Andreas Rumpfhuber (Ed.)

INTO THE GREAT WIDE OPEN

Jon
Goodbun

THE CELL, THE FIELD, AND THE TOWER: THE SPACES OF ECOLOGICAL CYBERNETICS

Ecology and cybernetics, in their everyday folk meanings at least, might seem to be completely dissociated fields: the first suggesting the study of living organisms in their environments, and the other conjuring images of automation, machines, and their control and management. They share however a concern with understanding systems, and as even the most cursory study shows, the histories of these concepts are intimately intertwined with each other. In fact, I argue that they have a common structure in a certain abstract spatial imaginary which determines thinking about systems in modernity. This spatial abstraction itself emerges through a new division of labour which transformed our production and thinking about bodies, machines, and buildings. This is the story of three architectural typologies – the bounded cell, the networked field, and the observatory tower –, a story which raises questions about the nature of architecture and its relationship to other forms of technical and scientific knowledge, and to systems theory in general.

The Second World War and the period following saw a reorganisation of production through cybernetics – here broadly understood as information technologies and their modes of deployment and operation. In the Soviet block, this was ultimately stymied by infighting within the swollen bureaucratic class; yet in the western capitalist economies, the decade of state capitalist war economics had transformed social, management, and labour relations, in multiple and contradictory ways. This prepared the ground for a social democratic capitalism, and a multi-scalar restructuring of the *oikos*, through a new kind of individual, home, city, and economy: a new system of production. However, the cybernetic reorganisation of production was not solely concerned with the production and management of human subjects, nor with the management and production of objects, cities, and spaces. Both were rather, part of a process of intensification of a specific rearrangement of the human metabolism as a whole within the broader web of life on this planet; a process whose development has followed flows of capital, yet whose roots (and futures) can be traced beyond this economic form. The so-called cybernetic turn was in fact primarily an ecological turn, a reorganisation of the production of nature on this planet (and increasingly into interplanetary and even interstellar space).

Modern – and here I mean modern in the broad Renaissance or Enlightenment sense – architectural, urban, and planning thought shared important moments of development with the natural sciences in general, and systems thinking in particular. Indeed, for the Venice School and Tendenza, architectural theorists broadly associated – from the sixties on – with Manfredo Tafuri and Aldo Rossi respectively, it was these very conditions of the emergence of architectural thought that determined the problems of modern architecture in a more narrow and contemporary sense.

Architecture developed in post-Enlightenment Europe as a discipline and practice suspended between the emerging scientific and technological arts and the need to plan cities and landscapes for a growing capitalist economy. All of these practices – planning, architecture, economics and accounting (notably double-entry book-keeping which introduced a new and abstract conception of the future), and the natural sciences – involved a new kind of thinking about systems, and new formations of space and time. The aesthetic 'system' which is first proposed by Leon Battista Alberti in fifteenth-century Florence reaches a particular self-consciousness in the Rossi-Tafuri axis, and architecture is faced with a choice: dissolution into inter-disciplinarity, or a dialectical engagement with techno-scientific development through autonomy, where the definition of architecture was expanded as a particular kind of theory-based systems discipline which included the city as its object. Describing the thinking of this period, Marco de Michelis for example would state that the "city as total architecture became describable and interpretable both in its wholeness and in the parts of which it was composed. ... The characteristics of its growth, its various social, economic, and political components, could finally be led back to a sole principle and a single practice."[1]

Thus, although not explicitly cybernetic, the discussions on the Italian left around autonomy, both in architecture and beyond, were shaped by systems thinking, and paralleled and anticipated

1 De Michelis, M. (2002). Aldo Rossi and autonomous architecture. In Terence Riley (Ed.). *The Changing of the Avant-Garde: Visionary architectural drawings from the Howard Gilman Collection*. New York: Museum of Modern Art. p. 91

in interesting ways the development of the concept of autopoiesis in cybernetics, in its conception of the discipline and the nature of architectural knowledge in relation to modern science, and in its understanding of the city-as-architectural-information itself. However, as de Michelis again notes:

> At the very moment that the European city was being systematically investigated in its architectural entirety, it was undergoing crucial processes of transformation, which radically changed its structure and the problems it presented, and also shifted those problems from the centre to the periphery, and further out still, to ecosystems that couldn't be reduced to the traditional structures of urban settlement.[2]

In fact, the dilemma that de Michelis observes here in the reflections of autonomist architectural thought has stimulated modern architectural imaginary since its inception as a vehicle of development of early mercantile capitalism in Renaissance Italy. More than that I would argue, following Manfredo Tafuri, that it is at this very moment – when architecture takes on the task of representing society in and through the city with an image of the classical city – that the possibility of total representation itself becomes redundant, as a new temporality takes over. Initially the spatio-temporal system that architecture presented was projected backwards, onto an imagined classical past, and the systemic image was one of a harmonious socio-spatial organisation. However, there were contradictions inherent within this projection, not least that this homeostatic image embodied in the ideal city of the Renaissance and early Enlightenment imaginary could not easily deal with *growth* as an urban reality or social ideology. As these contradictions started to explode with the economic growth of capitalism, the temporal projection playing out in architecture shifted and became future-oriented. This is the

2 Ibid., p. 93.

moment of modernity proper: the conscious attempt to strategise and plan the way in which systems that operate in the present conjure into existence strange attractors in the relational space-time of the future. Growth is of course both an ecological and an economic concept. It is highly significant, I suggest, that modern architecture became the site of a political struggle over the production and control of space and time, and as a systems discipline grounded in resolving an imaginary of whole–parts relations, within a context of growth. Furthermore, we have two models of ecological thought developed out of an architectural-urban imaginary: the homeostatic whole representing a concept of totality more broadly, and the far-from-equilibrium systems of the capitalist city in growth.

The systems of the world

Histories of systems theory often suggest that this is a twentieth-century science. However, there has been an awareness that the organisation of organisms requires a specific mode of understanding (the root *organ* here is itself a word whose meaning has oscillated over time between mechanical (its first usage) and biological entities), at least since Aristotle noted that "the totality is not, as it were, a mere heap, but the whole is something beside the parts".[3] In the English language the word 'system' first appears in the early seventeenth century, and is used to describe biological entities, but expands in abstraction such that when Isaac Newton publishes *The System of the World* in 1665, he completely radicalises and extends the cognitive spatial *oikos* via a journey around the orbits of comets and planets, before turning to the tides of the seas on Earth and their effects upon various rivers, in what gets close to being a proto-Gaian description of the planet in its cosmological environment as a complex system. Notably, in the first few pages Newton gives a description of the Temple of Vestas in Rome. The circular plan of the temple contained a hearth with a permanent fire in its inner circular cella. Newton claimed that the building acted as "a symbolic figure of

3 Aristotle. (330 BC approx.). *Metaphysics Book 8*. Retrieved from http://classics.mit.edu/Aristotle/metaphysics.8.viii.html

the world with the sun in the centre".[4] In fact, the symbolism goes further. As one of the oldest ancient cults, the hearth at the centre of the temple cella was a continuation of an ancient Greek domestic tradition of worshiping the goddess Hesta, whose name means household or *oikos* – which of course is the root word of both ecology and economy.

Temple of Vesta, Rome. The hearth is the most prominent feature of the ruins.

There is an important relationship between thinking about abstract systems of organisation, the emergence of the sciences, and the modern profession and discipline of architecture as a function of a specifically modern division of labour. In *The German Ideology*, Karl Marx and Friedrich Engels observed that as capitalism develops it instantiates a division between mental and physical labour – a division which they described in spatial terms as having its purest expression in urbanisation and the division

4 Newton, I. (1665). *A Treatise on The System of the World*. (London: F. Fayram). Retrieved from https://ebooks.adelaide.edu.au/n/newton/isaac/system-of-the-world/

between town and country. This division of labour manifested itself in actual architectural production in the separation of the knowledge of organising space and managing production from the actual physical act of building. The first widely recognised instance of this division of labour is found in the way that Filippo Brunelleschi in early fifteenth-century Florence organised the construction of the Dome of Santa Maria del Fiore, whilst also making significant contributions to science and geometry. Similarly, in his near contemporary Alberti and his theory of *concinnitas* (composition) we find an attempt to define an abstract systems theory of organisation, and a meditation upon how to think about part/whole relations. Architecture is theorised by Alberti as a producer of concepts which emerge as a systemic relationship between whole and parts: "Beauty is a form of sympathy and consonance of the parts within a body".[5] Alberti here suggests a second-order effect – self-empathy within an organism, and amongst its parts – as a proto-cybernetic definition of architecture as 'second-order building'.

In late seventeenth-century London, we find a similar relation between architecture, city, science, and technique to that which had so fascinated Tafuri and Rossi in Renaissance Italy, with the difference that this time the sciences of biology and ecology, and the necessity of planning, are all significantly more active. By this point, mercantile capitalism is well established, and we can find in the collective mind of this city all of the spatial components of a modern ecological systems awareness – albeit in nascent form. London, the first global capitalist city, finds itself in 1665 under the existential ecological threat of extinction due to the bubonic plague sweeping through its medieval streets, which would ultimately take a quarter of the city's population with it. Robert Hooke, a precocious polymath and architect, had been appointed curator of experiments for the Royal Society, founded in 1660 (other members included Sir Christopher Wren, Isaac Newton, and Robert Boyle). In fact, in *The System of the World*, Newton refers to scientific work produced by both Hooke and

5 Alberti, L. B. *De Re Aedificatoria*. Quoted in Forty, A. (2000). *Words and Buildings: A vocabulary of modern architecture*. London: Thames and Hudson. p. 220.

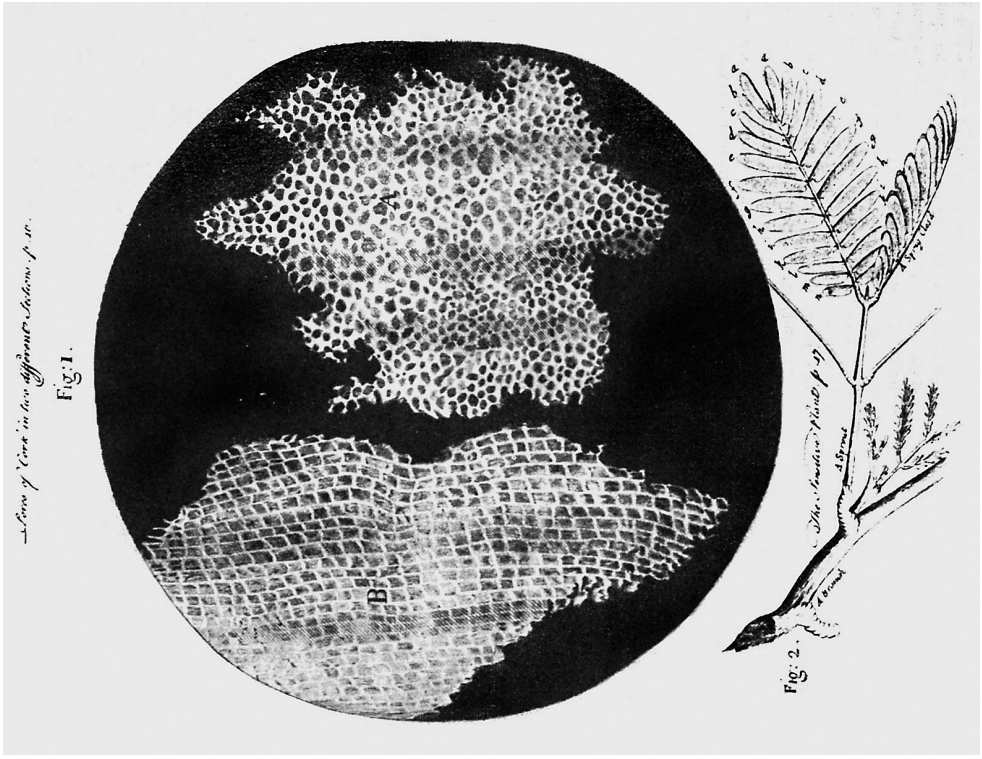
Wren. At the same time, accelerated in part by the biotechnical crises of London in the 1660s, these two are reproducing the kind of division of labour found in the Florentine offices of Alberti and Brunelleschi a century before: "it is Wren however, and Hooke and the designers in Wren's practice who are the real first British architects, willing and able to design buildings without themselves having had hands-on experience".[6]

Hooke built one of the first microscopes, and the extraordinary set of drawings and observations of various plants, minerals, and organisms that he produced were published as *Micrographia* in 1665. It is clear from Hooke's preface to *Micrographia* that he is moving towards an understanding of emergence, systemic feedback, and the cybernetic critique of form/substance dualism (which would not be properly formalised until the mid-twentieth century):

> The footsteps of nature are to be traced not only in her ordinary course, but when she seems to be put to her shifts, to make many doublings and turnings ... the subtlety of the composition of bodies, the structure of their parts, the various texture of their matter, the instruments and manner of their inward motions, and all the other possible appearances of things, may come to be more fully discovered; all which the ancient Peripatetics [a word for Aristotelian philosophers-JG] were content to comprehend in two general (and unless further explained) useless words of Matter and Form.[7]

6 Heyman, J. (2006). Hooke and Bedlam. In Hunter, M. & Michael Cooper, M. (2006). (Eds.). *Robert Hooke: Tercentennial studies*. London: Ashgate. p. 10.

7 Hooke, R. (1665). *Micrographia: or some physiological descriptions of minute bodies made by magnifying glasses, with observations and inquiries thereupon*. London: Royal Society.

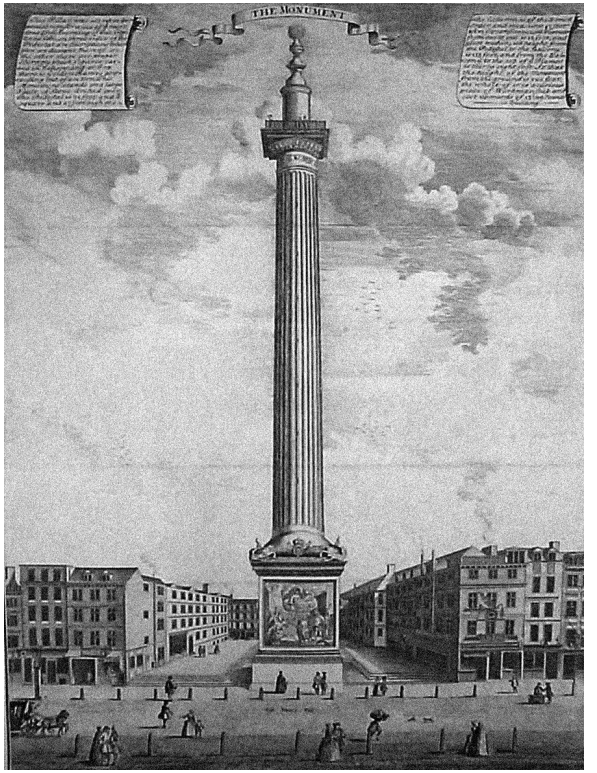


Robert Hooke's *Micrographia* with his images of the cells of cork wood in section (left) and plan.

Among the many objects that Hooke examined under the microscope was a slither of cork wood. He drew the repetitive structure of bounded enclosures he saw through the lens. They looked like a field of rooms to his growing architectural eye, and so he gave them an architectural name. He called them cells, and in the text goes on to elaborate the first theory of the cell as the fundamental biological unit. The cell, or cella, is an architectural term used to describes an architectural unit, a simple spatial enclosure such as that found at the heart of a temple, or a monk's cell in a monastery. As the most basic architectural unit, the cella is the production of a boundary, and is an act of labour that mediates a relationship between inside and outside – this is the first of our three typological dimensions of an ecological architecture.

In the preface to *Micrographia*, Hooke includes the description of a plan for a large telescope. Just a few years later, following a second existential ecological threat to London – the Great Fire – Hooke was to have an opportunity to build such a structure. The Monument to the Great Fire of London, which is still stands near London Bridge today, is a giant Doric column structure

Hooke's Microscope



The Monument to the Fire of London (depicted in a picture by Sutton Nicholls, c. 1753). As Hooke and Wren were partners in the same office, this structure is erroneously ascribed to Wren in many accounts. This drawing, which exaggerates the size of the column but emphasises its observatory tower function, and indeed its monumental function (remembering Aldo Rossi on the role of the monument in *The Architecture of the City*)

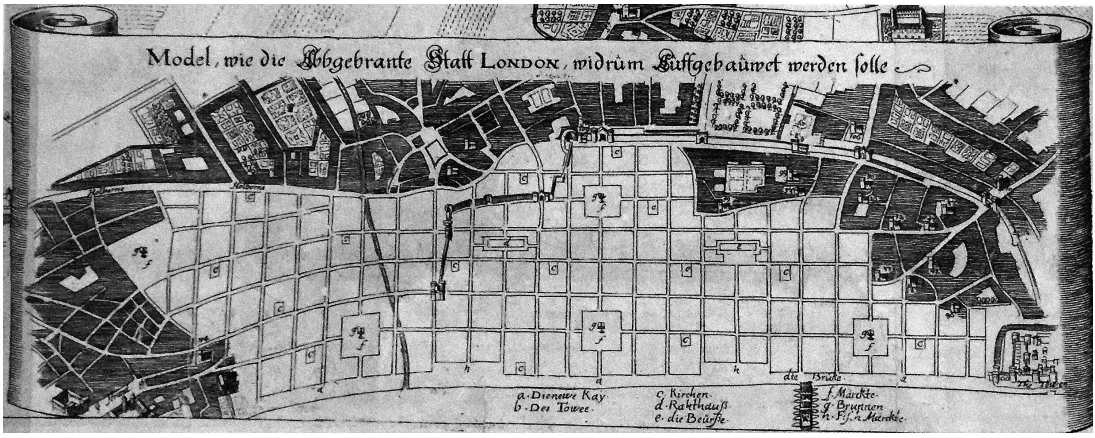
conceived as a double observatory. Hooke built a viewing laboratory for himself in the base of the tower, to allow cosmological observations to be made through the telescopic void that runs through the core of the column, while a helical public staircase runs up the interior to a platform at the top that provides views over the city. If the conceptual figure of the cell is the first typological dimension of ecological thinking, then the second is the tower/observatory.

The Great Fire destroyed a significant part of the old city, and Hooke joined the office of Royal Society colleague Christopher Wren, and was appointed as the main surveyor of the city in order to establish the condition of major buildings and lay out a new urban plan. Wren submitted a baroque proposal for the rebuilding of London. Hooke submitted a design for a modern grid. However, finally the previous medieval street layout was rebuilt, with some widening of the streets by Hooke, as the owners of the land in the city (already held by significant banking and finance capital interests) proved to be more powerful than the King's planners. In any case, the grid-network-field provides the final conceptual space needed to think in ecological terms.

So, the cell defines an interior space, an interiority, both in terms of subjectivity and morpho-topology. The field defines a relational horizontality. And the tower defines a cell as a plateau with a viewing position which is simultaneously within and outside the field. I am suggesting that these three spatial archetypes are the basis and prerequisite for thinking about systems, and that we find them present in the mind of Hooke in seventeenth-century London. The cognitive space required to think in abstract terms about life, observing machines, and cities co-produces both science and architectural urbanism in their modern forms – and necessarily co-emerges with what Jason W. Moore has defined as 'capital-in-the-web-of-life'.[8]

Furthermore, we can use these three spatial archetypes to help us to think about the different inflections of meanings the terms

8 See Moore, J. (2015). *Capitalism in the Web of Life*. London: Verso.



Hooke's drawn plan for the City of London has been lost (although this anonymous image is attributed as a simplified version of Hooke's plan)

cybernetics and *ecology* have come to signify in different contexts today. There are three major strands within cybernetics. Firstly there is the cybernetics of organisation: the study of how complex systems are organised, and often self-organised. This we can refer to as the cybernetics of the cell. Then there is the cybernetics of perception: the study of how complex systems perceive their worlds. This is the cybernetics of the tower. And finally there is the cybernetics concerned with the management of socio-technical systems. This is the cybernetics of the field. In a different way, there are also three distinct ecological moments. There is the actual discipline of ecology, i.e. the study of ecosystems. This we can call the ecology of the cell. There is ecology as a paradigm, or the projection of ecological thinking onto other disciplines (e.g. political ecology, industrial ecology, etc.). We can call this the ecology of the tower. Finally, there is the use of ecology to refer to the politics of the environment. This is the ecology of the field.

Cells, fields, and towers

Robert Hooke's discovery of the cell was an insight that took an architectural space – the cella, the inner sanctum of a temple such as that of the Vestas referred to by Newton – and used it to describe what seemed to be the fundamental unit of biology. As such, it could be understood as a foundational move of the method of reductivism that has characterised modern scientific

practice. Reductivism – for example the search for fundamental particles in chemistry and physics, or the search for the building blocks of life in biology and the natural sciences – proved to be an exceptionally powerful methodology. However, it comes at a price. If you cut up an animal, you can examine its organs, its cells, its genes and so on. Yet, once the animal is killed, you are not able to observe it working as a system. Ecology, cybernetics, and systems thinking in general are all examples of the emergence of modern meta-disciplines which sought to overcome the biases of reductive methodologies and understand the complex relationality of material, biological, and social systems.

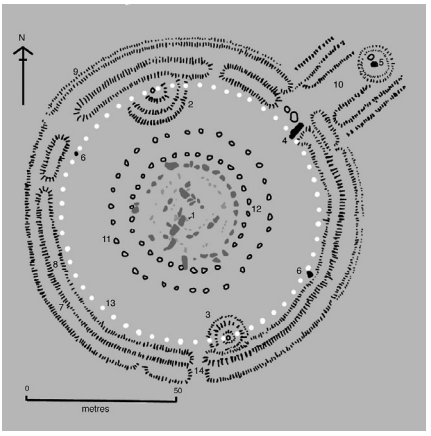
And cells are complex phenomena, whether we are thinking of biological or architectural versions. As the cybernetic biologists Humberto Maturana and Francisco Varela would reveal some three hundred years after Hooke's discovery, cells are worlds that manifest a radical interiority through the production of a metabolic boundary in a process that they called 'autopoiesis'.[9] Cells have an interior that is autonomous, in that it is epistemologically distinct from its exterior, yet they achieve what Maturana and Varela described as this 'informational closure' through a radically dialectical process: their autonomy derives from their very interdependence with their metabolic field, and, furthermore, this metabolic interface is always both a form of labour and perception. In fact as we shall see, the cell, the tower, and the field are in this way always co-defined and mutually implicated. Before moving on to consider the specific forms of some contemporary examples, it is useful to briefly review a particular cell-field-tower that is even older than the Temple of Vestas.

Stonehenge sets up a series of spatial relationships between an observer and a specific cosmological field. Here, a 'proto-architectural event' mediates an abstract yet practical conception concerning an extended human-natural environment. Stonehenge is located on Salisbury Plain, a natural landscape, yet also a field that was socially and politically produced. The plain itself is a large chalk plateau that sits at the junction of three chalk

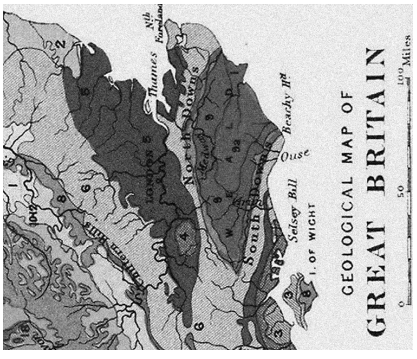
9 See Maturana, H. & Varela, F. (1980). *Autopoiesis and Cognition*. Dordrecht, Holland: D. Reidel.

ridges that run through and define much of the social and geological landscape of southern England: one ridge runs north-east from Salisbury Plain, through to the Chilterns and on out to the Wash, on the North Sea coast of East Anglia. Another runs east through the North Downs to Dover, and the third through the South Downs, ending at Beachy Head, separated from the North Downs ridge by the Weald (they are shown in beige on the geological map). On these chalk banks there would once have been forest, but these areas were cleared of the vast majority of their trees by human settlement, early in the bronze age, "not so much through systematic felling as by the slow encroachment of grazing animals".[10]

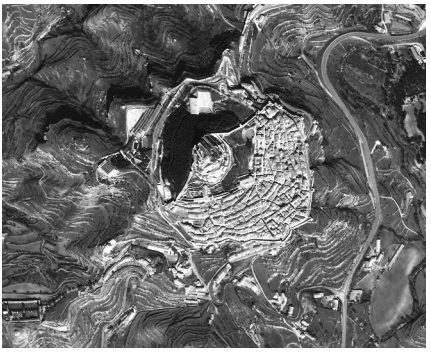
Stonehenge, Salisbury Plain



Plan of the Stonehenge earthworks and stones.



Plan of southern England, showing the three chalk ridges, meeting at Salisbury Plain, in off-white.



The walled city Morella in Spain

10 Collingwood, R. & Myres, J. (1936). *Roman Britain and the English Settlements*. Oxford: OUP. p. 10.

These landscapes settled over this period into the grassy meadow ecologies we know today. The chalk base provides good drainage, which made these areas good for grazing and agriculture. This meant that

> the value of large continuous tracts of habitable land, where an effective political and religious organisation could be developed, would fasten upon these plateaux and ridges of chalk and oolite as its natural home, and, as its corporate life took shape, would tend to regard Salisbury Plain as its home-land par excellence, the economic, religious, and political centre of Britain.[11]

The stone circles of Stonehenge mediate three distinct geometries then. They are a hub which marks the convergence of three spokes of chalk ridge, along which radiate the Neolithic economies of southern England. These stone circles set these geometries in relation to celestial patterns, and are the result of a complex ecological condition, involving a series of coupled systems: natural, social, economic, and technological. It is a structure simultaneously defined by the movement of planetary bodies, together with the agricultural practices that started to emerge out of the Neolithic period, and the effects that they had upon the landscape and local ecology. The architectural event here is that both mediates and conceptualises metabolic flows of matter, energy, labour, and communications, which are, in the words of David Harvey, "*wholly natural, and wholly social*, at the same time".[12] The architectural here is a technological prosthesis – *an organ* – that extends the human in time and space.

The structure of a late medieval or early mercantile capitalist walled city-state, such as the medieval city of Morella in the

11 Ibid. p. 8–9.

12 Harvey, D. *Reading Capital Lesson 5*. Online lecture retrieved from www.davidharvey.org

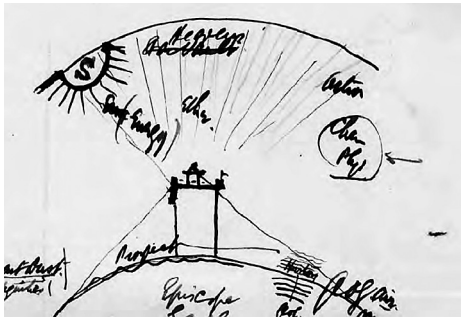
Spanish province of Castellón, presents a similarly complex ecological image. As a walled city, it presents a spatial structure defining a clear relation: an interior and an exterior. Closer inspection reveals that this large cell (the walled city) is composed of smaller cells (the individual buildings) and seems to quite directly represent one of the most dominant conceptions of the relationship between the human and the natural world, with human culture on one side of the wall, and non-human nature on the other. A closer look reveals however that in fact this nature/culture binary obscures a division of labour, in that the 'nature' outside the walled city is in fact itself a product of human production: note for example the agricultural terraces that surround and feed the city cell. A film, rather than photograph of this city, would reveal its metabolic relations with its extended field, as streams of food, objects, people, and animals flow into the city and waste flows out.

Of course, in order to have this view of the Morella city cell and its field, specific forms of mediation are required: in this case an aircraft or satellite with a camera. This mediating technology is itself a specific contemporary form of the observatory tower, and the extension of this type has been of singular significance in the development of late twentieth-century ecological thinking for a number of reasons. Extra-terrestrial satellites as observatories of various kinds are a crucial technology for observing and measuring the behaviour of the Earth (itself a meta-cell) as a complex system. It is these observatories more than any other that have both facilitated the growth of global communications networks (a new field), which have themselves then facilitated the growth of global capitalism around the planet. At the same time these extraterrestrial observatories have allowed us to see the changes this cybernetic reorganisation of ecological production has instigated. Notably, following Stewart Brand's ultimately successful campaign in the late sixties to get NASA to release an image of the Earth from space, the Earthrise image was credited with a transformation in ecological awareness.

The human inhabitation of space presented a unique set of challenges and insights regarding cybernetic and ecological thinking about the organism-environment relation. Cells-in-space were

U.S. Eastern Seaboard at Night from the ISS by NASA Earth Observatory

Earthrise – photograph by astronaut William Anders of Apollo 8 in 1968



Sketch of the Outlook Tower, drawn by Patrick Geddes, 1890s.

Patrick Geddes Outlook Tower, Edinburgh.

effectively conceived as closed systems: spacecraft are highly insulated bubbles, and air, water, waste, etc. are in a constant recycling loop. In the post-war period the technological and systemic insights that designing for the space programme generated were fed back into terrestrial architecture. The model of the closed system became valued within sustainable architectural design more generally, in situations where it was not necessarily appropriate, and in particular it offered a model where the cell was considered in isolation from a social and political field composed of extended, messy, and open systems.[13]

13 See The closed world of ecological architecture. In Anker, P. (2010). *From Bauhaus to Ecohouse: A history of ecological design*. Louisiana: LSUP.

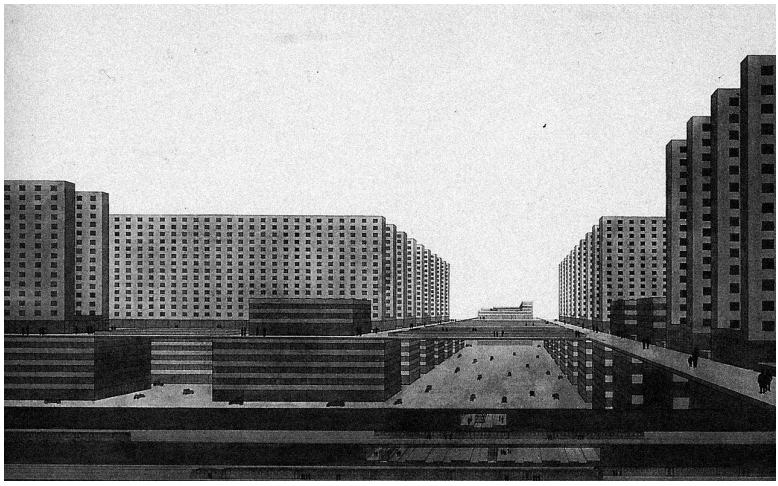
Perhaps the most direct historical instance of the observatory tower archetype is Patrick Geddes' Outlook Tower in Edinburgh, which itself contained a camera obscura, and which, in Geddes' sketch appears to be ready for launch into space. From this vantage point at the dawn of the twentieth century, the botanical polymath Geddes made a series of canonic interventions into the emerging discourses of both ecology and urban and regional planning. Geddes' work on the evolution of cities was important to Lewis Mumford, and to some extent anticipated the insight of post-war cybernetic ecologist Gregory Bateson, who argued that the fundamental unit of evolution is not the organism, but rather the organism-environment *relation*. Extending Bateson we might argue that buildings and cities actually constitute the unit of human evolution, as the concrete mediations of the labour process and what Marx would describe as "the metabolism between man and nature, and therefore human life itself".[14]

Such at least would seem to be the opinion of the twentieth-century German architect and theorist Ludwig Hilbersheimer, who was, as Daniel Köhler has recently noted, strongly influenced by Geddes' ecological conception of the urban as a mediation of sociological cellularity. Hilbersheimer's work has generated a wide and active commentary, especially from those – notably Tafuri, Rem Koolhaas, and Pier Vittorio Aureli – related to the Italian autonomist tradition we started this journey with.

In Hilbersheimer's enormous Groszstadt Architektur drawings, we are presented with a repetition of cells across an urban economic field, as panoramic images which place the viewer in an urban observatory-laboratory. The cells are assembled into slab blocks, and these are arrayed in a grid across an urban field otherwise devoid of the forms of civic and political representation traditionally given to architecture. The city itself does not have a boundary – it is no longer a cell – or rather the urban cell has extended to encompass the planet, and the space between slabs is pure circulation. In the Groszstadt drawings, the circulation is presented as vehicular traffic. However, in an unpublished text,

14 Marx, K. (1990). *Capital: A critique of political economy volume 1*. London: Penguin. p. 133.

Hilbersheimer states that "we no longer need agoras, forums, or public squares … should not the city itself be penetrated by nature?"[15] suggesting that for him, 'nature' and circulation are one and the same.

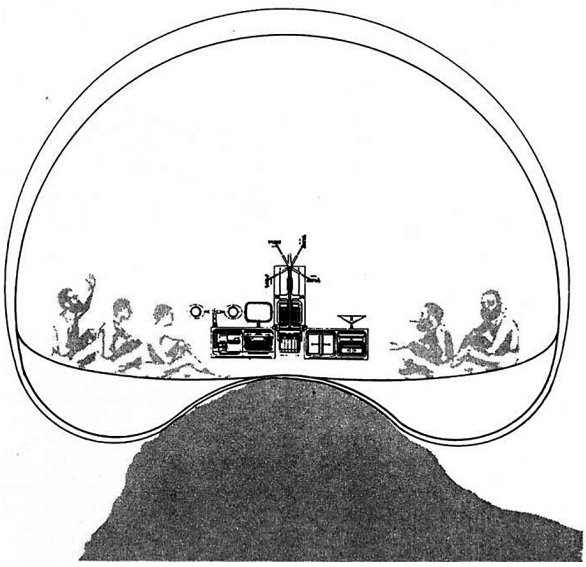


Ludwig Hilbersheimer, Highrise City (Hochhausstadt): Perspective View: East-West Street, 1924

Hilbersheimer anticipates the post-war moment wherein the cell undergoes a radical re-presentation in response to a changing conception of the techno-ecological field and production in general. If Hilbersheimer rethought the urban metropolis as a collective architecture of individual units, he prefigures how in the post-war period the urbanisation of the planet has reached a scale such that the division of labour itself has become ecological. Capitalism itself has radicalised the town/country opposition that Marx and Engels referred to. Yet it is not so much that their spatial division of labour has been overcome, rather it has been enfolded and extended within the production of nature as a whole. Aureli and others have rightly commented upon the issues that this presents for the possibility of the political in the contemporary metropolis, wherein Aristotelian distinctions between the political arts of field (*techne politike*) and the domestic arts of the cell (*techne oikonomike*) appear to have been dissolved.

15 Ludwig Hilbersheimer quoted in Köhler, D. (2016). *The Mereological City — A reading of the works of Ludwig Hilbersheimer.* Bielefeld: Transcript Verlag. p. 26.

Echoing Hilbersheimer some decades later, Robert Venturi quipped that 'Americans don't need piazzas as they should be at home watching television', and in a certain sense this is what we see in Reyner Banham and Francois Dallegret's A Home is not a House (1965) concept. Here we see what is often interpreted as a serviced bubble, and if that is all it is, then it would just be a dematerialised house. However, what we are actually seeing is a home where the hearth has been replaced by a media-entertainment system, and as such, we have a domestic cell which has interiorised the external relations of the urban through this substitution, which in an unexpected way reproduces Alberti's recursive whole/part systemic conception of the architecture of the city: "The city is like some large house, and the house is in turn like some small city".[16] If here then the home is still read as a certain kind of economic space – the space of the domestic oikos, it is one that is set within a bigger cell, the city-planet, and a bigger ecological economics. It is indeed the relationship of the cell to the city, staged as a double internality – the oikos wthin the oikos – that defines the contemporary possibility of the political, and indeed confirms the feminist observation that 'the personal is the political' through the global domestic cell.



Reyner Banham and Francois Dallegret, A Home is not a House, 1965

16 Alberti, L. B. (1452). *De Re Aedificatoria*.

Conclusion:
Systems theory as a site of political struggle

Who then are we now? Are we the physical matter that constitutes our bodies? Even when only ten percent of the cells in our bodies contain human DNA, and most of their constituent molecules are metabolised, excreted, or are in other ways replaced on a regular basis? And even though we are suspended within and constituted by a dynamic field of biological, mineral, energetic, social, and semiotic processes of indescribable complexity? This field of flows, ruptures, continuities, and distinctions is us, in our environment. Birth gave us a distinct kind of autonomy to be sure, but one that remains radically dialectical in nature, just as it was in the womb. Yes, we are autonomous, but our autonomy derives from our very interdependence with both our environment and a political ecology of others. We are towers: simultaneously in the world, yet at the same time distinct from it. This is, as the cybernetic biologist Francisco Varela states, "a knotty dialectic: a living system makes itself into a entity distinct from its environment through a process that brings forth, through that very process, a world proper to the organism".[17]

Or, are we not in any simple way directly identified with the matter of our bodies itself, but rather better described as radical observers, as dynamic unfolding patterns that are either perpetuated directly through embodiment, or emergent from the field of our bodies? Yet given that we know that the development of each and every human body and brain is utterly dependent on its perceptual relations across a socio-cultural milieu, together with its metabolic relations with an external environment composed of a more-than-human web of life and a space-time field of material-energetic processes, where do we even begin to draw the boundaries of the self?

It is clear then that if we want to understand ourselves and our world today, we need to understand the nature of systems – social

17 Varela, F. (1991). Organism: A meshwork of selfless selves. In Tauber, A. (Ed.) Organism and The Origin of Self. Kluwer, Dordrecht. pp. 79–107. Retrieved from http://cepa.info/1959

and cultural systems, technical systems, spatial systems, material systems, biological systems: systems which in their dynamic and networked assemblages operate as world systems.

The modern global economy is a mangled nest of complex interconnected systems. Our bodies and minds are a part of this, and are produced within this, even whilst they are also constantly 'autopoietically' re-producing their own conditions of emergence: this is the double internality of the human condition.[18] Everything that we make, do, and think changes the nature of these systems, and of ourselves, in subtle and not so subtle ways … sometimes reinforcing, sometimes undermining, sometimes transforming, sometimes bifurcating existing systems. As the study of cybernetics and ecology has repeatedly shown, one characteristic of complex systems' behaviour is that they are hard to predict, hard to plan … and yet we must manage with this condition, and we have to make choices and value judgements even whilst we lack a complete cognitive mapping of our current or future field. Thus, every ecology is always a political ecology; and it is in the nature of our thinking to not really understand them, to not intuitively grasp complex systems … or rather, we understand them through two very different modes of mental reflection: firstly through rational analysis – today typically various modes of algorithmic, cybernetic, and ecological thinking – and secondly, through mythic structures, where we rightly recognise the relative autonomy of complex systems: all complex systems are actually minor and major deities. Complex systems are actually alien minds and organisms which we co-evolve with … and that includes spaces, buildings, and cities.

In this way, Karl Marx suggested that what we call capitalism is a dominant 'alien power' that has emerged within and through our economic and ecological relations; yet it seems that there are many different specific modes of capitalism co-existing today, and many non-capitalisms too. On the one hand capitalism has become ecological – by which I do not mean more ecologically responsible, but rather more ecologically extensive and significant –,

18 I take the concept of 'double internality' from Moore, J. (2015). *Capitalism in the Web of Life*. London: Verso

integrating itself into and transforming the reproductive systems of the planet at every scale, from the biological cell to the networks of neurons in our brains, from the surface of the planet to the atmosphere within which we bathe. Yet there is a very specific political ecology at work in capitalism too, and importantly, there are alternatives, other possible future political ecologies, and other ways of living and becoming amidst a nest of other biological and material entities.

Thus, whilst for much of capitalism's history, it was the study of economics that was thought to be the discipline closest to the heart of the system, and political economy, the discipline which sought to really understand critically the workings of that system, today, as capitalism integrates its processes of accumulation into every sector of the biosphere, and as mainstream economics at least seems wholly incapable of articulating the full costs and values of the system it claims to know, it seems increasingly clear that a form of ecological discourse is replacing economics as the mode of thought necessary to comprehend the nature of our production of our selves and our world.

The roles that architecture, urbanism, and planning have played with respect to the ecological reorganisation of production are complex. The production of space changed as production was transformed more generally, and importantly, architectural research and practice also offered models for that change, as test-sites for an emerging ecological paradigm prototyped in urbanism and the built environment.

Architectural knowledge offered a certain kind of abstract space for these shifts, which were nonetheless very different to the philosophically grounding metaphors that architecture has historically supplied as cognitive maps to philosophical thought.

Although it is clear today that it is necessary to theorise human production with an adequate description of the environmental factors that are necessarily bundled and entangled with its development, this has rarely been done with adequate attention to the 'double internality' of the human condition in relation to nature,

and the spatial figurations of this in the production of what Marx and Engels referred to as 'definite modes of life'.[19]

So today, on the one hand we need to develop new ecological concepts when thinking about space, architecture, and cities. But we also need to recognise that to talk about, and to historicise and radicalise thinking about ecology and cybernetics through architecture we must acknowledge that there has been an ongoing political struggle over the development of these world–systems theories, and a series of overlapping attempts to grasp the nature of the double internality of the human condition regarding nature. If capitalism is becoming ever more ecological as it unfolds its organisational technosphere over and through the dynamic material, biological, and mental systems of the planet, we can see a true political struggle over the possibility of ecological thought to both cognitively map the nature of human production, and the potential to engage consciously with our planet through a form of ecological species–being, in the face of the very real likelihood that ever-greater ecological knowledge is constrained to act ultimately as an intensification of the abstract powers that capitalism deploys. Marco de Michelis concluded that:

> The very establishment of science and technique as independent bodies of knowledge, separated and isolated architecture from the real process of conformation to modern society and condemned it to a laboured and irresolvable course. This, for Tafuri, is the origin of the ideological nature of any modern architectural work: the fact of no longer being a protagonist of the real transformations that capitalistic development produces, of not being able to produce but only interpret them *a posteriori*.

19 Marx, K. & Engels, F. (1845). *The German Ideology*. Retrieved from https://www.marxists.org/archive/marx/works/1845/german-ideology/ch01a.html

> It could be said that architecture was no longer permitted to give form to reality but, at most, to re-form it (reform being a key word of modernity), to intervene *a posteriori* in order to ensure the rationality and the harmonious balance capitalistic development did not essentially possess.[20]

It seems however that this is not the whole story. In subsequent decades, it has been precisely cybernetic, systems, and ecological concepts that have allowed architecture to produce a spatial knowledge both useful to capitalist development, and critical of it. In 1970, Gregory Bateson was asked by the New York planning department to help them think about the possibility of planning, and this engagement prompted this significant thinker to reflect upon a lifetime in ecological cybernetics. A year later, in an unpublished paper, Bateson lamented that "every city is becoming an ecological monstrosity", and reflected upon the 'crisis of specialisation' that had seen architectural and urban systems thinking separated from the other arts and sciences. He drew a distinction between 'cybernetic philosophers' and engineers, and noted:

> we might say that first task in "ecological engineering" is not to solve problems but to identify them.. but this phrasing takes us back to the engineers philosophy that problems are in fact identifiable and solvable ... the systemic philosophy which must guide the biological planner is not like that, and is still largely unexplored.[21]

20 De Michelis, M. (2002). Aldo Rossi and autonomous architecture. In Terence Riley (Ed.). *The Changing of the Avant-Garde: Visionary architectural drawings from the Howard Gilman Collection*. New York: Museum of Modern Art. p. 94.

21 Bateson, G. (1971). Route 128 – The jobless engineers. In Notebook 45, late summer 71. University of California Santa Cruz: Gregory Bateson Archive.