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HOUSING NATURE, REPRESENTING »NATURE«: ARCHITECTURE OF CONSERVATORIES, GREENHOUSES AND THEIR TRANS-PROGRAMMATIC SCIONS

Abstract

Buildings intended specifically for growing plants – greenhouses, glasshouses, conservatories, orangeries and similar – represent relatively recent addition to the history and repertoire of architecture. In their three centuries of notable existence these structures managed to not only enable cultivation of climatically-exotic plants far away from their natural range, but also to form a particular genre of architecture, which developed through different phases, from high exclusivity to near irrelevance. Starting, not only from historical examples, but also form the general promise of enclosed ecologies, this paper aims both to analyze the phenomenon of greenhouse, as well as to propose directions for its possible further developments.

Keywords: greenhouse, glasshouse, conservatory, nature presentation, programmatic integration

ОКУПИТИ ПРИРОДУ, ПРЕДСТАВИТИ ПРИРОДУ: АРХИТЕКТУРА СТАКЛЕНИХ БАШТИ И ЊИХОВИХ ТРАНС-ПРОГРАМСКИХ НАСЉЕДНИКА

Сажетак

Грађевине намијењене гајењу биљака – стаклене баште, стакленици, оранжерије и сл. – релативно скоро ступају на историјску сцену и у општи репертоар архитектуре. Током своја три вијека постојања овакве структуре успјеле су, не само да омогуће узгајање егзотичних биљака далеко ван њиховог природног станишта, него и да се успоставе као посебан жанр архитектуре, који се развијао кроз више фаза, крећући се између високе ексклузивности и скоро потпуне ирелевантности. Полазећи, не само од историјских примјера, него и од обећања које са собом носе затворене екологије, у овом раду једнако се анализира постојеће стање феномена стакленика, као што се предлажу правци за његов могући даљи развој.

Кључне ријечи: стакленик, стаклена башта, репрезентација природе, програмске интеграције

1. INTRODUCTION: ORIGINS AND RELATIONSHIPS

Relationship between built space and plants is one of the most basic propositions of our experience of the world. Vegetation – or "nature" as it is often simplified to – represents the most basic context for architecture, save for climatic zones of extreme aridity, salinity or cold, and save for environments composed predominantly of built forms. Only sky "surrounds" architecture more often than plants. Still, for the most part of the architectural history, plants and buildings (especially interiors of building's envelope) very rarely entertained any sort of interconnectedness or close interaction. In classical antiquity such connections, on a grand enough scale and in royal interpretation, even qualified for a "world wonder" [1].

Several reasons for this lack of interaction appear as almost self-evident:

- Built space, as ever, being supremely resource demanding, costly and in short supply;
- Traditional building materials being often incompatible with humidity that larger plant ensembles demand (and also transpire).
- Translucent and transparent materials being (for a very long time) virtually non-existent and, later, very expensive.

Despite these reasons being crucial - and some of the associated problems insurmountable - no less important was also the lack of specific cultural, political and ideological preconditions for emergence of architectural-horticultural spaces. These preconditions have slowly started to emerge with early modern period and rise of two specific socio-cultural phenomena:

- Intense European exploration of the XV and XVI century, together with the fact that these (mostly naval) explorations were focused primarily on geographical areas with climatic conditions warmer than those found in Europe (that is, mostly tropics). From such locations, early (and later) explorers, often with some members of the crew versed in natural sciences, started to bring numerous seeds and live specimens of exotic plant life.
- Rise of the scientific method and worldview and, within it, clear emergence of distinct disciplines such as botany.
- Additionally, new narratives were also called for in the course of greenhouse building revivals of 1960/70's and 2010's. For seventies those were narratives of emerging (geo)systemic scientific disciplines, while the most recent impulses relate to either sustainability of food production, or to conservation of biological diversity - in an age of possible serious climatic disruptions.

With these historical conditions met, technological advances in iron and glass manufacturing started to shape the classical glasshouse – or 'conservatory' – of the XIX century. Still being very expensive, especially in light of existing glass and window taxations in England, France and other countries of Western Europe [2], the conservatory became the signaling device for wealth and social status. Initially being used for a wide variety of horticultural and social purposes, the glasshouse quickly became prime focus for many botanical institutions, which were in existence for decades and even centuries prior. Large conservatories, glasshouses, palm houses (etc.) were erect in Kew, Paris, Brussels, Copenhagen, Berlin, Vienna, St. Petersburg, New York, as well as in aristocratic estates, especially in Britain [3].

Figure 1. *Glasshouses at the Royal botanical garden Edinburgh [4],*

displaying an array of periods and elements: on the left side is the Temperate Palm House (Matheson, 1858) with substantial part of solid-wall envelope (quite unusual trait for the time, outside of the range of orangeries) and clearstory central nave for the tallest of species. On the photo, the Temperate palm house blocks the view to the octogonal Tropical Palm House (unknown architect, 1834). To the rear, research greenhouses (for nursery production, scientific work etc.) are visible, while the right side of the photograph reveals the Front Range (main glasshouse range, architect G. Pearce, 1960) with its hi-tec structural exoskeleton.

However, this glass-builders peak (exemplified most notably in Paxton's non-horticultural edifice of 1851) lasted only for several decades (approximately from 1830s to 1880s) and it brought forth buildings in relatively narrow stylistic range: cast- and wrought-iron girders, assembled for maximum span, and embellished in high ornamentation (traditional in appearance, but with few precise historical stylistic references) [3].

In this paper we will aim to outline the conceptual boundaries of the phenomenon of horticultural-architectural space, specifically in its version of botany-oriented programmes. We will explore reasons for the short-lived expansion of the XIX century and the logic (and inconsistencies) of the phenomenon's revival of recent decades. Further, we will try to (de)construct the conceptual apparatus for understanding and designing the botanical-architectural space, guided by its history, its general components, by recent examples and by our own design explorations in the field. Moreso, we will propose that there is a specific programmatic and aesthetic field in architecture, which is based on (re)presentation of botanical world. We find compelling reasons to increase clarity in this field, since the inflation of vegetation-related concepts threatens to unnecessarily and regretfully collapse the "bubble" in a similar fashion to the way it has happened at the end of XIX century.

2. DEFINING THE FIELD: CONTROLLED ENVIRONMENT

Great botanical conservatories[9], as well as their small, private, offshoots are far from being the only – or even representative – forms of plants grown in enclosure. The broadest typology, according to purpose, might be summed up through four broadest designations: general gardening, agriculture, special purposes and botany.

2.1. GENERAL GARDENING

These often combine several purposes, but also remain present in many other types, since interest in the practices of gardening and resulting ambientes are hardly ever absent from precisely designated botanical spaces. However, they do exist as a type in itself, in countless small conservatories, most often private, intended for growing of food, ornamentals and simply for pleasure.

Figure 2. *Interior of the Embarcadère Greenhouse, Royal Greenhouses of Laeken (arch. Alphonse Balat, 1874-1890), Brussels: glasshouse designed and used predominantly for enjoment of garden atmosphere, without any botanical pretensions. [5]*

[9] Note on terminology: "conservatory", "greenhouse" and "glasshouse" can often be used interchangeably, except when the applied materials dictate otherwise. "Glasshouse" is obviously inappropriate when glass is substituted with other translucent material. "Greenhouse" is the most general term, though it has its narrower connotation: small garden structure, often with glass alternatives. Here, interchangeable use is often only due to stylistic requirements of the text.

Historical accounts often mention origins of controlled environment gardening as being the matter of courts and royal wishes and excesses. According to Pliny the Elder [6], physicians of Emperor Tiberius (cca. 30 AD) proposed to the Caesar to eat a certain kind of vegetable (a cucurbite) every day of the year. Imperial gardeners achieved the task by devising carts that were drawn inside buildings by night, drawn outside by day – and on cold days covered with semi-transparent mineral slates (selenite). Much later, in different part of the world (but a few centuries prior to any European example of the age) Korean royalty in 1450's also enjoyed prolonged growing season of citrus trees, housed in structures covered in with *hanji* (specific kind of oiled paper), heated with ondol (underfloor heating), with substantial thermal mass of several earthen walls [7].

Proper greenhouses and orangeries started to appear in Western Europe in XVII century, mostly enticed exactly by gardeners (for citrus and other fruits, as well as for apothecaries) [3].

General gardening – for purposes of enhancing ambience and character of architectural spaces – remains today by far the most dominant form of horticultural-architectural space, from modest attached extensions in residential context, through all kinds of "green" embellishments of commercial enterprises (including housing), up to large public projects for new or revitalized spaces.

2.2. AGRICULTURE

Outside of scope of gardening and its multilayered interests, bulk production of food did not converge with controlled environments for very long time. It can be argued that demise of glasshouses as architecture coincides with continued improvements in glass and iron/steel manufacturing, which, especially during last decades of XIX century, democratized ownership of conservatories, thus decreasing its allure as wealth signaling item [8]. These same improvements brought forth opportunities for mass production of food, thus removing almost all practical limits to spread of agricultural controlled environments. The greenhouse escaped the realm of architecture, first into only specific tasks of agriculture and, later, into becoming significant force in shaping entire landscapes - like in Netherlands (where glass as material of choice still dominates) or south Spain (with polyethylene or other kinds of oil-derived translucent materials).

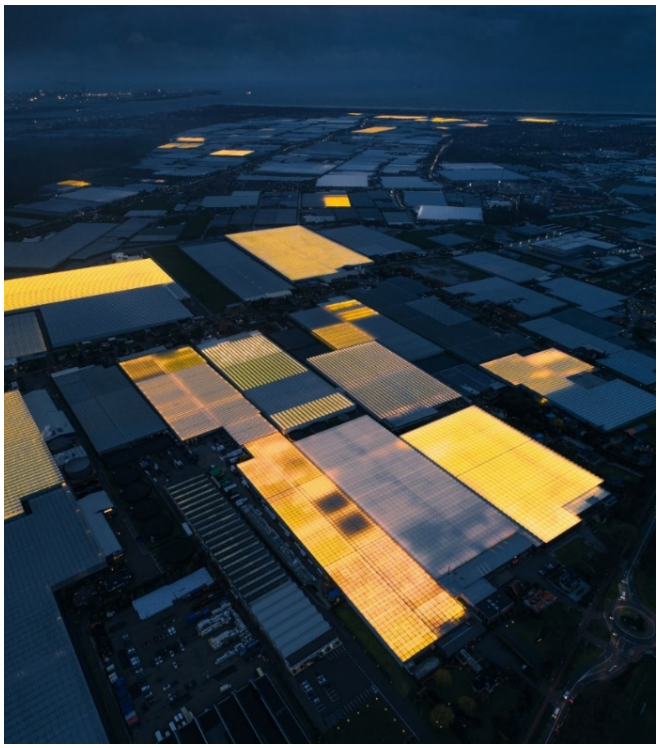

Figure 3. *Landscape dominated by agricultural glasshouses in Westland, Netherlands.[9]*

Past two decades has seen reconceptualization of agricultural greenhouse as particularly useful to architecture. Environmental costs of food production and transportation have made urban environments to be seen as adequate locations for reintegration of urban life with agriculture/gardening. [10] New concepts of "urban farms" emerged, either as mono-thematic or overlapping with other architectural progammes. Up until now, few have been built and put to (effective) production.

Figure 4. *Agrotopia, agricultural greenhouse with visitor and research facilities atop the agricultural market, Oostnieuwkerksesteenweg Roeselare, Belgium (Meta Architectuurbureau and Van Bergen Kolpa Architecten, 2022) [11]*

2.3. SPECIAL PURPOSES

During second part of XX century, specific qualities of light-admitting controlled environments attracted attention for experiments which surpassed individual disciplines such as botany or horticulture. Drawing both from theories of ecological microcosms [12], earth system science and perceived need to develop material and operational basis for outer space colonization, experiments such as Biosphere 2 were established, in which broader (systemic) parameters of general climate, energy circulation, biological productivity and human integration were deemed more important for exploration, than researching and presenting individual species[10]. [13]

Light-admitting and heat-retaining enclosed spaces do offer themselves for numerous other tasks, sometimes highly derived and quite innovative. For example, practices of ecological design, originating profusely in 1970's, greatly emphasized potentials of the greenhouse, in many combinations (for example, animal husbandry with entrapment and use of residual animal heat [14]. Perhaps the most interesting, both technically and culturally, is the use of greenhouses for biological wastewater purification. Pioneered by John Todd, these systems used complex assemblies of many kings of organisms (fungi, algae, bacteria, protozoa, up to molluscs, fish and higher plants). These would be assembled in purification sequences, in order to use up the organic matter in wastewater or bind the inorganic pollutants. Controlled environment envelope would be indispensable for optimal and consistent functioning of such systems, especially in temperate or cold climates [15]. The resulting appearance is that of a multifunctional greenhouse, where plants do dominate in size, but it is not strictly botanical or horticultural structure, but a *biological* one (in a sense of encompassing many kingdoms of life: plants, fungi, animals, bacteria etc.). It is also *ecological* (in a sense of both spontaneous and purposeful arrangements of organisms into interconnected systems). Finally, it is also *technological* (in a sense of having precise tasks, utilitarian boundaries and strict performance parameters). In addition, it represents an object with wider cultural mission: to address usual (mis)understandings about water, pollution, interconnectedness of life, and vitality of natural systems. Todd's work resulted in establishment of several smaller (often experimental) waste water treatment facilities, but it also fundamentally influenced a specific niche in waste water treatment technology. There, plants and glasshouses are being presented as tools for new urban integrations of these formerly unsightly technological facilities.

[10] Bioshpere 2 included two research "missions": with human crew being closed inside this ecological microcosm for up to two years, with food production and other life-sustaining systems being set up inside.

Figure 5. *Figure 5. South Pest Wastewater treatment facility (Budapest, 2012, architecture authorship unknown to us): Plants grown in controlled environment assist in the process of aerobic/oxygenated fixed-film waste water treatment.) Photo: paper's first author*

2.4. BOTANY

Botanical greenhouse (*stricto sensu* speaking) represents only a special purpose, if judged by predominance of use – since agriculture and general gardening cover by far the most of space and of individual examples. However, in terms of architectural achievements and paradigm framework, both historical and recent, it is botany (and its adjacent life science disciplines) which define the field.

There is a great degree of overlap between botanical conservatory and the one for general gardening and amenity purposes. Differences are linear, rather than discrete, but the main defining parameter remains probably the level – and the whole narrative – of *information* related to plants and their assemblies. In following sections, we will further explore properties and opportunities of botany-oriented conceptions.

3. BASIC SPATIAL AND MATERIAL PROPOSITIONS

In regards to the way architectural-horticultural spaces are conceived and materialized, we propose relatively simple set of parameters, leaving more complex ones for elaboration on a more conceptual level, as well as for exploration of design possibilities. Controlled environments on the interface of horticulture and architecture can be structured through:

3.1. TYPE AND DEPLOYMENT OF A LIGHT ADMITTING ENVELOPE

3.1.1. Translucent envelope being nonexistent

This possibility pertains, for the most part, to the creation of favourable microclimates through (partial) encirclement of plant-growing space by buildings, free standing walls, depressions in the ground etc. It offers relatively little in terms of increasing critical minimal annual temperatures. (For example, cloudy winter days with little solar gains, followed by clear night sky can result in temperatures similar to those outside of this microclimate.)[16] Still, there are possibilities for advancement of growing conditions on the opposing side of the spectrum: developing extremely warm (and dry) conditions for proper fruiting or flowering of certain species (as well as for avoiding certain plant diseases).

Traditional walled growing enclosures (either ancient or in XIX century intensive urban agriculture) are the principal example, but there are examples of combined use of this approach even in the relatively recent large scale botanical conservatories

Figure 6. *Walled orchards in suburbs of Paris, first half of the XX century.[17]*

3.1.2.Translucent envelope being auxiliary

Most (older) historical examples revolve around this concept: Tender exotic (or out of season) plants do grow outside in favourable weather conditions, but remain housed under translucent material in colder weather and/or by night. First (large and formal) European solutions for controlled-environment horticulture were *orangeries*, high-ceiling, high-aperture and multiple-door buildings intended for housing citrus (and other) plants during winter or night. During warmer parts of the year plants, in pots, would be carted outside, often to be formally presented in designated park-like spaces adjacent to the building itself.[18] Similar to the previous category, solar orientation of the buildings and yards would be such as to maximize thermal and light gains. Versailles orangerie, designed by Luis Jules Hardouin-Mansart, built from 1684 to 1686, represent one of the most prominent examples of this type of building. Smaller and simpler orangeries of the similar age exist in many other locations, with examples from Kensington (1705, Hawksmoor), Belvedere (Von Hildebrandt, 1714), Kew (1761, Chambers), Kuskowo (Argounov, 1764) and other accros Europe and somewhat later North America. [18]

Figure 7. *Orangery at Royal Botanical Gardens Kew (arch. William Chambers, 1761), now serves as a restaurant. [19]*

3.1.3.Buildings with (significant) translucent envelope - proper greenhouses.

Since this category comprises the central theme of this paper, here we will only note certain trajectory of change in the nature of the envelope itself: namely the innovation in designs of larger spans and hemispheric spaces. Second part and the end of the XX century saw large botanical conservatories being constructed in some form of geodesic dome, but it also saw acceptance of translucent materials other than glass. Most prominent examples include The Climatron, the greenhouse of the Missouri Botanical Gardens (Murphy and Mackey 1960) and much later the Eden Project (Grimshaw, 2001). These innovations were partially led by ambitions for both greater light penetration and increased energy efficiency: Replacement of heavy glass asks for fewer and smaller construction members, especially since single paneled glass remains unacceptably bad at conserving

heat, while multiple paneled glass elements would add even more to the weight. Advancements can be considerable, such as in the Eden Project, where main hexagonal elements span 11 meters, due to the lightness of ETFE insulated „pillows“ and with proportionally very thin and scarce structural members [20] . New and prominent glass envelopes are still being constructed, however. Remaining issues with thermal properties of glass are addressed either by adequate placement of other elements of envelope (see further: The Great Glass House by Foster and Partners), or by substantially less need for heat conservation (subtropical climate of Singapore's Garden by the Bay, Grant Associates et all., 2006-2012).

Figure 8. *The Eden Project, Cornwall, UK (arch. Nicolas Grimshaw, 2001), the largest public/botanical greenhouse in the world. The envelope is comprised of hexagonal-triangular tubular steel structure, covered with inflated panels made of ETFE (ethyltetrafluoroethylene). [21]*

3.2. TYPE AND DEPLOYMENT OF A NON-TRANSLUCENT (HARD MATERIAL) ENVELOPE

Besides being the important from the point of view of architectural composition, solid (and especially high mass) materials represent the valuable repository of heat, often gained in large quantities on clear days. This thermal mass enables moderation of temperature extremes – an uncommon concern of the XIX century classical conservatories of Europe’s temperate and humid North-West, unheeding regarding energy, at the time.

Deployment of hard materials in greenhouses can be structured as following.

3.2.1.None - ground being the only hard material, besides the skeleton

It is worth noting that the relationship of the ground and the upper translucent envelope can vary, from ground being flat, through constructing dug-ins on slopes (properly oriented, as in classic passive solar design of the 1970’s), to construction of greenhouses in depression. For example, Nicolas Grimshaw’s Eden Project is constructed on top of abandoned kaolin surface mine, While Norman Foster’s design for Great Glasshouse of the National Botanic Garden of Wales (2000) creates intentional earth banks on the lower (especially northern) parts of the greenhouse.

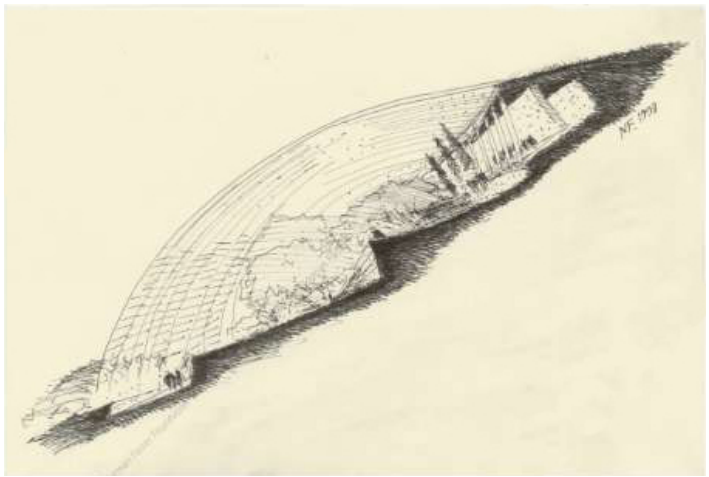

Figure 9. *Norman Foster’s sketch for the Great Greenhouse (arch. Foster and Partners, 1995-2000) of the National Botanic Garden of Wales. Ground “envelope” has several indentations across the section, in order to provide opportunities for heat capture and microclimate formation. [22]*

3.2.2.Hard materials being integrated in the envelope

As a type, classic orangeries, provide the most illustrative range of this integration: from solid materials dominating and forming inconspicuous (non horticulture-related) architecture, to roofs, and other parts of the envelope dissolving into transparent glass domes.

An important design consideration here becomes the ratio of thermal protection (provided by mass) to light penetration (provided, of course, by translucent materials)[16] The aforementioned orangeries – the more enclosed ones - could do away with maximum light penetration due to seasonal nature of their operation. Most of their plants were not tropical and thus had some form of dormant season, which, when acclimatized to temperate climate conditions, could be spent in less than ideally lit buildings.

Figure 10. *(Half)greenhouse, Banja Luka, Republic of Srpska, Bosnia and Herzegovina (arch. papers first author, 2011-2014) during construction of the heat-retaining northern wall and roof structure. Materials: earth, straw, wood, glass. Photo: paper's first author*

3.2.3.Greenhouses attached to other buildings

Here, besides architectural composition (both visual and spatial-programmatic), the main subject becomes the thermal and ambient interdependence between the main (hard material) space and the attachment. Unlike attachment, integration of greenhouse space with that of hard material architecture belongs to different conceptual domain, and in this paper will be explored in following sections.

4. CONCEPTUAL PARAMETERS AND POSSIBLE DESIGN AVENUES

I think one of the big architectural issues of the future is realizing the real significance of plants in human life. And the connection between plants and buildings can only get closer, I think.

Nicolas Grimshaw[20]

Enclosed – architectural that is - spaces admitting enough light and providing enough room for not only plants but their whole assemblies to grow, represent a rare addition to the historical *progress* of architecture – obviously not in a sense of material improvements, but in the sense of paradigm expansion. World of vegetation accepted into the world of *shelter* seems to offer a promise upon which indeed has been acted upon, but whose potentialities have hardly been exhausted.

Based on previously elaborated history and typology, herein we propose a matrix of parameters for design of greenhouses, as fully integrated elements and entities of architecture.

4.1. PROGRAMMATIC INTEGRATION AND SPATIAL DISPERSAL

Despite attached greenhouses being an established genre for considerable time, further integration still remains a fecund possibility – especially in domain of plant assemblies intended for botanical presentations. Botanical conservatories have historically, almost exclusively, tended to be isolated programmes, spaces and forms (and this includes the *attached* version). Modernist as well as more recent attempts certainly made steps toward further integration, but mostly in some form of a ‘great hall’. A decent example of this approach is found in Sheffield Winter Garden (by Pringle, Richards, Sharratt, 2002), while New York’s Ford Foundation (Roche, Dinkeloo, Kiley, 1968) remains one of the earliest - and arguably one of the most successful - integrations of semi-botanical plant assemblies and large, unifying hall-like spaces in buildings not primarily related to plant-presentation or leisure.

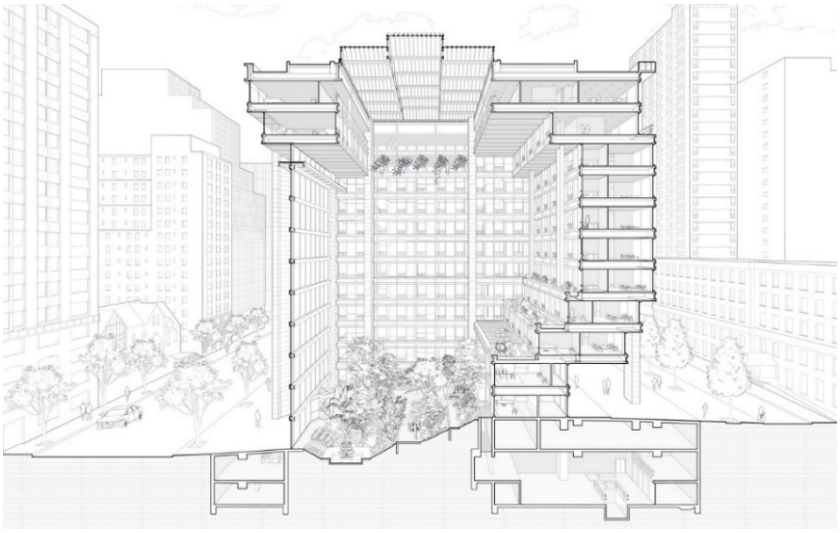

Figure 11. *The Ford Foundation, New York (arch. Kevin Roche, const. John Dinkeloo, 1968), perspective section. [23]*

Indoor botanical presentations have predominantly tended to form ever more isolated units, which was based on both botanical categorization/grouping as well as on needs for maintaining of proper climatic conditions. These conditions can differ strongly in between, for example, spaces devoted to desert plants and those devoted to warm humid environments. Further development of conservatory concepts stressed even more these groupings based on climate, rather than strictly botany. If this tendency to isolate space strictly along "scientific" lines is at least modified then broad opportunities arise to weave botanical narratives with other architectural programmes.

Figure 12. *Concept for the central building of Trapisti Arboretum, Banja Luka (arch. Paper's first author, third author and second author (exact order), 2020). Section through glasshouse and entry space, showing also use of ground indentation for thermal as well as spatial reasons (lowering of building's profile, while increasing the useful height). General spatial disposition, with glasshouse being an integral part of architectural form; its presentational function is continued into the solid envelope, which it transforms through thin clearstory roof opening. Photo: paper's third author.*

4.2. HIGHT VS GROUND

The dimensional range of different plant species is very broad – and it is conceptually relatable to dimensional-programmatic range of human built structures. Great conservatories, both contemporary and historical, have mostly responded to these botanical spatial requirements by creating spaces with balanced spread of ground surface to height – by creating, in the broadest sense, the hemispheric "bubbles". Variations, in XIX century examples, amounted mostly to incorporation of basilical structural and spatial composition, which allowed for taller plants to stand in central nave, and smaller ones in aisles. Still, geodesic domes of the past several decades contributed to the homogenization of the vertical-horizontal composition of the greenhouse. We believe it can be argued that this insistence on all-encompassing, even-spreading and homogeneous space greatly contributed to architecture of conservatories rarely surpassing its ascribed domain of aristocratic *folie* or scientist's glassed garden. Differences in plant height – and, additionally, in root space requirements – offer a much more diverse and structured palette of elements for architectural

composition. Here, the theme of *ground* shouldn't be overlooked: the rooting space of smaller plants is much more architecturally malleable than the verticality of palms and trees.

4.3. OBJECTS VS LANDSCAPES

Leaving (relatively) small botanical domain aside, we should pay additional attention to the main field of *production of space* in regards to enclosed horticulture – that of sprawling landscapes of agricultural greenhouses. Rather than confining it out of scope of architecture (or viewing it only in terms of the "phenomena" to be researched) these landscapes can be recognized as legitimate context of any architectural incursion. This seems especially valid in light of intensive (controlled environment) agricultural systems near or within urban centers having ever more importance for providing food for growing population. It is in these "seas of glass" that the solid-material architecture can play an organizing role, especially in conjunction with pronounced verticality or visible, out-of-glass, greenery.

5. CONCLUSION

Cultivation of plants in controlled environments – in *greenhouses*, *conservatories*, *glasshouses* - has been a very specific programme of architecture since its inception in XVII or XVIII century. Different demands for light (compared to those related to human indoor use) have at first prevented this architecture from emerging, but later, with advancements in iron and glass production, it quickly went to create fully illuminated, completely glazed buildings. These buildings, having their first and highest peak in XIX century, quickly created its somewhat simple and soon irrelevant genre– despite the ethos of the age being very favourable of glass as an instrument of architecture. A certain revival does appear from the 1960's onwards, but with high correlation to new types of construction (geodesic domes) with still little scrutiny given to the exclusivity of glass-only envelope and to the detriments of form based only in geometry. Adoption of the greenhouse in commercial agriculture, with the resulting uncontrolled growth of its use, pushes this type of structure further away from generally accepted realms of architecture and complex design. (Recent explorations of urban agriculture did however provide some renewed interest and relevance.)

Starting with the idea that basic tenants end elements of the *idea of greenhouse* promise substantially more than the history of its implementation has yet managed to provide, in this paper we proposed the structure for understanding this idea, as well as what could be, in our analysis, key design landmarks. Understanding begins with covering of basic domains of appropriate use of controlled horticultural environments, where historical dominants of gardening and agriculture are supplemented with special applications, such as constructed ecological systems for research, waste-water treatment etc. This analysis places the historical flag-bearer – the botanical conservatory – only in 'special' category, but, in doing so, implies different quality and potentiality of narratives of botanical/climatic/ecological assemblies compared to those intended only for general gardening/amenity.

Analysis of essential spatial and material propositions determines the typology according to the nature and potentialities of different types of envelopes, starting from the main one – the ground. Distribution of hard envelopes proves to be undeservedly neglected, thus suggesting the direction for possible programmatic and design improvements. However, surpassing the mere remolding of the mono-programmatic greenhouse, certain opportunities arise for (as of yet) sparsely explored cross-programme *integrations*. As the most promising among many, three conceptual parameters of integration are proposed for further expansion of the field:

A) rejection of the paradigm of the single, unified and maximized greenhouse space, or, in other words, suggestion for its *dispersion* throughout other spaces and programmes with which enclosed botanical spaces are being integrated;

B) malleability and expressive potential of markedly vertical plant spaces, along with the horizontal axes and pronounced adaptability of the concept – and spatial distribution – of growing *ground*.

C) Acceptance of sprawling agricultural *greenhouse landscapes* as a legitimate and interesting contexts for interpolations of solid-materials architecture.

In its most developed conceptual form, controlled environments containing exotic plants – organized and presented precisely as such (as ambassadors of biological and planetary riches from far away) – can play a role of secondary context. It would make for a complete additional layer of natural surroundings added to the one exiting in location. It also expands the notion of location, including the orientations according not only to near and far surroundings, but to the place and role of buildings and humans in larger processes of the Earth.

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