestion and excretion, become combustion devices and integral components of habitation (Fig. 2). The Metabolic Home is a digestive system that receives human output and waste in its multiple forms and converts it to various usable forms. This portrayal of the home urges viewers to look at debris, the waste of our own production processes, and the milieu of interrelated social problems that are linked to the production and transportation of waste, in a visceral way; via the raw ecologies of our bodies and the understanding that these problems are not simply statistical, abstract, and disembodied. They cannot merely be relayed only to the management of resources, but that they're landed on bodies and on the food we eat, the water we drink, and the air we breathe.

The idea of the house as a regenerative system prompted William Stumpf's "Metabolic House" in 1989, a project by the Minnesotan designer who investigated furniture design and ergonomics to explore energy efficiency and the local looping of water and bio-waste. In his own words, "Our houses should have a digestive system just like we do." For Stumpf, this principle was not rooted in biomimicry or physiology, but rather in exploring alternative patterns for energy re-use and consumption. This quest may forge new paths to habitation, both as a process of restoration of organic materials and recirculation of resources and remains relevant to contemporary concerns for decarbonization and non-extractive approaches to architecture.

In the exhibition, with different thematic spaces, we addressed three scales: the micro-scale of materials –from brick to soil-, the macro-scale of large-scale

Fig. 6 - "The Future Food Deal" a curatorial initiative for an open library by the Head Curators. Tallinn Architecture Biennale 2022. Photograph by Tõnu Tunnel.

Fig. 7 - "Edible Puffed Rice Organic Facade Finish" by Terreform One (Mitchell Joachim & Vivian Kuan). Tallinn Architecture Biennale 2022. Photograph by Petros Pattakos.

territories – food and geopolitics- and the meso-scale of habitation -the metabolic home.

"The Metabolic Home" redefined the concept of habitation and urged visitors to participate in a curated experiment (Fig. 8, 9). Each of the seven installations exhibited how metabolic processes related to food are linked to everyday domestic spaces and activities. Producing food was presented in a vertical robotic garden; processing in an interspecies kitchen; ingesting in a rewilded dining room; digesting in a lounge with an edible outer envelope; hydrating in a toilet that endlessly recirculates and filters water; breaking nutrients in a vertical terrace for harvesting; upcycling in a garage made of carbon negative voxels. Each domestic space was part of a larger domestic ecosystem and interacted with the other house parts in a feedback chain of resource exchanges.

In the section "From Bricks to Soil", the aim was to magnify the significance of the origin, process, use and destination of built matter (Fig. 5). With a focus on the micro-scale of materials, this section was a laboratory of experimental solutions for building prototypes and parts that are edible, upcycled, productive or compostable. Blurring the limits between natural and artificial, the projects presented are the outcome of "programming", hacking or adapting natural growth and harvesting processes with the goal to generate buildings and landscapes that produce food, become nutrients and food and enhance biodiversity.

Finally, in the section, "Food and Geopolitics," the scope was to engage with large-scale territories, planetary phenomena and bottom-up territorial actions via maps, drawings, films and visualizations of mass migration and food sourcing in challenging environmental conditions and zones of conflict. From local ground up material banks, to cultural practices rooted in the land and food (in)justice driven by ecological transformation, Food and Geopolitics highlighted the interdependencies of food systems, culture, political economy, and geography.

BEYOND METABOLISM

But moving beyond an understanding of metabolism as a collection of inhabitable machines—a reading which carries the heavy burden of modernism—we explore metabolism as patterns of energy and material generation and distribution within a 'multiverse' (or a 'pluriverse' as Arturo Escobar calls it). This reality does not tolerate the separation of humans and non-humans; rather, it urges the assessment

of a shifting web of life and death as well as alternative forms of matter, including non-human agents. In sync with the texts of Anna Tsing, Rosi Braidotti and Timothy Morton, among others, the framework of EDIBLE opens the notion of non-human agents to include not only biological, but also technological and cultural others, while it aims to explore the potential of all natural and technological expressions to mitigate the contaminating and extracting nature of our desires and protocols related to the production of the built environment.

So far, the role of building technology to insulate spaces from environmental flows has been suggestive of a moral discipline that protects buildings against disease, transferring an ideological framework of ethics to the micro-realm of materials. Nevertheless, in a new reality of interrelated crisis—namely that of public health, climate change, and environmental inequity—a new role may be cast for the notion of environment. Instead of the inactive, static, and historicized context within which an architectural object is placed, the environment—and the resources related to it—can quite literally become the object of design itself, introducing new principles of planetary co-habitation, circling of resources, and building performance.

How can we, therefore, design the architecture of metabolism?

How can architecture redefine resources, produce food, and be eaten away?

EDIBLE aims to reveal how architecture constructs, distributes, and leverages power via material upcycling, interspecies alliances, biopolitics and excremental processes. It maps and redraws the affinities of the built environment as a product of many forces, translated in the tensions between products and by-products, production and consumption and, finally, creation and decomposition.

Operating with an abundance mindset— rather than from a place of "scarcity"—TAB 2022 expands the definition of "resources" and the places for "mining" them, while providing actionable areas for designers and decision makers within a regenerative world that, in its turn, continuously recirculates the "food" required to sustain itself.

2022 TALLINN ARCHITECTURE BIENNALE CREDITS

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Fig. 8 - Metabolic Home performance during the opening day of the Tallinn Architecture Biennale on September 7, 2022.
Directed by Maria Ader. Photograph by Evert Palmets.

Fig. 9 - Metabolic Home performance during the opening day of the Tallinn Architecture Biennale on September 7, 2022.
Directed by Maria Ader. Photograph by Evert Palmets.

Food as a City Masterplan: Three Visions

diseño de comida
dieta
ciudad
escenarios especulativos
food design
diet
city
speculative scenarios

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En junio del 2021 tuvo lugar en Sevilla, organizado por LaPlasita, el congreso Ciudades Alimentadas. Mi ponencia consistió en plantear tres hipótesis donde una dieta se plantea como un agente urbanístico y social para planificar una Ciudad.

El título; Food as a City Masterplan

Las tres dietas eran analizadas y comparadas con mis proyectos de Food Design que actuaban como referencia, y finalmente se describía un escenario de como estos sistemas podían alterar la Ciudad, tanto urbanísticamente como socialmente.

De las tres dietas la que más me interesaba era la tercera, la que mediante la negación de la agricultura la ciudad pasaba a ser una plataforma relacional y de eventos, y donde este objeto comestible, La comida, es una parte importante de este set, libre del acto de cocinar y del tradicional comedor con mesas y sillas posicionado al lado de cocinas, almacenes de comida, y todas sus necesidades. De todas maneras, esta propuesta seria la mas especulativa, siendo la segunda la más realista.

La segunda propuesta consiste en unir la agricultura ecológica con los nuevos sistemas de economía colaborativa gestionados mediante DAO, blockchain y tokens, esto permite visualizar una gestión de huertos ecológicos de grandes superficies.

Este texto escrito a posterior intenta profundizar sobre todo en esta segunda vía, la del huerto ecológico de periferia, el “Extrarradio Jumbo Gardening”

In June 2021, LaPlasita organized a conference titled “Ciudades Alimentadas” (Fed Cities) Seville. My presentation there consisted of proposing three hypotheses for designing a city using a diet as an agent of urban and social planning.

The title: Food as a City Masterplan.

The three diets were analysed and referenced against my Food Design projects, and ultimately, I presented a scenario that described how these systems could alter the city on both an urban and social level.

Of the three diets described, I was personally most drawn to the third – which proposed that through the elimination of agriculture the city would become a platform for relationships and events, with food, the edible object, liberated from the act of cooking and from the traditional accoutrements of eating: dining rooms, food storage, all the usual necessities. This proposal was the most speculative I presented.

The second proposal was the most realistic and consisted of uniting organic farming with the new collaborative economy systems managed by DAO, blockchain and tokens. This created a visualization of how large-scale organic gardens might be managed.

This text, written after the fact, aims to provide an overview of all three proposals with a particular practical focus on the second, that of growing crops on the urban periphery, which I call “Extrarradio Jumbo Gardening”

HYPOTHESIS 1: LICHTNAHRUNG

This hypothesis is based on the book Living on Light: The Source of Nourishment for the New Millennium[1], by Australian author Jasmuheen. Lichtnahrung is normally defined as a lethal pseudoscience. There are several documentaries[2] about it. One was removed from social networks, after a German teenager died following the diet. Lichtnahrung, as its name suggests, consists of feeding solely on sunlight. The documentaries depict people who have tried and failed to follow the diet, and others who do supposedly follow it and claim it's difficult at first but gets easier. One afficionado lists "not having to go to the supermarket" as one of the diet's advantages. In one sequence, a couple sits at a table, but only one of them is eating. There are also interviews with doctors and nutritional specialists who declare that the diet is entirely incompatible with life.

The book The Buddha hinter dem Bretterzaun[3] (The buddha behind the picket fence), by Dutch novelist, poet and travel writer Cees Nooteboom, describes the author's experience as a young initiate in a Buddhist temple. I remember reading his account of how difficult it was to spend so many hours in a row meditating with his legs crossed, and how in the early days he lost weight due to the austere temple diet. After a while, he got to know his fellow initiates, who showed him how to hide a cushion to support those long meditation sessions, jump the fence on the weekend to go to McDonald's and even drink and visit prostitutes.

Armed with this knowledge, Nooteboom's daily hunger and discontent at the temple subsided. Lightnahrung is a diet as pyramid scheme, a system in which there is a sole creator, a variety of accomplices, and below them the scammed, who are numerous.

Fig. 1 – Antto Cooking, drawing. Plan of the Restaurant. Solar Kitchen Restaurant, Martí Guixé, 2011.

Related projects by the author

1/Solar Kitchen Restaurant[4], 2011

A restaurant that cooks with sunlight (Fig. 1).

2/Pharma Food[5], 1999

A macromolecule muesli that can be literally inhaled (Fig. 2).

3/Gatfog[6], 2004

An ultrasound machine that creates a gin and tonic mist

4/Camper Temporary[7], 2000

Customers can graffiti the walls of the stores, building a complicity with the brand (Fig. 3).

In the city that follows the Lightnahrung diet, there are those who believe, or who act as if they

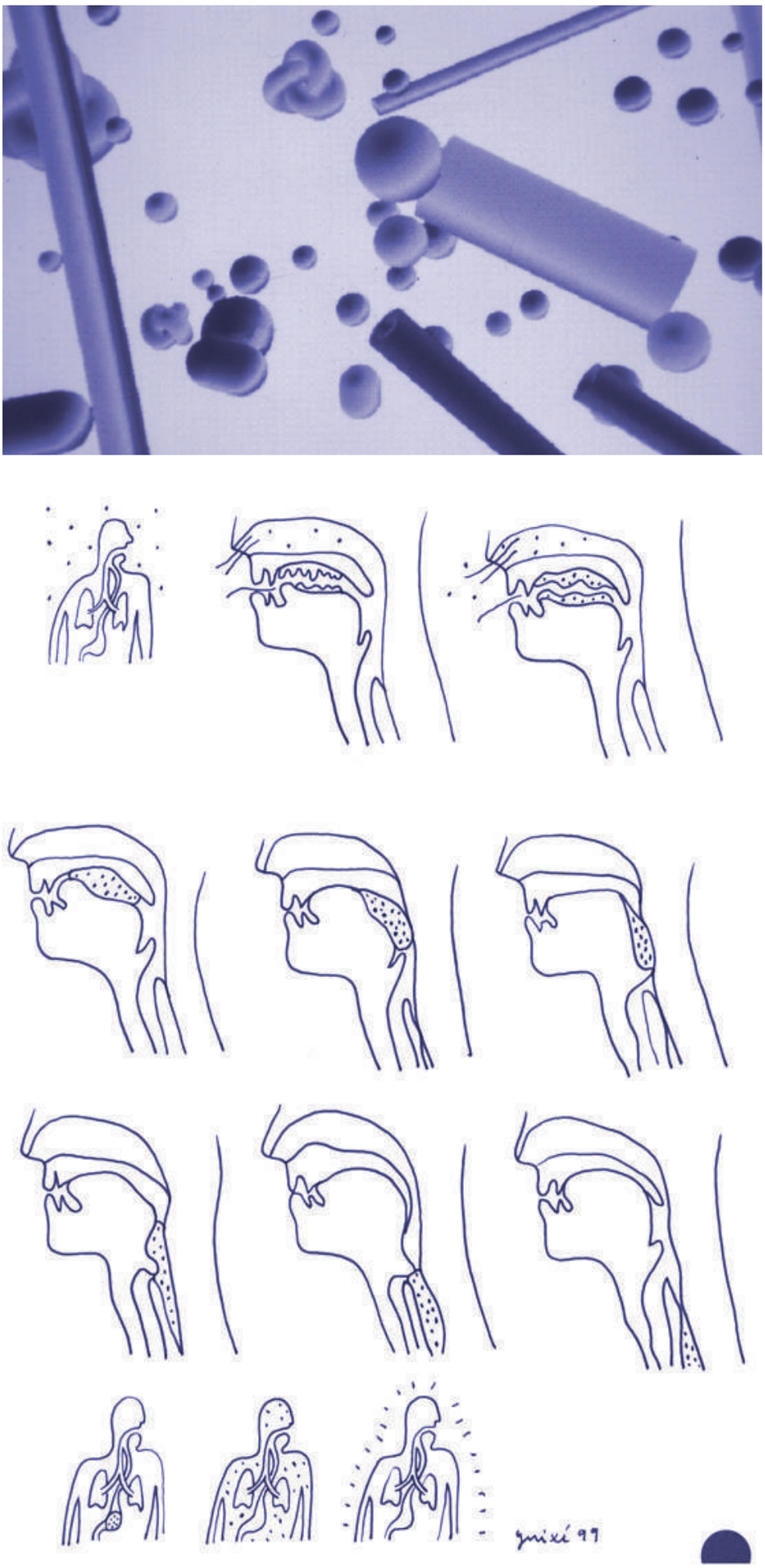

Fig. 2 – Pharma Food. Rendering of the micro muesli.
Drawing of the process of ingestion of dust. Martí Guixé, 1999.

do and therefore integrate into the city, while those who do not believe remain separate. The citizens who don't eat (at least publicly) are fed by light. There are no kitchens, no restaurants, no supermarkets. Food circulates illegally and in secret.

Effects

The city becomes closed and complicit. A wall of psychological protection is created between those who are inside and outside, and the day as regulated by food intake disappears. The city becomes a people united by the concealment of eating.

HYPOTHESIS 2: "EXTRARRADIO JUMBO GARDENING"

I know of two organic garden systems that are conceived and executed on a small scale, but which have potential to become large-area farming systems.

One is Gaspar Caballero de Segovia's "Parades en Crestall"[8] and the other the "do nothing" system developed by Masanobu Fukuoka[9], also the inventor of the well-known "seedballs," or Seed Bombs as appropriationists call it.

Rethinking these projects on a large scale presents two levels of difficulty: the cultivation and management of crops and their transport and distribution. With the latter issue I have a precedent, the workshop I gave at Slow Food Pollenzo[10] in Italy in 2008, which gave birth to the "Locale of the Locale" project.

Fig. 3 – Camper Temporary.
First shop in Milan. Photo Inga Knölke, 2000.

Fig. 4 – Final Presentation of the workshop Locale of the locale, Slow Food, Pollenzo. Foto Inga Knölke 2008.

Food Networks Workshop. Università di Scienze Gastronomiche di Pollenzo- Cuneo e Slow Food. Pollenzo, Italy. 2008

Locale of the Locale

Martí Guixé talks about a system to transport and distribute fresh fruit and vegetables around a fixed geographical area.

The project promoted the idea of designing a system or platform to, by means of a network of economic or social interests and influences, create a new link between producer and consumer.

The Pollenzo workshop was hectic for several reasons. I proposed that all participants (there were over 20) work in a single team, like a startup. I directed the work and each individual or subgroup was in charge of a function: research, conceptualization, design, drafting... it struck me as an effective format and was a direct reflection of the reality of developing ideas for commercial purposes. Some participants understood and rolled with the challenges, but a majority mutinied in the middle of the workshop and there were a number of heated arguments. Shortly before the workshop wrapped up, a computer virus destroyed the PowerPoint presentation we had developed and in the end we had a improvise a non-digital presentation. Presenting through storytelling and some pre-rehearsed choreography made us the star group at the event (Fig. 4).

The title: "The Locale of the Locale" refers to a place where everything is local (obviously referring to fruit and vegetables, which was the theme)

The issue was to design a system to organize the distribution of fresh products in a limited, "local" area. We wanted to bring producers and consumers of fresh organic fruit and vegetables as close together as possible. The two main points under consideration were sustainable agriculture and local distribution.

For this we needed an interface in the form of a brand. Since we were in Pollenzo (Piemonte) we put Slow Food (Pollenzo) as a reference and Turin as the center of our geographical area.

The "Locale of the Locale" consisted of a conceptual umbrella that encompassed a bookstore, an archive, a brand, a supermarket, a food production company and a space with daily news of fruits and vegetables.

It was a platform (of a kind very fashionable at the time) that acted as a local fruit and vegetable "publisher" and had a central building (the Locale) in Turin.

The Locale had a master of ceremonies, or curator, who made selections as though they were editing a fruit and vegetable blog, creating, essentially, a "market d'auteur."

The Locale also had a structure in place to process fruit and vegetables and make packaged products such as juice and soup, which created a new line of business for those products that were no longer saleable and promoted sustainability by not discarding them. Naturally, the packaged goods were organic and artisanal.

The Locale was to be managed by dividing shares in the business between the local city council,

the companies interested in buying space, the consumers and eventually the farmers. These shares also had repercussions on the people involved and were dependent on the sales and general management of the premises.

We fixed a radius of approximately 100 km in which our platform would be effective, and therefore the second aim of the project was to develop a system to bring fresh products from the countryside or the outskirts to the centre of Turin and the Locale.

It was decided that some slots on the premises could be opened with keys (now they could be opened with a smartphone code) to deliver merchandise. Some attempts were made to create an affordable 24-hour system: for example, a farmer's son going partying in Turin could make a delivery en route and be compensated for his time. Or someone from the countryside going to the doctor could likewise make a delivery, without having to manage delivery times or preplan the trip; the system allowed them to go at any time. Naturally, regular shipments were also forecasted.

This 100 km radius allowed for modularity, so that in the end large geographical areas could be configured in circular groups of 100 km in diameter that could supply entire countries.

The diagram used to calculate the distances and the supply was inspired by the PENTA[11] graphs, the "Plan Emergencia Nuclear Tarragona" a Nuclear Emergency Plan in case of catastrophe (using plans that are in fact of American origin), where the areas affected by radiation are indicated according to distance and wind (Fig. 5).

Seen today, this project from 14 years ago still seems modern, and it could be redefined through

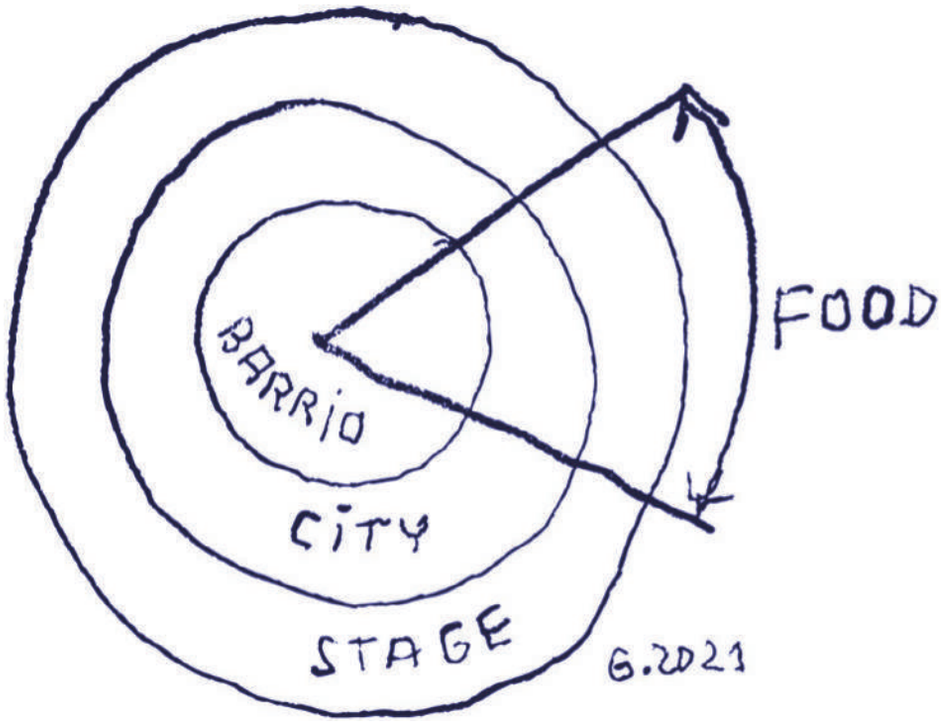

Fig. 5 – Food as a City Masterplan: Three Visions. Diagram.

new technologies, especially those based on DAOs (Decentralized Autonomous Organizations), Blockchain and tokens.

The collaborative economy and its remuneration systems creates a perfect platform to involve young people through gamification, which would allow a more agile and simpler implementation of remuneration management, and emotional involvement in the shares and processes.

Projects by the author

5/Food Facility[12] 2005

A restaurant outsources its kitchen and its cooks, and organizes its meals via other takeaway restaurants (Fig.6).

6/Park Life[13] 2003-2009

In Park life, work is play. Physical work, sometimes ancestral, is a sport.

7/Spamt karaoke[14] 2000

The collaborative economy blurs the border between producer and consumer (Fig. 7).

A 100km-area around the city with sustainable, organic agriculture based on the "Parades de Crestall" system of Gaspar Caballero de Segovia, or the "do nothing" of Masanobu Fukuoka.

Gaspar Caballero creates well-designed organic gardens organized into "parades," or strips. The garden areas can in this way be multiplied, scaling up production.

Masanobu Fukuoka proposes cultivation by means of planting seeded mud balls, and then doing nothing. These two alternate methods could configure different types of crops in city outskirts.

The process would be managed through DAO (Digital Decentralized Autonomous Organization), and work paid for via tokens.

Effects

The city becomes diluted as it reaches the outskirts, and an ecology or economy is built of movement, blockchain, elements of the participatory economy, real and virtual connectedness.

Displacement builds the city, mobility and self-management through digital technologies.

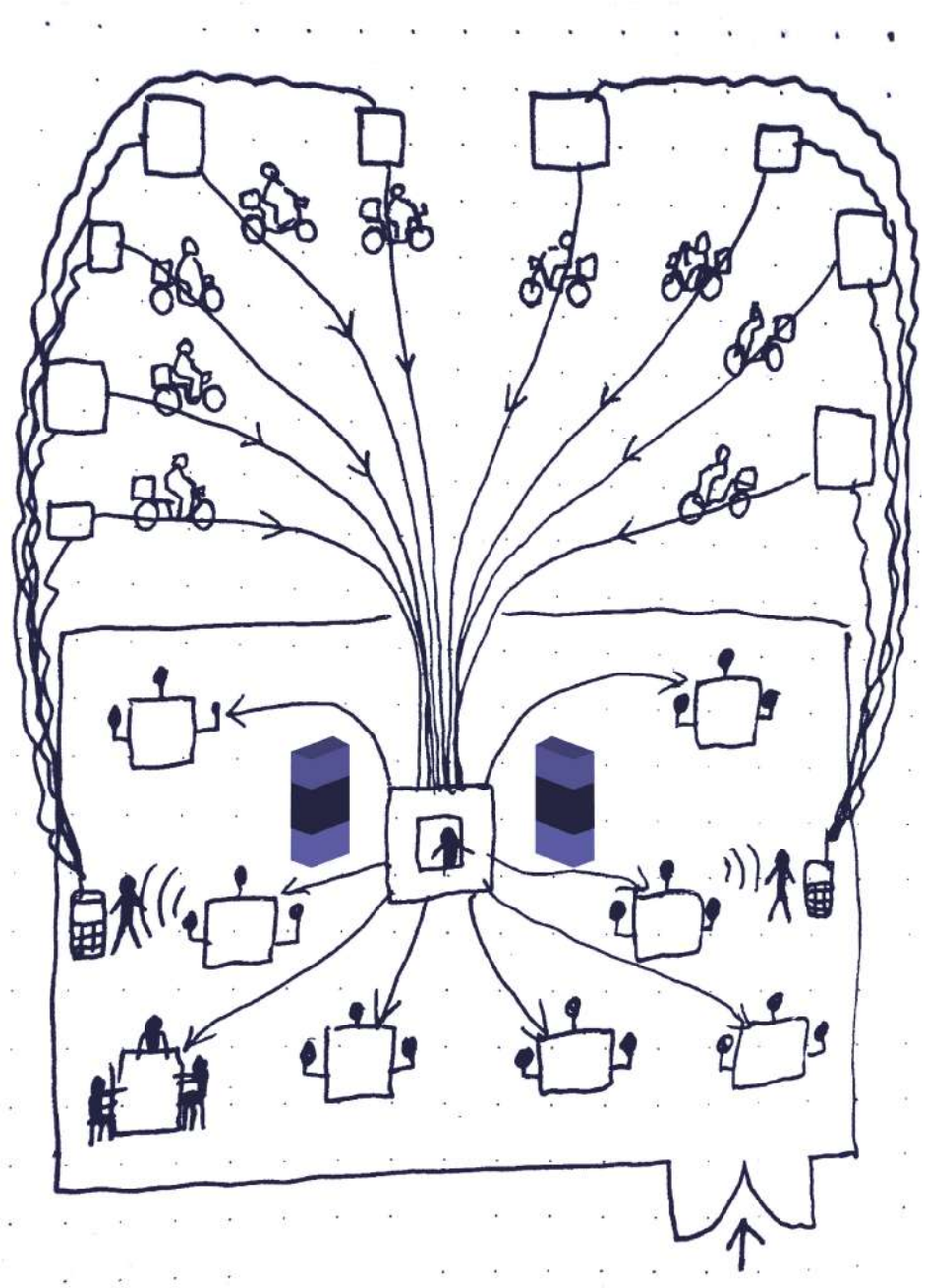

Fig. 6 – Food Facility. Diagram. Martí Guixé, 2005.

Fig. 7 – Spamt Karaoke. Foto Inga Knölke, 2000.

HYPOTHESIS 3: AGRICULTURE-FREE FOOD DESIGN

In the book The Golden Age of Humanity: Paleolithic Chronicles[15], author Jean Chavaillon considers the Paleolithic as the golden age of mankind. In this period groups of humans lived nomadically in Europe, moving continuously, completely free, hunting and gathering. There was no agriculture, and therefore neither the concept of economy nor of property or territory existed.

Humanity was on the same level as nature. The moment agricultural production began, the modern economy, capitalism and the consequent destruction of the planet began too.

The challenge, therefore, is to develop healthy and sustainable food without resorting to agriculture, through the technical cultivation of substances that can be combined to create a diet liberated from the constraints of nature. Long-term, the production of the bases of our diets, whether fruits and vegetables or meat or fish, becomes obsolete.

Projects by the author

8/Sponsored Food[16], 1997

The sponsorship of food production could potentially liberate us from the consumer society. This will become the "new nature" and humans will once again be able to circulate freely, eating for nothing, in a new golden age of humanity.

9/Tonic Death Diet[17], 2013.

Directed active hypotonia induced by hypnosis (Fig. 8).

A series of pills and instructions that allow people to forego traditional food for relatively long periods of time.

10/Digital Food[18], 2017

Food is printed through an architectural project, produced

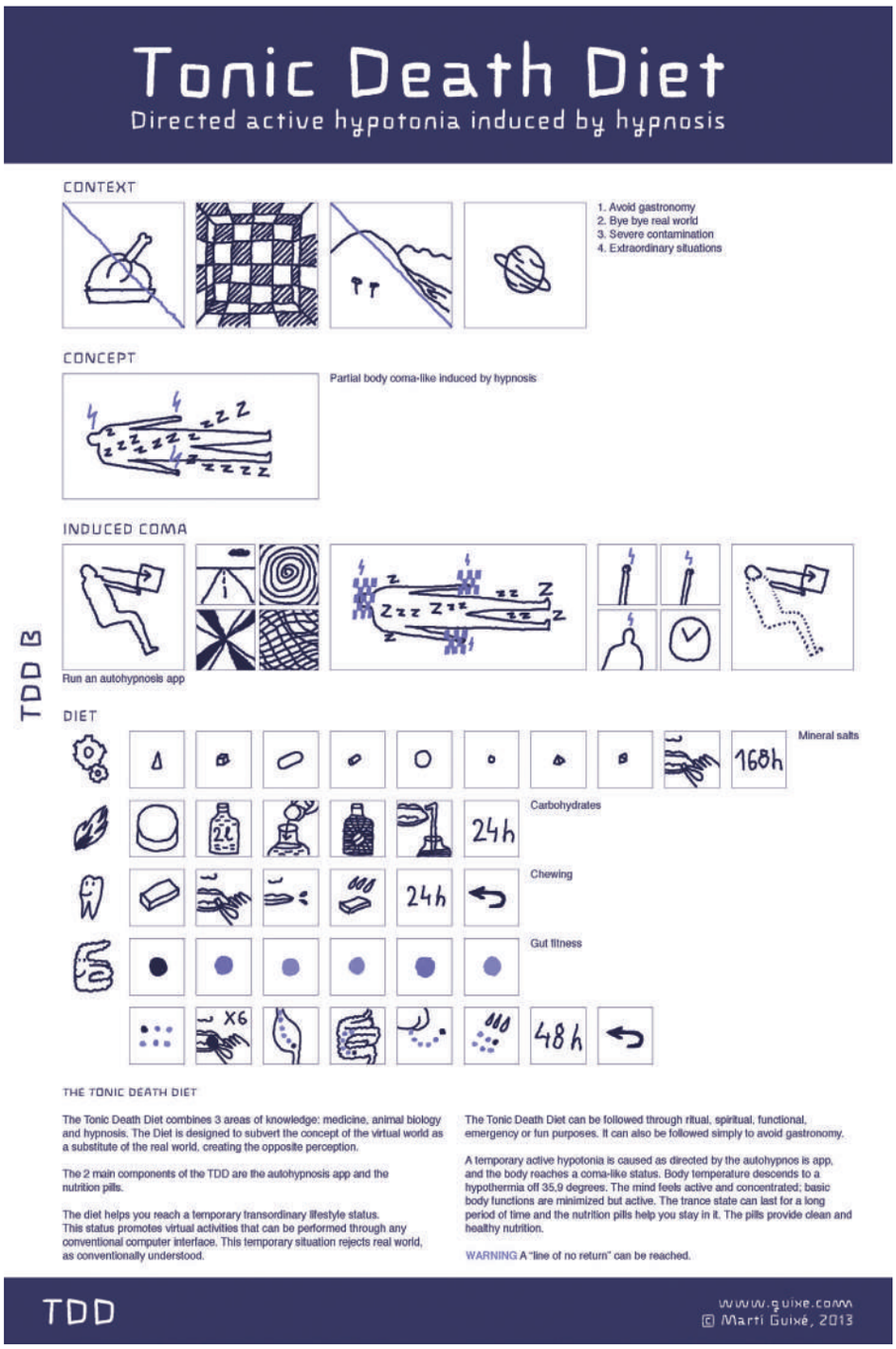

Fig. 8 – Tonic Death Diet. Instruction card. Martí Guixé, 2013.

from ingredients not linked to nature. The resulting diet is much more complex, technical, and tasty.

11/Pfic Bar[19], 2008

An urban element (a fountain) is instrumentalized to create new synergies between citizens, and promote new interpretations of a public space.

A city that doesn't farm, doesn't cook. Instead, there is an eco-friendly industry that builds healthy and delicious food to be eaten and enjoyed, invested with nutrients, stories and rituals.

Effects

The architecture is in the food. The city is just a set, a stage for the choreography. There is no manual production of food at all, only consumption. Eating is both leisure and sport, and the city is the new nature.

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Can we eat Earth Buildings?

The mineralogical common of earth building and edible earth practices

בנייה באדמה
אדמה אכילה
גיאופגיה
מינרלוגיה
מיצב אמנות

earth building
earth eating
geophagia
mineralogy
art installation

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Earth-based materials (namely, mud or dirt architecture) have been used for over millennia and are still sheltering approximately a third of the world population. These materials are currently experiencing a new Renaissance with construction methods and digital fabrication technologies that are highly focused on the mineralogical and particle characterization of optimal mixtures. Similarly, clay-based materials have been traditionally used as edible substances in almost every region globally: from the Middle East to India, and from Western Europe to the Caribbeans and Africa. Traditional recipes such as bonbon tè (Haitian mud cookies) and the Calabash Chalk (West Africa) have been used as part of human diet for religious beliefs, traditional local medicine, or as part of a regular supplement, a custom that has been interpreted by Western investigators as a pathology named Geophagia. This article presents a theoretical and experimental research-by-design investigation into the mineralogical content within earth materials and its role in building and human metabolism. A critical literature review on earth materials and their particle mineral content is presented, while analysing, comparing, and contrasting the ingredients that make a good buildable and edible earth artifact. The analysis reveals that both buildable and edible soil compositions share a common mineralogical base: the microstructure and water absorption capacity of clay minerals. The research-by-design process included creating buildable and edible artifacts based on traditional and current practices following the literature review. The project culminated in an architectural installation that maps earth artifacts for their compositions, critically contributing to the architectural field by provoking questions regarding the mutual dependencies between humans and their surrounding natural resources, while testing ideas and beliefs regarding the nature-culture divide that governs existing environmental paradigms.

חומרים מבוססי אדמה (כלומר, ארכיטקטורת בוץ או עפר) שימשו במשך אלפי שנים ועדיין משמשים, מחסה עבור כשליש מאוכלוסיית העולם. חומרים אלה חווים כעת רנסנס בעזרת שיטות בנייה משוכללות וטכנולוגיות ייצור דיגיטליות, תוך אפיון מדעי ומינרולוגי של תערובות אופטימליות. באופן דומה, חומרים מבוססי אדמה שימשו כבסיס למאכלים במסורות שונות ובאזורים שונים בעולם: מהמזרח התיכון ועד הודו, וממערב אירופה לאיים הקריביים ואפריקה. מתכונים מסורתיים מעפר, כמו עוגיות הבונבון בהאיטי, או מקלות קלאבש במערב אפריקה היוו חלק מהתזונה המסורתית מתוך אמונה דתית, כתרופה מסורתית או כחלק מהתפריט היומיומי. מחקרים עדכניים על אכילת אדמה הראו שחשק לאדמה, הבולט למשל אצל נשים בהריון, נובע לרוב מחוסר במינרלים. עם זאת, מנהג זה התפרש על ידי חוקרים מערביים כהפרעה נפשית ואף כפתולוגיה בשם "גיאופגיה". המאמר מציג סקירה תיאורטי וניסיונית של התוכן המינרולוגי של חומרי אדמה ותפקידם בבנייה ובחילוף החומרים האנושי. המחקר משלב בין סקירת ספרות ביקורתית, ניסוי חומרי ומחקר-על-ידי-עיצוב. בסקירת הספרות חיברנו את ההיסטוריות המקבילות של בניה באדמה ואכילת אדמה. בניסוי השוונו בין חומרי אדמה המשמשים לבניה ולאכילה ותכולת המינרלים החלקיקים שלהם ובחנו מה הם המרכיבים האידיאליים לכל אחד מהתחומים. סקירת הספרות והניסוי הראו בסיס מינרלוגי משותף הן לבניה באדמה והן לאכילת אדמה: מבנה המיקרו ויכולת ספיגת המים של מינרלים חרסית. בעקבות גילוי זה באמצעות מחקר-על-ידי-עיצוב, התחקנו אחרי הפרקטיקות המסורתיות והעדכניות ויצרנו חפצים הניתנים לבנייה ואכילה. המחקר הגיע לשיאו במיצב אדריכלי שקיבץ את כל התוצרים מבוססי חרסית שיצרנו במחקר-על-ידי-עיצוב, הממפה חפצי אדמה לבניה ולאכילה. מאמר זה תורם לתחום האדריכלי המדעי בכך שהוא מעורר שאלות בנוגע לתלות ההדדית בין בני האדם למשאבי הטבע הסובבים אותם, תוך בדיקת רעיונות ואמונות לגבי הפער בין טבע לתרבות השולט בפרדיגמות סביבתיות עכשוויות


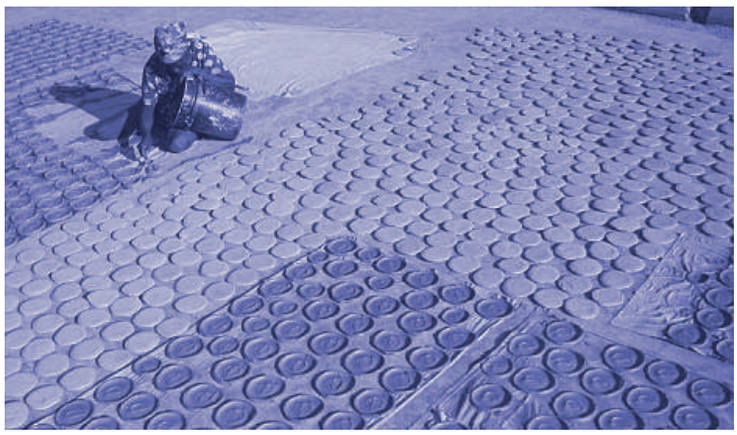

Fig. 1 - Traditional practices of using clay-rich soila as an edible substance, and as a building material. Image source: AP Photo/Ariana Cubillos, Science Photo Library/David R. Frazier.

The use of earth-based materials appears in two practices throughout history: in the construction of buildings and – far less commonly known or conclusively understood – in certain dietary consumption patterns. To put it simply; soil, the most important nutrient collector on earth, can be used for both building and for eating. This article presents a theoretical and experimental research-by-design investigation into the mineralogical content of earthen materials and their role in building and human metabolism. By converging the parallel histories of earth building and earth eating it suggests a first-of-its-kind attempt to expose the similarities and ask – could (and should) readily available soils be used as both buildable and edible substances?

For building practices, earth materials are among the oldest known to mankind, comprising structures that date over millennia and are still sheltering approximately a third of the world population (Niroumand, Zain, Jamil 2013). In contrast to the prevailing perception of earth as a vernacular material mainly in the Global South, vernacular earth architecture can also be found in Western countries, with more than 500,000 dwellings found in Germany, France, and the UK alone (Pacheco-Torgal, Jalali 2012). Meanwhile, with regards to earth eating, both cultural practices and individual behavior involving the ingestion of earth materials have been recorded for centuries across the world: in the Middle East, Ancient China, India, South Africa, the Caribbeans, and Europe. “Recipes”, so to speak, such as the Calabash Chalk, use clay-rich soils, whether for religious rites, as medicine, or to satiate a regular craving (Young et al. 2011). As opposed to buildable earth materials, no specific legislation exists for edible or healing clays, and these products are most often included within the concept of ethnopharmaceutics (Gomes 2018) (Fig. 1).

Despite many similarities and almost parallel historic and geographic routes - to the best of the authors’ knowledge - the two phenomena have never been compared or combined. This article aims to fill this lacuna by examining the parallel histories and converging them through an investigation into the mineralogical structure of clay-rich soils and its role in building construction –and human– metabolism.

Building materials affect human health and wellbeing, both physically and perceptually, via direct or unintended absorption such as touch, sight, thermal sensation, inhalation, and ingestion. Beyond the inhalation of material particles volatilized into indoor air, and dermal intake via gaseous and physical contact with building materials, a major exposure to substances in the built and interior environment is caused by ingestion intake through hand-to-mouth or object-to-mouth activities (Huang et al. 2019).

Therefore, just as “you are what you eat” rings true, so do the spaces we live and work in affect our lives and health. With more than 90% of human lives spent indoors, it is imperative to investigate healthier substances in building materials - beyond non-toxic - to substances that are nutritious and beneficial for ingestion in small quantities. Global nutrient deficiency has been an integral outcome of environmental degradation processes such as soil erosion and mass agriculture. Today’s eroded soils result in crops that tend to be of a lower quality: misshapen, smaller, and less nutritious to human health. As part of a critical pathway, this study suggests new interpretations to using, preserving, and consuming one of the most important nutrient collectors on earth: soil. Clay-rich soils are often combined with vegetable fibers and other additives that can be enacted as superfoods. By adapting superfoods within a clay-based environment, earth building components can introduce nutrients from soil to buildings, and from buildings to their occupants.

The article begins with a critical literature review that explores the histories, geographies, and traditions of using earth as

Fig. 2 - Colonialism material shifts led to replacement – or erroneously imitations of native practices. (Image sources: The G. Eric and Edith Matson Photograph Collection at the Library of the Congress, 364-LC-M32-A; A wood engraving by unknown artist, 1889, Alamy Stock Photo; Nebraska State Historical Society, RG2608-1190).

buildable and edible substances. It than delves into the particle mineral content of both material practices while analyzing, comparing, and contrasting the ingredients that make a good buildable and edible earth artifact. Discovering clay mineralogy as the common performance metric for both buildable and edible soil compositions, the Results section focusses on the research-by-design process of creating buildable and edible earth artifacts and presenting them in a public installation as part of the 2022 Tallin Architectural Biennale. As a speculative experimental demonstration, this research offers a unique perspective on human metabolism and nutritional intake by investigating earth-based matter as natural, healthy, nontoxic, and - presumably – edible building mass.

BACKGROUND
THE WESTERN BIAS

To investigate the extent to which soils can be adapted to mainstream building and consumption implementation, an overview of the perceptual barrier to using soil substances is much required. Both historical practices – of using earth as a buildable and edible substance – have experienced negative, and often, mistaken interpretations. Earth building has been pushed aside during the colonizing processes of industrial modernization due to the introduction of industrialized materials such as Portland Cement (Martinez 2017). As the dictates of architectural modernism and developmentalism (postwar international development) took root around the world, the desire to replace earth––a labor-intensive, highly variable and difficult to standardize material–– with mass-produced parts cohering with global economies of scale relegated earth-building to the sidelines.

Traditional practices of using earth as an edible substance, and as a building material have gained a negative perception as “dirty” and the poor people’s choice for housing. Fig. 2 depicts how material shifts due to colonialism have led to the replacement of native practices. The left image shows traditional Palestinian stone with clay mortar that was replaced by Portland concrete brought during the British Mandate. The middle image shows Indigenous Peoples in Tanzania processing earth to be used into bricks, a technique that has been mostly displaced by Portland-cement stabilized earth blocks. Lastly, the right image is an example of Sod construction as imitated by settlers on the prairie, as seen in imitation of Native technology.

Fig. 3 shows a global perception survey by the author identifying the extent of the negative perception of earth materiality worldwide. As part of this survey’s questionnaire, earth building experts repeatedly mentioned that, to their experience, there is a “poor public perception” and “peoples’ aversion to dirt” that creates a strong barrier to implementing earth materials in mainstream construction.

The survey showed that selected excerpts from 25% of earth building experts, including architects, engineers, and builders, from 12 different countries, mentioned the perceptual gap for integrating earth materials in construction projects, due to cultural prejudice and negative social perception. Experts also elaborated on the relation between poor perception and socioeconomic prejudice; for instance, an architect of rammed earth and adobe from a seismically active region mentioned that “unfortunately, most people feel unsafe and poor in earth buildings”; an architect making use of adobe, earthbags, and clay plaster from South East Asia added that “people do not treat earthen building as a permanent and standard building, they think only poor [people] use earth as a building material.” Lastly, some experts mentioned that another barrier is the lack of available technical data, and “lack of information on new developments and recent good examples”.

In the case of eating earth, perplexity – both from outsiders to a cultural community and sometimes from members within

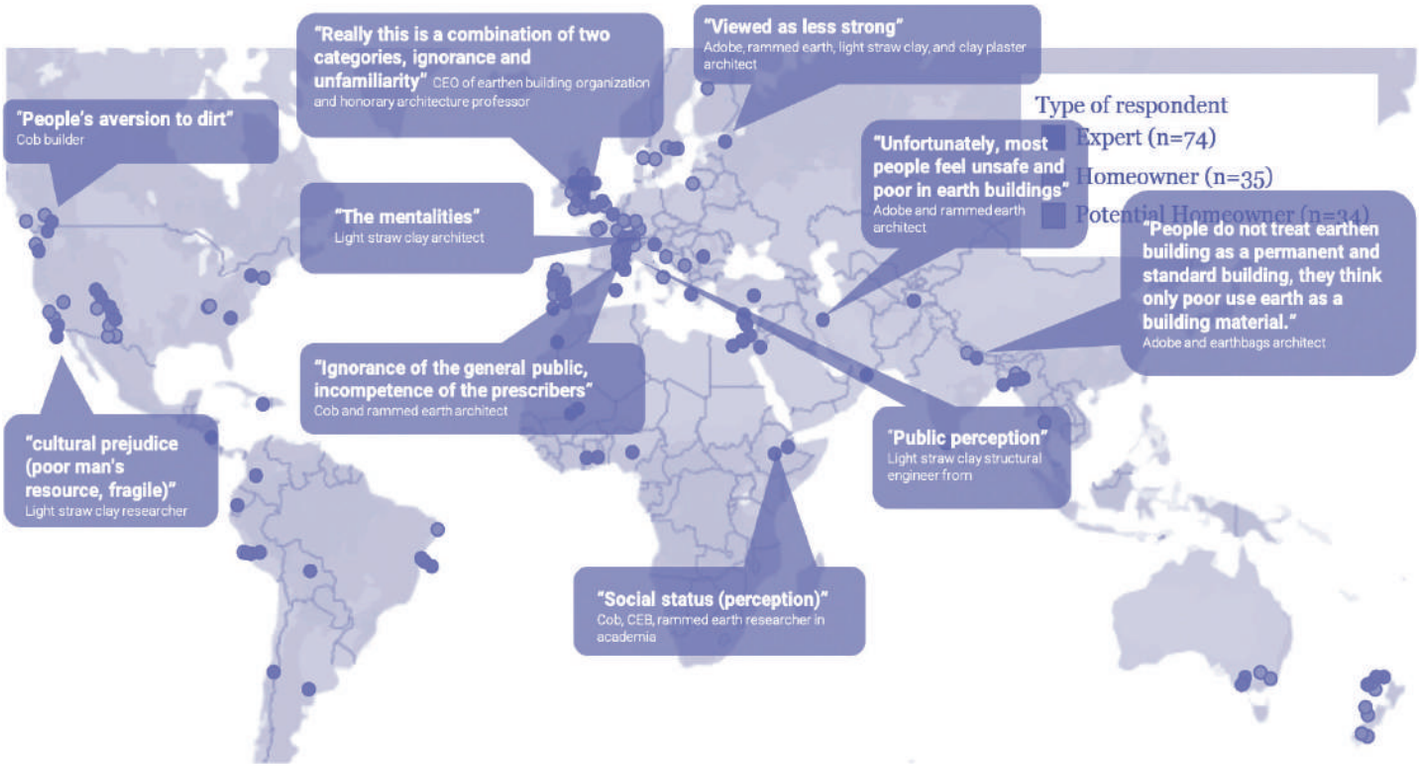

Fig. 3: Results from a global perception survey (Ben-alon et al. 2020), showing a perceptual barrier for integrating earth materials in construction projects, due to cultural prejudice and negative social perception.

the same society – has long led to associating it with the practice of Geophagia: a pathology or a psychiatric disorder involving unconstrained urge to consume earth, mud or dirt. Not only was it considered harmful to the consumer's health and digestion system, but the interchangeable use of "earth," "ground," and "dirt" also invoked notions of excrement, filth, and the dangers of decay. In that context, contemporary biases against the idea of earth-eating can also be traced to the perceived causal link between poverty and the practice – in short, the bias that eating earth can only be a desperate last resort in the face of food scarcity.

Eating earth was further assimilated as an eating disorder – Geophagia – during the 19th-century pre-colonial period when European explorers traveled to Africa on Christian missionary expeditions. Iconic, yet controversial British explorer, David Livingstone, described a local disease of clay eating at Zanzibar in his writing. He highlights that the phenomenon is not confined to enslaved people, "rich men who have plenty to eat are often subject to it."

The influence of colonialism was so deeply imprinted on the cultural prejudice of earth eating that it took several decades of civil and international warfare to begin to free the Western bias from its grasp. Consequently, in his book on Geophagia in China, Berthold Laufer, a German-American Sinologist, describes "a white, soap-like earth" eaten "with rice, because it melts like butter", and that "it is also used for white-washing their houses."

Where traditional practices of earth-eating exist, the earth eaten is specific and well-defined. This fact contradicts the assumption that eating earth is driven by hunger; only earth with particular qualities, such as color, odor, flavor, softness, and plasticity, that have been tested for generations are recommended for eating. From the standpoint of edibility, what is termed diatomaceous earth or kieselguhr, popularly known as mountain meal or fossil meal (in Chinese, stone meal or earth-rice), is a very light, porous earth resembling chalk that consists of the siliceous remains of very minute aquatic organisms or diatoms in several thousand varieties (hence, also styled infusorial earth).

However, more recently, attitudes have shifted regarding these phenomena. In the case of building with earth, the catalyst has been the urgent wake-up call due to the climate crisis and the need for more sustainable building practices and materials. In the case of earth-eating, a growing body of scientific evidence shows that eating earth can be traced to evolutionary advantages and can, in specific ways, provide certain benefits to its practitioners.

WHY EAT EARTH AND CAN IT BE CONSUMED?

Like the history of earth building's waning status throughout the 20th century, attitudes toward Geophagia were affected by modernity's standardization of hygiene and its emphasis on sanitation. Today, scientists have arrived at a more nuanced understanding

of microbiomes, including those inside the human body and their vital contribution to an individual's overall health. The critical role that gut bacteria and other micro-organisms play in metabolic processes and the immune system have proven to be of particular relevance for the reframing of Geophagy (Schnitzler 2022).

Unexpectedly, eating clay has also emerged in the last decade as a lifestyle fad, in the health and beauty sector. An ABC News piece in 2005 by Lallanilla, titled "Eating dirt might be good for you" (Lallanilla 2005), exemplifies Geophagia's contemporary reincarnation as an ancient health practice worth giving a try. Bloggers sharing their experiments with eating clay often cite a statement from actress Shailene Woodley in an interview with David Letterman in 2014 as a major catalyst for the practice's commodification (Wong-Shing 2020). Woodley's statement was covered by The Guardian, by Elan and used by the BBC as the lead in their article "Who, What, Why?: Why do people eat clay?" (BBC News 2014), which sparked a trend of purchasing bentonite clay for its purported detoxification benefits

In the scientific and anthropological literature, there are three hypotheses around eating earth: first, that earth is food, and Geophagists are simply people who are hungry; second, that earth provides micro-nutrients and serves as a dietary supplement, i.e., Geophagists respond instinctively to particular nutritional shortages; and third, that clay's micro-chemical structure allows for removal of toxins from the body. Each of these hypotheses emerge in relation to a number of cultural, religious, and individual Geophagic practices that have been observed across the world throughout time, as detailed by (Young et al. 2011) and summarized in the following subsections.

THE FOOD HYPOTHESIS: PEOPLE EAT EARTH BECAUSE THEY ARE HUNGRY

The Food Hypothesis is based on historical observations in which people eat (or crave) earth because they are hungry and as a substitute for food. For instance, during the Thirty Years' War (1618–1648), Germany faced increased food shortages such that that people began to mix white earth with flour and baked bread out of this mixture (Strose, Suhle 1891). In another example, during a famine in Lapland, Scandinavia, earth was mixed with flour and tree bark and baked into bread (Dahms 1897). Hunger has been a favored explanation of Geophagia by colonial explorers in Oceania, the Americas, and Africa.

The food/hunger hypothesis in itself does not arrive from scientific deduction so much as induction from surface facts; as such, the trajectory of this hypothesis reflects and tends to perpetuate the assumption of all Geophagia as a pathological relationship to food: a nonsense choice that individuals make, given its lack of nutritional value, or to which individuals are reduced to making during times of crisis, in countless disaster zones. This history is reflected in the term "dirt-poor", accounts of slaves in the Southeastern US, to reports in the 20th Century of inner-city children in Detroit eating dirt in the 1940s and 50s (Vermeer, Frate 1975). More recently, in 2008, for example, due to a food crisis in Haiti, media reporters published that Haitians could only afford bonbons terres, or earth cakes.

However, although consuming earth might provide some sense of fullness, there are many Geophagists who frequently have other food to eat, and earth cravings occur also when more typical food is available. Additionally, earth substances are extremely carefully selected, and while hunger necessitates a small fraction of non-food consumption around the world, it is safe to say that it does not explain the bulk of Geophagia.

THE MICRO-NUTRIENT HYPOTHESIS: PEOPLE EAT EARTH DUE TO NUTRIENT DEFICIENCY

Other observations provide support to the hypothesis that people are eating earth as an instinctive way to supplement their diets where nutrients are missing. These observations converge around the practices of pregnant women, as integrated into and supported by various religious rituals. Here, properties of fertility are attributed to the earth, and consequently, pregnant women comprise the main consumers: in these instances, Geophagia is said to cure barrenness, protect pregnancies, ensure safe deliveries, and counteract morning sickness. Scientists, with the knowledge of the nutritional needs of pregnant women, reason that the ingested clay might be serving as a supplement to meet these requirements. Studies on the relationship between Geophagia and calcium deficiency seem promising: Wiley and Katz, (1998), have found that dairy farming was inversely related to Geophagia during pregnancy, i.e., pregnant women were less likely to engage in Geophagia in societies in which calcium-rich foods were available. They thus concluded that Geophagia during pregnancy could be motivated as an intuitive means to increase calcium intake (Wiley, Katz 1998).

However, in her book, Sarah Young (2012) reports that Geophagia does not track micronutrient metabolism cycles and in fact, the opposite of supplementation may be happening; in some instances, earth materials may be causing micronutrient deficiencies. Experimental evidence supports

the idea that some earth substances interfere with the absorption of micro-nutrients and can thus contribute to deficiencies. The question then becomes, what might be going on for pregnant women (and the rest of the Geophagia population), if clay is not serving the purpose of micro-nutrient supplementation.

THE PROTECTION-DETOX HYPOTHESIS: PEOPLE EAT EARTH TO ABSORB TOXINS

Another hypothesis is that clay is extremely effective at removing toxins from the body. This hypothesis represents a synthesis of lateral scientific observations of animal behavior, a long transnational historical record of clays being used for medicinal purposes, and knowledge of clay's molecular structure and properties. Behavioral observations of animals support an emerging hypothesis of eating earth to absorb toxins. As plants are a major source of toxins - such as alkaloids, tannins, saponins, phenolics, and terpenes - animals seem to be aware of the benefits of adding clay to a plant-based diet (Young et al. 2011).

Earth has traditionally been used both internally and topically to heal a range of ailments. Clay soils have been described by historians as the "Medicine You Can Walk On" and types of clays such as the Terra sigillata were so valued for their healing properties that harvested pieces required the stamp of royal signets, as it was frequently counterfeited. Medicinal scriptures such as the Pliny's Naturalis Historia from the Roman Empire, and Dioscorides' De Materia Medica from Ancient Greece describe earth as an important medicinal practice; as an antidote to swallowed poisons and snakebites, as well as a treatment for dysentery, and a potent treatment for reducing inflammation around the eyes. Historical records also show medicinal use of clay soils by physicians, healers, and midwives throughout Europe to treat smallpox, dysentery, and pestilential (epidemic-causing) disease. Lastly, instances of Geophagia increase in parallel with tropical climate communities, where pathogen densities are higher (Young et al. 2011).

The Protection-Detox Hypothesis has been therefore the most widely accepted interpretation of Geophagia in the scientific community to date, and, in its basis is the mineralogical structure of earth-based materials.

WHY BUILD WITH EARTH AND CAN IT IMPROVE OCCUPANTS' HEALTH?

In contrast with other natural building materials, earth materials exhibit a number of advantages: a) they have high thermal inertia and structural capacity in compression; b) a better resistance to fungi, insects, and rodents, compared to exposed cellulose-based materials; c) potential abundance in and around the construction site; and d) a diversity of building forms and construction techniques, from sculptural monolithic assemblies to modular components (Racusin, McArleton 2012). Due to their high thermal inertia, earthen materials are particularly advantageous in warmer climates, especially when diurnal changes make for warm days and cool nights. When combined with bio-based fibers, earthen assemblies can provide both thermal inertia and thermal resistance to the building envelope. Additionally, the advantages of earthen assemblies as a thermal mass can be used in cold climates by placing it within an insulated envelope or by using Trombe walls; the assembly can store and retain heat from passive solar or active indoor sources and release this heat slowly over a period of time (e.g., over a cold night). Recent research has focused on the broader implementation of earth-based materials in the construction industry, by advancing building policy through a technical synthesis of structural, thermal, and environmental data on a range of earth-based construction technologies.

Earth assemblies were shown act as passive removal materials for internal environment quality against harmful volatile organic compounds (VOCs) (Darling et al. 2012). They also exhibit excellent moisture buffering capacities,

Term	Definition*	Used in traditional earth building?	Used in traditional earth eating?
Dirt	Dust, soil, or any substance that makes a surface not clean	No	No
Mud	Earth that has been mixed with water	Yes	Yes
Ground	The surface of the earth	No	No
Earth	The usually brown, heavy and loose substance of which a large part of the surface of the ground is made, and in which plants can grow	Yes	Yes
Soil	The material on the surface of the ground in which plants grow	No	Perhaps, on unwashed plants
Topsoil	(The soil which forms) the top layer of ground in which plants grow	No	Perhaps, on unwashed plants
Subsoil	The layer of soil that is under the surface level	Yes	Yes
Clay	Thick, heavy soil that is soft when wet, and hard when dry or baked, used for making bricks and containers.	Yes	Yes

Table 1:Earth terminology of interchangeable terms. *According to Cambridge Dictionary

Clay Mineral	Composition	Color	Relevance to Earth Building	Relevance to Earth Eating
Kaolinite	$Al_2(OH)_4Si_2O_5$	White to cream	Kaolinite consists of a strong hydrogen bond that makes it extremely difficult to separate the clay platelayers, and as a result, kaolinite is relatively stable for earth construction – water is less able to penetrate between the layers; thus, it exhibits relatively little swell on wetting (Yanguatin, Tobón, Ramírez 2017).	Kaolinites have a high specific area and sorptive capacity, low or null toxicity for users. They adhere to the gastric and intestinal mucous membrane and protect them; they can absorb toxins, bacteria and even viruses. However, they do eliminate enzymes and other necessary nutritive elements, and their prolonged use is not advised (Carretero 2002).
Illite	$(K,H_3O)(Al,Mg,Fe)_2(Si,Al)_4O_{10}[(OH)_2,(H_2O)]$	Grey-white to silvery-white	Ilite is characterized by a rigid structure, which is due to the presence of K+ cations in the spaces between the packets. These cations connect negatively charged surfaces, causing the illites to swell a little in contact with water, thus illites are classified as non-swelling minerals (Karpiński, Szkodo 2015).	Illite clay minerals are used in spas – they are mixed with water (geotherapy), mixed with sea or salt lake water, or minero-medicinal water, and then ma-tured (pelotherapy) or mixed with paraf-fin (paramuds) (Carretero 2002).
Pyrophyllite/Talc	$Al_2Si_4O_{10}(OH)_2$	Brown and brownish yellow	Pyrophyllite is both fire- and acid-resistant. it exfoliates when water is driven off upon heating, leaving a flaky mass. Calcined pyrophyllite has been studied as a cement replacement and it was shown to increase the compressive, tensile, and flexural strength of self-compacted concretes (Mansour 2020).	Pyrophyllite exhibits a unique ion-exchange and adsorption properties, which makes it an excellent soil condi-tioner for crop production, used instead mineral fertilizers (Murtić et al. 2020).
Montmorillonite	$(Na,Ca)_{0.33}(Al,Mg)_2(Si_4O_{10})(OH)_2 \cdot nH_2O$	Red, yellow, pink	Montmorillonite, as a hydrophilic miner-al, has a greater influence on the moisture balance between the earth assembly and the environment - buffering relative humidity and balancing moisture content (though resulting in lower strength, causing swellings, and correlated with the occurrence of a large number of microcracks) (Narloch et al. 2020).	Montmorillonites are characterized by their high water absorption, which results mainly from their structure and from the existence of interlayer cations. As opposed to Illite, it has a labile structure, i.e., interlayer spaces may expand (Kaczyński, Grabowska-Olszewska 1997). This mineral was demonstrated to be able to fortify the intestinal barrier by cross-linking with molecules in mucus. It has even been shown to cause increased mucus production (González et al. 2004). Montmorillonite was shown to be beneficial when added to amphetamines and antibiotics, since it slows the release and absorption of active components, thus allowing slow and controlled desorption of the drug (Carretero 2002).

Table 2: Clay mineralogical composition, color, and existing evidence for earth building and eating.

acting as a relative humidity "fly-wheel" that absorbs and releases moisture from and to the ambient air while maintaining optimal humidity levels for human comfort (Giuffrida, Caponetto, Nocera 2019). Economically, earth construction can be extremely affordable, due to the use of readily available materials from or around the construction site, such as the soils that are excavated for foundations. Therefore, building with earth is arguably healthier for both the inhabitants and installers/construction workers.

CLARIFYING EARTH TERMINOLOGY

Soils, especially those rich in silicates, are the most abundant solid substance in both the oceanic and continental crust (Schulze 2018). Yet, before addressing the science of consuming and building with earth, in order to dispel confusion on interchangeable terms, a much-needed clarification is needed for the terminology of earth substance, as shown in Table 1, in order to dispel confusion on interchangeable terms.

Earthen buildings are defined in the literature as either traditional and vernacular building methods (Niroumand et al. 2017), that utilize natural building materials (Wanek, Smith, Kennedy 2002). However, neither of these definitions is entirely accurate; some earth building materials are historically used in traditional construction (e.g., adobe), some were developed in the past few decades (e.g., compressed earth blocks), and some were used traditionally but nowadays are used with chemical or cementitious binders (e.g., stabilized rammed earth) (Ciancio, Beckett no date; Serrano, De Gracia, Cabeza 2016). Other uses have introduced heat energy; however, in burnt earth or clays, it is not possible to retrieve the microstructure of the natural minerals, unless allowed to undergo weathering for millions of years.

Generally, earth materials for buildings require soils taken from the sub layers of at least 30 cm below ground, termed subsoils. As opposed to topsoil, subsoil does not contain organic matter and will often be more clay-rich. Earth building can be thus defined as construction methods of building elements in which clay-rich subsoil is used as the main component, acting as a geological binder. The clay-rich subsoil matter, used as

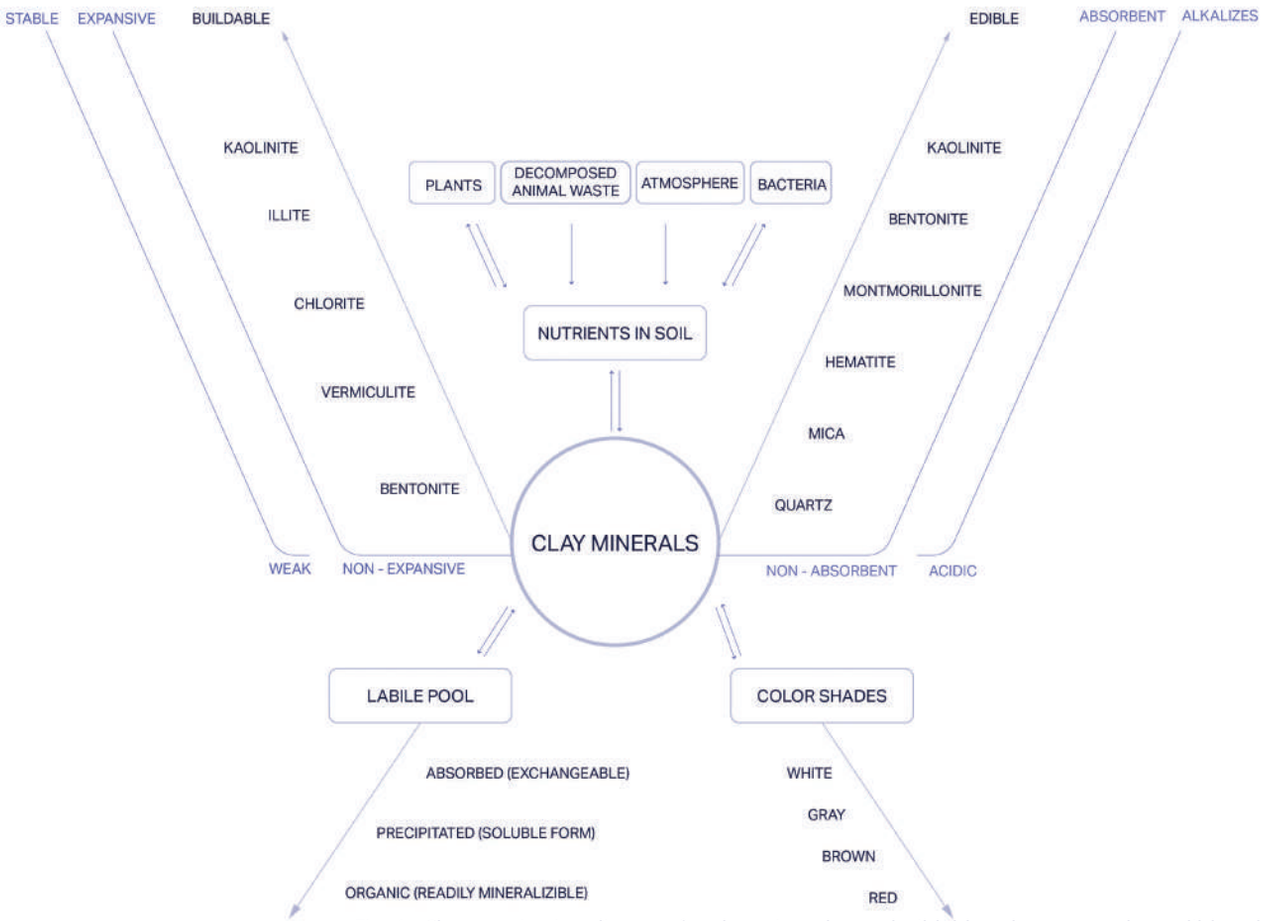

Fig. 4 - Characterization diagram for clay minerals as a buildable substance and an edible substance.

a binder, can be mixed with other additives to achieve different performance parameters. Subsoils that are rich with clay can be diluted with sand. Each constituent material within the earth mixture "recipe" contributes to specific performance characteristics within the mix design: sand and aggregates contribute to compressive strength, vegetable fibers act as reinforcement and contribute to flexural strength. Other additives can be used for sealing (such as flaxseed oil and cactus juice), and increasing the thermal resistivity (such as pumice).

MINEROLOGICAL ANALYSIS

Soil is formed due to natural weathering of rocks in processes taking millions of years. Cohesive soils are composed of both clay and non-clay minerals. Within the soil, clay minerals are the essential component for supporting plant growth, and on a metabolic chemistry level, clay counts as an

Sift Size	Microns	Opening (mm)	Retained Matter (g)	Percentage
4	4750	4.75	0	17.6
8	2360	2.36	0	23.7
16	1180	1.18	0.09	18.8
25	710	0.71	110	9.25
30	600	0.6	228	4.49
50	300	0.3	289	5.24
100	150	0.15	211	5.74
200	75	0.075	102	5.09
Silt/Clay	> 75.0	> 0.075	59.91	9.58

Table 3: Percentage of retained soil from sifted sample for the incorporated soil.

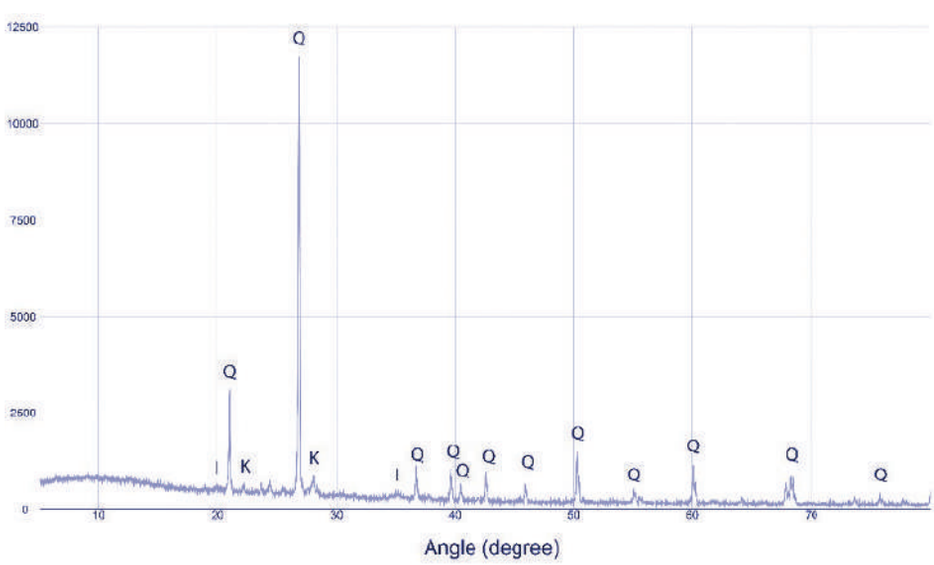

Fig. 5 - The XRD test results for the raw soils used in this experiment. Soil minerals are marked as [Q] for quartz, [K] for kaolinite, and [I] for illite.

Application:	Edible <----------> Buildable						
Type of Artifact:	Capsules	Chalks	Cookies	Bricks without fibers	Bricks with fibers	3D Printed clay bricks	3D Printed clay-fiber bricks
Soil (no added clay)	1S	2S	3S	6S	7S	9S	10S
Kaolinite (White)	1W	2W	3W	6W	7W	9W	10W
Illite (Grey clay)	1G	2G	3G	6G	7G	9G	10G
Pyrophyllite (Brown clay)	1B	2B	3B	6B	7B	9B	10B
Montmorillonite (Red clay)	1R	2R	3R	6R	7R	9R	10R

Table 4: Installation artifacts layout, from the edible to the buildable.

Fig. 6 - The research-by-design process of the [EAT ME BUILD ME] project.

Fig. 7 - View of the three video arts projections: edible earth fabrication process, table of elements, and the buildable earth fabrication process.

adsorbent mineral. Clay minerals consist of about 15 ordinarily classified minerals that belong to three main groups: kaolin, illite, and smectite. Among non-clay minerals, the most commonly found mineral is quartz (which can constitute up to 90% of the soil) and iron compounds such as goethite, siderite, and carbonates such as calcite. Clay minerals differ from other minerals due to their cation exchange capacity and their ability to absorb water (Narloch et al. 2020).

As such, the extent to which a certain clay can act as a buildable and edible substance depends on how stable, labile, or bioavailable the mineral is (i.e., able to be made workable during construction and/or be absorbed by the body). Clays are good at adsorbing positively charged molecules' cations, which means that clays can offer an organism protection by binding toxins and pathogens to them before they can even reach the gut wall (Young et al. 2011). In other words, clay can deactivate toxins not by destroying them, but by grabbing them before they can be digested, adsorbing them into some of that space in its crystalline structure. Unwanted chemicals and pathogens trapped in clays then move out of the body with other solid waste.

THE MINERALOGICAL COMMON GROUND FOR EATING EARTH AND BUILDING WITH EARTH

Suitability of clay minerals for eating and building with earth thus share important similarities: for both practices, Kaolin has been a favorite. Kaolin was shown to reduce nausea and poison-related sickness and death (Liu et al. 2005), while also being an ideal clay mineral for earth construction – water is less able to penetrate between the molecular layers; thus, it exhibits higher compressive strengths and reduced swelling on wetting (Narloch et al. 2020; Bolton Seed et al. 1962).

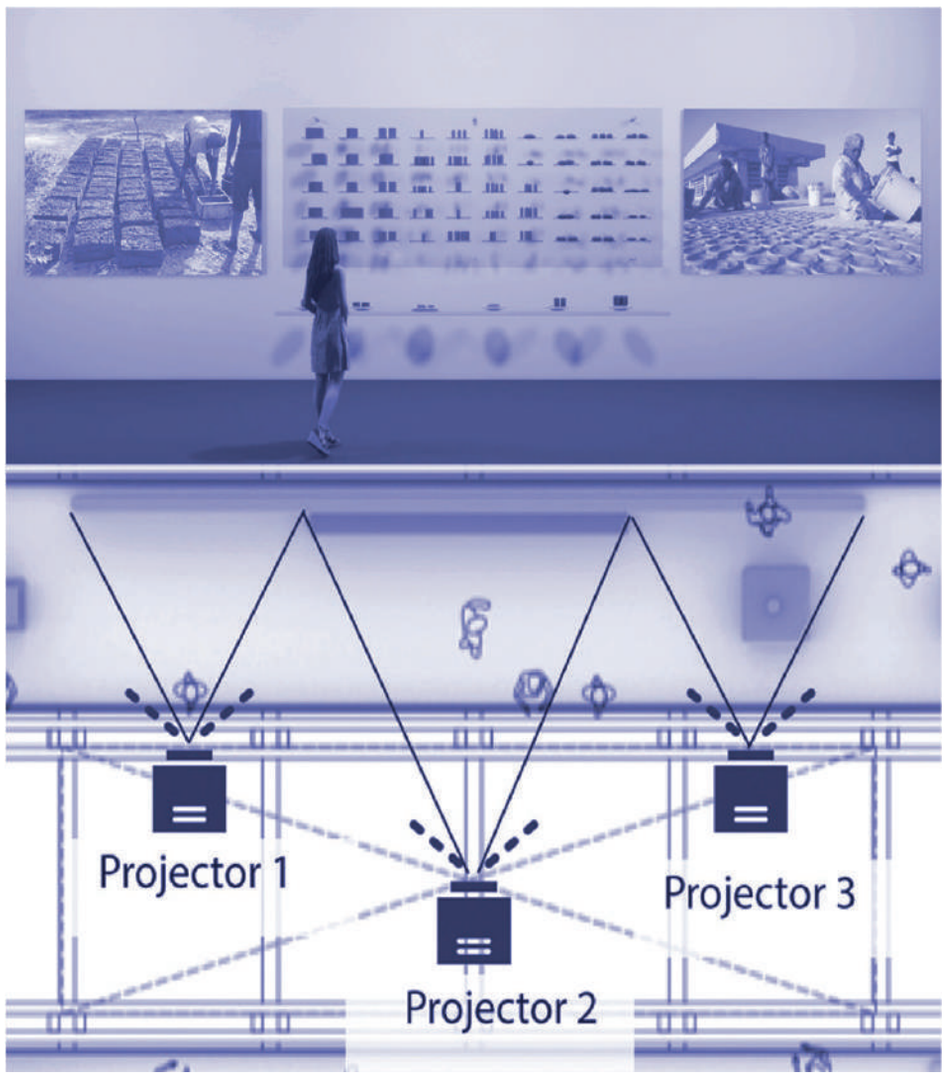

Fig. 8 - A render of the installation (above), and the projection layout (below)

WHAT PARTS OF SOIL CAN BE USED FOR EATING?

Surprisingly enough, both the buildable and edible parts of soil share a common mineralogical base: clay. Regardless of their geographic local or cultural habits, traditional earth-based recipes come with clear instructions on what type of soil to use and where to source it from. They all have in common the use of clay-rich soils, which includes minimal organic micro-bacterial activity. Although in everyday speech, "clay," in its plastic, moldable state, is associated with mud and dirt, in its particle state, when not suspended in water, it looks much like other particles of rocks that humans use as spices.

RESULTS AND DEMONSTRATION: THE [EAT ME BUILD ME] INSTALLATION

The mineralogical examination was demonstrated through a research-by-design, hands-on production of edible buildable artifacts. The result took the form of an architectural installation, titled the [EAT ME BUILD ME] project and presented at the 2022 Tallinn Architecture Biennale on "Edible; Or, The Architecture of Metabolism" (Kallipoliti, Markopoulou 2022). As a case study demonstration, the installation examined raw earth, with and without fibers, infused with clay minerals that correspond to Table 2.

As an experimental demonstration, the [EAT ME BUILD

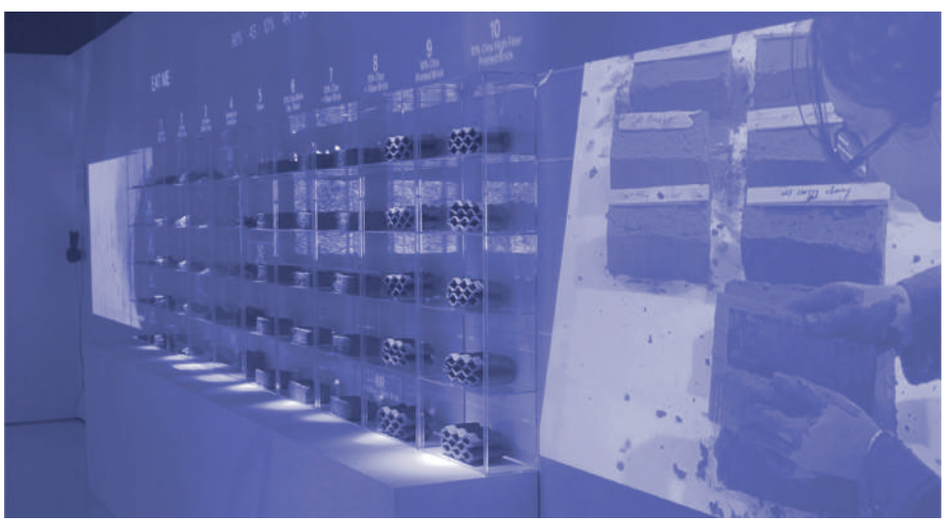

Fig. 9 - Details of the final installation.

ME] project aims to expose the similarities and convergences, the almost parallel historical and geographic routes of building with and eating earth, while asking questions such as: Can we develop edible clay building components that can absorb toxins? Can readily available soils be used as both buildable and edible substances?

MATERIALS GEOGRAPHY, MINERALOGICAL ANALYSIS AND WORK PROCESSES.

The soil used for the installation project was harvested from a recycling quarry located in Goshen, NY, 60 miles from Manhattan. The specimens were then tested for their clay content, particle size, and mineralogical content, to inform the elements arrangements on the scale from buildable to edible.

The results of the grain size distribution test, shown in Table 3, indicate that the soil used for this installation consists of 10% clay and silt. The XRD patterns of the soil show high intensities and broad peaks of silica in the form of α-quartz, as shown in Fig. 6. The analysis also shows that peaks of quartz overlap with the peaks of other minerals in the sample and so the other phases are not discernible. Peaks of other clay minerals include kaolinite and illite with lesser intensity.

The results of the XRD analysis alongside the results obtained from the particle-size sieve analysis indicate that the soil used in the installation requires additional clay minerals to be used for buildable and edible purposes. Thus, the soils excavated on site were infused with clay minerals to achieve a higher clay percentage, which also resulted in coloration of the mixtures.

Using the soil in different compositions, the research-by-design process (exemplified in Fig. 7), traced back traditional methods and developed new “recipes” of earth elements: from chalks, to cookies, to bricks.

INSTALLATION DESIGN AND ARTIFACT LAYOUT

Inspired by the Periodic Table of Elements, the visual language of the installation formed a matrix arrangement from buildable to edible earth artifacts, as detailed in Table 4. On the edible side, earth cookies, chalks, and capsules were fabricated and presented, replicating traditional recipes as well as offering modern interpretations for using earth as a food supplement. On the buildable side, manually

and digitally fabricated bricks showcase the state-of-the-art in manual and digital earth construction while introducing fiber (straw) reinforcement additives for enhanced strength, durability, and lightweight-ness. A light projection was developed to map the consistency of each element and, the reference to the periodic table.

On each side of the matrix, as shown in Fig. 8 and Fig. 9, a projected video was developed to document the fabrication processes, alongside excerpts of buildable and edible earth practices, as viewed from a Western point of view.

SIGNIFICANCE

As an experiment, the [EAT ME BUILD ME] project is a first-of-its-kind attempt to expose the similarities and to converge the almost parallel historical and geographic routes of building with and eating earth. It speculates upon a larger scope of building supply chain mechanisms, where earth-based materials are perceived, not as an ineffectual matter, but as a multidimensional resource that can be used for both a shelter and a meal, thus offering a futuristic perspective to the growing field of knowledge that investigate healthier substances in building materials. The final installation result, shown in Fig. 10, exhibited ideas and investigations into the nature/culture divide that governs existing paradigms of environment. While it literally maps the raw soil and clay minerals for their buildable and edible potencies, the experimental setup also produces a map of these various ideologies and their tensions, towards the current reformulation of our being in the world.

The installation served as both a tactical and conceptual exercise, aiming to re-discover supply chains of readily available earth-based materials as both building and nutritional substances. It offers a unique perspective on human metabolism and nutrition made possible by ingesting our surrounding building assemblies. As a speculative architectural installation, the project aims to radically suggest that possible earth- and bio-based assemblies can be submerged within building facades as natural, healthy, nontoxic, and presumably - edible building mass. To further stretch the idea of the green façade, where food is grown upon fabric systems or containers, the uniqueness of this experiment stems from its use of agricultural nutritional substance - namely farm to building and building to table as a source for minerals, nutrients, and superfoods within the building itself: an architecture that can be consumed.

CONCLUSIONS AND FUTURE RESEARCH

Earth materials have been used historically for two purposes: as a building material, and as an edible substance. Earth construction has been found dating over millennia and is still sheltering approximately a third of the world population. Similarly, sourced clay-rich earth materials have been traditionally used as edible substances across the world. However, negative modern interpretations have emerged to using earth; Earth building materials are often perceived as “dirty” and poor people’s choice for housing, and similarly, eating earth is associated with the pathology and poverty practice called Geophagia. While investigating the past of each tradition, this article finds that the use of earth as a nutritional resource for the built - and human - metabolism stems from the same source: the mineralogical structure of clay.

As part of this research, the mineralogical content of clay is analyzed according to its benefits for buildable and edible practices, resulting in four clays that are proven most potent for gastrotechture purposes: kaolinite, ilite, pyrophyllite, and montmorillonite. Each clay is analyzed for its potency and a map of clay minerals is created. The four clays are used as the base for the research-by-design process concluded in the EAT ME BUILD ME installation displayed as part of “Edible; Or, The Architecture of Metabolism” (Kallipoliti, Markopoulou 2022). As part of this project, raw soils are tested for their particle size and mineralogy content, while mapping their buildable and edible potencies, with the objective of identifying whether clay-rich soils can serve as durable building facades that can be, if such need arises, edible.

Linking anthropology, history, and building technology, this research examines and re-discovers supply chains of readily available earth-based materials as both building and nutritional substances. As a final demonstration, artifact “recipes” of earth and mineral clays are investigated, fabricated, and presented to envision possible integration within the built environment.

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Architecture for Fermentation and vice versa

arquitectura
fermentación
bioclimática
enfriamiento pasivo
cambio climático
architecture
fermentation
bioclimatic
passive cooling
climate change

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Una revisión de las estrategias de enfriamiento pasivo que pueden compartir para combatir el aumento de temperaturas a causa del cambio climático usando las casas matanceras del cerdo Ibérico como modelo hipotético donde ambas disciplinas convergen.

El cambio climático y el consiguiente aumento de las temperaturas son evidentes, y se necesitan soluciones que respeten el medio ambiente, la sociedad y la economía. La población humana se ha elevado hasta un punto en el que esas soluciones fueron diseñadas para colocar al ser humano en primera posición. Una demostración de este hecho se encuentra en los diseños de nuestras propias viviendas, que han sido mejoradas por donaciones de conocimientos procedentes de muchas otras disciplinas, entre ellas, la arquitectura. Varias técnicas de enfriamiento pasiva provienen de esta disciplina y podrían ayudar a enriquecer el portfolio de algunas otras que se verán afectadas por el mismo problema de aumento de temperaturas. La fermentación es una técnica ancestral que ha evolucionado hasta nuestros días y supone aproximadamente 1/3 de nuestra diversidad culinaria. La fermentación, al igual que la arquitectura, se basa en el diseño de entornos semi-aislados que facilitan cierto tipo de vida: microscópica, macroscópica o ambas. Asumiendo que el aumento de las temperaturas afecta a la estabilidad de la vida, tanto la arquitectura como la fermentación se ven comprometidos por dicho fenómeno y el cruce de técnicas de enfriamiento pasivo de forma multi, inter e incluso transdisciplinar puede ofrecer nuevas soluciones para ambas y muchas otras disciplinas. Para ello esta revisión propone como modelo hipotético de experimentación a las casas matanceras productoras de jamón ibérico, un espacio concebido para albergar tanto la vida humana como la microbiana y que por lo tanto también se verá afectada por el aumento de temperaturas. Se proponen por tanto futuros estudios que pongan a prueba las hipótesis planteadas en esta revisión.

A review of the passive-cooling strategies they may share to combat the rising temperatures due to climate change using Iberian pork slaughterhouse as a hypothetical model where both disciplines converge.

Climate change and consequent rising temperatures are evident, and solutions that respect the environment, society and economy are needed. The human population has increased to a point in which these solutions have been designed to put humans first. A demonstration of this fact lies in our own house designs, which have been improved by knowledge from many disciplines, including architecture. Several passive-cooling techniques have come from this discipline and might help others that will be affected by the rise in temperatures. Fermentation is an ancient technique that has evolved and now accounts for approximately 1/3 of our culinary diversity. Fermentation, like architecture, relies on the design of semi-isolated environments that facilitate a certain kind of life form: microscopic, macroscopic or both. Assuming that the rising temperatures affect the stability of life forms, the same rising-temperature challenge is shared by both architecture and fermentation; the cross-contamination of passive cooling techniques in a multi, inter and even transdisciplinary way, might create new solutions for both of these and many other disciplines. To this end, this review proposes a hypothetical experimental model, the Iberian pork slaughterhouse, a space that hosts both human and microbial life, and which will therefore also be affected by the increase in temperature. Future studies are therefore proposed to test the hypotheses put forward in this review.

In the transition from the 20th to the 21st century, global climate change has become more evident. During this transition humans have not only accelerated that change, but also become more aware of the resulting impact (Viola, 2020) at all levels, not only environmental but also social and economic. Improvements in communication and technology have increased the dissemination of knowledge, and the number of disciplines has increased, which have tended towards specialization, and investigating elementary particles trying to explain even "nothingness" (Genz, 2009). However, this very verticalization of knowledge has led to the loss of an overview of what surrounds us. Disciplinary specialization has been a consequence of the increase in quality and quantity of knowledge and, viewed in this light, one cannot say that it is a disadvantage. However, such specialization has created significant barriers that restrict permeability and blurring between disciplines (Hansson, 2008; Bechtel, 2013; Mestre and others, 2022). Disciplinary rigidity and lack of symbiosis in knowledge (not mutualism) are evident, not only at an academic level, but also at a professional level (Mestre and others, 2022). The separation between departments in buildings is a physical barrier that encourages the adaptation and isolated evolution of knowledge, just as living beings became bio-diversified with the separation of the continent Pangea (Blockstein, 1992).

Space can contain things and in order to contain, physical barriers must be erected, totally or partially isolating that space. This statement could be applied to a variety of disciplines, but architecture is certainly one in which humans have spent time figuring out how to get a perfect "isolated" —i.e. comfortable— space. Comfort is important, especially when it is related to our own species. However, there are still disciplines that rule life conditions through the management of space and its physical barriers. Microbiology is one of these; the management of micro-life depends directly on knowledge of space-control. This last discipline and the knowledge of space becomes even more interesting when humans are added to the equation, in what is known as the practice of fermentation. Within the variety of forms adopted by gastronomic science, fermentation is a technique that has evolved through history, absorbing the knowledge of human experiences. This fact is crucial; it was executed as an act of faith in its origins, when the lack of knowledge in microbiology and the biochemical processes were evident, although not limiting. Fermentations applied to gastronomy have gone from being a science to do science, culture, and economy. To do so, it has required knowledge, methods, techniques, and instrumentation from other disciplines (Battcock, 1998). This review aims to reflect on the interaction of disciplines that are apparently unrelated to each other, using Iberian pork slaughterhouses as a hypothetical model of the integration of passive cooling strategies. It is proposed that the contamination of fermentative techniques and spaces through architecture - and vice versa – are a form of biomimicry that generate results more adapted to the environment, economy and social functioning, in relation to the challenge of climate change and higher temperatures.

1.1. WHAT IS FERMENTING AND WHAT DOES IT MEAN FOR HUMANS?

Defined by biochemistry as a catabolic process of incomplete oxidation that does not require oxygen and whose product is an organic product obtained through the action of a ferment (Battcock, 1998). Fermentation in relation to our species goes further, as Francesc Xavier Medina affirms (Director of the UNESCO Cathedra in Food, Culture and Development; n.p.), One third of what we eat has been fermented at some point of its production. The action of micro-organisms is not and has not always been so evident in the products we consume, yet it still endures as a technique, culture, science, economy and trans-species society in today's world (Katz, 2020). The value that this transformation technique brings to the raw materials we consume is the reason why this technique has been with us for more than 7000 years (Babylon, now Iraq; Battcock, 1998) During all this time, and until the appearance of the microscope in 1590 (Ball, 1966; Lera, García, 2015), we were unaware of the micro-world around us, nor of the powerful transformation capacity that we were about to discover. This occurred from an act of faith in a transformation method used consciously in the biofuel, pharmaceutical and, of course, agri-food and catering industries (Grismer, Shepherd, 1998; Pretorius and others, 2003; Todaro, Vogel, 2014). In short, and in this context, fermentation can be redefined as the management of micro-organisms by humans in order to direct the metabolism of the former towards a specific transformation of the original substrates, obtaining as a final product this substrate in simpler parts and with added value at the organoleptic level (flavors, aromas, textures...), health (better assimilation, probiotics), environmental (sustainable), economic (with medium/high value in society in most cases, long conservation, production of materials and methods) and social (with strong roots in cultures, food identity).

The use of fire itself was considered the first technology and with the passage of time humans managed to "standardize"

and replicate it. Its ability to transform due to the transmission of heat was understood, and consequently, it dozens of ways to recreate and use it were invented; wood stoves, gas, electricity, microwaves, pyrolytic ovens, steam, convection, glass-ceramic, induction etc. (Clark, Harris, 1985; Gowlett, 2016; James and others, 2019). Nothing less has been done with fermentation; it was learned how to replicate those conditions in which the results were approximately the same, and with the advance in knowledge, even standardization was reached. The instrumentation and methodology used today for fermentation in the food industry have come to create their own market niche at the domestic level. From small to large scale, it is possible to acquire DIY production packs of the most popular fermented products: kimchi, sauerkraut, pickles, kombucha, vinegar, kefir, beer, bread and even wine, molds and cheeses...

Fermentation, as with fire, has also added value beyond the kitchen, in the pharmaceutical industry or in the production of biofuels. (Grismer, Shepherd, 1998; Pretorius and others, 2003; Todaro, Vogel, 2014). In these technologies, the tools used nowadays remain a hybrid between advanced technology and artisanal practices, that is to say, even if wireless, phone-controlled, steam, wide-range temperature ovens have been invented, traditional wood ovens remain functional and useful within human culture.

1.2. THE FUTURE OF FERMENTATIONS IN A WARMER WORLD

Fermentation is a tool for change, one more variable in the complex equation that aims to both buffer and adapt to climate change. Using the knowledge that fermentation represents one third of culinary diversity, the evolution of this technique and its adaptability to new conditions might ensure a solution for an important variable of the equation. From all of the consequences of climate change, rising temperature has been chosen in this review as the common challenge for both architecture and fermentation (Parra Marcos, 2020; Martin Miguelez, 2021). Both humans and micro-organisms (Ayaviri Nina, Vallejos Mamani, 2014; Cruz, 2016) will experience its consequences, humans in any case are made of the second ones, which leads to a series of hypotheses that must be answered: Will humans' home be adapted to the future rising temperature? And how is it intended to do this for micro-organisms' "home"? Do these questions lead to the creation of a new discipline, architecture of fermentations perhaps, the incubator of our probiotics?

Throughout history, fermentation has colonised most of the planet, from warmer to colder regions, and the versatility and diversity of materials and methods that humans have developed for this purpose, matches fermentation itself. Fermentation has a lot to learn from itself, by only cross contaminating different cultures traditions and innovations. Nevertheless, these learning processes still could be enriched by a cooperative effort with disciplines such as architecture. Fermentation, by definition is linked to humans with the benefits it brings, and this technology shows it to be a promising self-production, conservation and flavor developer in the present and close future. Therefore, fermentation is becoming and will continue becoming a part of human's living architecture and probably each discipline will evolve within their own academic field. Instead, this paper reflects on how both disciplines might work symbiotically, at first by simply mixing temperature buffering techniques (passive cooling technology) from each one before proposing hypothetical case studies in which further interactions will be exposed.

1.3. ARCHITECTURE AND CLIMATE CHANGE

Both architecture and fermentation share the same challenge and architecture has been studying bioclimatic strategies that might fit "fermentation architecture" for some time. It is obvious that there is an issue of scale to be solved if we talk about the house of micro-organisms at the level of amphorae, jars, chambers, tanks, etc. But if we talk about cellars, attics, caves, drying sheds or industrial processing halls, that scale is not simply a question to be explored, but rather a copy-cut from one discipline to another.

However, this reflection wants to avoid the unidirectional copy-cuts between disciplines to make rather the bidirectionality of knowledge-transfer, a vehicle that potentially generates a third knowledge not intrinsic to each of the disciplines separately; that is to say, it is not only the fermentations that learn from architecture, but vice versa. Different studies and experiments were reviewed, from the scientific literature and other forms, such as those from ancestral innovations that became tradition to reinvented tradition that turns back into innovation and opens new future horizons.

2. ARCHITECTURE AND FERMENTATION

Architecture and Fermentation, from the technical point of view, seem to be disconnected and to have nothing in common. Despite this, human architecture and fermentation both share same goal. Both disciplines aim to host living beings and/or biological processes within the spaces they create. These spaces are intended

to establish specific "indoor" conditions that benefits the living beings they contain (Fig. 1).

Benefitting a specific kind of life also means partially or selectively isolate those spaces from the "outdoor", that is to say, both keeping a specific range of "indoor" temperature, humidity, aeration, light exposure, as well as avoiding "undesirable kinds" of life apart from the "indoor" spaces. In the case of human architecture: insects, pathogens, rats, allergen, etc.; in the case of fermentation: pathogens, dust, spores, etc.

To summarize what has been said, fermentation and human architecture shares the same aims and enemies, therefore, both disciplines must evolve, dream and fight back enemies in cooperation.

Let's consider a wall and an amphora as two representative elements of the "skin" of our two disciplines to be studied, two elements that in both cases perform the function of partial isolation, the container that host a content.

Whether for fermentations or in our own homes, the goal is to protect a 3D space from the rest of the environment, not only from its conditions and meteorological effects, but also to create a specific environment that favors the development of life, that of micro-organisms or humans, whether to standardize the production of a wine or improve the comfort of our homes.

Surely there are areas in the globe where the rising temperature must be regulated in such a way that its final value coincides with the optimal temperature for the standardization of a wine, for example, and the perceived comfort in a home and yet, probably, the strategies used, and the energy resources are different for the same objective.

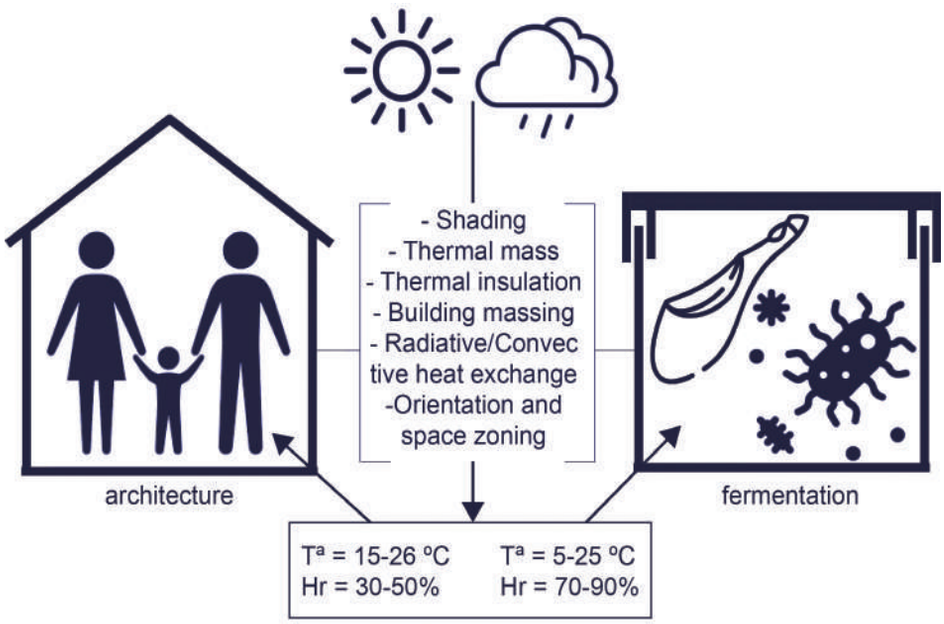

Fig. 1 – Common passive cooling strategies between architecture and fermentation to reach specific "indoor. conditions(n.p.).

3. ARCHITECTURE AND TRADITIONAL FERMENTATION METHODS

The past is and always will be a source of inspiration and learning, especially in those times and cultures in which necessity made from creativity a versatile problem-solver, adapted to the surrounding environment and resources. Architecture and the world of fermentation embrace this fact to such an extent that, if we want to look to the future, we must look at the sustainability of these disciplines in the past, learn from them, reconsider the knowledge of the present, and try to predict a hybrid application that adapts to different future scenarios. Bioclimatology has served and continues to serve as a link between both disciplines. Defined as an interdisciplinary scientific field that studies the interactions between the biosphere and the Earth's atmosphere, on a time scale of seasons or longer, it is the ecological science that studies the reciprocity between climate and the distribution of living beings on Earth (Bugenings, 2022). Even if this field has been already well studied, the potential it hides and how it can help architecture and fermentations is key to how we might adapt to the coming rising temperatures by using the lowest amount of energy.

There are many examples in which architecture has been crucial to the production of some of humans' most popular ferments worldwide. The wine cellars or the old Iberian ham slaughterhouses represent structures designed specifically for the transformation processes they host, in particular to create humidity and temperature conditions under a certain control. Two examples in which the definition of amphora or wall becomes one: a wine cellar can be seen as a large building with large walls that contains indoor small buildings with smaller walls or as a very large amphora that contains other smaller amphorae inside (Terrados-Cepeda, 2015). In both cases the contents are always semi-isolated and under optimal humidity and temperature

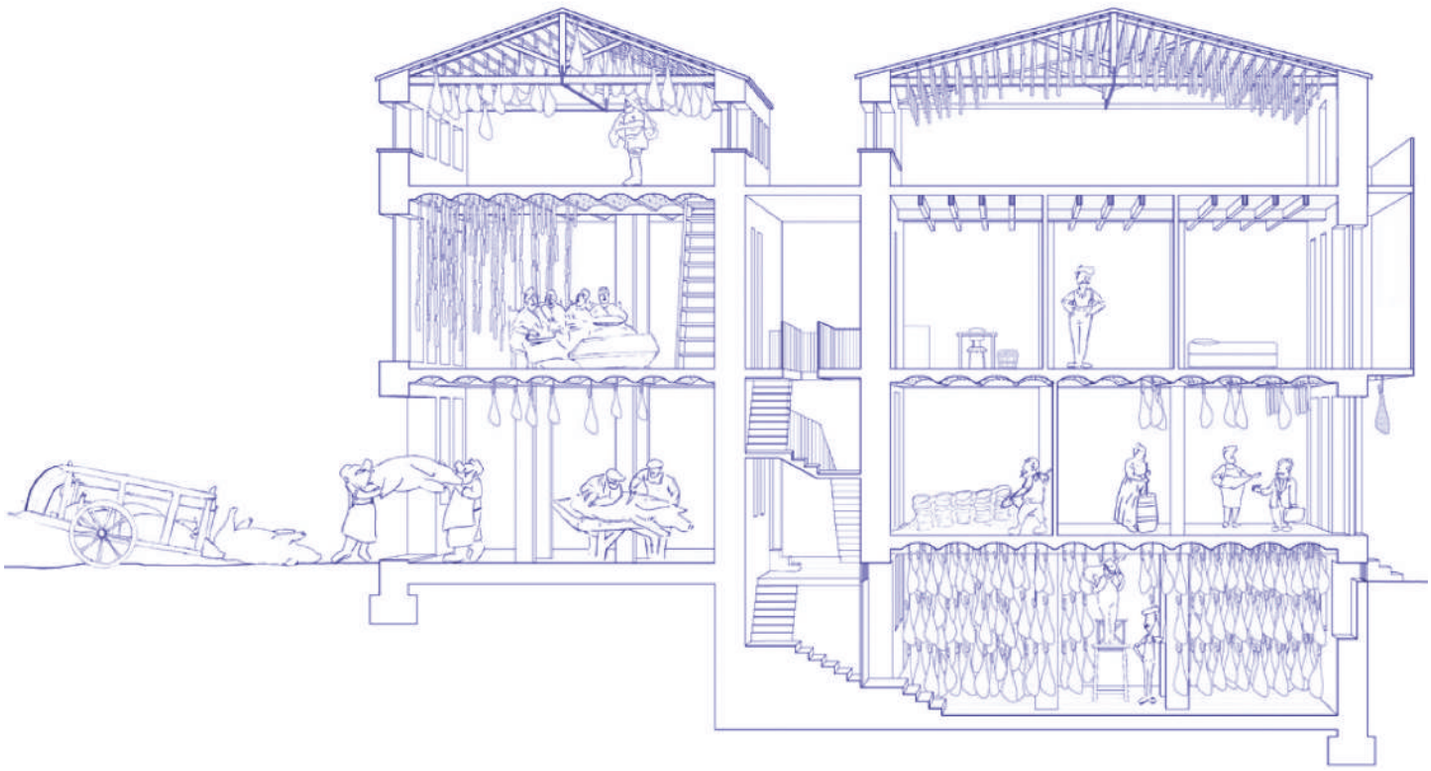

Fig. 2 – Schematic representation of a traditional Iberian pork slaughterhouse in Spain: a. ground floor, b. 1st floor, c. 2nd floor or "sobrado", d. cellar (Parra Marcos, 2020).

parameters for the proliferation of the type of life it contains, sometimes optimal for all these types of life at the same time.

From the beginning, the houses of Iberian ham (slaughterhouses), wine cellars, cider, breweries, cheese factories, vinegar factories, bakeries... took into account factors such as altitude, latitude, climatological phenomena, orientation and solar incidence, construction material, etc., factors that were managed by the principles of bioclimatology to such success at the technical level that even today we are still learning from it (Fathy, 1986). Even when the scientific-technical knowledge of the fermentation process was not the most advanced, certain parameters were considered that had to be controlled to maintain a certain standardization of the expected result. These are examples in which architecture offers solutions to a fermentative process. However, history has been using multidisciplinary collaborations, where two or more disciplines put themselves at the service of another discipline, but each of these disciplines continued to act under the framework of its own academic field, maintaining the original methods and conceptions of the academic field to which they belong (Hedegaard, 2019; Nicolescu, 2012). To face future challenges, such as temperature increase, we need new solutions that go beyond the frameworks of each of the disciplines separately.

Continuing with the Iberian ham slaughterhouses as an example, it can be found that several methods and techniques have been used to better control temperature and, above all, aeration, and humidity. This type of construction was called a "house", a space that by its very definition was not only intended to produce ham, but also to host the lives of the owners of the activity, what we might call home. A home designed to keep both humans and a fermentation process stable. These slaughterhouses were divided into 4 floors: the ground floor, with thick walls, destined to the reception of customers and sales in the front part, and to the reception of pigs and primary processing in the back part; 1st floor, with lighter and narrower adobe walls, destined for housing and accompanied by a drying room; 2nd floor, called the "sobrado", an open space under the wooden ceiling, used for drying and preserving hams; and last but not least, the cellar where a cooler and more controlled space was created for curing the hams for years (Parra Marcos, 2020). The vertical distribution (Fig. 2) of the structure itself shows the versatility in the use of spaces depending on their ventilation, orientation and exposure to light and therefore heat radiation. In addition, narrow windows can be seen in the facade and at street level that allowed the passage of air controlled by two adjustable dampers. All these techniques used are especially appropriate for by the climate of the area; in fact, they make this structure a bioclimatic architecture that passively takes advantage of the environment and climatic conditions to generate the desired environmental indoor conditions while consuming the minimum amount of energy (Mekhilef and others, 2012; Bugenings, 2022).

These design details endure to this day and have become part of our repertoire of traditions.

Traditions are successful innovations for a specific time and place, i.e., adapted innovations. If our climate changes, then the innovations of the past would become unsuccessful for traditions today, i.e., not adapted. One more reason to keep learning from solutions in different times and specific places. Vernacular architecture shows more methods of temperature damping and temperature lowering using passive strategies, with minimal or no energy involvement (Fathy, 1986; Cañas, Martín, 2004).

For humans it has been always easier to create heat rather than coolth, fire facilitated this fact. However, that is not the only reason; cooling means lowering particles movement and, to do so, energy involvement is needed.

Therefore, the main way to passive cooling a specific space is to avoid the source of heat, that is to say, release or exchange heat through the walls or amphoras; or simply get isolated from heat.

Heat Dissipation

The first strategy is called, heat dissipation and it can be achieved by different ways. Evaporative heat exchange or evaporative cooling takes advantage of the heat exchange between air and water. This heat exchange can be direct or indirect depending on the water contact with air. The main difference is that in the direct way the air has received a mass contribution in the form of water vapor, which increases the relative humidity of the inner space in which is conducted.

Evaporative cooling has left several examples that might involve both disciplines under study. It is a strategy that involves the use of water to a lesser or greater extent. Depending on whether it is a direct or indirect system, the volume of water required can be recirculated, or alternatively allowing to control the exploitation of water resources of the areas where they are to be applied (Palomar Aguilar, 2017). An amphora by itself is a good example of small and big scale evaporative cooling, the porosity of the clay used in their construction increases the surface of contacts consequently easing the heat exchange at the same time as it acts as a isolator.

Muscata, an example from the Middle East, it consists of a porous ceramic container, arranged in a window and protected from solar radiation by eaves and lattices. The evaporation of the water contained inside cools the air. The entry of this air is both through the window behind the vessel and the lattice that could be arranged in the wall at the bottom, while the exit is by thermal stratification at the upper end. is an example in which architecture and fermentation tools gathers in the same space; the difference with the slaughterhouses is that a non-fermentation process is hosted within. (Fig. 3; Palomar Aguilar, 2017).

It is inevitable to think that these jars or amphorae could not contain wine, vinegar, soy sauce, mead or even sauerkraut... However, the first drawback that would be encountered is the fermentation smell getting into the rooms. However, the basis of this review is that it would be

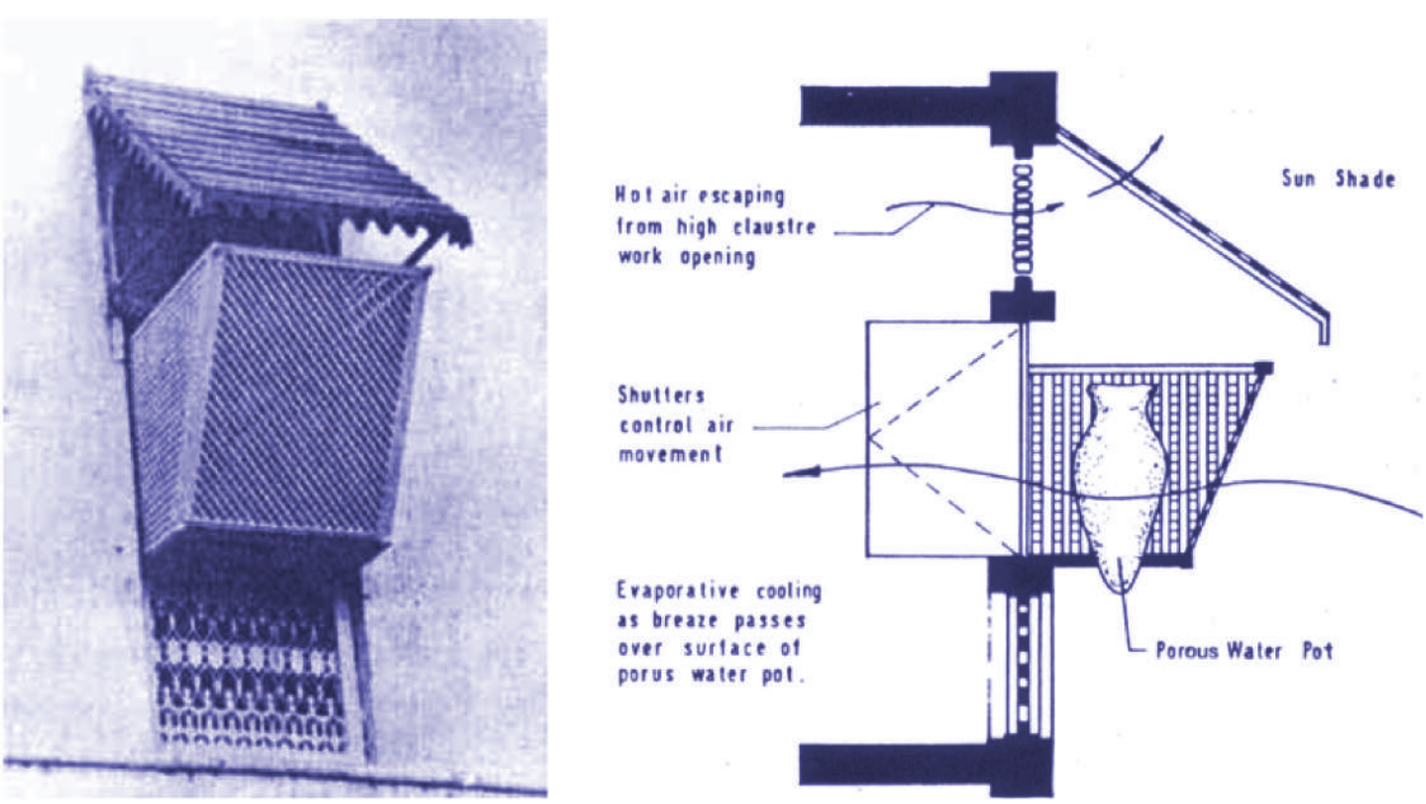

Fig. 3 – Muscata (Schiano-Phan, 2004).

vague to think that the innovation lies in replacing water with wine and that this would lead us to success. Once again there is a solution from other regions of the world called “Pot-in-pot”, which is used mainly in Africa for food preservation. It consists of two concentric ceramic containers between which a sand filling is placed and moistened. The evaporation of the outer layer keeps the contents fresh. We can already intuit that in the Muscata system, we could replace the jar by a “pot-in-pot” amphora system and in the space between we would place water instead of wet sand, thus increasing the expiration effect by the pot’s porosity. Thus making a stable temperature, both inside the room of the house and inside the amphora where our fermented food would be kept. (Fig. 4; Palomar Aguilar, 2017).

There would be more problems to solve: the porosity of the inner vessel should be minimal or nil, since the fermented liquid inside could pass to the interface where the water is located and begin to smell. To solve this problem, the innermost part of the vessel could be varnished, blocking the pores to isolate the fermenting liquid from the interface. In fact, Lee Kwang in 2006, evaluated the quality of Korean soy sauce in Korean earthenware (onggi) with different glazes - outside only, inside and outside, no glaze. Both glazed Korean “amphorae” resulted in sauces with higher levels of glutamic acid, enzyme activity and total acidity, i.e., better sauce quality (Lee, 2006).

Malqaf or Wind Towers is another example of architecture that uses an amphora as a passive cooler. The level of sophistication of long-established wind towers continues to be a model and inspiration.

These tall towers were intended to capture the breezes and introduce air movement inside the rooms of the lower part of the building. They originated in 2000 BC in the Qajar era (1781-1925) and were combined with the passive cooling technique we have seen at Muscata (Fig. 4). That is, they place an amphora inside the tower to further cool the breeze thus providing direct evaporative cooling (Fig. 5; Palomar Aguilar, 2017). Inevitable again, not to think of placing wine inside and applying the pot-in-pot system mentioned above. Perhaps the accessibility to the amphora is not adequate and it was not intended to be, but let’s not forget that we are reflecting on techniques of the past and molding them with a single objective, to combat rising temperatures.

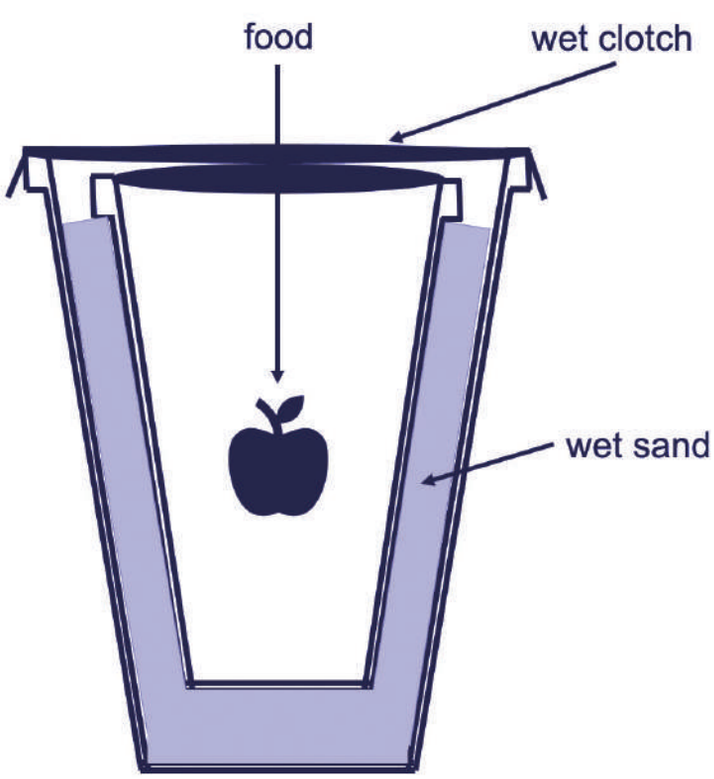

Fig. 4 – “Pot in Pot” (n.p.).

Both wind towers and muscata might be applied to slaughterhouses in order to lower the indoor temperature in the near future. Fig. 6 shows a schematic representation of how techniques used in a muscata and malqaf might be part of an evaporative cooling system in an Iberian pork slaughterhouse Assuming that stairs must be placed externally or internally in this hypothetical representation, the malqaf system or wind tower (e. Fig. 6) occupies that space with the aim of conducting cooled and wet air in the left side of the ground floor used for reception and primary processing of the pigs (left a. Fig. 6) and especially to the -1 floor (d. Fig. 6) where the coolest temperature must be enhanced for the curing process in combination with higher humidity, Fig. 1. In addition, two muscata systems(f. Fig. 6) have been placed on the first floor (b. in Fig. 6); in this way both rooms dedicated to human living and sausage preparation can be passively cooled, depending on wind direction of course. (Parra Marcos, 2020). The 2nd floor is for the first drying stages where higher temperatures are required, hence no passive cooling strategies have been added. Nevertheless, at the present time and in the near future, external temperatures might become so high that this floor might require similar solutions (Martin Miguelez, 2021).

Aside from evaporative cooling, there are some other passive cooling strategies that fit both disciplines under study. In both walls and amphoras the chosen

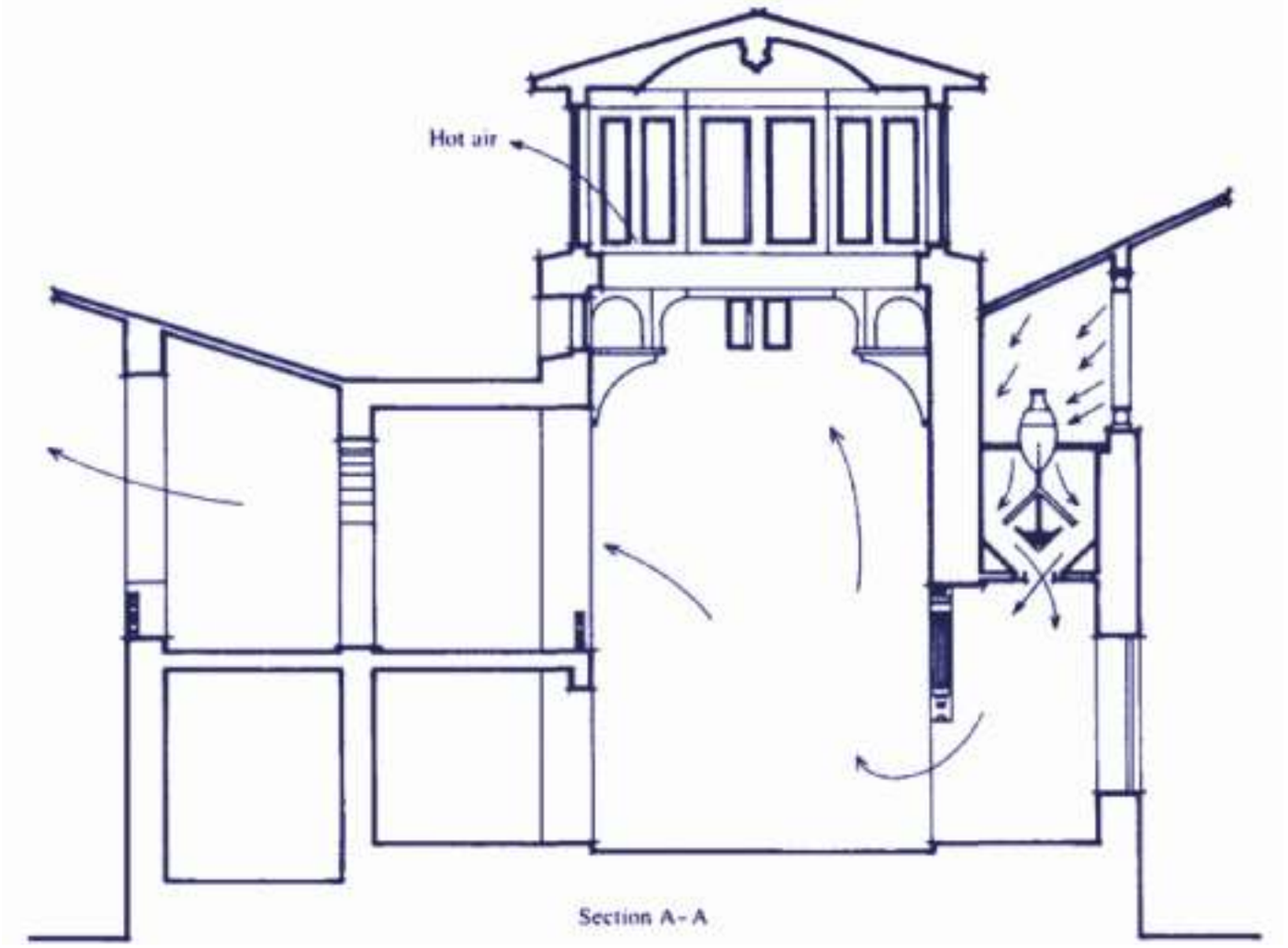

Fig. 5 – Malqaf with ceramic amphorae and humidified deflectors (Palomar Aguilar, 2017).

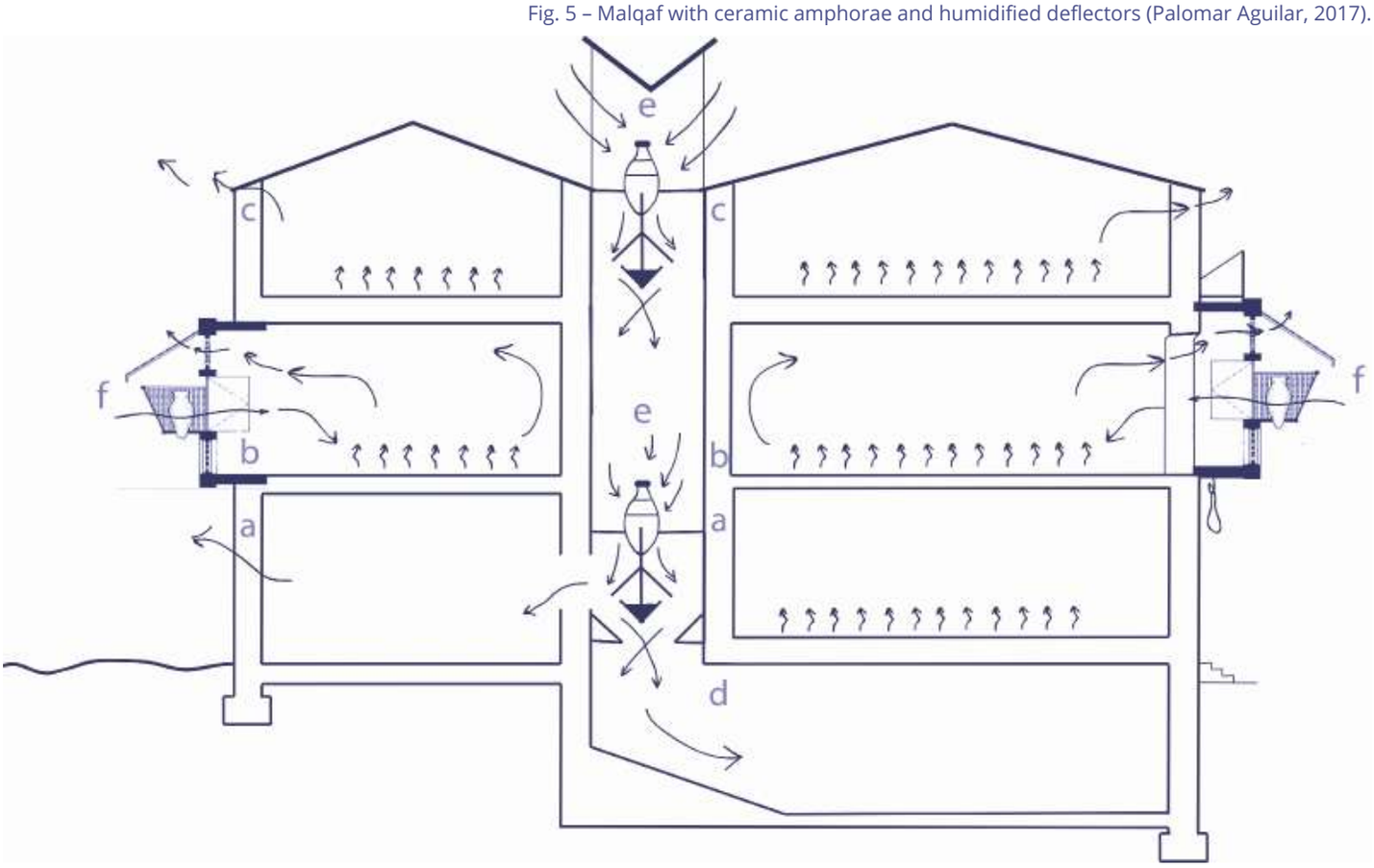

Fig. 6 – Schematic representation of hypothetical implementations of Malqaf with amphora as evaporative cooling (e) and muscata (f) at the balconies (n.p.).

material used to partially isolate the inner space is crucial for this same purpose and therefore also for better heat exchange. This is the case of Thermal Mass, which is mainly influenced by the nature (heat storage and transfer) and density of the material chosen. Another strategy that also aids with heat dissipation is the massing of the building, including its aspect ratio and compactness. This is one of the reasons why slaughterhouses have always been built upwards to reduce exposure to solar radiation.

The nature of the building material can also influence other strategies such as radiative and convective heat exchange, which take advantage of differences in daytime and nighttime temperatures or the air flow within the inner space, a natural ventilation technique.

Heat Exclusion

Solar radiation is one of the main sources of heat that needs to be addressed due to climate change. Heat exclusion is a complementary form of passive cooling that focuses on isolation against solar radiation. Shading methods have been used for this purpose, especially by designing different building geometries, interaction with vegetation or simply specific shading devices (Manzano-Agugliaro, 2015). Orientation and space zoning such as sun angles, local wind directions and seasonal and diurnal temperatures are key to optimizing orientation. Orientation is one of the most studied parameters; it can reduce the need for conventional heating or cooling and enhance the performance of other passive strategies. Space zoning, on the other hand, can influence both energy consumption and the quality of the indoor environment (Manzano-Agugliaro, 2015; Bugenings, 2022).

The use of these strategies alone or in combination have proved capable of reducing the internal temperature of buildings even in environments where the ambient temperature is very high (Manzano-Agugliaro, 2015; Terrados-Cepeda, 2015). As explained, each strategy offers a bioclimatic adaptation with greater or lesser results depending on the specific climate conditions of the specific area of the world (Jain, 2006; Kamal, 2012). Focusing again on the example of the second floor of the slaughterhouse (c. in Fig. 6), most of the heat exclusion strategies might be applied to the walls in order to buffer the increasing temperatures without necessarily cooling them down as certain heat and air flow is required by these drying rooms.

4. PRESENT AND FUTURE LINES

Examples from the past have been mentioned that continue to be of great use today. The simple cross-combination of techniques applied to the case study of the slaughterhouses shows the innovative potential of these ancient strategies in the present day. Several research studies are currently being conducted to combat rising temperatures in the present and future. The development of new technologies in combination with the passive cooling strategies mentioned above opens a new spectrum of solutions that will enable environments to be created that are adapted to specific ranges of humidity and temperature, even in places that will become even hotter (Kamal, 2012).

We can see how the wind towers of 2000 BC have undergone an evolution towards greater efficiency. In Fig. 7 we see how new materials have been selected in the walls of the tower (thermal mass and thermal insulation) depending on the level. These new materials are also intended to be vapor-resistant, preventing unwanted mold growth. The amphora used in the muscata has been replaced by perforated pipes and a pond at the base (direct evaporative cooling) and new layers have been added as the air descends. All this leads to greater efficiency in cooling the descending air column and better filtering of possible particles, insects or dirt (Kamal, 2012).

The improvement in the wind towers shows a convergence of multidisciplinary knowledge that goes further than the slaughterhouses did. Nonetheless, the replacement of the muscata system with perforated pipes and the consequent introduction of a water sump might bring problems related to the relative humidity inside. In this regard, it is proposed to use indirect evaporative systems such as the ancient muscata in combination with the new improvements. Fig. 8 below shows a breakdown of these improvements within the hypothetical model of an Iberian pork slaughterhouse. Compared to the hypothetical improved ancient slaughterhouse in Fig. 6, this new model decentralizes the central location of the wind towers and distributes the functions of the different layers in Fig. 7 all around the building, based on a profound understanding of the temperature and relative humidity required by both humans and the microorganisms involved in producing cured ham.

Starting from the upper part of the tower (head of wind tower in Fig. 8), all wind directions (Parra Marcos, 2020) flow in through a wire mesh, preventing birds and insects from entering. Once inside the tower head, the air descends to the second floor where it meets the first amphora (Fig. 8) or “pot-in-pot” system.

As it comes into contact with the water-filled (or other liquid such wine, perhaps) amphora, its temperature also descends, making it heavier and helping it to flow down to the following

floors. No connections with the second floor (or "sobrado") were strategized due to the higher temperature and dryness required for the process of drying sausage and Iberian ham. Instead, heat exclusion strategies were applied to maintain indoor temperatures or simply release heat automatically if temperatures rise above 35ºC and 30% Hr. To achieve this, automated breathing-holes have been hypothesized connected to sensors that output to the breathing-holes in the event that the temperature and relative humidity rise above the pre-established range. Furthermore, north-oriented rooftops (since the slaughterhouses are located in the northern hemisphere, sunlight impacts especially from the south, east and west; Valladares-Rendon and others, 2017) made from high heat transfer materials and covered with a garden, avoid perpendicular solar radiation and isolate the indoor space from a minimum heat adsorption in its surface.

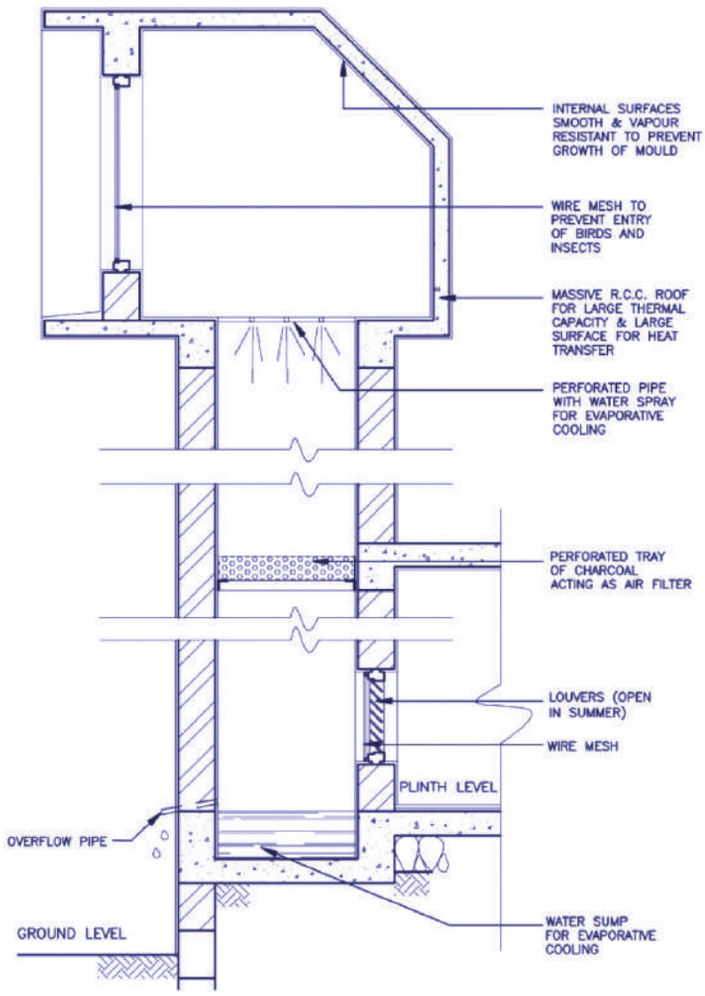

Fig. 7 – Section showing detail of a wind tower (Kamal, 2012).

Continuing to the first floor and past the amphora porosity, 2 ultraviolet lights have been fitted for water vapor sterilization. Perforated charcoal trays used in Fig. 7 are placed right after the UV lights for further filtration of any unwanted water droplets that might carry solids or pollution. Focusing on the safety protocol for pathogens, in microbiology and fermentation, the recent use of biosensors (input) and bioreactors together with new automated cooling systems, ohmic heating and Moderate electric field (MEF), etc., allow microorganisms to be controlled to extents that were not possible 50 years ago. Many of the direct evaporative cooling systems we have seen so far have certain drawbacks related to the growth of unwanted molds or microscopic algae, including the proliferation of Legionella. Legionella is a genus of bacteria with 48 species and 78 serogroups, most of which are associated with human diseases. The kind most often found in patients is L. pneumophila. There are protocols for preventing these pathogens; however, the incorporation of further biosensors, application of technologies such as ohmic heating for sterilization and the use of other non-pathogenic microorganisms that would serve as competition might serve as alternative solutions with a more microbiological and therefore effective approach.

Specifically, ohmic heating is described as being the process of passing an electric current through materials for heating purposes (Gavahian et al., 2020; Gavahian & Farahnaky, 2018; Knirsch et al., 2010). Initially applied to microorganisms, this type of technology was devised as a possible method of sterilization, because when set to high frequencies, it raises the temperature to levels that prevent life. However, (Gavahian, M., & Tiwari, B. K. (2020). Unlike traditional heating methods which usually rely on thermal conduction- and convection-based modes of heat transfer (as we saw in some of the passive strategies), ohmic heating relies on the direct generation of heat in the volume of the product, i.e., volumetric heating. This would therefore provide us with an alternative to microbial control in walls and amphorae in the slaughterhouse model. In Fig. 8, Ohmic heating devices are located at the output of the rooftop garden water tanks. A biosensor inside the water tanks has been fitted to detect the presence of certain pathogens such as Legionella. The biosensor outputs a signal to the ohmic heating device which aggressively and instantly sterilizes the water just before it reaches the amphoras.

The purpose of this system is to occasionally refill the amphoras

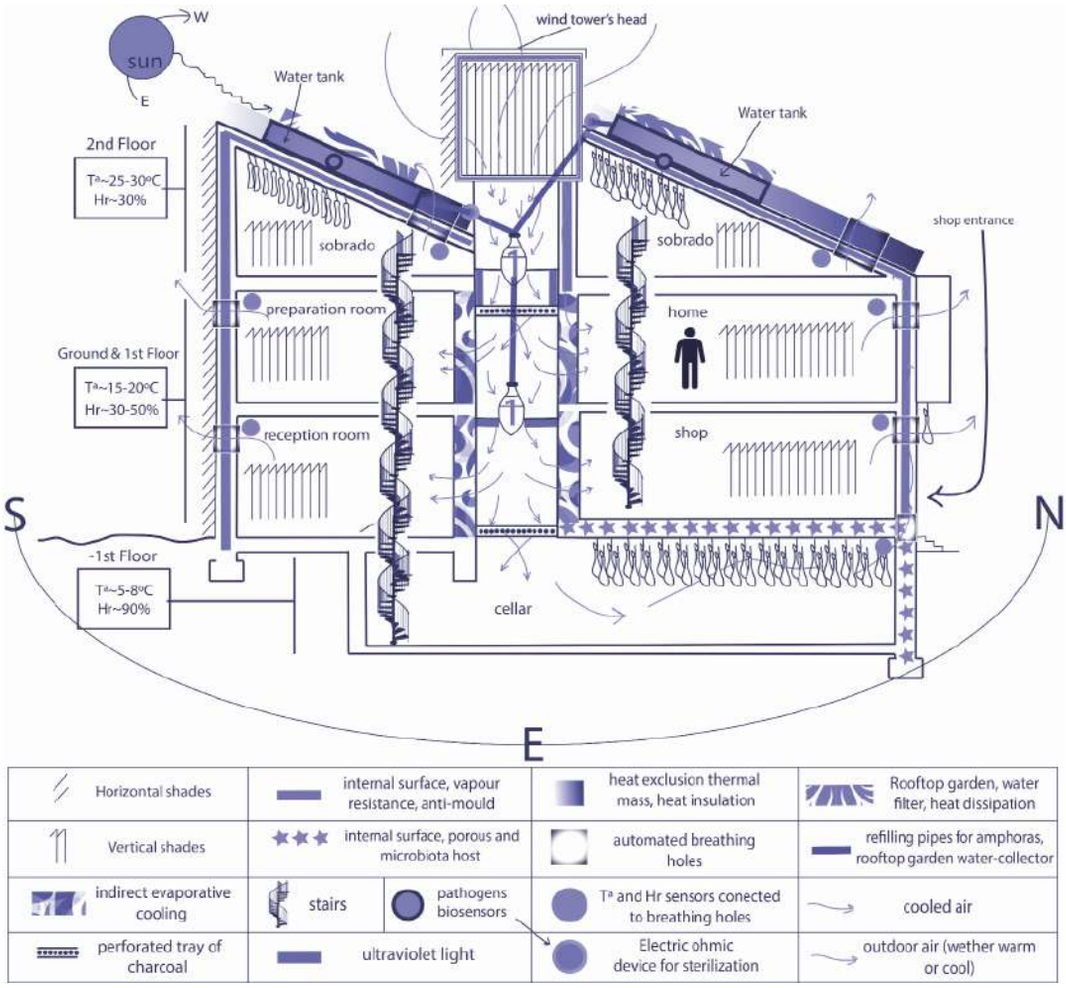

Fig. 8 – Schematic representation of a hypothetical Iberian pork slaughterhouse model which includes the passive cooling strategies explained in this review, both traditional and more innovative ones. 1. Amphoras. (n.p.).

by re-using surplus water from plant absorption that accumulates in the water tanks. In summary, there are 5 levels of protection against pathogens and pollution: the water tank biosensor, ohmic heat sterilization, ultraviolet lights, a perforated charcoal tray and the amphora microfiltration itself. At this point the clean and cooled air flows into both the first and ground floors through an indirect passive evaporative cooling wall. Passive evaporative cooling walls (PECWs) such the one shown in Fig. 9 use water capillarity to direct soaking vertical ceramic tubes. They are highly efficient and also create forms of shading that aid in dissipating solar radiation (He, Hoyano, 2010; Palomar Aguilar, 2017). In the slaughterhouse model the walls are internal, making the shading properties ineffective, even though indirect evaporative systems are more suitable for preventing over-humidification inside the first and ground floor, intended both for the manipulation of raw produce and for human dwelling.

PECW is a prototype, another idea within a whole spectrum of new projects that can and must enrich models such as that of the slaughterhouse. The inclusion of 3D printing technology in this prototype brings tailored and precise target solutions adaptable to any circumstances. There are works currently underway in which microorganisms have helped in the design and improvement of such strategies. Šál, J., & Nováková, P. in 2018 studied the benefits of increasing brick porosity by using fermented waste from biogas production. This study not only results in bricks that could fulfill the function of cool bricks but also offers an alternative use for the waste generated by this industry and all this through the indirect use of microbial fermentation. The study proposes the use of these bricks in the industry itself, since their ability to retain pollutants has been demonstrated, a feature that makes this solution even more interesting for extrapolation to buildings near factories, highways or even the agri-food industry close to cities. Bricks for passive cooling purposes might use microbiology not only for its functional properties but for its spontaneous design. Fractal proportions (Rajković, 2019) bio-mimic a porous, homogeneous design that could not only provide an evaporative cooling function but also shading. At present, several attempts at 3D-design are underway using mold mycelium as a skeleton (Attias, 2020), which might be suitable for use in the slaughterhouse model.

At this point and due to its weight, the air also continues to descend to the last and

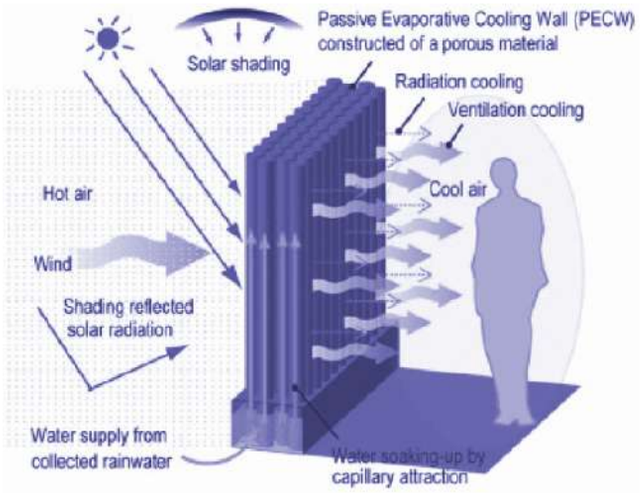

Fig. 9 – Prototype of PECW (He, Hoyano, 2010).

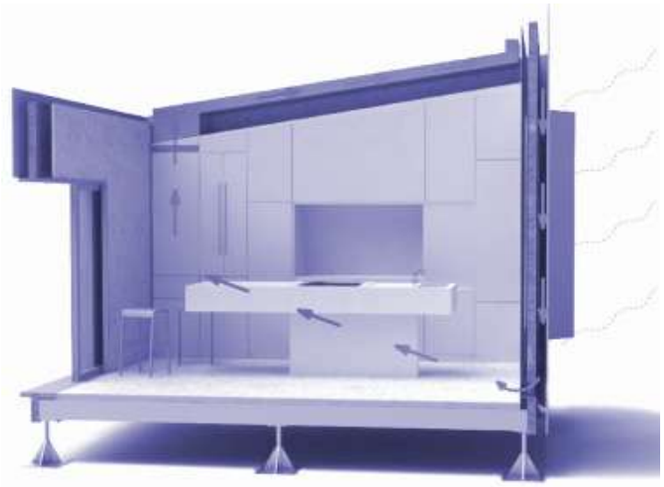

Fig. 10 – Top left: "botijo" effect, (Terrados-Cepeda and others, 2015).

probably most valuable room in the slaughterhouse, the cellar. As described at the beginning, it is here that the Iberian hams are stored and cured for up to 6 years, and the temperature and relative humidity conditions must be controlled. After all the layers of protection through the wind tower, the fresh air flows through a subsequent charcoal trail and enters the cellar, not only lowering the temperature, but more importantly, keeping it low (5-8ºC). The underground area is itself well insulated, and therefore, 90% Hr is achieved by accumulation and regulated by automated breathing holes. If the Hr becomes too high, the breathing holes open and allow the warm air to flow up, past the roof, where it is sterilized by the ohmic device and back down into the PECW, as seen in Fig. 8. This last is called the "botijo" (or "jug") effect, a reference to the passive cooling properties of the ceramic jug that can be applied to the walls of the house (Fig. 10; Terrados-Cepeda and others, 2015).

Finally, it should be mentioned that the main "sobrado" floors of the wind tower head are coated by an internal surface, resistant to vapor and mold growth due to the activities within these rooms. In contrast, in the cellar, porous traditional walls have been conserved, in this way the spontaneous or inoculated microbiota can be preserved over the years and continue to give the final Iberian ham product its special profile.

CONCLUSIONS

The combination of all these ideas might bring spaces with selective permeability to the type of life we want to promote, add value to the final products and increase indoor comfort. All this, knowing that we can detect (biosensors) and monitor (digital recording) the process while we fight against rising temperatures, combat climate change and consume as little energy as possible, especially non-renewable energy... While bioclimatic, biomimicry and architecture have been extensively studied over recent years, this review nonetheless casts light on these fields by adding complexity to the fermentation process. The application of climate-friendly architectural solutions in spaces where fermentation and habitation are combined, automatically involves infinite and versatile techniques operating in the opposite direction to normal, that is to say, from fermentation to architecture.

The interaction of Architecture and Fermentation is only one example of the infinite disciplines that might be married for a single purpose. The Iberian pork slaughterhouse is a model that shows the hypothetical interactions between disciplines with the aim of maintaining different life forms, buffering temperature rises due to climate change and using sustainable strategies.

However, further research must be carried out in order to test this model and understand whether the selected strategies, their interaction and the way they are applied are suitable for the activities hosted by this kind of space. With the common purpose of reducing climate change and its consequences, rethinking beyond the usual academic actors and introducing social relationships (Haribabu, 2010; Mestre and others, 2022), a closer transdisciplinary approach might introduce new knowledge that will help to understand a bit more how our planet works and how we can improve the ways in which we affect its stability.

Science often seeks measurable proof. The slaughterhouse model is a representation intended to seek hypotheses that will need to be tested and must be replicable. Coming from the past, slaughterhouses represent well-consolidated and successful structures that have seen almost no changes throughout their history. The main question for these conclusions might therefore

be: “Why change something that already works?”. Even aside from the climate change argument, the purpose of this review is to encourage creativity and a re-examination of things that we tend to believe have “already been solved”.

Science could tell us a lot about the technicalities that already operate within a traditional slaughterhouse, and also the technicalities that do not work within the proposed slaughterhouse model. Yet science is not the only field that can contribute to this purpose and there is no reason why we should not revisit the successes of the past.

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FARMING & SPACE FOOD

Junk Food

Radical approach to sustainability in Grahame Caine's Eco-House

arquitectura radical
Grahame Caine
eco-house
sostenibilidad
comida
radical architecture
Grahame Caine
eco-house
sustainability
food

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El objetivo de este ensayo es ilustrar una forma posible y extrema de entender el ciclo del reciclaje de residuos y la producción de alimentos a través de la experiencia de un arquitecto radical como el miembro de Street Farmers Grahame Caine en su propia Eco-House, ensamblada en Londres en 1972 y desmantelada en 1975. Nos situamos en el marco del material ya existente y la perspectiva de la arquitectura radical junto con una militancia política utópica y anárquica para responder a la cuestión de la sostenibilidad radical en una época en la que este movimiento estaba empezando. El proceso y el significado de este ejemplo temprano sigue siendo interesante no solo por su carácter extremo sino también como una lección de compromiso radical.

La ubicación de la Eco-Casa en el marco y la genealogía de proyectos relacionados con la naturaleza como Archigram, Superstudio o Archizoom también forma parte de este ensayo.

The objective of this essay is to illustrate a possible and extreme way to understand the cycle of waste recycling and food production. This is pursued via the experience of a radical architect such as Street Farmers member Grahame Caine in his own Eco-House, assembled in London in 1972 and dismantled in 1975. Using the framework of the already existing material, and the radical architectural perspective along with an utopian and anarchic political militancy, this essay aims to answer the question of radical sustainability in a time where this concept was starting. The process and significance of this early example is still interesting, not only because of its extremeness, but also as a lesson of radical commitment.

The Eco-House location within the framework and genealogy of nature-related projects such as Archigram, Superstudio or Archizoom's is also part of this essay.

To us, pollution is a greenhouse full of tomatoes and cucumbers and it's pretty healthy pollution.[1]

The construction of a shelter and to prepare food to eat are part of the group of basic human needs, those that we cannot do without but that accept improvements oscillating between the cultural, the social, the aesthetic, or the political. The result of these updates give rise to architecture and gastronomy respectively.

One of the most fascinating links between gastronomy and architecture, due to its literalness and immediacy, was provided by the radical group Street Farmer with the Eco-House designed and built by Grahame Caine in London in 1972. The house, understood as an active laboratory during the more than two years it was lived in, materialized the anarcho-ecological ideas of a group of architects who trusted in the reformist and emancipatory capacity of an architecture detached from the dominant technophile circles in the Architectural Association at the time.[2]

As part of a political and cultural agenda opposed to the aestheticization of technology, its authors (and fundamentally Grahame Caine, its designer and main inhabitant) built a manifesto to which the basic functions of architecture were added inventions such as electrodialysis, closed cycle air evaporation, compressive vacuum distillation, primary digesters, algae digesters, algae tanks, rainwater tanks, hydroponic gardens, solar panels, wind generators and other devices that turned the Eco-House into an authentic and updated *machine à habiter*, a device that transformed human waste into both methane, used for cooking, and other substances that were used in a hydroponic greenhouse that included *bananas and other tropical fruits.*[3]

The construction was made possible by the confluence of different factors such as the offer of a plot of land owned by Thames Polytechnic[4] and the donation of 2,000 pounds by Alvin Boyarsky, the president of the Architectural Association. In addition, Grahame, who was still a student at the time, managed to get the Woolwich district planning supervisor to grant a temporary building permit with a maximum duration of two years to build an "inhabitable housing laboratory"[5] that would achieve total self-autonomy by transforming household waste into fertilizer for growing vegetables within the house itself.

Construction began, with the help of the Street Farmers, in September 1972, so that the house would be up and running by the following Christmas, as the Eco-House was not just an architectural, technological or political experiment for it had to respond to the family needs of Caine and his partner, Fran Stowell.

The house had a considerable impact on the British press during its almost 3 years of life and became the protagonist of the episode called "Clearings of a concrete jungle" in the BBC show "Open Programs for Television" in June 1973. Other publications that included the Eco-House were "The house that grows" and "A new way of living" in the magazine *London Garden News* along with "Living off the sun in South London" in *The Observer*, "A revolutionary structure" in the magazine Oz (Fig. 1). and in issue 20 of the magazine *Mother Earth news* in March 1973.

It is ironic that despite the explicit support of both the local administration and the Architectural Association, the creator of the Eco-House, Grahame Caine, failed his final exam at the AA and never obtained his architectural degree. This is probably due to the fact that in his presentation of the house - which was the topic of his research - he did not provide

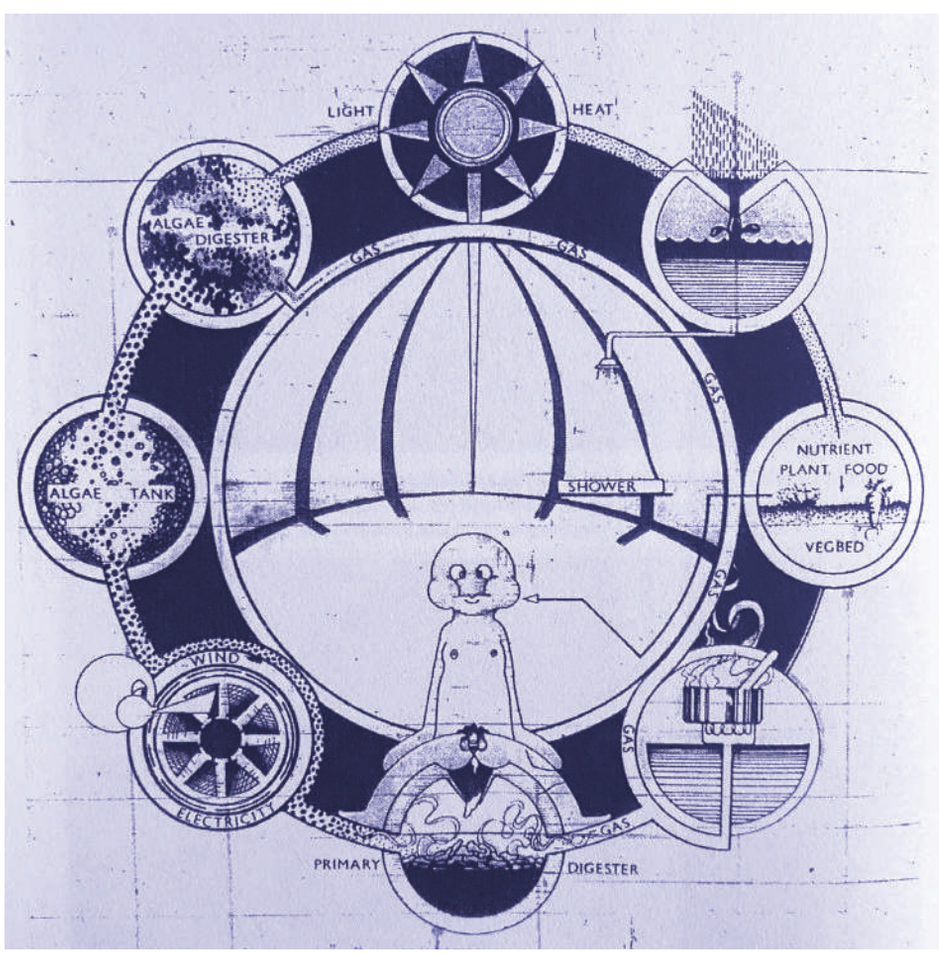

Fig. 1 – Magazine Oz.

drawings and conventional representations of the proposed architectural object. Instead, he dedicated himself to showing innumerable technical diagrams and data that he had collected on the performance of the different machines that made the Eco-House work, along with sketches of an alternative political reality detached from the infrastructural control of the state. Even more ironic is that the Architectural Association hired Caine as an instructor there the day after he failed.

It is interesting to point out that the Eco-House left no one indifferent, and that its disregard for the basic principles of composition, space or form - "form was anathema"[6] - aroused both the rejection and angry criticism of the architectural community (and the complains of the neighbours, for whom it was a "eyesore"[7]), but at the same time it gained the admiration and illusion of an emerging sector of the population that was looking for alternative and sustainable ways of inhabiting the planet.

Although probably the main interest of the house had to do with its biological, organic and self-sufficient character, the Eco-House distanced itself from its pretended counterparts. In other words, in the face of the fascination and technological optimism of contemporary architects such as Cedric Price or Archigram (satirized in number 3 of the magazine ARse, in which the Street Farmers participated (Fig. 2), who considered nature as the necessary (although irrelevant) background to what they wanted was the transfer of military technologies to the civilian sphere. Even in projects with a romantic natural aspect this occurred (Fig. 3). which are actually camouflaged forms of a figurative use of nature: "Since it is difficult to recognize these outlets from nature's own products, they are equipped with a homing signal that locates

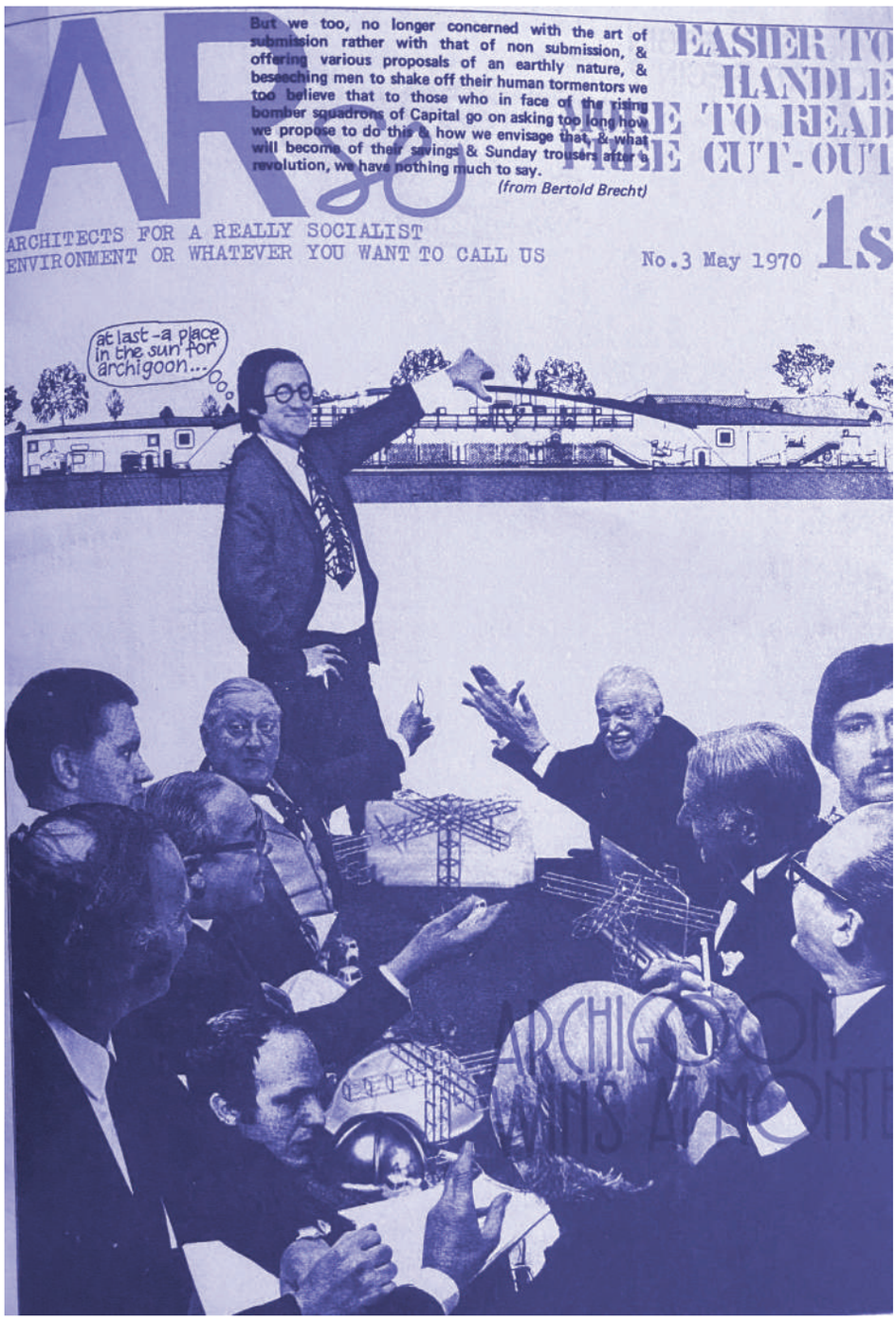

Fig. 2 – Issue 3 of the magazine ARse.

each one within a radius of one mile (...) The whole of London or New York Will be available in the world's leafy hollows, deserts and flowered meadows.[8]

A complete look at Radical Architecture is not the main goal of this essay, and yet it is interesting to look at least three projects that addressed the very core of nature as the main element to understand such an "artificial" discipline as architecture. New perspectives, such as the Architecture-tree branch as made up of plugs and drains... or of architects with a technophile appearance but clearly distanced from the redemptive spirit of modernity[9] such as Superstudio or Archizoom. In these the bucolic and pastoral reverie (Fig. 4). refers to archaeology or the ecstatic contemplation of nature as background, as an "exterior"(Fig. 5). but where the scientific reality, the pragmatism necessary to achieve the real viability of these projects, is not studied in detail (because it does not matter, it's just an image). The source of energy in all of them is not

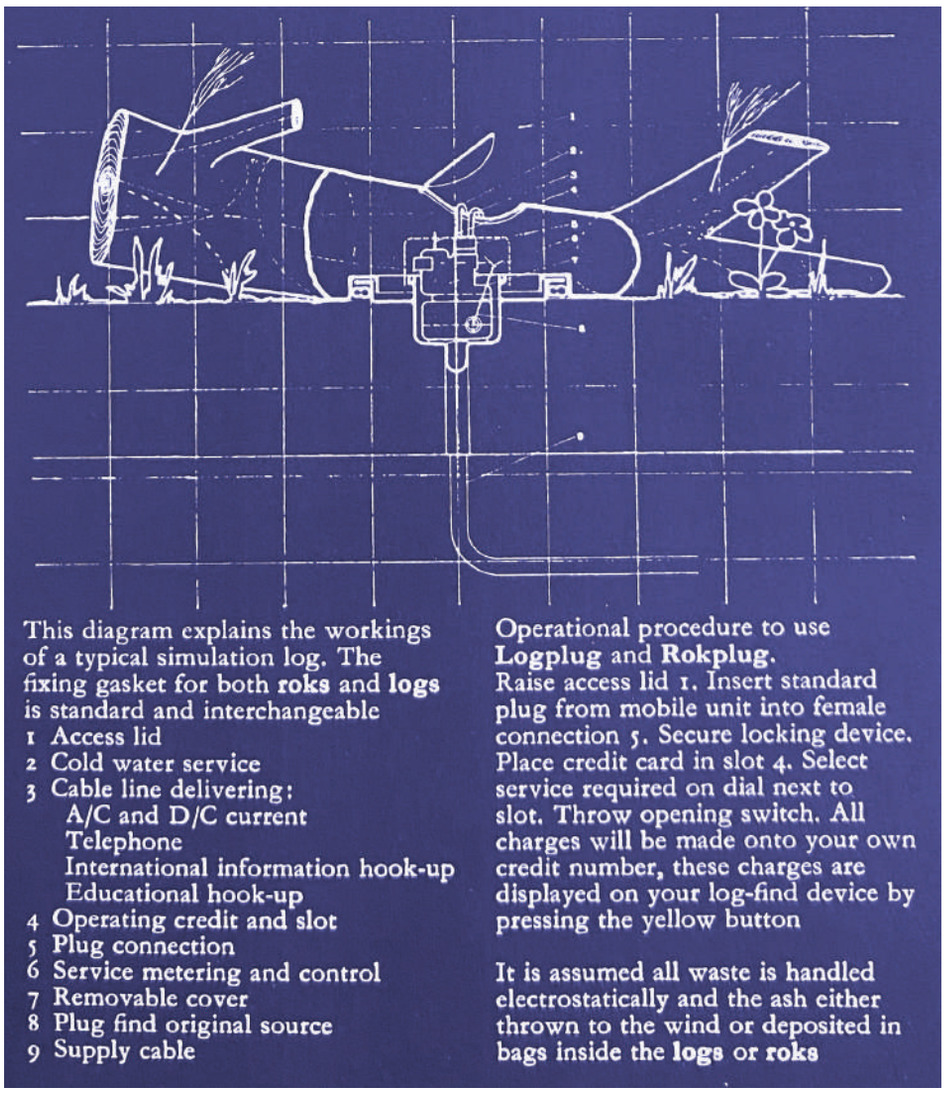

Fig. 3 – Logplug by Archigram.

Fig. 4 – Supersuperficie by Superstudio.

questioned, the 'system' will provide.[10]

The main problem for mobile living support systems is, of course, the energy source. Until an effective system is devised short-term energy will be taken from batteries of gas cylinders.[11]

Despite the graphic parallelism and a certain "naturalistic" or anti-architectural intention of some projects such as LAWuN by Archigram (Fig. 6)., that shaped a "robot-serviced landscape[12], the Eco-House is something else, a practical exercise to illustrate the necessary change in mentality that the Street Farmers promoted, the creation of "new age" of towns immersed in, and working with, nature.

The techno-ecological resonance can also be found in Banham's Environmental Bubble with the difference that it, in contrast to Caine's operativeness and militancy, it stands as the anti-architectural prototype that serves as a pretext to reflect on the idea that "A Home Is Not a House"[13] where humans, the environment and technology dialogue with new postulations. Pure conceptual architecture.

And coming back to this essay's main topic, it's important to note that the Eco-House was not metaphorical technology but the anarchist and counter-cultural version of autonomous ways of living[14] that included the entire catalog of ecological gadgets such as algae digesters, algae filtration systems, solar panels, wind generators or composting toilets[15]. Contemporary with the communes in the southwestern United States of America and the squatting movements in Great Britain, these shared Caine's political vision of ecology and consumption by disassociating or unplugging from state supply networks as part of an emancipatory manifesto. This was a pioneering movement in the creation and development of

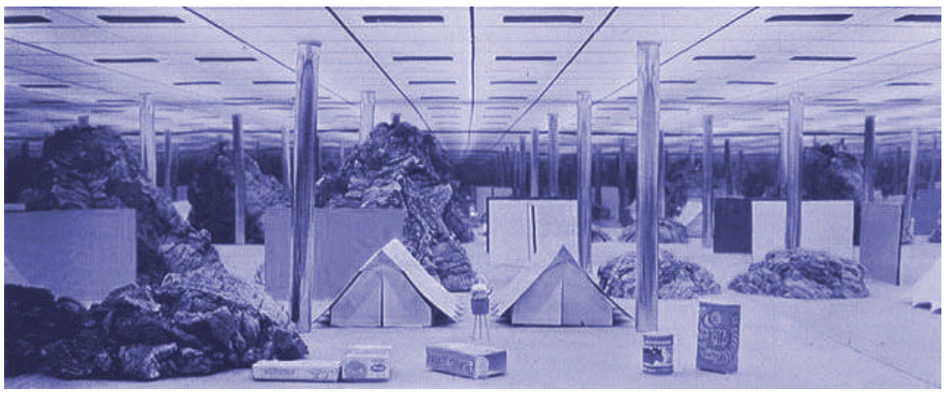

Fig. 5 – No Stop City by Archizoom.

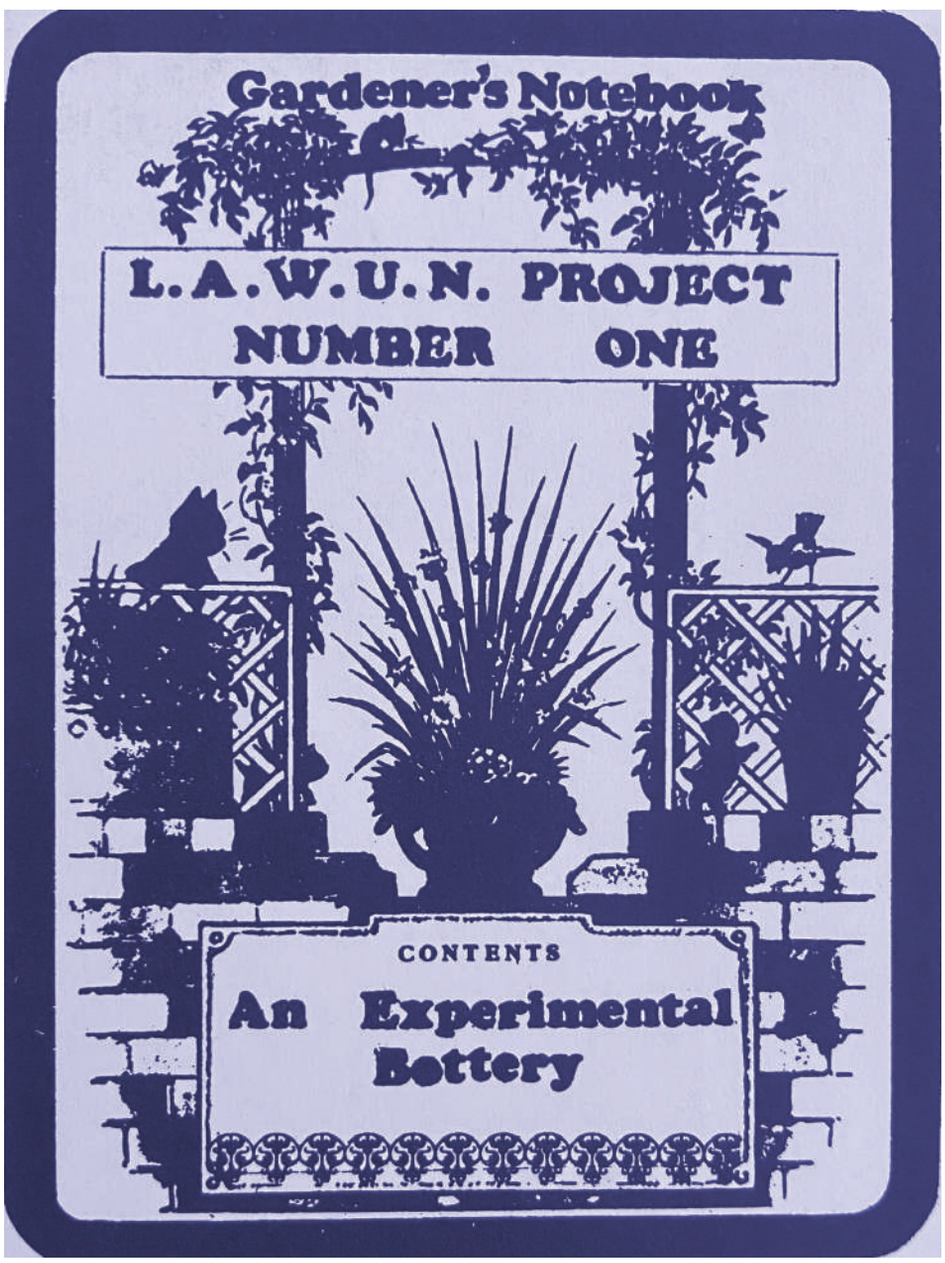

Fig. 6 – LAWuN by Archigram.

concepts such as ecology, self-sufficiency or the creation of life support architecture.

But, what is perhaps most remarkable about Caine's project (apart from its pioneering status, even before the 1973 oil crisis happened) is that it was built and tested for a sufficient period of time. Its greatest contribution to discourse was going beyond diagrams, drawings and specifications to arrive at a tangible and edible domestic reality that was working as an ecological system closed-in on itself and that reformulated both the idea of "house" and its design processes as well as the physiology and psychology of living. Specifically, making human physiology (food intake and human waste associated with it) complete the organism "house". Without an inhabitant - in this case the architect himself - there is no domestic space, because the recycling of those organic substances in a complex processing of products and by-products closed a cycle of design of the interior environment, which contrasted with ideas such as composition, aesthetics, context or proportion, all rejected in favor of organic flow diagrams and their optimal circulation. From the chemical diagram to the domestic space (Fig. 7).

Certainly the Eco-House, as a pioneering version of self-sufficient and ecological living, underwent multiple adjustments in its 'undesigned' organic growth, hence both Caine and his family had to experiment, analyze, monitor and change their eating habits (each meal was analysed regarding the future performance of the organic waste produced), the consumption of water or energy. Caine himself ended up knowing how to feed the house with the right nutrients or how much water to water the vegetables in the greenhouse,[16] how to control the chemical processes to generate electricity in a diagram executed daily where the excretory function was vital for the maintenance of the system, all this in a cycle so exhausting that Caine himself barely left the house[17]. Naturally, when the waste was not Caine's, the house noticed it in a cycle of biological interdependence or house-inhabitant symbiosis.

Caine himself explained how the act of defecation was essential to nourish the house, even going so far as to introduce

Fig. 7 – Eco-House.

detailed protocols to retain the feces and thus not damage the aquatic sub-ecosystems, to allow natural decomposition in the reconstitution of food and energy: "the reality is that twice a week you've got to get elbow-deep in shit."[18]

This process of conscientious self-analysis of one's own physiology reached the extreme of calculating calories, as the architect/inhabitant himself explains:

"Numbers were very important. I did all the homework. I knew how many calories and how much energy was being used up by the human body. I broke down my daily activities into components, which was an important part of running the Eco-House. I monitored daily what I ate. I have to say that the human body fascinates me. How much energy can it derive from one boiled egg? How long does it keep you, as an animal, going? It is really amazing"[19]

In the complete process of the house, the chemosynthesis of the digesters was essential and Caine himself was the one who carefully calibrated each of them to achieve the desired functions, even using the phase change of the materials, such as wax solar panels, where wax melted when the window was opened and hardened when it was closed again.

More energy was emitted in this phase change process than with conventional thermal conditioning devices.

Or also an invisible wall membrane that purified water, developed by General Atomics of San Diego.

The Eco-House also pioneered the analysis and incorporation of contemporary research on the use of solar energy (such as the General Report on the Use of Solar Energy, which cites that that between 20% and 30% of global energy consumption was dedicated to heating) with solar panels that stored heat and filtered rainwater with a series of tanks and digesters that transformed human and vegetable waste into both methane gas for cooking and nutrients for farming, as well as a fish pond that closed the cycle as a sink for the heat produced, something like an extra reservoir of water and a source of protein.

Contemporary architecture relates and also diverts from such a eschatological device with built examples as the 'Rambla Climate-House' by Andrés Jaque / Office for Political Innovation + Miguel Mesa del Castillo in Molina de Segura (Spain, 2021) which uses gray water from the house and takes advantage of sensors that measure humidity and environmental conductivity to complement and optimize the site's micro climate in order to repair a fragment of the existing dying rambla in a sort of climate activism as opposed to the anarch activism of its predecessor.

CONCLUSIONS

In conclusion, the relation between architecture and food starts off with the bold decision to build a house where cultivating and eating the food produced becomes the most important ingredient of it. As we've seen, the Eco-House was a living organism that pioneered current concepts such as ecology and self-consumption that reformulated the question: what is a house? It incorporated and performed many new functions compared with the traditional one of sheltering. Unconventional answers were many; such as manufacturing a productive inhabiting machine that took organic waste and natural resources (the sun, rainwater, wind, feces) and transformed them into gas, food, heat, clean water, hot water and electricity. A strange and liberating artifact, with an anarchist ideology and politically alternative to the dominant capitalism.

The invasion of dynamics and processes (both physiological and related to the environment) - anything but usual in the domestic space that the Eco-House requires - represents, perhaps, the main interest of this project both in its spatial component (the number, size and position of the devices mentioned) as well as in its social resonance (the material use we make of this type of proposal and the emotional involvement in the way of life it proposes); the construction of the house as a socially revolutionary and radical act. Architecture that is not designed but grows, architects-gardeners-scientists-cooks who resist the destruction of the environment and imagine realistic alternatives in a move opposed to contemporary utopias. As time goes by, the Eco-House remains a critical reference to any designer that wishes to understand the real meaning of sustainability, its inner commitment to resist compromises.

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NOTES

[1]Grahame Caine in Street Farm. P141.

[2]School where the members of Street Farmer, originally Peter Crump and Bruce Haggart, later joined by Caine, were studying.

[3]Grahame Caine. Eco-House. Mother Earth news 20. March 1973. P62.

[4]As part of Grahame Caine's final year project.

[5]Lydia Kallipoliti. From Shit to Food. Buildings & Landscapes: Journal of the Vernacular Architecture Forum. Vol. 19, No. 1 (Spring 2012), pp. 87-106. P87.

[6]Interview with Peter Crump in Colomina, Beatriz and Buckley, Craig. Clip, Stamp, Fold. Barcelona. 2010. Actar Publishers. P253.

[7]Lydia Kallipoliti. From Shit to Food. Buildings & Landscapes: Journal of the Vernacular Architecture Forum. Vol. 19, No. 1 (Spring 2012), pp. 87-106Archigram. Princeton Architectural Press. New York.1999. P110.

[8]Archigram. Princeton Architectural Press. New York.1999. P110.

[9]Luengo Angulo, Miguel. La Arquitectura Radical. Cinco puntos para una redescripción teórica. Buenos Aires. 2021. Editorial Diseño.

[10]The Project Agronica by Archizoom's leader, Andrea Branzi, further expands this research as the year 2008 proposal for the Grand Paris along with Stefano Boeri.

[11]Archigram. Princeton Architectural Press. New York.1999. P110.

[12]Archigram. Princeton Architectural Press. New York.1999. P114.

[13]François Dallegret. Reyner Banham, "A Home Is Not a House," Art in America, Vol. 2, 1965: 70-79.

[14]Like the space capsules developed by NASA, but in the ideological reverse.

[15]Stephen E. Hunt. The revolutionary urbanism of Street Farm. Bristol. Ed. Tangent Books. 2014. P141.

[16]Lydia Kallipoliti. From Shit to Food. Buildings & Landscapes: Journal of the Vernacular Architecture Forum. Vol. 19, No. 1 (Spring 2012), pp. 87-106.

[17]When he had to, he called one of his best AA students to fill in for him.

[18]Boyle and Harper, Radical Technology, p171.

[19]Lydia Kallipoliti interview with Caine. 2008.

From being Consumers to becoming Producers: DESIGNING CYCLES at 64°

subarktis klimatanpassning
lokal matproduktion
växthus
cirkulär design
living lab
sub-arctic climate adaptation
local food production
greenhouse
circular design
living lab

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I det subarktiska klimatet med extremt korta säsonger för odling och en marktäckning som domineras av skog och mycket lite jordbruksmark, erbjuder den byggda miljön en outnyttjad kapacitet gällande platser för livsmedelsproduktion. Detta relaterar både till det befintliga och, baserat på norra Sveriges dynamik gällande utveckling och befolkningstillväxt, det kommande byggnadsbeståndet.

Designing Cycles at 64° tar ett mångskalärt tillvägagångssätt som adresserar individuella byggnadstypologier och, som exempel på klimatanpassning av nordliga klimatzoner, staden Umeå, Sverige med dess mångsidiga stadsväv som helhet. Genom utvidgning av Bengt Warnes Naturhus (1974) koncept och efterföljande exempel, förutser vi nya multifunktionella arkitektoniska modeller att tillämpa i olika sammanhang och skalor (se fig. 2). Det bygger vidare på hypotesen att lågteknologiska-, lågkostnads- och landskapsbaserade lösningar är applicerbara i olika samhälleliga sammanhang och kan därför potentiellt bidra till att övervinna segregation (Redeker, Jüttner, 2020).

På latitud 64° N erbjuder interiöra landskap och deras koppling till vatten-, energi-, och mat-system intressanta möjligheter att förlänga växtsäsongen och diversifiera grödor, till att minska energiförbrukningen samtidigt som det tillhandahåller privata och offentliga rum med en hybrid mellan inne och ute. Genom att utforska växthustillbyggnader och växthusskal (GEE) som lokala passiva arkitektoniska lösningar, siktar DC64° på att bygga produktiva gränssnitt mellan den privata och offentliga sektorn, akademin som involverar disciplinerna arkitektur och stadsplanering, stadsvattenförvaltning, växtfysiologi och vertikal odling, såväl som allmänheten i ett living lab format. I den här texten vill vi reflektera över fas 0 av ett living lab, och över idén om en ny folklig tradition för lokal livsmedelsproduktion i den sub-arktiska klimatzonen och det sammanhang som definierar denna anpassningsbara process samt utarbeta konturerna av en tillämpningsbar metodik.

In the sub-arctic climate with its extremely short growing seasons and land cover that is dominated by forest with very little agricultural land, the built-up area offers an untapped capacity when thinking about sites for food production. This accounts both for the existing and, given the dynamics of Northern Sweden in terms of development and population growth, the forthcoming building stock.

Designing Cycles at 64° takes a multi-scalar approach addressing individual building typologies - and exemplarily for climate adaptation of northern climate zones - in the city of Umeå, Sweden with its diverse urban fabric as a whole. Expanding on Bengt Warne's Naturhus (1974) and following examples, we anticipate new multifunctional architectural models applicable in various contexts and scales (see fig. 2). It further builds on the hypothesis that low-tech, low-cost landscape-based solutions are applicable in different societal contexts and therefore potentially contribute to overcoming segregation (Redeker, Jüttner, 2020).

At 64° latitude, interior landscapes and their water-energy-food nexus offer interesting possibilities to extend growing seasons and diversify crops, and to reduce energy consumption while providing hybrid living spaces between inside and outside. By exploring greenhouse extensions and building envelopes (GEEs) as local passive architectural solutions, DC64° sets out to build productive interfaces between the private and public sector, academia - involving the disciplines of architecture and urban planning - urban water management, plant physiology and vertical gardening, as well as the general public in a living lab format. In this text we want to reflect on phase 0 of a living lab set up, reflect on the idea of a new vernacular for local food production in the sub-arctic and the context that defines this adaptive process and elaborate the outline of the methodology to be applied.

GREENHOUSE EXTENSIONS AND ENVELOPES (GEES) TO GROW FOOD AND MORE

Climate change demands a recalibration of our built environment to become more resilient. Retrofitting the existing building stock, repurposing vacancies, and expanding our building performance to integrate food production. Accumulatively, these may have a systemic impact both in terms of reducing water and energy consumption, as well as food miles, while buffering existing infrastructure networks and enabling local food production on site.

The active involvement of all stakeholders in the planning and future use of buildings and their immediate open spaces becomes key. How to create spaces that contribute to community building and social interaction while integrating a maximum of ecosystemic services is therefore a central question that demands implementable methods, tools, processes and design solutions.

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This accounts both for the existing and the forthcoming building stock, given the dynamics of Northern Sweden in terms of development and population growth (see fig.1).

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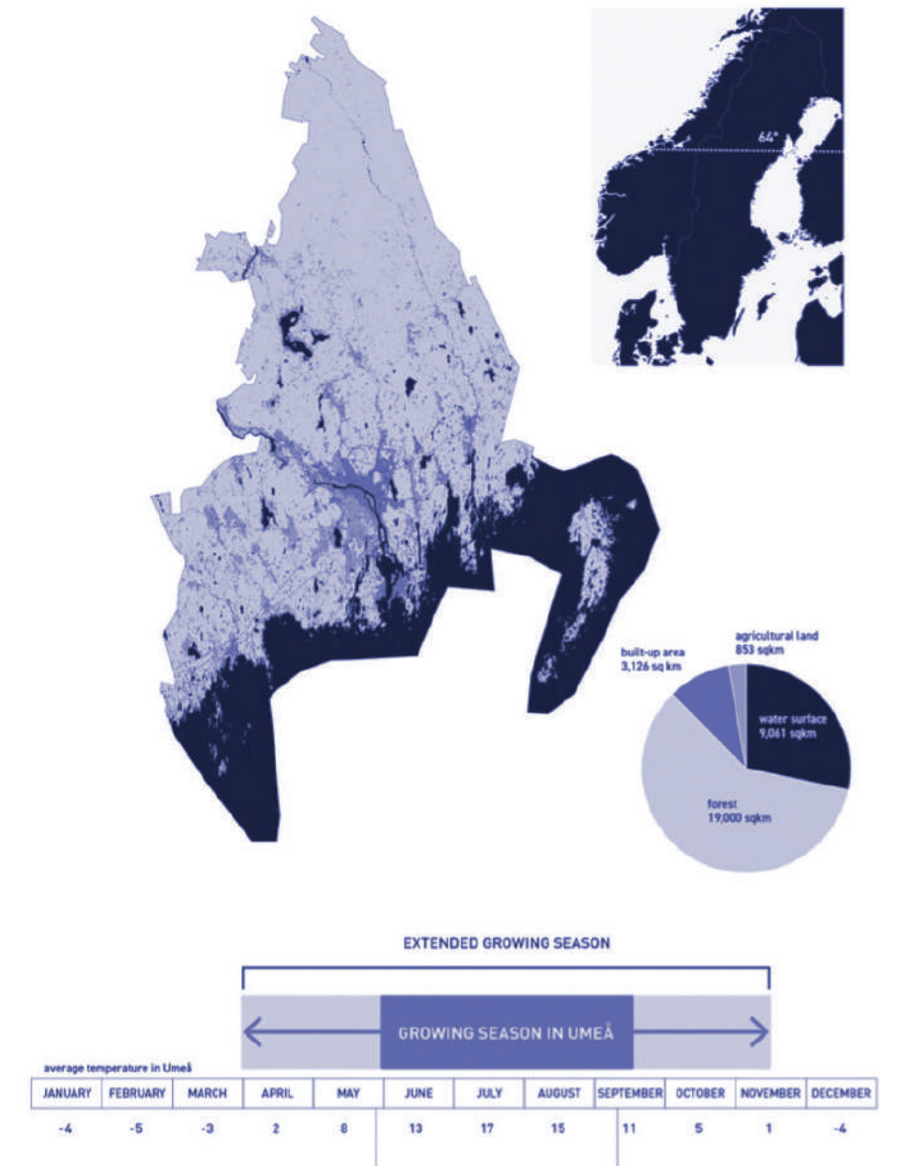


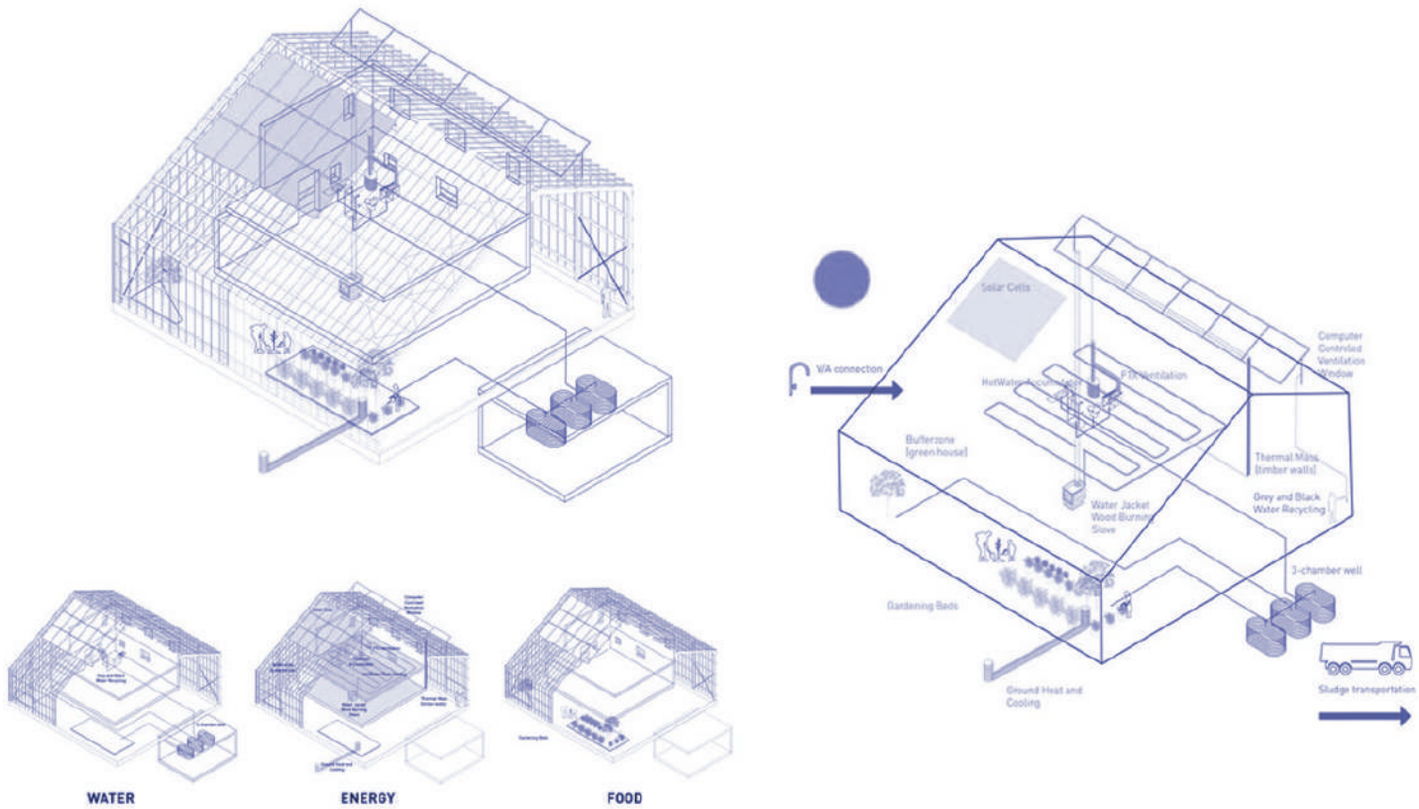
Fig. 1 - Land use and growing season Umeå municipality (graphics: Philipp Lott, Emelie El-Habta).

It further builds on the hypothesis that low-tech, low-cost landscape-based solutions are applicable in different societal contexts and therefore can potentially contribute to overcoming segregation (Redeker, Jüttner, 2020).

At 64° latitude, interior landscapes and their water-energy-food nexus offer interesting possibilities to extend growing seasons and diversify crops, and to reduce energy consumption while providing hybrid living spaces between inside and outside.

By exploring greenhouse extensions and building envelopes (GEEs) as local passive architectural solutions, DC64° sets out to build productive interfaces between the private and public sector, academia (involving the disciplines of architecture and urban planning), urban water management, plant physiology and vertical gardening, as well as the general public in a living lab format.[1, 2]

In this text we want to reflect on phase 0 of a living lab set up, reflect on the idea of a new vernacular for local food production in the sub-arctic and the context that defines this adaptive process and elaborate the outline of the methodology to be applied.



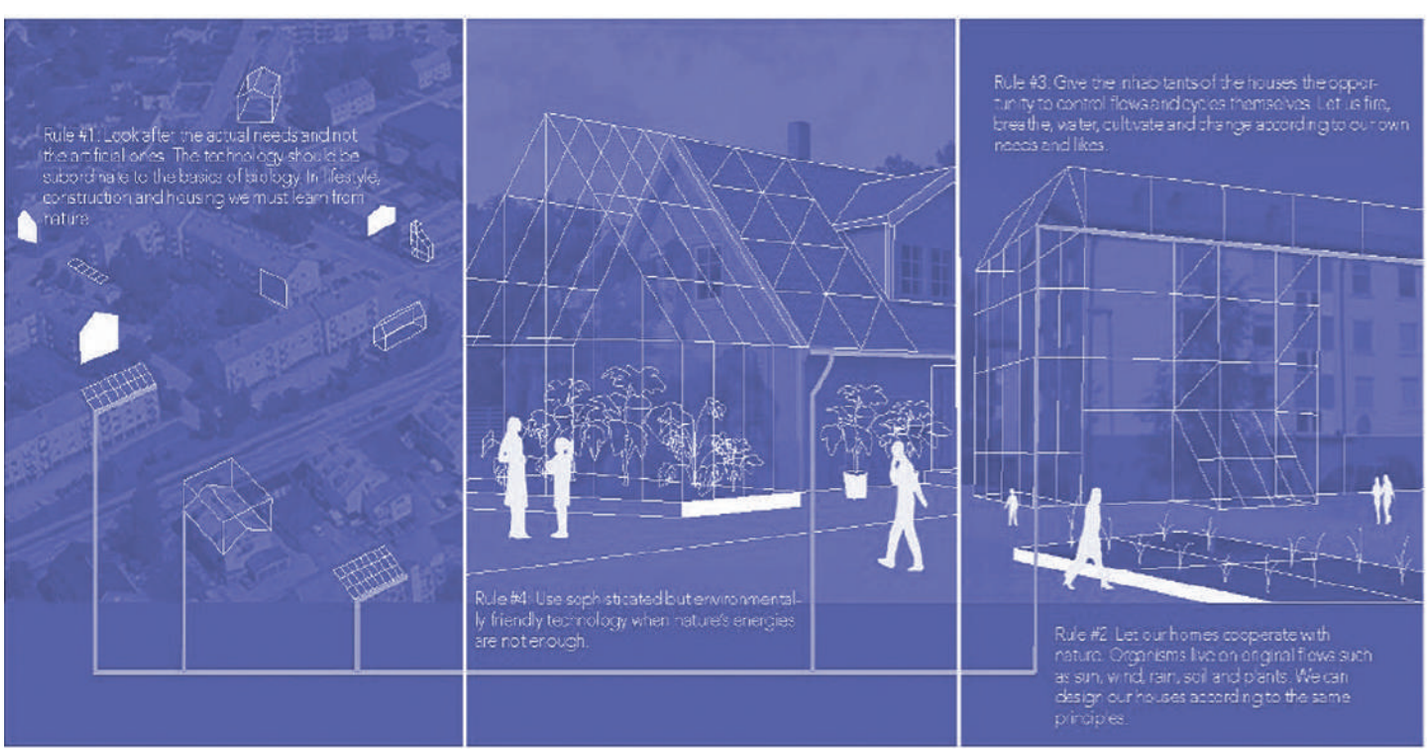


Fig. 2 Designing Cycles at 64° / above: Circularity diagram of Sundby Naturhus by Tailormade Architects, greenhouse Living, (visualization UMA design studio DC64° spring 2022, students: Cassandra Lundgren, Molly Mirsten) . / below: Naturhus principles according to Bengt Warne (graphics: Sara Zetterlund).

BACKGROUND

TOWARDS FOOD SOVEREIGNTY

The world's population is expected to grow to almost 10 billion by 2050, increasing agricultural demand – in a scenario of modest economic growth – by some 50 percent compared to 2013 (FAO, 2017). The majority of this population will be living in cities. Most texts and presentations start with a statement such as this one or similar. And yes, as we are urbanizing on rapidly diminishing resources; how we live and eat therefore plays a pivotal role. The food on our plates has become increasingly alienated from our local environment in terms of growing and refining different crops and other products. This relates to both the distance travelled (food miles) and its content. The amount of processed food on the market is steadily rising. As part of modernization and globalization, we expect to be able to find any type of food on our supermarket shelves at anytime of the year regardless of season and local growing conditions. This has become the urban norm for large parts of the world. Similar to how we have become accustomed to having the world's entire collection of popular culture at the end of a search button click, our food has become detached from the very soil and specific conditions required to produce it. Seen in a critical light, this poses some serious challenges, and we need to revert to more local production and circular processes in many of our everyday practices to be able to reach the climate goals set by governments around the world. In this context, the built environment offers an untapped resource that communities, practitioners and researchers have been exploring in recent years. The advent of climate change, global urbanization, the loss of industry and the commodification of housing has produced food dependencies, food deserts and resulting malnutrition specifically in underprivileged neighbourhoods. A growing environmental awareness and striving towards more stewardship have led to highly transformative agricultural bottom-up initiatives both in the urban and rural realm. Historically, we have seen similar developments in the 1990s in Cuba triggered by the collapse of the Soviet Union caused by the US embargo where a lack of fuel and fertilizers led to a resurrection of small-scale organic farming methods (see Atwood, 2017), influenced by the permaculture movement initiated by Bill Morrisson in the late sixties after being tired of the protest movement that he deemed incapable of bringing forward alternative models of living (see Mollison, 1988). And before that there was the self-organized allotment gardener's movement after the world wars, as for example on the outskirts of Vienna supported by intellectuals like Otto Neurath to spread awareness of these self-organized communities through the development of a pictorial language (see Redeker, Decaix, 2002). While the technical knowledge for doing so exists, adaptations to the current context and social models are often missing. By exploring models that include learning loops with the aim to be upscaled, the quest here is to overcome existing path dependencies which often only become tangible when alternative practices are introduced. By understanding food production as a spatial challenge, both in relation to its landscapes, buildings and infrastructure, it can be considered an architectural project to develop models that connect transdisciplinary knowledge in a holistic system with a direct relationship to the surrounding context.

Looking at bringing together existing research across different disciplines and scales, with the intention to generate new models from the building to the regional scale aiming to increase food sovereignty,[3] will enable consumers to becoming producers. Through research that engages in a transdisciplinary practice and using technology to nurture natural circular systems around us, we are currently trying on many different fronts to turn our negative environmental impact into a positive one. Connecting different systems to return to a more circular approach is one way to respond to the urgent need for action in our society. Using case studies and living labs as a way to gather existing knowledge and to test prototypes to become part of an open-source knowledge base, can enable reactivation of previously existing infrastructures for food production and distribution. This is also an important factor to create food sovereignty, a system in which the people who produce, distribute and consume the food are in control of its mechanisms and policies. Food sovereignty also puts an emphasis on local food economies and sustainable food availability as well as on indigenous people, who have been disproportionally impacted by climate change and disrupted foodways. Below we will outline an approach for how architecture, design and pedagogy can be used to strengthen local food systems in the North of Sweden at different scales – from the building to the regional scale, all grounded in the understanding of the local context, heritage and the specific challenges faced by different communities with different needs and possibilities.

In the context of Northern Sweden and the sub-arctic climate, questions around food systems and food availability are increasingly relevant in relation to our built environment and the future resilience of our communities. On a national scale, Sweden produces approximately

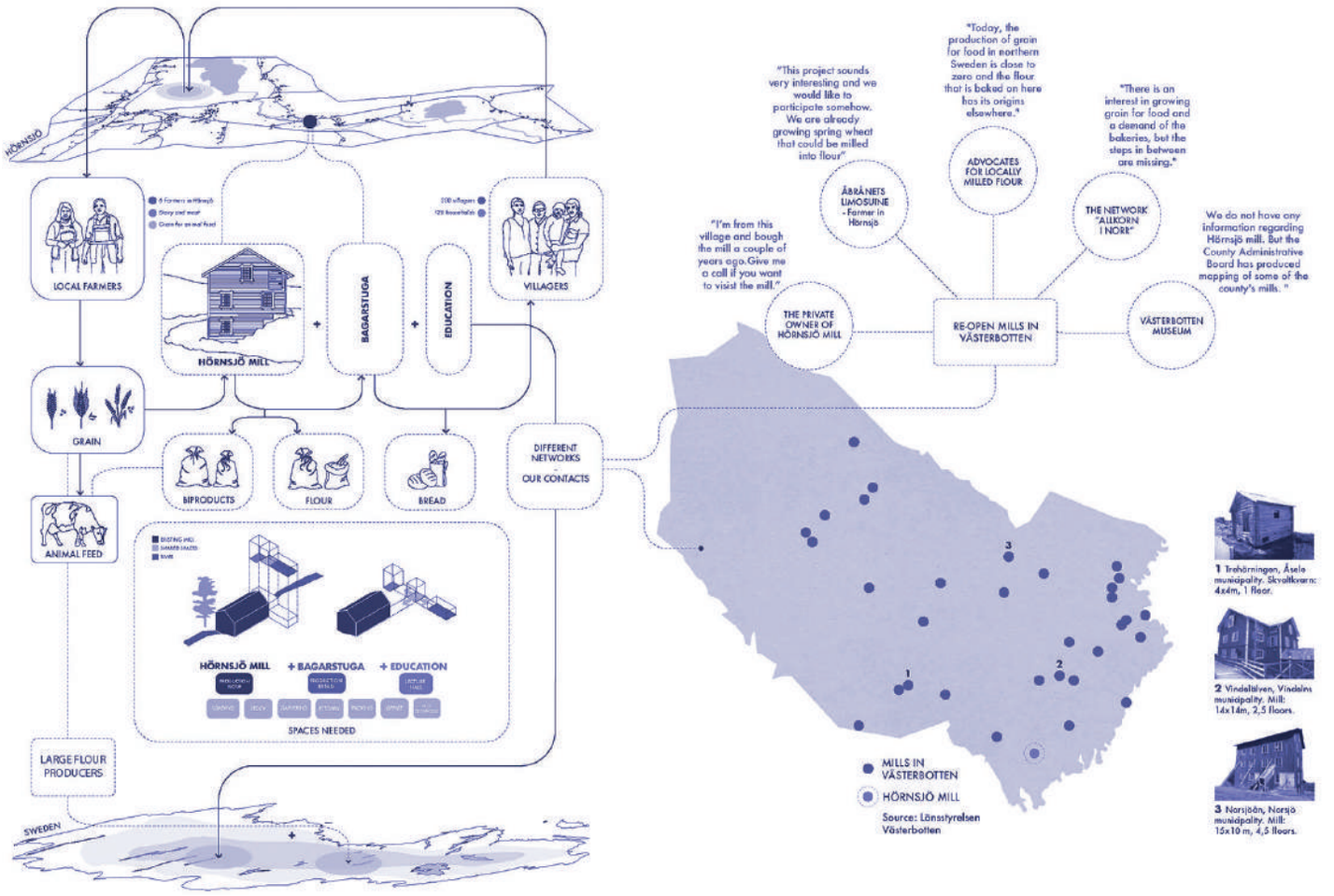


Fig. 3 From Wheat to Bread: Reopening the local mills in Västerbotten Region, students: Karin Wilstrand, Erica Grundström, UMA design studio Nordmaling Calling, spring 2021.

50% of its own required food[4] and has therefore put local food production on its national agenda for several years.[5] The pandemic crisis with closing borders put the spotlight on, amongst other things, the problem with reliance on globally imported food. The ongoing climate crisis and requirement to transition our societies into less fossil fuel reliance and lowering emissions, also reflect the need for a new approach to food production and consumption. Similar to many other industries where production has been outsourced globally, the food industry in Sweden has gone from local to the global scale over the past.

The larger questions this raises is: how can we increase the local production in the sub-arctic climate zone and still provide high quality food that encourages people to have a healthy diet? Can the introduction of productive programs in urban (and rural) environments also impact on communities' models for housing and local economies? Who is involved in the production and maintenance, and what models for this can be developed depending on existing conditions? How can we develop systems that can be applied to both the existing building stock - through re-adaptation and the activation of vacancies - as well as for new built developments? To understand the possibilities, and architecture as a holistic approach, we have to start by addressing the specific context: in terms of landscape, climate, the built environment and the communities within it. We find ourselves at phase 0, meaning that we are building up a knowledge base spanning across different disciplines in relation to the Naturhus typology and creating networks of people and communities. Finding the community to work with and establishing contacts, defining a collaborative working process and framework as part of the research project has proven to be the most time consuming but also most integral part of the work.

The Naturhus Principles and the Northern Swedish Vernacular

"It has been said that a haunting is the memory of something you already know, but that you have not yet lived. If we are to wisely welcome that ghostly memory as the unfolding of Global Warming, then I argue that 'greenhouse' is—beyond metaphor—a ghost of colonial trauma. Because, as a ghost, in its glowing glassy void, it hides the memory of the enslaved haunting the past, present, and future of agriculture, of the natural sciences, and their histories. The current industrial form of greenhouse stems directly from that dubious, ghostly technological history. It is the empty

Fig. 4 - From top clockwise: Freja Dahrl Kofoed, Martha Skytte and Randi Kjær doing their Ritual for Water at the Negathropic Anarchive, Denmark, DK, 2019 / The Wardian Table at Agropoetics: Soil is an inscribed body, Savvy Contemporary Berlin, 2019 / Earth Score Specularium at Experiment Färgfabriken Stockholm, 2015 / Works by Luis Berríos Negrón.

body of the illusion of control over nature, becoming the core conflict of interest that underlies how we extract andconsume nature, the opaque ghost of behaviour that drives Global Warming. So delusional is this drive, that greenhouse is conjured to be the promised saviour, the messianic Noah's ark that ought save mankind from itself … not just on this glimmering earthly world, but also as the extraterrestrial ark being sold to the billionaire class on the Moon and Mars by a group of supermen having the mother of all mid-life crises out in the public open. That self-fulfilling prophecy of virility and demise is what turns greenhouse into a ghost of double-bind, a doppelgänger of colonial memory. It is a paranormal projection of man's contradictory mastery and deposing 'greenhouse' in all of its privilege over nature, arguably deeply marking the geological timeline of the Anthropocene. It is then that I am compelled to ask: how is the ghost seen, sensed, and talked-to? Perhaps bymetaphors, at once as object and display of environmental relations. This is done, not to control or merely observe, but to shatter the glass of human observation itself, to (re)mediate the relations between the more-than-human worlds; to remember to forget the haunting ghost, to unlearn what makes life possible, and worth living, again. And again."

Luis Berríos-Negrón, 2020

Beyond the long list of greenhouse devices from the Wardian case and its historical displacement of plants, which can be consideredas the advent of our degenerated relations to biome, to the failed dystopian scenarios of biosphere autarky and the suburban winter gardens warmed by gas heaters to create thermal comfort at any price: How was the greenhouse envelope of the Naturhus conceived by Swedish architect Bengt Warne fifty years ago?

Naturhus Rule #1: Look after the actual needs and not the artificial ones. The technology should be subordinate to the basics of biology. In lifestyle, construction and housing we must learn from nature.

Naturhus Rule #2: Let our homes cooperate with nature. Organisms live on original flows such as sun, wind, rain, soil and plants. We can design our houses according to the same principles.

Naturhus Rule #3: Give the inhabitants of the houses the opportunity to control flows and cycles themselves. Let us fire, breathe, water, cultivate and change according to our own needs and likes Naturhus Rule #4: Use sophisticated but environmentally friendly technology when nature's energies are not enough (Bengt Warne, 1974).

For centuries, vernacular architecture has produced intelligent and natural building methods that we are currently trying to relearn and adapt to a trans-industrial context: by treating buildings holistically and incorporating food production and preservation as one component of many. This circular approach to the water-energy-food nexus[6] is particularly evident in the highly efficient and sustainable building principles that have been incorporated over centuries. Food was not considered a singular need. The coexistence of people, animals and surrounding nature functioned as a recurring revision of food procurement, food preservation and the recycling

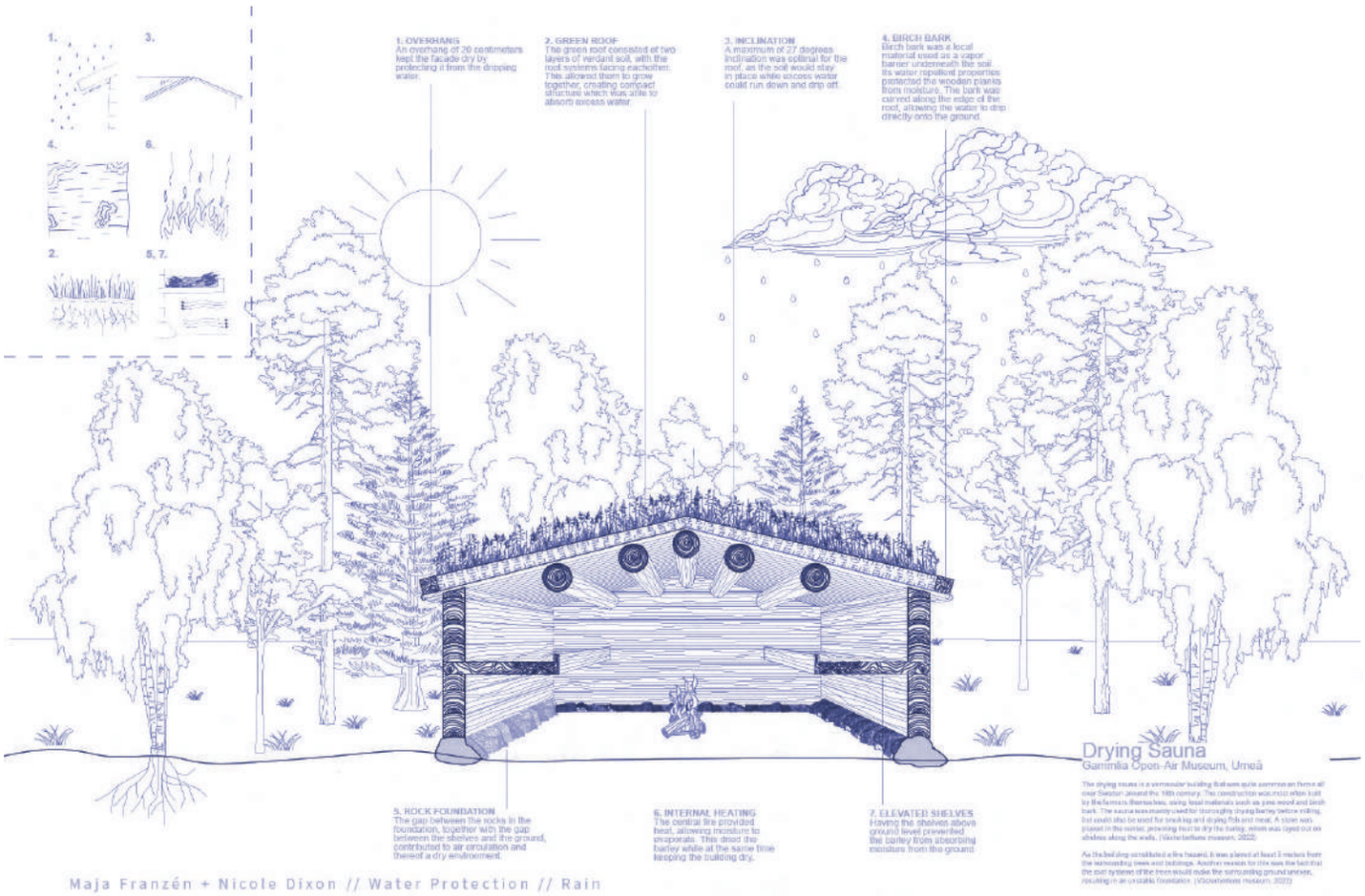


Fig. 5 - Barley-drying Sauna by Maja Franzén + Nicole Dixon, UMA design studio Closing Loops, fall 2022

of leftovers embedded in cycles. Thus, vernacular architecture was not viewed as a primitive building technique, but rather as a very flexible and adaptable way of using available raw materials from the region, responding to a given prevailing climate in a highly sustainable and simple way. Building houses meant passively and actively using natural influences such as wind, water and plants to generate energy.

It is therefore not surprising that in sub-arctic Northern Sweden, for example, food was stored in turf houses dug deep into the earth to harness geothermal energy. Simple topographical conditions and climatic factors such as sun, wind and water were naturally integrated into residential communities. There were pantries on stilts, deliberately built with round logs to protect food from invading animals such as rats. Drying huts for grain, which was also a sauna for the people, combining multifunctional tasks in one. Using biproducts such as reindeer skins as building materials for temporary Sami huts was just as important as using plants for food and their waste products in building houses. Nature was used, and every part was given a purpose without becoming exploitative. In this sense, vernacular means low-tech building, which is energy-and resource-efficient as well as cost-effective for the requirements of food production. Using natural resources such as geothermal heat, construction methods in vernacular architecture are historically optimized to keep stable ventilation, temperature, micro-climate and humidity control (Eldtrimner, 2022).

With few exceptions, the Naturhus model as a greenhouse envelope or extension (GEE) is today mainly applied to single detached housing. Diversifying this model to multiple apartment buildings and other programs demand adapted models which includes adaptation of the systems involved in relation to water, energy and food production and, most challenging, new user models. Through the updated models, we anticipate not only extending the growing season and thus potentially increasing local food production. This can be achieved by expanding the typologies from the Naturhus as a single-family detached house with a GEE to upscaled typologies such as multiple-apartment units or industrial/retail units, and by applying more productive growing reused materials engaging local In addition to user models, the project aims at developing an open-source model for building processes, with local and/or systems, we anticipate to design economically viable models by creating synergetic benefits regarding energy-efficiency, water harvesting and reuse. In addition, defining and testing more collective user models that also have an impact from a social sustainability perspective and

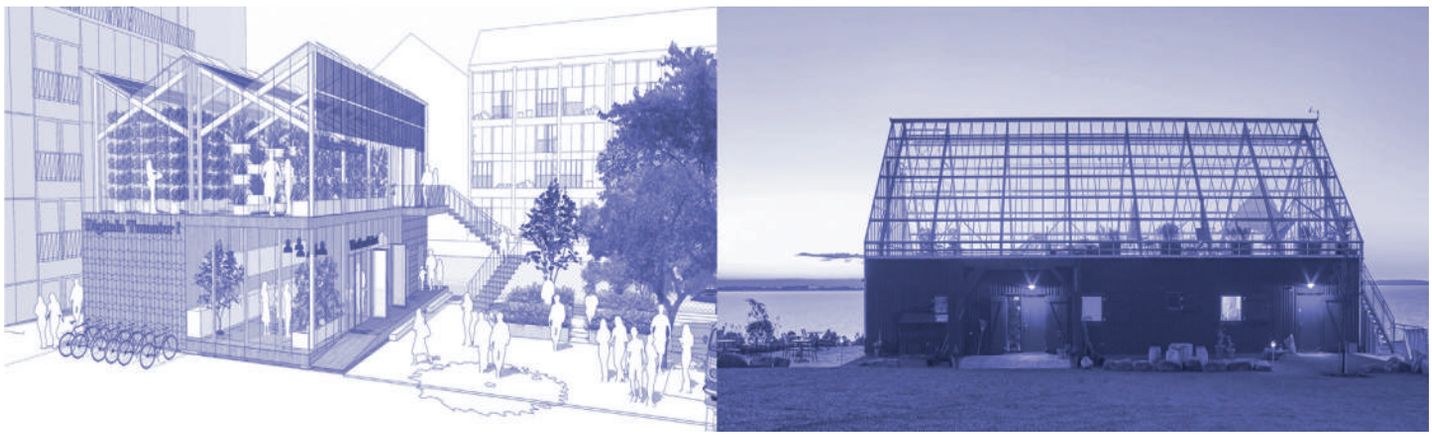


Fig. 6 - Digital Tomatoes, Greenhouse Living and Upgrenna Naturhus, Tailormade Arkitekter.

naturally raise intriguing design questions when it comes to the shared spaces this produces. In addition to user models, the project aims at developing an open-source model for building processes, with local and/or reused materials engaging local expertise, with the possibility of being adapted to other sites and communities. Some of the examples in this context are:

On a building scale, projects like the restaurant Moment in the self-built, mortgage-free permaculture community of Friland in Denmark are trailblazing DIY. Wastewater from the restaurant is reused to irrigate crops in the green house that are then used in the kitchen - under the monitoring of experts to ensure that the plants are free of pollutants. Uppgrenna Naturhus by Tailormade Architects which uses the EcoCycle system to purify wastewater makes use of its nutrients from up to 150 visitors which enables a disconnection from the municipal sewage water system. Digital Tomatoes by Tailormade Architects and Greenhouse Living, in cooperation with Gothenburg's energy company, use the heat produced by a neighbouring server plant to warm the greenhouse (see fig. 6). We-Houses in Germany, a co-housing model with multiple city locations, include rooftop plant beds and greenhouses, green walls, water treatment greenhouse farm and serves as through reed beds and its reuse. A new Supermarket in Wiesbaden, Germany, is hosting a rooftop an example of growing where you are selling the produce. The Million program is a large-scale Swedish housing program from 1965-1974 that is now in need of energetic refurbishment. Due to its scale and with its predominantly flat roofs it also offers potential sites for greenhouse rooftop extensions that could, due to its sheer scale, potentially offer a capacity of systemic relevance. An example of how these pre-fab building typologies can benefit from greenhouse extensions can be seen in the example of the Shine project in Gothenburg[7]. On the village scale RegGen villages provide a community model that aims towards self-sufficiency through the integration of high yield organic food, clean water, renewable energy and circular waste to resource management at the neighbourhood scale supporting the community (who also owns this data through AI and machine learning).

It is never one use that enables buildings to become productive and to be thought of holistically, ideally to create economically and socially viable models. As hosts for food production through GEEs, foremost energy savings and production have to be factored in, but also water recycling as ways to buffer centralized systems that are currently not laid out for climate change weather conditions. Specifically in the sub-arctic, snow requires an adaptation of existing systems: water harvesting turns into snow harvesting for which we yet find no formal examples in the domestic realm, but also snow loads raise structural questions when the greenhouse is not heated. When a greenhouse is not heated, a third climate zone in the form of a nursery (orangery) may be needed to enable germination temperatures to be reached. In conclusion, many exciting models are currently appearing, but data regarding user models and cohesive monitored productivity or temperatures are missing, specifically for this climate zone.

THE COMMUNITY

When talking about turning inhabitants from consumers into producers, it demands new forms of participation and raises questions of expert/non-expert collaboration. When looking at communities in Umeå in both the urban and rural context, we find both push and pull factors that drive a potential Naturhus model to increase local food production (see fig. 7).

In the urban context, Kollektivhus Umeå is an association that aims to build and live together as a community to counter the phenomenon of increasing loneliness. The model implies that private apartments are 10-15% smaller to allow for enlarged shared spaces for the inhabitants. In the spatial program for the common spaces, future

Fig. 7 - Push and pull factors: Holmön Island, exemplary for rural communities struggling with fluctuation in population numbers (left: data HUF, 2020) and urban communities like Kollektivhus Umeå looking for communal living (graphic: Erica Grundström, DC64° UMA bachelor design studio, spring 2021).

inhabitants wished for gardening and cultivation in relation to a shared kitchen and dining room (Grundström, 2022). The idea of growing food and sharing meals together as a community defines the Kollektivhusmodel for its 80 members.

In the rural context, the community of Holmön, is a former fishermen's island in the Baltic Sea of Västerbotten, just 10 km off the coast North of Umeå's river delta. Fishing, farming, and hunting were the main livelihood of the islanders for many centuries. Today, with a steady population of only 79 persons, and with a sevenfold increase in the summer months through visiting tourists and summerhouse owners, the island faces a number of challenges. Lacking appropriate public services produces water scarcity in the summer months due to a high influx of visitors, which impacts upon living conditions. And a ferry that is unable to work through the ice during the winter months often leads to prolonged periods of isolation. This disconnect to supply lines showed the islands biggest vulnerability; a reliance on "food imports" from the main land. Fishing today is highly restricted, but hunting, potato and vegetable growing, foraging the forest for berries and mushrooms, honey production and private gardens provide food for certain parts of the year and the local "Lanthandel" supermarket provides goods from the mainland all year round as long as the ferry is able to sail. In the local-economic analysis conducted by the community association Holmön Utvecklingsforum in 2020, 78% of the inhabitants wished for an increase of local food production, 83% naming potatoes and vegetables as their priority (HUF, 2020).

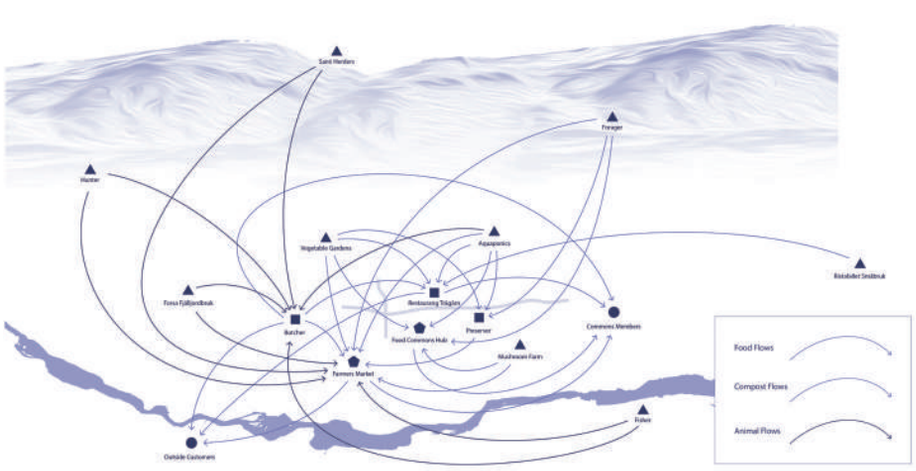


Fig. 8 - Village and the Plot: Food supply network by Karina Gataullina, Kasimir Suter Winter, Oscar Magnusson UMA Duved summer school 2021.

STATE-OF-ART / LIVING LABS

"Food and the rural versus the city and buildings: It did not require a lot of thinking until the idea popped up in my mind: food systems. That had to be the key for an innovative strategy for societal innovation, turning the rural into the innovation engine, even for urban development. It was in January 2018 and I had just started reflecting on Duved, asked to find a strategy for the development of the future of this small village in the Northof Sweden, situated in an area known for skiing and hiking, but also for artisan food. In the small scale of the village I saw something that had been in the back of my mind for a few years. I had been talking to chefs like Dan Barber, Magnus Nilsson and Douglas McMaster, and realised that their way of transforming the production system of food from the point of view of a restaurant, was in fact a starting-point for change in a much larger context than the restaurant itself. What they did, in redefining their roles as chefs, required change from everyone they were working with.

A couple of years earlier, in 2015, I was commissioned to lead the innovation program for the USA pavilion at the World's Fair in Milan. The theme of the Expo 2015 was how to feed the planet in 2050. One part of the program I curated was to 'exhibit' and accelerate nine new companies, all with different ideas of food-system innovation.

. We selected them carefully and they were all based on smart and relevant ideas. But I gradually realised that there was something lacking in the very idea of the start-up company: context.

The companies had solutions, but for a very specific, singular purpose. What they lacked – and what would have made their ideas better – was a context. A context where the singular solution of one company would be matched by another company's solution in a different field of food. Through collaboration and digital efficiency, the different solutions could, gradually, be turned into a new and innovative local food system. So, with these two things in my mind – the innovative chefs and what they demanded of their suppliers, and the new companies need for a context to match their solution with, I saw a glimpse of something big. The future of food and food systems needed the small scale of the village to show its potential. That was the starting point of Duved as a tool for societal change, based on collaboration between very many local partners, a journey that will take a few years to handle and that will include a greenhouse by Shigeru Ban.

Giving a lecture, in 2021, on Duved at the School of Architecture in Umeå, we continued to talk and came to the conclusion to set up a summer studio in Duved, where students would develop solutions for a common local future food system. The result?

Through the studio visionary material was produced by the students that will be used as inspiration for many years to come in the actual development of Duved, on food systems as well as, as a give non the side, on where the possibilities of the future role of the architect might be embedded.

It is all about switching positions, to find a better outlook on today's possibilities: instead of cities and buildings we need to look at the rural and on the future (local) food systems to move ahead toward what is needed for societal innovation, for the rural as well as the urban."

Jan Åman, Duved model, on context (unpublished)

The Duved model for local communities 2.0 is an example of a living lab in the Northern Swedish context, the village scale serving as a canvas to develop and test ways towards a more sustainable and resilient community following the approach of "governance through local collaboration". Among other goals, this includes the development of a food system that focusses on local production and circularity. The Duved model involves inhabitants, farmers, the municipality, restaurant owners and other local businesses, with the aim to influence the development of a village that is also becoming increasingly attractive for young families and others who want to escape the big cities to live in communities where they can engage themselves not least in growing food. As a living lab, the Duved model aims to inform policy making on a national scale based on the experiences and learning processes on the ground (Appelqvist, Almqvist, 2022).

Depending on context and authorship, there are multiple definitions of living labs (see Verhoef, Bossert, 2019). As a tool for transformative science to enable urban innovation and challenges, they have a large amount of user co-creation and should be in real life settings (see Maas, et al, 2017). As a complex and explorative approach, choosing a living lab format is motivated by complicated challenges and multi-stakeholder problems or solutions. They demand a location, budget and goal. Living Labs can speed up development and the adoption of new technologies (McCormick et al, 2017). For architects, the living lab format offers a practice-based, integrated, research-by-design approach that enables the transformation of our disciplinary practice - from developing a project to designing, realizing, monitoring and evaluating a research infrastructure that, as a learning model, needs to be able to incorporate change and inform the larger scale (system innovation).

MATERIALS AND METHODS

Phase 0: Beyond setting the agenda

As an emergent research environment at Umeå University School of Architecture, the UMA lab Designing Cycles at 64° sets out to explore directly and indirectly a new vernacular in response to current urgencies related to local food production and climate adaptation of the built environment.

It starts by creating a network around the topic of interest. When meeting new people, we don't know where that meeting will take us and how - through the combining of different perspectives, individual interests and expertise it might lead to entirely new paths or communal projects. Even though this can be a slower or less intuitive process when at first getting to know someone across a screen, it can still be said that the possibilities that opened up during the pandemic - i.e., digital meetings and creating networks - that were less bound by geographical constraints, has had an impact on how we approach new networks. Designing Cycles at 64° started with numerous meetings of potential partners and stakeholder groups with the aim to frame the task and to create a research team in response to current concerns, but also to engage in a joint discourse on the topic.

As a think tank informed by, and linking, research and education, we not only aim to explore

Fig. 9 - Umeå's flat roofs as potential sites for greenhouse extensions (DC64°graphic: Philipp Lott).

building design and performance, but also to anticipate implementation and user models. Applied to Designing Cycles at 64°, the living lab format is based on a transformative science approach: a mode of science that not only analyses processes of transformation, but also actively supports and accelerates them (Schneidewind et al, 2016). The ambition is to accelerate change through transdisciplinary collaboration and co-creation towards more self-sufficient buildings and inhabitants with a specific focus on food production. This approach relies on a network of practitioners and researchers in multiple fields supported by educational formats. In terms of education in our specific field, it involves the outline of architectural design studios that enable students to conduct case study and field research and to engage in design explorations in a safe environment. These may inform the project in different ways while exposing the students to a transdisciplinary In discourse beyond their current curriculum. Working with model clients and contributing to knowledge production creates a learning environment for all involved. The living lab approach is framed by the current funding period of two plus, through a follow-up call, potentially two more years if deemed successful the first phase the project involves five work packages:

A comparative atlas of case studies of selected existing Naturhus models in Sweden and internationally were researched together with students. Beyond their respective spatial organization and architectural expression, the atlas documents the project in relation to its water-energy-food nexus components and user models. We have introduced some of these examples previously in this text.

A site and foodshed analysis of Umeå as an exemplary model of a Northern city, illustrates spatial capacity and maps the existing foodshed. On the urban scale, we are performing a GIS-based site analysis to assess spatial capacities by documenting flat roofs, south-western elevations, urban voids, vacancies and plots exposed to noise pollution as potential sites for GEEs (see fig. 9); embedded in a regional foodshed analysis to understand current local food production and the importation of food to the region from global sources. On a building scale we are currently setting up a temperature log for an existing green house and cold roof to understand the temperature differences between inside and outside over the course of a year.
A participatory design: working with Lanthandel on Holmön, we are engaging in a research-by-design process with model clients and users as well as plant and water experts to develop a circular model with different climate

zones to maximise the growing season through a greenhouse extension and nursery in the cold roof, to produce a viable yield of leafy greens (green walls) and vegetables (plant beds), to conserve food in a root cellar and to harvest snow and rain to irrigate the plants and flush the existing water toilet. With the green house extension to the South (naturally ventilated) with solar panels and the root cellar expansion to the North the overall energy consumption of the building will be reduced (see fig. 10). An implementation and user model: by anticipating who will build and how (with local / reused /pre-fabricated building materials) and how and by whom the plant beds will be managed we are defining our living lab set up to be built, monitored and evaluated in the coming phase if deemed viable. And last, but not least, different formats of dissemination: by sharing this work with our students, in workshops with our project partners and stakeholders through an international symposium on the topic to bring together practitioners and academics from different fields of expertise, and through documentation and scientific publication.

(PRELIMINARY) RESULTS

DC64° has created a research environment that links architectural education, interdisciplinary academic practice (architecture, urban planning, plant physiology and decentralized, nature-based water treatment and reuse) with the work of NGOs and the public and private sector to define a preliminary design to explore the potential of a prototype to be built, monitored and evaluated in the next phase. Through research-by-design for an exemplary site, we are able to inform our research questions that engage in the construction, materiality and planting yield. It enables us to anticipate implementation and user models with our partners. In that way, it is not only a project design, but a communication tool with all stakeholders and partners. This project can also be viewed in the light of an on going discussion around the role of the architect, now and in the future, going from designers of buildings and spaces to also include the role of the facilitator and moderator of a building process operating from initiation, urban planning and policy perspective, circular building processes, implementation and user models.

DISCUSSION AND CONCLUSIONS

Transformative Science and Living lab formats to increase the impact of research demands for established partners on the ground, trust and management of expectations. Here it helps to start small and slow in a safe environment. To ensure the sustainability of any outcome, any intervention needs to be thought beyond the research project phase.

The biggest challenge of developing a test building in a real-life environment demands for a prototype that is “safe-to-fail”, in the sense that it offers additional benefits for the community beyond the model to be tested and evaluated. In our case this means, if the anticipated water-energy-food application and a viable user model - as the outlined goal of ‘turning buildings and their inhabitants from being consumers to becoming producers’ - is only partially successful, a plan b has to be in place. This can involve multiple solutions: from deconstruction to adaptation of the set-up, i.e. a different planting system or a change in the user model, or even a change in program. This has to be anticipated and communicated and demands a clear management of expectations and responsibilities. Further potential outcomes from looking at interior landscapes in the sub-arctic climate zone relate to the provision of an in-between climate zone that could have other uses and impacts than solely to produce food. This is especially evident in connection with multi-dweller housing, where a collective space could have multi-functional uses for the inhabitants and adding to the quality of life in the

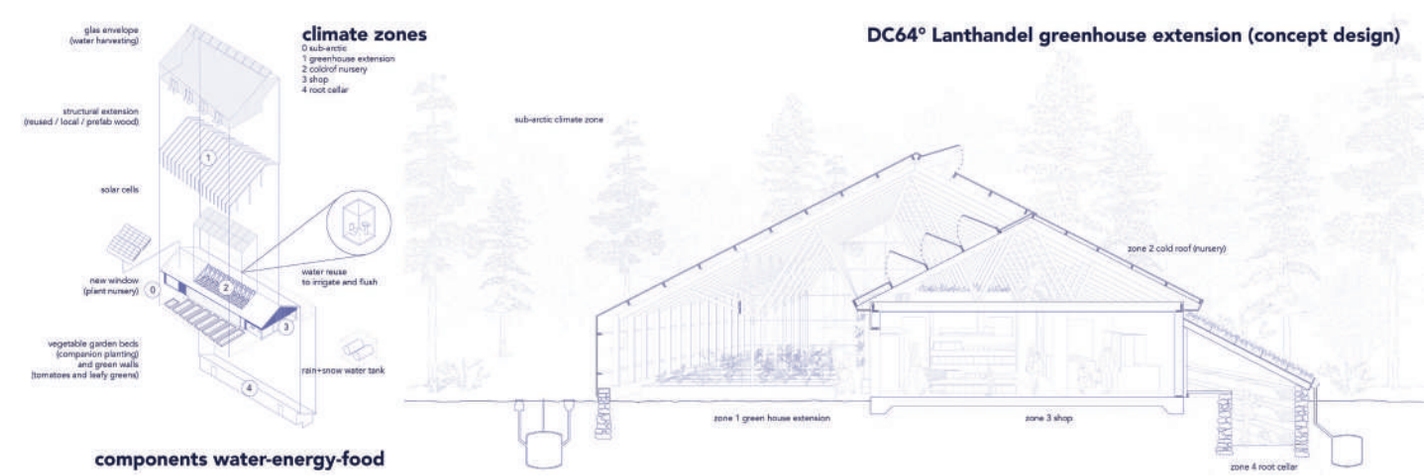


Fig. 10 - DC64° Climate zones and water-energy-food components (graphic: Cornelia Redeker, Constanze Hirt, Erica Grundström)

foreseen extensive renovations required in coming years to the existing national housing stock of Sweden.

In terms of how transformative science and academia may impact upon reality and driving change, the current system of publishing and the acquisition of third-party funding may need to be extended. In this context, the transdisciplinary collaboration of living labs may offer hopeful, if complex and challenging possibilities, to drive and accelerate change. For architects, landscape architects and urban planners in academia who are struggling with their core competence - which is spatial and increasingly holistic design - then Living labs, by including a physical intervention that is monitored and evaluated offer, a model for change.

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NOTES

1. Designing Cycles at 64° - Interior Urban Landscapes and the Water-Energy-Food Nexus is a two-year research project at the Umeå University School of Architecture together with SLU, Aarhus University, Umeå municipality and Vidden Bostad AB. The project is funded by the Climate adaptation fund of Vinnova, the Swedish Agency for Innovation

2. JPI Urban Europe defines urban living labs (ULL) as an approach to research and innovation to describe methods, approaches, and projects that involve a high level of stakeholder participation, co-creation, co-production, learning-loops and experimental approaches to improve urban life. (...)
In general, the ULL concept is applied to urban areas to institutionally densify the urban innovation ecosystems that deal with multidimensional challenges in urban areas (see ERA-NET Co-fund Urban Transformation Capacities, Project No. 101003758, Annex D: Urban Living Labs, p.65)

3. According to the IPC – International Planning Committee for Food Sovereignty, "Food sovereignty is the right of individuals, peoples, communities, and countries to define their own agricultural, labour, fishing, food and land policies which are ecologically, socially, economically and culturally appropriate to their unique circumstances. It includes the true right to food and to produce food, which means that all people have the right to safe, nutritious and culturally appropriate food and to food-producing resources and the ability to sustain themselves and their societies."

4. See https://www.svd.se/tufft-for-sverige-att-klara-maten-i-en-kris

5. See https://www.ja.se/artikel/53006/vi-har-mat-for-tio-dagar.html and https://www.riksdagen.se/sv/dokument- lagar/dokument/motion/sjalvforsorjning-av-mat-i-sverige_H8022602

6 According to the UN Economic Commission for Europe: The "nexus" term in the context of water, food and energy refers to these sectors being inextricably linked so that actions in one policy area commonly have impacts on the others, as well as on the ecosystems that natural resources and human activities ultimately depend upon.

7. 'SHINE' GÅRDSTEN SOLAR HOUSING RENOVATION in Gothenburg, Sweden, by Nordström Kelly Arkitekter AB is an older example from the late 1990s where a housing slab of the Swedish Miljoen Program was transformed by adding a greenhouse extension to preheat the air and use solar energy for water-heating and energy production. It also enhanced qualities of the shared hallway. (see https://world-habitat.org/world-habitat-awards/winners-and-finalists/solar-housing-renovation-gardsten-sweden/).

SCI-FI & FOOD DESIGN

RootSkin

From Soil to Soil

bio-inspired design
plant root textile
digital fabrication
circular design
computational design

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Food and architecture have always been intertwined. When humans started to build settlements, we began to dictate where the food would be grown. Simultaneously, natural resources such as water, light and nutrients dictate how a plant grows. When a climbing plant or vines are planted, humans begin to plan the route for the plant to grow, forcing it to take on certain forms. Is it possible to control the plant below the surface of the soil as it is above the soil? Plant roots seek out and grow towards the water source, posing the possibility to control the network of roots that are often hidden deep within the soil.

Today architects are working with nature to create an architecture that is both responsive to and harmonious with nature. As resources, in particular land, become increasingly scarce and our human population continues to grow, we have to find new solutions for both food production and housing. Our cities provide us with new opportunities to reshape the urban fabric while responding to these current issues. While plants provide food, they can also potentially provide other resources that could be used in architectural applications.

Plants already provide us with many benefits such as food, medicine, and cleaning the air, to name but a few. Often, once the fruit or seed is removed and the plant no longer fruits, the plant is removed from the soil and discarded - hopefully composted. This poses the question; is it possible to simultaneously harvest other elements of the plants and make use of them before they biodegrade and end up back in the soil? RootSkin is a research developed to explore the creation of biodegradable textiles made from the roots of plants as well as producing food during the “growth” of the textile. The aim being that these textiles can then form part of architectural installations such as skins for pavilions or buildings, for example. In addition, the natural biodegradation allows for an element of change to be incorporated into design.

INTRODUCTION

According to the Gaia hypothesis by Lovelock and Margulis, living things are part of a self-regulating mechanism on a planetary scale that has preserved habitable conditions for the past three and a half billion years: the oceans, seas, the atmosphere, the earth's crust and all the other geophysical components of planet earth remain in a stable and suitable condition for the existence of life thanks to the behavior and interaction of living organisms, plants and animals (Lovelock, 2009).

Anna Tsing (2015) describes the activities of life-forms as making worlds, stating that we are surrounded by many world-making projects, human and not human. World-making projects emerge from the practical activities of making lives that, in environments populated by multispecies, overlap creating collaborations: for example, bacteria help make the oxygen in our atmosphere, and plants help maintain it; while plants live on land because fungi make soil by digesting rocks. Species that collaborate are called companion species.

Collaborations between living forms maintain the earth in a state of equilibrium, and based on this principle Gaia has worked without foresight or planning on the part of organisms for millions of years, but the evolution of humans is changing that. This change has been described as the starting of a new epoch called the Anthropocene, the epoch in which human disturbance outranks other geological forces endangering the existence of all life forms.

During the last decades we have begun to gain awareness

Fig. 1 - Vision of RootSkin applied to the facade of a building as solar shading.

of the global implications of our actions and as a result, intentional self-regulation — from personal actions to global geoengineering schemes — is either happening or imminently possible. Making such conscious choices to operate within Gaia constitutes a fundamental new state of Gaia, which Timothy M. Lenton and Bruno Latour call Gaia 2.0. Operating within Gaia means emphasizing the agency of life-forms, their ability to set goals and their collaborations, fostering global sustainability (Lenton and Latour, 2020).

Up to now we (humans) have mainly conceived and planned co-existence and collaboration only as a single species environment, some examples are co-housing, co-working, community allotments and ethical purchasing groups (Mancuso S. et al, 2018). Designers can help people realize that we are all participants in complex systems that go beyond our human made constructions, systems that we cannot control, but that we should acknowledge, protect, and learn to live with and within (Antonelli, 2019).

What if we start to develop environments to host and foster multispecies co-existence and collaboration? What if exchange dynamics become the driver of the design of our cities, objects and services? What if we try to restore the environment's state of equilibrium through multispecies cooperation embedded in design?

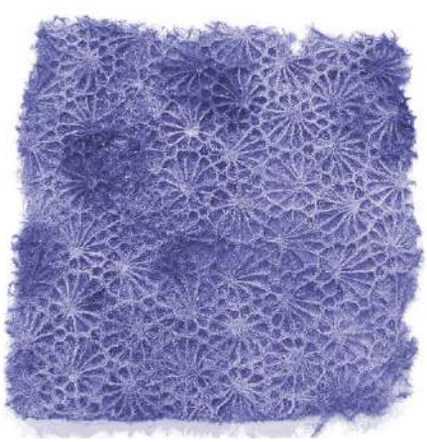

Fig. 2 - RootSkin test1 textile produced.

RootSkin is based on circular principles, created from humans, plants and bacteria collaborations and is taking advantage of robotics and digital fabrication to support the process. It merges activities such as plants and food production with the creation of textiles for the construction industry.

It consists of a network of edible plant (wheat grass) roots, creating a perforated membrane to be used to filter light in buildings. It can be used as a sort of tent behind a window's glass. It can be grown in our cities, for example on buildings' rooftops, on house gardens or applied in agricultural fields. When grown in cities, thanks to the implementation of plants in the urban environment, it brings further ecosystem services as, for example, alleviating the heat island effect, protection from flooding or air quality enhancement.

Rootskin grows on a planar panel covered with a layer of soil or hydrogel to cultivate the plants. The planar panel has a pattern milled into it where the water percolates through the soil deposits, guiding the roots' growth and defining the membrane perforation configuration. This support is integrated into urban surfaces, for example, part of a building's roof. Once the wheat grass, which is a super nutrient food, is grown and harvested, the plants end their lifecycle, and the root network is cut away, resulting in the patterned root membrane. When dried, RootSkin can be integrated into different urban and architectural scenarios providing a skin filtering light. With time the membrane will begin to biodegrade, returning the roots back to the soil to provide, through bacterial decomposition, the nutrients for the next plants to grow. This creates a closed loop cycle whereby no materials are wasted and underutilized.

RootSkin transforms urban morphologies into surfaces for food and biodegradable multispecies collaborations, closing the circle from soil, to roots, food and habitable spaces, and back to soil.

The following describes the steps that have been taken for the development of RootSkin.

INITIAL EXPERIMENTS

Creating the mold for the roots to grow, has been a fundamental part of developing RootSkin. After analysing the works of Diana Scherer (artist working with roots) and Zena Holloway (fashion designer working with roots), a strategy was developed to harvest the roots and to be able to separate them from the various layers of medium. The mold consisted of 4 layers. First, the CNC mold, then a large mesh followed by a more dense tulle, and finally, the seeds and growing medium. The mesh and the tulle were integrated to better help the separation of the roots at the end of the growing process. The initial experimentation was set up with a high quality plywood mold that was coated in a varnish to protect it from moisture. Next a layer of mesh was placed into the mold and a layer of tulle was placed above. On the tulle the seeds were placed with a mixture of hydrogel and vermiculite to retain the moisture and left for 2 weeks to grow indoors as it was too cold outside. For the quick experiments wheat grass seeds were used as the roots grew within 5 to 8 days.

The intricate pattern of the mold was developed using computational design and digital fabrication techniques. Computationally, the patterns were developed and then, using a CNC milling machine, the network for the roots were carved into the medium of the mold. The channels created attract the roots as they go searching for water and thus, are fundamental to the success of the root growth. Key factors to

consider in the design include the depth and width of the channels to allow the pattern to be clearly defined.

Furthermore, the design plays a crucial role in the way in which the roots interlock and create the textile. During the first experimentations, patterns that were dense and non-linear were used. This produced good results and the root textile was surprisingly strong as the roots grew in all directions. As the roots dried and shrank slightly, the roots further locked together, making the textile strong as seen in Fig. 2.

As the initial test seemed to work well, the mold was used several times. However, because of this multiple use, problems started to arise. The first issue being that hydrogel was passing through the tulle and blocking the network for the roots to grow but, the most problematic aspect was the fungus. As a result new experiments were set up to understand how to avoid fungus within the roots and on the mold.

PLYWOOD MOLDS

When working with wood, the biggest enemy was fungus. To address the issues of fungus, new small scale experiments were set up to test different coating strategies. Simultaneously, a new linear pattern for RootSkin was under development and therefore, the experiments were set up with the new pattern. Experiments were set up in plywood molds. One was given no coating, a second a natural epoxy resin and the last a sealant paint. However, whatever coating used, eventually the timber and coating began to show signs of fungus.

The seeds were planted in the molds and they were left for two weeks as the roots seemed to grow very slowly. This time they were placed in the courtyard as the temperature had increased and allowed access to maximum natural light. After two weeks the roots were removed, but the roots had barely grown and produced a lot of fungi. The first hypothesis was that there was too much moisture being retained and therefore, the tests that followed included adding drainage holes. To reduce the moisture build up, holes were drilled into the base of the molds to allow the overflowing water to escape. Again the experiments were left for 2 weeks, and still the same issues arose. In some cases there was even more mold than before. Upon further discussions with experts it was found that at certain times of the year there are a higher number of fungus spores in the air. It happened to be that RootSkin was being developed and grown during the period of the year with the highest number of fungus spores in the air. Instead of aiding, the drainage holes were further contributing to the fungi problem by exposing the roots directly to the air. At this point, the decision was taken to only grow indoors and new tests were completed at a larger scale.

In addition to the material used for the mold, it was noticed that the layering of meshes was also proving to be problematic. In some experiments, the roots were barely passing through the tulle and in other cases they were. As the experiments developed, this layering strategy was varied to find the optimal solution that promotes growth. Finding the balance between root growth and ease of harvesting became a key challenge while developing RootSkin.

Indoors, the decision was taken to test the plywood mold with the natural epoxy resin coating as out of three options at the smaller scale, this proved to be the best solution. The original layering system was used in a last

Fig. 3 - RootSkin test 2 plywood mold.

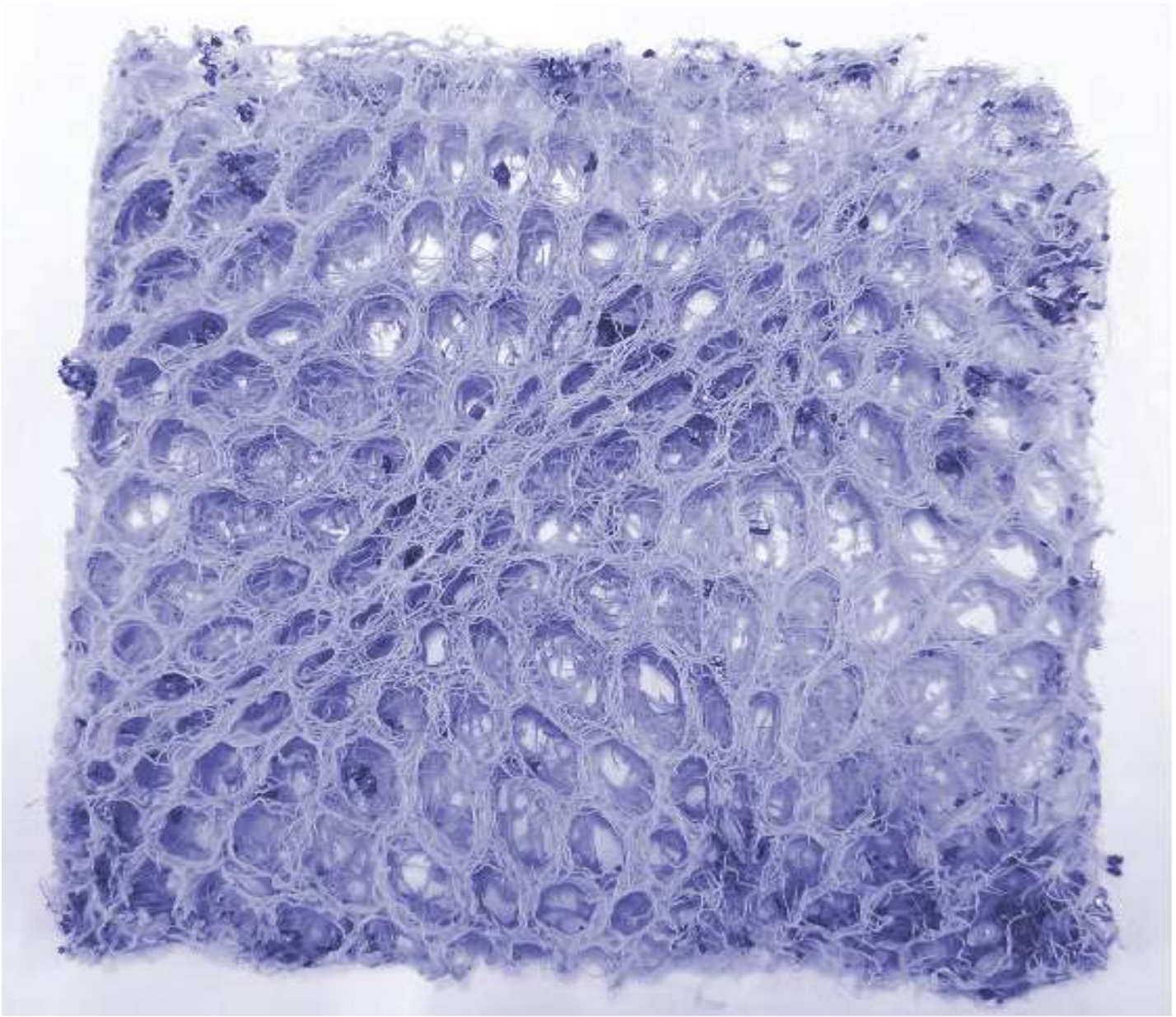

Fig. 4 - Rootskin Test 3 plastic 3D printed mold.

attempt to make the separation process easier. Similar to the small scale experiments, the roots took a very long time to grow and were not interlocking in a way that would allow for a textile to be extracted, Fig.3. While testing this large scale prototype, leftover seeds had been left in their plastic packaging container to germinate. Surprisingly, these roots had grown in four days, had intertwined and had produced a textile of roots. It was deduced from this that there was an issue with the mold material. While one might believe that roots would prefer natural materials, it turned out that they were thriving in plastic, an inert material.

3D PRINTED MOLDS

With this new knowledge, two small 3D printed molds were used to run quick tests. The results of these textiles were unlike what was achieved in the plywood molds, see Fig.4. The roots were very happy and grew within five to six days. The patterns of these molds were also denser, more defined, and allowed the roots to intertwine a great deal. The success of these textiles demonstrated that understanding the optimal material was key to the success of producing the root textile. While it was believed that the roots would prefer more natural materials such as timber, this proved not to be the case.

POLYCARBONATE MOLDS

RootSkin was developed to create facade panels and therefore achieving a scaled-up panel was fundamental. With the new knowledge that inert materials were proving to be the most successful, one last attempt was made using leftover 6mm polycarbonate. Thus, the pattern was milled into the polycarbonate and against our natural instincts, this proved to foster the best root growth. The roots thrived in the polycarbonate molds, an inert material, and grew much faster than they had done in previous tests. As a result, it was deduced

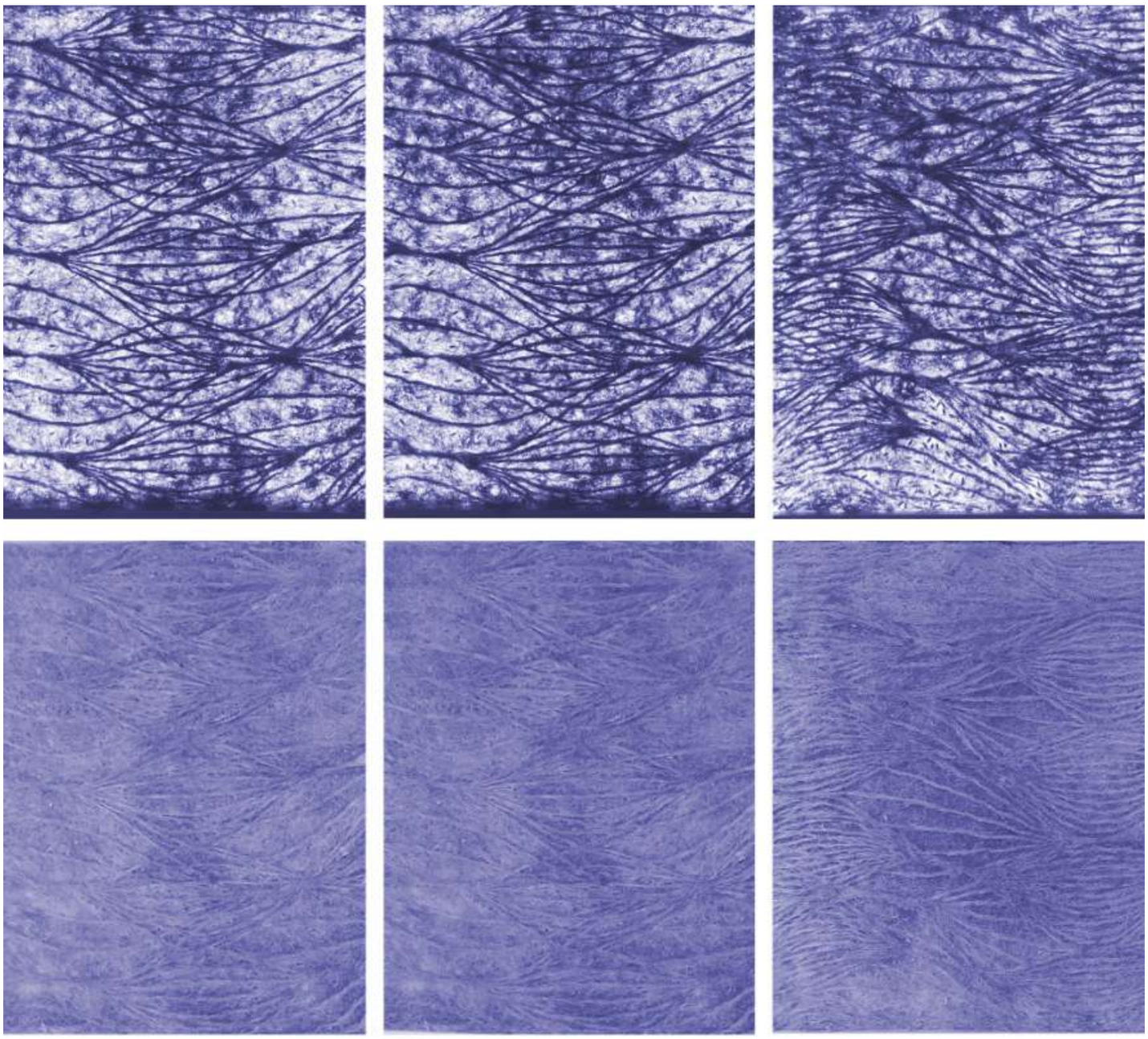

Fig. 5 - Rootskin Test 4 polycarbonate mold (upper level retro illuminated).

that the pH or glue used in the plywood was most likely affecting the growth of the roots.

In the initial experiment done with the polycarbonate, two layers of mesh were utilized. There were still doubts whether the fine tulle was hindering the growth of the roots. The next experiment was one with both meshes and one with no meshes. This meant the seeds sat directly on the mold. After just five days the roots without the mesh were ready to be harvested while the roots with the mesh had not grown as much but were already showing signs of degradation as seen in Fig.5. It was clear that the meshes were definitely impacting the root growth and would require further investigation. Therefore, for the final RootSkin panels it was decided to grow the panels without the mesh. While this proved to be successful in terms of root development, separating the layers took a lot of hours and was quite complex.

While contending with the issues of material use, another issue arose related to the linear pattern. At the small scale this was not noticeable, but at the larger scale this proved to be more problematic. The linear pattern meant there were less opportunities for the roots to cross and interlock. Instead, the roots were growing parallel to each other. Once the textile was removed from the mold, the roots began to react to the humidity resulting in a decrease in the definition of the pattern of the roots. To overcome these issues, the roots had to be cut and separated from the plant as quickly as possible and dried. When it took longer to separate the roots from the grass, fungi would begin to grow in the roots. The sun proved to be the best way to dry the roots in an even manner, Fig. 5.

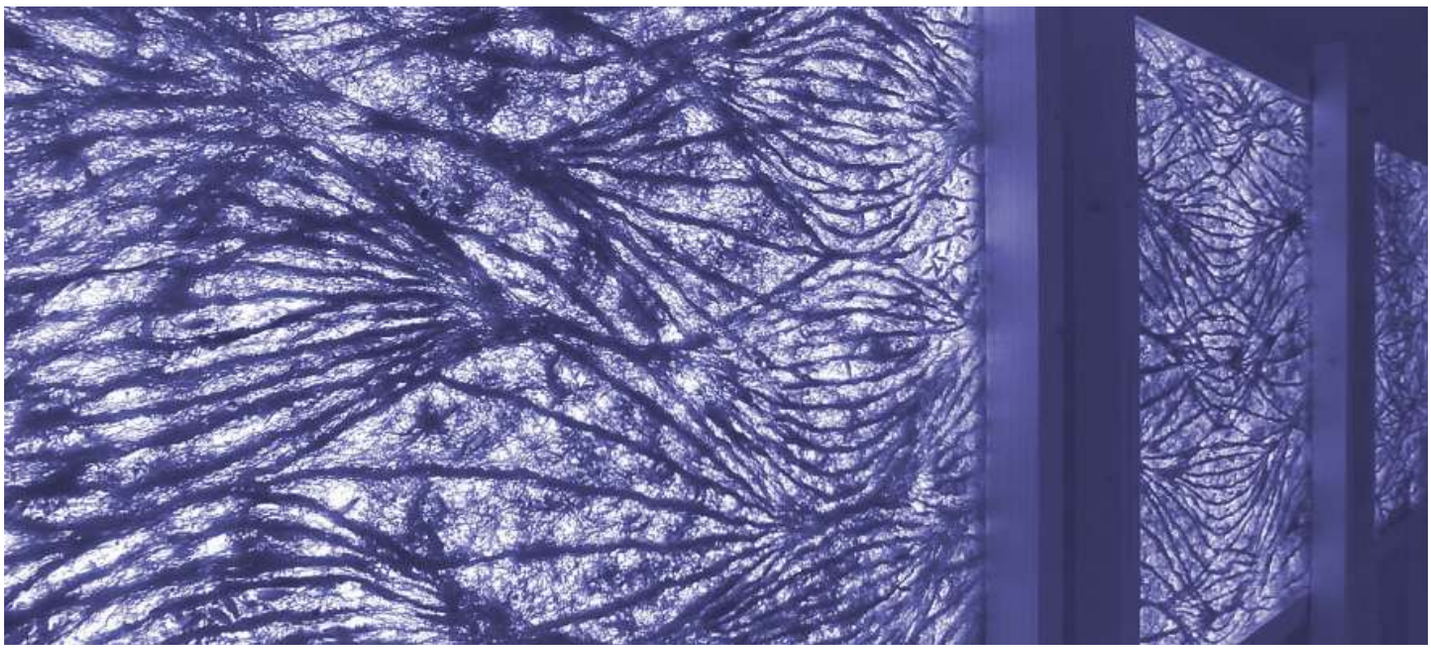

Fig. 6 - Rootskin presented in Tallinn Architecture Biennale 2022.

ARCHITECTURAL APPLICATION

Utilizing biodegradable materials in real life architectural applications poses several challenges. When working with plants there is always a level of unpredictability; whether it is will the plant produce its fruit, or will the roots be dense enough to create a strong textile. The goal of RootSkin was to develop a strategy that would make it possible to harvest the fruits above the soil for food and harvest the roots below the ground level to create a textile. Due to the nature of the textile and its translucency and biodegradability, it lends itself to becoming a skin that could be applied to buildings. As the density of roots can be controlled, this poses beautiful opportunities to play with translucency, Fig.6.

Furthermore, the biodegradable nature of the textile poses new challenges and/or opportunities. After a certain amount of time the textile will biodegrade, especially if it is exposed to the elements. This will create opportunities to renew or evolve the design of the skin overtime, creating an ever changing urban fabric. On the other hand, if the skin is to last a long period of time, coating strategies would need to be developed that also do not hinder the biodegradable nature of the textile.

CONCLUSION AND FUTURE PERSPECTIVES

Through the tests, we demonstrated how to develop a textile for the construction industry. The product is currently at a Technology Readiness Level (TRL) between 3 and 4. In order to rise its TRL and establish that it could be viable for the market the following research steps are required and foreseen in the near future:

(1) Further tests on the mold bottom panel material: at the moment we managed to grow it on plastic material; more natural and ecological materials need to be tested in order to enhance the product's sustainability.

(2) Further tests on the patterns: the textile pattern defines on one side the transparency and on the other side the structural resistance of the textile; further tests with different patterns will be useful in order to raise the structural resistance and make it possible to produce larger panels.

(3) Further tests on the plants used: wheatgrass has the advantage of being a superfood and being fast in growing; however, further tests with other plant species could make it possible to extend the range of plants from which RootSkin can be produced.

(4) Development of composite materials from rootskin: at the moment RootSkin degrades rapidly when coming in contact with water and consequently is mainly applicable to interior environments. Tests on creating composite materials from RootSkin that might resist water would allow for its use in the exterior environment.

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GRAPHICS & FOOD

The Disorder of the Dining Table

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INTRODUCTION

We became very interested in the Everyday when we were young teachers in the early 1990s. Shortly afterwards, we began working on the early design stages of Stock Orchard Street, colloquially known as the Straw Bale House. Drawn to the work of Michel de Certeau, Henri Lefebvre and others, we felt that architecture's connections with power and money balanced its potential in the wrong direction, and that the results often served the public poorly. People put up with what is given them by developers, planners and designers. Their genuine participation in shaping the world around them is limited, and usually confrontational. Architects seem interested in creating monuments to their own creativity and there is a hierarchy involved, in which large civic buildings, especially arts and cultural projects, and expensive privately-endowed monuments are the holy grail.

At the same time, these buildings serve the elite and do not form much part in people's daily experiences and routines. The local High Street, the school, the shops and cafes, the GP's surgery, the bus stop or train station, the typical workspace – these are the places occupied on a daily basis by ordinary people conducting their ordinary lives. They are places typically occupied by women, whose experience is often overlooked. Ordinary citizens spend most of their hours in such places, and as such, they deserve to be better. For we all acknowledge (at least, those that are aware of spatial practice at all) that a better environment is better for physical and mental health and wellbeing, self esteem, productivity and a positive attitude to life. By neglecting these basic pieces of infrastructure, architects abrogate responsibility and care to those that don't care or those who don't appreciate their importance.

We felt this was neglectful and wrong. We recognised that designers had a role to play in improving everyday backdrops, and wanted to highlight the role the Everyday can play in everyone's experience and enjoyment. In particular, we were excited by the fact that everyday places are those in which people can occupy with greatest creativity. For example, the public realm can't be controlled, so people can use it in unpredictable ways, from simple jay walking, sticking up a notice about a lost cat, leaving your old furniture out on the street for someone who wants it to take away, to more organised or considered events like running a race or performing street theatre. This sort of 'play' is the type of behaviour celebrated by de Certeau when he talks of the actions people can perform against the 'proprietary powers'. They are mini acts of creativity, of resistance and of challenge to the norms. Yet architects have a problematic relationship with this kind of behaviour because it doesn't conform to predicted models, and challenges their notion of control.

Spatial practice should be about celebrating these acts of creativity, embracing unpredicted events and laying out possibilities for imagination. Instead of closing these down, we want to embrace such potential creativity, inviting people to explore space and place in unexpected ways.

The dining table drawings take up this idea and illustrate how this could play out in the planning of a home. At the same time, the set of images illustrates the problem of representing action within the confines of conventional orthographic projection. The latter privileges static space and time, ideality and, of course, predictability. But in doing so, it closes down unexpected action, making assumptions about rituals and cultural preferences that may not actually pertain. In so doing it closes our eyes to diverse ways of understanding the world.

THE DRAWINGS

Working within the parameters of cultural custom and practice, the scenario is set for a meal for eight people. The table top represents the plane on which the action takes place but at a larger scale could be a floor plane. The **first drawing** represents the world as the architect sees it: a white ground that signifies the pristine, the tabula rasa, and the black lines that depict the outlines of a controllable event - static, ritualistic and predictable. We assume what will take place and take it for granted.

The **second drawing**, however, represents what happens over the duration of the meal, capturing the event as it unfolds in time. Like a Muybridge time-lapse sequence, it records successive moments in the movements of diners' chairs and tableware as they socialise, enjoy themselves and linger over the meal.

Just like Muybridge's work, orthography is not the obvious medium to capture time. Like movies, the method involves mini-moments of stillness. But put together, these moments add up to an evocation of the event in which your imagination can fill the gaps. Although apparently chaotic, our knowledge of the unfolding meal allows us to understand what is going on.

To our minds, this more accurately captures the event than the first drawing. Accepting the accidents, embracing the unexpected and learning to admire the 'dirt' that results, is part of acknowledging that life isn't always as we expected; and this challenges our ability, as architects, to predict and manage the realities of lived experience.

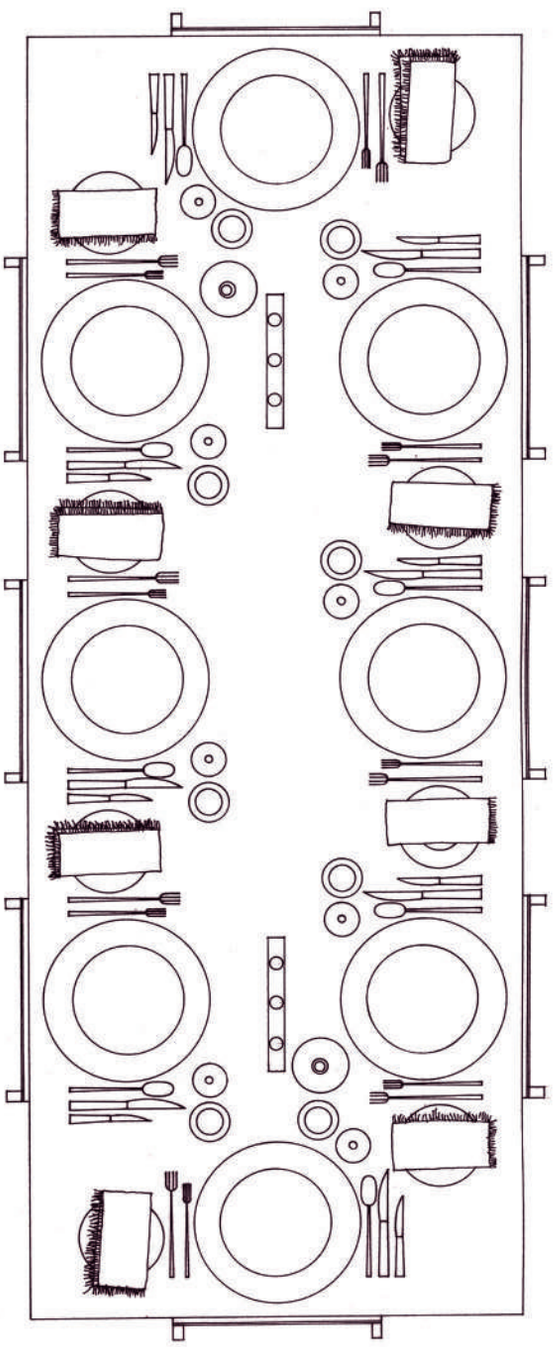

Fig. 1 – The Lay of the Table. An architectural ordering of place, status and function.
A frozen moment of perfection.

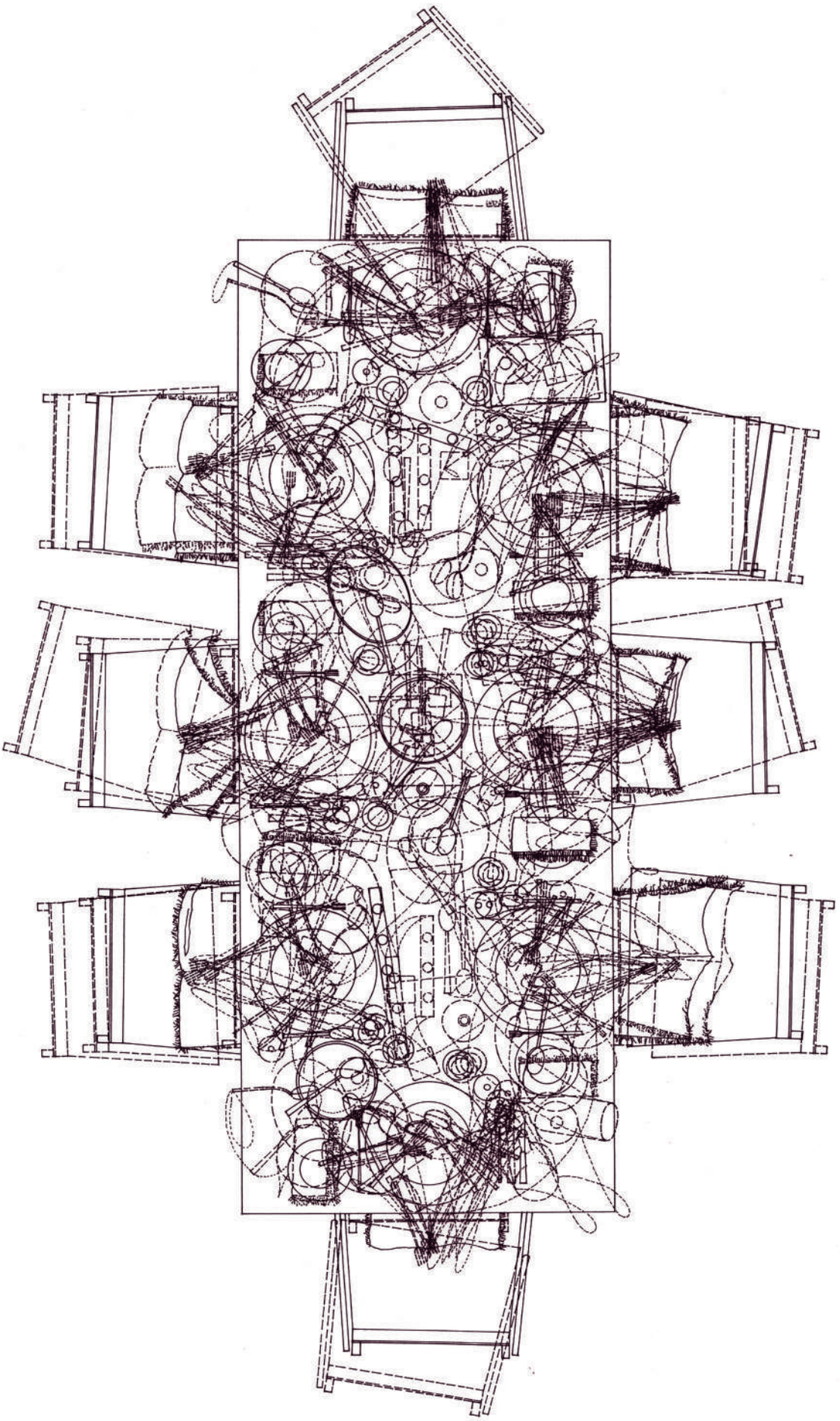

Fig. 2 – The Meal. Use begins to undermine the apparent stability of the (architectural) order. Traces of occupation in time. The recognition of life's disorder.
THE DISORDER OF THE DINING TABLE © Sarah Wigglesworth, 1997.

As a record of the finished event, the **third drawing** documents the traces left behind on the table top. Like the Turin shroud, the cloth bears witness and registers the happening for posterity. Once again, the image is static, but the traces left on the 'tablecloth' are a reminder of the unique but random social intercourse that took place as the meal advanced in time.

To our minds, this more accurately captures the event than the first drawing. Accepting the accidents, embracing the unexpected and learning to admire the 'dirt' that results, is part of acknowledging that life isn't always as we expected; and this challenges our ability, as architects, to predict and manage the realities of lived experience.

This is what an architecture of the Everyday must do.

The plan of the house at Stock Orchard Street follows the order of the trace of the meal. This is shown in the **fourth drawing**.

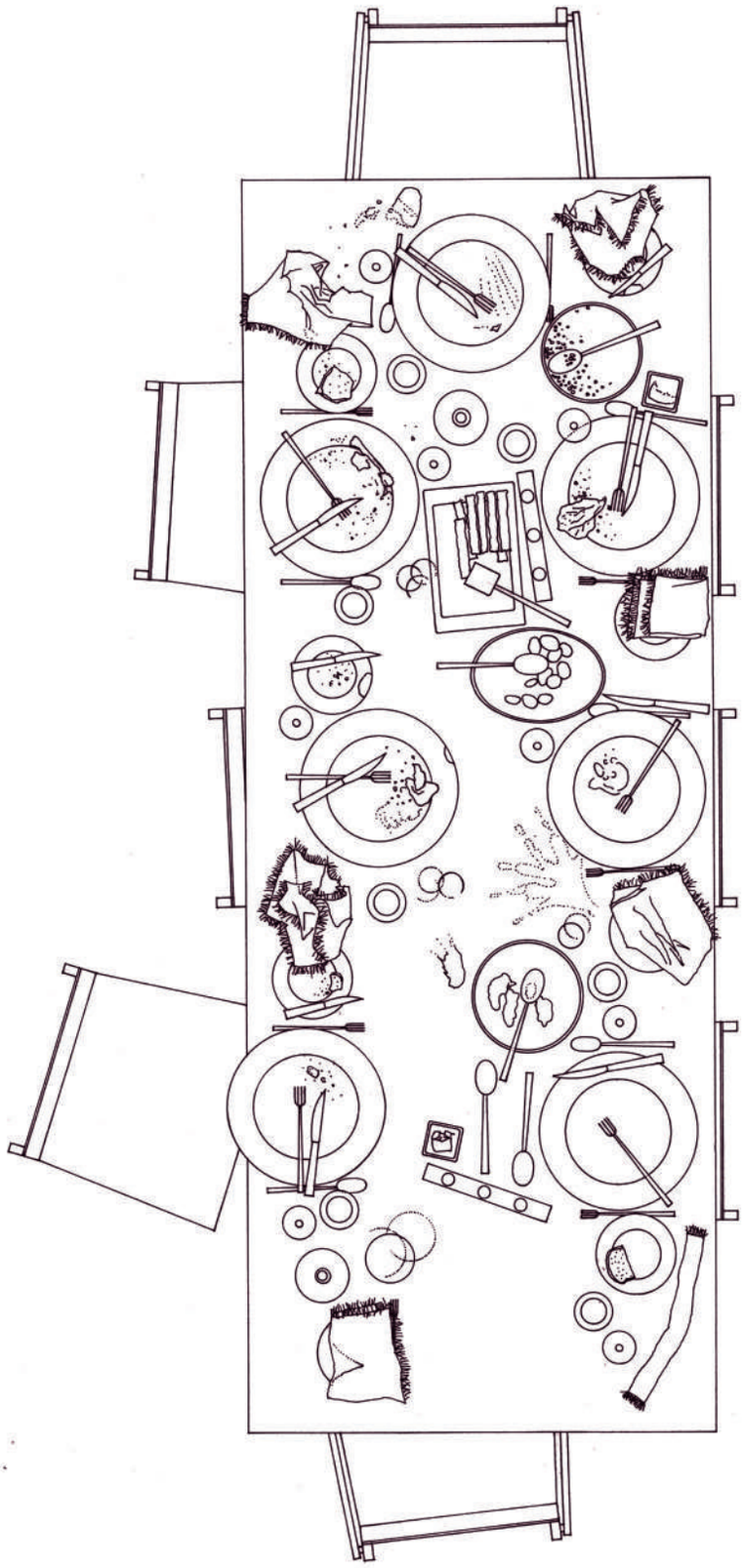

Fig. 3 – The Trace. The dirty tablecloth, witness of disorder.
Between space and time. The palimpsest.

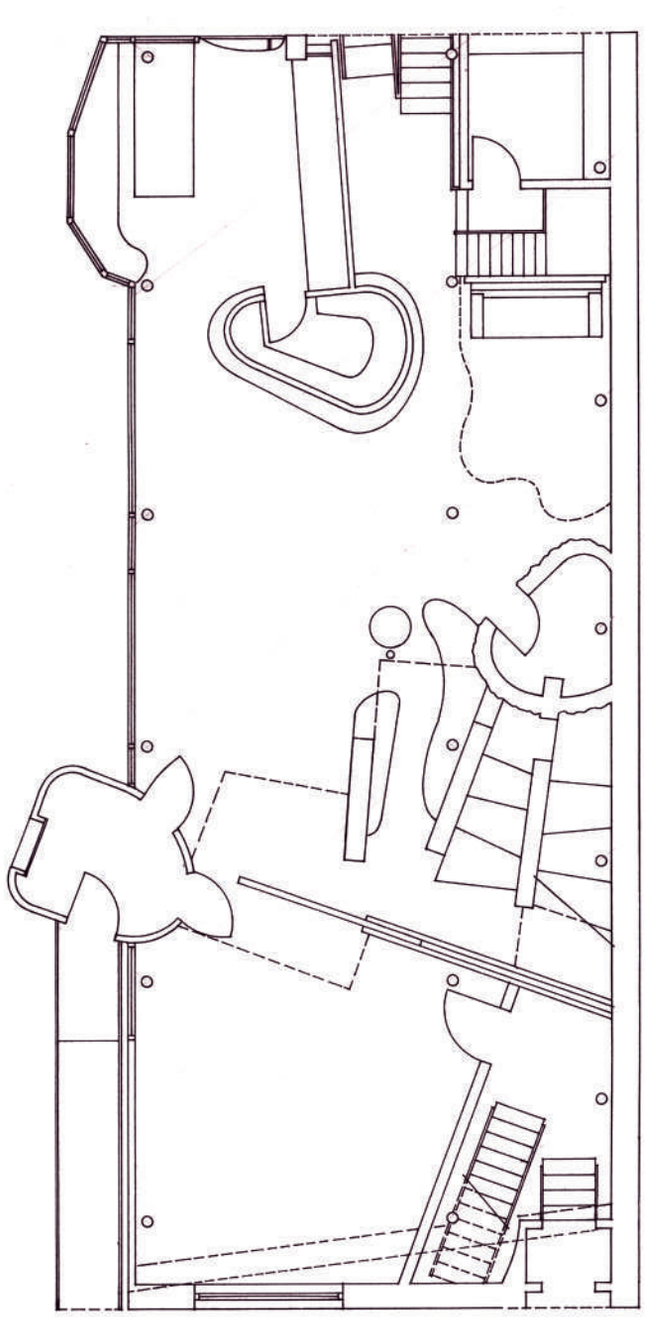

Fig. 4 – The Lay of the Plan. The trace transformed into a plan. Clutter filling the plan(e).
Domestic difficulties disrupting the order of the grid.
THE DISORDER OF THE DINING TABLE © Sarah Wigglesworth, 1997.

FUTURE ENVIRONMENTS & FOOD

Virtual Phenomenology

A Critical Essay about the Relationship between Virtual Environments and the Senses

immersive
virtual
phenomenology
senses
gustatory

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This article focuses on the content, process, and outcome of the design brief titled virtual phenomenology under the professional elective course DDFT 473 – Virtual Environments. The emphasis of the course tackled the relationship between the virtual realm and the senses using virtual reality HMD and controllers as tools allowing students the possibilities to create virtual spaces inside virtual reality. Students spent more than 50 hours inside the virtual void trying to correlate and ignite specific senses in relation to each created virtual space. Despite the tremendous researches related to immersive education, this article attempts to showcase the process and outcome within the framework of VR Sketch application and how the usage of VR technology affect and empower the creation of virtual spaces through the senses rather than focusing on a traditional 2D iterative method of creating architectural spaces.

Throughout history technologies have augmented human physical and mental capacities. Immersive technologies that include extended reality equipment (e.g., virtual reality and augmented reality head-mounted display) provide immersive three-dimensional virtual environment experiences that have greater impact than that of non-immersive tools (e.g., 2D computer monitor, mouse and keyboard). Inside immersive virtual environments, users can experience powerful emotions and feel psychologically as if they were present in these environments (Adams, 2004; Blascovich & Bailenson, 2005).

In an experiment done on students in immersive VR or via a self-directed PowerPoint slide show, the results showed that students reported lower motivation, interest, and engagement ratings when viewed in non-immersive way (Parong, J., & Mayer, R. E., 2018). In addition, virtual reality has enhanced students' learning experiences by providing them with a highly interactive simulated virtual environment (Kung Wong Lau & Pui Yuen Lee, 2012). The consensus obtained from many researches done on the use of virtual reality in learning environments demonstrates the positive impact of this technology on the ability of learners to solve problems, discover new concepts, increase motivation, and offer a high level of interactivity among others (Geris, A., & Ozdener, N., 2020). This paper will discuss the relationship between the virtual realm and the senses using virtual reality HMD and controllers as tools to allow students the possibilities to create virtual spaces inside virtual reality. Then it will focus on the selected process and outcome that specifically highlights the sense of taste and how students attempted to manifest a virtual gustatory space inside virtual reality. The paper will discuss how design process and outcome has allowed for both a final virtual space which stimulated the senses when experienced and the use of VR as a tool to design a space that is empowered by a specific sense.

VIRTUAL PHENOMENOLOGY

The utilization of immersive technologies has provided the opportunity to experiment with many existing theories and bringing them to the virtual realm; many of these studies tackled different topics such as the study on the feasibility and benefits of using immersive virtual environments where presence level was higher in the IVE compared to the still images experiment (Birenboim, A., et al., 2019). Another work specific to the usage of VR in higher education showed that the interest in immersive VR technologies for educational purposes seems to be quite high (Radianti. J., et al., 2022).

While many papers and articles have tackled the notion of phenomenology in their studies, a lot less included the impact of immersive technologies on such notion due to the fact that advancements in these tools are recent. Daniel O'Shiel in his book the phenomenology of virtual technology has dedicated a chapter where he writes on the changed selves and the values in VR, AR and MR technologies (O'Shiel, D., 2022). At the School of Architecture, Art, and Design of the American University in Dubai, the Center for Research, Innovation, and Design (CRID) is well equipped with state-of-the-art immersive technologies, hardware, and software that provided the students the opportunity to experiment and explore such a notion. Certainly, the sense of presence in a virtual classroom (Fig. 1, where each green capsule is representing one student) required a physical presence (Fig. 2, where each student is using a VR HMD in order to control the green avatar inside the virtual classroom) in a space that can allow students the 6 degrees of freedom where they can design any form, shape and space out of the thin air. The application used to make that collaboration plausible is done by VR Sketch, that is a plugin of SketchUp. The software allows for both individual engagement and design for a single user or a collective one for multiple users. It also allows a direct connection between the SketchUp file and the work that is being created in VR Sketch. In addition, it provides a clear, simple, and efficient way to design accurately architectural spaces with a friendly user experiences characteristics that are not present in other software. One of the design briefs of the "DDFT 473 – Virtual Environments" course titled "Virtual Phenomenology: Five senses Five Spaces" requested students to create virtual architectural spaces that can celebrate the human experiences and challenged them to connect these experiences with the human sense perception. In addition, the brief not only highlighted the importance of taking into consideration the philosophy of phenomenology but also added the significance of how to reflect it virtually and related to the virtual space.

The brief emphasized that students must connect three out of five senses in a sequential manner dedicating one sense per each space to be created, designed, built, and explored inside virtual reality for virtual reality experiences. It was mandatory for students to spend more than 50 hours inside virtual reality in order to accomplish this task throughout the three-and-a-half-month-long semester. Many students find it more challenging to correlate virtual spaces with specific senses; for example, the sense of hearing (Fig. 3) in contrast to the sense of touching (Fig. 4) and the sense of smelling in contrast to the sense of seeing. One of the students described her

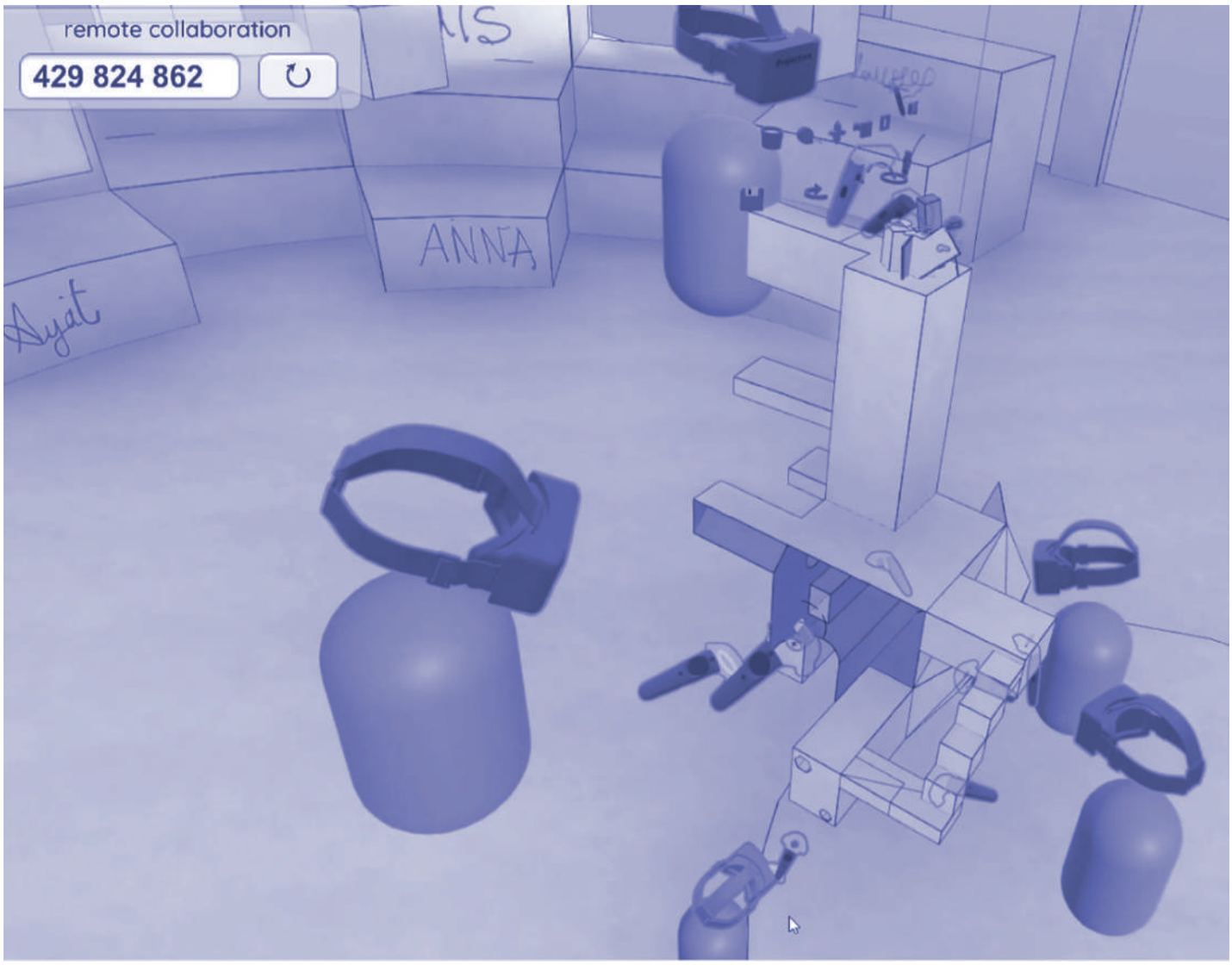

Fig. 1.

Fig. 2.

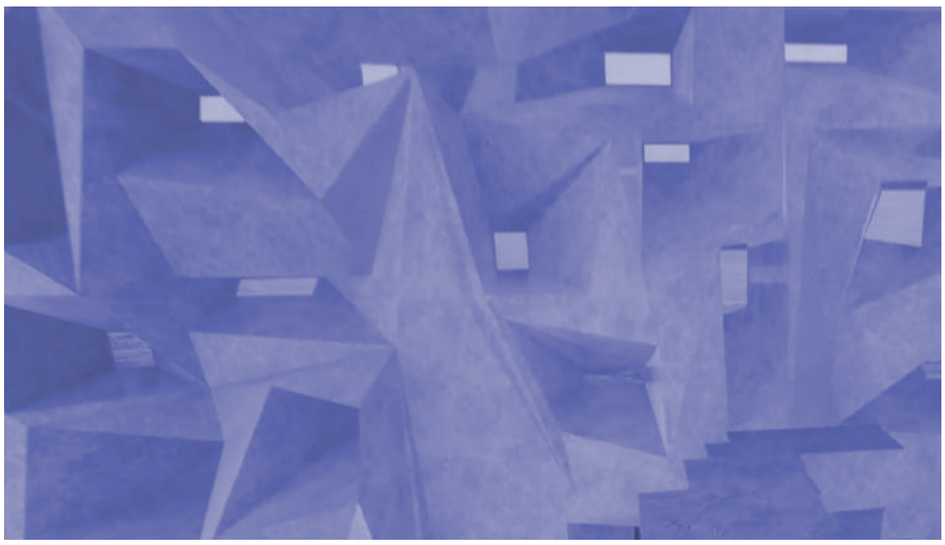

Fig. 3.

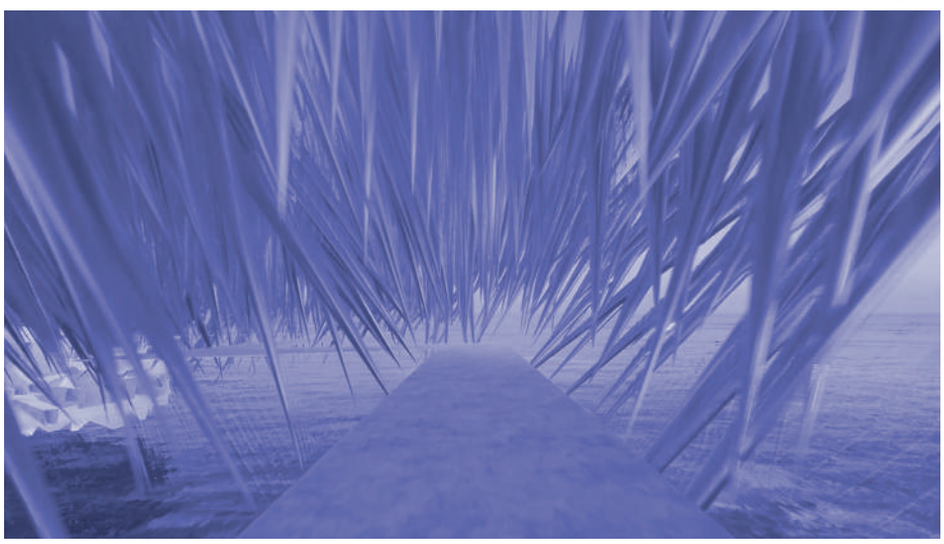

Fig.4.

project as follows: “A journey of non-traditional exploration of the senses into an abstract linear space that paves the way for the user through the soulless world around.” The goal was to identify what would ignite a certain sense and try to create an architectural virtual space that stimulate and reflect that specific sense. It was also important to engage the sense not only in the design outcome (Fig. 5) but also in the design process (Fig. 6).

VIRTUAL ITERATIONS

The students were asked to not only use virtual reality as a mean to navigate a 3D model that was built in a traditional 2D method, rather they were asked to immerse themselves in the virtual void and try to come up with iterations of their spaces in relations to their senses while being inside virtual reality. Accordingly, multiple methods were applied and students experimented in different ways to reach the desired outcome; Some students reverted to traditional 2D methods where they have uploaded a 2D sketch done by hand into the virtual void (Fig. 7). Some have used a 2D image that threshold, they felt less restricted

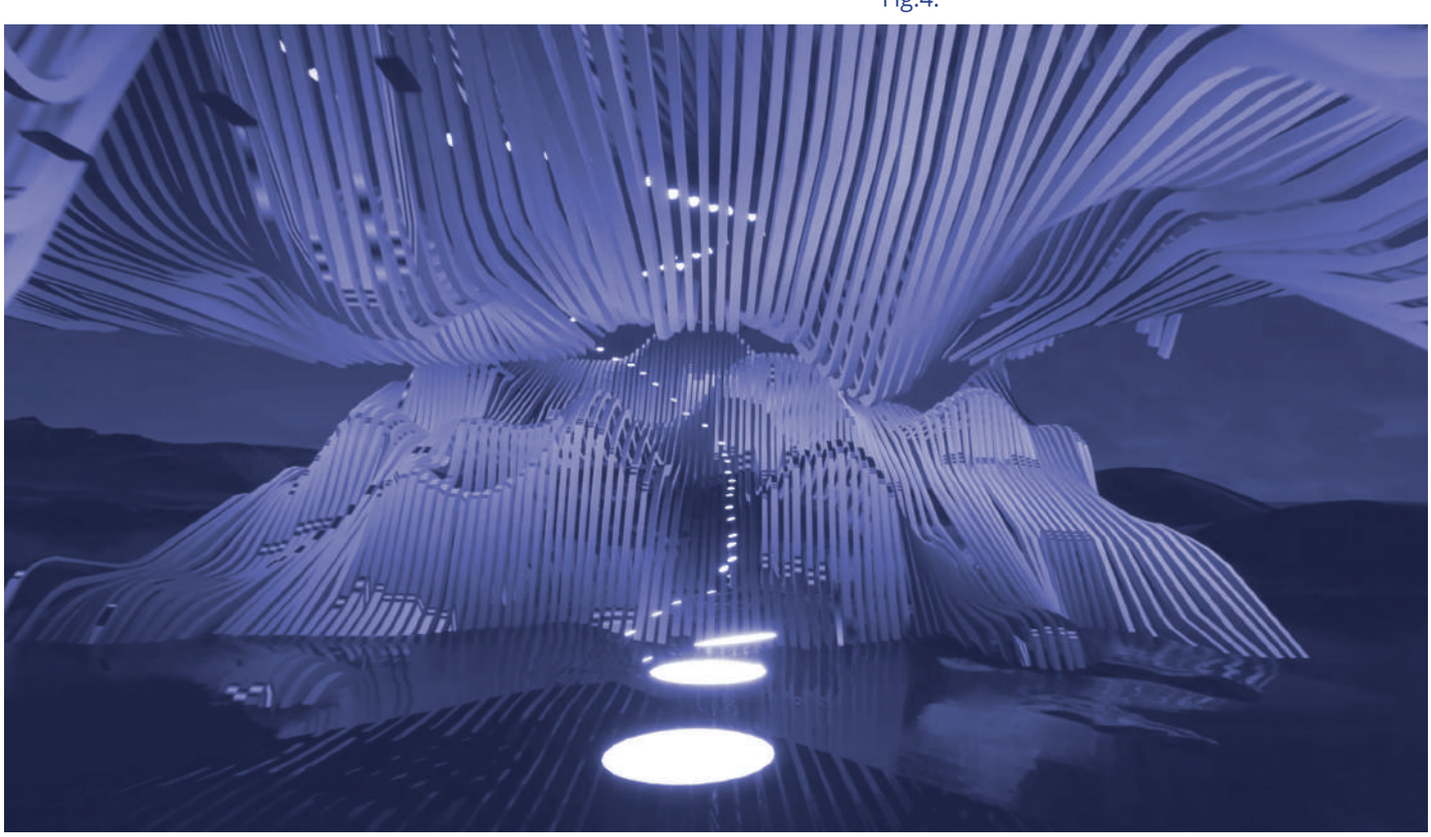

Fig. 5.

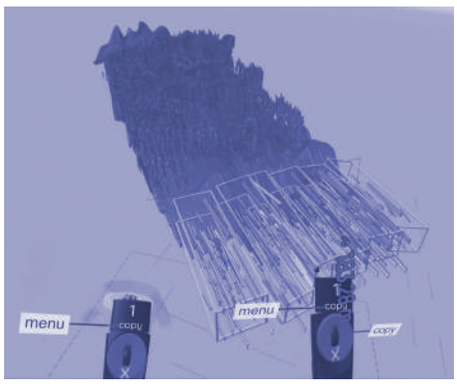

Fig. 6.

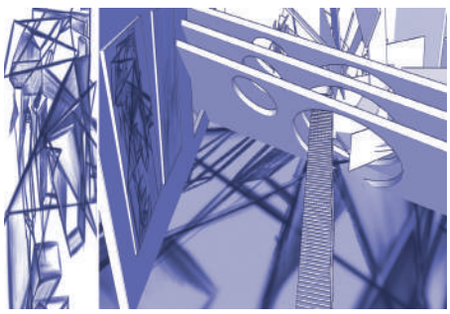

Fig. 7.

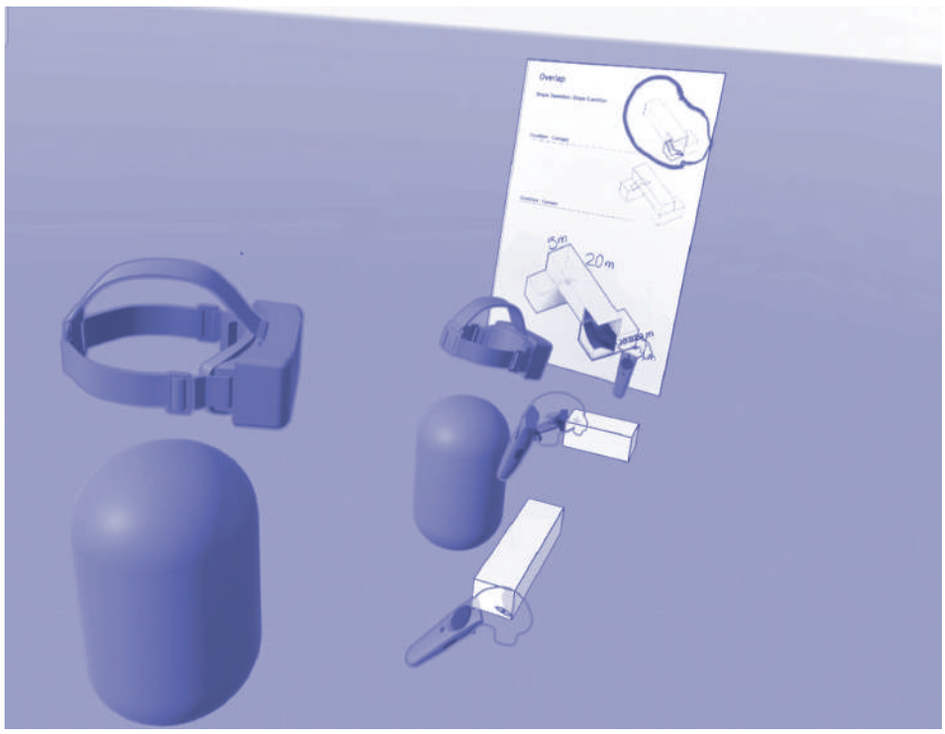

Fig. 8.

when designing in VR than on 2D flat surface or screen. This may be due to the connection between the immersive virtual environment and the capacity of the student to manipulate them and to manage the created objects with their hands using the VR controllers as seen in the images below.

TASTING THE VIRTUAL

Juhani Pallasma in his Eyes of the Skin, writes about how visual experiences can be transferred to taste, and the impact of certain colours and subtle details in evoking oral sensations. He continued elaborating upon the interior sensation of the mouth being the starting point of the human sensory experience of the world (Pallasma, J., 2012). There is no doubt that human senses are the medium - and perhaps one directly inside the virtual void as an inspiration or a way to build a 3D model based on information

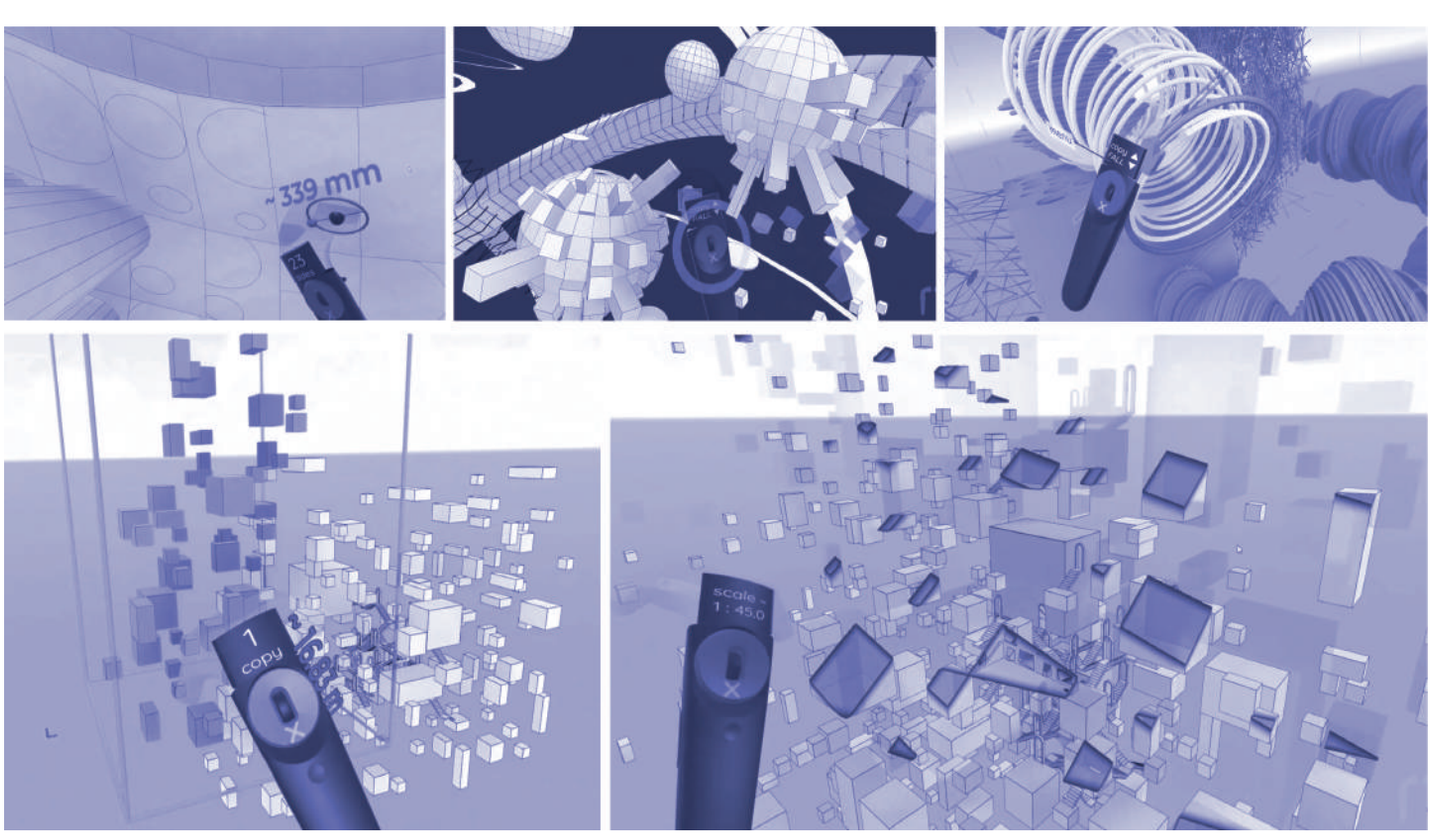

Fig. 9-13.

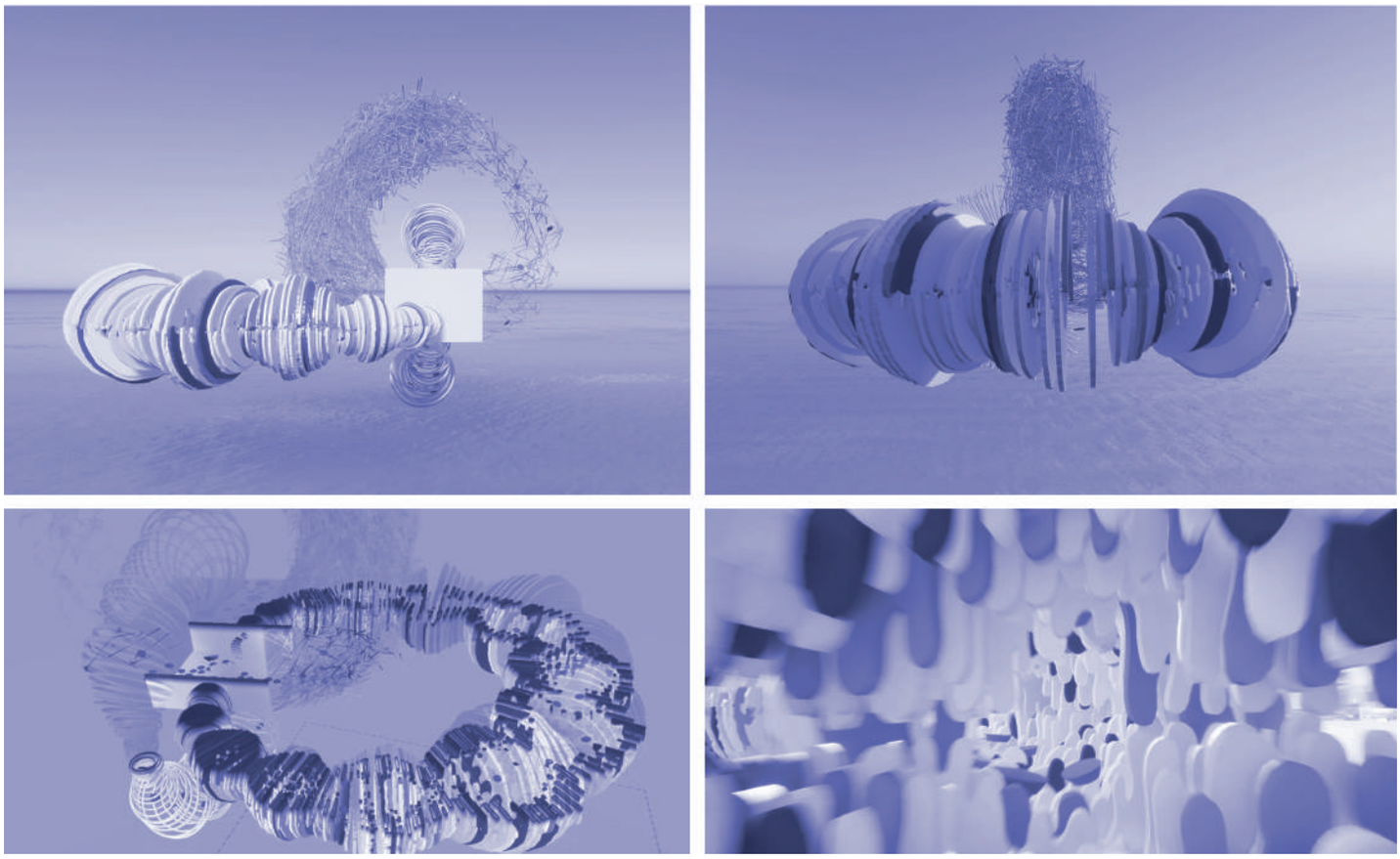

Fig. 14-17.

drawn on an existing 2D surface (Fig. 8).

Many students tried to build their spaces directly in 3D inside the virtual void and attempted to argue that they are - the tools by which architectural spaces are experienced, and through that, textures, materials, and colours play an important role in the way space is perceived and explored.

Across the board, all students were challenged to materialize the virtual spaces that manifested the sense of tasting. They argued that creating a virtual space triggering the sense of taste is more difficult than creating a physical one because in the virtual realm one can only stimulate the sense of vision rather than the other senses that usually play a significant role in experience, specifically the olfactory and haptic sense.

In the project named “Virtuality” the student explained that in the space dedicated to the sense of taste, she played around with the idea of melting food that apply iterations and overlap them directly in 3D (Fig. 9 -13). The majority of the students have expressed that it took them less than 10 hours inside VR to feel confident working and manoeuvring virtual environments. However, they mentioned that once they passed corresponded to melting ice cream (Fig. 14 - 17). The use of a light colour palette depicted different flavours, and the space was made of multiple spheres forming a wormhole like loop around the central passage. As one goes through those spheres, one finds that they get further and bigger towards the middle, and get closer and smaller at both the beginnings and ends. In another project called “Re-Birth”, the student explained that the exploration of this new virtual world is similar to a baby trying to experience the real world through the five senses. For her, technology is inspired by the human anatomy from cells to wires and everything in between, and accordingly, VR can allow for a deeper connection and creation of impossible spaces that relate to the senses. With specific reference to the space of taste, she elaborated that being surrounded by elements of different shapes, sizes, and colours, can stimulate the gustatory system and make one fully indulge in a state of relish. The pathway around the colourful candy-like shapes (Fig. 18 - 21) provides an immersive experience with a virtual sensibility for each taste and the multi-coloured confetti-like explosion acts as a finale to the overall experience and ensures leaving the virtual space on a “sweet” note.

While the experiences of spaces were made by the creators of the designs, there was a need to conduct peer review and feedback where students have accessed each other’s designs in an immersive way to provide insight on the feelings that they are experiencing and whether these feelings validate the intention of the creators.

CONCLUSION AND FUTURE DIRECTIONS

While the interface of a specific application can empower the human computer interaction, immersive technologies in general, and VR specifically, can provide a much more engaging experience due to its power to completely surround the users and separate them from the physical world. In line with the design brief that highlighted the human senses with the creation of spaces, VR has provided the possibilities for students to design virtual spaces that managed to put them in direct contact with their senses and by that informed them about the creation of these spaces. And even if human senses are overwhelmed by visual inputs, and some spatial expressions of senses were more challenging than others, students have managed to master the tool at hand and then use multiple traditional and non-traditional methods to accomplish the task. Another important observation on the process and outcome of this work, is that the majority of students felt more creative and engaged when designing inside virtual reality compared to its non-immersive counterpart, such as traditional 2D papers and computer screens.

There are tremendous opportunities in how human senses can inform and be informed by immersive technologies for design purposes. The power of VR is that it can engage the user more than any other non-immersive tools, and while other haptic technologies can be incorporated in such experiences, it will still need the proper design application that allow such interactions. As this is being written, there are currently some HMD that are capable of perceiving and giving feedback on human hand gestures rather than the usage of hand controllers. These advancements will for sure have their impact on how the future of immersive designs will unfold, and by that providing further intuitive and perhaps organic corporeal interaction between the human senses and the designed spaces.

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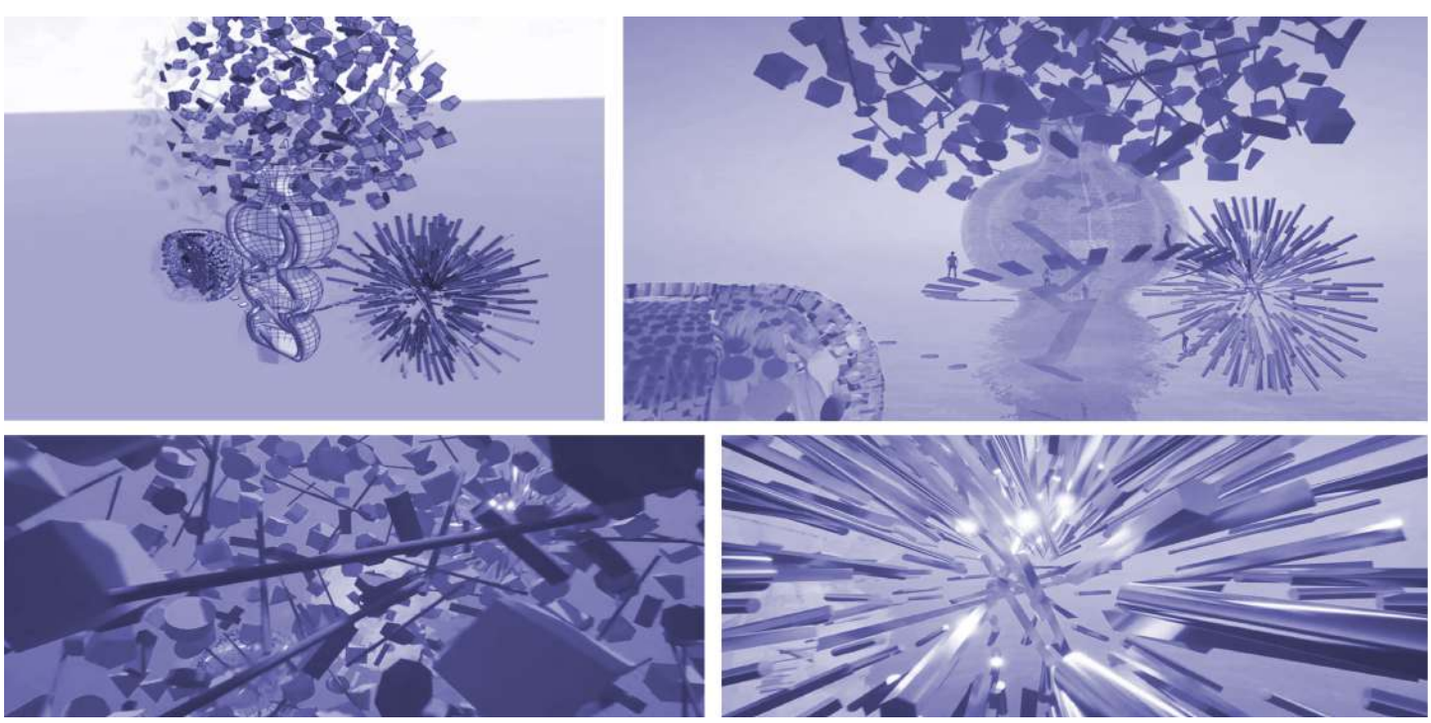

Fig. 18-21.

The Blur Table

An investigation of the virtual experience through the social act of the meal

virtuellt rum
dela en måltid
social distansering
bostadsarkitektur
virtual space
sharing a meal
social distancing
domestic architecture

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Den sociala distanseringen under Covid-19-pandemin utmanade hemmets funktionalitet. När de rumsliga övergångarna mellan privata och offentliga aktiviteter plötsligt försvann, fanns en suddig härva av sinnestillstånd kvar på matbordet. Med datorn som verktyg kunde otaliga formella och informella sysslor utföras från samma plats. Idag har de flesta återgått till fysiska lokaler men spår från pandemin finns kvar i vårt sätt att arbeta. Med hemmet som basis undersöker projektet förhållandet mellan virtuellt rum, fysiska objekt och användaren. Snarare än att försöka förbättra hemmet och dess interiör, föreslås sätt att arbeta med det virtuella ur ett arkitektoniskt perspektiv. De verktyg arkitekten använder för att undersöka rum används här inte för att illustrera tankar, utan för att utgöra tankar. Det virtuella får ett sammanhang genom mötet med måltiden som social akt och kan därmed förstås ur ett fenomenologiskt perspektiv. Måltiden förblir central genom projektet då den möjliggör rumslig aktivering och skapar friktion mellan det virtuella och det fysiska. De idéer som utforskas i projektet sammanställs i *The Blur Table:* den gränslösa möbeln.

The social distancing of the Covid-19 pandemic challenged the performance of the home. A blurry tangle of states of minds was left on the dinner table when the spatial transitions between private and public activities suddenly disappeared. Myriads of formal and informal activities could be conducted from the same spot, often with the computer as tool. Today, most are back in physical facilities, but traces from the pandemic are left in the way of working. This project investigates the relationship between virtual space, physical objects, and the user in a domestic context. Rather than improving the home and its interior, the project suggests ways of working with the virtual from an architectural point of view. The space-investigating tools of the architect are used not to illustrate thought, but to constitute thought. By intersecting the findings on the virtual with the social act of the meal, the virtual is given a context and can thereby be understood from a phenomenological perspective. The meal remains central throughout the project as it enables spatial activation and creates tension between the virtual and the physical. The notions explored in the project are synthesised in The Blur Table: the border-less furniture.

This project explores the relationship between virtual space, physical objects, and the user in the context of physical distancing during the Covid-19 pandemic. When the pandemic lifestyle peaked, whole days of activities could be conducted from the same chair. Today, the covid-19 pandemic has loosened its grip, and most are back in physical facilities.

However, there is no returning to a pre-pandemic way of working. It left traces that are here to stay in terms of communication. The enforced remote working many found themselves in during the pandemic paved the way for the virtual-physical communication that is the post-pandemic way. In schools and offices, virtual meeting options are now standard practice, as are physical rooms dedicated for this purpose solely. The criteria of which we measure the performance of a building has changed as new needs are to be satisfied.

Understanding how virtual and physical space interact with each other and with its users has become part of the architecture profession. Using the fundamental tools of the architect, drawing and modelling, this project aims to constitute a gateway to an architectural way of thinking about the virtual.

The virtual intersected with gastronomy when one served as a tool to understand the other. The social act of the meal became the apparatus that not only manifested the project's investigated issues in space and time, but further expanded them.

Food also has a value as a symbol of being opposite to the virtual; something physical with an inherent sense of realness to it. Through this conjunction, the virtual could be understood as part of a human experience, rather than merely a technical device.

BACKGROUND

In 1956, the British artist Richard Hamilton explored technical devices and usages in the home in his artwork *Just What is It That Makes Today's Homes So Different, so Appealing?* The collage displays a living room decorated with logos, emblems, gadgets, and two humans. Among the objects is a television screening an image.[1] Today, homes are filled with technical devices whose content changes without connection to their physical form, like the television in Hamilton's collage. Despite being immaterial, this content highly controls our behaviour.[2] How can architects, whose medium is space, obtain a deeper understanding of the human interaction with non-spatial technologies?

In his 1992 article *Architecture in a Simulated City,* Japanese architect Toyo Ito contemplates how architecture can stay relevant in cities filled with virtual media. He describes the unpredictable and disproportionate relationship between the material and immaterial qualities in objects with virtual content, suggesting that *goods-as-entities* therefore are losing their significance. Using car design as an example, Ito explains that "Volkswagen and Citroen were designed using forms that imply a variety of mechanical functions [...] Current cars are designed almost as an image which is irrelevant to the mechanism."

Virtual content also lacks the conventional life cycle of physical objects. While the physical device is produced, worn, torn, and disposed, its content exists on its own terms with a capacity to embody new devices. Thus, a challenge appears, according to Ito: how should architects design *architecture-as-entities* that endures through these ephemeral conditions? He presents the following solution: "I do not mean that architecture should be replaced with video images or that temporary buildings should be used. We should, rather, build fictional and ephemeral architecture as a permanent entity."[3]

During the Covid-19 pandemic, functions of the city moved into the enclosure of the home.[4] Despite the long-established domestication of virtual devices, the blueprint of the home has remained relatively unchanged. New, however, is our way of interacting with the home interiors. In her 2018 essay *The 24/7 Bed,* Spanish-American architecture historian and theorist Beatriz Colomina explores the bed's role in the virtual society. No longer tied to physical facilities, work can be performed from bed. The work-home division, established during industrialization, has thus disappeared, giving way for what she calls a new horizontal architecture of "... a collapse of traditional distinctions between private and public, work and play, rest and action."[5]

In her 1998 text *The Dining Table,* British architect Sarah Wigglesworth celebrates the collapse of distinctions when examining the dining table in her work-home. Gathering objects, like pepper mills and letters, indicates what activities have unfolded. Stains and scratches make permanent evidence of activity on the surface. Over the day, the table experiences different phases such as business meetings and mealtimes. Despite these phases, Wigglesworth argues that the table never belongs exclusively to one practice, because of the everlasting presence of physical traces. Inspired by the organic and ambiguous use of the table, Wigglesworth adopts the conjunction of these conventionally separated programmes.[6] Despite not dealing with virtual technologies, the study is relevant to the understanding of the virtual through its

phenomenological examination of objects and of multi-use of singular places. with virtual technologies, the study is relevant to the understanding of the virtual through its phenomenological examination of objects and of multi-use of singular places.

Hamilton displays domestic technology as means of expression, hierarchically positioned alongside humans; the enclosure of the home appears merely a display cabinet. In attempting to save architecture from becoming static relics, Ito encounters two paradoxical challenges: "... to make something real while goods hardly have reality. [...] to create a permanent space in a constantly changing city."[3] Colomina and Wigglesworth examines the entanglement of states of mind caused by our contemporary inhabitation of traditional furniture.

All these notions are synthesised in the 2019 installation *The Venn Room* by the interdisciplinary architecture studio Space Popular. The project explores a virtual merging of physical homes made possible by virtual reality. The blueprints of the homes intersect like Venn diagrams, creating new hybrids. Virtual objects become memorabilia of domestic activities, like the physical objects on Wigglesworth's table. Space Popular wonder if these ornaments will be the status symbols of tomorrow, as the television is in Hamilton's setting. *The Venn Room* creates architecture that is virtual and temporary, a concept rejected by Ito. As indicated by his phrasing in the matter, virtual content is often considered to exist outside *real life.* Here, Colomina's and Wigglesworth's understanding of experience is crucial.

Are interactions with virtual content not *real,* or does it exclusively concern the virtual content?

Fundamental notions can be extracted from these works that lay the foundation for working architecturally with the virtual. First and foremost, one must sift focus from space as a binary system of solids and voids. Instead, human states of minds produced by the entity-less contents of digital devices is what constitutes virtual space. Secondly, domestic objects are embedded with meanings regarding identification, expression, and memory. Virtually produced objects act in a similar manner, but lacks the familiar life cycle of tangible, physical objects.

Thirdly, it is urgent to investigate the sense of reality in relation to the virtual Set within the context of the socially distanced student during the Covid-19 pandemic, this research aims to investigate the following question:

What is the relationship between virtual space, physical objects, and the user?

1. MATERIALS, METHODS, AND RESULTS

1.1. METHODOLOGY

To test and expand on theories discussed in the background of section, a series empirical explorations were conducted, where each lead to an intermediate result. The fundamental tools of the architect, drawing and modelling, were used to perform the explorations. Visual material was not initially produced to communicate thought, but as a way of thinking through making. By using familiar methods of investigating physical space, the virtual could be understood through an architectural lens. Three main themes were extracted from the experiments:

The virtual and reality, The virtual and sharing space, and The virtual and privacy. The concepts were then tested in an architectural performance with two objectives: to manifest the explorations in space and time, and to further expand on the investigated notions leading to new intermediate results. All the results were then synthesised in a physical design: *The Blur Table.*

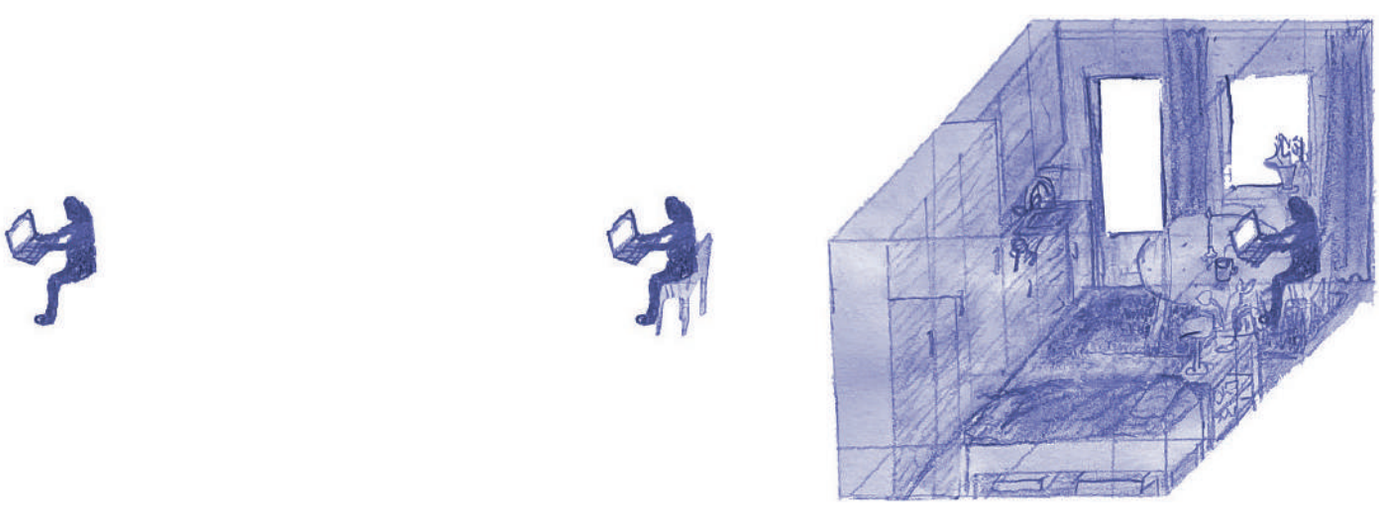

Fig. 1 – The physical object as anchor. Werme Oscarsson, E. 2021.

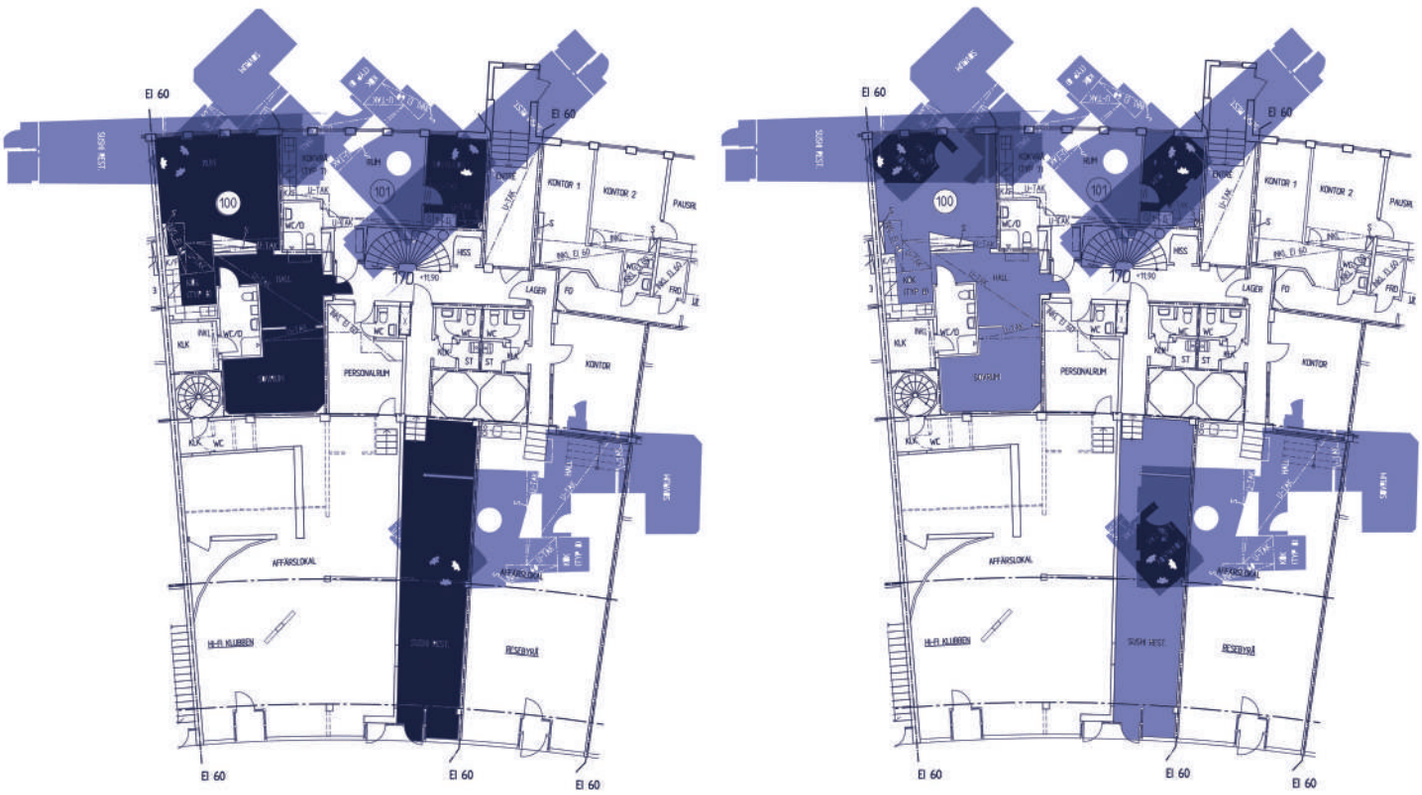

Fig. 2 – Shared virtual space in physical apartments. Werme Oscarsson, E. 2021.

The site of the project is the home in general. Different domestic buildings with different qualities are analysed throughout the project. However, the main site of investigation was my own studio apartment.

The studio apartment is ideal for the intentions of the project. It is a place in which many found themselves confined during the pandemic; a place where the challenges of social distancing investigated in this project collide.

1.2. EXPLORATIONS

1.2.1. THE VIRTUAL AND REALITY

Toyo Ito's opinion that goods now lack reality is an example of how virtual content is often not considered *real.*2 The Cambridge Dictionary defines the word real as "things as they really are, not as they exist in the imagination, in a story, on the internet, etc.", and provides the following example:

"Why waste time on virtual friendships, when there are people out there in the real world who want to spend time with you?".[7] While the question of what really is real can be philosophised, these examples demonstrate the common view of the virtual as something existing outside the *real world.*

In practice, when engaging in virtual activities, physical objects become anchors that remind us we have a body and a place – that we exist in the real world. (Fig. 1)

1.2.2.THE VIRTUAL AND SHARING SPACE

When people meet virtually, they bring their place with them. These places intersect and create a shared virtual space. This volume of this virtual shared space is the same in every physical space, even though the physical spaces differ. (Fig. 2) Space Popular describes this phenomenon:

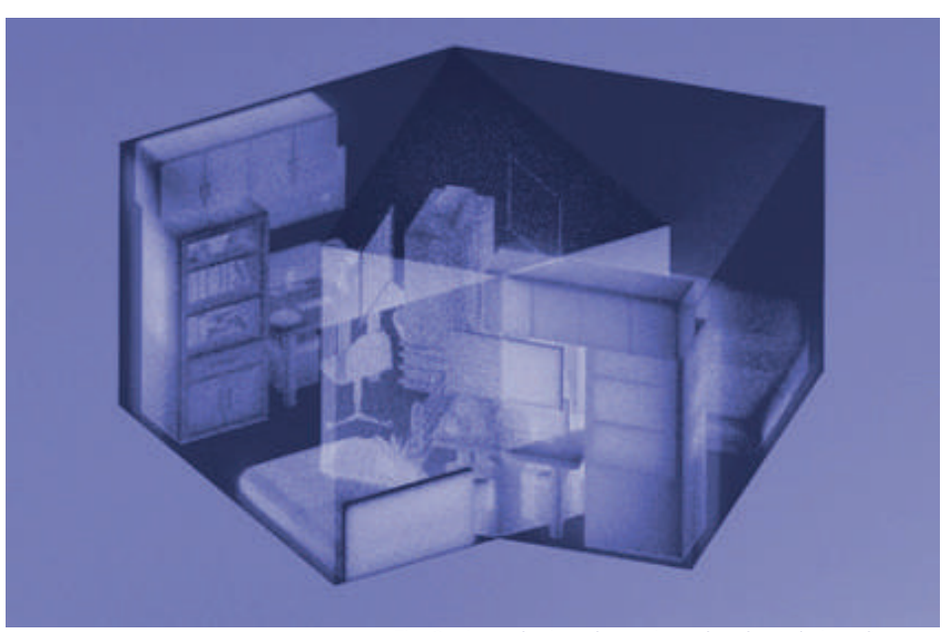

Fig. 3 – Introducing clutter into the shared virtual space. Werme Oscarsson, E. 2021.

The home will be to the experience of virtual space what the body is to the physical experience of architecture. Our bodies dictate which doors we can pass through, what size our beds –and therefore our bedrooms– need to be, or how high a tread can get. In the same way, the size and layout of our homes dictate where we can stand, sit, walk or reach in a virtual world.[2]

This idea is not only applicable software we use today. The physical environment is always present when video calling, not only on display for the receivers of the call, but emotionally for the inhabitant. What happens if we introduce furniture? Clutter? Other people living in the same space? (Fig. 3)

1.2.3. THE VIRTUAL AND PRIVACY

"As you bring your domestic blueprint into the virtual environments that you share with others, hybrids are formed, overlapping formal and functional categories in unprecedented ways and thus challenging our social codes and rituals", argues Space Studio.[4] Working from home challenges the home's performance in terms of privacy. To deal with this, there are both virtual and physical strategies to adopt. Software offers virtual background that attempts to blur everything but people. Physical spaces and the bodies inhabiting it are rearranged to only share chosen parts. Physical tools such as curtains and screens, can be used to hide what is desired to be hidden. (Fig. 4)

1.3. ARCHITECTURAL PERFORMANCE

1.3.1. INTENTION AND STRATEGIES

The explored notions were tested in an architectural performance with the aim to spatially assemble the project's components: virtual space, physical objects, and the user; the three extracted topics needed to constitute the performance. The incorporation of *The virtual and reality* required for an encounter between virtual space and something inherently real and physical. One option was to work with furniture, but this lacks the social component. The meal, however, is both inherently real and a reason to meet. The chosen activity became the virtual lunch.

The virtual and sharing space is most clearly understood when participants in different physical spaces meet in the same virtual space. The virtual interface was not to be investigated in its design, nor constitute an obstacle for the users, as the intention was to achieve undirected conversation. The online conferencing platform Zoom, used for video meetings in the participant's university, was sufficient for this purpose.

To investigate *The virtual and privacy*, the level of spatial direction needed to be determined beforehand. What kind of space should the participants be situated in? Should they be permitted to use privacy strategies? How should the video and audio equipment be set up? There were two evident paths to choose between. A carefully directed performance controls the environments and documentation, but risks losing the desired social spontaneity.

A less carefully directed performance engages the participants and allows unpredictable but contextually common phenomena to occur.

The latter was chosen, viewing the undirected conversation as a building block in the ensemble. To enable post-analysis, the participants were required to use a web-cam and to photograph their physical setup.

Fig. 4 – Virtual/physical strategies of privacy. Werme Oscarsson, E. 2021.

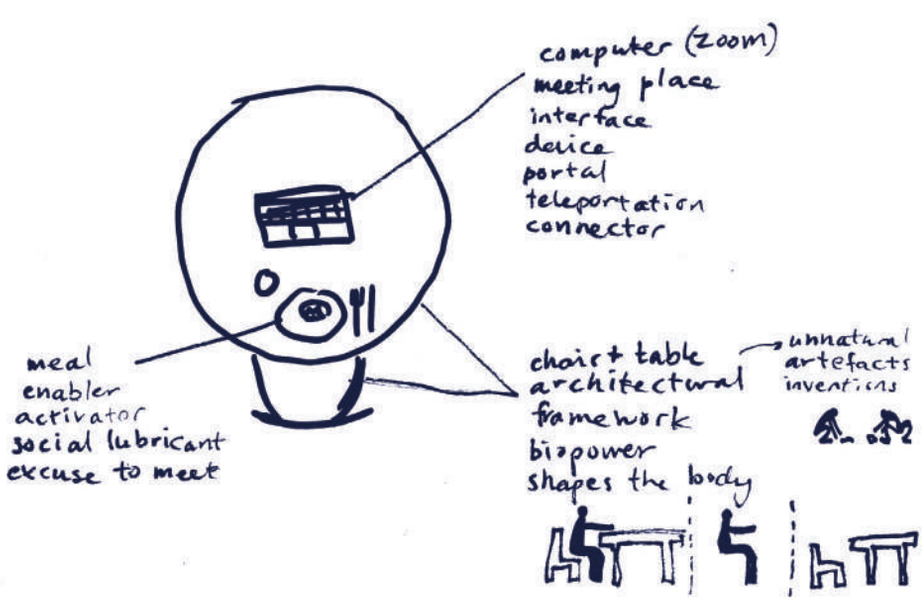

Fig. 5 – Investigating the roles of the objects. Werme Oscarsson, E. 2021.

Fig 6 – Spatial activation.
Werme Oscarsson, E. 2021.

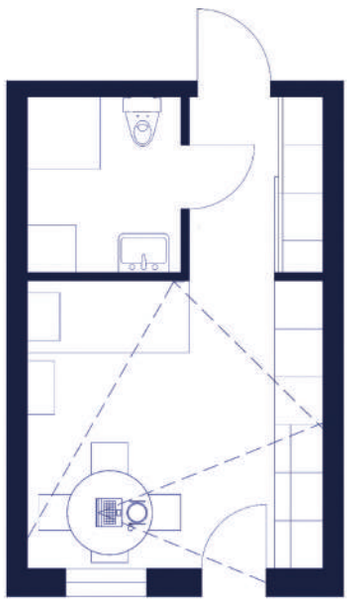

Fig. 7 – The plan visualises the camera setup.
Werme Oscarsson, E. 2021.

1.3.2. PREPARATIONS

The respective roles of the involved objects (Fig. 5), spatial activation (Fig. 7), and documentation (Fig. 6) were analysed before the performance. This established a general idea of the unfolding of the event to ensure the right preparatory measures. The participants were sent a spontaneity. A less carefully directed performance engages the participants and allows unpredictable but contextually common phenomena to occur. The latter was chosen, viewing the undirected conversation as a building block in the ensemble. To enable post-analysis, the participants were required to use a web-cam and to photograph their physical setup. digital invite listing the virtual location, date, time, required equipment (meal, chair, table, computer, and camera, and documentation instructions (photograph the setup in plan and elevation before the event). For documentation and reflection, the performance was to be recorded in two ways: with Zoom's own recording function and with an external camera in my apartment.

1.3.3. EXECUTION

Each participant documented their setup. The lunch lasted forlasted for 45 minutes and included eating, talking, and coffee drinking. Several unpredicted phenomena occurred. People who were not formally invited, but shared physical space with invited participants, joined the lunch. One participant was not in its home but in a university building. While the invitation had not stated anything on these topics, it was unforeseen. (Fig. 8)

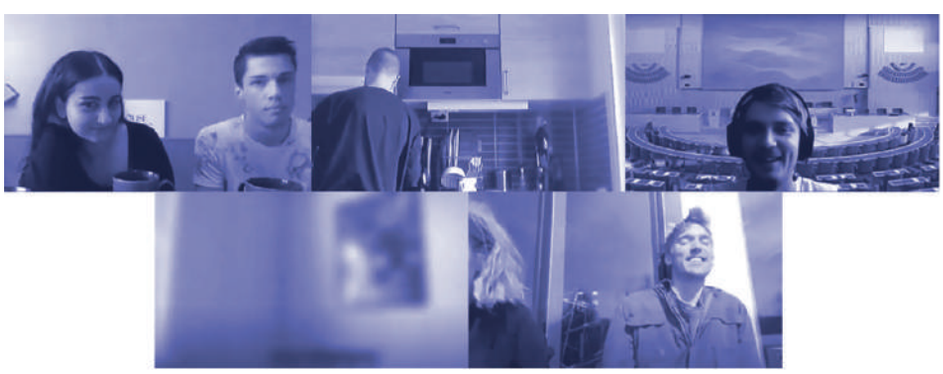

Fig. 8 – Screenshot from the recording of the virtual lunch. Werme Oscarsson, E. 2021.

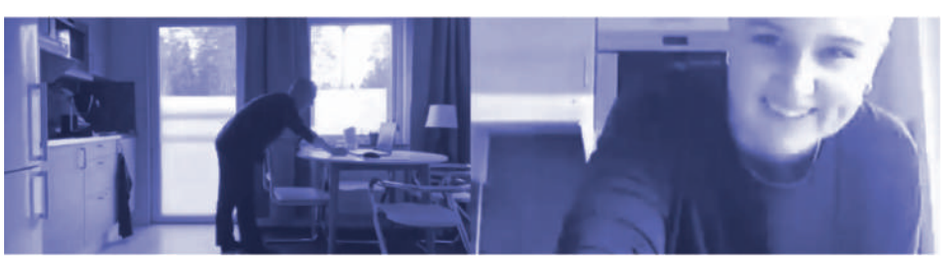

Fig. 9 – Interaction with the screen. Werme Oscarsson, E. 2021.

1.3.4. INTERPRETATION

The performance made visible the role of virtual meeting interfaces in relation to the user and his or her physical surroundings. They function as sources of input and output: transmitters of spatial, physical efforts. Mouths were used to speak on one side; ears were used to listen on another. Through the act of making a cup of coffee, the space and objects of a participant's home was activated. As a response, another participant repeated the process in their home. Chain reactions of events passed through the virtual transmitter.

(Fig. 9) Thus, a question posed in the background section is answered: are interactions with virtual content not real, or does it exclusively concern the virtual content? The performance exhibits a clear connection between virtuality, the body, and physical objects. Stating that activities concerning the virtual are not real becomes comparable to saying a conversation is not. *The Virtual Lunch Document* aims to simultaneously communicate the performance physically, phenomenologically, and multi-sequentially. (Fig. 10)

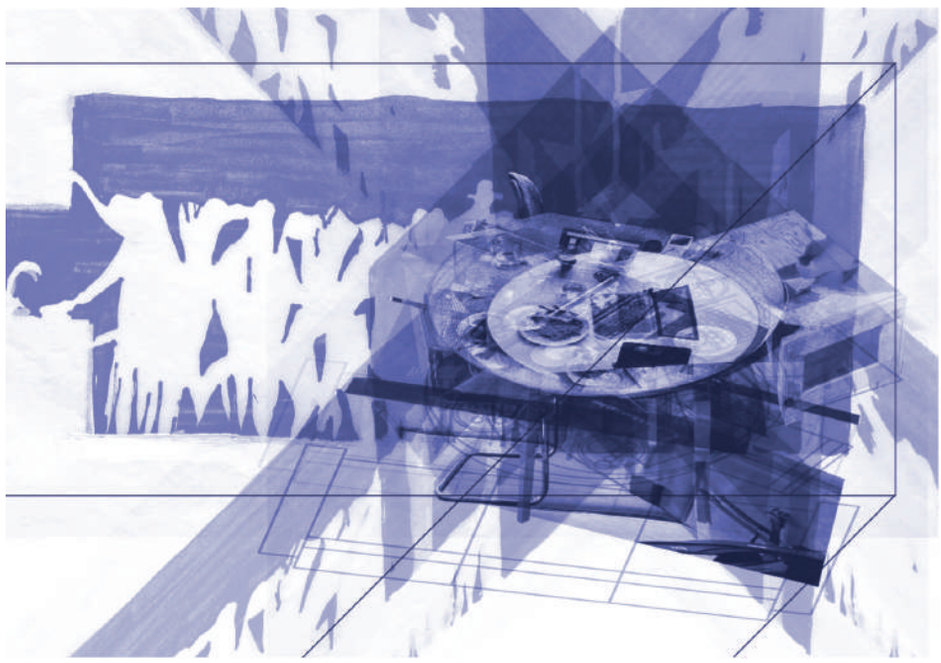

Fig. 10 – The Virtual Lunch Document. Werme Oscarsson, E. 2021.

2. DESIGN

2.1. INTENTION

Diagrams of the set ups in different hierarchical arrangements demonstrate that no representation of the experience is wrong. Physical spaces can contain multiple virtual spaces simultaneously – and virtual spaces can contain multiple physical spaces simultaneously. This ambiguity is a fundamental characteristic of the virtual experience. The lack of spatial transitions between virtual spaces, physical spaces, and states of mind creates a mental blur. (Fig. 11).

Applying Toyo Ito's reflection on architecture in the virtual city, the next step was to materialise the investigated notions into furniture.

2.2. RESULT

The outcome of this project aims to synthesise the intermediate results from the explorations. *The Blur Table* presents a distinction between different kinds of objects - the mundane and relatable tools and the alien object that is the new piece of furniture. The table becomes the interface between mundane objects and the user, rather a presence than an object. Thus, the design deals with the notion of *The virtual and reality.* (Fig. 12) Like Wigglesworth's table6, *The Blur Table* manifests

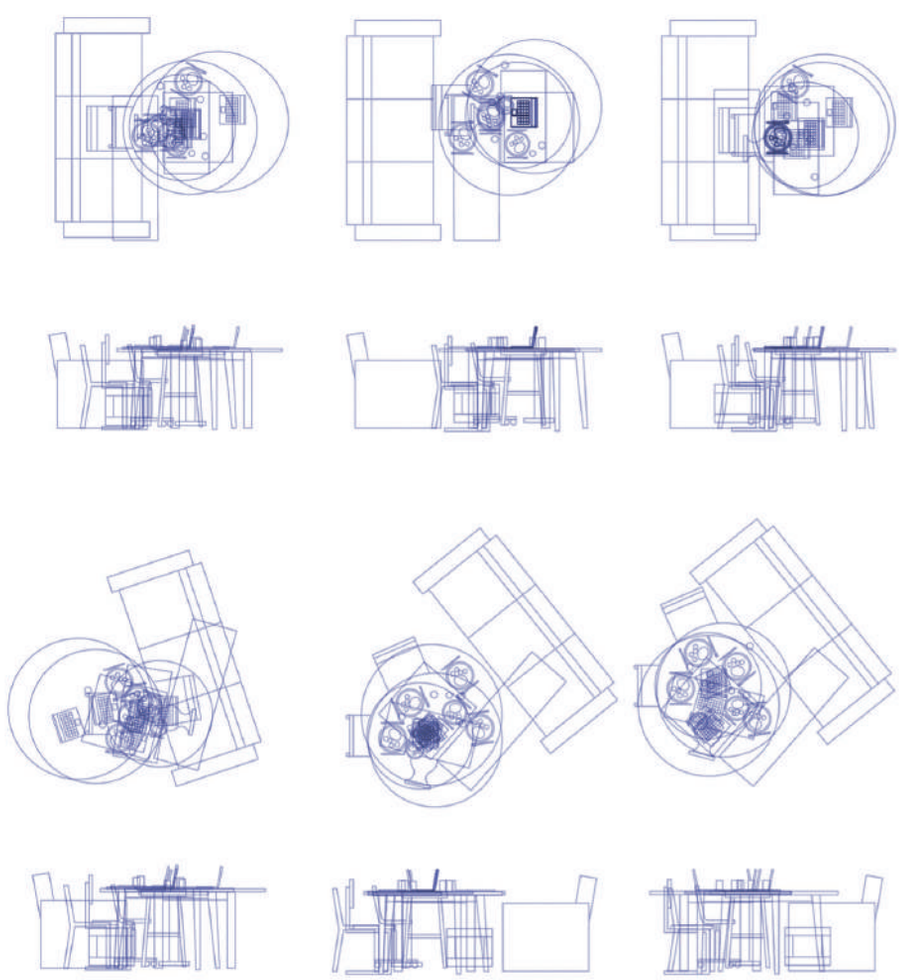

Fig. 11 –Diagrams investigating the phenomenological experience of the virtual event. Werme Oscarsson, E. 2021.

life's different sides – not through phases, but through varyingly visible but everlastingly present domestic objects. This distinction omits the temporal stages of Wigglesworth's table; everything that has happened, happens, and that which will happen is present simultaneously in *The Blur Table* through the embedded meanings of the physical objects. Using *The Blur Table* thus becomes a matter of *(The virtual and) sharing space* – not with others, but with oneself in different moments in time. There is also the question of *The virtual and privacy;* the objects inhabiting the table, as well as the home the table inhabits, will be intimately linked to the person they belong to. With *The Blur Table,* they are always on display. (Fig. 12) Like the architectural performance, The Blur Table manifests the virtual experience in space and time. The idea of the virtual meeting software as a transmitter can be applied to the table. In this case, however, the table acts as the interface. The user on the one side of the transmitter is the human, on the other side are the objects. The table is an enabling structure creating the conditions for interactions between the users. When one interaction leads to the next, a chain reaction of spatial, physical events passes through the physical transmitter. While the meal was the tool to reach the table, in the context of the performance, The Blur Table is the interface to reach the meal. (Fig. 12)

3. DISCUSSION

The aim of the project is not to improve the home nor its interior, but to find ways of understanding and working with the virtual architecturally. Thus, *The Blur Table* should not be regarded a practical furniture to be used in the home, but an artistic materialisation of the unravelled notions.

What is the relationship between virtual space, physical objects, and the user? Researched architecturally, the question must be answered in the same language: the visual material. Just as the early material was produced to constitute rather than to illustrate thought, the latter material is produced to constitute rather than to illustrate a result. Intermediate results can be derived from the research, such as the concept of the virtual meeting interface as a transmitter. Providing a finalized answer, however, would be to risk harming the infant that this research is. The network of ideas and relationships entangled in the visual material is not yet mature. Knowing what the project is and what it might become can only be properly understood when doing the next step, as has been the core methodology in this project.

However, there are other imaginable directions for this project. It was conducted from the point of view of a young Swedish student living in a studio apartment in Umeå during the Covid-19 pandemic. Focused on that experience, it excludes all other experiences of both the virtual and the pandemic and its consequences. Different domestic blueprints might give different results, as might alternative lifestyles. To deepen the architectural understanding of the virtual, other experiences should be investigated.

Another possible direction is to dive deeper into the different forms of virtual technology. This project focuses on virtual meetings and not on virtual reality and augmented reality. It is possible that these immersive technologies will become domesticated in the future, as are computers and smartphones today. Bringing the spatial dimension into the virtual, they are relevant concerns for architects to be involved with.

4. CONCLUSIONS

The engine driving this project is the entanglement of subjects that initially seemed unrelated. By investigating non-spatial entities with space-investigating tools, essential themes could be extracted. Joining the themes with the social act of the meal, new ideas could be derived. The virtual needed to be activated into the virtual experience, which was made possible by multiple conjunctions. When working architecturally with virtual communication conducted from the home, three themes are relevant: the connection with physical space and objects, the sharing of virtual and physical space, and privacy of the users. These themes should be thought of not only practically but also phenomenologically from the point of view of the user.

To conclude, *The Blur Table - An investigation of the virtual experience through the social act of the meal,* is partly a study of a way of working, partly a study of the subject it investigates. It presents an open ended, synthesising design whose primary purpose is not to propose improvement, but the materialisation of notions unravelled in the process.

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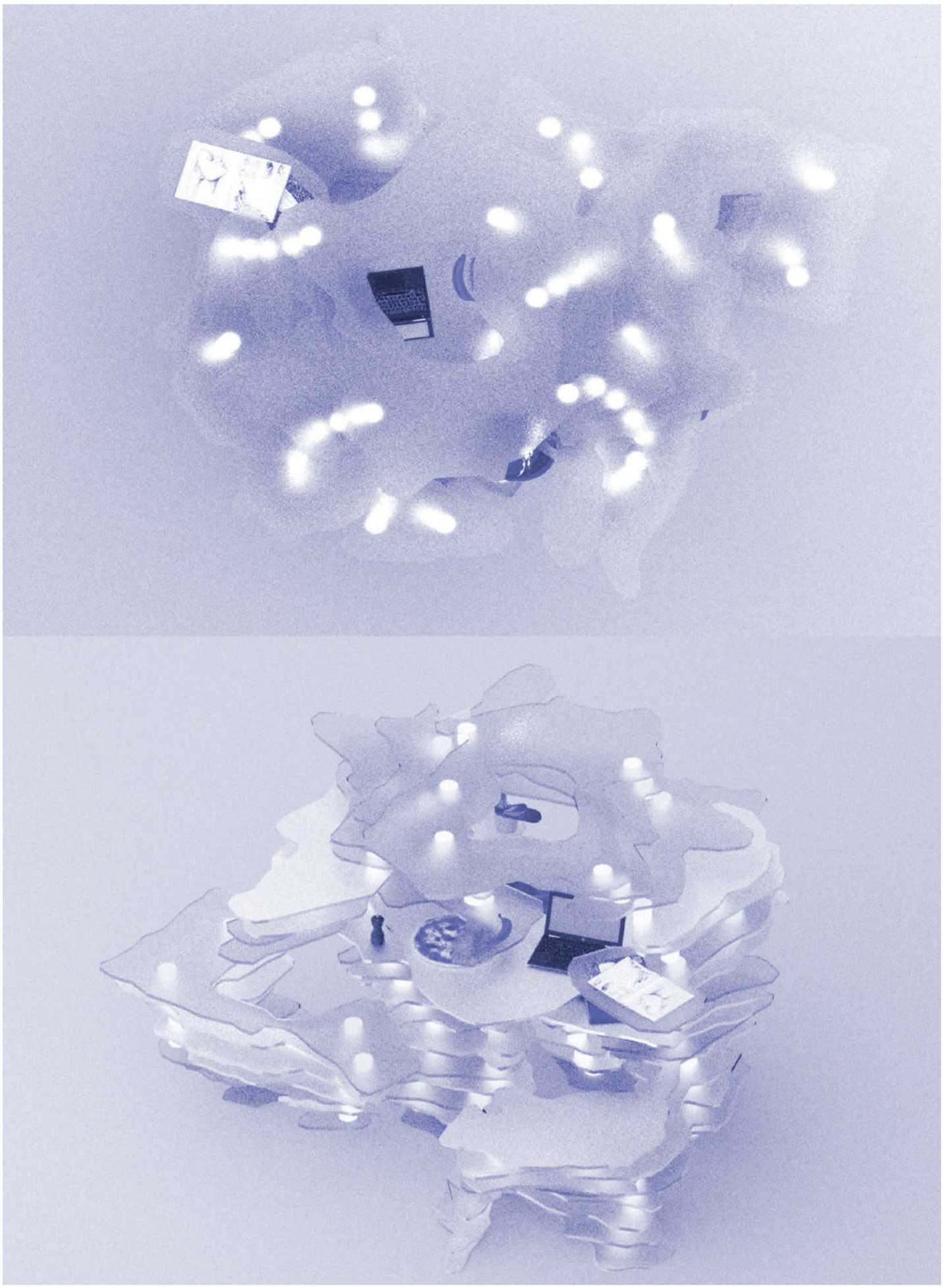

Fig. 12 – The Blur Table. Werme Oscarsson E. 2021.

MULTISENSORIAL EXPERIENCES & FOOD

The Form of Taste

On the Origins, Implications, and Applications of Shape -Taste Crossmodal Correspondences

shape
taste symmetry
orientation
balance
texture
neatness

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A growing body of experimental research now demonstrates that neurologically-normal individuals associate different taste qualities with design features such as curvature, symmetry, orientation, texture, and spatial location. In fact, the form of everything from the food itself through to the curvature of the plateware on which it happens to be served, and from glassware to typeface, not to mention the shapes of/on food product packaging have all been shown to influence people's taste expectations, and, on occasion, also their taste/food experiences. At the same time, however, curvature in small and larger-scale architectural forms (such as furniture, and the internal layout of the servicescape) is also associated with preference and approach motivation and may thus potentially be used to bias, or nudge, the food behaviour (and choices) of consumers. Although the origins of shape-taste and other form-taste crossmodal correspondences have yet to be fully elucidated, that has not prevented a growing number of designers (including typeface designers, plateware manufacturers/potters), marketers, advertisers, and chefs, from starting to incorporate the emerging insights concerning these various, and seemingly ubiquitous, affinities between form and taste as a source of inspiration for their creative practice.

While the colours we associate with tastes may well be based on the internalization of the statistics of the environment in the form of crossmodal correspondences (Motoki, Takahashi, & Spence, 2021; Spence, Wan, Woods, Velasco, Deng, Youssef, & Deroy, 2015), it is much harder to forward such a statistical account of the close connection that has also been shown to exist between shape, or other form features, and basic tastes (Spence & Deroy, 2012, 2013b). This is especially obvious in the case of the shape properties that people tend to associate with drinks such as beer and carbonated/still water, given that the latter typically do not have a specific form.

There have long been hints that a subset of synaesthetes experience shape concurrents in response to taste/flavour inducers, such as the synaesthete reported some years ago by Cytowic (1993) who was once overheard saying that the roast chicken that he was preparing was burnt because it had 'too many points' (see Day, 2011, p. 12, pp. 16-17). The synaesthete in this case, a man by the name of Michael Watson noted that "Sugar made things taste 'rounder' while citrus added 'points'." (quoted in Cytowic, 1993, p. 66). At the same time, chefs such as Paul Bertolli of the Oliveto restaurant in Oakland, California have occasionally described how they construct menus based on the shape properties they metaphorically associated with tastes and flavours of the dishes, drinks, and/or ingredients. Intriguing research (though totally underpowered by today's more rigorous scientific standards) reported by Cytowic and Wood (1982) suggested that a gustatory-shape synaesthete tended to associate acidity with angularity.[1] The use of shape/form language is also common in the world of expert wine writing (e.g., terms such as linear, rounded, balanced, etc.; Peynaud, 1987).[2] Similarly, it is interesting to see how researchers attempting to describe the sensation associated with the addition of kokumi, the so-called 6th taste, suggests that it adds 'roundness' (see Devenyns, 2019). By contrast, certain cheeses are commonly described as having a 'sharp' taste. Nevertheless, an emerging body of crossmodal correspondences research demonstrates that the majority of neurologically normal people do indeed tend to associate specific shape properties, such as curvilinearity and symmetry, with particular taste qualities, at least amongst the four or five most commonly-mentioned basic tastes (e.g., sweet, sour, bitter, salty, and possibly also umami).

Intriguingly, shape properties have been shown to influence our (food) behaviours at multiple scales. The shape of food itself, as well as the shape of the plateware on which it happens to be presented bias both people's taste expectations and on occasion their taste experiences as well. Meanwhile, the shape of the furniture/table, and even the shape of dining environment (or servicescape) may influence a viewer's approach/avoidance tendencies/behaviours (Vartanian, Navarrete, Chatterjee, Fich, Leder, Modroño, Nadal, Rostrup, & Skov, 2013). And, given that people generally prefer curvature over angularity, incorporating more of the former into one's designs may well elicit more approach motivation too. Intriguingly, the preference for curvature is not uniquely human, but has also been documented in great apes. In fact, according to Ingrid Lee (2018), author of Joyful: The surprising power of ordinary things to create extraordinary happiness, the reason why round forms are appealing is because of their link to the shapes found in nature.

Going one stage further, one might even consider the space of the building itself, especially when one considers such striking designs as the iconic building in which the Vespertine restaurant is housed in Los Angeles, California. Certainly, the evidence that has been published to date already suggests that larger-scale interior architectural features (such as shape and colour) may be associated with taste qualities, and thus bias taste experiences (Chen, Huang, Faber, Makransky, & Perez-Cueto, 2020; Motoki et al., 2022; Spence, 2020a; Spence, Velasco, & Knoeferle, 2014; Velasco, Jones, King, & Spence, 2013).[3] Note, though, that such perceptual effects stand apart from, though may be linked to, any effect that they may have on approach/avoidance motivation/behaviour.

Anecdotally, it has been suggested that even small-scale form features may bias the likelihood that people will try a given food. For instance, leading UK 'nose-to-tail' chef, Fergus Henderson, has been quoted as saying that: "Disgust is always rooted in a perception of asymmetry," he says suddenly. "Geometry cures it. Take the haggis, for instance. It's made of sheep's stomach and sheep's lights, but people will eat it because it's comfortably round. Sausages have always been allowed in because of their shape. People are somehow reassured." (Gopnik, 2012, pp. 138-139). While a clear and full understanding of the origin(s) of such form-taste correspondences is yet to be forthcoming, that certainly hasn't stopped a growing number of innovative designers from starting to incorporate such knowledge concerning the crossmodal correspondences as sources of inspiration in their creative practice, including in the world of food and drink experience design. In this narrative historical review, I summarize the literature on form-taste correspondences, and highlight a number of the recent attempts to apply the insights in the fields of design and experiential marketing.

While there has long been an interest in the interface between architecture and artistic culinary practice (Horwitz & Singley, 2004), the emerging awareness of the crossmodal correspondences that connect form features with taste qualities and the oral-somatosensory attributes of food (such as creaminess and spiciness), is currently inspiring a number of creative individuals toward a new approach to design, one that operates across a wide range of spatial scales and media. Illustrative examples of a number of the ways in which form-taste correspondences have recently been incorporated into various aspects of design practice, from the design of functional plateware (i.e., plateware that enhances the desirable attributes of taste) through to immersive virtual reality advertising and sensory marketing are discussed.

1. VISUAL FORM CORRESPONDENCES WITH BASIC TASTE QUALITIES

Although many form features can be assessed by touch/haptics as well as by eye, the majority of the empirical research that has been published to date has tended to assess such crossmodal correspondences visually. And perhaps the single most extensively studied visual design feature is curvilinearity.

1.1. Curvilinearity

An extensive body of research conducted over the last decade or so has unequivocally demonstrated that people intuitively match roundness with sweetness, while picking angular forms to represent the other four basic tastes (Spence & Deroy, 2012, 2013b). Roundness is also associated with, and tends to accentuate, creaminess. Meanwhile, it turns out that sourness and spiciness are both strongly associated with angularity (Gil-Pérez, Rebollar, Lidón, Martín, van Trijp, & Piqueras-Fiszman, 2019).

Researchers have demonstrated that participants from both India and China also tend to match sweetness with roundness (Liang, Biswas, Vinnakota, Fu, Chen, Quan, Zhan, Zhang, & Roy, 2016). At the same time, however, Bremner Caparos, Davidoff, de Fockert, Linnell, and Spence (2013) documented a strikingly different pattern of taste shape correspondences in the case of still/sparkling water and chocolate varying in terms of its bitterness. While Western consumers have been documented to match carbonation, and increasing bitterness (e.g., in chocolate samples) with increased angularity, the Himba tribe of Kaokoland in Northern Namibia exhibited a very different pattern of results. The 34 unschooled semi-nomadic herders with little exposure to Western culture or artifacts did not exhibit a significant association between angularity and carbonation, while showing the reverse mapping when asked to pick the rounded versus angular shape in response to chocolate samples varying in cacao content (30%, 70%, 90%). As yet, there is no convincing explanation for this cultural difference in shape-taste crossmodal correspondences, though it would be helpful to see this isolated empirical finding replicated.

1.2. Symmetry

There are several kinds of symmetry, including rotational, reflectional, and translational. Nevertheless, in a series of online studies that was conducted by Turoman and colleagues, and published in 2018, asymmetry was shown to be associated with acidity/sourness and bitterness in groups of participants from Taiwan and the West (UK, US, and Canada). At the same time, however, the latest research also provides some evidence to suggest that symmetry (or regularity of form) may also be associated with sweetness (Juravle, Olari, & Spence, 2022).

1.3. Texture

Researchers have recently established that people preferentially match specific tastes with particular visually-perceived textures as well. Such crossmodal correspondences go beyond specific food forms that are semantically linked to specific taste qualities, such as the textural appearance of candyfloss being associated with sweetness. Back in the 1930s, the Italian Futurists had already intuited the existence of a certain relationship between felt textures and tastes, a phenomenon they christened 'Syn-tactilismo'. It is, though, important to stress that the ubiquitous nature of such intuitive crossmodal associations, as documented by contemporary research, has tended to move people's thinking away from searching for an explanation for such phenomena in terms of synaesthesia (given that the latter is rare, and defined in terms of idiosyncratic connections between inducer and concurrent) and rather towards an explanation in terms of the increasingly popular crossmodal correspondences instead (Spence, 2011).[4] Intriguingly, there is mounting evidence that textural cues, seen and/or felt, can accentuate certain taste, oral-somatosensory attributes of food (Velasco et al., 2013).

1.4. Tasting typeface

Different typeface designs vary in a number of visual features including curvilinearity and weight etc. (Velasco & Spence, 2019). Early research on taste-typeface by Velasco, Woods, Hyndman, and Spence (2015) demonstrated that people associate sweetness with a more rounded typeface while associating a more angular

typeface the other basic tastes (at least in the Western participants whom they tested). Velasco et al. (2018) subsequently went on to show that the same typeface curvature-to-taste correspondence applies in groups of participants from Colombia and China (i.e., in different languages involving, in the latter case, a different script). Other researchers, meanwhile have investigated the taste qualities associated with curvilinearity of typeface in the context of a range of food product packaging (Velasco, Salgado-Montejo, Marmolejo-Ramos, & Spence, 2014) and the design of a chalkboard menu for beer (Otterbring, Rolschau, Furrebøe, & Nyhus, 2022).

1.5. From 2D to 3D forms

Cytowic and Woods (1982) introduced a range of 23 abstract shapes (one 2D line and the rest abstract 3D shapes) to their earlier study. However, the very small sample size – one gustatory-shape synaesthete, one chef/restaurateur, and two other control participants – did not allow for any concrete conclusions, as acknowledged by the authors themselves. In 2011, Deroy and Valentin had a larger group of participants (N = 46) match three beers to a set of 34 shapes, half of which were 2D and the remainder 3D. However, in the latter case, it appeared to be curvilinearity rather than the distinction between 2D vs. 3D that was driving the participants' associations, though there was some hint in the data concerning sweetness and voluminousness.

More recently, Juravle et al. (2022) evaluated the taste associations that participants had with the so-called platonic solids together with several other 3D shapes (see Fig. 1). Intriguingly, it turned out that the sphere was strongly associated with sweetness and to a lesser extent with umami. By contrast bitter and sour were associated with the more angular forms. Surprisingly, none of the shapes were significantly associated with the salty taste.[5]

1.6. Orientation, position, and movement

A spatial element to taste has been reported recently, with sweet tastes being associated with higher locations. There may be a link here to the higher pitch that tends to be associated with sweetness. One might also speculate on the question of whether sweet-tasting foods are more likely to be found above the ground, whereas bitter-tasting foods are perhaps a little more likely to be found on/under the ground instead. Were such a speculation to be confirmed empirically, it might then provide a statistical account for such elevation-basic taste correspondences.

There is growing research on the importance of orientation to the aesthetic appreciation of food. Ascending to the right is seemingly often preferred over ascending to the left. The cardinal orientations are often preferred over oblique orientations for linear elements.

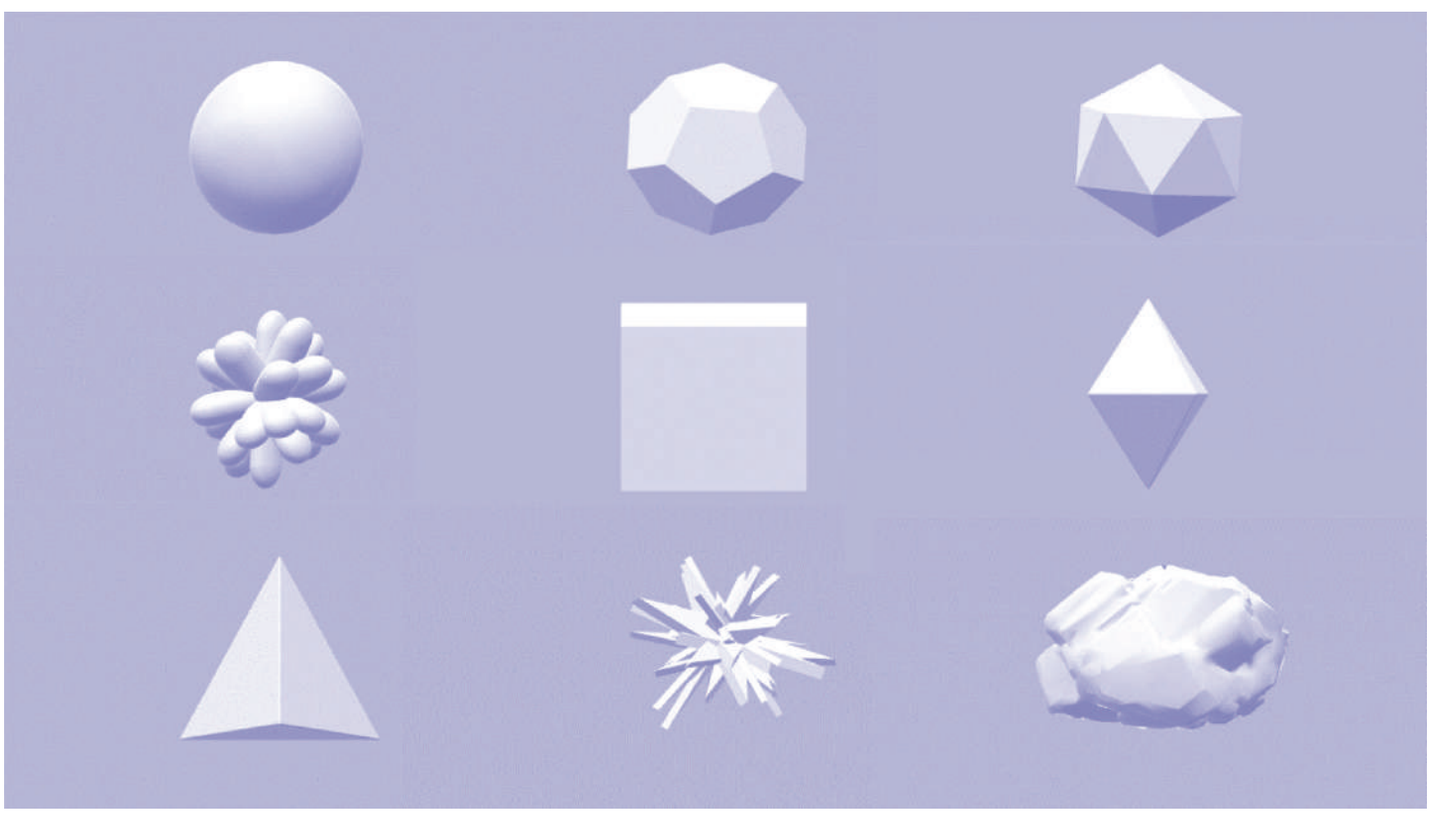

Fig. 1 -. The nine shapes (including the five Platonic solids) that were associated with taste properties in Juravle et al.'s (2022) recent online research. Note that the participants saw each of the shapes rotating continuously in the actual study.

The ascending to right preference in the arrangement of linear food elements appears to hold regardless of language (and hence reading direction) and culture.[6] Meanwhile, when it comes to angular shapes, such as the triangle, then it turns out that food arranged in an inverted triangle is liked just that little bit less than the same food when oriented away from the viewer/diner (Michel, Woods, Neuhäuser, Landgraf, & Spence, 2015).

Different foods and, by extension, different dominant basic tastes have also been associated with speed (Woods, Spence, Butcher, & Deroy, 2013). So, for example, the majority of people will rate lemons as 'fast' rather than 'slow', whereas prunes and bananas are commonly rated as slow. Such speed-taste correspondences may link to the speed at which different taste sensations are experienced phenomenologically, with acids being much more soluble in saliva, and hence being perceived more rapidly than the other basic tastes.[7]

1.7. Balance, neatness, and harmony

Several studies have revealed that, as might have been expected, balance, neatness, and harmony are all relevant features as far as the aesthetic appreciation of food design are concerned (Velasco, Michel, Woods, & Spence, 2016). They can perhaps be considered as collative stimulus properties. However, aesthetically plated food is rated as more attractive than effortfully arranged plating that is not as especially aesthetically pleasing. At the same time, the ratio of the various elements on the plate has also been reported to play a role, with one industry-sponsored piece of 'research' suggesting that arranging one's curry with rice in accordance with the golden ratio helps to make it look more attractive (Deroy & Spence, 2014). Ultimately, however, it appears as though consumers are normally drawn to energy density, and hence the spatial layout of food that gives rise to the impression of the greatest amount of food is likely to be appreciated most (Woods, Michel, & Spence, 2016). Relevant here, the preference for round plates for serving food might also be explained by the psychophysical bias toward estimating circular food presentations as containing more food than rectangular presentations.

2. EXPLAINING SHAPE-TASTE CORRESPONDENCES

The spatial aspects of taste sensation, has long been linked to the discredited tongue map. Certainly, different oral sensations have a different spatial localization/volume. For instance, consider only how the 6th taste 'kokumi' is often described as giving rise to a sensation of mouth-fillingness (Devenyns, 2019).

2.1. The shape of taste experiences

To date, very few studies have taken seriously the hypothesis that a richer spatial dimension is present in flavour experiences, as in most other perceptual experiences. That said, this hypothesis appears in the writing of William James, who considered that "in the sensations of smell and taste, (the) element of varying vastness seems less prominent but not altogether absent. Some tastes and smells appear less extensive than complex flavors, like that of roast meat or plum pudding, on the one hand, or heavy odors, like musk or tuberose, on the other." (James 1887, p. 2). James also presented this perceptible spatial dimension as an explanation for the kind of correspondences that have been documented between taste and shape/form: "The epithet sharp given to the acid class", he wrote, "would seem to show that to the popular mind, there is something narrow, and as it were, streaky in the impression they make, other flavors and odors being bigger and rounder" (James, 1887, p. 2)."

Meanwhile, the famous French oenologist Emile Peynaud (1987, p. 220) wrote that: "However lacking in imagination he might be, when a taster works the wine in his mouth and feels it with his tongue, he absorbs not only impressions of taste, but also impressions of volume, form and consistency. He forms a physical image of the wine. This is part of a curious 'optical effect' of a taste, a phenomenon which it would not be inappropriate to call stéréogustation." Once again, the crossmodal matching would appear to be based on automatically-generated visual mental image of the form of the wine (Spence & Deroy, 2013a). A few pages later, Peynaud writes that "Anyone who has tasted a Jurançon, the sweet wine from the Pyrenees foothills, will understand Orizet when he writes: "It is the contradictory nature of Jurançon to be rounded at one end, and pointed at the other."" (Peynaud, 1987, p. 272).

2.2. Emotional/hedonic mediation

Emotional, or hedonic, mediation has been suggested as a possible explanation of the crossmodal correspondence between taste and shape by a number of authors (e.g., Velasco, Woods, Deroy, & Spence, 2015). The basic idea being that liked tastes (such as sweetness) would be paired with preferred shapes (such as roundness), whereas generally disliked (or dangerous) tastes such as bitterness and spiciness would be associated with threatening shapes (e.g., those that are angular). According to the results of a series of studies conducted by Velasco, Woods,

Marks, Cheok, and Spence in 2016, a semantic differential space with the principal components (or dimensions) of hedonics and intensity accounts for people's responses to taste.

Should emotional/hedonic mediation provide part of the explanation for why certain tastes are matched with particular shapes, then there may be interesting research to be done by varying sweetness intensity, given that populations tend to split into sweet-likers, sweet-neutral, and sweet-dislikers, as a function of increasing sweetness (e.g., Velasco, Woods, Liu, & Spence, 2016). At the same time, however, it should also be noted that individual differences in the preference for curvature in objects have been reported, possibly mediated by shape familiarity, expertise, self-construal, and an individual's loneliness (Chen, Jiao, Fan, & Li, 2021).

2.3. Spatiotemporal analogy

One might also wonder whether there might be some spatio-temporal analogizing at play in the matching of taste experiences with the temporal experience of tasting, such that taste sensations that evolve slowly on the palate, such as sucrose may be matched with curvature (i.e., gradual spatial transitions) whereas sour tastes, which tend to appear and disappear from perceptual experience.[8] The rate of alcohol evaporation, and hence mouth cooling is often reported as being important for wine-tasting when trying to judge the alcohol content hence hinting at rate of change of sensations also possibly being important. One might consider such structural isomorphism, should it be demonstrated to occur, as a form of metaphorical crossmodal mapping. Once again, something similar has now been demonstrated in chimpanzees in the audiovisual domain.

2.4. Semantic associations between shape and taste

Certain shapes may take on more of a semantic meaning, as when a curved horizontal line is seen as a smile or frown (Spence, 2021). Anthropomorphism can also influence the meaning associated with shape stimuli, potentially imbuing them with emotional meaning and thereafter taste. There may be important cultural factors at play here, considering, for example, the close affinity that many Italians feel between particular pasta shapes being paired with specific sauces.

2.5. Imprinting

One might also consider whether there may be some form of imprinting of taste-shape correspondences based on early experiences.[9] For newborn humans, consider only how the earliest conscious taste experiences are presumably based on the sweet-umami taste of breast milk associated with distinctive rounded red-purple aureole. By only a few months of age, the evidence shows that babies are already picking up on the statistics of the environment in terms of the colours and shapes of objects associated with taste.

2.6. Interim summary

While several speculative accounts have been put forward to explain why it is that people consensually match various form features with taste qualities, none has yet been generally accepted, and indeed several of the explanations may help to explain some of the data. One point to bear in mind here, though, is that just because people consensually match shape/form properties with basic tastes when tasked to do so, that does not mean that such crossmodal correspondences would necessarily be dominant (or top-of-mind) under those conditions (or in those contexts) where other visual stimulus parameters (such as colour or material properties) might also be varying (see Motoki, Saito, & Velasco, in press; Motoki & Velasco, 2021). Colour is often more salient than form/shape features. It has recently been reported that people with high autistic traits show fewer consensual crossmodal correspondences between visual features and tastes. As yet, the implications of such findings for an understanding of the causes of crossmodal correspondences between shape/form, colour, and taste are unclear.

3. SENSORY NUDGING WITH FORM-TASTE CORRESPONDENCES

The evidence goes beyond merely showing that people share consensual mappings between shape and taste. These natural affinities may even bias our food behaviours, and hence may provide a subtle means of nudging our food behaviours moving forward. This is both in terms of the intelligent means of nudging people's taste expectations, and possibly also their experience through shape. It may also bias, or nudge, people's approach/avoidance behaviours. Across a wide range of spatial scales preference for approach motivation toward round forms has been documented. However, some of the research that has started to investigate whether it is possible to nudge people's choice behaviour in relation to food through manipulating typeface curvilinearity has thrown up some surprising results.

3.1. On the shape of sweetness/creaminess

The shape of creaminess: Consumers expect and perceive rounded chocolates to be creamier than squared chocolates. Psychophysical research confirms

earlier observations from the marketplace concerning the impact of rounding the shape of foods (chocolate) on creaminess/sweetness perception. The alternative explanation in terms of melting differences should perhaps also be mentioned, though this suggestion has attracted little empirical support.

There is evidence that staring at angular shapes can bring out the sharpness of cheddar cheese. Liang, Roy, Chen, and Zhang published research in 2013 demonstrating that participants showed a small, but significant reduction in their threshold for tasting sweetness after being presented with subthreshold visual images that were either rounded or angular. That being said, it is worth noting that people may associated different degrees of curvilinearity with the aroma, taste, and mouthfeel/texture of complex foods such as cheeses (Spence et al., 2013). At the same time it is also worth bearing in mind that certain iconic confectionary shapes may come to take on a semantic/branded association – be it iconic triangular shape of Toblerone, though to the seashell shape of (Guylian).

3.2. Food design

The chef Jozef Youssef has worked these insights into another of the dishes served at his *Synaesthesia* dining concept. Just take a look at Fig. 2, and ask yourself which half-plate you would call 'bouba', and which 'kiki'? The answer to this question should be obvious. The food on the left of the plate is the

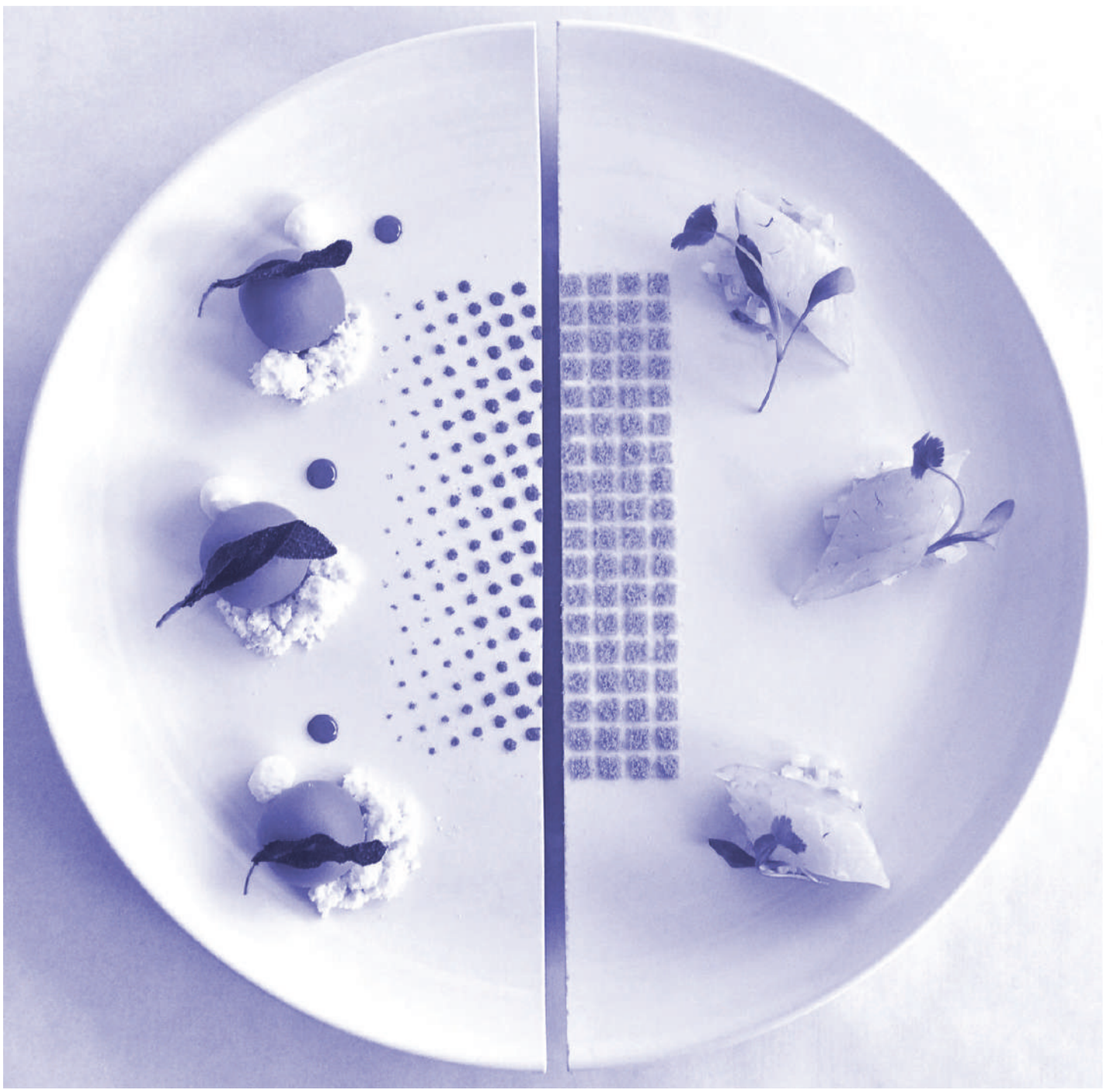

Fig. 2 - The Bouba-Kiki dish created by chef Jozef Youssef of Kitchen Theory as part of his Synaesthesia dining concept.

bouba, whereas the other food is the kiki. Certainly, that is the way that the majority of the diners in the restaurant responded when the dish was placed before them in the restaurant. The chef had deliberately chosen to incorporate tastes, flavours, and textures to match each side of the plate. Angular fish with sharp crunchy rhubarb on the right, and bouba-esque potato dumplings on the left.

With the rise in 3-D food printers, there is growing interest in conveying taste/flavour properties through the use of complex form features. Across a series of three experiments, Li, Liang, Zhou, and Kang demonstrated that people's preference for symmetry in foods may be linked to/mediated by perceptions of naturalness in a study published in 2022.

3.3. Glassware shape

Curvature in beer and wine glasses brings out fruitiness. In such cases, it is natural to consider the shape features of the glassware as affecting physico-chemical properties of volatiles in the headspace over the glass. However, it would seem more likely that it is the psychological crossmodal correspondence between taste and shape that is really doing the work, especially given research showing that simply varying the outer texture of the drinking vessel can elicit such effects. There would also appear to be a correspondence between the shape of a coffee cup and the expected taste of the contents. At the same time, however, glass shape has also been shown to influence drinking behaviour, though the mechanism is likely to be somewhat different.

3.4. Plate shape

Jialin Deng created a set of conceptual plates designed to match each of the five basic tastes (Spence, 2020a; Spence et al., 2015) (see Fig. 3). Meanwhile Reiko Kaneko the potter from the Midlands created the first set of perception-enhancing sculptural plateware for Neff kitchens and launched as part of the Eurocucina trade show in Milan in 2018 (Hauer-Bain, 2018) (see Fig. 4). Several research groups have now demonstrated the influence of plate shape on people's expectations of the food that is served from them. Chen et al. (2018) assessed the impact of rounded plateware with rounded protrusions that were more or less pronounced. Given the other findings just mentioned, this factor was combined with plate colour (white vs. black). That said, not everyone is necessarily equally enamoured with the recent explosion in unusually-shape plateware. The MasterChef judge, William Sitwell, for one, has argued that square dining plates are an 'abomination'.

There may though be an important question here about foreground-background interactions. In one of the first studies to investigate the impact of plate colour and shape scientifically, Piqueras-Fiszman and her colleagues served a pyramid shaped mousse off of one of three plates that varied from round to more angular (see Fig. 5). However, contrary to the findings of the majority of the subsequent research that has been published, the shape of the plate exerted no influence over participants' taste ratings. In hindsight, one possible explanation for this early null result may have been that the striking foreground shape properties of the food may have overridden any impact of the shape of plateware that may have faded into the background. Relevant here, separate research has shown that people have been shown to respond differently to the inferred taste of colour pairs depending on whether they are presented side-by-side, or one in front of another (Woods, Marmolejo-Ramos, Velasco, & Spence, 2016; Woods & Spence, 2016).[10]

Researchers have recently started to investigate the impact of shapes presented on the plate itself; Others, meanwhile, have used digital technology to project an angular asymmetric green shape over foods and so potentially enhance the sourness.

3.5. On the shapes on/of food product packaging

There are correlations between shape and taste (Velasco, Woods, Petit, Cheok, & Spence, 2016). In an early design study, Overbeeke and Peters (1991) demonstrated how the form of unbranded dessert packages were consensually associated with particular kinds of desserts. In the case of form/shape rounded labels, and rounded packaging forms are both more approachable and linked with sweetness. Many years ago, Cheskin anecdotally reported how rounding the angular corners of the Fleischman's gin bottle label helped because it would make the product more approachable to women. By contrast, in the context of packaging, angular forms may help to capture the customers' attention which may be advantageous. Other researchers have recently assessed the impact of transparent windows in product packaging.

Downward-pointing angular shapes, such as an inverted triangle automatically capture people's attention because of a link with the brain's fear circuits. This can either be a good or bad thing in the context of food product packaging. On the one hand, the use of inverted triangle may be beneficial to capturing consumer attention in the wine aisle, given the wide and ever-changing range of bottles that are displayed. By contrast, displaying angular slices of cake/pizza,

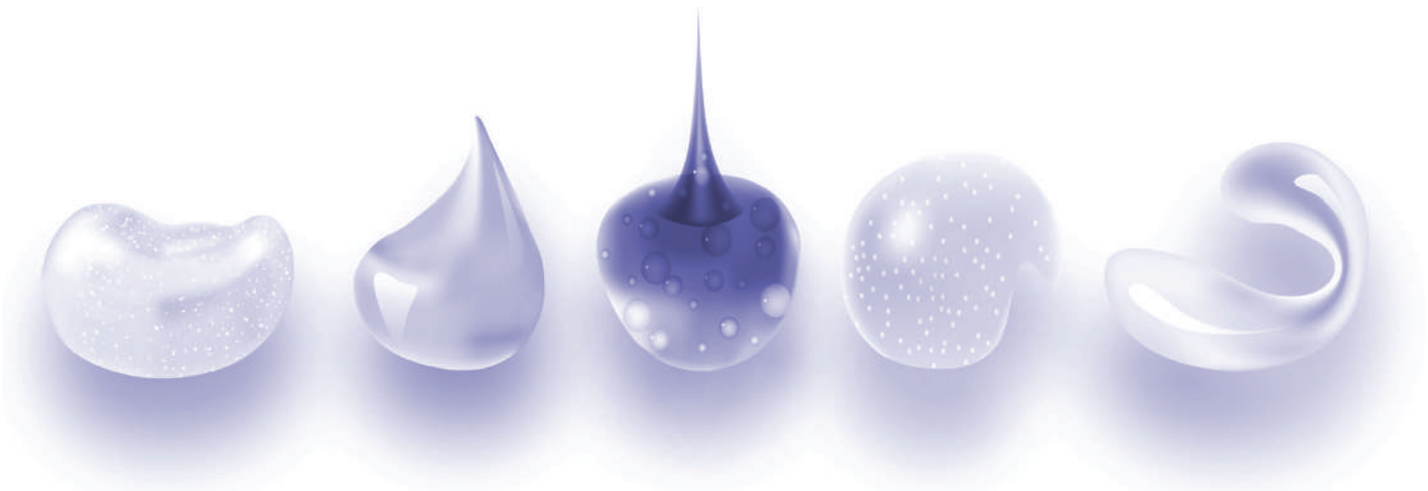

Fig. 3 - Jailin Deng's plates conceptual plates designed to match each of the basic tastes

Fig. 4 - Reiko Kaneko's plates for seafood, Thai green curry, and a sweet deserrt bowl. These designs were based on the emerging literatue on the crossmodal correspondences between shape, colour, texture, and taste.

Fig. 5 - The angularly-shaped strawberry dessert served to participants from one of three differently-shaped plates in a study by Piqueras-Fiszman et al. that was published in 2012. The shape of the food in the foreground may have minimized any impact of the variation in plate shape in this study, perhaps explaining the null results reported.

pointing down, or rather oriented toward a customer are liked that little but less and between shape/symmetry and healthfulness. Of course, playing with the shape of a product and/or its packaging can act as a design innovation strategy.

3.6. Typeface design to bias taste perception and food choice

Researchers have demonstrated that people will rate a sweet-sour food, such as a jelly bean as tasting slightly sourer if presented in a bowl with curvy typeface saying 'Eat me', as compared to eating jelly bean from a bowl with angular typeface instead (Velasco, Hyndman, & Spence, 2018). In 2020, Rolschau and colleagues conducted an intriguing study where they manipulated the angular vs. curvy typeface on a chalked beer menu. They were able to show that the curvature influenced expectations, though biased choice and taste perception in a slightly unexpected way (seeing sweet but choosing sour, as the title of their paper put it). In a subsequent study, they went on to show typeface angularity effects on older, but not younger, consumers (Otterbring et al., 2022). Again, why this should be is currently unclear, but suggests that further research is needed.

3.7. Furniture forms and interior layout

Approach behaviour toward round (as compared to angular) forms, be that furniture forms, through rounded tables and interior floorplans (Vartanian et al., 2013). Circular vs. angular servicescape has been shown to influence the customer's response to a fast service encounter. It has also been reported that approach/avoidance can be predicted from curvature features present in images (Thömmes & Hübner, 2018).

3.8. Multisensory environmental design

Combining round environmental shapes with sweet colours of pink/red/purple. Velasco, et al. (2013) were able to demonstrate that people's ratings of a whisky were significantly higher in terms of perceived sweetness than when compared to other multisensory environments that were designed to bring out grassiness, or textured finish of the aftertaste. Meanwhile, Chen et al. (2020) conducted a VR tasting study and were able to demonstrate that shape features of the environment influenced taste (see Fig. 6).

3.9. Advertising/ marketing

It is intriguing that various multisensory (audiovisual) virtual reality (VR) installations have now been created on the basis of correspondences. Take, for example, the pop song and music video developed by The Roots in collaboration with Stella Artois beer (e.g., https://www.anheuser-busch.com/newsroom/2016/08/stella-artois-and-the-roots-stimulate-the-senses-with-a-one-of-a-kind-song-you-can-taste/).

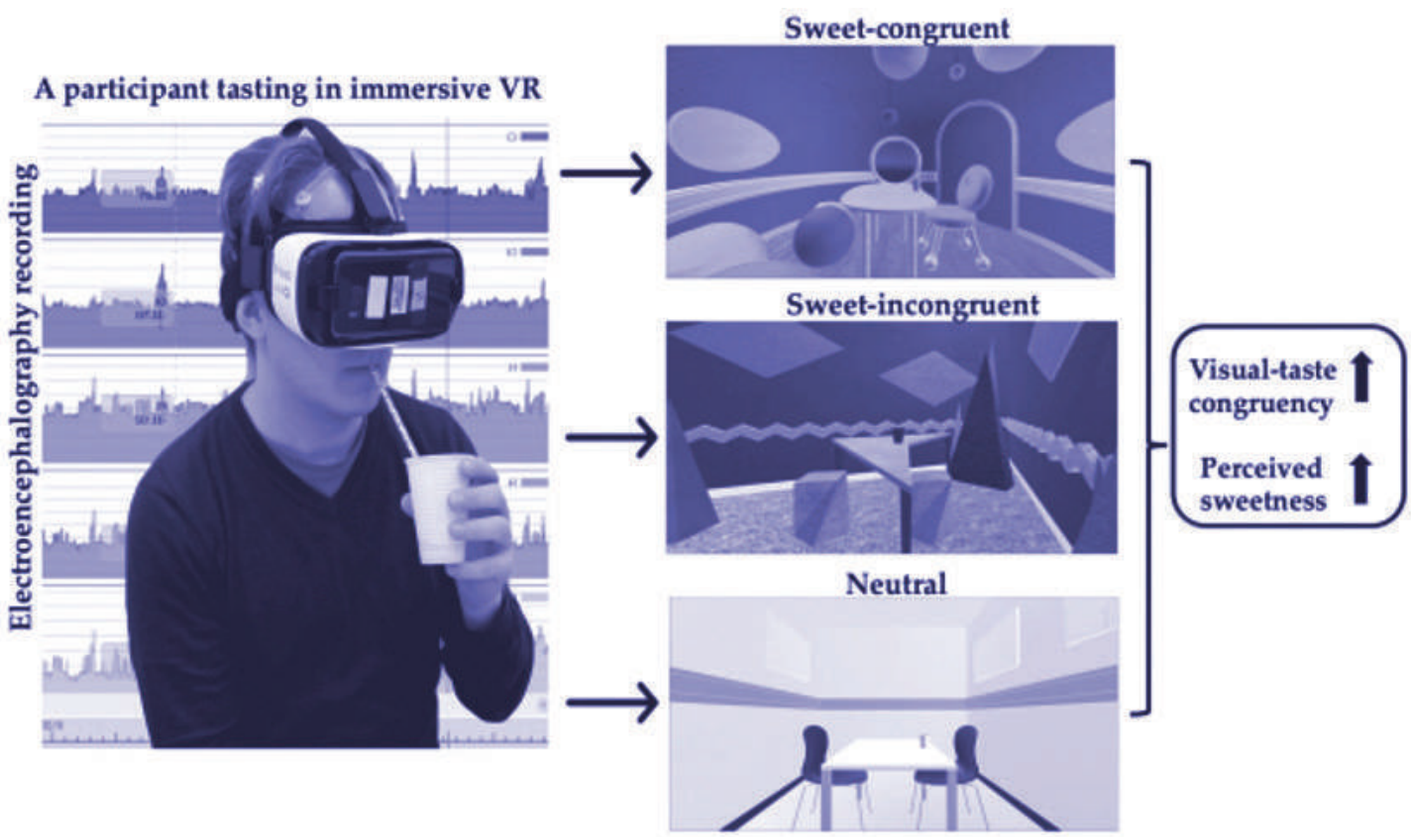

Fig. 6 - Sweet-congruent, sweet-incongruent (i.e., bitter), and neutral VR environments that were presented to participants in Chen et al.'s (2020) studies. The round shapes and pink-red colours of the sweet environment enhanced sweetness as predicted when compared to sweetness in the bitter environment with black and grey colours and angular shapes. [Reprinted under Creative Commons CC BY 4.0.]

Fig. 7 - Two stills frames (shown side by side) from the Stella Artois x The Roots collaboration highlighting the different forms and colour used for the bitter and sweet versions of the music video.

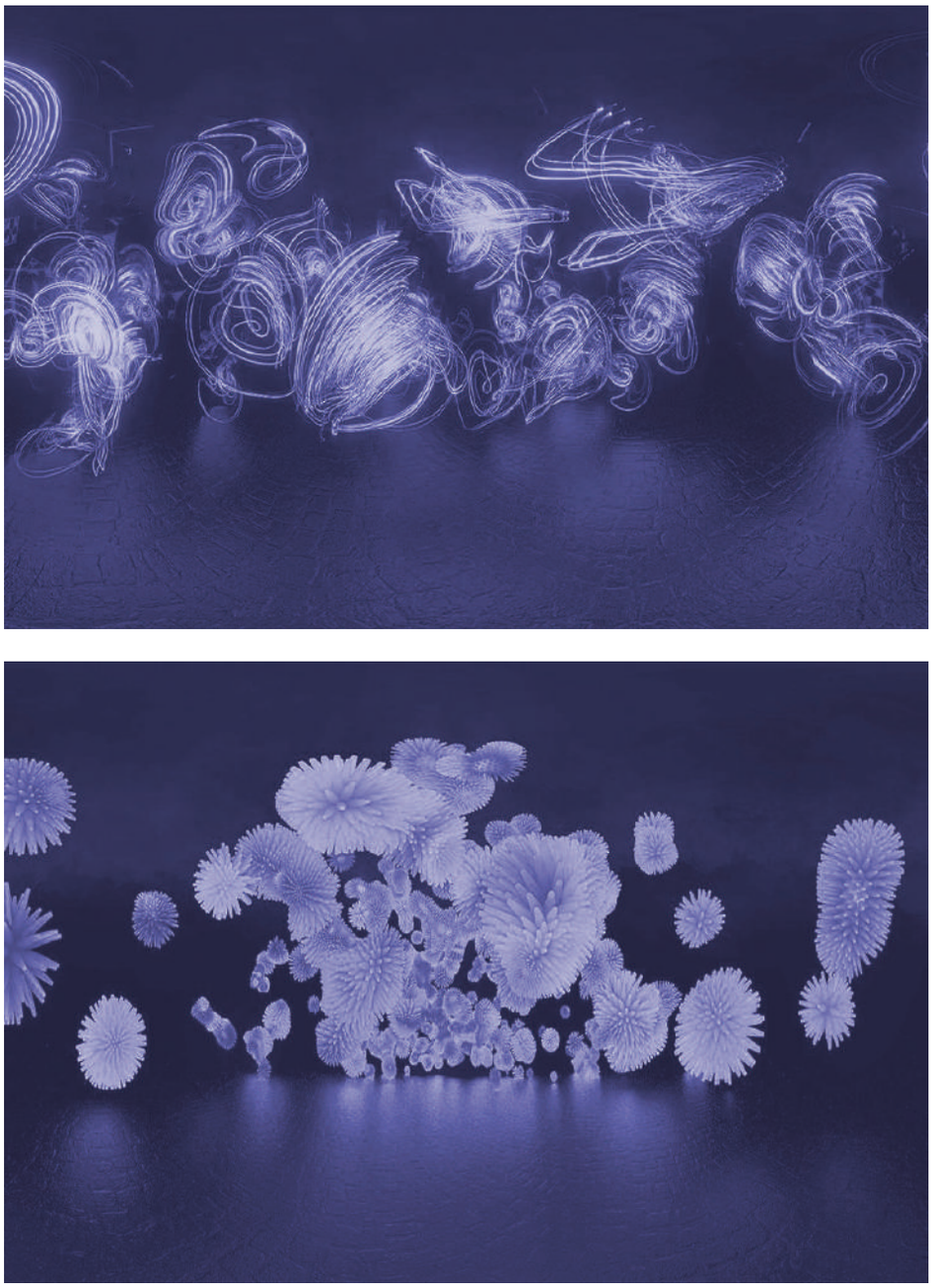

Fig. 8 - Two stills from the Guinness VR experience, highlighting the different forms and colours associated with the taste of two of the three beers.

Stella Artois teamed up with The Roots, the experience designers, Bompas and Parr, and myself to create a special music video in 2016 as part of Le Savoir, a multisensory entertainment platform (e.g., Birkner, 2016). The idea being that people sitting at home might enjoy the drink (Stella Artois beer), and by moving the cursor on their screen while watching the specially composed track and associated music video (called "Sweet to the Bitter End") in order to bring out a sweeter (fruitier) or more bitter version of the instrumentation/ video backdrop (the bitterness associated with the hops) (see Fig. 7). The suggestion that this personalized version of sonic seasoning could then be used to adjust the drink to taste.

According to the research, black (and white) is one of the colours most strongly associated with bitterness, while red is often associated with sweetness; Bitterness is associated with angularity and sweetness with roundness; Low-pitched notes and brassier sounds tend to be associated with bitterness, while tinkling high notes (e.g., of the hi-hat) are associated with sweetness. Albeit with a little artistic license, these visual and auditory correspondences were all incorporated into the track, which also referenced sweetness and bitterness. The online activation was also associated with a series of dinners. Todd Allen, VP of Global Marketing at Stella Artois had the following to say: "It's bringing millennials' passion points of food, music and art together under one platform to deliver an immersive dining experience, all perfectly paired with Stella Artois...We're very excited to bring it to the market." (quoted in Birkner, 2016).

Manuka honey recently created an immersive audiovisual installation based on the emerging knowledge concerning crossmodal correspondences between form and taste, Guinness created a VR experience for shoppers in Tesco supermarket ('Guinness VR Immersive taste sensation MPC Creative', 2017; Glenday, 2017; Hills-Duty, 2017; see Fig. 8), while Johnnie Walker Blue Label developed their Flavour Organ concept that incorporated texture, colour, and sonic seasoning to help take premium customers around the world on a flavour journey. In all cases, digital visual content created inspired in terms of colour, movement, and form, based on emerging research from crossmodal correspondences. The emerging findings concerning the consensual mappings between form and taste are increasingly being used as an inspiration for those wishing to create immersive, multisensory, experiential, (and occasionally experimental) tasting events.

4. CONCLUSIONS

In recent years, a number of putative explanations have been put forward in order to try and help explain the consensual mappings that have increasingly been documented between shape and taste/mouthfeel characteristics. Ultimately,

while it is still unclear which of these explanations may help to explain the existence of shape-taste correspondences, they are increasingly being incorporated in the design of foodscapes and the built environment. There have also been a number of creative examples of digital content designed to match, and possibly also modify/enhance the tasting experience based on such form-taste correspondences (Velasco et al., 2013), sometimes combined with elements of 'sonic seasoning'. The latter can be considered as another kind of crossmodal correspondence.

Ultimately, such research can be seen as highlighting the potential of the emerging field of gastrophysics (Spence, 2017), to take us beyond traditional, more synaesthetic approaches to design, and to provide an innovative new direction for research at the interface of architecture and food.

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NOTES

[1]This synaesthete is unusual in that the shape–taste synaesthesia only emerged in his twenties. When cooking "He then adjusts seasonings (at times by trial and error) to alter the taste's shape, making it "rounder," giving it more "inclination," "sharpening up" the corners, or unwinding the "curlicues." " (Cytowic & Woods, 1982, pp. 37-38).

[2]The oenologist Emile Peynaud (1987, p. 221) writes that: "I have searched through numerous texts and have encountered all the expressions that I mention here at least once, but can I be sure of having picked them all up? A wine is formless if its image on the palate is unclear. The following words immediately evoke simple forms: spherical, round, rounded, oblong, flat, threadlike, rectilinear, lanky or long limbed, square, angular, sharp, pointed, twisted, corked concave, convex."

[3]The poet and fellow Balliol Scholar, Matthew Arnold, once described the 'sweet vista of the city' of Oxford (https://www.poetryfoundation.org/poems/43608/thyrsis-a-monody-to-commemorate-the-authors-friend-arthur-hugh-clough).

[4]Confusing matters somewhat, though, synaesthetes are presumably likely to experience many of the same crossmodal correspondences as the rest of us non-synaesthetes, hence perhaps explaining the angularity-acidity connection picked-up in the responses of the synaesthete in Cytowic and Woods' (1982) study.

[5]Given that umami and kokumi are both associated with mouth-filling sensations (Devenyns, 2019), it might be expected that they would be linked with more voluminous forms. Interestingly, kokumi is often described as adding roundness to the taste/flavour of foods (Devenyns, 2019). That said, these newer taste qualities have yet to make it into research on the crossmodal correspondences. One challenge perhaps being that kokumi substances have no taste in and of themselves, but add 'roundness' and 'length' to sweet, salty, and umami taste sensations.

[6]It remains, though, an open question as to how a viewer's/diner's handedness may influence their preference for the orientation, position, and layout of food (as when served on a plate). This might be expected to interact with culture, e.g., in the differing ways in which cutlery is used to bring the food from plate to mouth. However, once again, more research is needed.

[7]According to personal correspondence with Joshua Berger of Sydney (May 27th, 2022): "The peak taste of a lemon is a fleeting sensation (perhaps because the components are hydrophilic/acidic and disperse in saliva/your mouth quickly) - in comparison with say peanut butter, which being a butter is, of course, lipophilic and 'sticks around' and could be imagined or associated with a 'slow' taste. That's a plausible statistical contingency that COULD explain the propensity for fast and slow tastes."

[8]Were this spatiotemporal account to be correct, then it might predict that different sweeteners would be associated with different shapes, since they have been documented to exhibit very different temporal profiles in consumer experience.

[9]Konrad Lorenz first introduced the term introduced the notion of imprinting in 1935. Tinbergen subsequently went on to demonstrate that newly-hatched ducklings would form a special attachment and follow around whatever visual stimulus they were first exposed to. In humans neonates, one might thus consider the imprinting possibilities associated with the pink aureole and nipple for breast-fed children

[10]Favre and November (1979) combine different colours and shape properties in order to convey taste qualities in their marketing book on the use of colour in communication.

ATLAS

Food for Atlas

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The **UNIVERSITY of Universities** (**UoU**) is an international network of academics from European schools of architecture collaborating to provide two-week online workshops across the academic year for students from different universities who work together remotely and in a collaborative way.

This Atlas section shows the work that undergraduate and master's degree students have produced in three workshops where the relationship between architecture and gastronomy (as in the call of this issue# 4 Gastrotecture) has been the central theme, the cultural diversifier and nexus of unity among participating students.

The first two workshops are part of the UoU network. Students of the Digital Design and Fabrication course in Architecture at the American University in Dubai joined this European teaching project. They participated in the workshop of Architecture & Food: An International Buffet in September 2020 and the 2043 A Dinner with Churchill in the Metaverse workshop in February 2022. The workshops lasted two weeks and were online.

By putting gastronomy from such diverse locations and nationalities at the epicentre of the workshops, the outcomes reflect the richness and diversity of their cultural backgrounds. In the same way, a part of these exercises was to reflect on the work tools and means of graphic expression that clearly and completely represent projects that distance themselves from recognised architectural forms and graphics and delve into the discipline of gastronomy.

The acceleration of online meetings and virtual settings brought by the pandemic has also been the subject of study in these workshops. The 2043 A Dinner with Churchill in the Metaverse workshop in 2022 has provided an opportunity to reflect and propose bids that allowed us to enjoy unimaginable gastronomic experiences until recently. Taste is perhaps the most complex sense when transferring it to virtual environments. The ideas presented by the students show a high capacity for imagination and creative freedom typical of their university years, where priority is given to stimulating knowledge and having a holistic vision between subjects and disciplines.

The third and last workshop presented here is entitled Bigamies for gastronomy and was held face-to-face during the International Seminar and Workshop on Transdisciplinary Knowledge Transfer in the Basque Culinary Center, Donostia-San Sebastián, Spain, on March 2022. The students of the Master in Gastronomic Sciences, unlike UoU architecture students, have a background closer to gastronomy and far from architecture. Among them are graduates in pharmacy, biotechnology, chemical engineering, cooking, food technology, nutrition and dietetics, and advertising, to name a few. In addition, their places of origin are the USA, Colombia, Peru, India or China.

This workshop provided the opportunity to experience the gastronomy-architecture binomial in the opposite direction to the predecessor workshops. The workshop was conducted with the biologist José de la Rosa, and a joint lecture was given by both academics showing a theoretical-practical framework of architecture-biology associations.

These three workshops and the selected work of the students demonstrate the multiculturalism in contemporary higher education and how architecture allows for building a common language for communication. Society and education are progressing towards overlapped disciplines with their boundaries openly and intentionally blurred.

WORKSHOP: Architecture & Food. An International Buffet

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CONTENT

Architecture, open and expansive in nature, has explored unlikely interactions and projected hybrids with unpredictable results. Danish architect Bjarke Ingels has defined it as bigamy;

"Take multiple elements that apparently don't fit together and merge them to create a new creation or genre". (1) This positioning will allow us to get out of the accepted parameters of architecture and, in doing so, give life to new ideas that previously seemed impossible or unknown.

AIMS

To become familiar with the edible world from an architectural perspective. To study and understand the inherited relationships of the DESIGN & FOOD bigamy.

To highlight students' local culture and encourage, through online group work, the discovery of other gastronomic and architectural backgrounds.

To take an introspective journey to our body and the spaces surrounding us by stimulating the senses involved in eating. To create + Act + Collaborate + Iterate + Invent + Question + Disseminate + Transcend

METHOD

In this workshop we will work on the architecture-food bigamy:

We will present edible products-objects.

We will draw the conditions demanded by objects that are perishable and edible, the actions and rituals associated with them and the spaces defined around their tasting protocols.

We will rethink architecture and context from the gastronomic objects and, in reverse

We will rethink culinary art and its elements from an architectural approach.

PART 1: ANALYTICAL-DESCRIPTIVE (Individual Work)

Find an edible product that is man-made and has become iconic in your country & culture. Analyse the making of and the relationships, proportions and rules between its parts.

PART 2: REPRESENTATIVE (Individual Work)

Draw in 2D cad a detailed architectural representation of the object. Find out your own graphic language that best provides a comprehensive representation. Include dimensions, annotations, views name, section lines and scale.

Prats, E. & E. Miralles (1991). "How to lay out a croissant". El Croquis 49/50: 240-241. https://unit01greenwich.wordpress.com/2013/12/02/how-to-lay-out-a-croissant-by-miralles/

PART 3: NEW TASTING EXPERIENCE (Group Work)

Arrange working groups of 10 members each for one of the following topics:

1-TIME, 2-STRUCTURE, 3-SOCIAL INTERACTION, 4-PROCESS, 5-HISTORY, 6-CUTLERY, 7-FORM-FUNCTION, 8-SUSTAINABILITY, 9-GEOMETRIC PATTERN, 10-TECHNIQUE

It is recommended that groups are made up of students from different universities and that the topic matches your product and interests.

The whole group will jointly develop the following:

1. Design a new edible product that represents the fundamental values of your category. It must be a contemporary design, innovative and aligned with new technologies.

2. Conceptualize and design the ritual and space for the tasting of that new edible object/food/product. Design new utensils/cutlery, new technologies and new spatial, social, sensorial, interactive and emotional conditions that define how to eat it.

Martí Guixé on food karaoke, edible objects and techno-tapas. https://www.youtube.com/watch?v=UkOi55jpJiU

L'Ex-Designer Project Bar. https://www.youtube.com/watch?v=9Nh-EG3qv5E

An Experimental Feast, Plated by Artists to Amuse and Confound. https://www.youtube.com/watch?time_continue=400&v=TdSp_BaEQ24&feature=emb_logo

Experimental gastronomy: Breaking all the dinner party rules. https://edition.cnn.com/style/article/experimental-gastronomy-dinner-steinbeisser/index.html?TB_iframe=true

3. Show the relationship with the human body through sequences, phases, times, temperatures. Work with reference images that support your proposal, merge them, combine them with some 2D/3D drawings you might draft, create physical models, etc. Output: Multi-layered drawings, collages, sketches, physical, etc. Anything that clearly supports the understanding of your proposal.

Philippe Rahm Drawings digestion, evaporation, radiation drawings. http://www.philipperahm.com/

PART 4: PERFORMATIVE (Individual Work + Group Video Clip)

Create the physical/virtual setting and represent the architectural scenography generated by the object and its tasting protocol.Create a group video providing a complete vision of the new tasting experience. The output video must have a perfectly connected narrative and a consistent format as a unique visual piece. VV Maximum length: 5 minutes

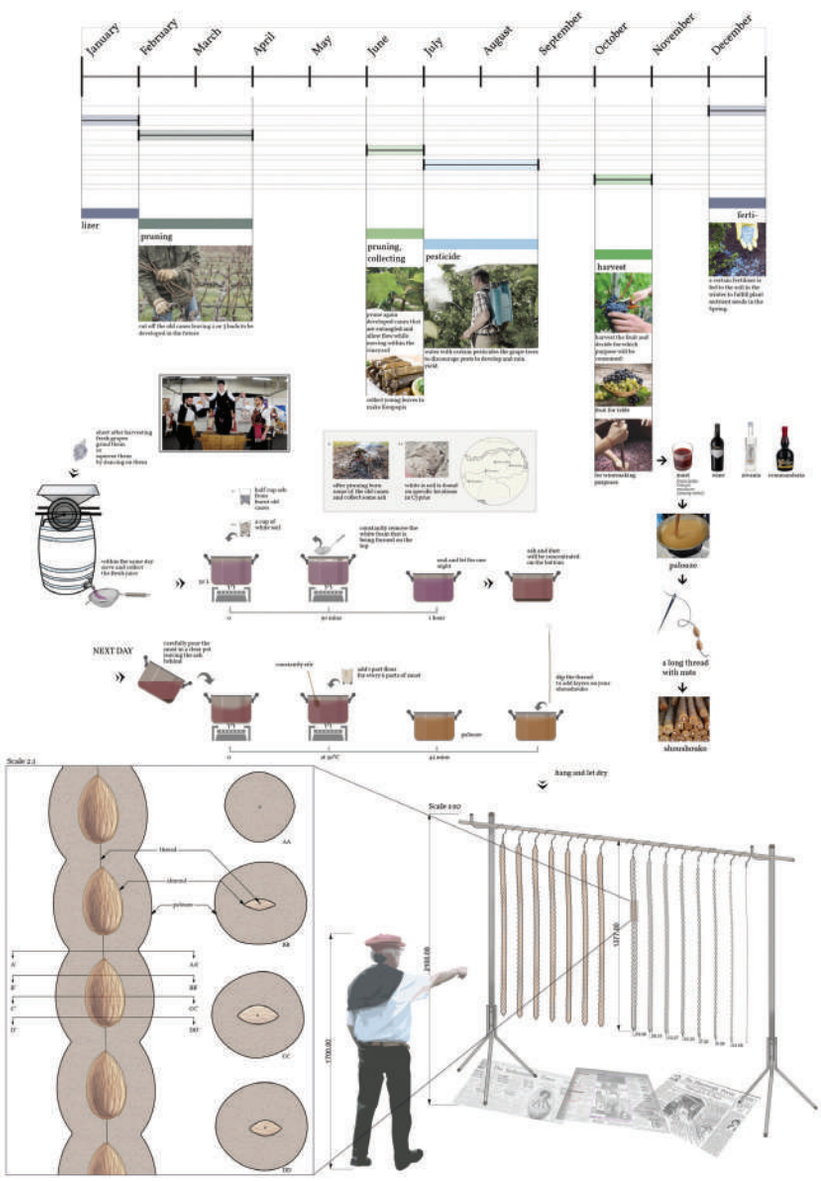
(1) Bjarke Ingels: Architecture should be more like Minecraft. (2015, January 28). YouTube https://www.youtube.com/watch?v=cIsIKv1lFZw&t=137s

Part 2 Representative

Shoushouko

Christos Savva[1]

[1]University of Nicosia, Cyprus

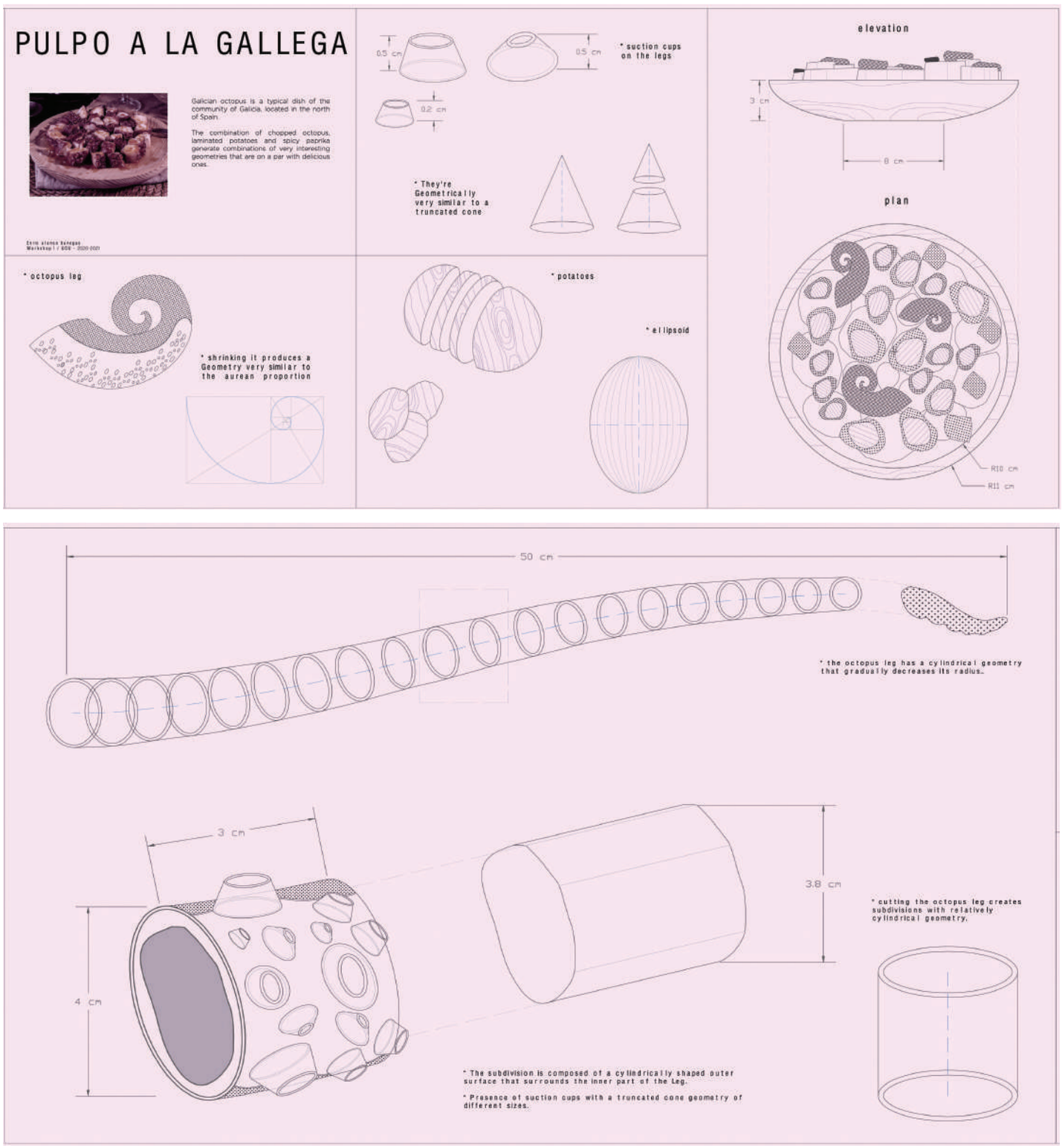


Shoushouko is a traditional Cypriot grape juice-based sweet created from whole almonds or walnuts that have been soaked before being strung with cotton thread, and Palouze, which is made from young must. The thread is dipped in Palouze and then let dry. This process is repeated multiple times and takes several days to reach a thickness of usually seven layers with a diameter of up to six centimetres.

Pulpo a la gallega

Enric Alonso[1]

[1]University of Alicante, Spain

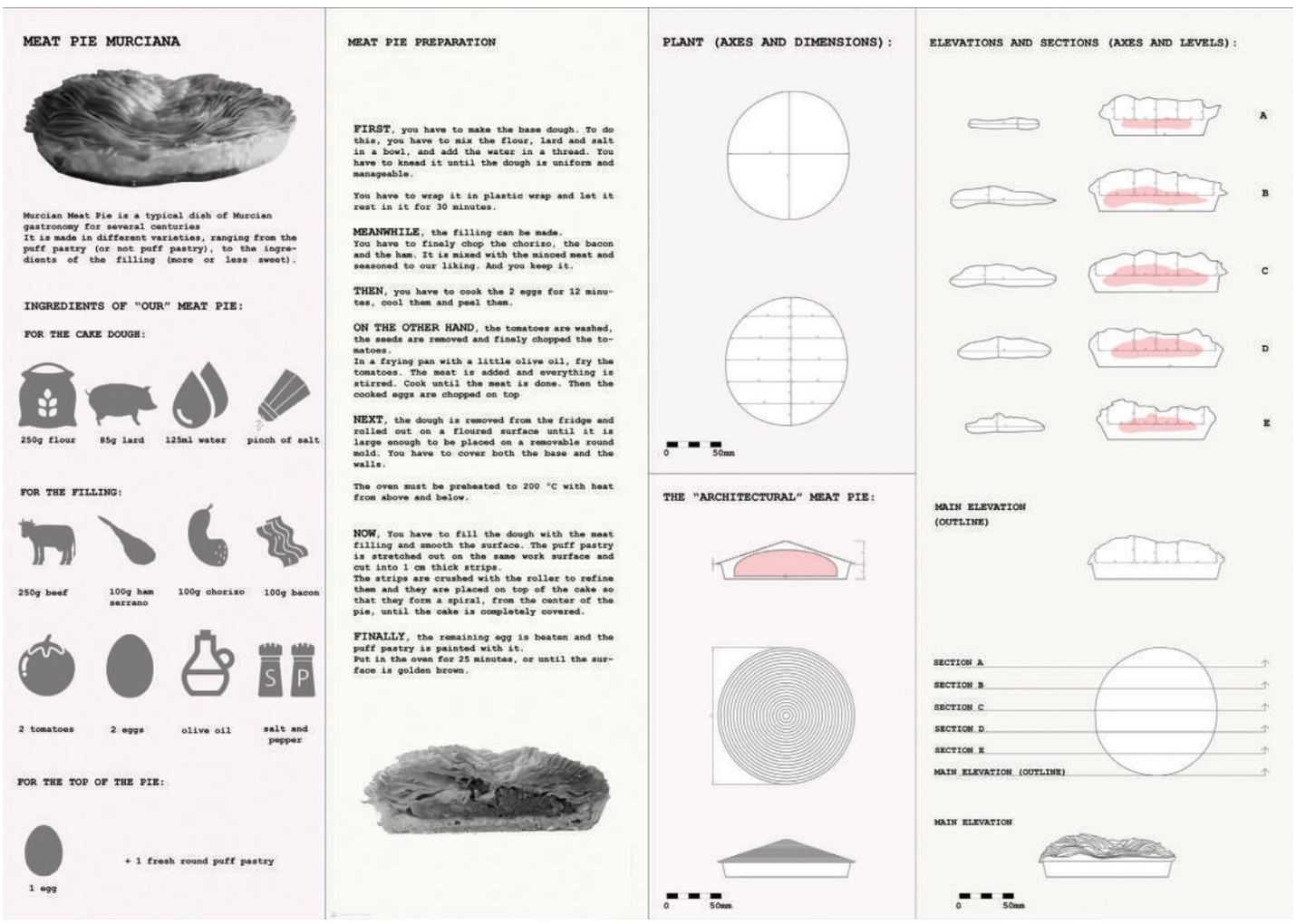


Galician octopus is a typical dish of the community of Galicia, located in the north of Spain. The combination of chopped octopus, laminated potatoes and spicy paprika generates combinations of very interesting and delicious geometries.

Pastel de Carne murciano

Gonzalo Carrillo[1]

[1]University of Alicante, Spain

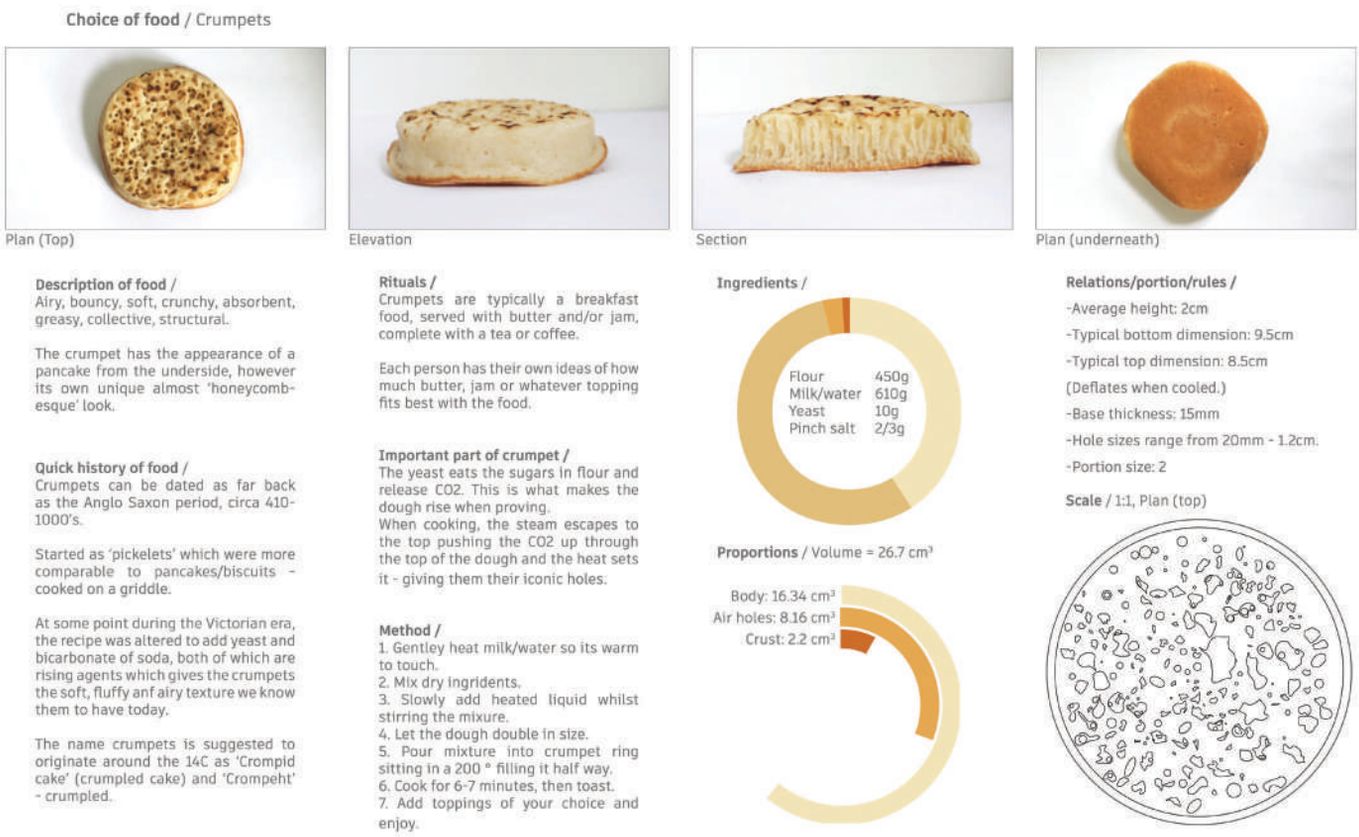


For many years, Murcian cuisine has been known for its Pastel de Carne murciano (Murcian Meat Pie). There are various ways to make it, from puff pastry or no puff pastry to more or less sweet filling ingredients.

Crumpets

Heather Knights[1]

[1]UWE Bristol, UK

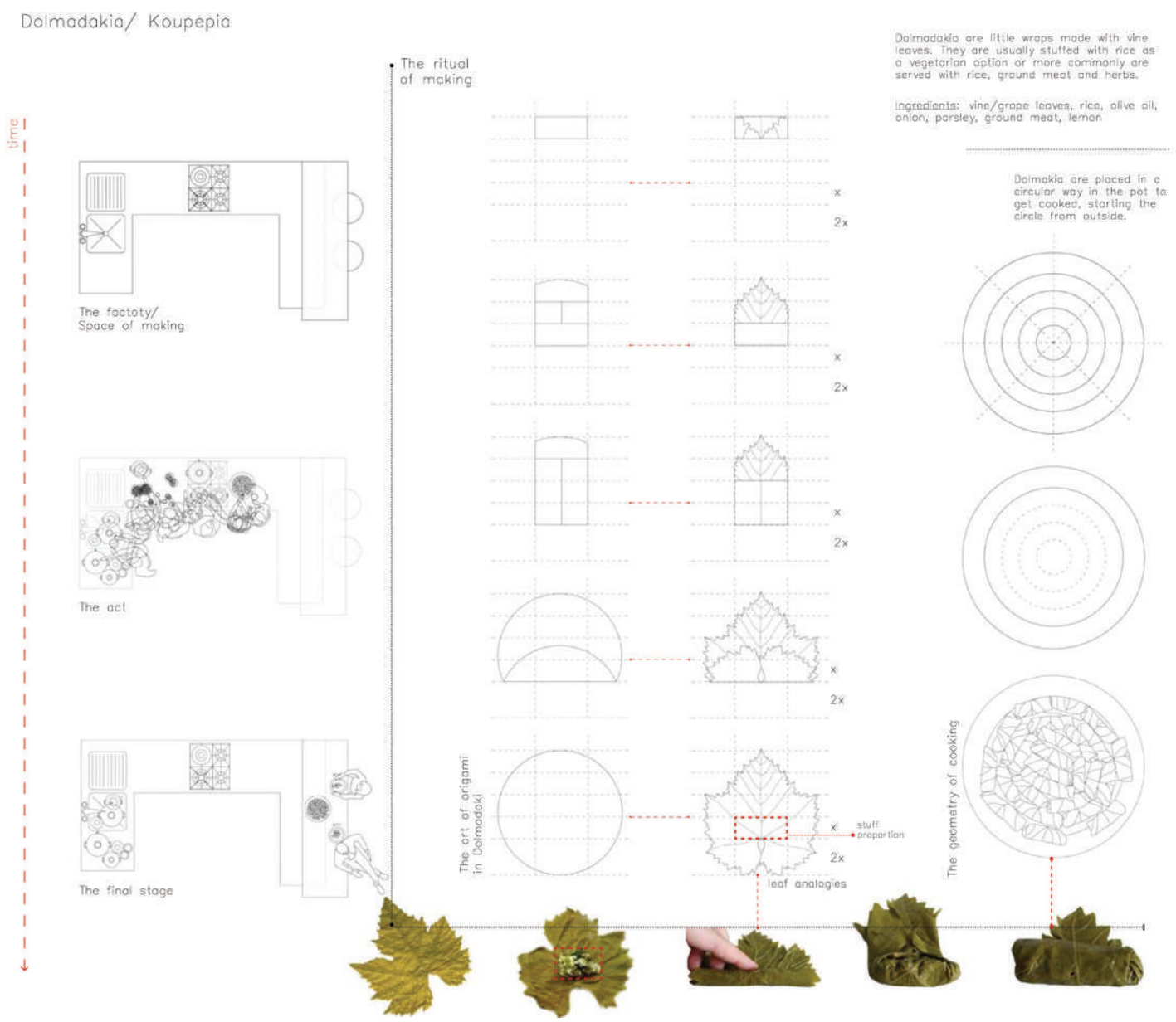


The crumpet has the appearance of a pancake from the underside; however, its own unique almost 'honeycomb- esque' look. Crumpets can be dated as far back as the Anglo-Saxon period, circa 410- 1000's. Started as 'pickelets' which were more comparable to pancakes/biscuits - cooked on a griddle. At some point during the Victorian era, the recipe was altered to add yeast and bicarbonate of soda, both of which are rising agents which gives the crumpets the soft, fluffy and airy texture we know them to have today. The name crumpets is suggested to originate around 14C as 'Crompid cake' (crumpled cake) and 'Crompeht' - crumpled.

Dolmadakia

Maria Tziakou[1]

[1]University of Nicosia, Cyprus

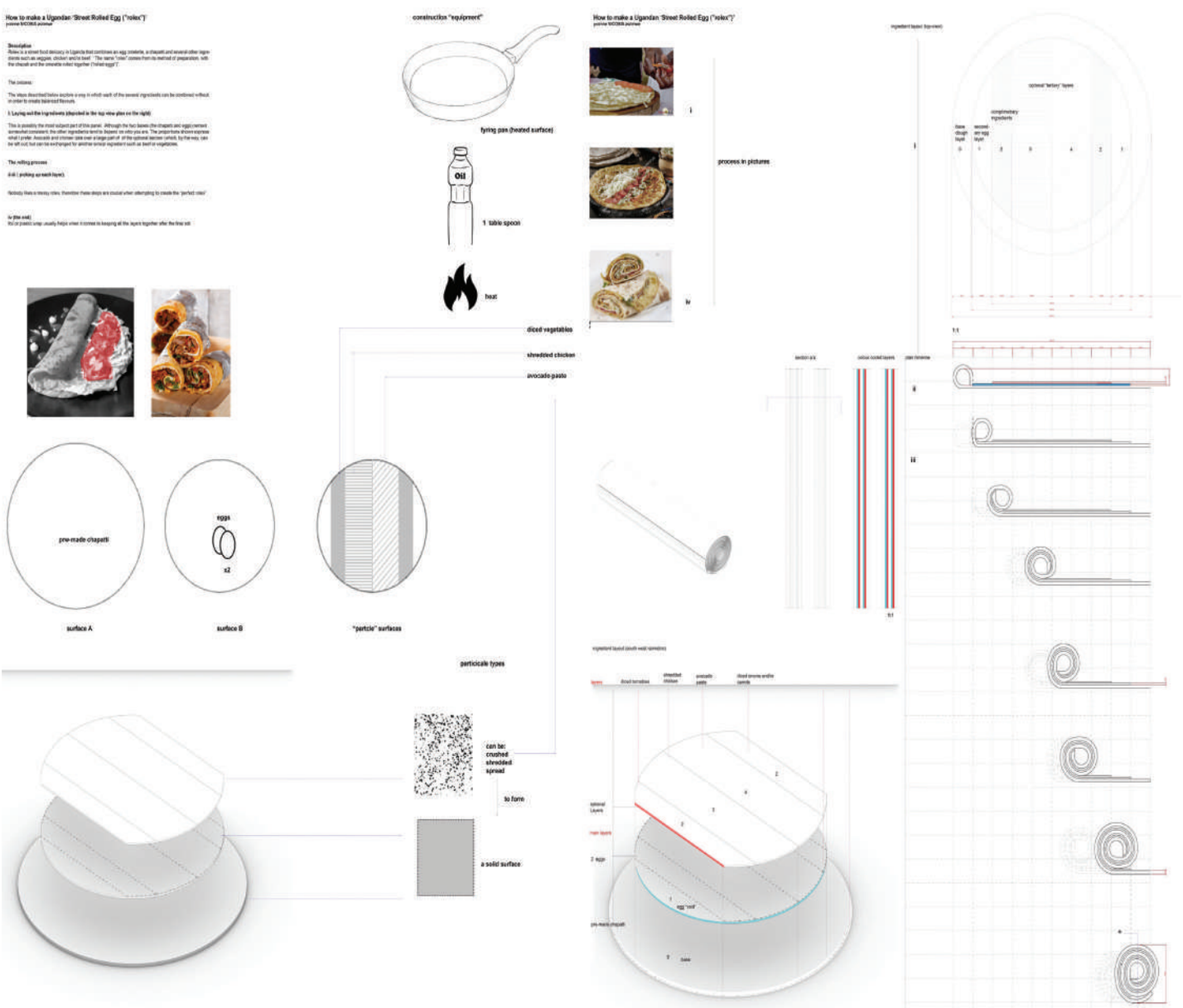


Dolmadakia is a little wrap made with vine leaves. It is usually stuffed with rice as a vegetarian option or more commonly served with rice, ground meat and herbs.

“Rolex” Ugandan street rolled egg

Yvonne Asiimwe[1]

[1]University of Nicosia, Cyprus



A street food delicacy in Uganda that combines an egg omelette, a chapatti and several other ingredients such as veggies, chicken or beef. The name “Rolex” comes from its preparation method, with the chapatti and the omelette rolled together as “rolled eggs”.

Part 3 New Tasting Experience. Sustainability Group

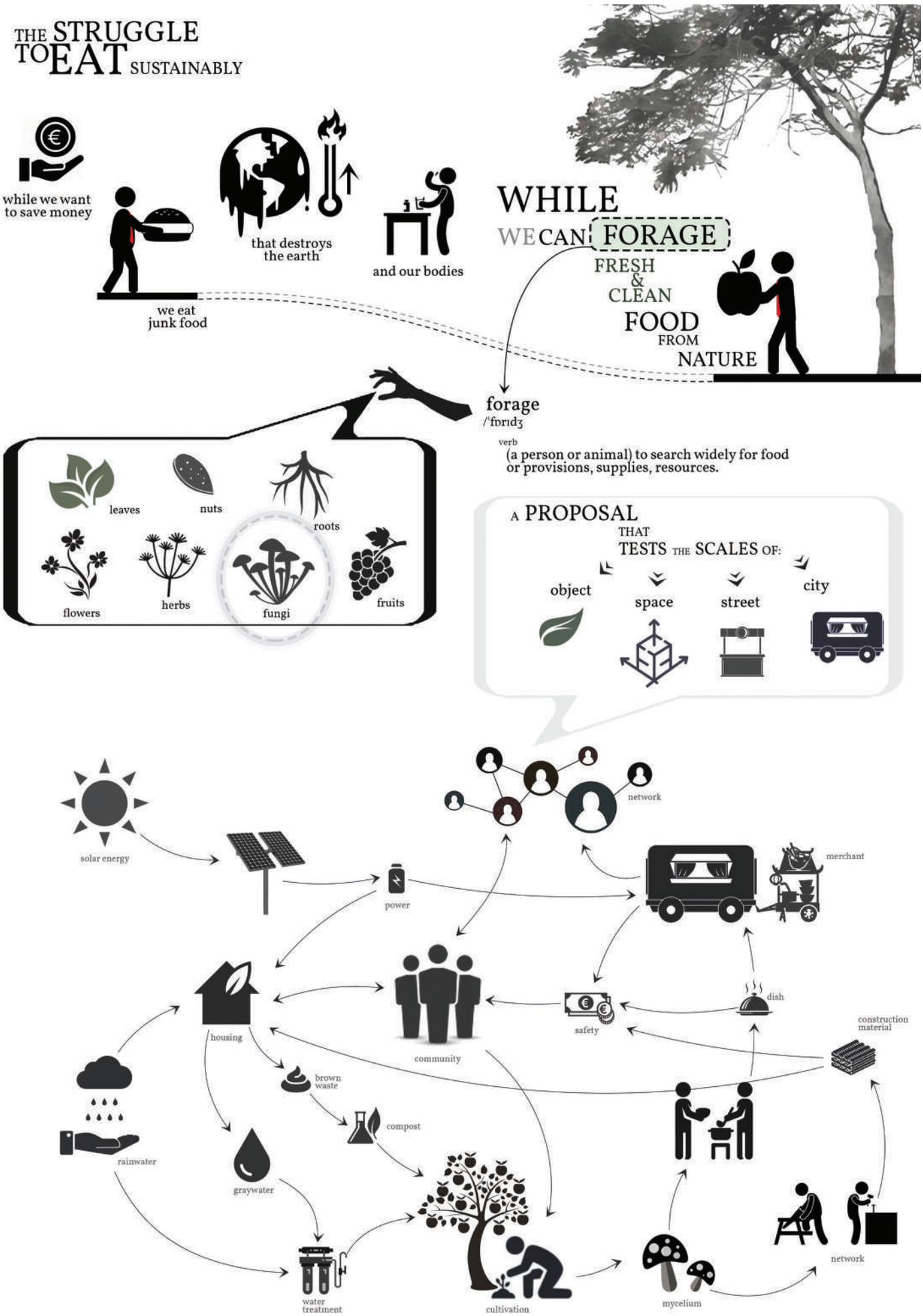
Christos Savva[1]; María Ponce[2]; Jorge Plaza[3]; Natalia Lozano[4]; Enric Alonso[5]; Helena Jenkinson[6]; James Reed[7]; Francis R D Mussenden[8]; Bradley Homer[9]

[1]University of Nicosia, Cyprus
[2,3,4,5]University of Alicante, Spain
[6,7,8,9]UWE Bristol, UK

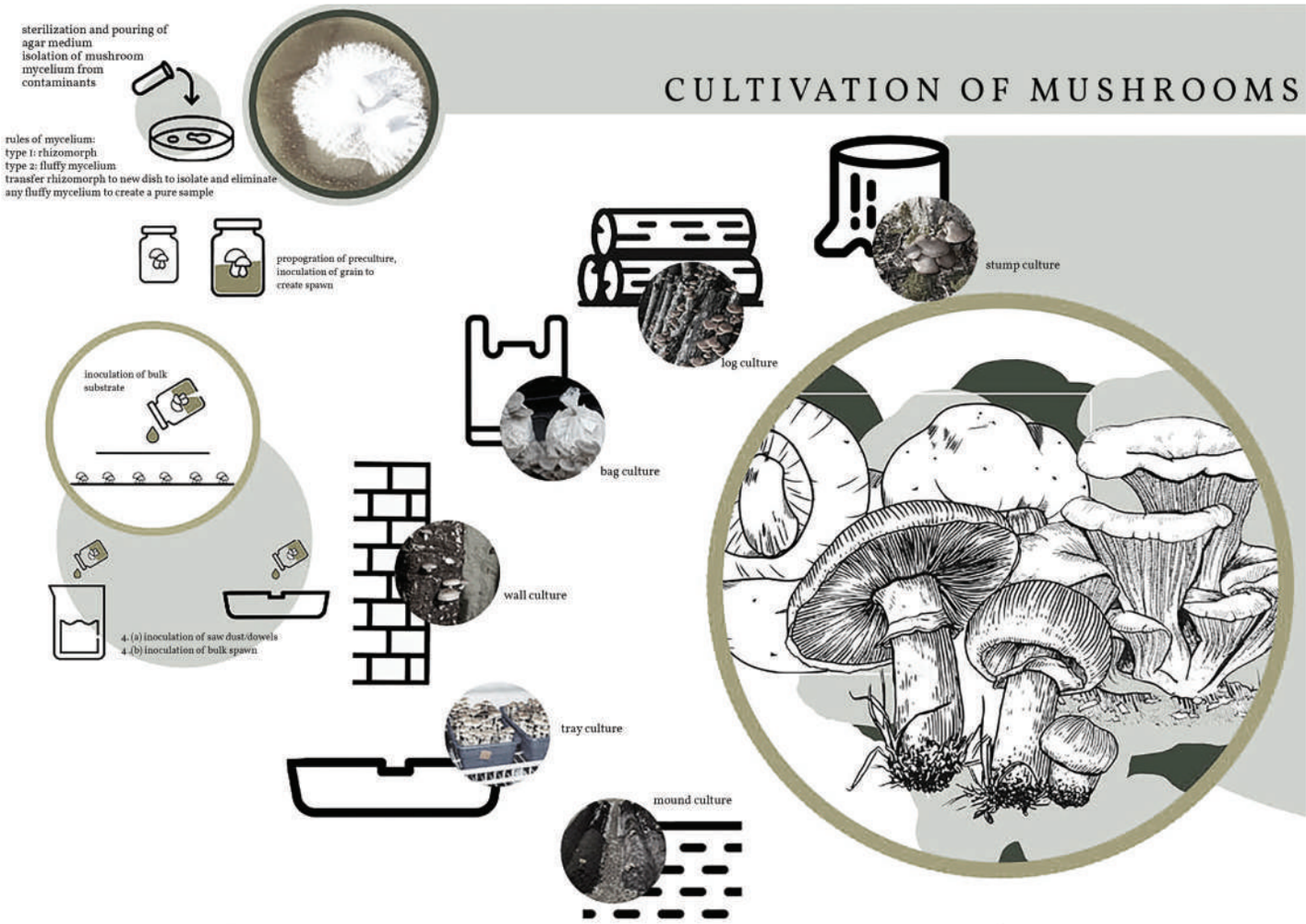
The team's primary concern was the issue of eating sustainably and healthily. The proposal includes working within a community with a focus on cultivating "mush-rooms" to create a new dish, and new materials and build resilience through time. These processes are sustainable in terms of the quantities of human energy needed for specific processes, costs, and impact on the environment and the community. The cultivation of fungi can yield food, and medicine and is already being taken further through specific processes we started creating a construction material and building various objects and buildings. The proposal includes processes of constructing with mycelium composite material objects like utensils, furniture and an ephemeral pavilion. Its primary structure is composed of mycelium composite elements creating a meandering effect. On the canopy, trays are being formed to allow the cultivation of mushrooms making the pavilion a living, growing organism. The final part of our team's proposal is a whole new tasting experience. The performance describes a new way of eating a proposed sustainable dish derived from mushrooms and holds a message, invitation, or hope.

Video

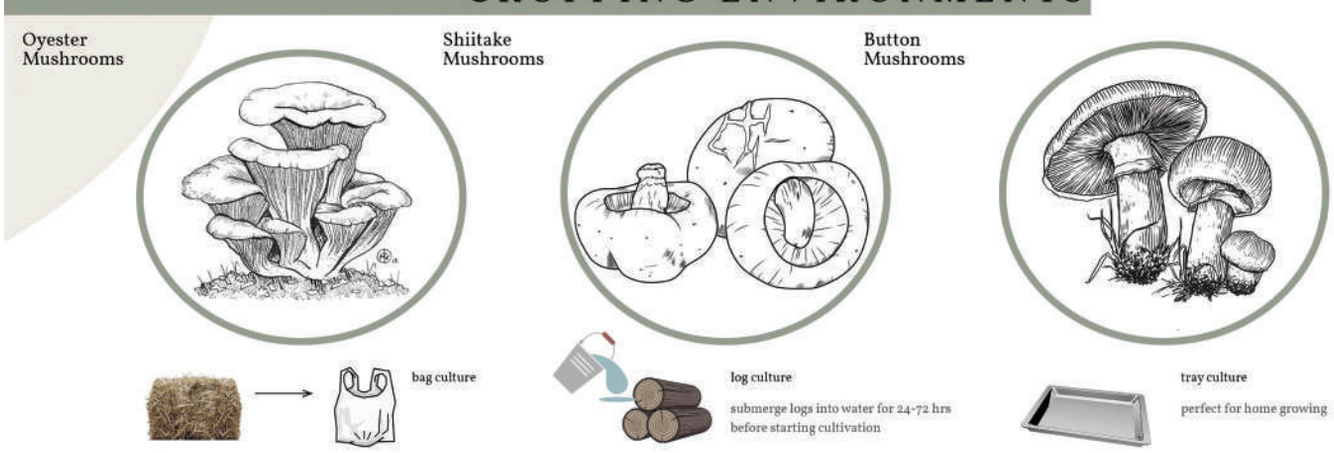
https://www.youtube.com/watch?v=Wes2_tp_RGw


THE STRUGGLE TO EAT SUSTAINABLY
while we want to save money
we eat junk food
that destroys the earth
and our bodies
WHILE WE CAN FORAGE FRESH & CLEAN FOOD FROM NATURE
forage
/ˈfɒrɪdʒ
verb
(a person or animal) to search widely for food or provisions, supplies, resources.
leaves
nuts
roots
flowers
herbs
fungi
fruits
A PROPOSAL THAT TESTS THE SCALES OF:
object
space
street
city
solar energy
power
network
merchant
housing
community
safety
dish
construction material
brown waste
compost
rainwater
graywater
water treatment
cultivation
mycelium
network

CULTIVATION OF MUSHROOMS



CROPPING ENVIRONMENTS



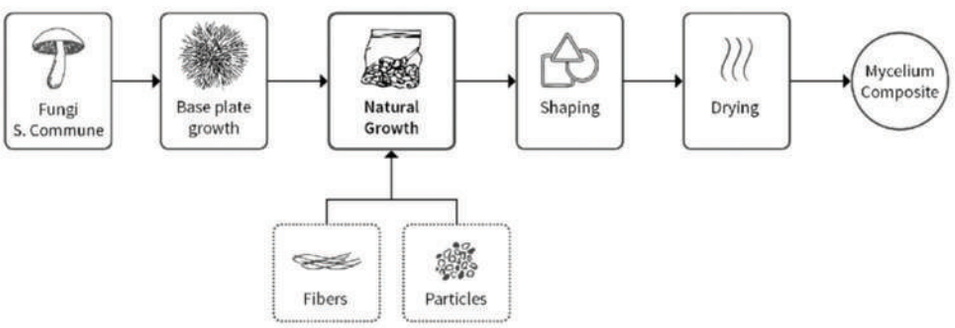
	Oyester Mushrooms	Shiitake Mushrooms	Button Mushrooms
HUMIDITY	95%	85% - 90 %	65% - 70 %
AIR TEMP	55-60 ° F	59-68 ° F	60-74 ° F
DURATION	2-7 weeks	7-14 days (regrowth for 2-5 years)	7-14 days (will continue to grow for 3-6 months)
LIGHT	2,000 lux / diffused natural light	ambiental light or 10 lux in 270-420 range	does not require direct sunlight
HARVEST	directly before uncurved margains are elevated to plane	directly before incurved margains flattern and the cap expands	directly before the caps pop open
WATER	misting twice daily	mist once or twice a day for 5 minutes at a time	Mist everyday to keep the beds moist

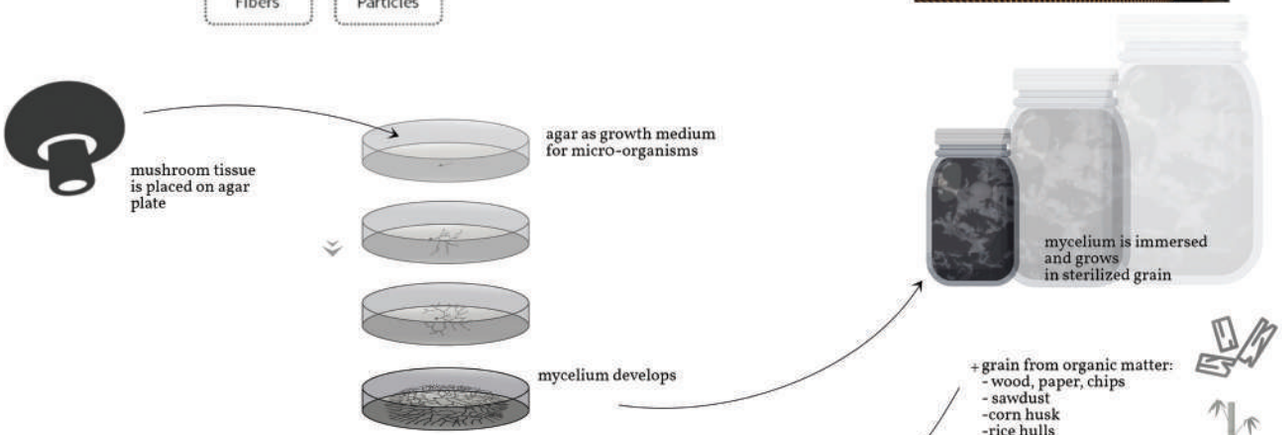
FUNGI CULTURE

CULTIVATION OF MYCELIUM

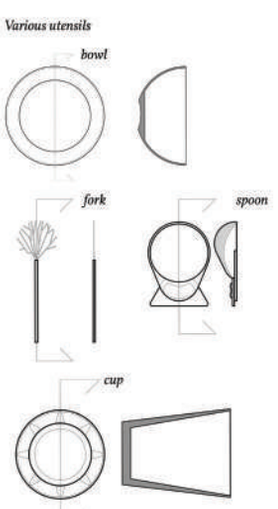
- floatable
- waterproof
- fireproof
- flexible
- durable
- heat resistant
- sustainable
- decomposable

for: food
packaging material
tools, utensils
furniture
construction material
- insulation panels
- acoustic ceiling tiles
- bricks, blocks
- wall partitions





mycelium composite material



HOW TO USE MUSHROOMS SUSTAINABLY

FOREST
return to nature
physical action
education
gatherings
collectiveness

CITY
experience food
education
consumption
social engagement

WHY MUSHROOMS?

Mycelium is one of the most abounding living systems on Earth, it's a tissue composed of wire-like microfibers that are part of the fungal roots


no deforestation


easily grown


can be cultivated everywhere


cost effective

HOW IS IT MADE?

01 
harvest the mushrooms for the mycelium

02 combine mycelium with wood chips 

03 
break up mixture in order to loosen to the particles

04 pack the myceliated wood into your chosen mould 

05 leave mould for 5 - 6 days or until the myceliated wood has filled the mould 

06 
remove the myceliated wood from the mould , which should leave a smooth finish (depending on the mould you've used)

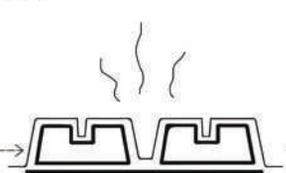
07 cover the myceliated wood for another 4 days in order to keep the thin, smooth exterior around the grown shape 

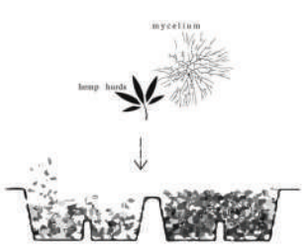
08 
remove covering and let the myceliated wood dry to stop the growing process and to kill growing process


generate a 3D model of the moulding or the construction block

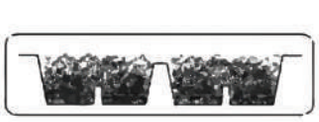

create the volume with a CNC machine

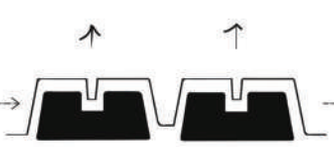

hard tooling is generated


hard tooling is generated



mix mycelium with grains and let grow for 4 days


the mycelium grows


mycelium composite is removed from the tray

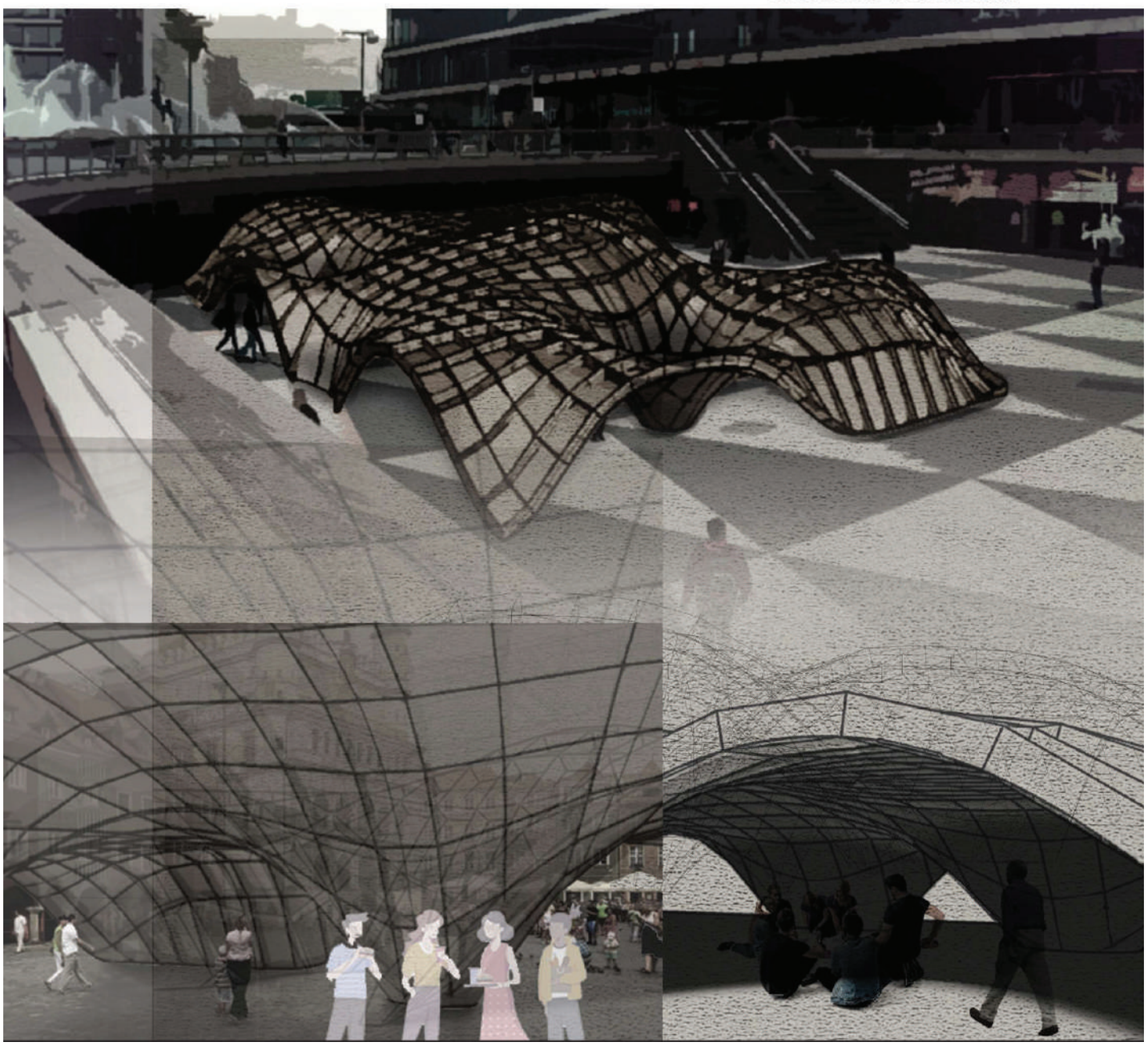

let grow for another 2 days to create velvety layer of overgrowth


heat the organism to stop growth

Ephemeral pavilion made of mycelium pieces with parametric patterns that you can put together and then disassemble to take it away from that place so that it does not have a bad impact.

Sustainable and zero waste cultural activities and workshops to educate about the cultivation of mushrooms and all its possibilities and benefit for the community and the environment.

New sensorial and interactive ritual for the tasting of our mushroom based food. The temperature, humidity and other conditions will be adjusted in this environment to recreate the forests where the mushrooms are cultivated.



Part 3
New Tasting Experience. Cutlery Group

Tristan Sanchez[1]; Malak Benmoussa[2]; Zaynab Aboudou[3]; Hasnae Mirali[4]; Ibtissam Bakkach[5]; Maxwell Robinson[6]; Josiah Searle[7]; Jake Fellows-Samuel[8]; Elham Al Dweik[9]; Taimaa Barakat[10]; Farah Ali[11]

[1]University of Nicosia, Cyprus
[2,3,4,5]University of Alicante, Spain
[6,7,8]UWE Bristol, UK
[9,10,11]American University in Dubai, UAE

This proposal aims to playfully explore different forms of love and relationships through an interactive mode of utensils, cutlery, and food. This newfound culinary experience is as valid and exciting as the many forms of intimate relationships between humans.

The Arabic food “Yalanji”- incredibly popular stuffed grape leaves, common across all Arab countries- was selected in this redefined culinary experience. The process of selecting, making, and eating “Yalanji” is intimate and phenomenological. The vine leaves are often intricately selected, cleaned, and stuffed with rice and other secondary fillings. This mesh between rice’s neutrality with the slightly acidic and textured vine leaf is usually eaten as finger food, and, is often a staple.

The redefined Yalanji proceeds to create a new eating experience that highlights the already fun, intimate, and democratic use of the food. Different kinds of love are placed and analysed: platonic, sexual, parental, etc. Varied kinds of relationships can create their new “Yalanji” differently. Through the selection of the ingredients, the process of “Yalanji” is expanded into an experience reflective of the couple that eats it. Food thus becomes a continuity of our personal and intimate relationships: varied and- ideally- filled with love.

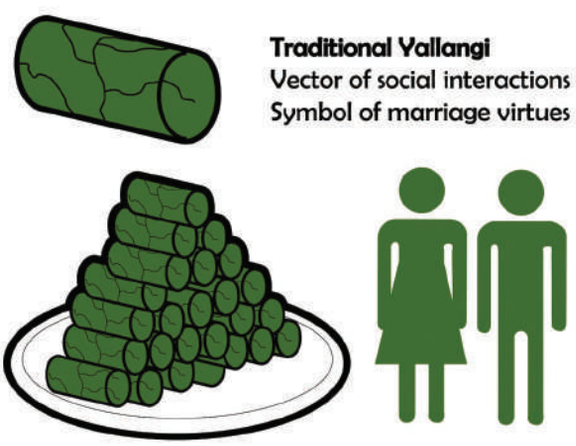
At the heart of the reinvented yalanji
is the social interaction
between different types of relationships.

The yalanji and cutlery are deconstructed
into ingredients and materials to be assembled;

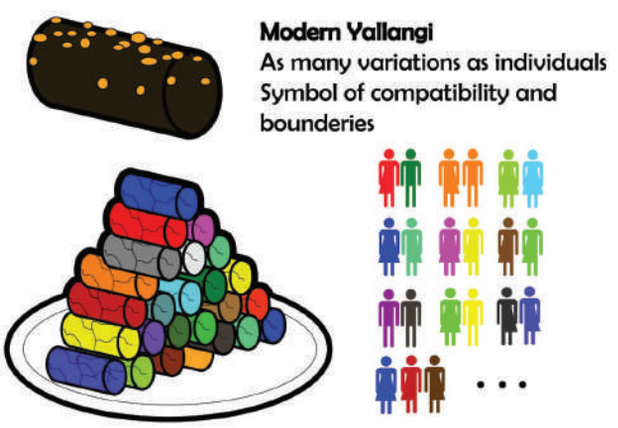
Each level
of the ingredients is reflective of the layers of the relationship...

There are infinite possibilities-

which one is yours?



Traditional Yallangi
Vector of social interactions
Symbol of marriage virtues



Modern Yallangi
As many variations as individuals
Symbol of compatibility and
bounderies

The Ingredients.

1. The Wrap

The essence is the same for all-
Love is Love.

Layer I- The essence

2. The Filings

Complex and Intricate.
The filings show the **diversity** in the inner self.

Layer II- The Gender.

The Ingredients.

3. The Toppings

Undefined and Open.
The toppings provide an added layer;
who are you attracted to?

Layer III- The Gender.

4. The Dip

Sprinkled with love-
You and your partners-
What are you?

Layer IV- The Relation.

The Combinations

Her Wrap

Her Fillings

Her Toppings

Her Wrap

Her Fillings

Her Toppings

Her Dip

The Combinations

Her Wrap

Her Fillings

Her Toppings

Her Dip

His Wrap

His Fillings

His Toppings

The Combinations

His Wrap

His Fillings

His Toppings

His Wrap

His Fillings

His Toppings

His Dip

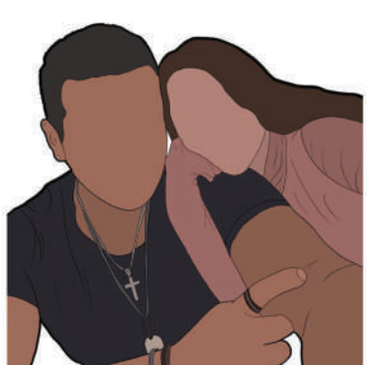
The Combinations

His Wrap

His Fillings

His Toppings

His Dip



Her Wrap

Her Fillings

Her Toppings

Her Dip

The Cutlery

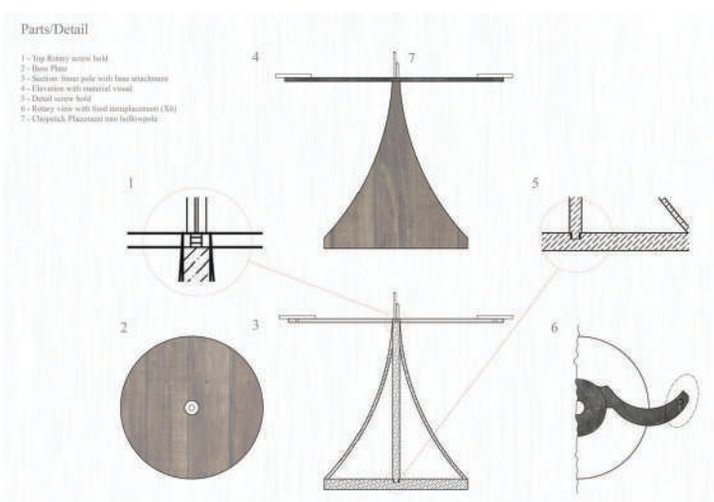
Undefined,
Unrestricted.
The are infinite possibilities.

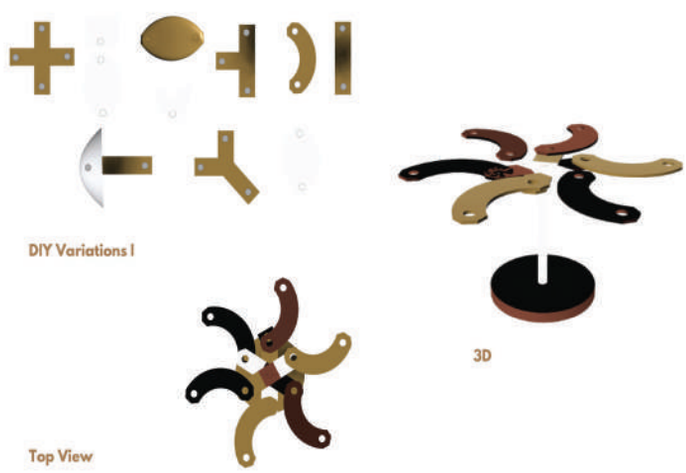
Grab, Remove
Tighten, Scoop
(I hope the Yalanji does not fall out).

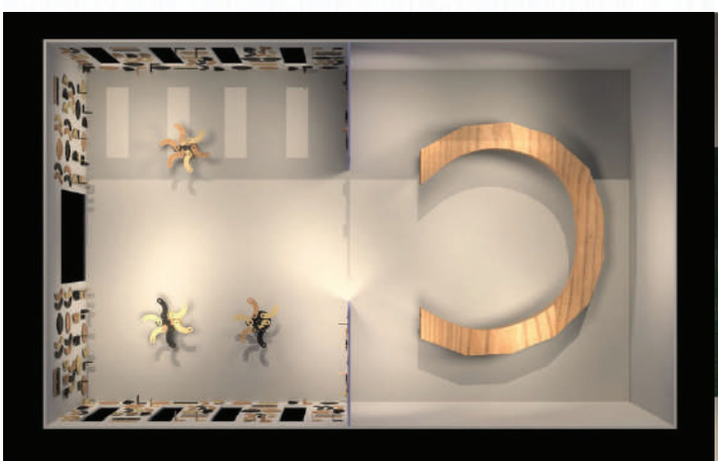
Again. Repeat. Redo.
Add, Hold,
Screw.

Add, Hold,
Screw,
(This yalanji tastes... New?)

Compare, Smile,
Laugh,
(I love him).







WORKSHOP: 2043, a Dinner with Churchill in the Metaverse

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jcarrillo@aud.edu

CONTENT

Sir Winston Churchill (1874-1965), British Prime Minister (1940-45, 1951-55) in his speech to the House of Lords on October 28th, 1943 said *"We shape our buildings; thereafter they shape us,"* requesting the House of Commons, bombed out in May 1941 during the World War II, be reconstructed exactly as before. He stated that the old Chamber's rectangular configuration shaped the two-party parliamentary system, the essence of British democracy. This profound and powerful statement reveals how the environment we have constantly created shapes and affects us and how we perceive things. Since 2020, the pandemic has made more apparent the flexibility or rigidity, not only spatial, of the structures that organise the world we inhabit, the times of adaptation and the human predisposition to change. On the other hand, it has also revealed the increasingly recurring technological lifesaver, based on the need for networked, remote work without physical limitations—a clear invitation to reflect on how we architects can position ourselves to unfold the future. University of Universities, a pioneering example of adaptation, becomes the ideal setting for this reflection.

In *With a new mind,* Daniel H. Pink (2008) speaks of the end of the "Knowledge Age" and the beginning of a new era, the "Conceptual Age", where the future belongs to a type of person with a global and creative vision. That seeks transcendence instead of people with logical, linear and computational capabilities, typical of the information age. In the middle of an intermittent pandemic, we will consider whether, as Churchill did with an old camera after World War II, we cling to the replica of the already known models that have shown their deficiencies, or we begin to anticipate what the new ones may be like. Physicalities, spatialities and social relationships will "shape" the future, and consequently us, or our alter-egos: the avatars. It is time to enter The Metaverse.

The Metaverse responds to the growing incursions and dependence on the virtual world, where users can interact socially and financially using an avatar. Interactivity, incorporeality and continuity are essential for its operation. The Metaverse concept is not new but originates in 1992 in the novel *Snow Crash* by American writer Neal Stephenson. In 2018, director Steven Spielberg popularised it with the film *Ready Player One*, based on the 2011 Ernest Cline novel of the same name. Different companies such as Epic Games, Roblox and Facebook are leading and developing their Metaverse concept which will converge the physical or tangible with the digital. These companies will not constitute the Metaverse by themselves. However, they are already the first "architects" and inhabitants in it, and they are anticipating a paradigm shift for many professions and markets, architecture being one of them.

As the futurist Matthew Ball points out in *A Framework for the Metaverse,* what happens in this space will become part of our culture. *"Building things with friends within virtual worlds will become common, and major events within the most popular virtual worlds will become pop culture news stories."*

AIMS

To learn from our experiences by taking an introspective journey to the food-space relationship.

To propose new ways of socialisation around virtual/ hyperreal food experiences.

To look around us and highlight the physical formats that are falling into disuse or being replaced by digital formats that reinforce our increasing dependence on the virtual world: digital money, documentation, art, workplaces, education, entertainment, shopping, and socialising.

To conceptualise the future and propose a new professional framework for architects and designers.

METHOD

Among the many transformations and changes in different sect ors that The Metaverse proposes, this workshop invites us to focus on a critical economic and social engine in most cultures. We will talk about food and its power to socialise. We will first look at it by analysing the traditional role it has played in our lives as a binding agent of social and family relationships, a builder of memories, and a stimulator of meanings. After looking at the past, we will now reflect on the relationship that food establishes with the spaces where it is enjoyed. More specifically, we will imagine those gastronomic spaces of the virtual future.

PART 1: FOOD-SPACE-FOOD (Individual Work)

Describe a space and food/ meal from your culture that both are intimately and uniquely intertwined, creating a distinctive symbiosis as a food-space relationship. Your chosen space gives the food a unique dimension, just as the food gives the space an exceptional grade. Tell us, using ppt format, how the food builds the space and vice versa.

Bonus reflection, any finding in other species?

PART 2: ARCHAEOLOGY OF THE VIRTUAL GASTRONOMIC FUTURE (Teamwork 3 Students)

After extensive research, groups will present, using ppt format, the most relevant findings of existing experiences around food, or that can relate to food, in virtual environments. Reflect on how this "Meta-reality" can affect our relationship with food. Conclude with a summary table/chart/ diagram of the most relevant features of the findings.

PART 3: 2043 (Teamwork 5 students)

We are in 2043, a hundred years after Churchill's mythical quote *"We shape our buildings; thereafter they shape us".* The students propose a space, menu and eating experience in The Metaverse for virtual social gatherings around food. The following will be designed and presented (ppt):

1.The virtual space: a transformable geometry and atmosphere

2.The menu: 1 starter + 1 main course + 1 dessert showing their cutlery and eating ritual

3.The eating experience in 4 interactions: avatar-avatar, avatar-food, avatar-space, space-food

Do not miss including Mr. Churchill's avatar in the performance. Important note: The student's mindset should be wholly detached from reality. A dining experience in The Metaverse should benefit from unprecedented, exceptional and fictional conditions.

Along with the ppt presentation, students will submit an A4 landscape manifest with the ten key features of the dining project. Each feature page includes the feature name, descriptive short sentence and image.

GUEST JURORS

Dr. Juan Carlos Arboleya. Physical Biochemist. Expert in improving sensory and nutritional properties of foodstuffs

José de la Rosa Morón. Gastronomic Scientist and Food Alchemist Lab

Dr. Georges Kachaamy. Architect, expert in Future & Virtual Environments

Jashan Sippy. Food-Architect. Expert in sustainable food future

José Antonio Antoli Salva. Architect, Enterpreneur

Dr. Francesca Zampollo. Food Design Thinking Consultant, Teacher, Facilitator, Researcher

Sergi Freixes. Historian, food designer and graphic designer.

Caroline Hobkinson. Anthropologist

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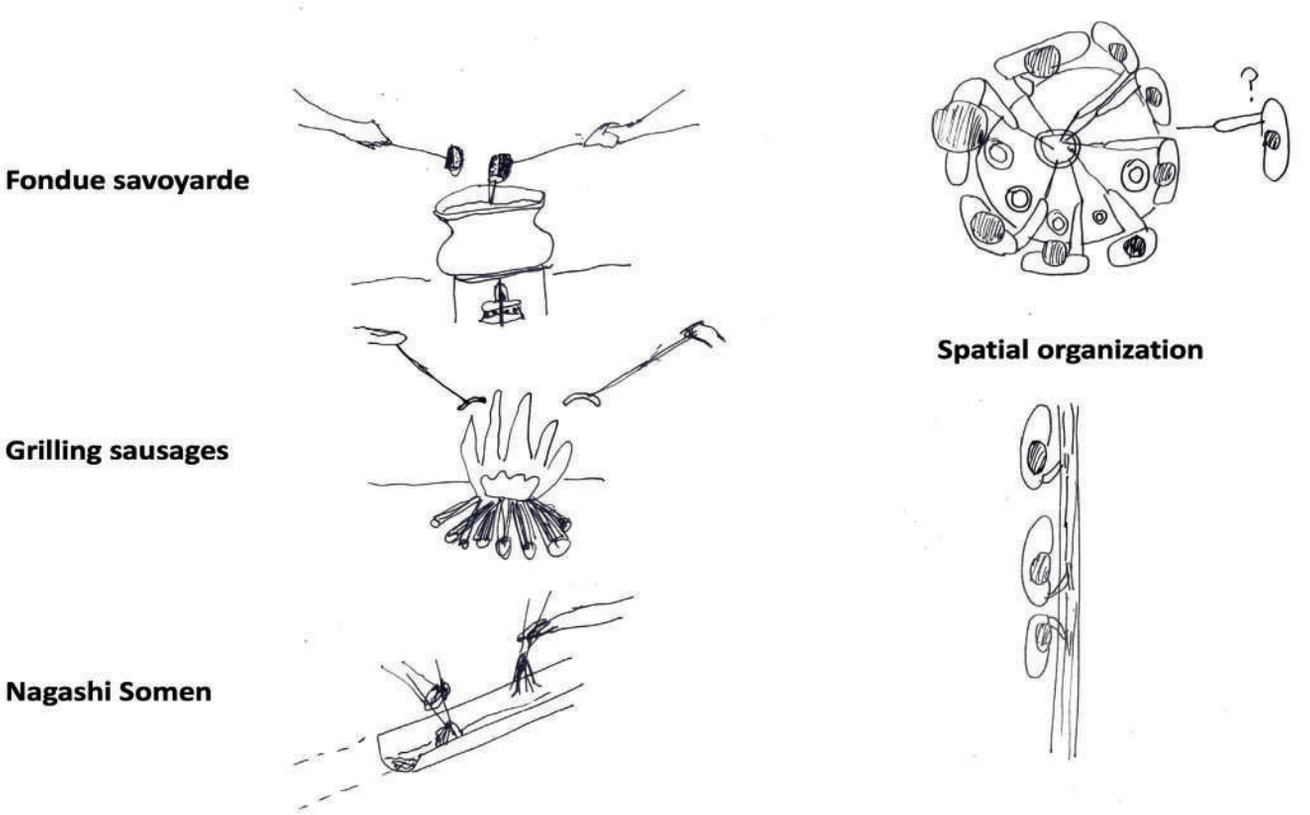
Part 1
Food-Space-Food

Theodore Curtius[1]

[1]University of Alicante, Spain



Fondue savoyarde

The fondue is a very social dish, originally from the Alps, between France and Switzerland. It involves a unique pot called a “caquelon”, put on a small stove that keeps the cheese warm and the consistency stable.

The fondue creates a circular space, like the primal campfire where everyone gathers around. Since the cheese needs to be kept at the same melting temperature, everyone has to reach for it from their seats, using special cutlery, the “pique à fondue”.

Grilling sausages over a campfire

This is probably an international thing to do when camping, but I remember doing it in Germany and France. The space is made of the campfire, the wood sticks that link the gap between the human and the food, separated by the difference of temperature, and the humans. It reminds me of fondue, even though in this situation the action is made to cook the sausage when a fondue is an act of helping yourself to get food.

Nagashi Somen Noodle Waterslide

This original way of eating noodles comes from Japan. The water flows and brings noodles that are dunked in a sauce inside a bowl before being eaten. You must fish for the noodles from the bamboo noodle slide with the chopsticks.

It is an architecture specially designed for this kind of meal, there is a fundamental relation between space and food.

Part 2 Archaeology of the Virtual Gastronomic Future

Theodore Curtius[1]; Vit Kucerovsky[2]; Taimaa Barakat[3]

[1,2]University of Alicante, Spain
[3]American University in Dubai, UAE

Part 3
2043
Se[tast]e you in the Metaverse

Theodore Curtius[1]; Vit Kucerovsky[2]; Taimaa Barakat[3]; Farah Ali[4]; Dheyaa Dheyaa[5]

[1,2]University of Alicante, Spain
[3,4,5]American University in Dubai, UAE

We design our own Metaverse food such that users can enjoy it from a Virtual to a Real World experience. We provide a gamified metaverse connected with real-world sense.

VIRTUAL SPACE

A rainforest start. The visitors arrive in a rainforest with ingredients ready to be harvested, hunted or fished. To enjoy the game experience, they have a list of ingredients they need to gather for the next steps and they can customize their avatars.

Cooking incubator. After collecting the required ingredients, they access a portal that teleports them into a cooking incubator to enjoy a cooking VR experience.

Cooking incubators are floating freely in the air space. Here represent a collective space, where users can cook, interact, taste and experience the virtual food together.

The Biomes are different scaled particles simulating different perceptions and environments. They stimulate our sensitivity and perception in the real world through their virtual experience. The largest scaled Biome 1 city is a rich structure. We can dive inside and find a smaller Biome 2.

THE MENU

Starters: Biomes soup (depends on the thing you harvested).

Main course: Taste your neighbour, kill him before.

Dessert: Architecture buffet (gravel, concrete, styrofoam).

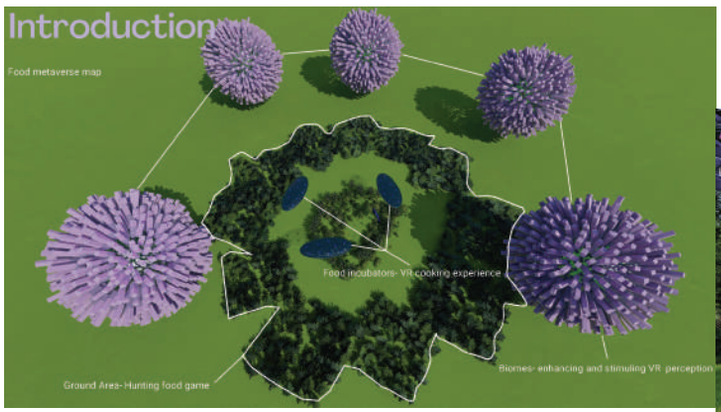
THE EATING EXPERIENCE

Starters begin in a virtual nature, an environment to explore with all the senses. A bubble in the middle of the biomes concentrates the visitors gathering everyone around food and together they cook what everyone looted in the Biomes.

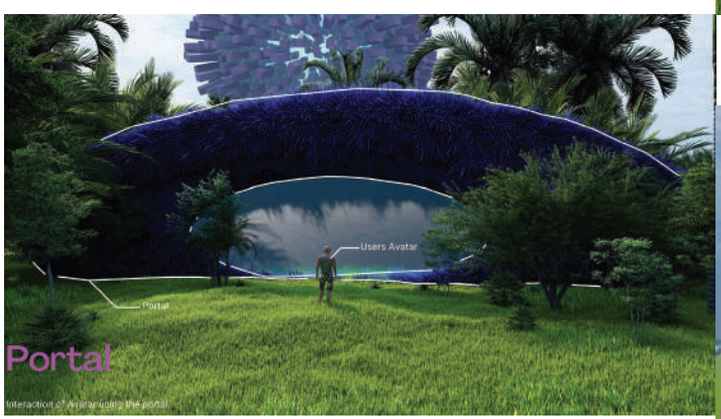
Cutlery

How and what do you eat in the Metaverse? VR Mask: puts you in the virtual world. Scent diffuser: get an olfactory perception of your environment. Water straw: carries water, whose taste is changed by the scent diffuser. Chemical diffuser and “consistency modifier”: a chewing-gum-like element that changes its consistency and diffuses a taste. Intra-bone conduction system: to hear the crunch of what you are eating.

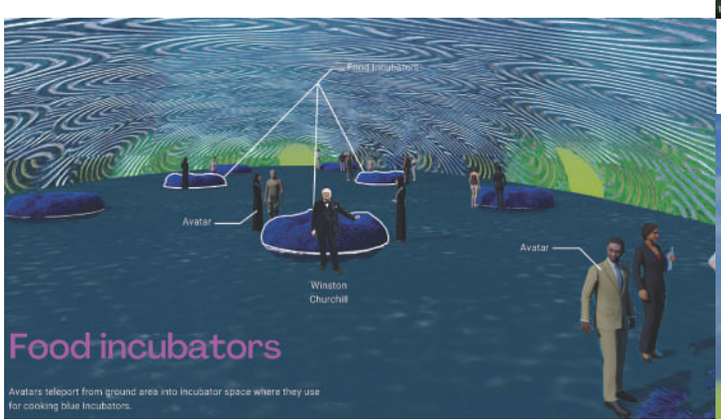
Video https://www.youtube.com/watch?v=of3N3IXmDp8

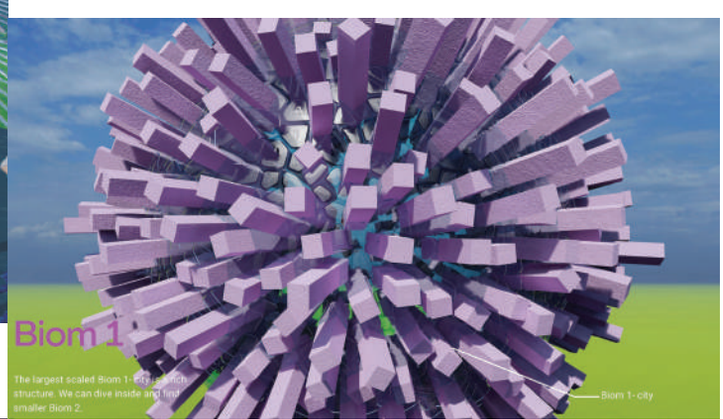

Introduction
Food metaverse map
Food incubators- VR cooking experience
Biomes- enhancing and stimulating VR perception
Ground Area- Hunting food game

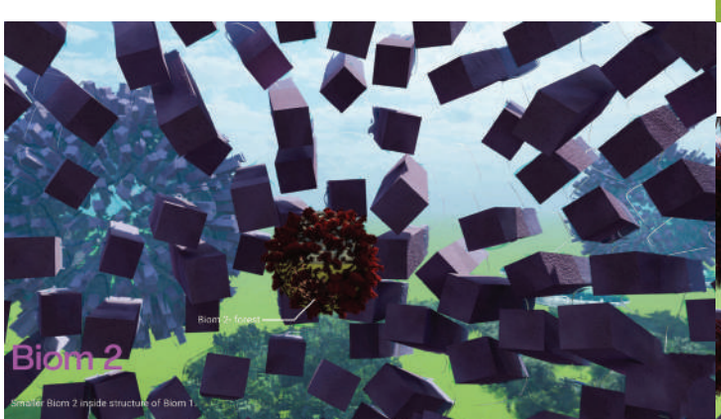

A rainforest start
User can customize his avatar and than collect the needed food
Food collectibles
Users Avatar

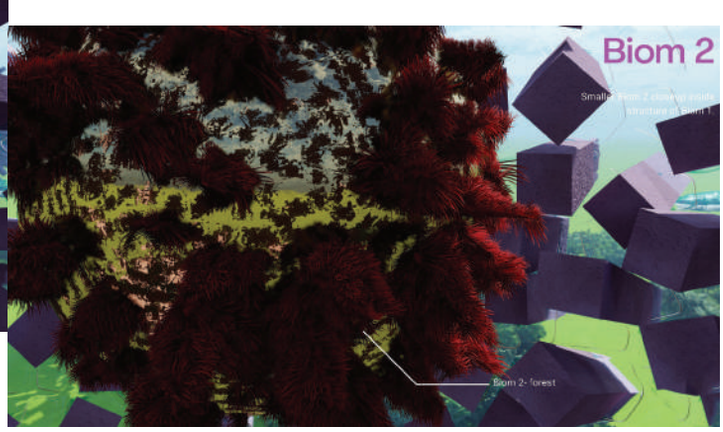

Users Avatar
Portal
Portal
Interaction of Avatar using the portal


Food incubators
Food incubators are floating freely in the air space. They represent a collective space, where users can cook, interract, taste and experience the Virtual food together


Food incubators
Avatar
Avatar
Winston Churchill
Food incubators
Avatars teleport from ground area into incubator space where they use for cooking blue incubators.

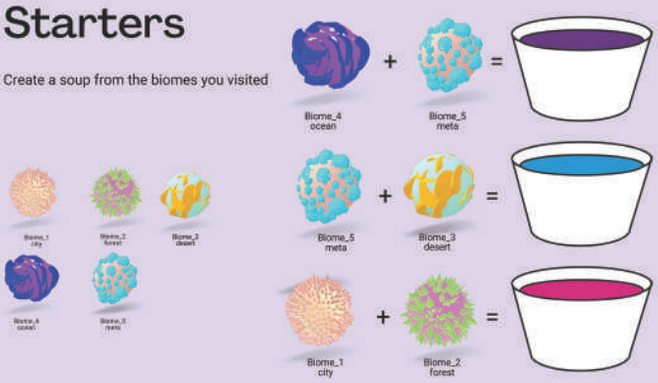

Biom 1
Biom 1- city


Biom 2- forest
Biom 2
Smaller Biom 2 inside structure of Biom 1


Biom 2
Biom 2- forest

Starters

Create a soup from the biomes you visited

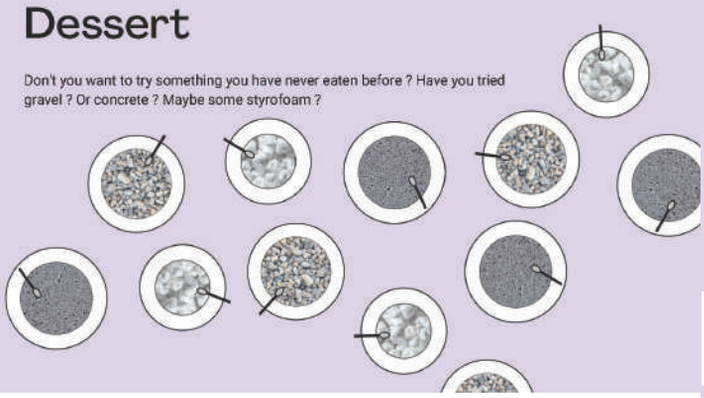


Main course

Someone has to die - let's taste what you are, to get to know you better !

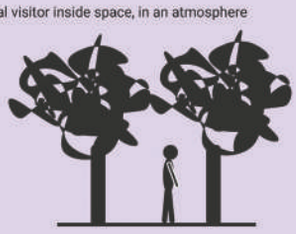
Dessert

Don't you want to try something you have never eaten before ? Have you tried gravel ? Or concrete ? Maybe some styrofoam ?



SPACE AVATAR

The virtual visitor inside space, in an atmosphere



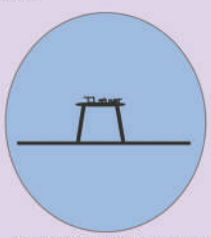
Starters begin in a virtual nature, an environment to explore with all the senses

A buble in the middle of the biomes concentrates the visitors to gather everyone around food

SPACE FOOD

How is the food intertwined with the space that surrounds it ?

The virtual nature to loot the ingredients

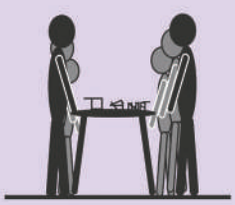


The bubble around food, protecting it and the gathering created by the food

AVATAR AVATAR

The relationship between the characters

Try the taste of someone Main course

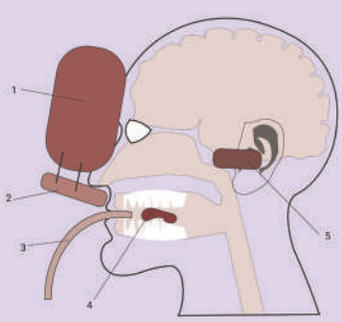


Cook together what everyone looted in the *BIOMES*

CUTLERY

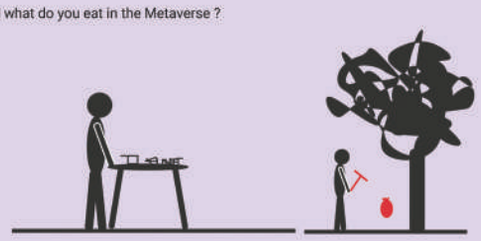
How and what do you eat in the Metaverse ?

1 - VR Mask
Puts you in the virtual world
2 - Scent diffuser
Get an olfactory perception of you environment
3 - Water straw
Carries water, who's taste is change by the scent diffuser
4 - Chemical diffuser and consistencer
A chewing-gum-like element that changes its consistence and diffuses a taste
5 - Intra-bone conduction system
To hear the crunch of what you are eating



AVATAR FOOD

How and what do you eat in the Metaverse ?



Cooking

Harvesting the food

WORKSHOP: Bigamies for gastronomy

Carrillo Andrada, José Antonio[1]; de la Rosa Morón, José[2]

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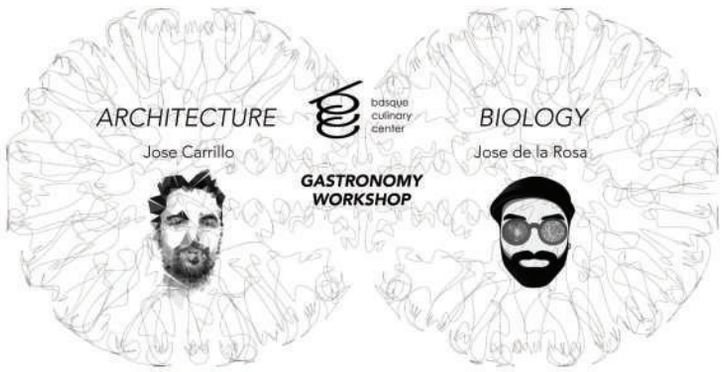
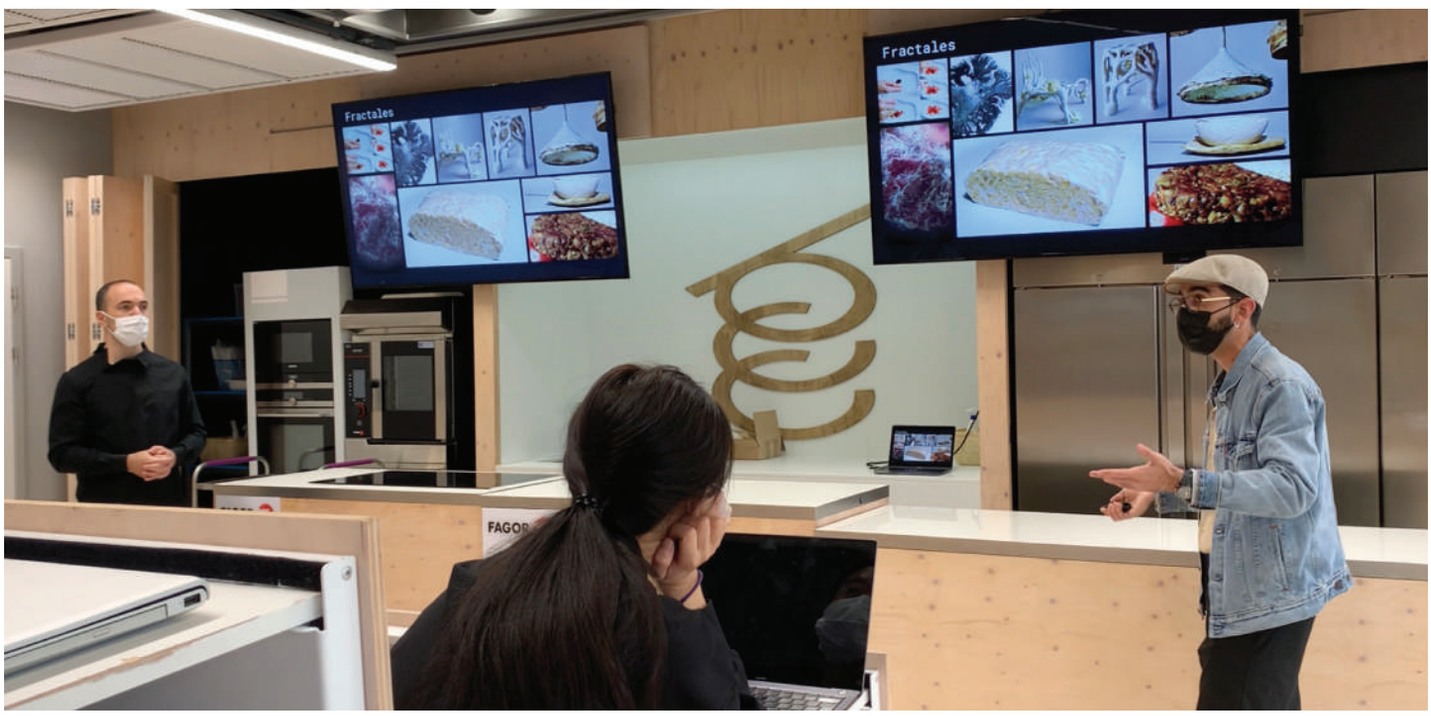
The workshop was held during the International Seminar and Workshop on Transdisciplinary Knowledge Transfer for the Master in Gastronomic Sciences of the Basque Culinary Center, Donostia-San Sebastián, Spain on March 13-17, 2022.

The students were grouped into their Master project teams: Sustainability, Enzymes, Plant-based/Towards 3S, Sensory Perception and Nutrition.

The workshop began with a lecture by instructors José Antonio Carrillo, an architect, and José de la Rosa, a biologist, where we shared examples that linked architecture and biology. We presented the concept of bigamy to the students through projects such as the Copenhill building by BIG Architects in Copenhagen in 2019. Case studies were shown where biology had inspired architecture to solve problems previously decoded by nature, and we spoke about biomimicry. Some soap bubbles models and studies were introduced to explain the design and structural analysis of the tensioned structures invented by Frei Otto for the Olympic Stadium in Munich in 1972. When talking about the minimum surfaces achieved in the stadium, we were also able to talk about the properties of gyroids, soap bubbles and their architectural translation in the Beijing National Aquatic Centre designed by PTW architects and Arup engineers in 2008. As well as the Edible Cloud - VOM - By Plat Institute 2021, a new gastronomic technique that allows generating flying clouds of thin helium-filled bubbles with infinite flavours and aromas. When talking about multidisciplinary teams that merge architecture and biology, we showed the work of Neri Oxman and her team, leading a new era for a design where microorganisms, bodies, products or buildings can interact symbiotically. So that instead of building them, they can grow, as is the case with the Silk Pavilion 2013.

Students were finally introduced to the assignment, the game Gastrogamy: Gamifying design innovation for a more sustainable future. Working in teams, they were asked to develop an unprecedented product, strategy, or gastronomic project that reflected the hybridisation of the backgrounds and specialties of the members of each team. They had to justify the value that multidisciplinarity and bygamies add and their potential economic, social and environmental impacts. The format for telling the proposal was left open, with options such as sketches, physical models, songs, courses, menus, presentations, videos, business models, etc.





The workshop pursued the following Learning Competences:

1. Integrate knowledge and face the complexity of formulating designs based on information that, being incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of their knowledge and judgments.

2. Know how to communicate their conclusions and the knowledge and ultimate reasons that support them to specialised and non-specialised audiences clearly and unambiguously.

3. Possess and understand the knowledge that provides a basis or opportunity to be original in developing and applying ideas, often in a research context.

4. Be able to use design thinking and methodologies from different disciplines and transfer them as innovative projects in the gastronomy and hospitality sector. To develop innovative business proposals in gastronomy and food design, sharing information with people, companies, and associations and consolidating an active presence in local and global markets.

5. Understand the aesthetic and sensory aspects of gastronomic products and acquire the ability to perceive, through all the senses, the images, impressions or sensations that said products evoke to know the sensory aspects of said products. Likewise, be able to evaluate the design impact and analyse the processes by which the client selects, organises and interprets the stimuli to give meaning to their gastronomic option.

6. Design standardization protocols for new food products or services, optimizing, directing and supervising the different processes.

7. Know how to apply the knowledge acquired and their ability to solve problems in new or unfamiliar environments within broader or multidisciplinary contexts.

Almarte: Almorta on Mars Plant-based Group

Leire Izagirre[1]; Álvaro Sánchez[2]; Rubén Palomero[3]; Irene González[4]

[1,2,3,4]Basque Culinary Center, Spain

The proposal developed by the plant-based group is to cultivate Lathyrus sativus (Almorta) on Mars to solve the problem of there being only limited space for cultivation on Earth. To do this, they propose creating an interdisciplinary working group where people from different fields, such as engineering, architecture, microbiology, agriculture and carpentry, jointly design greenhouses adapted to the climate of the red planet. This legume is chosen based on its beneficial nutritional properties and ability to be grown in extreme climates. Similarly, its ability to fix nitrogen in the soil is highlighted, which enriches the substrate necessary for the growth of other types of crops.


ALMARTE

Balloon Beer Sensory Perception Group

Natalia Oroya[1]; Shubham Sandilya[2]; Teresa Moral[3]

[1,2,3]Basque Culinary Center, Spain

Introduction

Following our union through our core project and with beer being the central theme of it, we consider that there is no better way to offer an experience to reflect our character as individuals and our journey as a team.

Need in the gastronomic world

In the search for a differentiating factor within the gastronomic world, we consider offering the customer an experience in which beer tasting and the customer are the centers of the project.

Proposal

The set has a base supporting all the elements that make up the dish. Also, the central globe encloses three main components of this experience, as these will reflect the customer's personality.

The three elements (globes) contained within the central one consist of three different preparations; they will be exposed to the customer when the central element is exploited. It should be mentioned that the three elements will be connected to the support by threads.

These three elements will be suspended and have different flavours, with which we seek to make the customer feel identified while tasting them. To determine the flavours, the team must carry out previous research on the flavours that cause pleasure or not to our customers. To make use of new technologies, the idea of using QR codes or surveys was raised, allowing us to know more about the customer and offer a more satisfactory experience.

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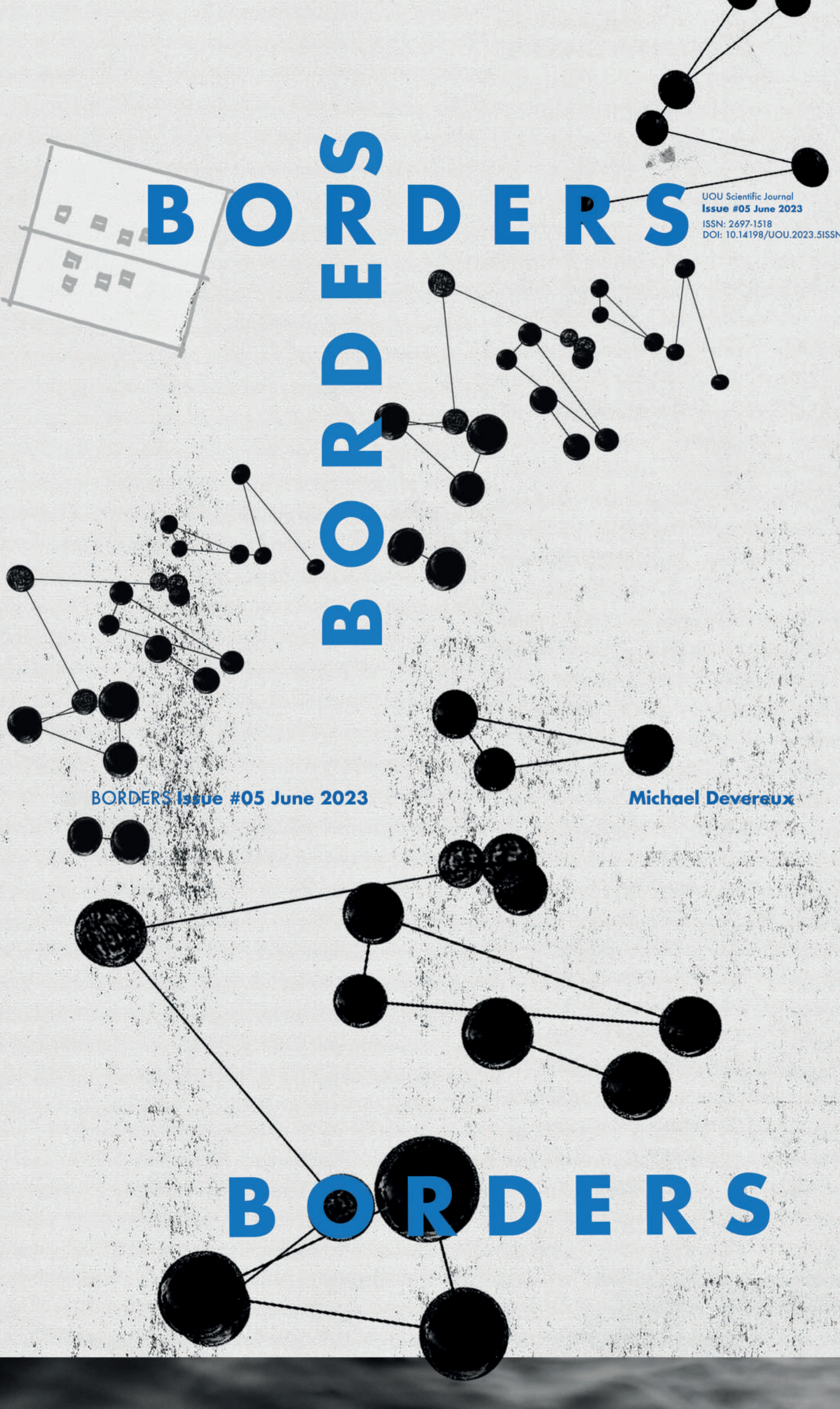

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Michael Devereux

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Issue #05 / BORDERS, Frontiers and Thresholds in Architecture and Urbanism

editor in chief: Mike Devereux (UWE Bristol, UK)

01 November 2022:
Call opers.
01 March 2023:
Full paper submission.
01 April 2023:
Outcome of double-blind peer review process.
01 May 2023:
Final submission of completed papers.

BORDERS invites contributions that explore the themes surrounding borders, frontiers and thresholds in architecture and urbanism – in their widest meanings and through many media. This call serves to introduce the theme, but contributors are encouraged to submit material that purposefully questions, discovers, explores and experiments with the subject in its widest sense at any and all of its scales.

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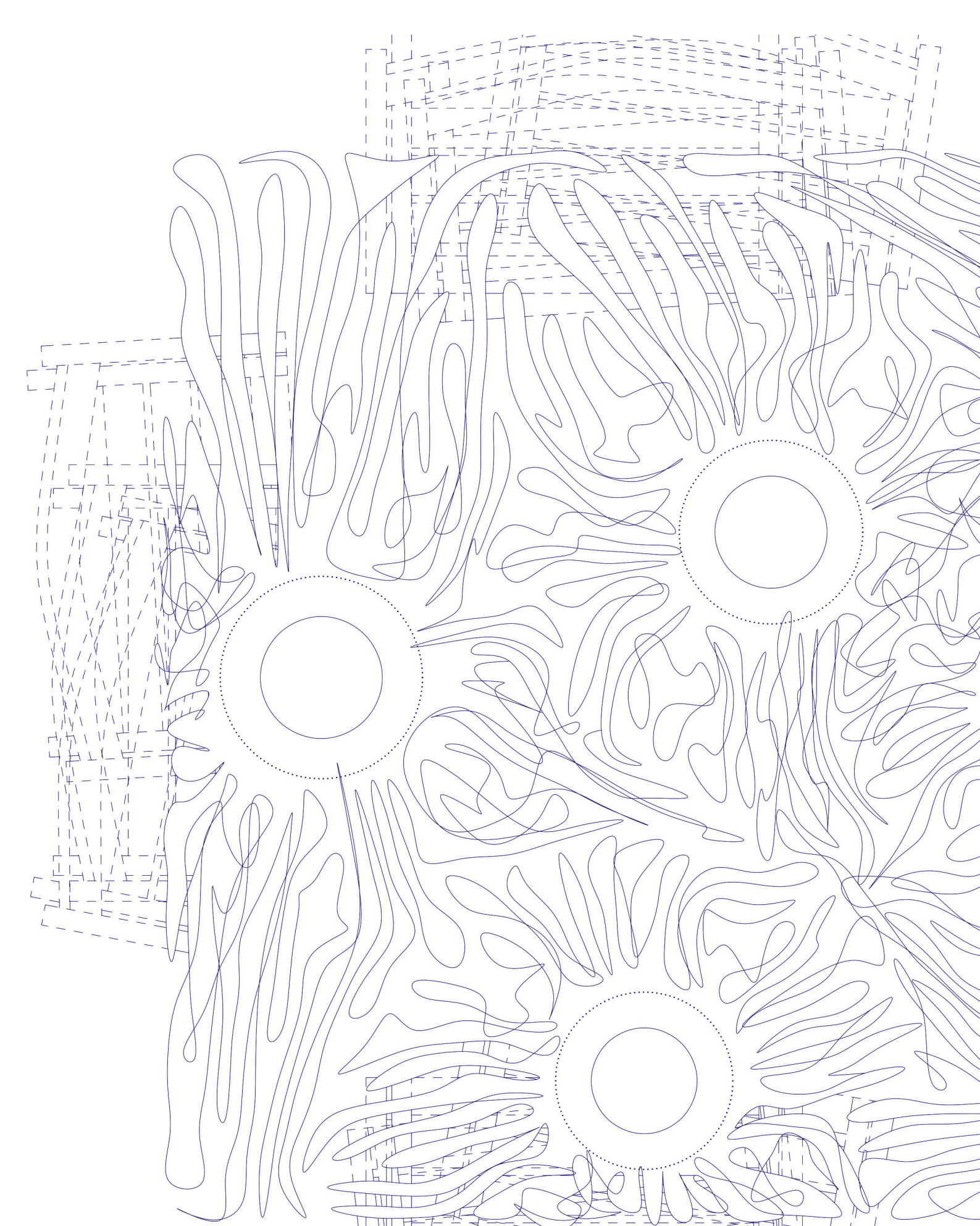
UOU is the scientific journal of **UNIVERSITY of Universities**. It is born out of the collaboration of international schools of architecture, sharing their intercultural interests.

Every issue underlines a specific topic addressed by one of the universities involved in the Research Project, with a focus on Pedagogy in Architecture.



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