EXECUTIVE SUMMARY

Prepared by
John P. Eberhard, FAIA
2003-2005 Latrobe Fellow
the AIA College of Fellows

•This Executive Summary uses the following logic:

•At the end of the 19th century there were many upheavals including seven inventions that changed cities

•Architecture began a "Century of Change"

•It is likely neuroscience knowledge will mark the end of that century

•What is neuroscience ?

•How is this related to social and behavioral science ?

•What concepts have emerged from ANFA's work so far?

•What does this mean to architecture education?

•What should it mean to the profession ?

EXECUTIVE SUMMARY

In May 2003 the College of Fellows of the AIA, with Betsey Olenick Dougherty, FAIA as the Chancellor, awarded their Latrobe Fellowship to the Academy of Neuroscience for Architects (ANFA).

The San Diego Chapter of the AIA established ANFA.

What is meant by a "White Paper."

According to the British Government (where the concept was created) *White Papers* are documents produced by the Government setting out details of future policy on a particular subject. A White Paper will often be the basis for a Bill to be put before Parliament. The White Paper allows the Government an opportunity to gather feedback before it formally presents the policies as a Bill. It contains detailed proposals for legislation, and is the final stage before the government introduces its proposals to Parliament in the form of a Bill.

This White Paper is the culmination of the two years John Eberhard, FAIA has served as the Latrobe Fellow of the College of Fellows. When the Academy of Neuroscience for Architecture received the Fellowship and he was made the Latrobe Fellow, he outlined a two-year plan.

- The first six months were to be spent interviewing a large number of neuroscientists who live and work in the San Diego area.
- The second six months was devoted to designing an undergraduate course in neuroscience and architecture, and then conducting a series of seminars (based on the design) at the New School of Architecture & Design in San Diego.
- The third quarter was devoted to exploring the creation of interdisciplinary doctoral programs in a number of universities with both graduate architectural research programs and neuroscience programs.
- The last six months has seen a concentration on preparation of this White Paper. It will be presented to the AIA Board of Directors in their May 2005 meeting in Las Vegas. It will also form the basis for a workshop to be conducted during the Convention in Las Vegas.

EXECUTIVE SUMMARY

The visitors to the fair saw immediately that its greatest power lay in the strange gravity of the buildings themselves. No single element accounted for this phenomenon. Each building was huge to begin with, but the impression of mass was amplified by the fact that all the building were neoclassical in design, all had cornices set at the same height, all had been painted the same soft white, and all were so shockingly, beautifully unlike anything the majority of visitors ever had seen in their own hometowns.

The Devil in the White City
by Erik Larson

THE END OF AN ERA AND START OF ANOTHER

In a story called "Fair Weather" a thirteen-year-old farm girl named Rosie, who lives in central Illinois, is invited to Chicago to see the 1893 World's Columbian Exposition. She calls her visit to the *white city* "the last day of our old lives."

In more ways than she realized, Rosie was correct about the White City standing at the threshold of a new era for architecture. Perhaps the Exposition was only a harbinger of this new era and forces at work in the world were inevitably destined to change the physical fabric of urban places in dramatic ways. Perhaps it happened in Chicago because conditions were ripe for revolutionary changes in the technology of building. Perhaps it was the last day of the old life of the classic architect – trained at the Ecole de Beaux Art in Paris and a member of a distinguished gentlemen's fraternity.

As will be described in the sections of this report entitled "Inventions That Reshaped the Urban Fabric" and "Upheavals at the Turn of the Century", a new "Century of Change" was ushered in by 1900. These changes dramatically reshaped what it meant to be an architect.

More than a century later architecture stands on the threshold of another new era. The enormous body of knowledge being created by neuroscientists is about to dramatically change what it means to be a professional designer. The Century of Change had begun in 1906 with Sabine's application of physics to improve listeners' ability to hear in a Harvard auditorium -- creating what is now called the field of Acoustics. Other applications of physics and chemistry soon produced design tools for building structures and electrical systems, lighting calculations, measurement of the thermal environment, the hydraulics of plumbing systems, etc.

EXECUTIVE SUMMARY

"So gorgeous was the spectacle on the May morning of 1910 when nine kings rode in the funeral of Edward VII of England that the crowd, waiting in hushed and black-clad awe, could not keep back gasps of admiration…... Together they represented seventy nations in the greatest assemblage of royalty and rank ever gathered in one place and, of its kind, the last. The muffled tongue of Big Ben tolled nine by the clock as the cortege left the palace, but on history's clock it was sunset, and the sun of the old world was setting in a dying blaze of splendor never to be seen again."

Barbara Tuchman in her book, *The Guns of August.*

UPHEAVALS AT THE TURN OF THE CENTURY

The end of the 19th century and the beginning of the 20th century may have witnessed the greatest set of upheavals ever experienced. Not only were long reigning monarchies being replaced by new forms of government, but also everywhere in the arts and sciences dramatic changes were afoot.

Architecture was impacted not only by the White City and the enormous appeal of classic design that flowed from that, but by the rise of mavericks like Wright and Sullivan in the United States, and Le Corbusier and Gropius in Europe.

Picasso and his group of friends lived in an era of dramatic change that occurs rarely in Western history. These young men believed that they were living in an heroic age where anything was possible. They needed no accolades from society. They shared everything, including knowledge, and strove to produce art and literature that would match the incredible achievements in sciences, mathematics and technology.

The striking changes in musical style that occurred about 1900 were a turning point in the history of Western music comparable to the dramatic transformation of the early 14th and early 17th centuries. But never before had the change been so rapid, and never before had there been such a diversity of resulting styles. The experimental works of Arnold Schoenberg and Igor Stravinsky about 1910 heralded a new epoch in music.

The corpus of Einstein's paper entitled "On the Electrodynamics of Moving Bodies," the so-called relativity paper, is at first glance no different from other papers of that era. Yet first glance deceives: It was daring in both style and content. Page for page, Einstein's relativity paper is unparalleled in the history of science in its depth, breadth and sheer intellectual virtuosity. Einstein developed one of the most far-reaching theories in physics…. The 1905 theory of relativity, written in white heat in about five weeks, remains the clear turning point marking "the last day of physics as we knew it".

EXECUTIVE SUMMARY

INVENTIONS THAT RESHAPED CITIES

The following matrix shows the historic systems used in cities for centuries, followed by the "second generation" system that emerged at the end of the 19th century, and the basic invention that made the new system possible:

HISTORIC METHODS	SECOND GENERATION	INVENTION or DISCOVERY
Masonry walls and timber roofs	**STEEL FRAMES** 1883 in buildings	Bessmer Process for steel (1855)
Stairways, ramps and pulleys	**ELEVATORS** Elisha Graves Otis	Safety latch for hoists (1889)
Candles, oil lamps, gas lamps	**ELECTRIC LIGHT** And generators	Light Bulb (1880)
Wood stoves and fireplaces	**CENTRAL HEAT** Furnaces & ducts	Oil Burner (1868)
Outhouses, privies, slop jars	**INDOOR PLUMBING**	Flushing valve (1878) & sewers
Messengers and Mail delivery	**TELEPHONE** Switching centers	Telephonics (1876)
Horseback and horse & carriage	**AUTOMOBILE** Henry Ford (1896)	Internal combustion engine by Daimler (1885)

Perhaps the greatest impact on architecture in the history of the world was precipitated by seven major inventions towards the end of the 19th century. For thousands of years the pace of change in the materials and methods used to design and build the fabric of cities was slow. So quickly were these new inventions introduced that only electric lighting was considered for incorporation in the Columbian Exposition of 1893

What is even more remarkable than the fact that these inventions all appeared at the same period in history as the other "great upheavals" (shown on previous page), but that even after a century of change, there have been no new inventions to displace these seven. They have become integrated into architectural specifications, building codes, and engineering specialties. Dislodging them with new inventions will not be easy, even though in the largest cities in the world (only two of which are in the United States) these inventions cause enormous problems of pollution, congestion, and constant breakdowns of centralized systems.

EXECUTIVE SUMMARY

"*Architecture is a communal art, having to do with the whole man-made environment, the human city entire, rather than only the individual environment, and rather than only the individual buildings within it."*

Vincent Scully, America at the Millennium, Architecture and Community

ARCHITECTURE IN A CENTURY OF CHANGE

Architecture in this paper means all of the places and spaces used by humans for living, working, learning, healing, governing, etc. This means the entire built environment, not just those special buildings designed by a few well-known architects. All of these spaces are enclosures for activities. The experiences of a child in school, a patient in a hospital, a worker in an office, a mother in her home, are all important to understand. Neuroscience stands ready to provide knowledge that will advance this understanding.

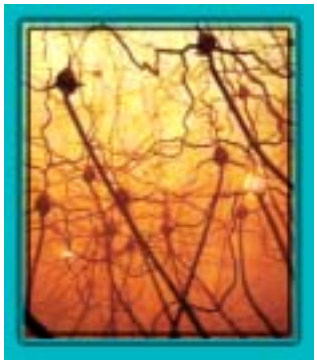
"My definition of architecture is the art of making places. It is not an artist's sculpture. It's not the art of painting. Places can be rooms or corridors. They can be porches or streets. They can be gardens, golf courses. Places are made by human beings for human habitation. And that is how you need to evaluate them."

Robert Campbell, FAIA, architecture critic, The Boston Globe

...in the making of things and buildings, we may distinguish between our own culture, which is very self-conscious about its architecture, art, and engineering, and certain other cultures which are rather unselfconscious about theirs. The features which distinguish architecturally unselfconscious cultures is that there is little thought about architecture or design as such. There is a right way to make buildings and a wrong way... Since the division of labor in such cultures is limited, specialization is rare, there are no architects, and each man builds his own house.

Christopher Alexander, in Notes on the Synthesis of Form, Harvard Press, 1964

EXECUTIVE SUMMARY



We know from many studies that have been done on perception, learning and memory how the brain processes an object, in both sensory and motor terms. We know how knowledge about an object can be stored in memory, categorized in conceptual or linguistic terms, and retrieved in recall or recognition modes.
Antonio Damasio

THE BASICS OF NEUROSCIENCE

Neuroscience is the study of the brain and the mind. In the main body of this report there is a ten-page description of the basics.

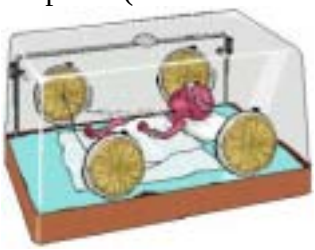
The field of neuroscience includes four areas of exploration of the brain and the mind:

- Genetic studies of the formation and plasticity of the brain
- Molecular and cellular studies of the brain
- Cognitive neuroscience studies of behavioral activities of the mind
- Systems studies of visual systems, aural systems, etc.

There are thousands of experiments now being conducted in neuroscience labs, but few of them have any direct application for architects. This is likely to change dramatically in the next decade. Some of the issues to be studied in the context of neuroscience seem clear, e.g.:

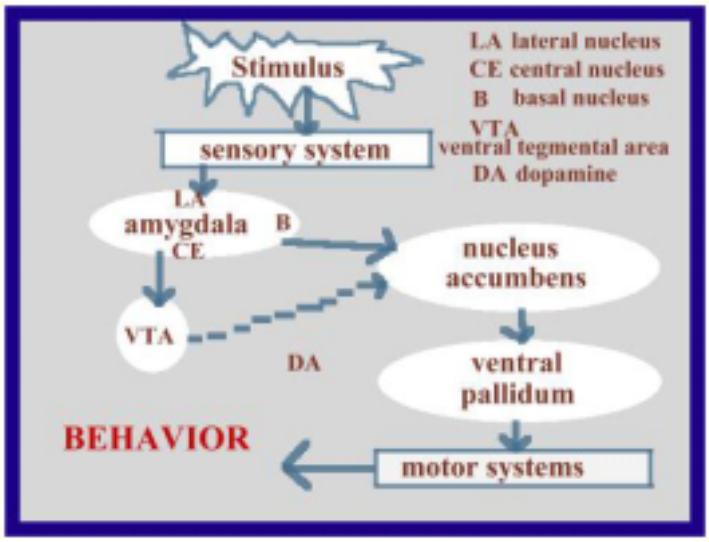
- How does the architectural setting of their school impact the cognitive ability of children?
- How do visitors to a hospital find their way in complex architectural settings?
- Why do most people who enter a church like North Christian Church in Columbus, Indiana feel a sense of awe?

An example of a previously unrecognized design issue is the work of Dr. Stanley Graven in neo-natal care units of hospitals.(see details at: www.architecture-mind.com)



This work established a direct negative impact on the brain development in infants from the normally noisy environment of these units as well as the uncontrolled lighting conditions found there. Design criteria based on the desires of nurses and doctors were often detrimental to critical development stages of premature infants.

EXECUTIVE SUMMARY



The study of aesthetics seems esoteric, unpredictable, and perhaps slightly decadent in its struggle to explain feelings and body reactions without the advantage of precise experimental methods.

Kent Bloomer and Charles Moore, *Body, Memory, and Architecture*, Yale University Press 1977

The Social and Behavioral Sciences

There is a long history of research and observation by those trained in one of the many fields associated with social and behavioral science that bears on architecture. Not all of these research results (or observations) have proven to be useful or directly relevant to those who practice architecture. However, sufficient work has been done over the past fifty years (and some earlier) that is of value, and consequently should be acknowledged as a basis for neuroscience studies. There will be no attempt to be exhaustive in exploring this subject, but a few examples are offered. An early example is:

Social Science observations are something like the observations of light before the development of the science of physics in the 19th century. The social science observations are not necessarily wrong, but they are limited. Observations of how humans interact with their environment are based on "informed suppositions" and usually careful methodology. The limit of these methods is that we know a good deal about what happens during environmental interactions, but we don't know why humans respond the way that they do. As a result of studies of the brain and the mind by neuroscientists with modern scanning equipment, it is possible to know much more about how humans "experience" their environment, about why they have such experiences, and about what might be done by designers to influence experience.

EXECUTIVE SUMMARY

There are certain hypotheses that can contribute more to basic science, could be more easily "banked" for future research and application, but not be immediately "applied" to solving problems. There are others that might be considered "clinical/architectural" that might be immediately applicable to design problems. And, there are "robust" hypotheses that could do both.

From the writings of John Zeisel, a member of the ANFA Board

HYPOTHESES FROM ANFA WORKSHOPS

In this section of the White Paper are recorded the sixty hypotheses that have been developed in the three workshops conducted by ANFA during the past two years. Some of them are statements of what the group that created them felt to be intuitively correct. Others are clearly intellectual statements that can serve as a basis for Ph.D. and Post Doctoral experiments over the next few years.

A dictionary definition of Hypothesis is:
A proposition, or set of propositions, set forth as an explanation for the occurrence of some specified group of phenomena, either asserted merely as a provisional conjecture to guide investigation (working hypothesis) or accepted as highly probable in the light of established facts.

Normally a scientist hopes to convince himself that his initial conception (his hypothesis) is correct. If a succession of tests agrees with (or fails to falsify) this hypothesis, it is regarded as reasonable to treat the hypothesis as true, at all events until it is discredited by a subsequent test. The scientist is not concerned with providing a guarantee of his conclusion, since, however many tests support it; there remains the possibility that the next one will not. His concern is to convince himself and his critical colleagues that a hypothesis has passed enough tests to make it worth accepting until a better one presents itself.

The hypotheses summarized in the main report are "butt-ups", attempts to use neuroscience methods to impact the experience-based intuitions of professional designers. Three areas are covered:

1. The design of healthcare facilities
2. The design of sacred places
3. The design of K-6 classroom spaces.

Reports for each of these workshops are also available on the ANFA website: **www.ANFArch.org**

EXECUTIVE SUMMARY

ARCHITECTURE EDUCATION IN A CENTURY OF CHANGE

The Flexner Report dramatically changed the medical profession in 1914. It established the concept of teaching clinics in which doctors in training were exposed to real patients with real diseases. Teaching clinics also became the institutional setting for introducing new technology and new medications on an experimental basis. They are, today, the primary setting for medical research and medical student's experience with real patients.

It would seem wise for the architectural profession to take steps to establish teaching clinics for architects in training who would be exposed to real clients (and users). These teaching clinics could be used to introduce new knowledge and to conduct experiments of future value.

Neuroscience projects for Studio-Clinical Studies

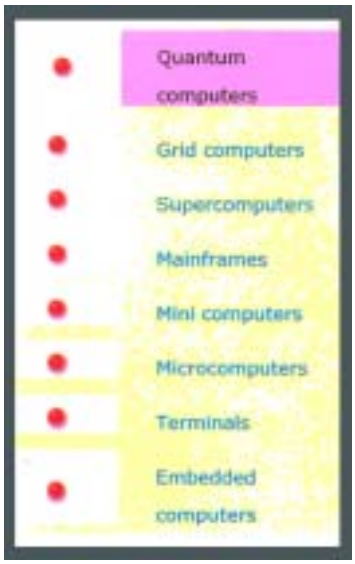
The following paragraphs provide preliminary ideas for clinical studies that might be done in collaboration with architectural firms and student teams, working with neuroscience PhD students. Such clinical studies, with real children, could be added to the knowledge base used in the design of the schools.

1. The impact of light on cognitive ability. Investigate the impact of daylight as it impacts interconnect-edness and interactions of the visual areas of the brain. Consideration of both daylight and artificial light on cognition would be included.
2. The acoustic environment of the classroom. Sound waves reaching the auditory cortex in young children require special attention in order for them to select the voice messages from their teacher and enhance aural perception for learning. Neuroscience studies could help explain why this is so.

"Studio has come to define design education, and yet that has not always been so. For most of the history of architectural education, students worked alongside architects on the job site or in the office, as apprentices. Architectural education emerged from the craft guilds that arose in Europe in the 12th century, which served as the major way of organizing the work, exerting control over membership, workplace conditions, markets, and relations to the state. The craft guilds also determined who could join, and the length of apprenticeship, the dues and fines members had to pay, the means of production, the pace and hours of work, and who could practice in what market. There was little separation between work and education, and between design and construction."

Thomas Fisher, Dean College of Architecture and Landscape Architecture, University of Minnesota

EXECUTIVE SUMMARY



The AIA Technology in Architectural Practice (TAP) Knowledge Community serves as a resource for AIA members, the profession, and the public in the deployment of computer technology in the practice of architecture. TAP monitors the development of computer technology and its impact on architecture practice and the entire building life cycle, including design, construction, facility management, and retirement or reuse.

AN ADVANCED CONCEPT

For thirty years computers have been used in architectural practice. In the beginning computer use was dominated by word processing applications of specifications and correspondence, with some applications for relatively simple math computations of structural or HVAC designs. As the technology of computers became more sophisticated their use as "drafting machines" was introduced. By the end of the 80's software was available that made it possible to prepare reasonable 3-D views of designs.

By the end of the 90's the architectural drawings produced by computers were sophisticated enough that most offices had completely switched to computer-based systems for producing working drawings. Graduates of architectural schools are expected to enter the employment market with computer skills. Consulting engineers can exchange databases with their architectural clients, enabling much easier interfaces.

It seems likely that the next phase of development in electronic media will be systems that support conceptual thinking. These are likely to be based on Quantum Computers (more fully explained in full report). How the concepts will be represented and communicated in order to serve as guides for the realization of the object(s) conceived could be the result of research in neuroscience and quantum computers. It is more than likely that such representations will not be the traditional working drawings used by architects today.

Thus neuroscience holds promise of changing the technology of practice as well as the knowledge base of architecture.