

RICE UNIVERSITY

**Change of Heart:  
Rethinking the Prescriptive Medical Environment**

by

Marina Nicollier

A THESIS SUBMITTED  
IN PARTIAL FULFILLMENT OF THE  
REQUIREMENTS FOR THE DEGREE

**Master of Architecture**

APPROVED, THESIS COMMITTEE:



Fares el-Dahdah, Associate Professor  
Architecture; Chair, Architecture



Eva Franch  
Visiting Wortham Fellow



Dawn Finley, Assistant Professor  
Architecture

HOUSTON, TEXAS  
MAY 2009

UMI Number: 1466811

### INFORMATION TO USERS

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleed-through, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

**UMI<sup>®</sup>**

---

UMI Microform 1466811  
Copyright 2009 by ProQuest LLC  
All rights reserved. This microform edition is protected against  
unauthorized copying under Title 17, United States Code.

---

ProQuest LLC  
789 East Eisenhower Parkway  
P.O. Box 1346  
Ann Arbor, MI 48106-1346

## **ABSTRACT**

The environment and its effects on our physiological health and well-being have long been essential components of medical treatment regimes. Though many of these regimes may have experienced only short-lived success as products of trends in popular culture, the complex relationship between environmental exposure and cure is one that is fundamental to the understanding of the medical sciences. The endeavor to more fully understand its complexities continues even in the light of what modern advances in medical technology have revealed to us. This thesis addresses the need to rethink the use of environmental qualities in medical facilities, looking to and expanding upon how they were used in past paradigms.

## ACKNOWLEDGMENTS

There were so many times during this process where I felt I could have never finished without the support of my studio-mates, friends, and advisors . . .

I especially want to thank my committee, for all their support and criticism that helped me find my way.

*Dawn, for your indispensable support through all the awkward-adolescent phases of the project. I always looked forward to our meetings.*

Eva, for the bursts of energy and imagination that were so vital to the development of our projects.

Rachel Dewane and Jenny Apostol, for your help on one of the most frustrating sections ever.

Curt--my partner in everything last-minute, in Studio PTM. Our late nights provide me with some of my fondest memories over the last 4 years. Ok so maybe not the very last nights. But so many others!

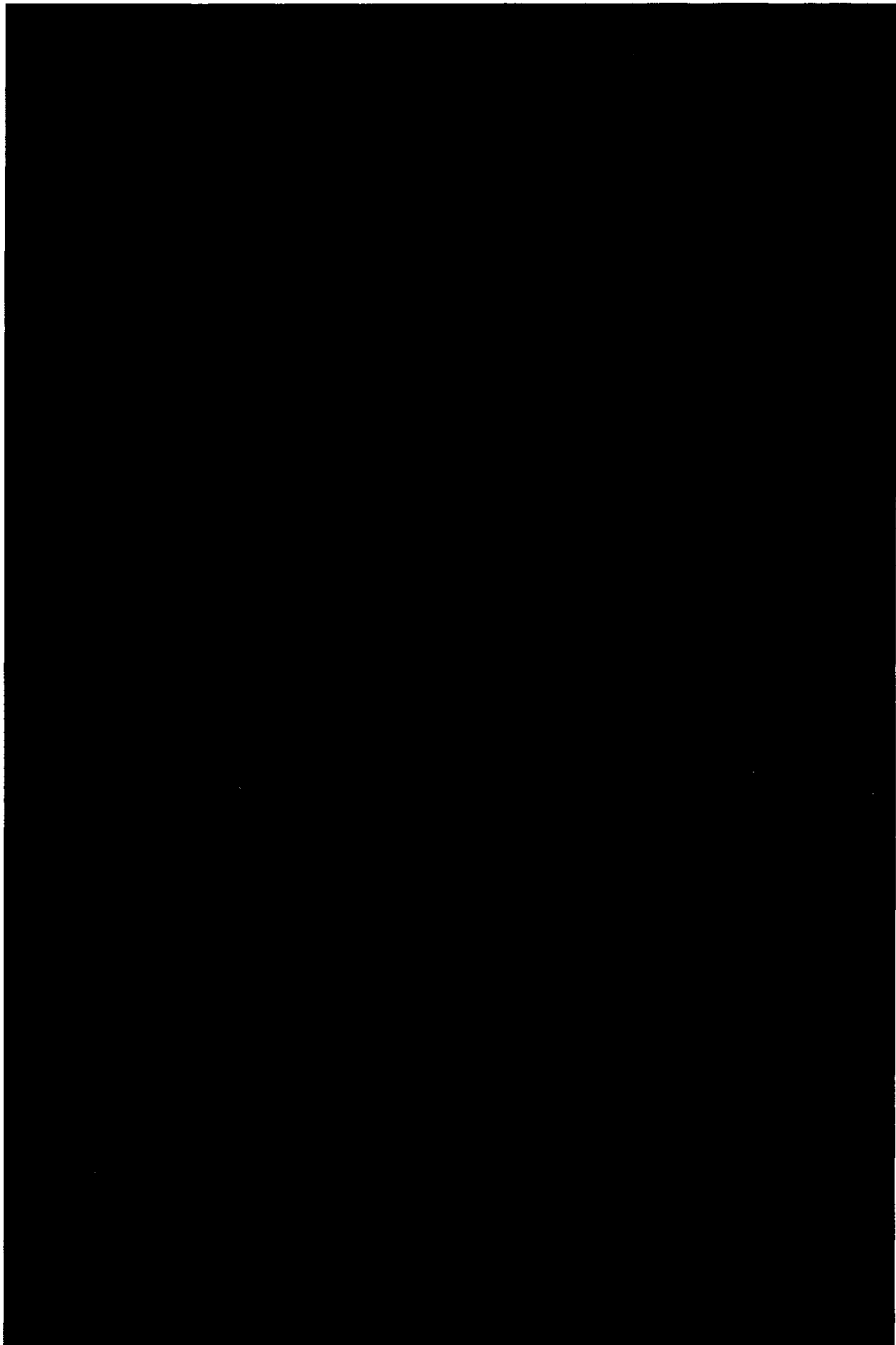
Maria, for always being so good to me, making sure I was fed and pinned up on time when things were a little crazy. I'm going to miss being around you.

Sean. For everything.

THANK YOU!

## TABLE OF CONTENTS

6	Preface
9	Environment and Cure
13	Cure and Design
16	The Prescriptive Paradigm: Modernist Sanitariums
17	The Prescriptive v. the Experiential
19	Architecture
20	Environment
22	Material
24	Location
25	The Experiential Model
26	The Site
27	Urban Condition
29	Environmental Condition
32	The Facility



## PREFACE

The human body responds to its spatial and environmental surroundings in very subtle ways. Our most basic reactions to our environment can be read, essentially, in our vital signs; yet as many of these phenomena are subtle enough to be easily overlooked without some sort of monitoring device, they have been too often dismissed as fleeting emotional and sensorial effects that have little impact on our physiological system as a whole.

These qualities can do much more.

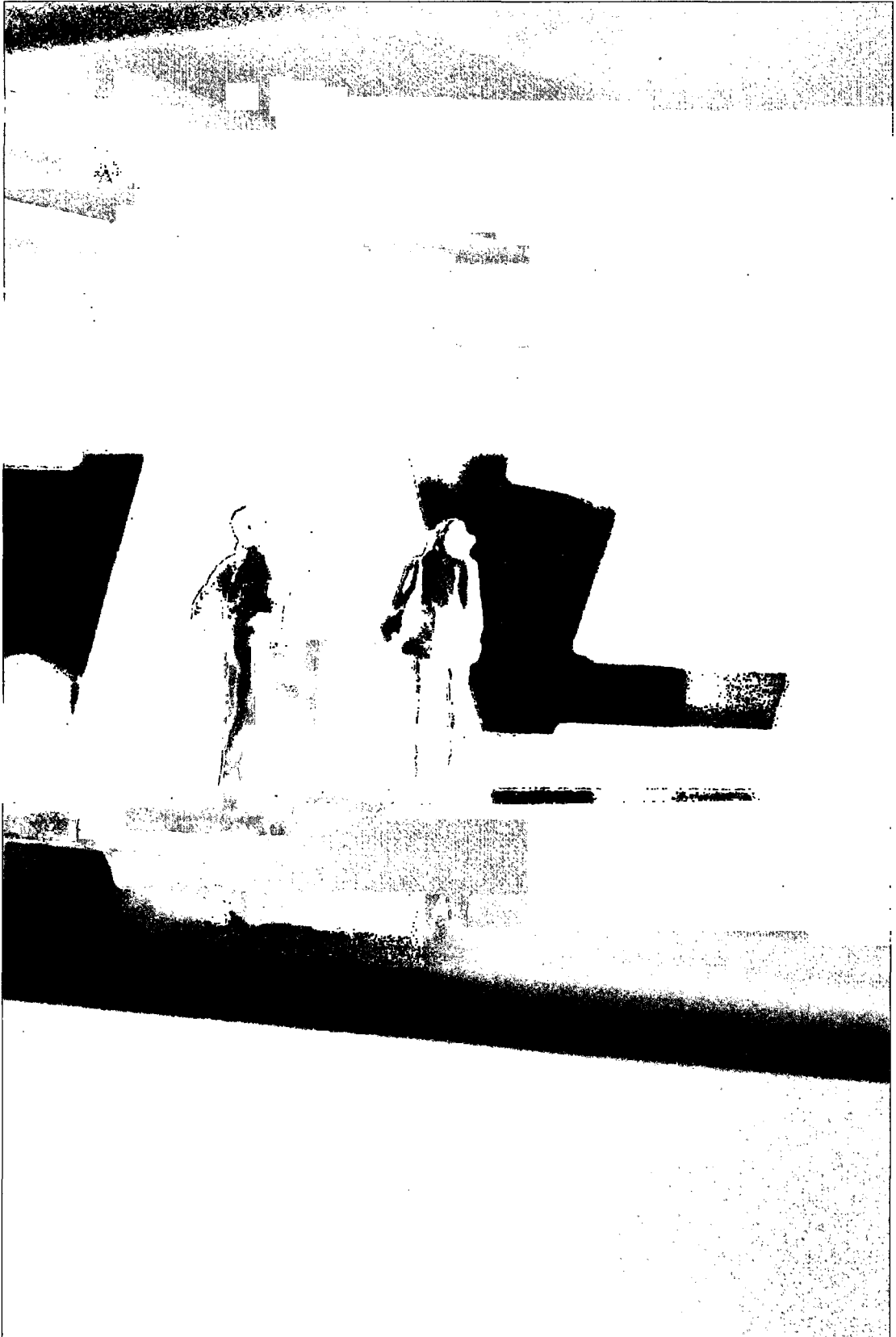
They can act as an architectural base for a very important body of research, expanding beyond the limited range of possibilities imposed on them by existing models of medical environments.

We need to create spaces that provide, through their experience and material substance, enough variability in environmental effects that individual differences in reception and response can be studied and used as a part of curative regimens. The need today for experimental and preventive treatment methods requires a new approach to this symbiosis between medicine and architecture, from which new typologies should emerge.

Although these environmental factors have been continually been important considerations in the design of medical facilities, the role they have played as generators of new types of experience and treatment has been limited. They have been utilized in much the same way as a prescribed medication would be: in controlled doses, allowing only for a highly regulated exposure dictated by a particular treatment regime.

Instead of continuing to implement this prescriptive paradigm in medical facilities, the spaces themselves should act as experiential platforms that provide a broader spectrum of environmental qualities, so that we may better understand their effects on our psychology—and ultimately, on our physiology.



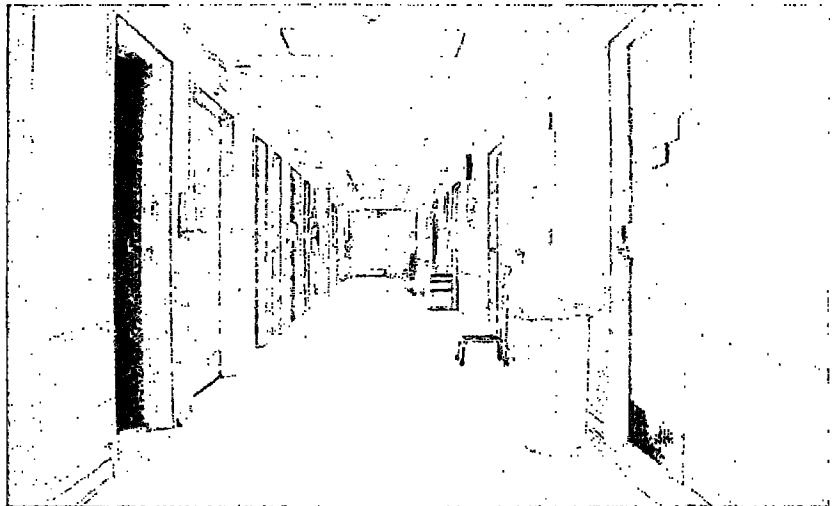


## ENVIRONMENT AND CURE

The environment and its effects on our physiological health and well-being have long been essential components of medical treatment regimes. Though many of these regimes may have experienced only short-lived success as products of trends in popular culture, the complex relationship between environmental exposure and cure is one that is fundamental to the understanding of the medical sciences. The endeavor to more fully understand its complexities continues even in the light of what modern advances in medical technology have revealed to us.

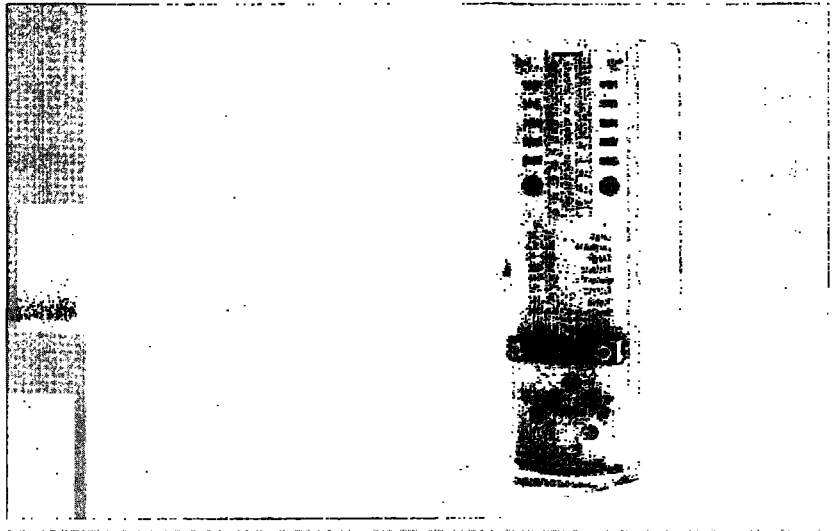


*Left: Sanitarium patients receiving treatments of exposure to sunlight and fresh air as part of tuberculosis treatment and prevention regimes; Right: Fresh-air activities at the Battle Creek Sanitarium*



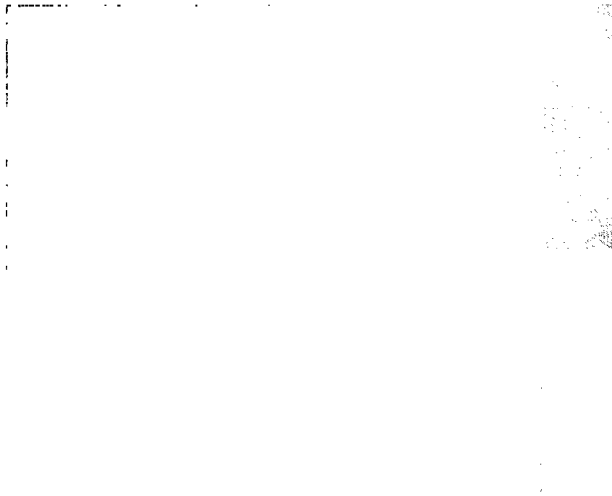
### **THE MEDICAL ENVIRONMENT**

The great majority of medical facilities today have are completely insulated from the outside environment, understandably to shelter both the patients and the technological equipment housed inside. However, as in the example of the sanatorium typology, medical facilities can incorporate a more flexible relationship with their environments, both natural and artificial, as part of both their design and treatment methods. Considering the growing body of research that links cardiovascular health to more subtle influences in the environment, these elements will inevitably become a part of preventive and rehabilitative measures in cardiology.



## SOUND

New studies show that rhythmic formulas such as the rosary, classical music, and even yoga mantras have a powerful slowing influence on our breath and can thus can synchronize and reinforce inherent cardiovascular rhythms. Researchers have found that breathing at six breaths per minute (.1Hz) induces a rhythmic pattern that is both physiologically and psychologically beneficial, particularly as a part of a cardiovascular treatment regime.



## LIGHT

Medical therapy of exposure to light, or heliotherapy, has long been successfully used as part of treatment regimes for tuberculosis, various skin diseases, vitamin D deficiency, and a number of affective disorders; sunlit spaces and regular exposure to natural light were integral to traditional sanitarium regimes. A growing body of evidence suggests that heliotherapy is emerging as a valuable addition to treatment of heart disease, as low levels of vitamin D are associated with a number of cardiovascular risks.

## CURE AND DESIGN

Curative trends can become social movements, carrying enough momentum to become cultural phenomena that impact the design ethics of a particular period. This was the case at the turn of the twentieth century, when a new approach to the treatment of tuberculosis coincided with the advent of modernism in architecture. The new methods required a very specific set of architectural and environmental conditions, which were closely associated with the curative regime itself.



*Left: Paimio Sanitarium windows Right: Sanitarium patients receiving treatments of exposure to sunlight and fresh air as part of tuberculosis treatment and prevention regimes*

The environment that dictated the design of many modernist medical institutions, specifically sanatoria for tubercular treatment and prevention, was essentially a typology that revolved around the climatic characteristics of the building and its site. What began as architectural features necessary to accommodate a curative regimen which consisted of regulated intervals of exposure to sunlight and fresh air, temporal and spatial isolation, and a sterile material palette resulted in the iconic formal language of modernist design.

Tuberculosis was not even considered to be a treatable condition until the second half of the nineteenth century; and in the following decades, the climatically-based treatment regimes thought to alleviate the systems of the disease became a part of a much larger social movement and new health culture. Hermann Brehmer was a young medical student, suffering himself from tuberculosis, when his doctor recommended that he move to a more temperate climate in order to alleviate his symptoms. After spending some time recuperating in the Himalayas, Brehmer returned home cured and healthy, and went on to found the first tuberculosis sanitarium where the treatment consisted of a regime of exposure to fresh air, sunshine, and healthy eating habits. As the tuberculosis epidemic continued to threaten the major urban centers of Europe and the United States, an increasing number of these medical facilities appeared. The vast majority of these sanatoria were being built in more rural areas, away from the larger cities whose crowds and dust were frequently being blamed for the health woes of their population. Thus the siting of these facilities served not only to fulfill the very specific climatic demands of the treatment regimen: the remote locations also functioned to a certain extent to isolate the contagious from the general public.

The new sanatorium regimen came to be known as the "Cure", and was promoted by most medical communities at the turn of the century as being the most effective curative and preventive treatment for tuberculosis. It came to include not only the prescribed exposure to a particular exterior environment, but also a controlled period of rest—usually conducted in the afternoon, outside, usually in the space of two hours, and in silence. The course of treatment ranged in duration from a few weeks to several years during the more intense periods of tuberculosis epidemics in the urban centers of Europe and the United States. Many of these sanatoria were built with the same set of design principles that had dominated the design of traditional medical hospitals and health resorts.

The link between this new health culture and applied design was apparent in the design of furniture. Many sanatoria at the time began utilizing loungers and

reclining chairs for their patients, as the chairs favorably positioned the body to best receive the prescribed exposure to the outside air. And unlike more traditional pieces, the recliners used in European private and public sanatoria were not upholstered; it was thought that a more open structural design would be less likely to harbor any lingering contagions. These recliners captured the modernist design ethic and its association with the popular health reform initiatives of the early twentieth century: soon, they became immensely fashionable as icons of the movement and its implied lifestyle. The chairs themselves, as tools of the curative regimens, also impacted the design of the sanitariums, as many of their typical architectural features were specifically designed to accommodate them. Sundecks were built wide and deep in order to fit a group of recliners, and as in Aalto's Paimio sanatorium, some individual patient rooms had their own balconies large enough to accommodate a single chair. And as with the recliners themselves, these accommodations, driven by the curative methodology, ultimately became integrated with the larger modernist design aesthetic.



*Left: Aalto's Paimio Chair; Right: Le Corbusier's lounge recliner*

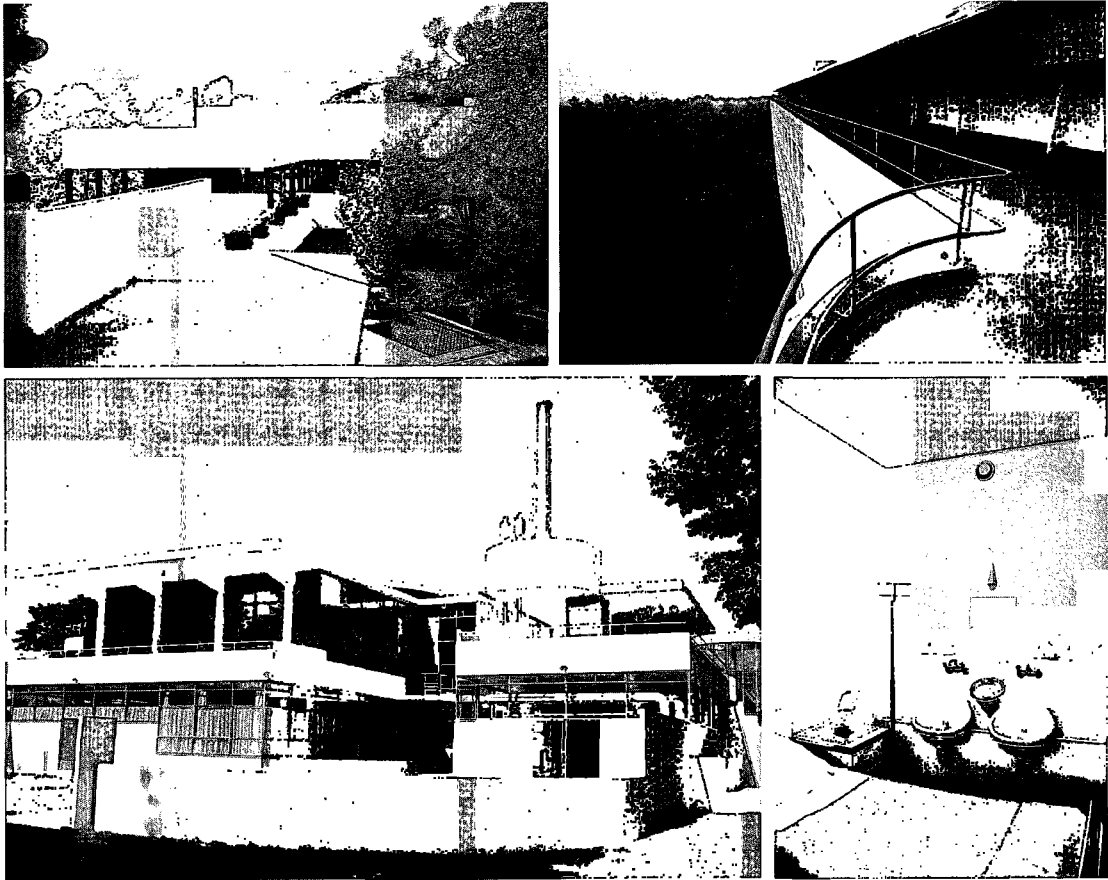


## **THE PRESCRIPTIVE PARADIGM: MODERNIST SANITARIUMS**

The prescriptive typology is perhaps best exemplified by the design of the modernist sanitarium, which sought to utilize architectural space as a sort of “medical instrument”. Popular ideas about what constitutes a healthy environment gave rise to many of the components that became the formal trademarks of modernism—the flat roof was devised as a means to provide additional sunning surfaces for tubercular patients; while the deep verandas, wide private balconies, and covered corridors served as organizational tools to isolate contagious patients from the general staff. The architecture of the prescriptive typology so prevalent in modern medical facilities was considered to be part of the treatment regimen for tuberculosis, which during the first half of the twentieth century had become a global epidemic. It was not until the 1950’s that an antibiotic was determined to be the only effective treatment for the disease, but the modernist emphasis on the curative effects of certain environmental exposures. The component-based paradigm the movement sparked retained a certain hygienic quality that the modernist sanitariums embodied.

## **THE PRESCRIPTIVE V. THE EXPERIENTIAL**

This new experiential model expands upon the prescriptive model in several ways, in terms of how it relates to its architecture, environment, materiality, and location.



*From left to right: Neutra's Lovell Health House, Aalto's Paimio Sanitarium, Duiker and Bijvoet's Zonnestraal Sanitarium, detail of patients' room in Paimio*

## ARCHITECTURE

The architectural model of the modernist sanitarium embodied a prescriptive use of components that not only facilitated, but often acted as key elements of the treatment regimes. Expanding the effects of these architectural components, the experiential model further enables a relationship between architecture and treatment.

### PRESCRIPTIVE

#### component-based

- *flat roofs, terraces, and balconies provided surfaces for sun exposure*
- *deep verandas and covered corridors aided in prescribed isolation*

### EXPERIENTIAL

#### experience-based

- *generated by gradients of experiential intensities*
- *emitting surfaces / nodes*
- *variability of enclosure*

## ENVIRONMENT

The use of environmental qualities is no longer geared towards a moderated exposure, but is rather about offering a wider range of gradient intensities.

The prescriptive model of the curative attempted to incorporate environmental elements into both its architectural substance and its treatment regimen. At the time that many of the modernist health facilities were being built, it was commonly acknowledged that moderate and carefully controlled exposure to sunlight and to particular altitudes and climatic conditions would alleviate some tubercular symptoms. Visits to these establishments were prescribed, as were the conditions and durations of the exposures themselves. Today, of course, there is ongoing research to determine how and to what extent environmental factors such as temperature, natural and artificial light, and sound affect our health, and despite there having been some interesting conclusions, it is still an area of research that requires more investigation and exploratory trials.

### PRESCRIPTIVE

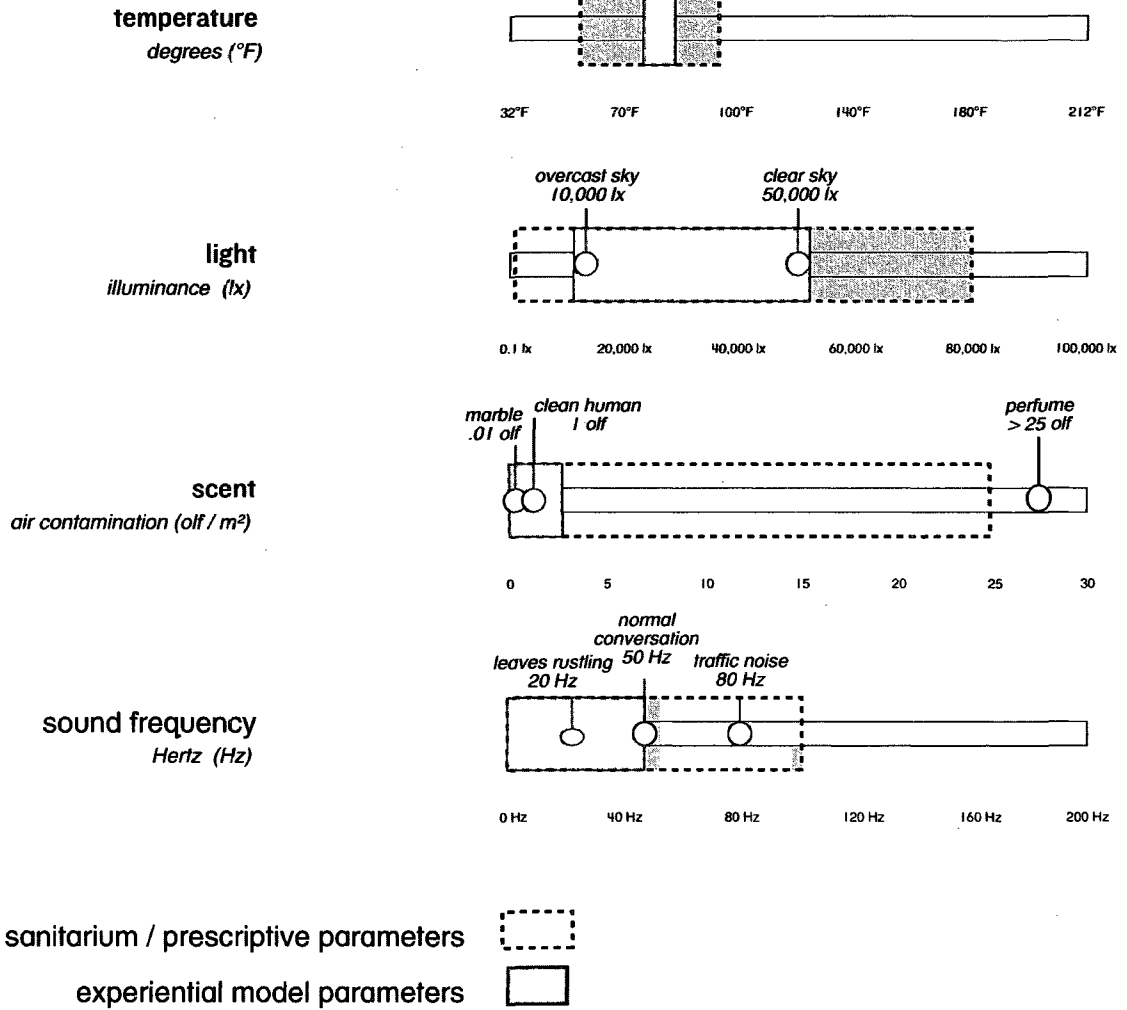
#### moderation

- *controlled exposure to light*  
*controlled exposure to particular exterior climate*

### EXPERIENTIAL

#### intensities

- *range of intensities of light, temperature, scent, and sound*
- *diversity in range of natural v. artificial conditions*



## EXPANDED ENVIRONMENTS

An experiential model facilitates this type of research by expanding the range of environmental variables. The participant is encouraged to experience as wide a range of conditions as possible so that the effects of these conditions can be studied.

## MATERIAL

The experiential model also uses materials in a different way. Materiality was neutralized by the prescriptive model in order to create hygienic, easy-to-clean surfaces; thus a material language of white concrete and steel structure became standard issue in modernist medical facilities. The experiential model seeks to use materials to work with the environmental intensity of a space—by amplifying and diversifying existing conditions, or functioning as a source for new ones.

### PRESCRIPTIVE

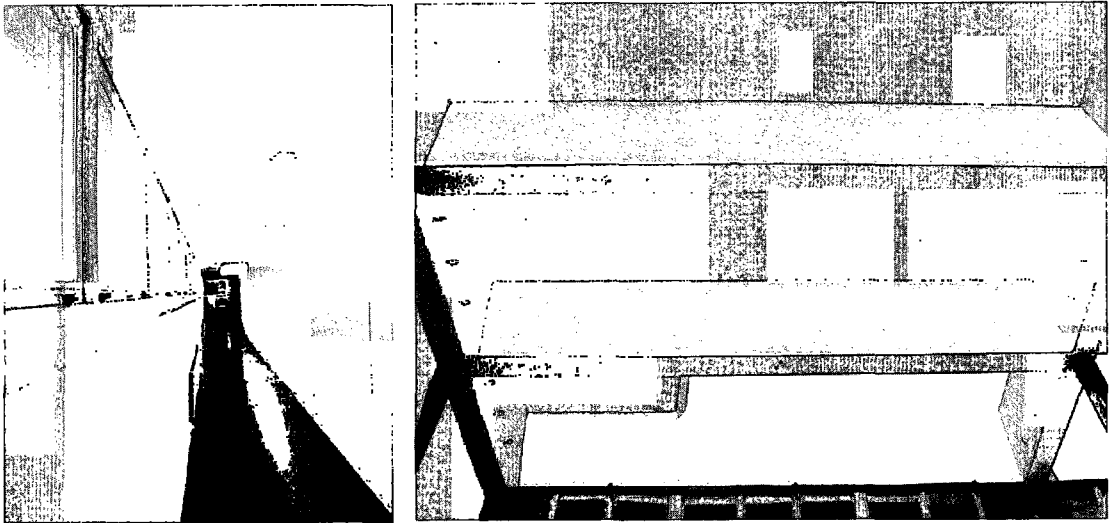
neutralize

- *primarily determined by demand for sanitation and proper hygiene*

### EXPERIENTIAL

amplify / generate

- *determined by what diversifies and amplifies environmental qualities*



*From left to right: Paimio Sanitarium corridor; concrete detail from Lovell Health House*



## LOCATION

Most sanitariums and health resorts designed with the prescriptive paradigm have specific needs regarding their site. Their regime of exposure to light, temperature, and clean air limited called for very particular climatic conditions falling within acceptable ranges. This is why the vast majority of these facilities were built in remote, rather idyllic locations near the coast or tucked away in alpine forests, away from any urban centers, which were considered to be too dense and dirty to be of any use for a treatment regime. And considering that accessibility is important to any curative facility, the new experiential model is freed from these limitations. By allowing for a gradient system of environmental factors (including that of interior-exterior relations), the experiential model can exist in a large city, even one located outside temperate climatic zones. A combination of natural and artificial systems thus supplements the environmental qualities of the city, incorporating them into its intensity gradients.

### PRESCRIPTIVE

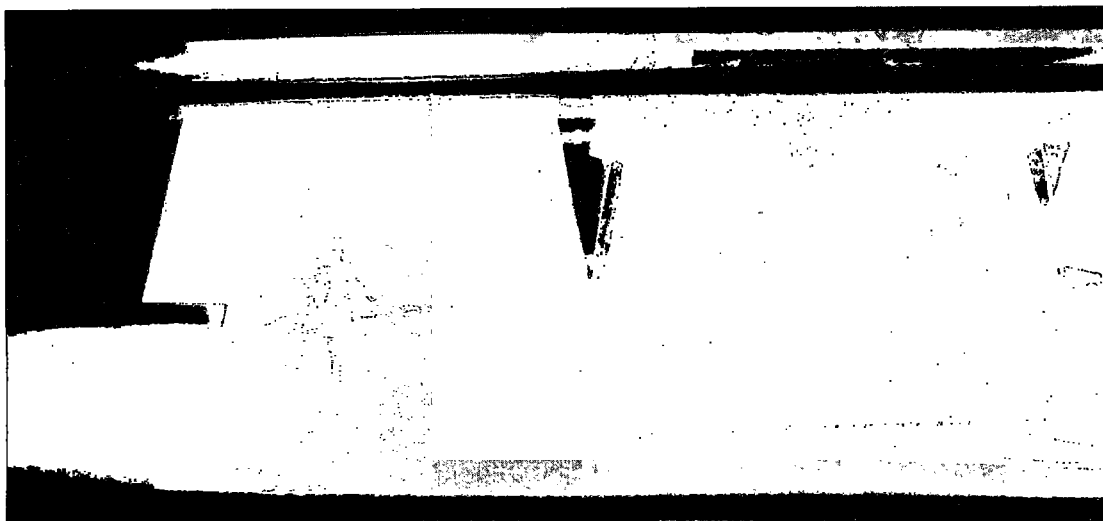
remote / pastoral

- *treatment regimens called for removal from the city environment*
- *emphasis on the pastoral*
- *predominately elite patients*

### EXPERIENTIAL

central / urban

- *no longer constrained to temperate climatic zones*
- *densely populated urban center*
- *greater public component*



## THE EXPERIENTIAL MODEL

The prescriptive model of the curative environment attempted to incorporate environmental elements into both its architectural substance and its treatment regimen. Allowing for a greater range of intensities of these environmental factors, the experiential model encourages the participant to place himself within the gradient according to his intuitive preference instead of being prescribed a specific level or intensity of exposure. This new expanded range of conditions moves the typology beyond a prescribed use of environmental elements.

The modernist sanitarium regarded environmental qualities as essential considerations in its architecture as well as its curative regimes. The proposed experiential model does as well, but expands beyond using them in a prescribed way. As there is still much to be learned about how the body responds to its environment, and the repercussions of this response on general health—so this model places these investigations at the root of its design.

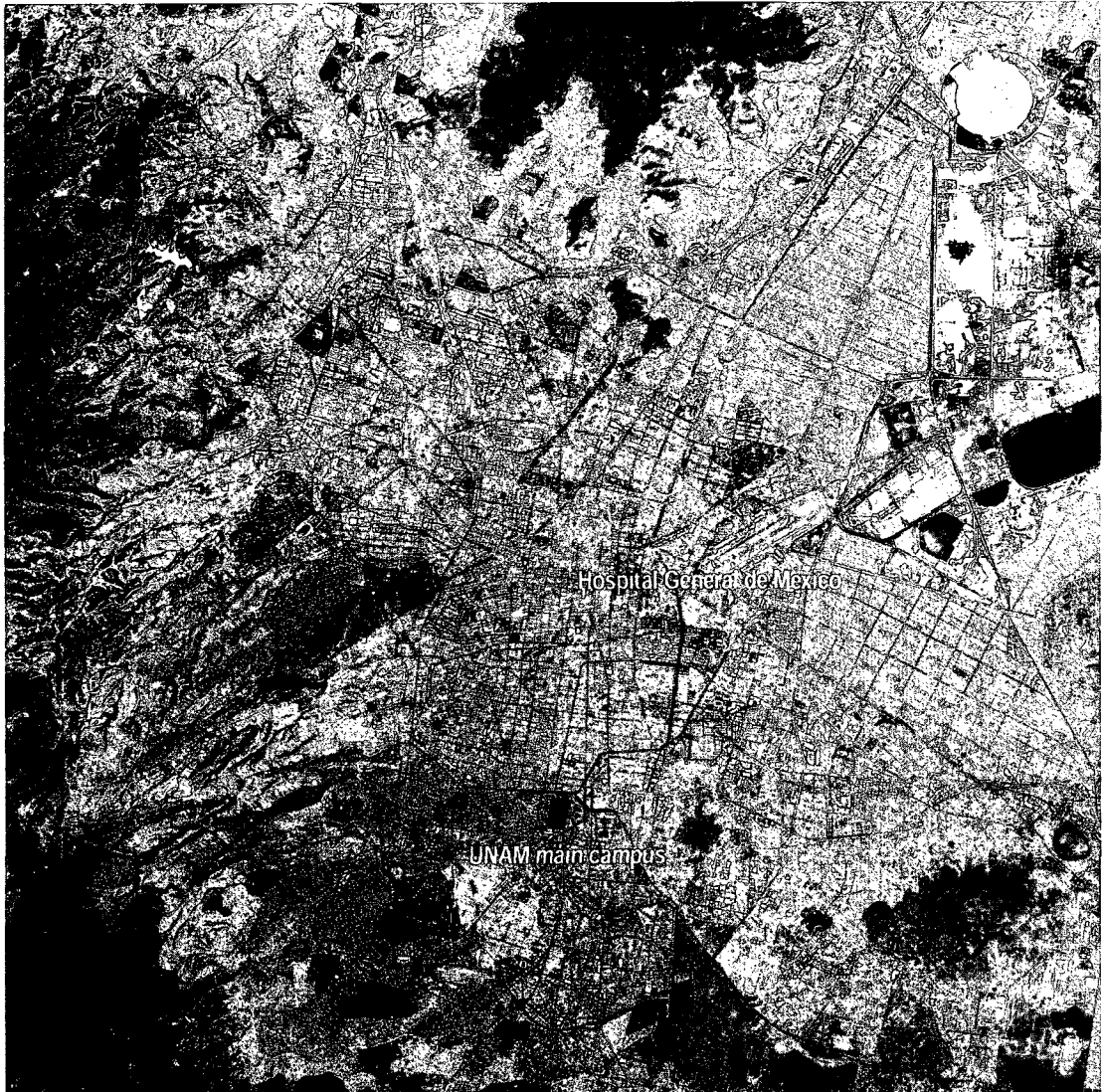
## THE SITE

## URBAN CONDITION

The sanitarium typology--due to its treatment regimen--was largely restricted to rural areas with sunny, temperate climates and plenty of clean fresh air. Whereas the prescriptive model necessitated an isolated location with very particular climatic conditions, the new experiential model is freed from these constraints and can be sited in dense urban areas, where it is accessible to a much larger and more varied population. Even in a notoriously polluted mega city far from the temperate climatic zones, this facility can be sited where it would be the most useful.

Additionally, the research component of the proposed facility can be incorporated into the academic arenas of large cities, adding to the exchange of information between clinical and research fields of the medical community.





## URBAN SITE

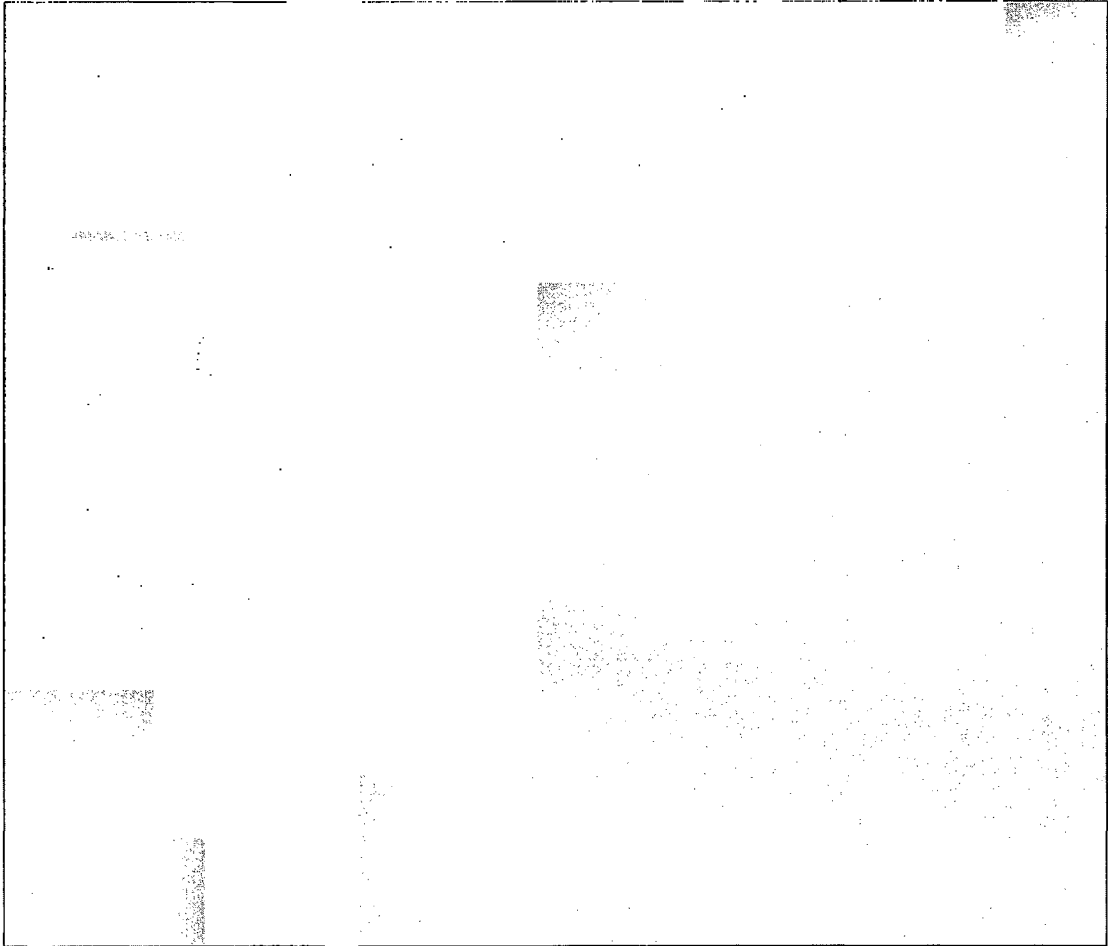
The mega-metropolis of Mexico City, home of the largest university in Latin America (UNAM, or the National Autonomous University of Mexico), which conducts 50% of Mexico's scientific research.

UNAM's department of experimental medicine functions out of the city's largest hospital, the Hospital General de Mexico, located away from the main campus in the center of the city.

**ENVIRONMENTAL CONDITION**

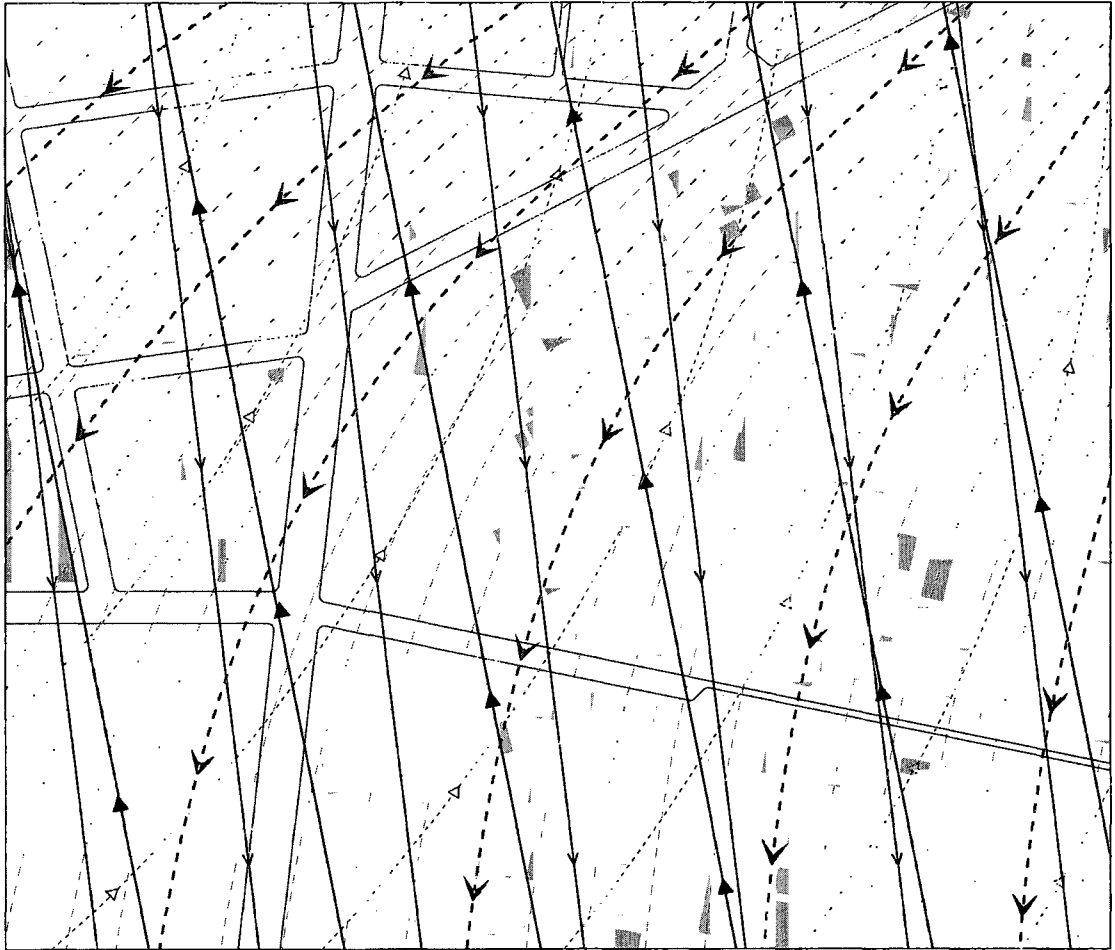


filtering from street trees



sound





prevailing airflow

- ▼ afternoon
- ▲ evening
- △ day
- △ night

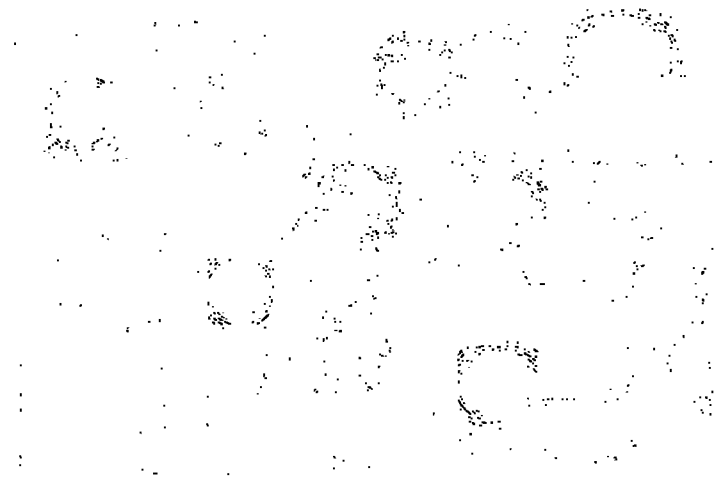
## THE FACILITY

The proposed facility serves an intermediary function between the hospital and the national university's department of experimental medicine, located just adjacent to the site. Visitors to the hospital—those attending appointments as well as those waiting for family members—will be provided a place to spend time while serving an important role as subjects in the medical research community. Upon entering, a visitor will be outfitted with a vital sign monitoring device that wirelessly communicates their physiological information to researchers at the facility. The device receives information on the visitors ECG, heart rate, skin temperature, and posture, among other indicators. Then the visitor is free to wander the primary research floor of the facility, which is made up of a series of enclosed, semi-enclosed, public, and semi-public environments of varying temperature, sound level, and light. By moving through these spaces, the visitor relays valuable information to and through the building itself, acting as the focus of the experiential model.

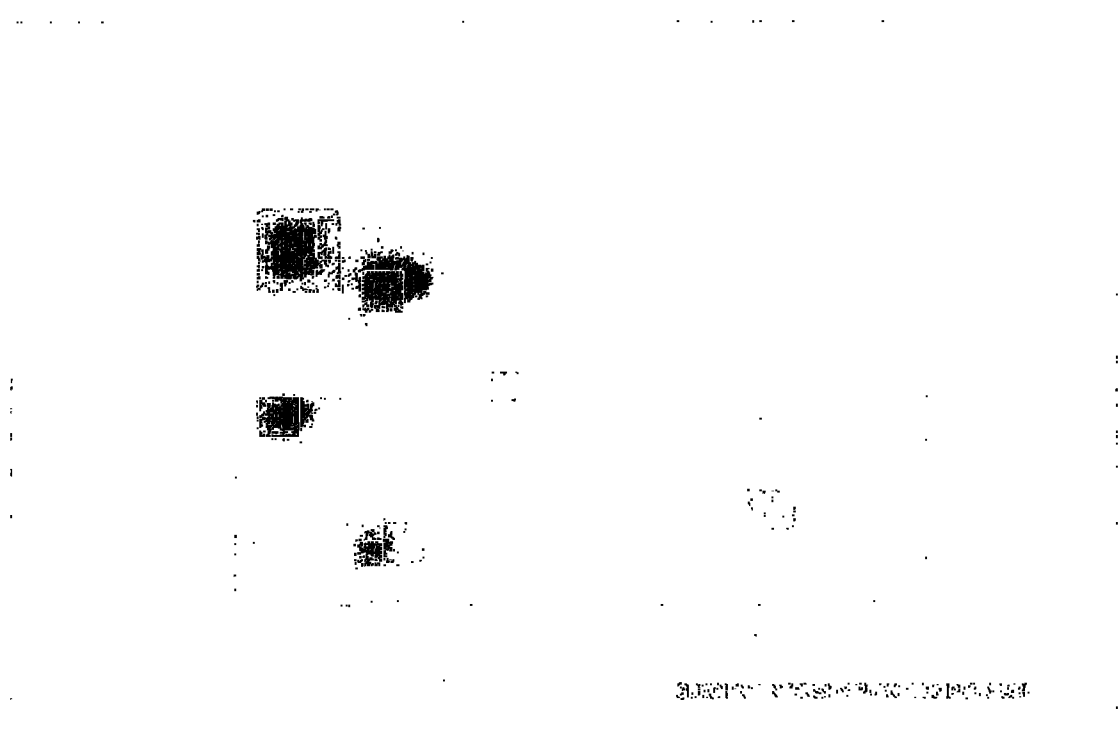


# GRADIENT INTENSITIES



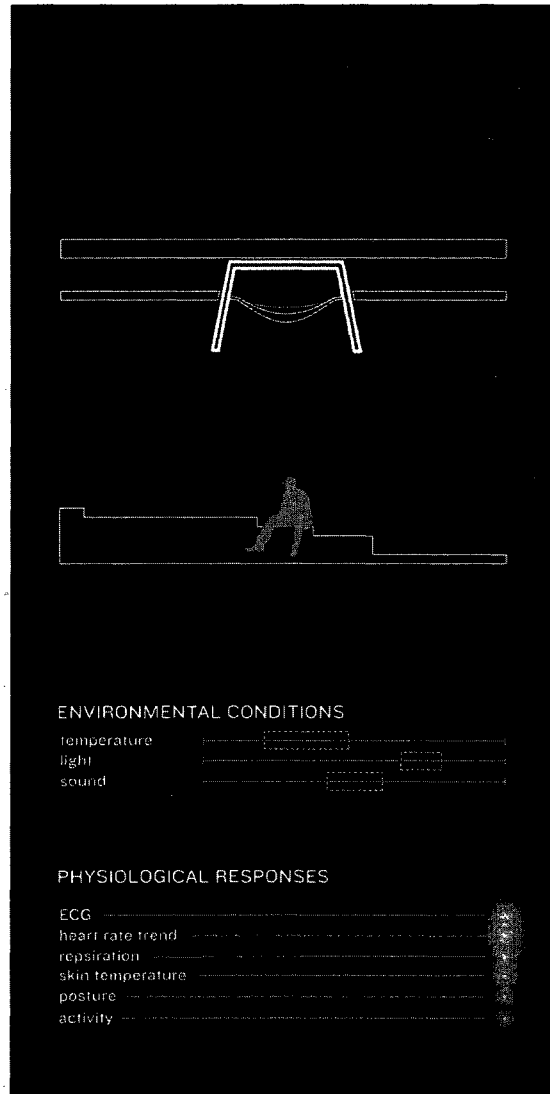
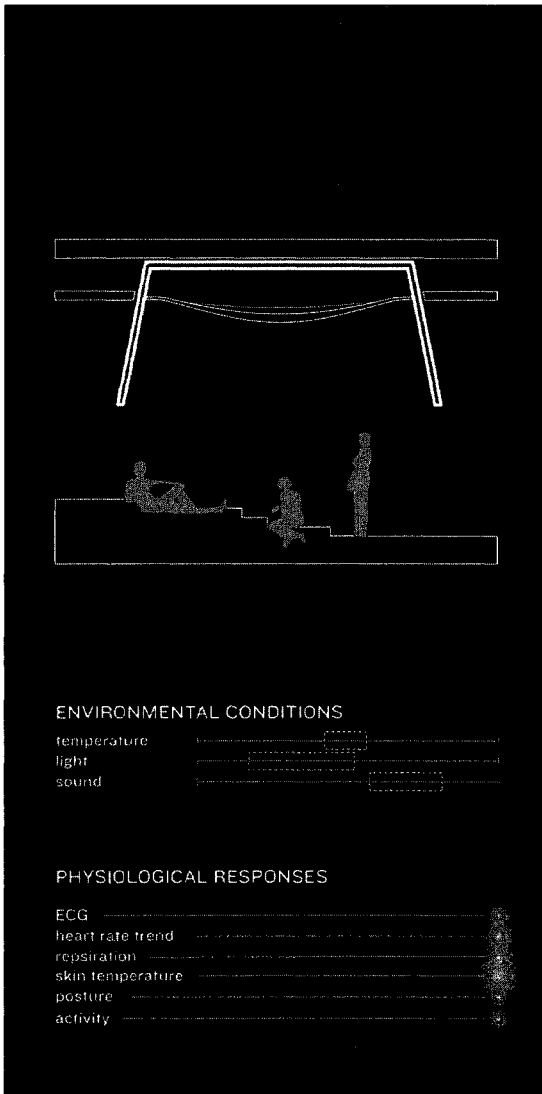


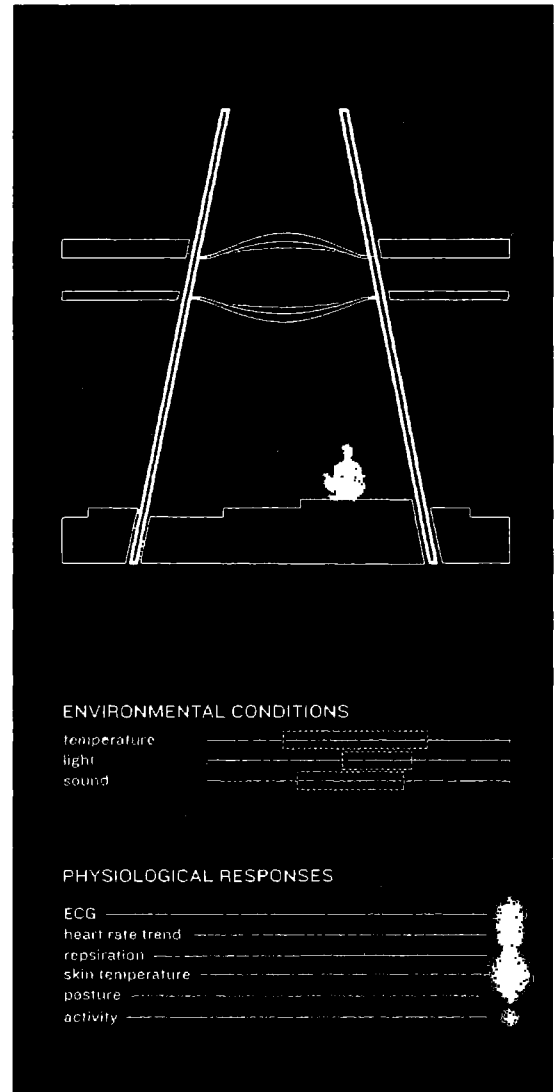
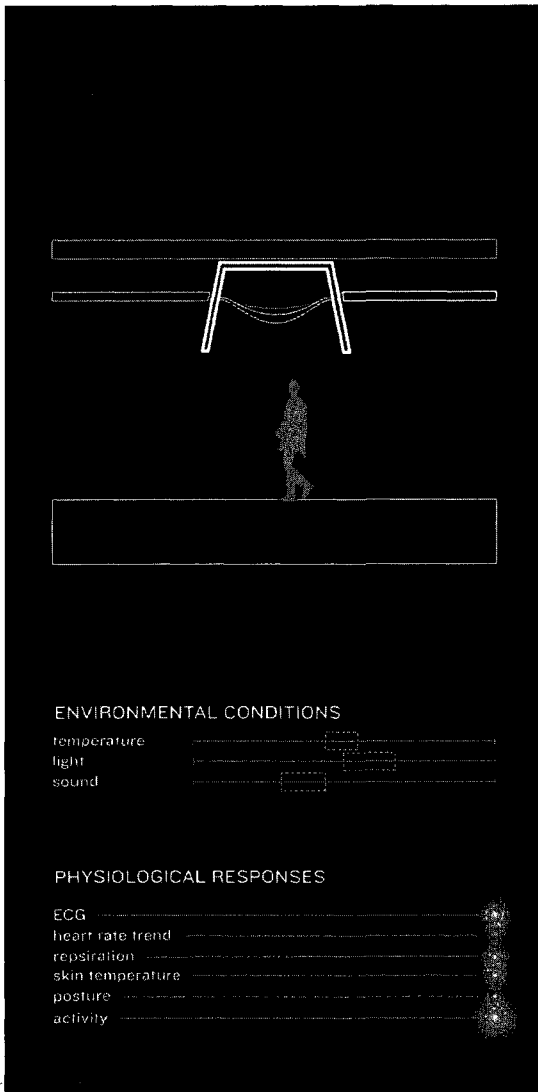
BRITISH MUSEUM, LONDON



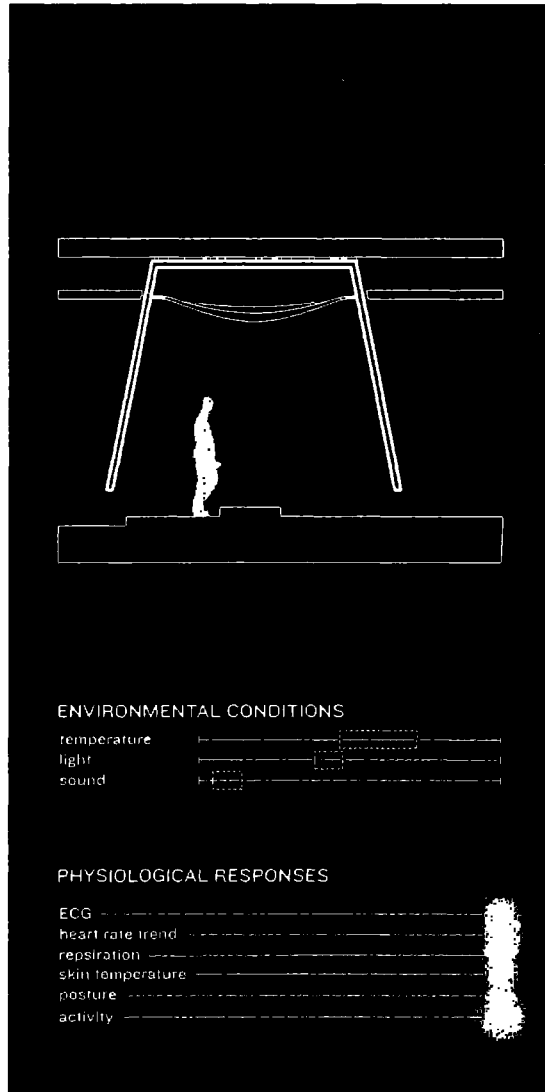
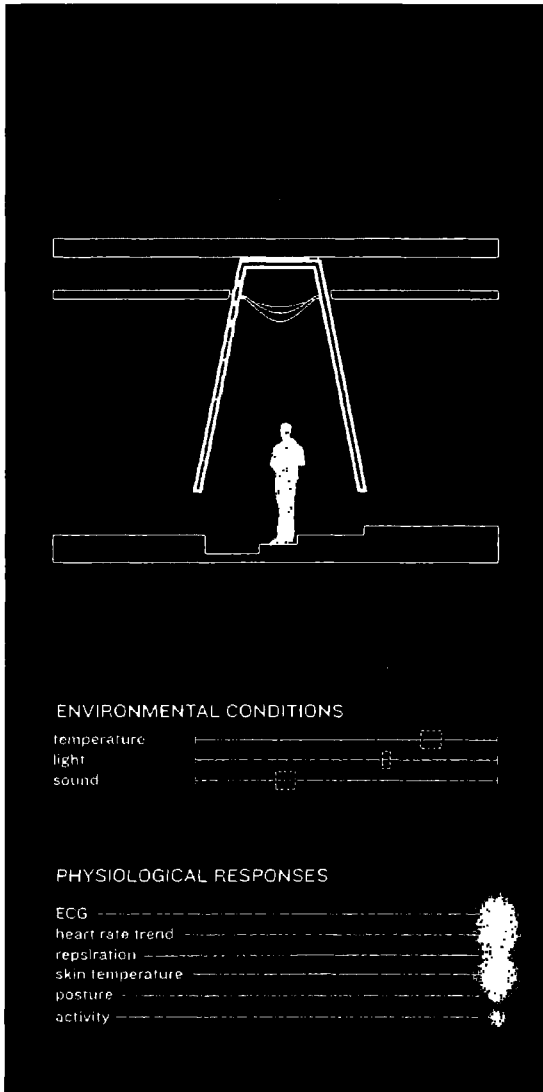
SECRETARY OF THE INTERIOR

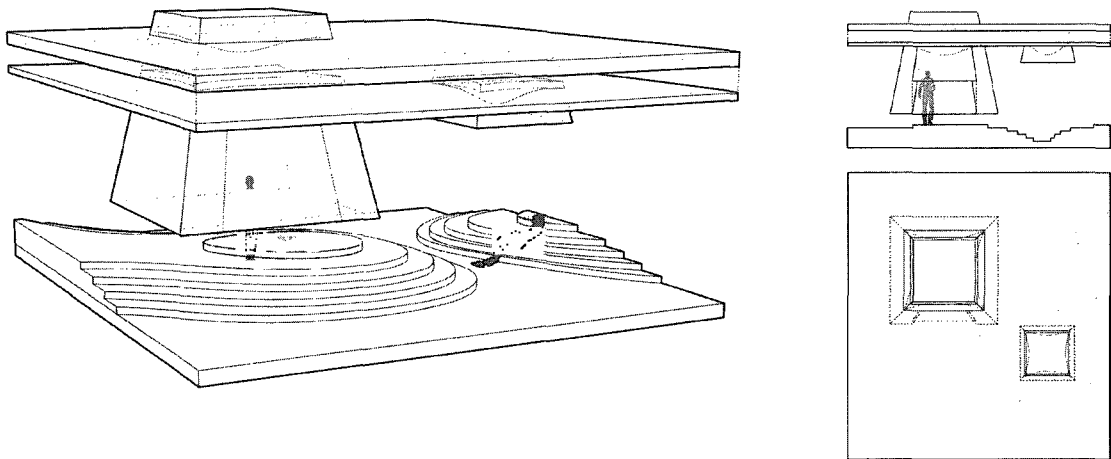
# ENVIRONMENTS AND RESPONSE





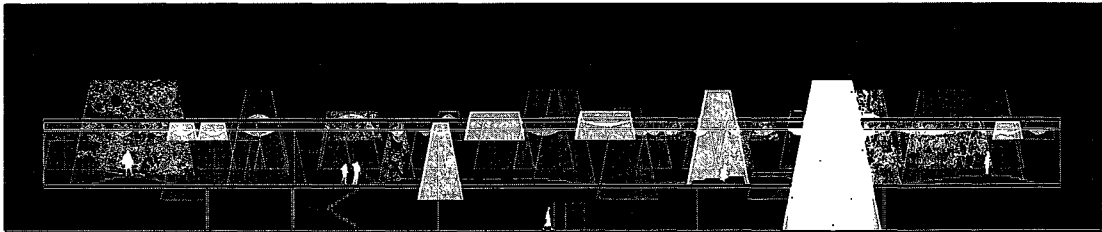




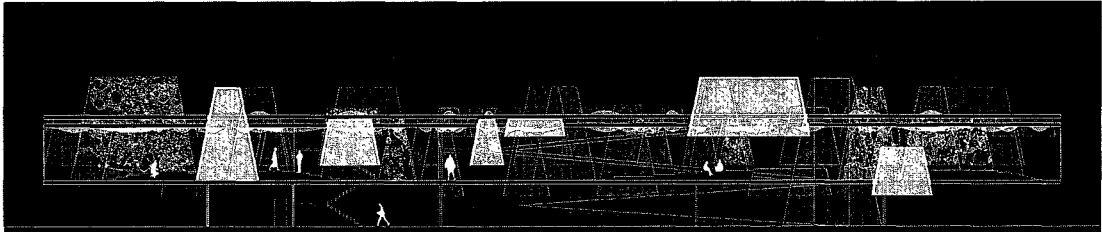


At the human scale the research environments will function as partially (or fully) enclosed microclimates. The interior “topography” offers a surface that allows for the visitors to position themselves in a variety of ways in relation to the intensities

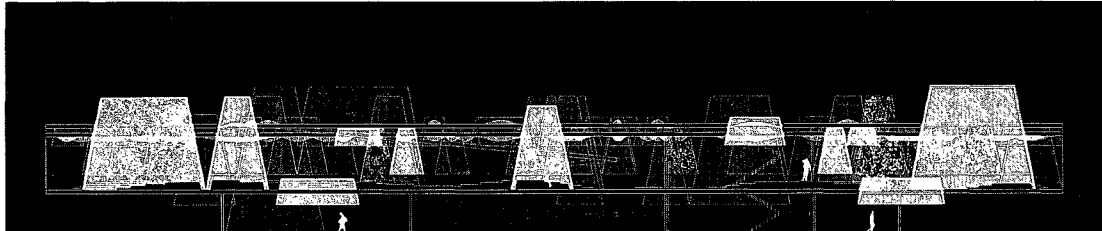
SECTIONS



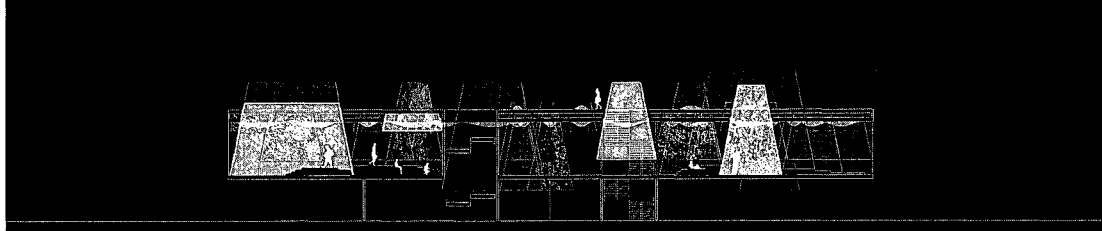
SECTION A



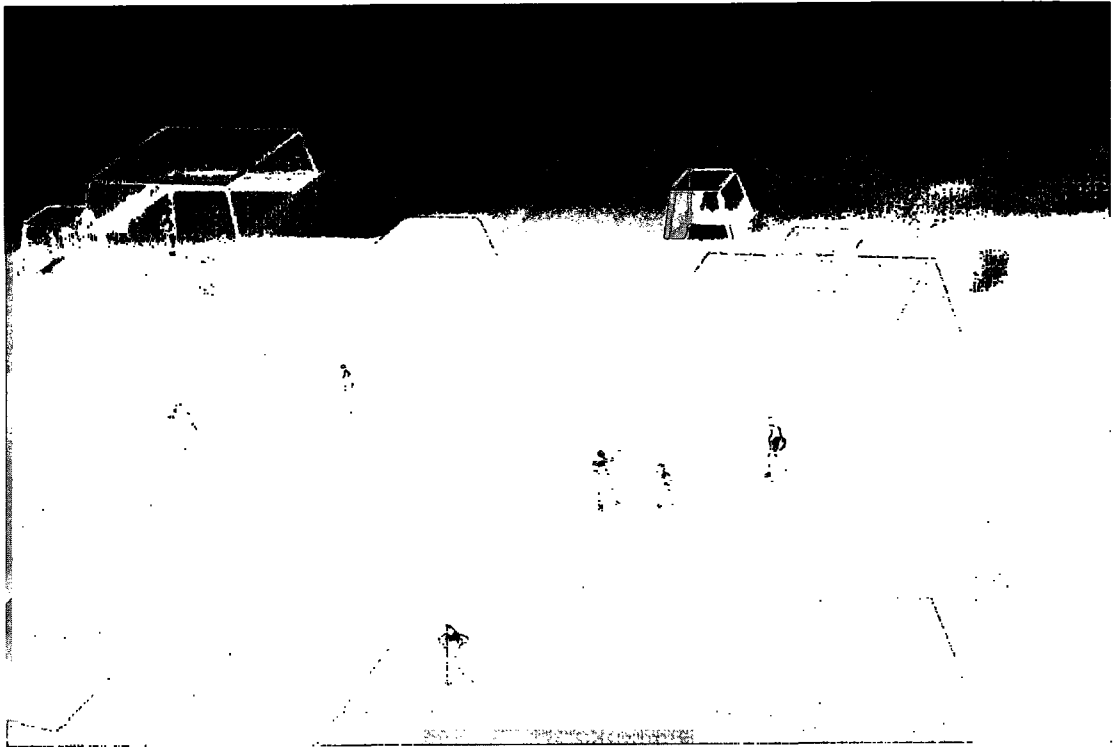
SECTION B



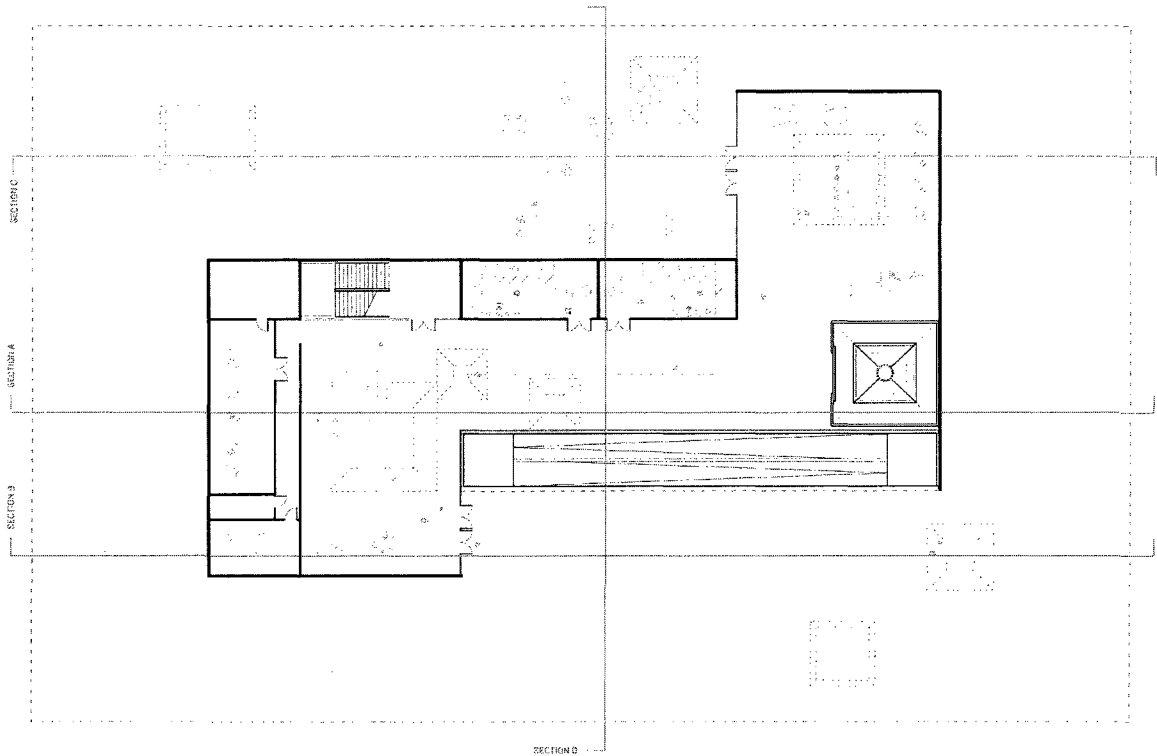
SECTION C



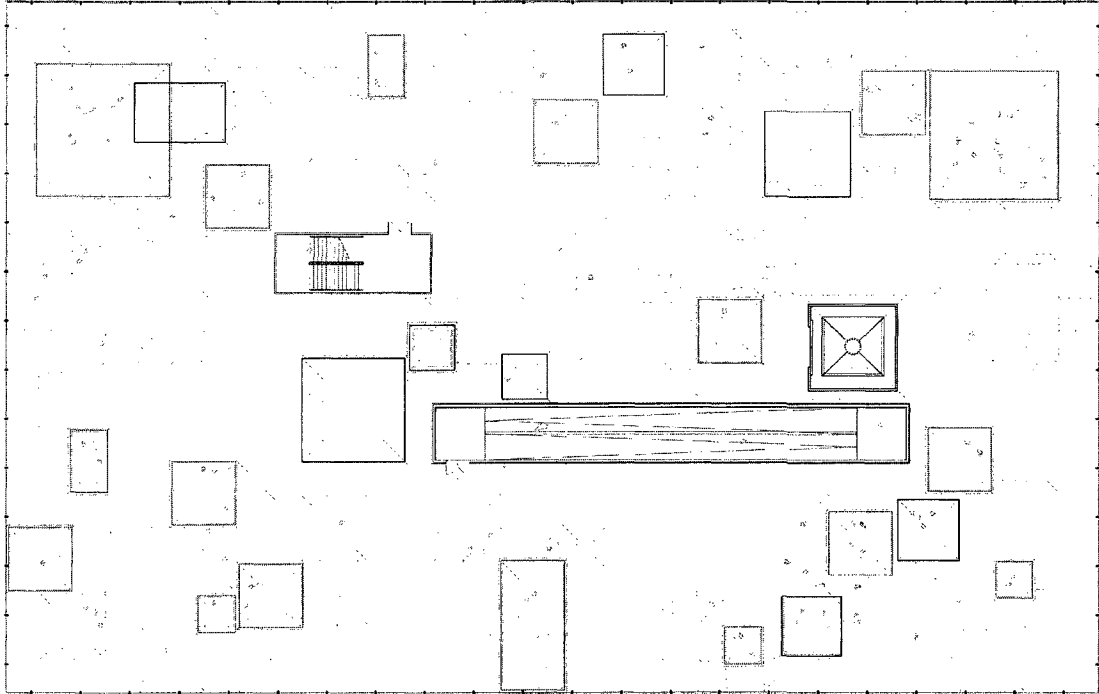
SECTION D



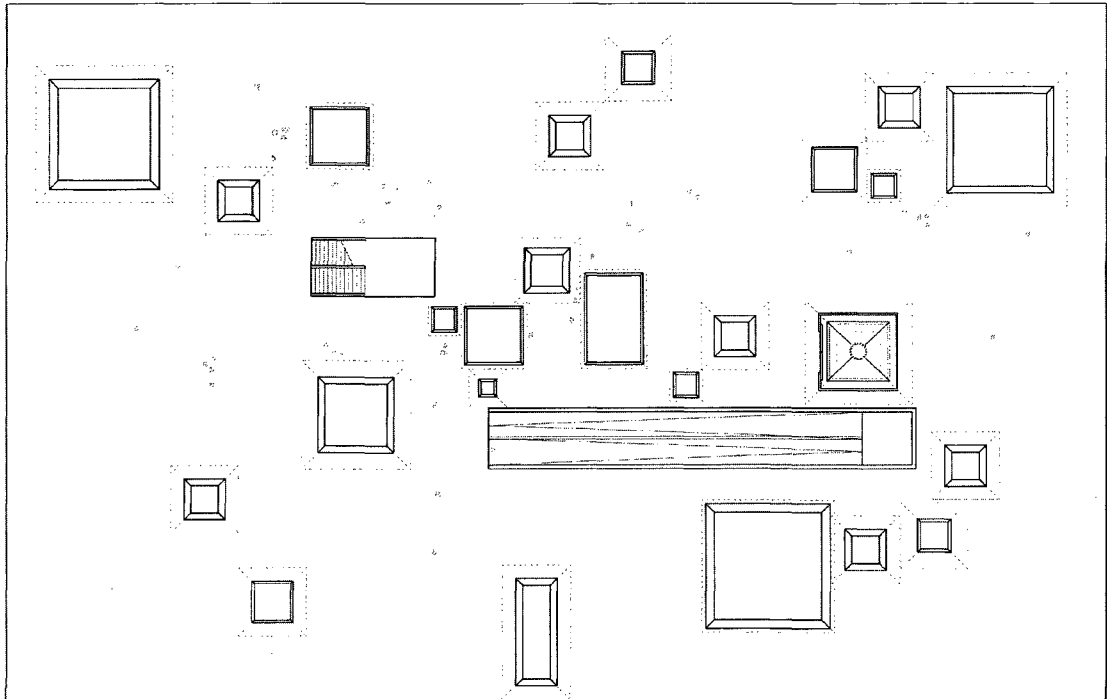
### FLOORPLAN 01: ADMINISTRATION AND MONITORING CENTER

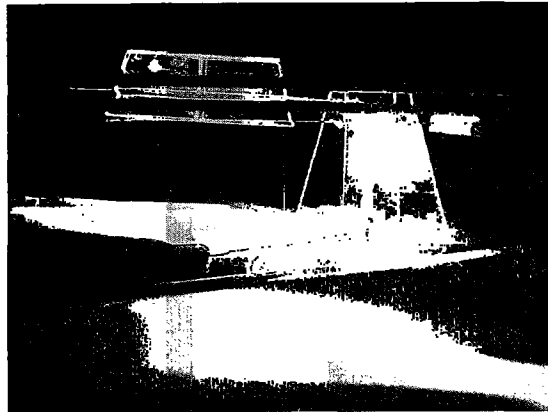


**FLOORPLAN 02: RESEARCH FLOOR**



**FLOORPLAN 03: PUBLIC ROOF GARDEN**







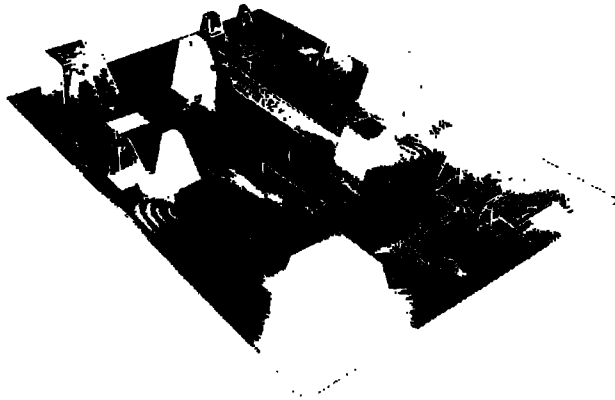


FIG. 6 - 10000



FIG. 7 - 10000

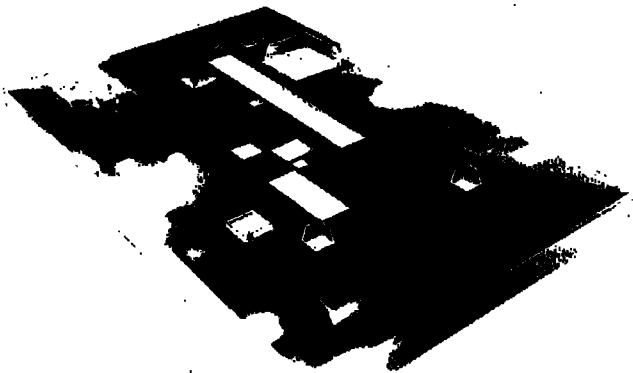
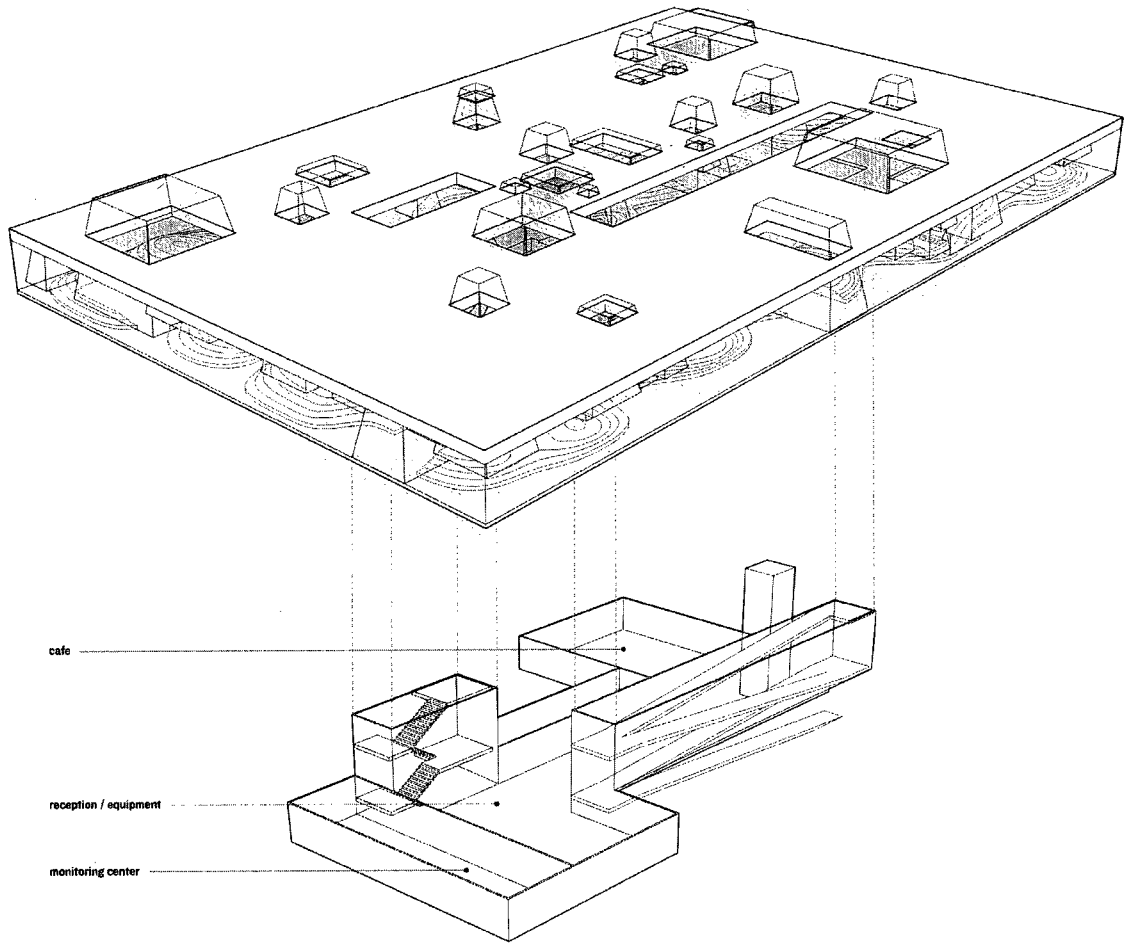
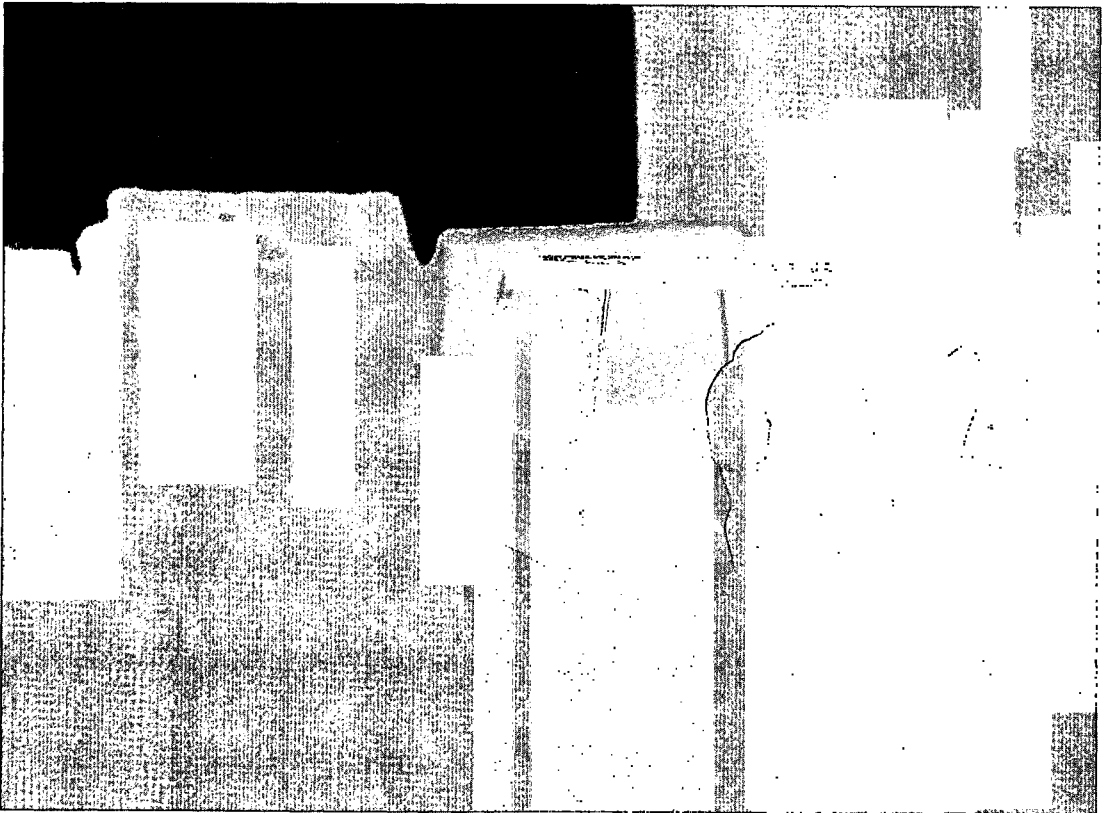
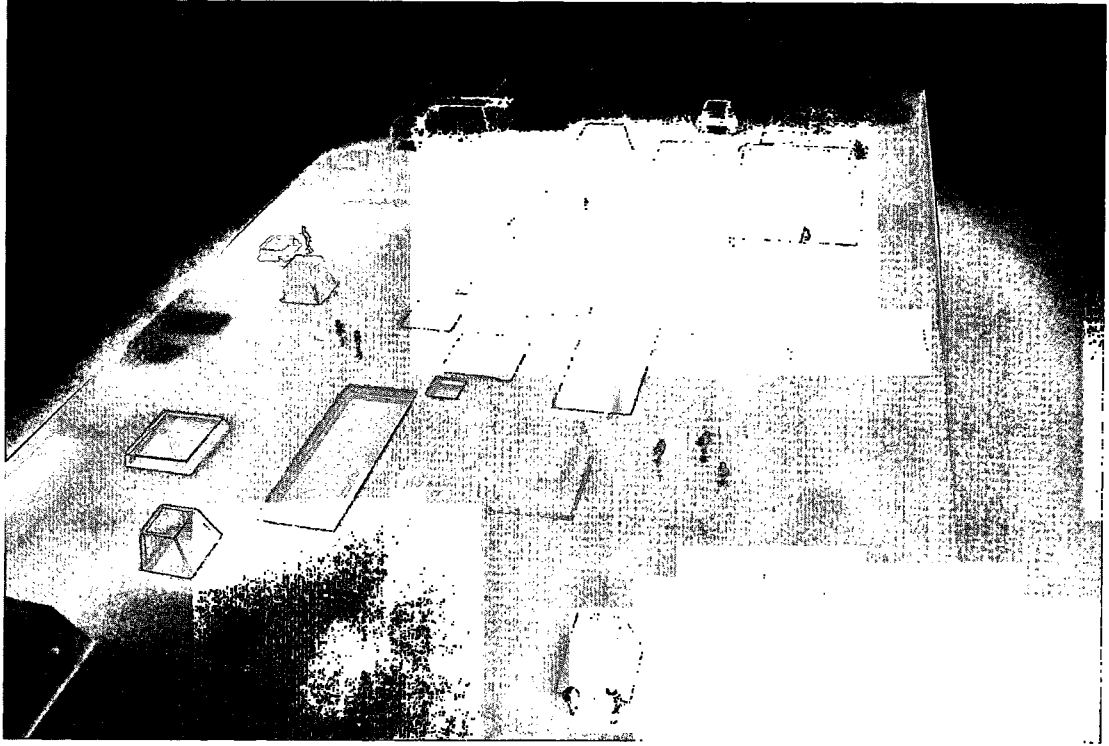


FIG. 8 - 10000





## SOURCES

American Heart Association: <http://www.americanheart.org>

American Heart Association Journals: <http://circ.ahajournals.org/>

Bihari-Axelsson, Susanna and Runo Axelsson. "The role and effects of sanatoriums and health resorts in the Russian Federation". *Health Policy* 2002 January; 59(1): 25-36.

Binet, Jacques-Louis. *Les Architects de la médecine*. Paris : Les Éditions de l'Imprimeur, 1996.

Campbell, Margaret. "What Tuberculosis Did for Modernism: The Influence of a Curative Environment on Modernist Design and Architecture". *Medical History* 2005 October 1; 49(4): 463-488.

Dvorjetski, Estée. *Leisure, Pleasure, and Healing*. Boston : Brill, 2007.

Enhanced Cardiology: <http://www.enhancedcardiology.com/>

*Green Healthcare Institutions : Health, Environment, and Economics*. workshop summary, Institute of Medicine of the National Academies. Washington DC : The National Academies Press, 2007.

Nelson, Randy J. , Gregory E. Demas, Sabra L. Klein, and Lance J. Kriegsfeld. *Seasonal Patterns of Stress, Immune Function, and Disease*. Cambridge : Cambridge University Press, 2002.

World Health Organization: <http://www.who.int>

Zeidler, Eberhard H. *Healing the Hospital : McMaster Health Science Center Conception and Evolution*. Toronto : Zeidler Partnership, 1974.

