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inside *the architecture of closed worlds, or, what is the power of shit?*

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abstract

This article reviews *The Architecture of Closed Worlds, Or, What is the Power of Shit?* Published in 2018, *Closed Worlds* is an aggregation of written and visual material covering over four years of research by its author, Lydia Kallipoliti, on the subject of closed worlds. Through combining studies in the fields of spatial design, biology and technology, Kallipoliti establishes closed worlds as a new typology of interior space that internalises architecture and the environment in a technologically dependent, synthetic naturalism.

Based on an extended review of Kallipoliti's multiple works on the subject, this essay unpacks the key contributions of *Closed Worlds* to our knowledge of sustainable design: from establishing the origin of closed worlds in the NASA space program of the 1960s; to demonstrating their adaptation to an idealised architecture of environmental resistance in the 1970s; to their contribution to absurd environmental policy in the 1980s. Using writing and drawings to demonstrate the flaws of closed worlds in the built environment, Kallipoliti establishes a platform for critical reflection on sustainability and rejects the idealisation of green thinking in design. By addressing the concept of loss in closed worlds, in the form of shit, Kallipoliti argues that uncertainty rather than sustainability has the phenomenal potential to instigate change.

Rather than rejecting the concept of, or the need for, environmentally conscious design, *Closed Worlds* problematises the field of existing ideas to assess the credibility of ethical claims. By using factual examples of real projects, *Closed Worlds* questions principles that have been institutionalised in an attempt to avoid the pitfalls of well-intentioned but ultimately misguided ideals. In the face of mounting environmental catastrophe, this book is poignant, as it advocates for the need to address complexity, rather than efficiency, by looking directly at the uncertainty of the natural environment and asking hard questions about real problems of survival.

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the architecture of closed worlds, or, what is the power of shit?

The Architecture of Closed Worlds, Or, What Is The Power of Shit? is so much more than a book. It is best described as a project constructed from the aggregation of research material in the forms of theoretical analysis, case studies, ficto-critical narratives, experimental visualisations, diagrams, animations, graphic visualisations, installations, impersonations, performances, websites, a lexicon, and more (Figure 01). Collectively, this immense concentration of material and activity speaks in generative and complex ways about two of the most critical issues confronting our interior environments: technology and sustainability.

Figure 01:
Cover image of *The Architecture of Closed Worlds, Or, What Is The Power of Shit?* (2018), by Lydia Kallipoliti. Design by Natasha Jen/Pentagram © Pentagram.

In the spirit of generative exploration, this essay reviews *The Architecture of Closed Worlds, Or, What Is The Power of Shit?* in an extended format that draws on Kallipoliti's multiple works on the subject. Kallipoliti's argument concerning the contribution of closed world thinking to sustainable design is unpacked to demonstrate how this book establishes a platform for critical reflection on the idealisation of green thinking in spatial design. Further, this essay addresses the argument that complexity, rather than efficiency, is a necessary foundation to problematising the institutionalisation of environmentally conscious design in interior environments.

the evolving counter history of closed worlds[01]

Starting its life as a spin-off from Lydia Kallipoliti's Princeton PhD, *Mission Galactic*

Household: The Resurgence Of Cosmological Imagination In The Architecture Of The 1960s And 1970s (2013), this project first manifested in the *Architecture Theory Review* article, 'Closed Worlds: The Rise and Fall of Dirty Physiology' in 2014.[02] This article introduced Kallipoliti's key research contribution concerning the 'genealogy of closed resource regeneration systems' in the American space program, and their translation to the cultural imagination of the American architecture profession in the 1960s and 70s.[03] This was followed by the *Volume* article, 'Endangered Pieces Of Nature And The Architecture Of Closed Worlds' in 2015, which elegantly introduced the characterisation of the concept of closed worlds via analogy to Haus-Rucker-Co's artwork of a miniature hut in the landscape preserved in a glass jar, *Piece of Nature* (*Stück Natur, 1971–1973*).[04] In 2016, the project débuted as the phenomenal

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exhibition *Closed Worlds* at Storefront for Art and Architecture gallery in New York, and the associated conference, Closed Worlds: Encounters That Never Happened, at the Cooper Union (Figure 02). This full-scale experimental and participatory exhibition was developed in collaboration with Pentagram Design and was supported by the Graham Foundation and the New York State Council for the Arts.[05] It brought together the project's compelling archival research and critical theory with absorbing visual design. The exhibition also featured the artwork, *Some World Games* by Farzin Farzin, which reconstructed a series of archived closed worlds in virtual reality, providing visitors with the opportunity for immersive engagement.[06] The depth and diversity of content at this exhibition was met with high acclaim, laying the groundwork for the book of the project, and later receiving the ACSA's Creative Achievement Award for excellence in design, scholarship and research.[07]

From this success, the project modified internally, to surface as the symposium paper, 'Ecosystemic City' at the Responsive Cities symposium in Barcelona (2016), as 'Endangered Pieces of Nature and the Architecture of Closed Worlds' (2016) at The City College of New York, and as other papers at the Construmat Innovation Congress in Barcelona (2017), and at the Ambiguous Territory symposium, University of Michigan in 2017.[08] After the book was published in 2018 by Lars Müller Publishers, the project's research has continued through an ARCH Research Fellowship at the University of Queensland and through its inclusion in

the 'New Canonical Histories' series at the Architecture Association London in 2019.[09] Recently, the *Closed Worlds* exhibition has begun travelling as its own closed world, re-exhibited at the WUHO Gallery, California and the UTS Gallery, Sydney, Australia.[10]

inside the architecture of closed worlds

The book itself takes a cross section through much of the project's extensive material. Dynamic by design, it provides more of an introduction to this field of research than a summary. The bulk of the content consists of 37 closed world case study analyses, described as 'Living prototypes'[11] Each case study consists of a short commentary written by Kallipoliti and invited contributions, archival images and documents, key terms and features unique to each world.[12] The scope of these closed worlds is extensive, featuring some familiar projects such as: 'House of the Future' (1956) by Alison and Peter Smithson, and 'Geoscope' (1962) by Buckminster Fuller and John McHale; more recent projects such as 'Eden Project' (2000) by Grimshaw Architects, and 'Masdar City' (2008) by Foster and Partners; and an eclectic series of worlds such as the prosthetic exoskeleton 'Man+' (1967) by Cornell Aeronautical Laboratory, 'EPCOT' (1966) by Walt Disney, and many live-in laboratories.[13] These case studies extend over an eighty-year period from 1928 to 2008, and have been bracketed into overlapping influences to which each closed world responds.[14] These influences demonstrate the evolution of this genre of enclosed spatial design from its origin in a causal responsiveness to hostile environments

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Figure 02:
Participatory installation at the exhibition *Closed Worlds* (2016), Storefront for Art and Architecture. Curated by Lydia Kallipoliti, design by Natasha Jen with Melodie Yashar and Janghyun Han/Pentagram. Photo by Jake Naughton © Jake Naughton.

such as 'underwater', 'bioastronautic', and 'outer space', to experimental architectures compelled by countercultural resistance, such as 'autonomous houses' and 'self-reliant communities', to the 'eventual institutionalised absurdity' of closed world ideology in 'ecotourism' and 'corporate ecology'.[15]

To orient our flicking through the 211 pages of case studies, Kallipoliti has included an essay to articulate the central concepts

and themes of *Closed Worlds* (discussed in detail below), established in her earlier publications and PhD. In addition, she has included a collection of supportive archival material entitled, 'A minor history of Man, Environmental Awareness, Books, and Design Speculations of Closed Worlds'.[16] Broken into four infographics, this material 'reflects upon parallel historical narratives of enclosed spaces', across a slightly longer time period than her own study—roughly from

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1916 to 2008.[17] Each infographic addresses the origins, legacies and trends concerning discourse on sustainability, across the four design fields of representation, policy, spatial design and publications.[18] Finally, the book concludes with an extensive list of reference material for each of the 37 Living Prototypes.

Other contributions to the book come in the form of three short-form essays by Mark Wigley, Bess Krietemeyer, and Michelle Addington, adapted from their papers presented at the *Closed Worlds: Encounters that Never Happened* (2016) conference.[19] These endearing essays speak to the clever conference format, where each speaker was 'asked to impersonate historical figures and invent adventures: to dress like them or speak like them.'[20] So playful was this format that it was carried through to the Storefront for Art and Architecture advertisement for the conference, which listed the 'participants' as Reyner Banham, Buckminster Fuller, Jacques Cousteau, Victor Olgyay, Neil Armstrong, Ray and Charles Eames, Walt Disney, Peter Van Dresser, Hans Hollein, and John McHale, before (or in place of) the actual speakers' names that impersonated them.[21] Mark Wigley's impersonation of Buckminster Fuller is moving in its description of Fuller's achievements, legacy, and opposition to the closed world classification; he simultaneously justifies the impersonation by considering the concept of Fuller's consciousness as its own closed world.[22] Bess Krietemeyer writes through the voice of graphic designer, Erik Nitsche, to illuminate the fascinating circumstances of 'devising ways to

graphically portray their faith in unlimited growth' for General Dynamics's cold-war era development of defence technologies.[23] The third essay by Michelle Addington speaks of her own real experience starting her career at NASA, and the formative role of 'disconnection' in transcending the body in the exploration of space.[24]

The book also contains significant visual content established for the *Closed Worlds* (2016) exhibition. These include the expandable foldout timeline that graphically characterises each of the 37 case studies into the closed typologies: self-reliant communities, corporate ecology, autonomous house, earth colonies, ecotourism, equipment and pods, and assigns the ecological footprint of production and consumption to each via colour coding (Figure 03).[25] This information is included as a 'net-zone' diagram for each case study and is used to colour code their pages' fore-edge, creating a multicoloured marbling effect down the book's pages, like a contemporary fore-edge painting. There is also the inclusion of an engaging series of 'feedback drawings,' designed in collaboration with Temitope Olujobi, that visually address Kallipoliti's critical position on the non-linear behaviour of complex systems.

the art of closed worlds

The term closed worlds, as Kallipoliti defines it, describes the idea of 'synthetic naturalism' that took root in the cultural imagination of spatial designers in the 1960s and 70s.[26] This idea concerned a new way of seeing the classic relationship between humans, the natural environment and their

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built environment, based on new methods of mediation via emergent technologies. To introduce this idea and to unpack the motivations that drove its conception, Kallipoliti uses an analogy to the miniature sculpture *A Piece of Nature* (*Ein Stuck Natur, 1971-1973*) by Haus-Rucker-Co.[27] This artwork, consisting of a sealed glass jar containing a miniature hut nestled in a tiny landscape scene, is described by Kallipoliti as the classic image of 'domesticity in the meadows.'[28] She suggests that this classic image of the 'primeval shelter' in the landscape speaks to Marc-Antoine Laugier's eighteenth-century idea of the origin of architecture in the primitive hut, emerging from nature through 'natural principles of construction and decoration as the closest analogy to reason.'[29]

The poignant shift in this classic image in the artwork comes from the new role played by the glass jar itself. Hermetically sealed in order to stop the 'transfer of matter or energy' between the jar's contents and the real world beyond it, this transparent glass edge analogously operates as a new technology of conservation; a technology invented to protect this interior world from loss.[30] This motivation of protection is an admirable endeavour in the face of the environmental crisis of the 1970s, although Kallipoliti complexifies its positive benefits by considering what is truly lost in this act of conservation.[31] She suggests that, by internalising the natural environment in the jar, this artwork speaks to the loss of the idea of 'untamed land.'[32] More than simply protecting the natural environment from mounting forces that threaten to destroy it, Kallipoliti suggests that what is lost in

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the jar's glass confinement is the sublime perception of nature as an 'unbounded,' 'indeterminate field'—a truly imperceptible other.[33] Furthermore, by including the primitive hut as Laugier's logical extension of architecture from the laws and principles that govern the natural world, Kallipoliti appears to suggest that the jar articulates this 'lost empire of reason' in the built environment, based on the loss of nature's agency to define it.[34] By describing the enclosed hut as an image of the 'fabricated sensation of domestic safety in a natural setting,' she suggests the artwork epitomises the anxiety of the 1970s to conserve domesticity, as much as the natural environment, now that the origins of both had become inconsequential.[35]

With the hut now an artefact of a bygone era of architectural reasoning, Kallipoliti instead introduces the concept that closed worlds have displaced the classic relationship between architecture and the natural environment. Analogous to the jar itself, she describes closed worlds as transparent envelopes that internalise both architecture and its natural setting as the conversation of domesticity. Sealed from the real exterior world, closed worlds aim to create what Kallipoliti describe as a new 'Garden of Eden,' 'intended as replications of the earth in its totality,' although synthetically and through a new type of interior environment that simulates architecture's classic relationship with nature.[36] Using 'sensorial immersive' technology, closed worlds create interior conditions of self-sufficiency that maintain life via designed natural conditions, by cyclically controlling 'material and energy' resource

pathways.[37] Kallipoliti concludes the jarred paradise analogy by suggesting this 'canned domestic cosmos depicts a transformation in the field of ecology, from the purity of nature as a realm outside the human-made to a technologically mediated science of instrumentation.'[38]

Importantly, Kallipoliti suggests that this artwork epitomises a new, two-fold understanding of how we now see the relationship between our natural and built environments: firstly, as a microcosm of the new interior closed worlds we construct in an era characterised by both advancing technology and advancing environmental catastrophe; and secondly, as the earth itself, perceivable as a closed world with finite resources and limited energy pathways that we must now internally maintain in order to sustain life.[39]

the origins of closed worlds

One origin of closed worlds is introduced by Kallipoliti as deriving from 'closed resource regeneration systems or smaller highly engineered earth microcosms,' developed during the NASA space program of the 1960s.[40] In her essay, 'Closed Worlds: The Rise and Fall of Dirty Physiology' (2015), Kallipoliti describes the emergence of an unexpectedly insurmountable frontier in space exploration. Not the technology required to get to space, but the technology required for the 'management of human physiology' to sustain human life in a sealed interior over long distances and times.[41] She describes how, based on the exploration of the new and completely inhospitable environment of

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space, a new way of thinking about the design of interior spaces was required, in order to 'carry along an artificial environmental earth bubble' in it.[42]

One example Kallipoliti discusses is NASA's 'Living Pod,' which was an 'hermetically sealed environment' designed for four astronauts. Built on earth, this pod was designed to simulate the necessary management of a cyclical resource environment that astronauts would need to maintain in order to survive in space.[43]

> If they were to venture into space, it would be necessary to convert all of their human waste to oxygen, water, and, hopefully, food. Human waste products, even urine, would be processed to reclaim water using techniques of electrodialysis, closed-cycle air evaporation, and vacuum compression distillation.[44]

Significantly, Kallipoliti describes how this closed world experiment was the first that 'documented in real time the residency of the four man crew in a promotional motion picture for television entitled The Case for Regeneration'—a process that offered an early glimpse of closed world living to the broader cultural imagination.[45] In both this essay and the Closed Worlds book, Kallipoliti describes how this coupling of the idea of closed world living with space exploration deeply affected the cultural imagination of the 1960s. She argues that perhaps the most significant impact of closed world thinking resulted from the collective perception of the 'whole earth'

view 'in the famous Earthrise [photography] series taken by Apollo 8 in 1968.'[46] In these, arguably some of the most famous photos ever taken, Kallipoliti suggests the effect of seeing the earth in its entirety as it rose above the surface of the moon cemented the existential realisation of humanity's finite place in the universe. This new awareness of the limits of our terrestrial existence galvanised a collective anxiety concerning the need to maintain and protect our single planet as the precious commodity that we inhabit.[47]

designing closed worlds

The translation of these ideas of closed worlds from the realm of space exploration to the arena of the built environment is tracked by Kallipoliti through the coupling of man and machine. She describes how, in order to 'maintain life,' closed worlds developed new technologies to 'match, one by one, all the characteristics' of the 'natural ecosystem' necessary to sustain life.[48] The interior space of closed worlds was conceived as a '"man-machine"' hybrid where 'the physiology of his ingestion and excretion—becomes part of the system he inhabits, as a combustion device.'[49] The result was a new, dematerialised and blended perception of humans and the natural environment in a new type of interior space dependant on technology; a 'biotechnological image,' 'where human agency was delegated in terms of input and output,' and nature was reduced to the artificial management of abstracted interior resource pathways.[50]

Attempts to perfect the net-zero loss of resources from closed systems, to make them infinitely renewable, are insightfully

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described by Kallipoliti as a new interpretation of an ideological utopia.[51] This striving for idealisation, she suggests, established a foothold for closed world thinking in the architecture profession. Grounded by the desire to return to simpler times in the face of mounting environmental catastrophe throughout the 1970s, closed worlds enabled the technology-dependent exploration of interiors that facilitated the classic domestic image of an autonomous architecture, harmoniously integrated into the landscape.[52] Simultaneously, this idealisation of closed worlds established a site from which the architecture profession could rally its rejection of the exterior real world, now perceivable as the chaotic other driven by desires of environmental exploitation. [53]

In the "Autonomous Houses" special issue [*Architectural Design*, January 1976], edited by Martin Spring and Haig Beck, the architecture of unrootedness appears under the umbrella of "autonomy" both to popularise an ecological and libertarian way of living and acting and to herald "autonomy" or independence from the energy grid as a political statement against consumerism and capitalism.[54]

As admirable as these motivations were, Kallipoliti problematises the benefits of these endeavours by investigating the endgame of this ideological approach to closed worlds in the architecture profession. From investigating the issues of the 'sick building syndrome' during the 1980s, Kallipoliti demonstrates that this condition—which

had a detrimental effect on the health of a building's inhabitants—resulted from the poor circulation of air between interior and exterior environments.[55] Importantly she recognises that the construction of 'architecturally airtight' office buildings of the 1970s and 80s was the hyper-efficient result of a 'rigid conservation ethic' that was 'earnestly instituted against profligate energy consumption in buildings.'[56] This paradox, of hyper-efficient closed worlds making people sick, is significant, as it evidences a far deeper concern about the viability of sustainable thinking, on which the concept of closed worlds in the built environment is based. By addressing presumptions in the architecture profession on sustainability, Kallipoliti establishes a theoretical platform from which to 'raise a series of questions about the ontology of autonomous enclosures.'[57]

the failure of closed world thinking

Kallipoliti establishes the telling features that offer insight into this paradox of closed worlds by drawing our attention to how sick building syndrome was diagnosed. She describes the curious circumstances concerning the difficulty in establishing the building's interior environment as the identifiable cause. Due to the wide range of symptoms and inability to establish 'a single underlying mechanism that produces ill health effects,' sick building syndrome could only be recognised via the aggregation of a wide 'constellation of signs.'[58] By combining 'human and nonhuman subjects into the sensorial, chemical, and atmospheric environment of habitation' Kallipoliti suggests that the confinement of closed worlds systems established an interior ecology based on a

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'complex mixture of parameters,' in which sick building syndrome was one unpredictable result.[59]

Importantly, this effect of unpredictability in closed systems was not an isolated incident of the office tower. As described by Kallipoliti, the original closed resource regeneration systems of NASA's earlier Living Pod evidenced similar conditions.[60] Its astronauts experienced 'nausea and headaches' due to the contamination of the closed system by their own waste.[61] Significantly, she demonstrates that this contamination 'was not the direct result of the malfunction of its subsystems or feedback loops,' as the astronauts' waste was managed by the systems designed to recycle contaminates.[62] Rather, Kallipoliti describes how finely grained waste material that was not collected by the recirculatory process contaminated their living environment.[63] Importantly, this material was not simply uncontained waste, but was the result of fine material that 'randomly coagulated in disorderly patterns,' resulting in contaminants that were 'considered "new bodies" produced by the system.'[64]

Described by Kallipoliti as a 'nonaetiological pattern,' these examples establish the particular role that uncertainty plays to sustain an irreducible and potentially catastrophic type of unpredictability in closed world systems.[65] She cites the unsuccessful investigations of Captain Robert Freitag and several biologists 'to define the basic supporting relationships between man, animals, plants, and microorganisms' in closed ecologies, concluding that rather

than being a simple problem of technology or botany, 'artificial ecosystems were unpredictable in their evolution.'[66] What this suggests is that closed world interiors are *ecological* by nature and therefore contain the potential—like living things—for unpredictable change.[67] The consequence of this finding appears to be foundational to the paradoxical scenario of the closed world office tower, that aimed to support a healthy interior environment but ultimately resulted in its inhabitants becoming sick. It demonstrates that at its core, the ambition to idealise interior environments was flawed, because it didn't account for the random unpredictability of the natural world.[68]

Importantly, what is most revealing about this conclusion is how this flaw is in fact only understood as such when seen from the perspective of an institutionalised approach to sustainable design in the built environment. Artificial ecologies of closed worlds are flawed, not because they don't work, but because they worked in ways that their designers did not intend or desire. In this sense, it appears that closed worlds do in some ways accurately emulate the deep qualities of real natural environments; not by establishing a cyclical ecosystem able to sustain life, but by internally emulating the central driving force of uncertainty, abundant in the natural world. Unlike Haus-Rucker-Co's glass jar sculpture, which Kallipoliti suggests epitomised the perception of taming unkempt nature, the unpredictability of closed worlds reveals that nothing can keep at bay the imperceptible chaos of the natural world.

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confronting the power of shit

Understanding the predictable flow of material and energy in closed worlds as an idealised fantasy, Kallipoliti establishes a critical line of questioning concerning the paradox that underpins the institutionalisation of the 'ethics of environmentalism' in 'new political ideologies' and 'new forms of capital.'[69]

> Decades after having sealed many buildings, we may consider the viability of closed ecological systems and the process of translating planetary ideals to environmental policies and consequently to a set of physical rules and artifacts in the building industry.[70]

One approach that she pursues is through confronting the agency of loss as a destabilising focus that interrupts the idealised equilibrium of closed world systems. The particular form of loss that she focuses on is that of shit, specifically the faecal matter accumulated as the unwanted by-product of human action in closed worlds. Insightfully, Kallipoliti emphasises that shit is 'intricately enmeshed with the physiology of the body and is thus woven into the ecology of habitation,' but that it has generally been thought about as a 'phantom,' 'historically a disenfranchised narrative, excluded from contemporary environmental concerns.'[71] She argues that it is necessary to address this 'dirty' contributor to ecological thinking in order to address the paradox underpinning its institutionalisation.[72]

The importance of addressing shit is made clear by Kallipoliti in how she unpacks its particular characteristics. She suggests that shit 'indicates a stage of incoherency, one where information is so finely grained and scattered that it cannot form bonds in identifiable patterns'; she goes on to characterise it as a 'state of indeterminacy and uncertainty.'[73] This coupling of shit with information in its maximal state of uncertainty speaks to the thermodynamic law of entropy, which describes the inevitable accumulation of disorder and randomness in a closed system. By alluding to this law in order to describe the by-product of human action, Kallipoliti appears to invoke the rules of physical science to literally and figuratively contest the utopian idealism of closed world systems—proving their impossibility.

Insightfully, rather than simply establishing that shit ruins utopia, Kallipoliti recognises that it is a necessary resource to the recycling process, an alchemic substance, and that it subsequently supports the same utopian ideals that it contests. Evidenced here is what appears to be the core of the paradox that problematises the 'ethics of environmentalism.'[74] This dual role of shit as both destructive of and necessary for closed world ecological thinking identifies the broader issue of the role of uncertainty as that which destabilises the foundation of institutionalised sustainability in design.

Embracing the need to address uncertainty in order to seriously consider the 'ontology of autonomous enclosures,' Kallipoliti suggests that the disorderliness of shit is in fact its power, which she subsequently equates to the same power as money.[75] She describes

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both money and shit as 'materials' and not 'concrete objects', based on their ability to go through a series of 'different material states all the way to becoming objects of value.'[76] The significance of this speaks to a new ontology of autonomous enclosures based on the power of uncertainty to sustain generative change in an alchemic economy of recycling.

> The purpose thus is to discredit the significance of objects and to support the view that materials exist merely in stages, while they absorb qualities from their previous stages: mud is shit deodorised, sand is mud dehydrated, pebbles are sand hardened, and 3-D-printed beads are pebbles unearthed.[77]

Uncertainty, as a generative device for change, is identified as the foundation for a material thinking to contest the central idea that sustainable design should be a device to sustain, by maintaining in stasis the utopian ideal of a perfectly circular, unchanging world. Rather than furnishing this critical field that she has established with her own ideas, Kallipoliti leaves it open, suggesting plainly to her readers that, '[t]o write a counter history to optimised circular economies in material conversions, one perhaps needs to look at shit. Only through this raw confrontation may the ecology of life be somehow useful.'[78]

drawing on the power of shit

Rather than rejecting the concept, or the need, to be environmentally conscious in design, *Closed Worlds* problematises the field of existing ideas. Importantly, this is not pursued as an academic exercise in antagonism, but rather, is done to assess the credibility of ethical claims. In many respects, this project is more environmentally conscious than less, as it raises questions in order to take environmental design practices seriously. By using factual examples of real projects, it questions the 'absurd principles' that have been institutionalised, and attempts to avoid the pitfalls of well-intentioned but ultimately misguided ideals.[79] In the face of mounting environmental catastrophe, this book is poignant, as it advocates for the need to address complexity, rather than efficiency, by looking directly at the uncertainty of the natural environment and asking hard questions about real problems of survival.

> [I]t is critical to question to what degree resource conservation strategies are sustainable forms of practice, and also recognise how impossible ideas become institutionalised through a series of bureaucratic mechanisms and are eventually labeled as 'eco-friendly', or even worse, 'green.'[80]

One significant way that this is pursued in the *Closed Worlds* project is by considering the role of architectural drawings in the representation of cyclical closed resource systems. In her *Architecture Theory Review* article, Kallipoliti speaks to a new illustration of the human figure that emerged from NASA's exploration of closed resource regeneration systems.[81] Unable to be differentiated from the environmental technologies that now sustain the human figure, such drawings were invented as representations of '"man-

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Figure 04:
Representation of a 'man-machine'
system that idealises the movement
of materials along abstract,
linear pathways, implying perfect
translation with minimal or no loss.
Published in *Clip-Kit* (1966) edited
by Peter Murray and Geoffrey
Smythen; in Robin Middleton's
article 'Living' in *Architectural
Design* (February 1967, p. 36); and
in Lydia Kallipoliti's article 'Closed
Worlds: The Rise and Fall of Dirty
Physiology' in A*rchitectural Theory
Review* (December 2015, p. 72).[84]

machine" systems [that] were human feedback loop diagrams, illustrating the body as a closed ecology' (Figure 04).[82] Importantly, these illustrations idealise the movement of resources along abstract, linear pathways and imply a perfect translation of energy and materials from one state of a system to the next, with minimal or no loss. What results are illustrations that embed the same 'absurd principles' in idealised representations that would later manifest as the paradox of closed worlds.[83]

Significantly, as evidenced by Kallipoliti, these representations were widely circulated through several of the first architectural publications that were responsible for the initial introduction of these ideas to the architectural community in the 1960s and 70s.[85] The impact of this, it can be argued,

demonstrates the particular agency of this type of drawing in establishing the idealised perception of closed resource regeneration systems to a welcoming architectural imagination. It suggests that the illusion of certainty, implied in the exactitude of these idealised representations, affected the pursuit of the ideological utopia in closed worlds.

This representational language for ecological simulation models, derivative of electronic circuits, has become the primary tool architects use to visualise performance and energy flow.[86]

It is this particular role of the image, operating as a technology of idealisation, that Kallipoliti contests with the feedback drawings produced as part of the *Closed World* project.[87] She argues that, '[s]ince the 1960s, Howard Odum's Energese, or Energy

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Figure 05:
Example of a feedback drawing by
Lydia Kallipoliti and Tope Olujobi
that attempts to problematise the
visual language of closed system
environmental representation, in
*The Architecture of Closed Worlds,
Or, What Is The Power of Shit?*
(2018), by Lydia Kallipoliti. Design by
Natasha Jen/Pentagram
© Pentagram.

Systems Language, has instrumentalised ecosystems, as well as human agency, in terms of input and output.'[88] Through an unquestioned application of lines and arrows as the visual vocabulary of sustainable design, closed environments have been understood as linear, simple, cyclical systems. In order to contest this reduction of environmental complexity in the visual field, the 'feedback drawings' explore an attempt to address uncertainty in architectural representation—problematising the 'language of environmental representation by illustrating loss, derailment, and the production of new substances and atmospheres (Figure 05).'[89]

Compelling as they are, these 'feedback drawings' leave space for questions about how they depict the capacity of closed systems to tend towards something never seen before. Beyond the depiction of loss,

the suggestion of the generative capacity of uncertainty in the visual field of architectural representation creates exciting opportunities in drawings to shift the visual rhetoric in environmental discourse from a technology of idealisation to a technology of change.

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notes

01 All dates have been taken from those stated in the 'Acknowledgments' section of the Closed Worlds book. See: Lydia Kallipoliti, *The Architecture of Closed Worlds, or, What is the Power of Shit?* (Zürich: Lars Müller Publishers, 2018), 4-5.

02 Lydia Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' *Architecture Theory Review* 20, no. 1 (2015): 67-90.

03 Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 67-9, 86.

04 Lydia Kallipoliti, 'Endangered Pieces of Nature and the Architecture of Closed Worlds,' *Archis* 46, no. 4 (2015): 100-5.

05 With research by Lydia Kallipoliti (PR), Alyssa Goraieb, Hamza Hasan, Tiffany Montanez, Catherine Walker, Royd Zhang, Miguel Lantigua-Inoa, Emily Estes, Danielle Griffo and Chendru Starkloff, and research support from Syracuse University School of Architecture and Rensselaer Polytechnic Institute. See: 'Closed Worlds,' Storefront for Art and Architecture, accessed November 20, 2019, http://storefrontnews.org/programming/closed-worlds.

06 Some World Games was produced by Farzin Lotfi-Jam, Sharif Anous, and John Arnold from Farzin Farzin. See: 'Closed Worlds,' Storefront for Art and Architecture, accessed November 20, 2019, http://storefrontnews.org/programming/closed-worlds.; 'Winners: Closed Worlds Design Competition,' Storefront for Art and Architecture, accessed November 20, 2019, http://storefrontnews.org/programming/winners-closed-worlds-design-competition.

07 '2017 Architectural Education Award Winners,' Association of Collegiate Schools of Architecture (ACSA), accessed December 8, 2019, http://www.acsa-arch.org/awards_archives/2017-architectural-education-award-winners.

08 *Deliverable 2.1: Symposium Report, Responsive Cities: Urbanism in the Experience Age* (Barcelona: Institut d'Arquitectura Avançada de Catalunya, 2016), 18.; 'Anthropocene: Lydia Kallipoliti,' The City College of New York, accessed November 29, 2019, https://ssa.ccny.cuny.edu/events/anthropocene-lydia-kallipoliti/.; 'Kallipoliti to speak at innovation congress, Barcelona,' Rensselaer Architecture, accessed November 29, 2019, https://www.arch.rpi.edu/2017/05/kallipoliti-innovationcongress.; 'Symposium: Ambiguous Territory: Architecture, Landscape, and the Postnatural,' M Taubman College, November 29, 2019, https://taubmancollege.umich.edu/events/2017/10/05/symposium-ambiguous-territory-architecture-landscape-and-postnatural.

09 Varied dates exist for when this residency took place at UQ, either 2018 or 2019. See: 'Creatures: Self-reliance, disobedience and the strange premise of living machines,' The University of Queensland, accessed November 30, 2019, https://www.architecture.uq.edu.au/creatures; 'ATCH draws international visiting research fellows for 2018,' University of Queensland, accessed November 30, 2019, https://www.architecture.uq.edu.au/news/atch-draws-international-visiting-research-fellows-2018; 'Lydia Kallipoliti,' The University of Queensland, accessed November 30, 2019, http://atch.architecture.uq.edu.au/lydia-kallipoliti; 'Lydia Kallipoliti: The Architecture of Closed Worlds,' AA, accessed November 30, 2019, https://www.aaschool.ac.uk/pressrelease/new-canonical-histories.

10 'WUHO' is the acronym for 'Woodbury University Hollywood Outpost.' It is Woodbury University's experimental exhibitions gallery. See: 'WUHO Presents Closed Worlds,' Woodbury University, accessed November 27, 2019, https://woodbury.edu/news/wuho-presents-closed-worlds; UTS is the acronym for The University of Technology Sydney, Australia. See: 'Closed Worlds: Curated by Lydia Kallipoliti,' UTS ART, accessed November 11, 2019, https://art.uts.edu.au/index.php/exhibitions/closed-worlds.

11 Introduced as such on the foldout leaf of page 28. See: Kallipoliti, *The Architecture of Closed Worlds*, 28.

12 Commentary contributors include: Christina Ciardullo, Daniel Barber, Anthony Vidler, Andrés Jaque, Bess Krietemeyer, Peder Anker, Michelle Addington, Janette Kim, Mark Wigley, Anna Dyson, Mitchell Joachim, Nader Tehrani, Ross Exo Adams, Albert Narath, Wulf Böer, Caroline Maniaque, Jonathan Massey, Eric Carver, Beatriz Colomina, and Theodora Vardouli. See, Kallipoliti, *The Architecture of Closed Worlds*, 4.

13 Kallipoliti, *The Architecture of Closed Worlds,* 36-247.

14 See foldout timeline: Kallipoliti, *The Architecture of Closed Worlds*, 29-32.

15 For the genres, see: Kallipoliti, *The Architecture of Closed Worlds,* 29-32.; for the discussion of 'eventual institutionalised absurdity,' see: Kallipoliti, *The Architecture of Closed Worlds,* 250.

16 Kallipoliti, *The Architecture of Closed Worlds*, 248-263.

17 Kallipoliti, *The Architecture of Closed Worlds*, 250; based on dates provided in these infographics on pages 253 to 263.

18 The four fields are entitled: 'figure of man' (representation), 'institutionalizing environmental awareness' (policy), 'speculative design projects' (spatial design), and 'publication' (publications). See: Kallipoliti, *The Architecture of Closed Worlds*, 250-1.

19 Kallipoliti, *The Architecture of Closed Worlds*, 264-279.

20 Kallipoliti, *The Architecture of Closed Worlds,* 4.

21 Closed Worlds,' Storefront for Art and Architecture, accessed November 20, 2019, http://storefrontnews.org/programming/closed-worlds; 'Closed Worlds: Encounters That Never Happened,' Storefront for Art and Architecture, accessed November 20, 2019, http://storefrontnews.org/programming/closed-worlds-encounters-that-never-happened.

22 Kallipoliti, *The Architecture of Closed Worlds*, 264-268.

23 Kallipoliti, *The Architecture of Closed Worlds,* 271.

24 Kallipoliti, *The Architecture of Closed Worlds*, 276-9.

25 Kallipoliti, *The Architecture of Closed Worlds,* 28-33.

26 Kallipoliti, *The Architecture of Closed Worlds,* 3; Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 68.

27 Kallipoliti titles this artwork, *Piece of Nature (Stück Natur)* in 'Endangered Pieces of Nature.' See, Kallipoliti, 'Endangered Pieces of Nature,' 100-5; Kallipoliti, *The Architecture of Closed Worlds*, 13-5.

28 Kallipoliti, *The Architecture of Closed Worlds*, 13.

29 Kallipoliti, *The Architecture of Closed Worlds,* 13.

30 For the reference to 'transfer of matter or energy,' see: Kallipoliti, *The Architecture of Closed Worlds,* 3; for discussion on the idea of the conservation of the natural environment, see page 13.

31 Kallipoliti, *The Architecture of Closed Worlds*, 13.

32 Kallipoliti, *The Architecture of Closed Worlds,* 13.

33 Kallipoliti, *The Architecture of Closed Worlds,* 13.

34 Kallipoliti, *The Architecture of Closed Worlds,* 13.

35 Kallipoliti, *The Architecture of Closed Worlds,* 13.

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36 For reference to 'intended as replications of the earth in its totality,' see: Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 67; for reference to, 'Garden of Eden,' see: Kallipoliti, *The Architecture of Closed Worlds,* 13, 15.

37 Kallipoliti, *The Architecture of Closed Worlds,* 13.

38 Kallipoliti, *The Architecture of Closed Worlds,* 13-14.

39 'The contained microcosm is as much a sample of nature as it is a representation of the earth in its totality.' See: Kallipoliti, *The Architecture of Closed Worlds,* 13.

40 Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 68.

41 Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 73.

42 Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 73.

43 Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 69-74.

44 Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 74.

45 Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 72.

46 Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 68; Kallipoliti, *The Architecture of Closed Worlds,* 14.

47 Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 68.

48 Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 74.

49 For reference to '"man-machine" hybrid,' see: Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 69, 74; for reference to 'the physiology of his ingestion and excretion,' see page 68.

50 For reference to 'biotechnological image,' see: Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 74-5; Kallipoliti, *The Architecture of Closed Worlds,* 17.

51 Kallipoliti, *The Architecture of Closed Worlds,* 18.

52 Kallipoliti, *The Architecture of Closed Worlds,* 13-15.

53 Kallipoliti, *The Architecture of Closed Worlds,* 13-15.

54 Kallipoliti, *The Architecture of Closed Worlds,* 14.

55 Kallipoliti, *The Architecture of Closed Worlds,* 20-21.

56 Kallipoliti, *The Architecture of Closed Worlds,* 20-21.

57 Kallipoliti, *The Architecture of Closed Worlds,* 3.

58 Kallipoliti, *The Architecture of Closed Worlds,* 21.

59 Kallipoliti, *The Architecture of Closed Worlds,* 21.

60 Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 78; for reference to 'closed resource regeneration systems,' see page 68.

61 Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 78.

62 Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 78-9.

63 Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 78.

64 Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 78.

65 Kallipoliti, *The Architecture of Closed Worlds,* 21.

66 Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 79.

67 Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 79.

68 Kallipoliti quotes Stewart Brand to establish this point: '"Self-sufficiency is an idea, which has done more harm than good. On close conceptual examination it is flawed at the root".' See: Kallipoliti 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 79.

69 Kallipoliti, *The Architecture of Closed Worlds,* 21.

70 Kallipoliti, *The Architecture of Closed Worlds,* 21.

71 Kallipoliti, *The Architecture of Closed Worlds,* 17; Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 68.

72 Kallipoliti, *The Architecture of Closed Worlds,* 17.

73 Kallipoliti, *The Architecture of Closed Worlds,* 18.

74 Kallipoliti, *The Architecture of Closed Worlds,* 21.

75 Kallipoliti, *The Architecture of Closed Worlds,* 3, 18.

76 Kallipoliti, *The Architecture of Closed Worlds,* 19.

77 Kallipoliti, *The Architecture of Closed Worlds,* 19.

78 Kallipoliti, *The Architecture of Closed Worlds,* 19.

79 Kallipoliti, *The Architecture of Closed Worlds,* 15.

80 Kallipoliti, 'Endangered Pieces Of Nature,' 105; rephrased in: Kallipoliti, *The Architecture of Closed Worlds,* 17.

81 Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 74; for reference to 'closed resource regeneration systems,' see page 68.

82 Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 74.

83 For reference to, 'absurd principles,' see: Kallipoliti *The Architecture of Closed Worlds,* 15.

84 Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 72.

85 Kallipoliti, 'Closed Worlds: The Rise and Fall of Dirty Physiology,' 74-5.

86 Kallipoliti, *The Architecture of Closed Worlds,* 23.

87 Kallipoliti, *The Architecture of Closed Worlds,* 23, 35.

88 Kallipoliti, *The Architecture of Closed Worlds,* 35; rephrased on pages 22-3.

89 Kallipoliti, *The Architecture of Closed Worlds,* 35; rephrased on pages 3, 23.