Robert Samuels 2002

Perennial Old-City Paradigms

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Abstract

This paper attempts to relate an eclectic mix of empirical and experiential 'evidence' to a common notion: that old-city urban form is both sustainable and habitable. Findings from research (conducted by the author) in *non*-old-city environments (public-housing, a high-rise city…and inside school buildings) will be hypothetically interpreted in relation to old-cities. Theoretical frameworks back up the interpretations: drawn from crime- prevention-through-environmental-design, urban climate, and light-performance disciplinary areas. Issues discussed include: perceptions of fear and victimisation afterdark (mapped in an urban residential environment), evaluated relative to a 'populated-street' urban model (where community-presence naturally supervises places). Thermal measurements (in a high-rise 'canyon', eg) show *heat* embodied in the urban form (and roads…and cars) - which heat, emitted to the night sky, alters the urban climate. This will be extrapolated to the old-city urban form which (it is argued) moderates climatic extremes, in hot and cold cities alike. From yet another perspective, daylight is considered a fundamental parameter for a city to be socially-sustainable. People spend a considerable proportion of their lives inside buildings, where the internal light is deficient in wavelengths essential for well-being and performance. Knowledge drawn from evidence of the affect of light on mood and performance - in research with school children - will be projected, again, to old cities *ie* walking and open-sky cities, where exposure to 'full-spectrum' daylight is more likely. Finally, the related notion of pedestrian prioritisation will be addressed *ie* where policy implements a hierarchy of movement modes the integration of the walking citizen with vehicles (two-wheelers, in particular) becomes feasible, as in Bologna, an arcaded city. 'Streets-for-people' lies at the core of the old–city experience, and the arguments made here; the key reason for the perennial success of this urban-form over time.

*(all photographic evidence is by the author)

Introduction

The intention of this paper is to place the 'old-city' centre stage as an urban form consistently adapted to human needs and preferences in all cultures and any climate *ie* as pertinent hundreds of years ago as for the foreseeable future, as an ecologically appropriate urban form. Old-city form encompasses a compact, densely populated yet humane-scaled and community-animated, pedestrian-oriented complex *streetform*, set within a multi-dimensional mixed land-use-and-activity context and an extraordinary nodal spatial syntax. Unlike the 'urban village', 'new urbanism' or 'woonerf' paradigms which function at low, suburban densities, the old-city scale is clearly urban, with a dense-mix of lifeworlds. Moreover, it seems plausible too that *cellular grids* are climate-adaptive - in the sense that weather-extremes are moderated rather than exacerbated – as in hi-rise canyon-cities. Essentially, the complex spatial grid of narrower, irregularly shaped streets and medium-rise, or median-rise buildings, contiguous and compact, exposes less surface-area to both sun and air mass, reducing the need to cool or heat as the case may be, and moderate rather than aggravate wind flow. The climatic and human advantages of organic streetform cities have been attested to by urban theorists over the centuries: Vitruvius (directing streets away from prevailing winds); Alberti (narrow winding streets minimising climatic extremes); Palladio (narrow streets and high houses provide mutual shade in hot climate cities (Mumford [1]; Morris [2]).

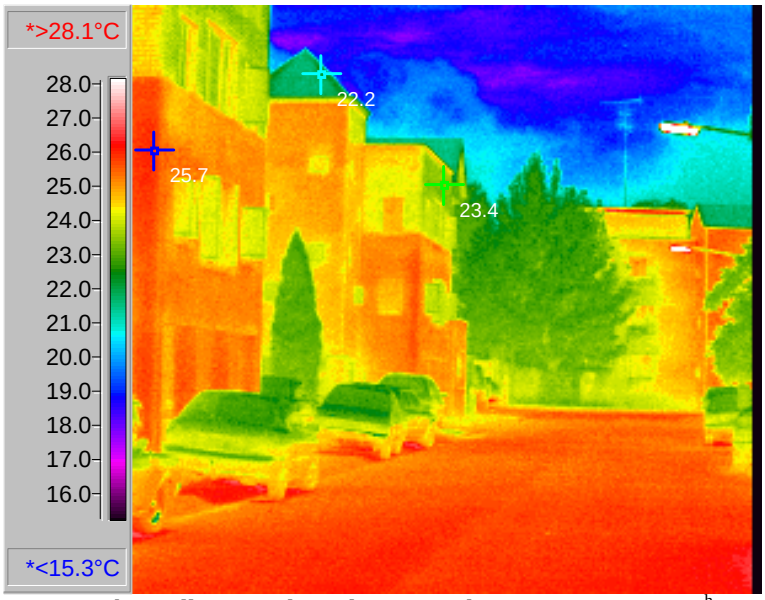
Urban climate and urban form

The ubiquitous *thermally-polluted* city is an emergent *but* unforseen phenomenon of 20th century global urbanisation. There is an intimate, almost covert relationship between heat and energy-use: the consumption of energy resulting inevitably in the production of waste heat – even from 'cool' (and otherwise non-toxic) renewable energy use. Since greenhouse gases are noxious only in their heat-absorbing capacity; and heat is the active agent in climate change – the importance of conditions which give rise to substantial quantities of thermal pollution should not be under-estimated: heat rising synchronously with rising greenhouse-gases – impacting together, on both urban and global climate.

Cities modify their climates…urban-form, in other words, generates micro-greenhouse events, over and above anthropogenic thermal-lifestyle emissions. The temperature of the urban air dome can be from 5 to 10^{o}C higher than the surrounding countryside (NASA [3]); precipitation, thunderstorms, hail and violent winds exacerbate (Bornstein [4]) – even downwind of urban hotspots; air pollution is magnified; heat stress affects the vulnerable, and discomfort and ill-mood arise in the many. Contemporary cities in particular are implicated in the creation of such unnatural climates; high-rise

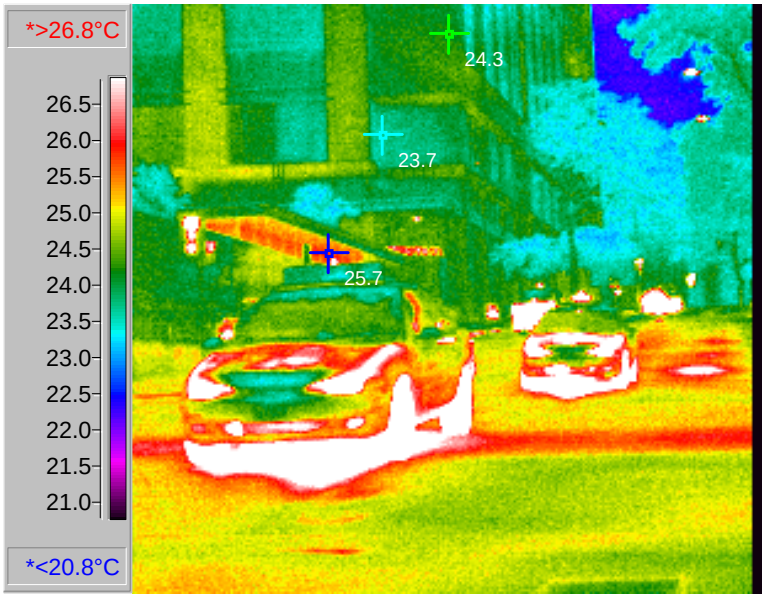
building-canyons magnifying the impact of urban form on climate (Arnfield, *et al* [5]; Santamouris [6].) In contradistinction, old-city formats appear to moderate climate extremes, rather than exacerbate them, the building-to-street-ratio, skyview, and grid complexity being fundamentally responsible for these differential effects. Also crucially involved in this urban climate relationship are thermal mass and thermal sinks. The absorption of heat, whatever its source, and its re-emission at night, flowing to the cooler night air sink, is the generator of the urban heat island phenomenon. Essential too, is the energy expended and greenhouse-gases emitted from cooling artificially warmed cities; and buildings exposed to the higher ambient air temperatures prevalent in urban canyons (Santamouris, [6]). Heat air-conditioned out of buildings is injected back into the urban air mass, further complicating microclimatic conditions (Samuels, [7]).

Extrapolation from form to climate is simplified when thermal signatures of urban configurations can be visualised in three-dimensional complexity, and colour (white to red = hot; green to blue = cool temperature). Thermal images of Sydney-city (below) indicate temperatures embodied in the built environment, and also the thermal sink and evaporative-cooling capacity of trees (see also Givoni, [8]).



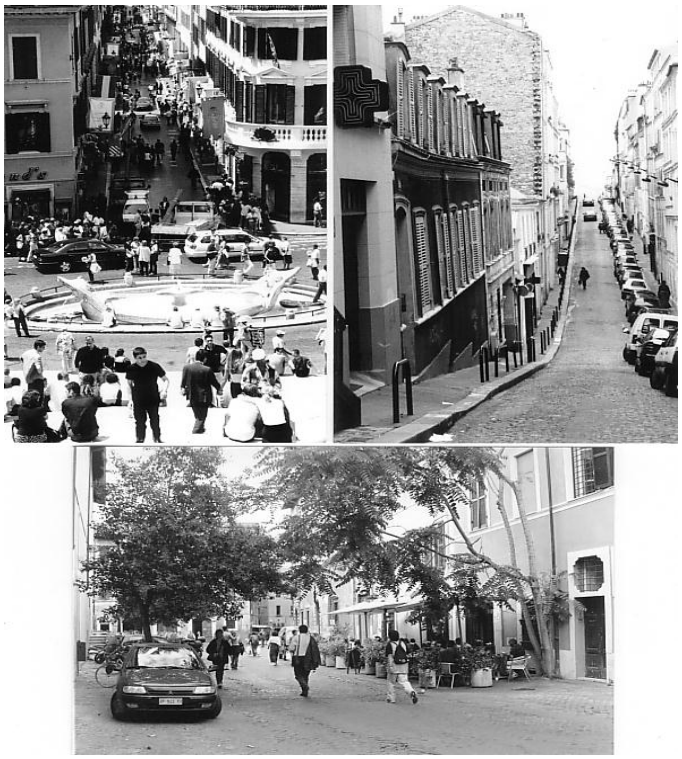
'urban village' medium density/medium-rise setting, @21^{h}
parked cars have cooled, trees are cooler but 'trapped' in canyon; sky is cool

Another aspect, not widely appreciated, but clearly visible in the thermal imagery, is the heat emitted by fossil-fuelled internal-combustion vehicles – constituting an invisible but insidious emission of waste heat to the urban air mass. Engine and exhaust-system temperatures can radiate above 80^{o}C; tyres are hot too (40^{o}) – both are off the scale in the image below, but have been measured independently using a hand-held radiation-temperature device. This heat is radiated downwards and deposited in the road, and then emitted to the urban air mass.



Sydney CBD @ midnight; hot buildings radiate to night air, cars are very hot

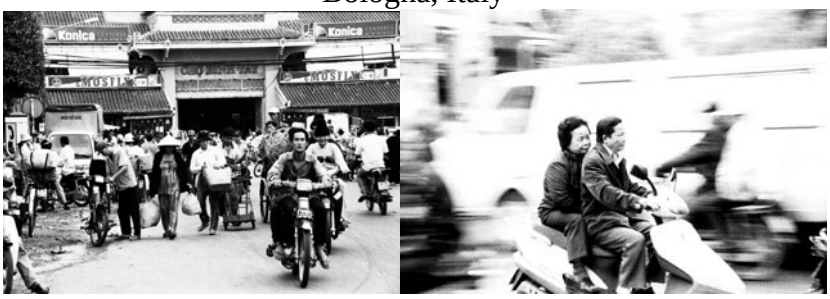
A better argument for pedestrian prioritisation would be hard to imagine…*streets for people* in Bernard Rudofsky's inimitable phrase [9]…as the essential catalyst of bio-ecological sustainability. Below are shared and living streets in contemporary old-city domains.



Paris and Rome

Returning city-centres and edge-cities predominantly to pedestrians necessitates a radical change in hierarchical status but not the complete remove of vehicular traffic. Exclusion would be untenable in today's cities, they have been designed for cars; and even inadvertently enhance criminal opportunity potential. Examples of cities where two-wheeler vehicles and pedestrians predominate are widespread (from Rome to Avignon, Marrakech to Hanoi…). Bologna is particularly satisfying, with its pedestrian arcade-lined streets, and its ingenious scooter-parking system. In the old city of Hanoi endless rapid interactions occur along the narrow streets and at the intersections, every cyclist conscious of pedestrians - who cross almost without hesitation, negotiating their way; indeed, I was witness to no accidents in old-city precincts. Noise and pollution are endemic to combustion engines. Yet, solutions are to hand, hybrid hydrogen/solar motors are feasible now; and grid configurations that discourage vehicle-use are environmentally benign. They are the antithesis of planning visions espoused by the 'new internationalists' in the 20s and 30s, but still ubiquitously prevalent today: 'a modern city lives by the straight line…the curve is ruinous…we must de-congest the centres of cities in order to provide for the demands of traffic' (Corbusier, [10]).

Bologna, Italy



Hanoi, Vietnam

There is more. Pressure systems are generated by urban form and mass. Air moves to low pressure, open areas; and heat moving to cooler places leaves a vacuum in it's wake. Nature, we all know, abhors a vacuum, so air whether hot or cool moves to fill it. At intersections and other nodes, where thermal and pressure systems interact, heat rises, and air masses intersect - frequently already accelerated by combined canyon and venturi effects. The climate, inevitably, is affected, to a greater or lesser degree. Essentially, anything that *minimises* the

absorption and re-emission of heat and the spatial-disruption of air-mass flow, can be considered ecologically benign. Urban heat islands cause pressure field deformations, too (Bornstein, [4]). Heat stored in the urban mass diminishes heat-exchange capacity (thus cooling); while street canyons reduce long-wave heat loss (Oke, [11]) to the cool night-sink. Compact configurations, interspersed with sinks and shaded nodes, and with ample skyview appear preferable to contemporary linear chasms where winds accelerate and spiral, and heat is trapped. In butterfly fashion, simple changes multiply exponentially through urban weather systems, just as they do through global systems.

Inexplicably, the concern of architects and planners, and environmental policy-makers is not also with heat. Energy is all the rage. Urban climatologists, however, do recognise the importance of the need to reduce urban heat island effect; and researchers at LBL (Akbari, *et al* [12]) are devising low-e technologies to minimise urban absorption, to help cool cities. Heat, now artificially, onerously and energy-intensively extracted via air-conditioning, could be extracted from the urban mass and channelled from building interiors, concentrated on building rooftops and converted to steam, transformed back into energy (without breaching the second law of thermodynamics). This previously noxious waste heat could provide emission-free, depletion-free and virtually cost-free power for cities. And simultaneously remove thermal discharge that currently plagues urban environments, violating their climates.

Daylight, mood, performance and urban form

Humans are light/dark adapted, by nature. Inbuilt bio-chemical switches tune these rhythms, the *photo-sensitive* melatonin-secreting pineal (neuro-endocrine) gland, in particular responding to daylight and darkness in a complex photon-neuron interrelationship. Arousal and attention, and quiescence and inattention oscillate, and full spectrum light is the key, setting the biological clock, the *élan vital* of emotional balance. Having evolved in the presence of natural daylight and sunlight for millennia, this sophisticated adaptation is now compromise: most city-dwellers spend the majority of their daylight hours inside buildings which are artificially lit with spectrally inadequate light. Whether the light is of sufficient lumen strength, as determined by illumination standards, is a question apart. The issue is two-pronged, concerning daylight and artificially created light. Standard fluorescent lighting has a light quality rating or colour rendering index of 65, daylight is 100; this difference is significant. Even where daylight enters buildings (with positive emotional and energy affects) transmission through glass ‘attenuates’ the light, and it is no longer equivalent to natural daylight. Ironically, this is exacerbated by modern solar control glass, frequently used on high-rise office towers (intended to reduce heat load, improve comfort and minimise energy consumption for cooling). Even 3mm, single-pane clear glass permits only 86%

visible spectrum and 78% UV transmittance; while low-E insulated glazing or 13mm bronze plate glass reduce transmission levels to about 30% of the visual spectrum (ASHRAE [13]; Clarke [14]).

More than 30-years of research into relationships between light and productivity, performance, health and mood consistently indicate that internal light approximating daylight quality is positively linked with fewer vision problems, less fatigue, lethargy and headaches, diminished hyperactivity and, simultaneously, enhanced alertness and improved performance. In spectrally unbalanced artificial light or in the absence of daylight cortisol secretion (a stress hormone) increases, visual acuity drops, dissatisfaction increases, and the 'winter blues' (seasonal affective disorder or SAD) becomes prevalent. Other studies indicate the positive impacts of ultraviolet exposure, particularly UVA, with enhancements in immunological, enzymatic and anti-bacterial resistance, as well as increased academic performance and reduced fatigue, and decreased neuro-endocrinal stress secretions (Hollwich [15]; Lewy [16], Erikson & Kuller [17]; Wurtman [18]; Wolfarth [19]; Brainard *et al* [20]; Samuels [21, 22], *inter alia*). Of special significance for the urban hypothesis elaborated (later), are experiments measuring spectral irradiance inside buildings, where higher UV concentrations are recorded when the windows are open, and not only glass but building materials are shown to absorb UV wavelengths too (Kok, *et al* [23]).

Results from a repeat study by the author [22] on the affects of light quality on the mood and 'affective performance' of school children (see Heschong [24] re: 15-25% improvements in academic performance – maths and reading) indicated a *highly significant influence of full spectrum light* on virtually every aspect evaluated via a specifically devised 35-item Psycho-Biological Assessment Scale. PBAS categories include: inattention, anxiety, depression and SAD symptoms (lethargy, etc), as well as behavioural problems such as hyperactivity and aggression. The scale is a derivation from and combination of several other, pre-standardised scales (Devereux; Conners, *eg*) and a self-report SAD scale piloted by the author in previous research on office workers, with additional explanatory semantic cues - and proved highly robust statistically. Lighting conditions were experimentally varied across a range of classrooms (unknown to respondents) and teachers then administered the scale, evaluating their students after at least 6 months of exposure. Tables 1 and 2 below illustrate statistically the highly positive impact of daylight-simulating fluorescent lighting on just one performance category: Inattention. Items A1 to A8 include: lacking concentration/distracted; off-task behaviour; restless; pre-occupied, etc. Similar results emerged in all the other categories.

Table 1: Multivariate Tests

Test	**Value**	**F**	**Sig.**
Pillai's Trace	.131	5.873	**.000**
Wilks' Lambda	.869	5.873	**.000**
Hotelling's Trace	.151	5.873	**.000**
Roy's Largest Root	.151	5.873	**.000**

Table 2: Univariate Test

Dependent Variable	**F**	**Sig.**
A1	32.859	**.000**
A2	17.190	**.000**
A3	14.230	**.000**
A4	24.087	**.000**
A5	24.930	**.000**
A6	19.428	**.000**
A7	19.442	**.000**
A8	31.092	**.000**

Extrapolating and hypothesising from research showing positive influences in people of all ages, it is pertinent to imagine this affect at an urban scale, and in public open spaces in CBD precincts. Again, exposure to full spectrum light facilitates neuro-endocrine functioning. Thus, environmental conditions that influence this relationship, by removing the vital wavelengths of light, implicate glazing and concrete and other materials which absorb part of the biologically pertinent spectrum. Consequently, in contemporary urbanised environments natural daylight penetration to the level of streets and squares should be expected to be radically reduced by the skyscraper canyons (further research pending). And, old-city formats, with their median-rise structures and nodal emphasis - set within a wider *horizontal* dimension - are naturally advantageous in these terms, exposing the streets to more sky; except where they are very narrow and the buildings are relatively high (as, for instance, some streets in Naples), which mimic canyon geometry. Street to building ratios could be as critical a factor for daylight penetration as for thermal emissivity. Another impact of linear-grid, traffic-oriented cities is air pollution, photochemical ozone smog - which again reduces spectral transmission. Pedestrian-prioritised domains are less polluted, by definition.

In a more synergetic sense, thermal discomfort at ground level (due to heat stress or wind chill, or air-turbulence or driving rain) is likely to discourage outdoor-use in canyon settings. This will impact, indirectly, not only at the photo-neuronic individual level, but also on sense of community – since it is equivalent to ‘avoidance behaviour’, a central tenet discussed in the following section.

Urban form, night animation, fear and security

Sense of community is at the core of urban security. Of the many situations which impact on neighbourhood spirit, fear of victimisation is the most salient. To the extent that it is experienced disproportionately afterdark, is the theme pursued here; it's relationship to contemporary and old-city forms, the supposition.

Offenders are motivated by a host of environmental cues that emerge afterdark, assessing relative risks and rewards, while like-minded communities, on the other hand, are more likely to naturally 'police' places at night for which they feel a sense of responsibility and attachment. Of course, crime also occurs during daylight hours; but the fear element is much abated - and 'crimes against the person' do occur more frequently during the dark hours (reviewed recently in Samuels [25]). Complementary evidence from research in a mixed-tenure residential domain; on university campuses; and on an inner-city public housing estate indicate that fear of crime and of harassment is elevated at night (Samuels [26], [27]; Judd, Samuels *et al*, [28]). Whether such apprehension is accurate or exaggerated, reasonable people modify their lifestyles and practice avoidance behaviour to accommodate their fears. Frequently, people avoid going out at night at all - 16% of respondents in the housing estate research mentioned here. And that all-important sense of community appropriation is lost when a sufficient number of them recoil from using the built environment afterdark. Official, recorded statistics suggest that fear far outweighes actual levels of crimes, but given the exclusion from these rates of *un*reported crime *and* harassment (not necessarily 'illegal') a true picture is not attained. Victim surveys, which take such factors into account, indicate that fear is indeed warranted (Painter, *et al* [29], *inter alia*). There is an important gender issue too; fewer female than male travellers feel secure at railway stations at night (CityRail Commercial [30]); and 50% of women in another study would not work late at night and then catch a train home, compared to only 5% of men (Aungles *et al*, [31]). It is instinctively understood that people intent on offensive behaviour prefer places and times where they can see but not be seen.

It is, thus, a responsibility of environmental designers to help ensure that the built environment can be used without trepidation at all times of day and night; yet it is probably true to say that architects do not imagine the buildings they design, nor urban designers the settings they approve, as changing their 'personality' at night. If focus was given to designing for the most vulnerable time of day (night, *sic*) and most vulnerable people, as part of a comprehensive 'universal design' paradigm, a high degree of crime-and-fear-prevention potential could automatically be built-in. Night animation domains are an essential element in such an equation; and old-cities abound in such places (dormant domains are few and far between). Self-evidently, night domains need to be carefully illuminated, as must paths to public

transport nodes. Of special significance are clear sightlines - powerful, in-built, situational deterrents. At sightline-nodes lines-of-sight and movement paths intersect, and people gather (see Troyes, over); anyone entering the area readily perceives others already there - a major tenet of street-wise behaviour. People-policing will occur *un*selfconsciously in places where people of like-mind congregate comfortably and without fear. Hi-rise mono-dimensional canyons restrict natural surveillability and congregation opportunities in the public domain; working unconsciously against community attachment.

Crime, fear and victimisation mapping generates socio-spatial-indicators, illustrating relationships between people and places. Crimes rates are mapped from police GIS data; while the spatial experience of the community of residents is extracted from *in situ* surveys. Fear-victimisation maps of inner-city high-rise public housing residents (Judd, Samuels *et al* [28]) indicate overlap between areas feared and where people tend to be victimised. But, places perceived as threatening are avoided at night too. Neither the large park nor the railway station feature as victimisation locations afterdark - yet they are the most feared places. In a nutshell, mapping allows place interpretation to be informed by psycho-social and environmental-criminological theory; with specific implications for the afterdark design of urban domains (Samuels [32]).

old-city node: Troyes, France

hi-rise public housing, Sydney

It seems reasonable: to extrapolate from the specific to the generic; to reflect on heat and light and fear at night at an urban scale; to question canyon-city design; and incorporate the solar/renewable revolution in the built environment; build-in thermal sinks, and convert heat-to-energy albeit indirectly; to champion the 'living street' , the perennial paradigm itself; even to talk of habitability and sustainability without prescription.

Relationships suggested here associating urban form and human factors require further research. Measure the light-spectrum UVA concentrations at the base of canyons and in old-city nodes, in diverse climates; photograph radiant temperatures embodied in urban configurations (and climates), and landscaped urban thermal environments; develop GIS crime-maps for old-city precincts (in

different cultures), and elicit experiences from residents of Paris' nodes – unearth some spirit; and indulge a passion for *flannerie.*..still to come.

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