The Journal
of Architecture
Volume 8
Autumn 2003

Architecture for health – 2050: an international perspective

Stephen Verderber *Tulane University, New Orleans, LA 70118, USA*

The planning and design of environments for healthcare is complex and at times contradictory. Research and critical discourse have been fragmented and have not provided the degree of support required by the architectural profession. This dilemma is compounded by the enormous capital investment countries around the globe expend annually to promote the health status of their citizens. To help rectify this situation, landmark international developments in the relationship between architecture and health are outlined within a dualistic conceptual framework that is part historical and part futurist. Prognostications for the year 2050 are offered on issues concerning the rise of alternative care settings to the traditional acute care hospital. This portion of the discussion examines the rising importance of home- and community-based care, the functions of nature as a therapeutic modality, patient empowerment, the critical need for socially equitable and sustainable environments for healthcare, and the need for new paradigms in the planning and design of therapeutically supportive care and treatment settings. Two developments in particular, functional deconstruction and residentialism, are described in some detail as is the critical role of interdisciplinary approaches in meeting the global research and practice challenges which lie ahead in this century.

Introduction

Since the mid-nineteenth century architecture has evolved from a vocation with a singular emphasis on professional practice to a much broader disciplinary endeavour. This process has involved a search for greater professional relevance to society while seeking to establish autonomy within the community of professions. Relevance and autonomy, it has been reasoned, correspondingly carry greater stature and prestige than one or the other alone. It has been further reasoned that the generation and legitimisation of new knowledge through research carried out within a discipline of architecture would further propel progress toward attaining this aim. By comparison, such a model had been successfully adopted by the medical and legal professions over one hundred years ago as these disciplines elevated themselves to relatively high societal visibility and relevancy. In recent decades a *discipline* of architecture has ever so slowly, pedantically evolved, accruing its own body of knowledge in a rather haphazard manner (Robinson, 2001). Although no precise global statistics exist, the amount of research on this subject has remained scant in comparison to the massive capital resources invested annually around the globe in the name of improving the level of health of societies. Genuine disciplinary-based contributions to new knowledge in architecture remain in their infancy from the standpoint of their positivist foundations and in terms of truly elevating, i.e. further validating, the field of architecture in its entirety in the eyes of society.

1360–2365 DOI: 10.1080/1360236032000134808

Architectural theory is gradually evolving from a traditional reliance on historical precedent to a position informed by critical analysis and, to some extent, scientific method. As Lang points out (1987), disciplinary activity in architecture remains rather fractured and diffuse largely as a function of the continued, at times random, borrowing from allied fields in the social sciences, the humanities, and the engineering sciences. Lang refers to this persistent, chronic dilemma as the lack of synthesis within and between the major streams of research activity which constitute a nascent *discipline* of architecture. Synthesis in the context of the present discussion is defined as the need to reexamine precursors of value in acquiring a useful understanding of the present condition, precursors which can inform a course for future action.

Critics who argue that research within architecture too infrequently coalesces the three data points of past, present, and future have pinpointed one of the main reasons why the disciplinary knowledge base of the field advances at such a glacial pace. It is essential for historical perspectives and new developments to be examinable in transversive paradigmatic discourse across time and space without focusing specifically on the past, the present, or the future. The discipline of architecture can in turn contribute codified knowledge by aiming higher, setting as its goal the eradication of fragmented efforts in a search for relevance without sacrificing autonomy. The three principal aims of this discussion are: 1. To view research on the subject of architecture for health in the context of an emerging discipline of architecture; 2. To present a dualistic historical-futurist perspective guided by a chronology of landmark developments; 3. To sketch some prognostications for the discipline and practice of architecture for health for the year 2050.

In the first half of the following discussion various periods of development, or *waves*, are delineated based on the work of Verderber and Fine (2000).[1] International, epochal developments in architecture, health and society are cited which span more than three thousand years of human history. This chronology, presented in Figures 1a, 1b and 1c, is a composite *road map* of transformational events, present trends, and plausible future trends. A series of thirteen statements are numerically keyed to its central datum line. The author owes a debt of gratitude to the work of the late John Thompson and Grace Golden, and their landmark book *The Hospital: A Social and Architectural History* (1975) for their articulation of major developments from the age of ancient Greece to the mid-twentieth century.[2] This chronology can function as little more than an introduction to a fascinating, polymorphic, and at times contradictory subject area.

1. The city-state emerges as the provider of centres for sickness prevention and retreat, and for the patient's communality with the natural environment. Early hospitals in the Middle East and in Asian urban centres are advanced in comparison with their European counterparts.

From earliest times, the cave functioned as a refuge for the care and treatment of the sick and dying. In the earliest neolithic settlements, a sickhouse was set aside for the care of the ill as it was considered

The Journal
of Architecture
Volume 8
Autumn 2003

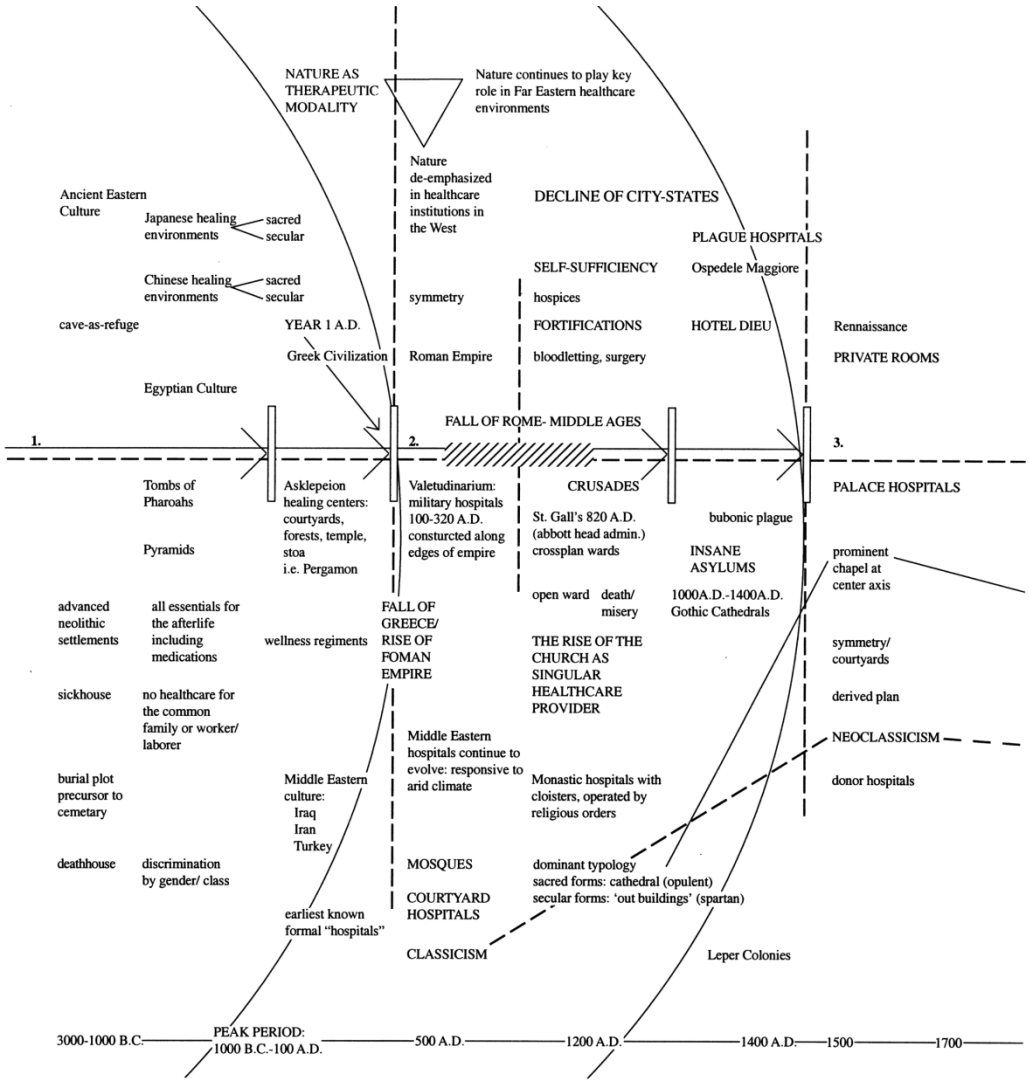

Figure 1a. Chronology of healthcare architecture 3000 BC–1700 AD.

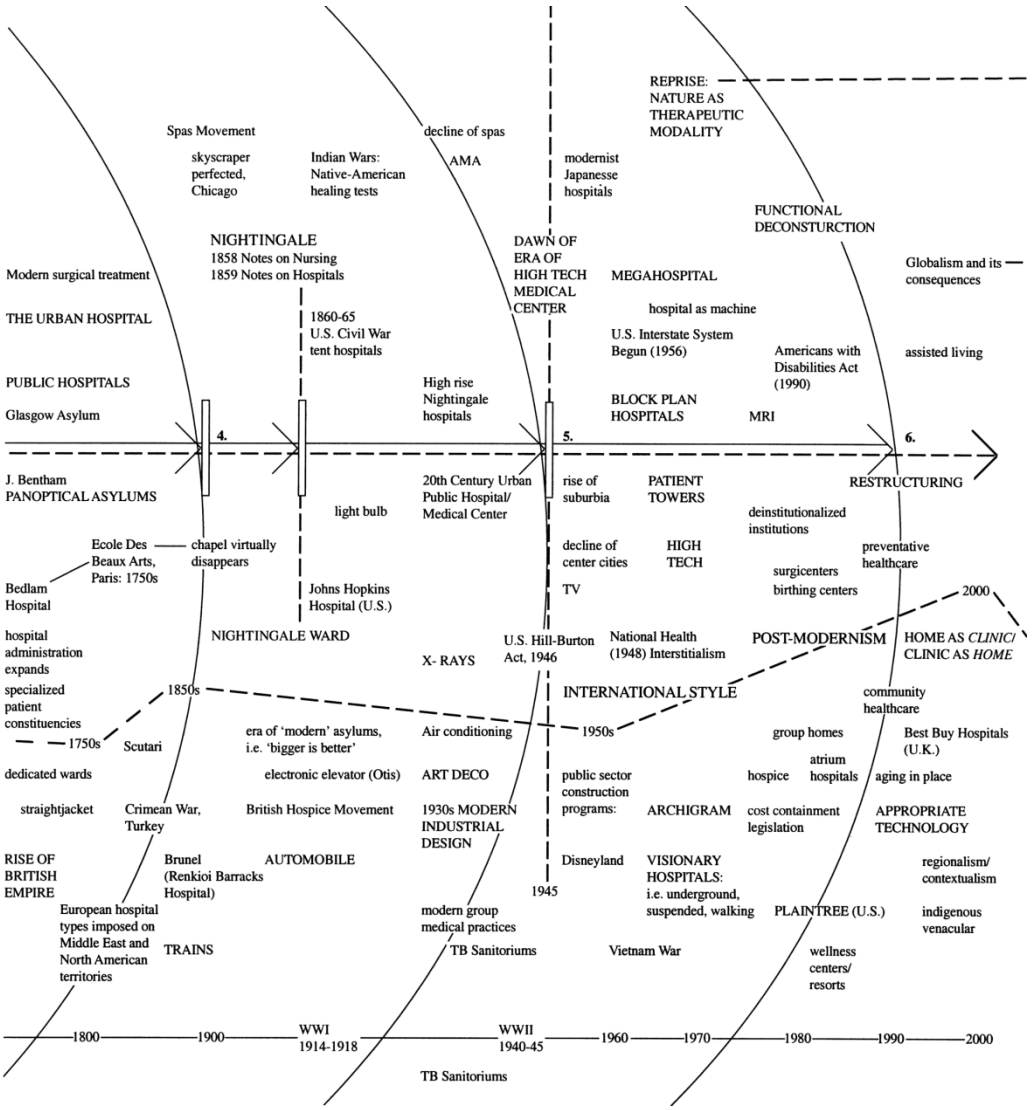

Figure 1b. Chronology of healthcare architecture 1800–2000 AD.

The Journal
of Architecture
Volume 8
Autumn 2003

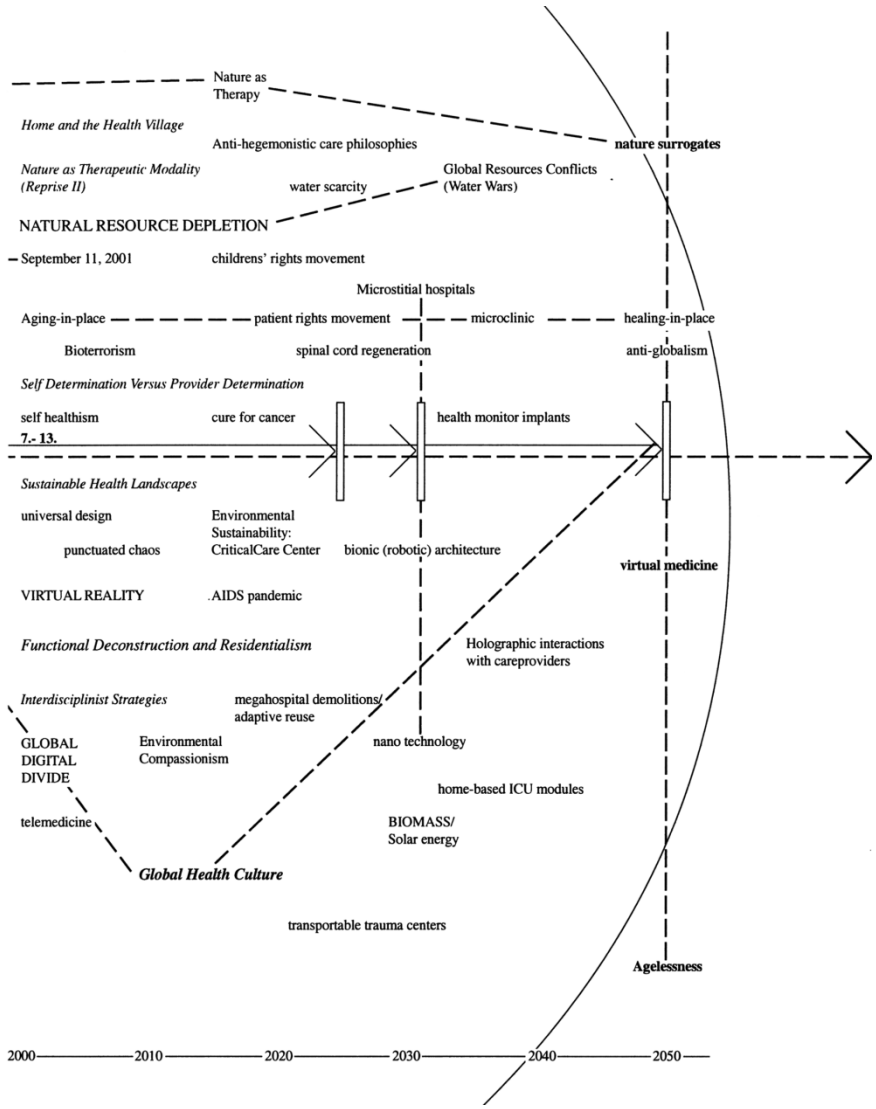

Figure 1c.
Prognostications –
healthcare architecture
2000–2050 AD.

acceptable practice to separate these individuals from the mainstream community. Nonetheless, the bulk of care for most was provided in the home setting, by immediate family members. Later, in ancient Greece, the natural environment was a central component at the Asclepieum at Pergamum (Fig. 2). By contemporary standards the typical treatment was based on wellness care, emphasising a protocol of communality with a nature-related treatment regimen, be it water, vegetation or air, for their restorative amenity. The earliest known formal hospitals, later to have a profound impact on European hospital architecture, were built in the Middle East, in Iraq, Iran, Egypt, and Turkey (Montague, 1982). Throughout Europe the sickhouse and the deathhouse evolved as the repository for the disenfranchised, indigent, insane and terminally ill. In these buildings patterns of segregation and discrimination dominated.

Healing environments in Japan and in the Far East distinguished between *sacred* and *secular* settings early on. Similarly, Chinese healing environments centred on the home, with the private dwelling as the principal care setting where, in multigenerational settings, younger family members typically provided care for the aged within the household. Across the Roman Empire, following the fall of Greece, military hospitals referred to as *valetudinarians* were constructed as a direct response to the need to repair and return soldiers to battle.

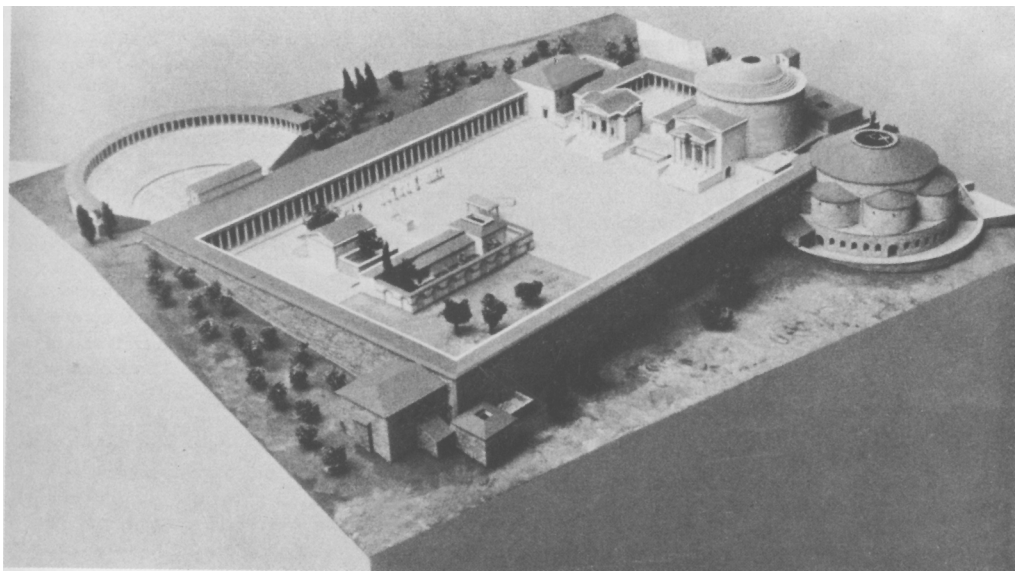

Figure 2. Asclepieum, Pergamum, Greece, c.600 BC (model).

The Journal
of Architecture
Volume 8
Autumn 2003

2. In Europe, Christian religious orders provide care through networks of monastic hospitals based on cross-ward plans, and the separation of sacred from secular facilities. Precursors to the modern medical centre campus evolve. Middle Eastern medical centres continue to be more advanced than their European counterparts during this period.

In mediaeval Europe, deadly diseases such as the bubonic plague swept through entire communities in a matter of days, at times killing more than 90% of the inhabitants. With the decline of secular city-states (and following the mid-fourth century adoption of Christianity as the religion of the Empire by Constantine the Great), the Catholic Church emerged to fill the void in healthcare across Europe from the fifth to the fourteenth centuries. A mainstay of medicinal care throughout this period, bloodletting, was relied upon in the treatment of a vast assortment of ailments, diseases, and sicknesses. Later, the antecedents of modern scientific surgical procedures would be introduced as a progressive alternative to mediaeval treatment protocol.

Gradually, the Catholic Church, with its singular emphasis on faith as the means to redemption and salvation (if not recovery, which seldom occurred), deflected emphasis on nature as a treatment modality. The virtual disappearance of the incorporation of nature in this manner in Western health institutions would last until the rise of health spas in the late nineteenth century in the USA and earlier elsewhere. In contrast, the therapeutic amenity of nature would remain a central concern in Far Eastern care settings. Hospitals in Cairo and Baghdad were considered more advanced than their counterparts in central and northern Europe with respect to scientific medical advances, and with respect to the influence of architectural responses to climate in the mosque hospitals built during the Middle Ages.

In villages and cities of mediaeval Europe an order emerged whereby social misfits, undesirables, the disfigured, disabled, and the infirm were sentenced to miserable institutions by public decree. In large cities vast institutions descended into hellholes for these outcasts. Physicians and hospital administrators first achieved a modicum of autonomy and self-sufficiency in terms of social status and influence in the scope and quality of care at this time. Fortifications were built to protect monastic medical centres. Within the compound were myriad secular structures, all of which supported the function of sacred space – the church-wards. Infirmaries and 'accident rooms' were created for the on-site care of the sick and injured.

St. Gall's monastic hospital was constructed in the ninth century AD in what is now Switzerland and, later, the Monastery at Cluny was built in France (Fig. 3). Dozens if not a hundred or more such medical centres were built. The concept of care centred on individual patients hearing mass each day from their bed within the large open ward, as close to the altar as practicable. Single wards eventually were expanded into replicated *cross-ward* open-plan monastic chapel-wards on a single site. These chapel-wards were places of disease, displacement, illness and utter misery. The *hospice* at this time first appeared as an alternative:

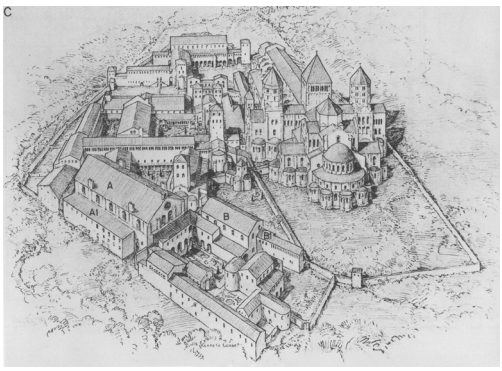

Figure 3. Monastery, Cluny, France, c.1157.

part-inn/part-infirmary, providing a counterpoint to the hellish conditions of the chapel-ward. These waystations served capably during the Crusades (as do their contemporary successors up to the present day), affording respite for the sick and the dying.

A new building type, the insane asylum, was developed as the repository for the mentally ill and for social outcasts. In urban centres vast medical complexes were built, housing upwards of a thousand beds each, such as the Hotel Dieu in Paris, operated at first by the church and later in partnership with local government. Increasingly, in municipalities with public governmental (non-feudal) rule, local authorities controlled admission to the hospital. Vast plague hospitals, such as the Ospedele Maggiore in Milan, were constructed with public funds and then became subject to neglect due to chronic underfinancing.

3. Hospitals, during the Renaissance, were designed and built principally to emulate palaces of the period. The public hospital emerged as the successor to the donor hospital, i.e., a hospital donated as an act of charity by a wealthy philanthropist or private benefactor. The advent of humanism placed 'man' (the human being) at the centre with attendant interest in the workings of the human body. Scientifically based medical education and practice proliferate during this period.

The Italian Renaissance represented a reawakening of interest in classical antiquity and in the idealisation of the cultural values embodied in classical thought and governance. The Abbot of the mediaeval medical centre had overseen a vast staff of ward superintendents, logistical support assistants such as bookkeepers and dietitians, and ward attendants.

For the insane, new techniques were developed to maximise control of the patient-inmate, such as in the seventeenth century at Bethlehem (Bedlam) Hospital in London (Fig. 4). Bethlehem Hospital typified neoclassical architecture as expressed in healthcare facilities. Its stately appearance, from the exterior at least, was to convey a noble *face* (façade) to the world. Within, however, conditions for the patient-inmate were deplorable. The private room, by no means a recent invention, having first appeared in private rooms for the influential in early monastic hospitals, essentially was for the benefit of the upper classes. Meanwhile, the lower classes continued to be relegated to immense, unkempt, disease-ridden, hell-hole wards, often three or more per straw mattress. At the palace hospital in Wurtzberg, Germany (1576–1585) and similar institutions

The Journal
of Architecture
Volume 8
Autumn 2003

Figure 4. Bethlehem (Bedlam) Asylum, London, 1676.

built in the same period in Italy, England, and France, the chapel diminished in physical size, placement, and importance, paralleling the rising status of organised, scientifically based medicine.

'Advanced' (or so-called) care philosophies for the mistreatment of the maladaptive insane were personified by the invention of the straitjacket, first used at St. Thomas's Hospital in London in the eighteenth century. Nature vastly diminishes in importance in Western culture. The large, and frequently, multiple courtyards dominating the palace hospitals of the Renaissance become more diminutive in size and eventually disappear entirely from urban hospitals, constantly expanding on land-starved sites in dense urban neighbourhoods. Based on the writings of Jeremy Bentham, among other leading healthcare facility experts, a new prototype developed, the Panopticon Asylum. The Glasgow Asylum (1801–1810) was among the most significant of this new

building type. The amenity provided for the inmate was negligible.

4. The modern transposition of effective medical and nursing principles into architectural form begins with the work of Florence Nightingale. The Nightingale ward, and later adaptations of Nightingale principles to the 'skyscraper' hospitals, occur internationally.

Innovations in the design and function of the hospital were incorporated in the colonies ruled by the British Empire during the eighteenth and nineteenth centuries. The political pressure at home to succeed at war elevated the overseas military hospital to a level of critical importance. This trend would manifest itself in healthcare architecture, dominating a period of approximately eighty-five years (1860–1945), beginning with the work of Florence Nightingale and ending with World War II (1939–1945). Nightingale was dispatched to the front lines of the Crimean War in Turkey in late 1855, in a last-ditch attempt to reform a failing makeshift barracks hospital. At Scutari, in a converted military installation on top of a fortified bluff, she encountered a mortality rate unacceptably high. Prior to her arrival nearly 11,000 out of 14,000 troops were housed in the infirmary or deemed too ill to be designated as battle ready. The ensuing scandal caused a government to fall.

Meanwhile, Brunel designed and constructed a new barracks hospital at Renkioi, Turkey (1855), remarkably similar to what would become known internationally as the Nightingale Ward. A prefabricated patient care ward, housing fifty patients, was designed and pretested in Paddington, London. The hospital at Renkioi consisted of two rows of one-level prefabricated wards, built of wood, arrayed along a dual circulation spine. This facility proved highly successful in terms of reducing patient mortality rates. At Scutari, with thirty-eight nurses, Nightingale transformed a deplorable facility.

Upon her return after the war, Nightingale wrote two influential books, *Notes on Hospitals* (1858), and *Notes on Nursing* (1859). Among her many innovations were provisions for fresh air circulating within a bright, cheerful, open ward with no more than 30 patients per ward, in a volume 30 feet wide by 128 feet in length, such as at the Marquand Pavilion, Bellevue Hospital, New York City (Fig. 5). Her functionally driven planning model was modernist in its layout. Its interior expression was non-ornamental, aesthetically. However, nearly all hospital exteriors continued to be cloaked in the neoclassicism in vogue. Her writings set the standard against which all hospitals would be judged, to a greater or lesser extent until 1945, and constituted a precursor to the present practice of

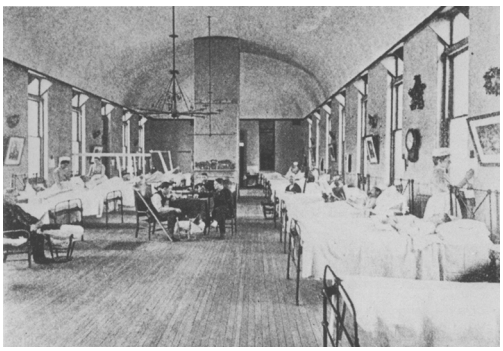

Figure 5. Marquand Pavilion, Bellevue Hospital, New York City, 1893.

The Journal
of Architecture
Volume 8
Autumn 2003

the interior healthcare facility planner, in many cases, a specialist apart from the person charged with the design of the exterior of a hospital or related health facility.

In North America, during the Indian Wars waged against Native Americans throughout the 1870s and 1880s, the US Army constructed tent hospitals in the Western sector as a means to provide medical treatment for wounded soldiers. These facilities carried forward advances introduced a decade earlier, during the American Civil War (1861–1865).

High-rise hospitals of the pre-WWII period first incorporated central air conditioning systems in their adaptation of Nightingale's modern healthcare facility planning precepts. Specialised departments with new architectural requirements, e.g., radiology, appeared, and dramatic growth occurred in the urban centres where they were constructed on 'tight' sites. The Superintendent answered to a board of directors. Exponential expansionism occurred in order to keep pace with new medical technologies, expressing a mantra of bigger is better. Bed capacity was a key indicator of institutional status among peers. As community hospitals were built in new suburbs, networks of roads were built outward from older urban centres. The private car now made it possible for patients to travel further more expediently for care, fostering an entirely new type of hospital.

5. The International Style dominates the hospital as a building type. The movement to incorporate advanced building technologies results in the interstitial hospital movement and the unabated expansion of the modern medical centre. Health planning emerges as a distinct profession. Health-based political bureaucracies emerge in countries around the globe. The regional teaching hospital evolves in recognition of the need to allow for internal flexibility and external extension in a highly complex, dynamic organism.

The massive utopian megahospital of the late twentieth century represented the apotheosis of an unyielding belief in the power of medical science in the post-1945 era. Beginning in 1946, the race was on to construct ever larger and more complex hospitals and medical research centres, often occurring at the expense of long-established ethnic neighbourhoods, disfigured in the name of urban renewal. Medical centres were transformed in a single decade (1946–56) into behemoths of unprecedented urban scale and complexity – as 'mediaevalist' enclaves. By the 1960s, critics assailed hospitals as frequently being obsolete from the opening day. Chronic renovations, upheaval, and premature obsolescence in the face of dramatic advances in medical science and technology gave rise to a new wave of thought.

The interstitial hospital was conceived as a vehicle capable of responding to the period's hyper-accelerated rate of change in the healthcare landscape. Architecture was a delimiting force in the view of many an administrator and medical chief of staff. The hospital had to become anticipatory, no longer solely reactive to external determinants. Interstitialism was to promote 'infinite' internal flexibility – universality – achieved by intermittently

Figure 6. McMasters Medical Center, Hamilton, Ontario, 1972.

stacking one layer of, say, a patient-care floor, with a technical support floor either directly above or below. One of the largest of the megahospitals, the massive McMaster's Medical Center in Hamilton, Ontario, which opened in 1972 (Fig. 6), was to represent the ultimate response to the architect's curse of accelerated facility obsolescence. Its proponents asserted the interstitialist hospital was to be reinventable one hundred years or more into the future. Soon it was learned, however, that it cost as much as 30–40% more in initial construction costs to incorporate interstitial systems. Compromises appeared such as partial interstitial systems where only one half or one third of the total floor areas per floor were served by an unoccupied support floor, such as at the St. Mary's Hospital on the Isle of Wight, in the UK. Many hospitals in developed nations which in 1980 operated 800–1000 beds, by 2000 staffed hundreds fewer beds.

6. The downsizing and redeployment of healthcare services express a pattern of functional deconstruction within the postmodern hospital. A hub (mothership) and spoke (clinic) system of care delivery widely disperses care to an increasing number of small-scale facilities in community out-patient settings. Accordingly, smaller concentrations of beds for inpatient care are required in acute care hospitals. Increasingly, the hospital is a last resort and

The Journal
of Architecture
Volume 8
Autumn 2003

reflects the failure of primary and secondary care systems to prevent illness and disease. Information technology and the Internet emerge, providing assistance in the promotion of sickness prevention. A digital divide persists globally, as does the inequitable distribution of services. Healthless versus healthful societies emerge, in the extreme. Health promotion, sickness prevention education, and self-empowerment occur, inhibited by a global discrepancy between high-tech and low-tech societies, and conflicting priorities between private and public agencies. Inequitable access and poor quality of healthcare for the poor and disenfranchised remain at critical levels on an increasingly populated planet.

A new period in the ontology of architectural movements in healthcare appeared at the end of the century, synchronous with the advent of the Internet and World Wide Web. The Internet, functioning as the primary source of global communications over the coming decades, is fostering innovations in healthcare and in architecture for health. New developments are enormously influencing medical science, leading to the advent of the empowered patient and will affect in some way all places where healthcare is dispensed and care received.

7. By 2050, for those fortunate enough to have one, the home, not the hospital, will be the centre of one's healthcare 'universe' supplemented by anyplace where one has online access to health information.

The hospital and its successor institution will retain an essential role in the care of only the most acutely ill. This is already occurring: online medical databanks and telemedicine practices are being formed in anticipation of the coming boom in home-based virtual healthcare. The dwelling will need to be rethought in support of its new function as a virtual clinic. Holographic 'consultation sessions' with one's caregiver will occur in the family room or kitchen. The possibility exists, in theory at least, for the patient, if equipped with such resources, to have access to health information anywhere, anytime.

8. The physical space at present separating the individual from contact with the natural environment will gradually disappear. Buildings for health will increasingly express anthropomorphic forms and anti-machine imagery.

Artificial terrain tools and software packages will make it possible to fuse transparent linkages between human sensory modalities and the content of the experience of natural environments. Immersion landscapes, many of which are already to be found in zoos and aquaria, combine various elements of such real and virtual natural landscapes, and are able to be geared to suppress any undesirable, i.e. counter-therapeutic, content. They are fully controllable and monitored to create a desired effect such as at the Lied Jungle at the Henry Doorly Zoo in Omaha, Nebraska (www.vterrain.org, 2002). The cultural critic Umberto Eco writes of 'hyperreality' – imitations intended to be better than the originals. Artificial rain forests such as at the zoo in

Omaha at present provide visitors with a condensed version of world travel in which they experience only the most interesting and edifying features of natural places. Experiences such as these will be well integrated into the planning and design of hospital and related healthcare settings by 2050. The therapeutic effects of artificial landscape simulation in buildings will enhance the healing process. The natural environment itself will by then have been widely contaminated; all that will be left will be faint recollections of the real thing, for simulations will be the norm rather than the exception (Bentley, 2002).

Translucent, backlighted curvilinear wall panels replace the stoic traditional walls in the corridors of the *Arizona Center for Health and Medicine*. The panels traverse the colour wheel, presenting a dawn to dusk panoramic progression (Calmenson, 1999). In 2050, hospitals in dense urban settings will be able to tune out all undesirable, i.e. counter-therapeutic, stimuli (noisy traffic, smog, etc.). Active simulations will be supplemented by passive devices such as wall murals (a technique used at present in a number of institutions) and sophisticated lighting. One of the first modular patient rooms to incorporate active nature simulations is *The Wellness Room*. Walls and ceiling can be specified with an aluminium lightbox housing photographic artwork. Backlighting is used to activate the nature scene and to provide ambient lighting, controllable by the patient (www.wellnessllc.com, 2002). Techniques such as these will certainly appear quaint by mid-century. Architects can take a leading role in creating intelligent design applications for virtual nature technologies.

As for buildings designed for health in 2050, the 'CO2', its nickname derived from its plan configuration, a community health and wellness centre in Narita, Japan, near Tokyo, by M. Kazuhiro (2000) perhaps provides a glimpse into the future as it embodies nature and anthropomorphism in its parti (Fig. 7). Today, we think of the natural environment as itself the best source of contact with nature for the sick and diseased. Organic patterns found in nature provided inspiration and artefact for built form as actual trees become structural elements (Fig. 8). These interior trees anchor a white fabric membrane roof system, beneath which rooms are deployed around a pair of

Figure 7. Community Health Centre, Narita (Tokyo), 2002.

Figure 8. Courtyard, Community Health Centre, Narita.

The Journal
of Architecture
Volume 8
Autumn 2003

Figure 9. Interior, Community Health Centre, Narita.

courtyards shaped by the irregular curvature of the structure (Fig. 9). In this manner, nature is brought into buildings as a means to protect it, to 'save' it, ironically, from 'destruction', and to preserve its inherent beauty for future generations to admire well into the twenty-second century, when deforestation will have done its irrevocable damage to the earth' s virgin forests.

9. The digital divide will continue to separate the haves from the have-nots in the global healthcare landscape.

By 2050 the expert, empowered patient will have emerged only in those cultures wealthy enough to afford the technology for doing so. In sharp contrast, the sheer volume of information available will elevate the patient and family to an unprecedented level of sophistication in richer societies. In poor societies the recipient (already widely referred to as the 'consumer' in rich countries) will be more acutely aware of their plight, and the available options, and therefore less (or more) empowered than at any time in history. An im-pediment to attaining political balance between the privileged and underprivileged in societies will remain what is widely referred to as the digital divide – those with Internet access versus those without. This is no different from the Middle Ages, when those who could afford to barter for privacy received a private room far from the hellish open ward.

10. Healthcare organisations will be forced to become better citizens to sustain and enhance human life without promoting environmental degradation. The functional deconstruction of hospitals and allied institutions will continue to occur and new uses for vacant hospitals will be created. As obsolete hospitals are destroyed, environmentally compassionate new uses for their former sites will be articulated.

Hospitals are often among the worst polluters in their communities. They generate excessive amounts of toxic waste, and the institution is nearly always planned and built with little regard to issues of environmental sustainability. The time has come

when healthcare facilities must realise, accept, and appreciate the value of architectural sustainability (Ashton, 2002). At the very least they will be forced to acknowledge the public relations wisdom of being able to 'market' their institution from this perspective. By 2050, all healthcare providers will have been required to adopt 'zero waste' policies. Hospital incinerators will have been demolished, having outlived their original purpose. Where possible, site planning and building massing will be 'reinvented' in a reprise of traditional Nightingalian practices, such as in the nineteenth and early twentieth centuries, in microhospitals.

The biggest problem will remain excessive resource consumption. By 2050 the notion of healthy bodies, healthy environment, will of necessity be widely accepted (Green and Wright, 2002). But by then it may be too late. In the latest *Global Environmental Outlook*, the UN Environment Programme points out that one of the three pillars of sustainable development, the environment, is 'seriously listing' because of the distortions placed on it by excessively insensitive human actions. There is a paramount need to reduce the excessive consumption of the more affluent – 'as long as the richest 20% continue to account for 86% of consumption, sustainable development will never be achieved' (Thurgood, 2002). Healthcare facilities globally will have to adopt the zero waste concept, following the lead taken by the manufacturing sector, where the initial objective was simply to reduce emission of wastewater and solid waste.

In India there are more than 5,000 small and private hospitals and nursing homes. Increasing population has caused a rapid proliferation of health facilities. India alone generates 3 million tons of medical waste annually and this figure is growing by 8% each year. Waste segregation at the source remains the number one problem, a looming crisis by 2050, yet this concept is not ingrained whatsoever in the culture, and therefore remains a low priority for administrators (Express Healthcare Management, 2001). In many parts of the globe, such cultural indifference will continue to hinder progress. Architects, armed with the results drawn from successful case studies, in consort with physicians, can lead in these re-education efforts in the community (Connor, 2002). Architecture and the fields of community health and social ecology will merge into a single entity, in part out of regulatory necessity.

Steve Connor, in 'Hospitals for a Healthier Planet' (2002), outlined current best practices in sustainable hospital construction. Architectural research on this subject will need to identify ways in which improved healthcare facilities can be integrated with eco-parks in towns and neighbourhoods. Improved on-site management of waste from the point of site preparation and construction onward, and the establishment of materials specifications on a 'fitness for purpose' basis will be mandated by law. In addition, policies will require that little or no waste is created from the demolition of old buildings (as all materials will have to be rechanneled). Buildings will be designed for ease of disassembly and redeployment, with recycled first-generation building materials used only when absolutely necessary. Contractors will be daily participants in centralised waste exchanges in order to stream old waste to new 'wasteless' uses.

The Journal
of Architecture
Volume 8
Autumn 2003

The process of functional deconstruction appeared in the US in 1983 with the advent of federal healthcare cost containment legislation. It has more recently begun to occur in other highly developed countries. Immense hospitals have become too expensive to staff and operate. Hospitals are being forced to reexamine their mission, scope of services, and community role. The trend towards outpatient care has resulted in a precipitous drop in the demand for inpatient beds needed for overnight stays. This process is ongoing in the US and is occurring in many countries, including the UK (in its recent Best Buy hospitals), and Japan, both of which have been loath to accept a less than singular role for the highly centralised hospital in the total scheme of things. The functionally deconstructed hospital will require architectural research on its future complexion and its civic function, public and patient perceptions of its role, and its very sustainability in a resource-starved world. The movement toward smaller residential patient-focused care centres is deeply rooted.

Meanwhile, the international hospice movement will continue to symbolise this rejection. The palliative care dispensed in a hospice is a late-twentieth century reaction against the scale and hyper-institutionality of the megahospital. As for acute care, smaller Critical Care Centres (CCCs) will emerge in the coming years although large teaching hospitals attached to medical schools will always be needed (Verderber and Fine, 2000). In the microstitial hospital and larger facilities alike, every inpatient room will possess transformable step-up or step-down technological capability at a moment's notice: from the most intensive levels of care to its use as a pre-operative dormitory room. Due to cost constraints, small-scale wards will return. Older, architecturally inflexible institutions will simply be too costly to maintain. Architectural research will be called upon to examine viable, high-care, cost- effective options without sacrificing the element of humanism. Obsolete hospitals, no longer justifiable on either a quality of care or economic basis, will be demolished by the hundreds, or adapted to new uses, such as housing for the underprivileged.

11. Interdisciplinarianism between architecture and allied disciplines will be essential in the coming decades.

Collaboration denotes openness to the necessity of sharing, of collective problem solving. New coalitions will, out of sheer necessity, occur with global resource management, optical imaging and holography, human genetics and biomedical engineering, chaos theorists, nanotechnologists, community health agencies, public policy experts, gerontologists and other social scientists, and specialists in many other fields. Useful architectural and environmental design research will be needed on the issue of design intervention, scenario planning, and identification of effective community-based participatory planning protocols.

12. In wealthy countries, patients' rights movements will blossom by 2050. In poor societies patients will continue to struggle to attain even minimal control over their health conditions. Advanced health technologies, including

nanotechnology, will have an uneven impact globally on human health and well being.

With the proliferation of HIV/AIDs and the outbreak of unforeseen plagues and epidemics in the coming decades, newly formed patients' rights groups will by default adopt extremist tactics. In a wave of anti-globalism, certain hospitals and clinics may be destroyed by patient care anarchists, while other factions will seek subtler means of change to the healthcare systems in their countries. Although much of this anger will be focused on the government-based systems of care around the globe, dysfunctional hospital architecture will come to represent an easy, symbolic target. Sustainable provider-recipient partnerships will by definition be explicitly democratic, with proponents taking the view that people cannot be persuaded to care for themselves when they haven't had a voice in their own fate. Healthcare autocracies, for the less fortunate, will issue decrees as to who will live and who will die, as cost will emerge as the overarching factor in the age of possible human cloning.

Community development professionals have known for years that in order to engage effectively with disadvantaged groups one must first address the power imbalances that persist between them and the provider, i.e. the governmental agency, head-on. This practice is widely referred to as 'linking social capital' (Tuxworth, 2002).[3] However, the digital divide will persist as a major political and practical barrier in the coming decades within the informational cognoscenti in the effective dissemination of health-related knowledge.

Aside from geopolitical interventions, advances in biomedical science will result in what will become known as the agelessness movement. The debates are already reaching fever pitch (Kramer, 1997; 2001). In an essay 'On Becoming Posthuman', Max More describes the science of extrophy, a state attainable, in his view, in the aftermath of sweeping advances in neurophysiology, neurochemistry, and human genetics. He asserts that we have taken our first steps along this road by altering our species' genetic structure to remedy nature's failures, and will soon develop a cure for cancer. We can now use Prozac, Piracetam, Hydergine, and Deprenyl to modify our physiology, enhance our concentration, and slow brain aging. Research into more specific and powerful modifiers will accelerate as we apply new tools from molecular biology, computer-assisted molecular design, and brain imaging. Health-monitoring machines are becoming more organic, self-modifying, and intelligent. Artificial life, neural networks, fuzzy logic are trends which signify that the human race is beginning to incorporate its technology into ourselves. Computers and their interfaces will rapidly evolve to fit us: from mainframes and text-based interfaces to PCs and GUIs, PDAs, voice-recognition, and knowbots. How long before nanocomputers are implanted? We have embarked upon the road towards transmutation of the elements themselves in a bizarre quest for immortality (More, 2001).

Molecular nanotechnology will eventually afford total control over the structure of matter, allowing us to build anything, perfectly, atom by atom, even the reconstructed body. Some futurists believe that the abolition of aging and most involuntary death will be one result (Uldrich, 2002). Machine

The Journal
of Architecture
Volume 8
Autumn 2003

intelligence researchers, roboticists, and cognitive scientists foresee even more radical possibilities. We may be able to 'upload' ourselves, our psychological outlook, memories, emotional responses, and values. This will occur just as we now do with software, only from our biological brain to our synthetic brain. Powered by these devices our cognitive mental processes could function hundreds of thousands of times faster than at present. This is the epochal world depicted in Steven Spielberg's futurist film *AI* (2000). More attainable at a much earlier date will be the discovery of spinal cord regenerative medicine (Vikhanski, 2001) and the fusing of robotics with the design of the built environment (Mulhall, 2002), including the application of robotic personal assistants, or RPAs, for residents in long-term care settings. This is already occurring in Japan on a pilot-case basis (Stewart, 2002).

13. Greater diversity is/will be essential to the success of future research endeavours in architecture for health. This will require the broad participation of 'end- user' constituencies previously shut out of the planning and design process.

A far broader spectrum of participation will be needed, including those affected by issues of racial equity, gender equity, and economic and political marginalisation (Bingdman et al., 2002). It no longer suffices for the health facility researcher to speak only with the staff and administrators of the institution. Who will represent the poor residents of the local community? The distance between the end user, usually at the bottom of the decision-making pyramid, and the leadership of an organisation, usually at the top, will have to be compressed, and, in extreme cases, inverted.

Throughout history, architects, no strangers to making future-oriented prognostications, have often worked in isolation, adopting an aloof, heroic stance. The vehicle of the design competition has fostered this predilection to a large extent (Allgood, 1997). Many building proposals, in the context of competitions or otherwise, have been linked to polemical manifestos (Toy and Jencks, 2000). Regardless, healthcare clients have generally been loath to use the design competition as a means to award commissions for their buildings. Such autonomous, thrice-removed modes of communication with society will not suffice in 2050 if the profession hopes to have any reasonable prospect of retaining social currency. It is a currency at present considered by a growing number of critics to be in a mode of declining valuation. It will require speaking to people with whom the architect and health planner may have little in common by way of background, sometimes telling a client that no new building is needed whatsoever, as it would conflict with the sustainability of affected bio-ecological systems. There will be no valid excuses for dismissiveness or discrimination.

Healthcare architecture will have to respond to a series of new challenges in the coming years (Fig.1c). First, new knowledge of facility transprogrammism will be warranted with regards to universal flex properties of buildings and the demise of single-use buildings for healthcare in crowded, land-starved urban landscapes. Westerners can

learn useful lessons from the Japanese, who have mastered the design of multi-programmatic (far beyond the static concept of 'mixed use') buildings in their densely packed cities. New anticipatory 'flex' properties of buildings must be researched to allow for readily reconfigurable permutations in response to occupants' evolving daily and long-term needs and aspirations.

Second, new forms of person–nature transactions in the healthcare milieu need to be developed: the tectonics of nature transportation and assimilation into the healthcare setting have barely been explored. Therapeutic views of nature from hospital room windows have been proven to have a positive impact on well being. This work, however, has been centred largely on the patient's access to *authentic* natural content. Much more work is needed on this facet of person–nature transactions as well as on artificial landscape representations from a multi-sensory standpoint.

Third, architectural tectonicism research will be needed on the increased blurring of the lines intrinsically, traditionally, separating humans from buildings. Advanced technologies will enable humans to attain a far greater level of interactivity with their setting. Bionic and robotic engineering and anthropomorphism will have a strong influence in design decision making on the human side. New, sustainable materials, assembly systems, and tectonic anatomical-operational systems will have a similarly profound influence on the tectonic side of this equation.

Fourth, future research must fuse all this with the timeless, enduring qualities of architecture. These humanistic properties include the importance of place, hierarchy, appropriate scale, harmony with context, enclosure, appropriate materiality, appropriate ornamentation, the importance of art, the need to control the trend toward excessive commercialism in architecture, and the timeless importance of community (Salingaros, 2002).

Summary

Geopolitical and population issues demand attention. The world's 6.1 thousand million population increases by nearly 9,000 persons each hour. Several worldwide population institutes estimate that, by 2050, between 9 and 9.5 thousand million people will be living on the planet (World Health Organisation, 1998; 2000). Populations in need of global architectural intervention will include communities ravaged by HIV/AIDs, malaria, tuberculosis, plagues such as the virulent Ebola virus in Africa, and new strains of yellow fever. Add to this the profound pain caused by new settlements built in places where they should not be, such as in low-lying coastal zones, earthquake-prone regions, and in the midst of notorious 'hurricane alleys'.

Viewed in this larger context, the intent of this paper, rather than to present a manifesto of any sort, is merely to sketch some of the many events which are unfolding now and just beyond the immediate horizon. Dismissal would be unfortunate, as there is a reluctance to accept new research-based knowledge by the profession. Robinson (2001) writes:

> Today it is insufficient simply to assert expertise. Expertise must be backed up by a clearly defined, visible, usually linguistically described, coherent body of knowledge. Lacking this, the profession of

> architecture has found itself at a disadvantage relative to other fields and with questionable status as a profession. . . . Before, the architect was simply trusted to know about building . . . the architect (now) must provide verbal evidence and justification for one's decisions…the existing structure of this knowledge base and of theory within architecture, however, does not easily incorporate . . . New forms of explicit knowledge . . . Rather than simply being (put) in the responsive mode, architects will have to become proactive, generating full discussion of (the) issues.

Futurist perspectives always run the risk of didacticism. As with any attempt to look into the past as a means to examine the present and the future, this effort will be viewed sceptically by some. At the very least, it is hoped, it will be of some value to specialists working in its central subject area. It is also hoped that this conceptualisation and others like it can serve as stimulants for an expanded, far more generously funded set of new initiatives. The private and the public sectors need to work in tandem, becoming more active sponsors of such work. It is time to recognise that the research enterprise in the area of architecture for health has much to offer societies around the globe.

Notes

1. An organisation, *Global University Programs in Healthcare Architecture* (GUPHA), was founded in 1998. The group's objective is to articulate prognostications for the year 2050.
2. This timeline was first developed by the author for use in a course called *Architecture and Human Health*, taught at Tulane University.
3. Tuxworth reasons that as long as the gap between the promise of local democracy and what it actually delivers to the individual is so wide in ultra-capitalistic societies, it is highly unlikely that shopping will be dethroned as the ultimate expression of self.

References

Allgood, L. (1997) 'Architects Have Been Shopping Their Visions for 2,500 Years'. *Emory Report*, Vol. 50, Number 8.

American Institute of Architects (1995) *On Honoring Teaching Excellence* (Washington, DC, American Institute of Architects).

Ashton, J. (2002) 'From Sickness Treatment . . . to Sustainable Development'. *Green Futures*, Issue 34, May/June.

Bentley, P.J. (2002) *Digital Biology: How Nature is Transforming Our Technology and Our Lives* (New York, Simon and Shuster).

Bingdman, A., Sanders, L. and Zorach, R., eds. (2002) *Embedded Utopias: Gender, Social Change, and the Modern Metropolis* (London, Routledge).

Calmenson, D.W. (1999) 'Participatory Healing'. *ISdesignet Magazine*. March <http://www.isdesignet.com/magazine> (July 2002).

Connor, S. (2002) 'Hospitals for a Healthier Planet'. *Green Futures*, Issue 34, May/June.

Editorial (2001) 'Managing Biomedical Waste'. *Express Healthcare Management*, Issue 16, 31 April 2001.

Green, E. and Wright, M. (2002) 'Healthy Bodies, Healthy Planet?' *Green Futures*, Issue 34, May/June.

Kramer, S. (2001) *The Continuance of Existence* (Santa Barbara, CA, Creations in Consciousness).

Kramer, S. (1997) 'Agelessness'. *Self Help Magazine*, August.

Lang, J.T. (1987) *Creating Architectural Theory: The Role of the Behavioral Sciences in Environmental Design* (New York, Van Norstrand Reinhold).

Montague, J. (1982) 'Hospitals in the Muslim Near East: A Historical Overview'. In Bradfer, F., *Architecture Hospitalière, Part I, Islamic Hospitals* (Washington, DC, Center for Research in Architecture, Catholic University of America).

More, M. (2001) 'On Becoming Posthuman'. <http://www.maxmore.com> (July 2002).

Mulhall, D. (2002) *Our Molecular Future: How Nanotechnology, Robotics, Genetics, and Artificial Intelligence will Transform Our World* (New York, Prometheus Books).

Robinson, R.W. (2001) 'The Form and Structure of Architectural Knowledge: From Practice to Discipline'. In Robinson, J.W. and Piotrowski, A. (eds.), *The Discipline of Architecture* (Minneapolis and London, University of Minnesota Press).

Salingaros, N. (2002) 'The Architectural Contributions of HRH. Charles, The Prince of Wales'. <http://www.math.utsa.edu> (July 2002).

Stewart, A. (2002) 'A Silver Lining?' *Japan Inc.*, 29:3, pp. 6–8.

Thompson, J.D. and Goldin, G. (1975) *The Hospital: A Social and Architectural History* (New Haven, Yale University Press).

Thurgood, M. (2002) 'Waste Future – 2020 Visions – and a Zero Waste World?' *Green Futures*, Issue 35, July/August.

Toy, M. and Jencks, J., eds. (2000) *Millennium Architecture* (New York, John Wiley and Sons).

Tuxworth, B. (2002) 'Sit Still While I Empower You . . .' *Green Futures*. Issue 35, July/August.

Uldrich, J. (2002) 'Eleven Reasons Why Nanotechnology Will Arrive Sooner than Expected'. *Futures Research Quarterly*. Vol. 18(1).

Verderber, S. and Fine D.J. (2000) *Healthcare Architecture in an Era of Radical Transformation* (New Haven and London, Yale University Press).

Vikhanski, L. (2001) *In Search of the Lost Cord: Solving the Mystery of Spinal Cord Regeneration* (Washington, Joseph Henry Press).

Vterrain. (2001) *Artificial Terrain Tools and Software Packages*. <http://www.vterrain.org> (July 2002).

Wellnessllc. (2002) 'The Wellness Room'. <http://www.wellnessllc.com> (August 2002).

World Health Organisation (1998) *District Health Facilities: Guidelines for Development and Operations* (Geneva, World Health Organisation).

World Health Organisation (2000) *Global Water Supply and Sanitation Assessment 2000 Report* (Geneva, World Health Organisation).