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1.11 Arcosanti and Communal Living

The Architecture of Communal Living: Lessons from Arcosanti in Arizona



Arcosanti: East Crescent under construction, 1999

Cosanti Foundation

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Paolo Soleri's arcology model (architecture + ecology) addresses issues of sustainability by advocating living in a balanced relationship between urban morphology and performance within dense, integrated and compact structures. Within these structures material recycling, waste reduction and the use of renewable energy sources are adopted as part of a sustainable strategy aimed at reducing the flow of resources and energy through the urban system.

Today, as governments, eager to deliver major environmental improvements, press on with as yet untried and largely untested 'centrist' policies of urban living, there is a need to research relevant models of the 'compact city' approach. Issues involved with the intensification in the use of space, higher residential densities, centralisation, compactness, the integration of land uses and aspects of self-containment need to be examined. Over the last ten years, as the criteria of sustainability have become more widely accepted and understood, the relevance of the Soleri's urban model has become clearer.

Arcosanti, begun in 1970, offers a laboratory for testing the validity of Soleri's ideas. This paper examines arcology and Arcosanti within the context of sustainability. Since the energy crisis of the mid 1970s, efforts at Arcosanti have been directed toward the definition and testing of various architectural effects on a community-wide scale that could offer a response to many of today's environmental problems.

But progress is painstakingly slow. Lacking the level of funding and resources that would enable it to be convincing, Arcosanti now represents not so much a specific prototypical solution, but an activist-engaged strategy that advocates the possibility of building our dreams and visions. In a world plagued by so many problems and so few alternatives, it nevertheless continues to offer a beacon of hope on the threshold of a new millennium.

A new urban setting

Located around seventy miles north of Phoenix, in the central Arizona desert, *Arcosanti*, a

unique laboratory devoted to testing a new ecological alternative to the modern city, has been developing slowly over the last 30 years. Arcosanti is a working prototype for a new kind of city, one that is being designed, built, and inhabited as a three-dimensional, highly concentrated urban structure.⁶⁷ A permanent experiment in urban intensity, directed by architect and visionary Paolo Soleri, when complete it will house an environmentally benign 'learning/doing' community of five to six thousand people on only fifteen acres of land. Set on the edge of a mesa above the Agua Fria River, in the middle of an 860-acre nature preserve containing orchards, agricultural fields, canyons and high desert hills, the compact structures of Arcosanti, face towards the sun to gather its energy. When complete they'll stretch no more than quarter of a mile on any one side, but will rise to as much as thirty stories tall. Inside the structures will contain the economic, cultural, and social infrastructure normally scattered around a modern city, while providing residents up to two thousand square feet of living space per family. A series of orchards will line the north side of the structure, creating a unique fusion of urban and agricultural environments. Outside there will be expansive views of another three thousand acres leased from Arizona State, to be kept as undeveloped open space. An integral part of the design will be five to seven acres of south facing sloping greenhouses, an 'energy apron' acting as a central system for producing food and collecting energy to support the prototype town.

Since 1970 Soleri has used Arcosanti to rethink modern urban planning. Rather than accept the logic of two-dimensional cities, and what he sees as the inherent wastefulness of suburban sprawl, he has developed a laboratory to explore the idea of "urban implosion" - wherein the city infrastructure contracts and intensifies in order to become more efficient, ecological, and sustainable. Soleri believes that cities can be designed in such a way that the vitality of urban life can be increased, without destroying the surrounding environment that sustains the habitat. The *arcology* concept, from which Arcosanti derives, prohibits the motor car from the city and instead advocates the widespread use of pedestrian walkways, lifts, escalators, and moving platforms. Because of the compact nature of the urban structure, most journeys by foot would take about fifteen to twenty minutes (about the same time as it takes typically to walk from inside a shopping mall to the outskirts of the car park in cities like Phoenix and Los Angeles). The 'controlled implosion' at Arcosanti would stabilise the community at around 350 people per acre - ten times the population density of New York City.

Arcosanti, now listed on the state map of Arizona, is officially a small town. As such it is faced with the challenges of daily existence but, at the same time, its aim is fixed firmly on the future. By trying to anticipate it and moreover attempting to plan for it, Arcosanti strives to keep the road to the future open, while recognising that paradise here on earth can only ever be an imaginary condition. With each passing year Phoenix is creeping ever closer to Arcosanti. It is conceivable that, in the not-too-distant future Arcosanti will simply be another of its suburbs.

Today the vast majority of us now live in cities. And around the world, as these cities reach unprecedented sizes, their increasing social and environmental problems need to be addressed if we are to avoid catastrophe. The formless urbanity of megalopolis that sprawls out across endless landscapes of development, devouring energy and resources and

⁶⁷ See Paolo Soleri, *Arcosanti: An Urban Laboratory?* (Avant Books and the Cosanti Foundation, San Diego, CA, 1983)

destroying people and land in its wake, is eroding the ideal of the traditional city. The process has, according to Bookchin (1980), already turned the notion of city planning into a myth.⁶⁸ And yet we are at a critical point in the history of human settlement. The built environment does not work. It consumes and pollutes too much. In our age of globalised economies and culture, the overlapping challenges of environmental decline, technological revolution and population explosion require that we look upon the built environment in new and different ways. Our new age demands a new urban setting.

Models of sustainable urban development

The term *sustainable development* has been used since the Cocoyoc seminar (1974) to catalyse debate concerning the relationship between economic growth and the natural-resource base on which it depends. The widespread interest in theories, ethics, and practice concerning sustainability indicates an increasing concern about the adverse impacts that conventional models of development have had on the environment, in both the developed and undeveloped parts of the world. Today, as environmental problems have been brought more sharply into focus (particularly urban environmental problems) sustainable development is being described as a fundamental goal and the term is being used to suggest how, on both the local and global scales, the lessons of ecology can be applied to economic progress. By suggesting that environmental protection and continuing economic growth can be seen as mutually compatible, it attempts to displace the 'limits to growth' argument.⁶⁹

Although the concept of sustainable development has been criticised as being too vague and contradictory⁷⁰ it has, in recent years begun to achieve political priority status. As more people are willing to accept that, in large part, the environmental crisis is caused by the way our cities are designed and built, governments across the globe are demanding a planned response to urban environmental problems. Such a response needs to be based on solid theoretical foundations as well as hard technical evidence. There is a general recognition that if we are to hand on a decent living environment to future generations, we need now to assemble radically different collective thought processes that are able and willing to engage in discussions about possible alternative futures within a rapidly urbanising world.

And yet there seems to be a real dearth of new ideas about the future of society. Those big ideological differences of the kind that inspired the grand urban 'metanarratives' of planners like Ebenezer Howard (*Garden Cities of Tomorrow*), Le Corbusier (*La Ville Radieuse*) and Frank Lloyd Wright (*Broadacre City*) don't seem to exist any more. The obvious question thus arises; who will create an environmentally sustainable society?

Within the academic and policy literature emerging around the notion of the 'sustainable cities', a number of different models have been developed which represent radically different

⁶⁸ Bookchin, M. *Toward an Ecological Society* (Black Rose Books, Montreal & New York, 1980), p. 135

⁶⁹ See Meadows, D. H. *et al*, *The Limits to Growth* (Earth Island, London, 1974) and Meadows, D. H. *et al*, *Beyond the Limits: Confronting Global Collapse or Envisioning a Sustainable Future* (Earthscan, London, 1992)

⁷⁰ See, for example, I. Illich, "The Shadow Our Future Throws" in S. Anzouvin (ed.), *Preserving World Ecology* (H. W. Wilson & Co., New York, 1990) pp 177-185 and M. O'Connor (ed.), *Is Capitalism Sustainable? Political Economy and the Politics of Ecology* (Guilford, New York, 1994)

views of how such cities might be realised. These vary from the non-spatial free-market attempts to foster sustainable development by redefining market pricing and regulatory systems, to models based on re-designing the physical fabric of the city to improve resource efficiency and bring about a self-reliant city.⁷¹ The *compact city* idea is now being promoted as a major component of the various strategies emerging to tackle some of these problems.⁷² The rationale for its implementation lies in a set of strategic benefits that are seen as the outcome of more compact urban forms in which travel distances are reduced lessening fuel emissions, rural land is saved from development, local facilities are supported and local areas become more autonomous.

The arcology model

Within this context Paolo Soleri's *arcology city model* or *ecological city model*, which builds upon his ecological design work dating back to the 1950s, attempts to address issues of sustainability by advocating a balanced relationship between urban morphology and performance within cities designed to conform to what Soleri describes as the *complexity - miniaturization - duration (CMD)* paradigm. The model recognises the need for the radical reorganisation of urban sprawl into dense, integrated compact urban structures in which material recycling, waste reduction and the use of renewable energy sources are part of a sustainable strategy aimed at reducing the flow of resources and products through the urban system. Soleri calls these urban structures *arcologies* (embodying the fusion of architecture with ecology) to underline their conceptual basis, both in the discipline of architecture and the science of ecology.

The concept is that of a structure called an arcology, or ecological architecture...Such a structure would take the place of the natural landscape inasmuch as it would constitute the new topography to be dealt with. This man-made topography would differ from the natural topography in the following ways:

1. It would not be a one-surface configuration but a multilevel one.
2. It would be conceived in such a way as to be the carrier of all the elements that make the physical life of the city possible - places and inlets for people, freight, water, power, climate, telephone; places and outlets for people, freight, waste, mail, products and so forth.
3. It would be a large-dimensioned sheltering device, fractioning three-dimensional space in large and small subspaces, making its own weather and its own cityscape.
4. It would be the major vessel for massive flow of people and things within and toward the outside of the city .
5. It would be the organizing pattern and anchorage for private and public institutions of the city.
6. It would be the focal structure for the complex and ever-changing life of the city.
7. It would be the unmistakable expression of man the maker and the creator. It would be diverse and singular in all of its realizations. Arcology would be surrounded by uncluttered an open landscape.⁷³

The complexity-miniaturization-duration paradigm

In line with the modern ecological view of science emphasising a holistic, systemic approach, he argues that all of nature, "from bacteria to God" conforms to an imperative involving three fundamental principles:

⁷¹ Houghton, G. 'Searching for the Sustainable City: Competing Philosophical Rationales and Processes of 'Ideological Capture' in Adelaide, South Australia', in *Urban Studies* 36 (11), (1999)

⁷² Jenks, M. *et al* (eds.), *The Compact City: A Sustainable Urban Form?* (E & FN Spon, London, 1996)

⁷³ Soleri, P. *Arcology: The City in the Image of Man* (MIT Press, Cambridge, Mass., 1969), p. 13

1. COMPLEXITY. Many events and processes cluster wherever a living process is going on. The make-up of the process is immensely complex and ever intensifying.
2. MINIATURIZATION. The nature of complexity demands the rigorous utilization of all resources - mass-energy and space-time, for example. Therefore, whenever complexity is at work, miniaturization is mandated and a part of the process.
3. DURATION. Process implies extension of time. Temporal extension is warped by living stuff into acts of duration, i.e., the eventual "living outside of time".⁷⁴

In nature as an organism evolves its complexity increases and it develops into a more compact and miniaturised system. In this way the process of evolution acts against the direction of entropy. For Soleri humanity stands in "the flow of [this] evolutionary process and gains meaning from its place and role in that process".⁷⁵ He argues that successful and sophisticated forms of life, such as the human city must follow the complexity/ miniaturization/ duration path in order to become a "more lively container for the social, cultural, and spiritual evolution of [humankind]". More events can occur in a more complex system. An increase in "eventfulness" brings with it the phenomenon of "liveliness".⁷⁶ According to Soleri, by following the (CMD) paradigm his arcology model stands in opposition to urban sprawl with its inherently wasteful consumption of land, energy, time and human resources.

The ecological platform

Arcology's ecological model derives from the elimination of the motor car, and the reclamation of all the space associated with this form of transportation in roads, car parks, showrooms, garages, petrol stations, repairs, junkyards. Typically today's cities devote up to sixty percent of their land for car functions. By eliminating the car from inside the city and reserves it for use outside an arcology would need about two percent as much land as a typical city of similar population. Walking becomes the main form of transportation inside.

The philosophical and theological scope of Soleri's thinking crosses traditional boundaries between the subjects of architecture, ecology, biology, urban design, sociology, environmental studies, and art. Developed from his doctoral research in human ecology, completed in 1946, Soleri's conception, in opposition to the fragmented nature of current cities, involves the creation of a new physical layer, what he calls a "neonature".⁷⁷ The scope of his arcology is to produce a theoretical model for this new landscape that would be designed to support biological, human, and social evolution while containing human societies along with all their material goods. Sustainability is simply part of our theological and technological evolution. The architect's sacred task of ecological design is then directed towards the attainment of the *Civitas Dei* (City of God) as the next step in the progressive transformation of human existence.⁷⁸ Soleri's model of sustainable urban development sees,

⁷⁴ Soleri, P. *Arcosanti: An Urban Laboratory?* (Avant Books and the Cosanti Foundation, San Diego, CA, 1983)

⁷⁵ Cobb, 'Paolo Soleri and Christian Faith', Preface to Soleri, *The Omega Seed* (1981), pp. 13-26

⁷⁶ Soleri, P. *The Bridge Between matter and Spirit is Matter Becoming Spirit* (Anchor Press/Doubleday, Garden City, NY, 1973), p. 207

⁷⁷ Soleri, *Arcology* (1969), p. 20

⁷⁸ *Ibid*

in the contraction and greater sophistication of the city (including all its equipment, machinery, infrastructure, services, etc.), both the efficient possibility of achieving more with less and the chance of reaching new levels of human development. Such transformation involves a radical revision of the current social, cultural, political and economic structure. The function of arcology is to facilitate the breakthrough to these new levels of individuality and community.

Soleri's wide philosophical reach, ranging from speculation on the evolution of the cosmos to his eschatological hypothesis is daunting but the integration of his philosophical and theological thinking with ideas about the design of cities has given him a unique status both as a philosopher and as an urban planner. In adopting a position historically rooted in idealism he sees architecture as more of a social calling than a material activity. Because it is primarily an informational process it can help lead to an ecological revolution.

By promoting a different kind of urban model, he envisions the possibility of re-naturalising the natural environment. According to Luke (1997), by striving to achieve a different social order and, in so doing encouraging a wholesale re-evaluation of the extent of our impact on the natural environment he is contributing to radical ecology's mission of world disclosure.⁷⁹

Towards Two Suns

Soleri asserts that 'the most common mistake' about his work is the assumption that "years of introspection have produced a take it or leave it package". Rather he says "I am proposing a methodology and at the same time trying to illustrate it".⁸⁰ The methodology was initially developed within the *Mesa City Project* (1958-67).⁸¹ Then in 1969 Soleri published *Arcology: the City in the Image of Man* and followed this with an exhibition of drawings and models entitled 'The Architectural Vision of Paolo Soleri', which toured the United States and Canada to record attendance numbers. In both the book and the exhibition he sketched out giant structures that would dwarf the Empire State Building. The thirty *first generation arcologies*, designed between 1963 and their publication in 1969 consist of two groups: *Dionysian* and *Apollonian*. Dionysian arcologies are affiliated to Mesa City and are configured in a "free form" character. Like Novanoah II (a city for 2,400,000 to float on coastal waters or open sea), Arcoforte (20,000 people on a sea cliff), Veladiga (15,000 people on a dam site), Stonebow (200,000 people above a ravine or canyon), and Theology (with a population of 13,000 set within a cliff). Apollonian arcologies are characterised by the elementary geometry of the envelope and the simplicity of the form: a cube, sphere, pyramid, hexahedron, cylinder, etc. Examples of these are Arcube (a city of 400,000 people located on flatlands), Hexahedron (a city of 170,000 on any topography), and Asteromo (70,000 people living in space) and the original proposals for Arcosanti (for 1,500).

With the development of the next generation of arcologies, *The Two Suns Arcology* (1975) in responding to the growing energy crisis of the mid-70s Soleri split the architectural concept
⁷⁹ T. Luke, 'Developing an Arcological Politics' in *Eco-critique: Contesting the Politics of Nature, Economy and Culture* (University of Minnesota Press, Minneapolis, 1997), pp. 156-7.

⁸⁰ Soleri, P. *The Omega Seed: An Eschatological Hypothesis*, (Anchor Press/Doubleday, Garden City, New York, 1981), p. 206

⁸¹ Mesa City was a theoretical regional plan to house 2 million people on around 55,000 acres (about the size of Manhattan Island) on an isolated and pre-flattened desert plateau. Developed as part of Soleri's ongoing research in the field of "architecture as human ecology" Mesa City was specifically aimed at introducing the idea of "corposity into the urban morphology, a premonition of the arcological concept".

of the first generation structures in half "exposing the core to the sun". This produced some highly significant related effects; it gave greater priority to the main source of renewable energy and placed the arcology concept much more firmly into its own ecological niche. The ideas that emerged in *the second generation arcologies*, within the concept of the 'energy city' also served to reinforce the relationship between architecture and ecology.

In 1975 six major (and simple) architectural 'effects' were described, collectively under the aegis of the 'urban effect'.⁸² These offer a response to many of today's environmental problems":⁸³

The *greenhouse effect* is a membrane that seals off an area of ground that can be cultivated, extending the growing season to practically twelve months, and also saves a great amount of water...With the "greenhouse", one has intensive agriculture, limited use of water and extension of seasonal cycles. This is the *horticultural effect*. Then there is the *apse effect*. Some structures can take in the benign radiation of the sun in winter months, and tend to cut off the harsh radiation of the sun in the summer. By the *chimney effect*, which is connected with the greenhouse effect, one can convey, passively, energy through the movement of air; the heat from one area to another. So we have these four effects; there is also the capacity of masonry to accumulate and store energy - *the heat sink effect*. With relatively large masonry, one can store energy during the warm hours of the day, and give it out during cool or cold hours of the night. The intent is to see if these five effects can be organized around what I call the *urban effect*. The urban effect is the capacity of mineral matter, to become lively, sensitive, responsive, memorizing... If we were to co-ordinate those six effects together, then we definitely could save on resources like land, water, time, energy, materialism, and have a better ecological sanity.⁸⁴

These effects were combined in a series of designs for second generation arcologies, including *Air Dam Arcology*, *India Village*, *Maryland Arcology*, and *Regina Arcology*. In these proposals the entire form of the urban structure as well as a huge area of south-facing greenhouses containing vegetable gardens, are designed to maximise the use of solar energy while reducing dependence on external energy sources. This approach offered the generative principles for the development of Arcosanti as an 'energy city' during the 1980s and 90s.

Perhaps Soleri's most important contribution is in beginning to rethink human ecology and encouraging us to re-conceptualise the extent of the human impact on the natural environment. Although he vigorously denies the suggestion that his model is utopian, in re-casting of the relationship between society and nature, arcology conforms to the "classical" utopian typology and the positive utopian energies here, rather than be denied, should be acknowledged and affirmed. A special power of the utopia is its ability to present political and social ideas in an unusually imaginative way, functioning as bearer of a vision and offering inspiration for those with a desire to look forward and gain insight into a feasible imaginable future. Despite the economic, social and technological uncertainties, utopias dare to paint a futuristic picture of society and offer readers a glimpse into 'their own' future. But perhaps their greatest attraction is that they stimulate us to think in a participatory way,

⁸² P. Soleri, 'Two Suns Arcology' in *aaq* 7 (2), (1975), pp. 33-41. The urban effect is described as a universal effect involving the transformation of mineral matter into mind via the potentially unlimited power of complexification and miniaturisation. Soleri says it is 'that fundamental phenomenon in which two or more particles of physical matter begin to interact in ways other than statistical or fatal, that is, in ways which are organic or living'.

⁸³ Luke, (1997), pp. 161-2

⁸⁴ Soleri, P. *Technology and Cosmogensis* (Paragon House, New York, 1985), p. 137-8

and so encourage reflection. The reviewer is forced to take a stand and critically reconsider his opinions about the most desirable way in which the economy, society and the state should be organised. Utopias, in this sense, act as a 'critical norm', developing criteria with which to measure current social development. They can stimulate theoretical experiments, encourage attempts to break through fixed patterns of thinking and test unorthodox combinations of ideas.

Soleri's response to urban environmental problems

An arcology is designed to improve the life quality of its inhabitants, and to be highly efficient in the processes of production and consumption. The model derives from a desire to come up with a workable alternatives to today's unsustainable patterns of urban development, an ambition now shared by many urban designers and planners such as Peter Calthorpe⁸⁵, Andres Duany and Elizabeth Plater-Zyberk, Herbert Girardet⁸⁶, Richard Register⁸⁷, Richard Rogers⁸⁸ and the Urban Villages Group. What sets Soleri apart is his radical approach to solving these problems the sheer scale of his vision, and his determination, since 1970 to build a prototype at Arcosanti to test his ideas. After Two Suns Arcosanti (meaning architecture "before things" or "anti-materialist architecture") was re-designed to rely as much as possible on the 'soft technologies' of sun and wind power and other renewable energy so as to reduce pollution and dependence on fossil fuels. Because it needs less energy per capita the model renders recycling and the use of solar energy more feasible than in present cities. Material recycling, waste reduction, energy conservation, and the use of renewable energy sources each become part of a strategy for sustainability aimed at reducing the flow of resources and products through the habitat.

In theory at least arcology offers a response to many of today's urban environmental problems. In particular in offering a holistic prototype in Arcosanti that deals with a whole raft of issues such as *self-containment of habitat, land use, urban transportation, food and energy production and the habitat's impact on natural resources and pollution* the model confronts problems of exponential population expansion and the inefficient use of land, air and water; pollution caused by technological society; energy and natural resource depletion, distribution and consumption; food scarcity; the loss of quality of life through waste, affluence and opulence and the physical and social segregation of people, things and activities, and the increasing problems of social alienation and exclusion

Self-containment of habitat

Through its adherence to the complexity-miniaturization-duration paradigm arcology is dedicated to the 'old' notion of containment in opposition to the relatively recent idea of diaspora (where the car is the main protagonist). Soleri's metaphor for the city "in the image of man" emphasises this idea of self-containment. The self-containment of humans within the

85 Calthorpe, P. *The Next American Metropolis: Ecology, Community and the American Dream* (Princeton Architectural Press, New York, 1993)

86 Girardet, H. *The Gaia Atlas of Cities* (Gaia Books Limited, London, 1992)

87 Register, R. *Ecocity Berkeley: Building Cities for a Healthy Future* (North Atlantic Books, Berkeley, CA., 1987)

88 Rogers, R. *Cities for a Small Planet* (Faber and Faber, London, 1997)

structure of our bodies allows us to communicate and interact with other humans. Having a complex system contained within a body "is the imperative for any organism capable of connecting effectively with the 'outside'".⁸⁹

Without self-containment the city cannot act effectively with the surrounding natural environment. Soleri argues that "ecological sanity...is dependent on centres of life so intense as to retain within their boundaries (city-town) the bulk of the planetary population and its paraphernalia".⁹⁰ But he points out that the converse is also true. When the city loses sustenance from the countryside it is doomed.

... if we were scattered to the four winds we would not be able to contain the complex arrangements of matter-energy that allows performance and we would just disappear and die. Arcologies will be contained within a "skin" that will make it possible to "perform and achieve", to communicate, so the city can be in a position to control itself.⁹¹

Land use

The arcologies presented in 1969 were located on marginal lands, far from main transportation networks, many poor in resources and generally considered difficult to "colonise". Since these may be the sort of reserves where future cultures will have to settle, (leaving fertile lands free for increasing crop cultivation), the task is to demonstrate the viability of the self-containment of a community on such inhospitable land. Many civilisations throughout history have had to deal with restrictive eco-systems. They have survived by making the best of the environment. Arcologies use the land, its geological structure and its water as the main physical resource, as well as the sun, the climate and connections with neighbouring communities in order to do more with less. Arcosanti's semi-arid location in the desert presents particular challenges to settlement.

Adopting a higher concentration of land use deriving from a mixed use development is an effective method of altering the impact of a settlement on the natural environment. Arcology is mixed use in its purest form - accommodating a variety of uses within one structure. In contrast to sprawl, an arcology acts as a large integrated, self-contained structure. Its compact design allows agricultural land and biologically diverse habitats to remain preserved beyond the city's perimeter. In an attempt to reintegrate people within their community Arcosanti is designed as a mixed-use complex, containing homes, offices, schools, parks, and a cultural centre. The belief is that a close interaction of city functions and people will induce a greater sense of community. Mel Roman, psychologist and family therapist, believes that in place like Arcosanti:

... the integration of living, working and recreation become a very natural part of everyday lives. Its not something you have to take a child to see, to do, but rather something that is experienced in everyday life.⁹²

Integration is a main goal and points to the reshaping of the entire urban landscape and, along with it, the culture that such a landscape supports. For Soleri our information age offers society an unprecedented opportunity to bring together the main components of life,⁸⁹ P. Soleri, *Selected Paolo Soleri Papers: 1981-93* Volume 1 (Cosanti Foundation, Scottsdale, 1993) p. 45

⁹⁰ Soleri, *Arcosanti* (1983), p. 17

⁹¹ P. Soleri in P. Bonvicini, 'Soleri Dialogues' in *L'architettura: cronache e storia* 422, (December, 1990), p. 874

⁹² Mel Roman, Family Psychologist cited in Mayne, *Soleri's Cities: Architecture for the Planet Earth and Beyond* (1993)

but the habitat that we have constructed for ourselves during the last century is alien to such integration. Therefore, he argues, it needs to be reconfigured.

Urban transportation

In the United States traffic jams account for around \$100 billion a year in lost productivity. Many European cities with good mass transit systems have been all but ruined by cars. London and Paris, for example, are among the world's great cities but their environments have been diminished by the near-constant noise and exhaust of cars on their streets. In the UK the Royal Commission on Environmental Pollution warned in 1994 that in Britain "the unrelenting growth of transport has become possibly the greatest environmental threat". Our car-dominated transport system, the report said, is unsustainable.⁹³

Like many critics of car dependency Soleri is not against the technology *per se* but against our complete reliance on it for transportation. While he acknowledges planning efforts that aim to produce more efficient land use patterns thereby reducing the number and frequency of car trips, and the introduction of fuel-efficient technology in car design and manufacture, Soleri contends that such improvements fail to attack the core of the problem. They are, he says, simply "a better kind of wrongness". By virtue of its compact design, Arcosanti would allow cars to be relegated to service areas on the periphery or reserved for travel between communities.

Food and energy production

Arcology aims at a degree of autonomy and self-reliance, rather than 'self-sufficiency'. Self-sufficient communities, which aim at total self-provision of food and energy, and the complete recycling of wastes, are according to Soleri "extravagant and devoid of sense". There is no way the Earth or anything in it, he argues, can be perfect because it is a small part of a much larger system. The arcology concept is directed instead at a more restrained and judicious use of resources via the power of complexity and miniaturisation and the discipline of frugality.

The degree of self-reliance in food production has changed as the arcology concept has evolved. In *Mesa City* the settlement was designed to be entirely dependent on the produce of the surrounding hinterland and on traditional agricultural practices. With the development of the *Two Suns* approach food and energy (radiant) were to be produced within south-facing greenhouses located within the city. These are designed to support the city's population at a minimum level. Other produce is imported from outside to supplement the goods and services provided on this self-reliant base (e.g. electricity from the main grid).

All Soleri's projects after 1958 have explored methods of generating and harvesting energy from renewable sources and have aimed at transforming the urban structure into an "energy machine". In the *Two Suns* approach the city is conceived of as a complex in which living, working and learning are integrated with food and energy production. The city becomes both consumer and producer. Apses and *exedra* (semi-circular edifices - developed from the apse form) that respond to the Sun's trajectory as energy devices and large expanses of greenhouses attached to the city, are used to generate heat and electricity as well as to grow food, help define the urban structure as an 'energy city'.

⁹³ Royal Commission on Environmental Pollution, *Eighteenth Report: Transport and Environment* (HMSO, London, 1994)

Impact on natural resources and pollution

Arcologies, through a blend of energy conservation and land use efficiencies, together with waste recycling systems, could maintain the ecological integrity of the region while placing fewer demands on the environment in terms of land, water, soil, fuel and other resources. By reducing the demand for petrol-based transportation systems air quality could be radically improved. Non-pollutant passive solar-active energy systems such as wind turbines, photovoltaic cells, and solar cooling and heating would further help to reduce water, air and land pollution.

James Lovelock's Gaia hypothesis sees the earth as a self-regulating system in which conditions suitable for life are maintained by feedback processes involving both living things and the non-living part of the planet. In similar vein Soleri sees both the planet, and the arcology as "a semi-autonomous organism, constantly recycling and digesting parts of itself, constantly redefining its own "constitution".⁹⁴ By combining various passive energy strategies within a single integrated urban system, arcology aims at a theoretical and architectural synthesis, in which philosophical, ecological and theological ideas are "woven into a structure of great beauty and integrity, and which, at the same time, is a structure of stunning frugality from the standpoint of energy conservation".⁹⁵

... all arcologies are "small" in the sense of their being miniaturization of performance. They take the place of the megastructures of breakdown and paralysis. Los Angeles is a super-megastructure, incorporating all the syndromes of waste, pollution, and segregation. The urban effect of arcology is at the opposite end of the spectrum... a complex, miniaturized, self-limiting habitat is the best site for more efficient, less costly disposal and recycling programs. Naturally frugality is the most cost effective way to confront the pollution-recycling-cost dilemma. ⁹⁶

Unfinished business at the urban laboratory

In *Two Suns* Soleri discussed the theoretical potential of the urban scale of the *greenhouse effect*. At the urban laboratory at Arcosanti, among other experiments, volunteers have been working towards a large-scale practical demonstration of this idea. The area covered by the greenhouses is described as the *energy apron*. Locating the greenhouses lower than the habitat structures and spaces means that the naturally accumulating warm air can be passed through tunnels up into the living areas. Because of convection no additional energy is required as long as there is a chimney at the end of the tunnel. Cooling using evaporation is also being explored, whereby cool air created by misting at cooling towers at the top of the structure, forms moist air which falls back through the tunnels.

The conceptual work involving the design of a large central system for food and energy production was carried out from 1974-1976.⁹⁷ Extensive research, carried out from 1976-1978, resulted in the construction of a prototype greenhouse in 1979. This facility has been operating in a passive mode since March 1979, generating both agricultural and climactic

⁹⁴ Soleri, *Arcosanti* (1983), p. 24

⁹⁵ H. Skolimowski, Foreword in Soleri, *Two Suns Arcology* (1975)

⁹⁶ Soleri, *Arcosanti* (1983), pp. 24-8

⁹⁷ This work was made possible by a grant from Xerox Corporation, with matching funds from the Cosanti Foundation, the American Revolution Bicentennial Administration and the Environmental Research Laboratory at the University of Arizona.

data necessary for further greenhouse development, specifically aiding in the designs of the first full-scale segment of the energy apron. Soleri wrote on the greenhouse research project in 1985:

If the greenhouse is on a flat area, quite definitely you need energy and equipment to ventilate the greenhouse in the summer, but if you slope the greenhouse, you introduce the chimney effect, and the greenhouse is self-ventilating. One can take the greenhouse and make it into a wafer, a sun collector, then you can incorporate the sun collector in the roof. This is the normal way of going about producing hot water. Or you can make the greenhouse with two effects: one as a sun collector, and the other as a food producer. Warm air can be pumped into the house and can produce some vegetables, as a form of energy, which is, let's say, the warm air, automatically through the chimney effect. If one takes the house and transforms it into a multiple kind of aggregate like a village or a town, and then one enlarges the greenhouse proportionately, one begins to see the possibilities of having a solar town.⁹⁸

The greenhouses are designed to benefit from:

- *heat collection* - curved surface retaining walls are designed to collect maximum winter sun and create a warmer environment in the greenhouse;
- the *greenhouse shading* - deciduous plants growing from the membrane support columns will shade the greenhouse during the hot summer months. Winter leaf drop will allow maximum sun penetration;
- a *membrane system* - the greenhouses will be covered with a polythene film anchored on four sides and tensioned by jacks to eliminate tearing of the membrane by wind flutter. The film will be used instead of glass for both economic and aesthetic reasons.

In addition to the practical aspects Soleri observes that the greenhouses will be "a demonstration of ways to touch on global issues: food inequity, climate change, and how to produce food in an ecologically sane way".⁹⁹

Most of the world's arable land is already under cultivation. Around two-thirds of the world's marginal land is located in the semi-arid desert with climatic conditions similar to Arcosanti. The remainder is deemed largely unsuitable, being too cold, wet, arid or mountainous to sustain current agricultural methods. Increasing global food production by improving the productivity of land already under cultivation is one method of obtaining higher yields. Another is to explore methods of bringing marginal lands, generally ill-suited to agriculture due to adverse climatic and topographical conditions, into production. Arcosanti's experimental work on the passive energy apron addresses both of these areas of investigation. The experimental greenhouses aim at gathering conclusive evidence of the benefits of their wider application as part of a holistic strategy.

The greenhouse allows frugal water management by using only a tenth to one thirtieth of the amount needed for open-field irrigation. In the desert, which has a high percentage of sunny days throughout the year, this is clearly a significant factor. Because of Arcosanti's altitude cold winters are problematic to crop growth but within the greenhouses the growing season can be extended all year round, doubling the yield. During the winter, crops in the greenhouse grow much faster and without the stress of frost. A larger variety of food can also be grown which can supply the cafe and residents with salad greens which grow quickly and remain tender because of protection from temperature extremes and winds. The greenhouses also contain flowers, herbs, and tomatoes year round and keep a variety of crops planted

⁹⁸ Soleri, *Technology and Cosmogensis* (1985), pp. 138-9

⁹⁹ P. Soleri, *Double Exedra: the Indian School Proposal* (Unpublished Cosanti Foundation Paper, 1991), p. 12

successively for continuous harvest.

Paolo Soleri has long advocated the need to redefine the American Dream before it spreads too far across the overpopulated developing world. His alternative within arcology attempts to reconcile individuals and community needs, and economic realities and motives; with ecological awareness and cultural achievement, and aims to bring us back from the brink of an impending and insane attack on our Earth's ability to sustain us. The project was represented at the EXPO 2000 in Hannover, Germany where the theme was 'Humankind-Nature-Technology: A new world arising'. Along with Curitiba, in Brazil, Arcosanti was chosen as one of the featured 'Projects around the World'.

Through the years, Soleri has been variously described as either a madman, a practitioner of some obscure religious order, or a visionary.¹⁰⁰ His theoretical writing is cryptic, his style complex and philosophical. In 1991, in describing the *Edge City* Joel Garreau identifies a common problem in the interpretation of his ideas:

Soleri is still out there in the desert in Arizona building Arcosanti...But he keeps talking about eschatology and nobody can understand...a thing he says, so he has had little practical influence in current urban planning.¹⁰¹

This is now changing. While we may not understand or agree with everything he says, more people, particularly those involved in shaping the built environment, are moving towards Soleri's way of thinking. Today governments in China, India and Japan are seeking out Soleri's advice on urban development issues. Environmentalists have recently nominated him for a Nobel Peace prize.

If our society is to be sustainable, human imagination, ingenuity, energy, and labour must be directed to the building (and reconstruction) of cities that future generations can inhabit within an improved ecological setting. Perhaps while Arcosanti lacks the level of funding and resources that would see it grow in scale as a fully operational living, working community of five to six thousand, the real value of the work going on there is not so much in defining a specific prototypical *solution* but in offering both a 'critical norm' against which we can measure existing urban environments. It also offers something that, in our all-too-cynical postmodern world, is rather unique - an activist engaged strategy that advocates the possibility of building our dreams and visions. In a world plagued by so many problems, and blessed with so few alternatives, this may prove to be the most important lesson of all. Above all, Arcosanti offers a beacon of hope for a more sustainable future.

In any case this morning at a meeting held around dawn in front of the project's main

¹⁰⁰ See, for example, P. Plagens, 'A Visit to Soleri's Eldorado' in *Art in America* 67 (1979), pp. 65-71; J. C. Glen, 'Prototype Communities of Tomorrow: Arcosanti' in *The Futurist* 14 (1980), pp. 35-43; J. T. McFadyen, 'The Abbot of Arcosanti' in *Horizon* 23 (1980), pp. 54-61; M. B. Pennington, 'Arcosanti Monastery No. 1' in *America* 144 (March 14, 1981), pp. 207-9; N. M. Bloom, 'Human Beehives: Paolo Soleri's Arcosanti' in *Science Digest* (March 1981), pp. 42-7; M. Grossworth, 'Arcosanti: A Laboratory for the Living' in *SciQuest* 54 (1981), p. 11-15; D. W. Dunlap, 'Future Metropolis' in *Omni* 7 (October 1984), pp. 116-24 P. Weingarten, 'Futuristic City: a Radical Vision Still Out of Focus' in *Chicago Tribune* (July 10, 1988); L. David, 'Paolo Soleri : Man for All Seasons' in *Ad Astra* 1 (November 1990), p. 31; 'Paolo Soleri's Arcology: Updating the Prognosis' in *Progressive Architecture* 72 (March 1991), pp. 76-8; M. Pastin, 'For Selfish Reasons, Arizonians Should Look Again to Arcosanti' in *Business Journal* (May 20, 1991)

¹⁰¹ Garreau, J. *Edge City: Life on the New Frontier* (Anchor, New York, 1992), p. 249

vaults a small group of people will have been discussing the daily work programme. Others can decide whether the work is experimental or utopian, a science fiction fantasy, an Orwellian nightmare, or a new evolutionary stage in the progress of the human spirit. They have some unfinished business to be getting on with and they'll be measuring their own progress by the amount of concrete they manage to pour today.