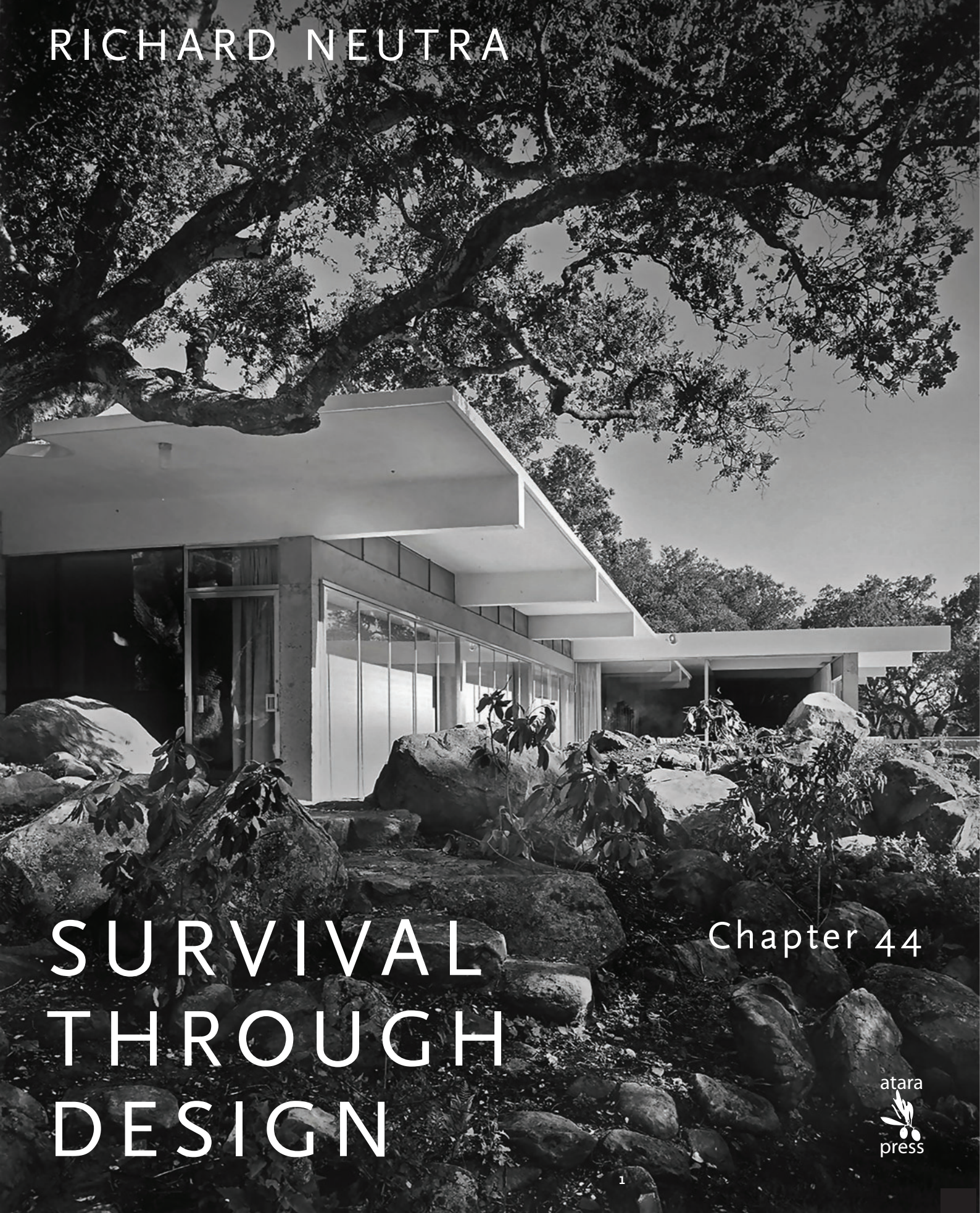
RICHARD NEUTRA



SURVIVAL THROUGH DESIGN

Chapter 44

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CHAPTER FORTY-FOUR

Design Changes Outer Life as Well as Inner Balance

Design, never a harmless play with forms and colors, *changes outer life as well as our inner balances.*

Architecture is a social art. It becomes an instrument of human fate because it not only caters to requirement but also shapes and conditions our responses. It can be called reflective because it mirrors a program of conduct and living. At the same time this art of a planned environment does more, it also programs our daily conduct and our entire civilized life. It modifies and often breaks earlier established habit.

We have keenly felt the need to probe into the general background of design and to search for the methods that ought to make its activity safe and sound for its vast consumership.

The primary interest is in what seems to remain 'constant' in these human consumers; it will be reckoned with as firm ground. From there our curiosity proceeds to what may be modifiable in human makeup and to what possibly should and could be changed in everyday requirements. Their steadiness is often only *supposed* to be legitimate and reliable.

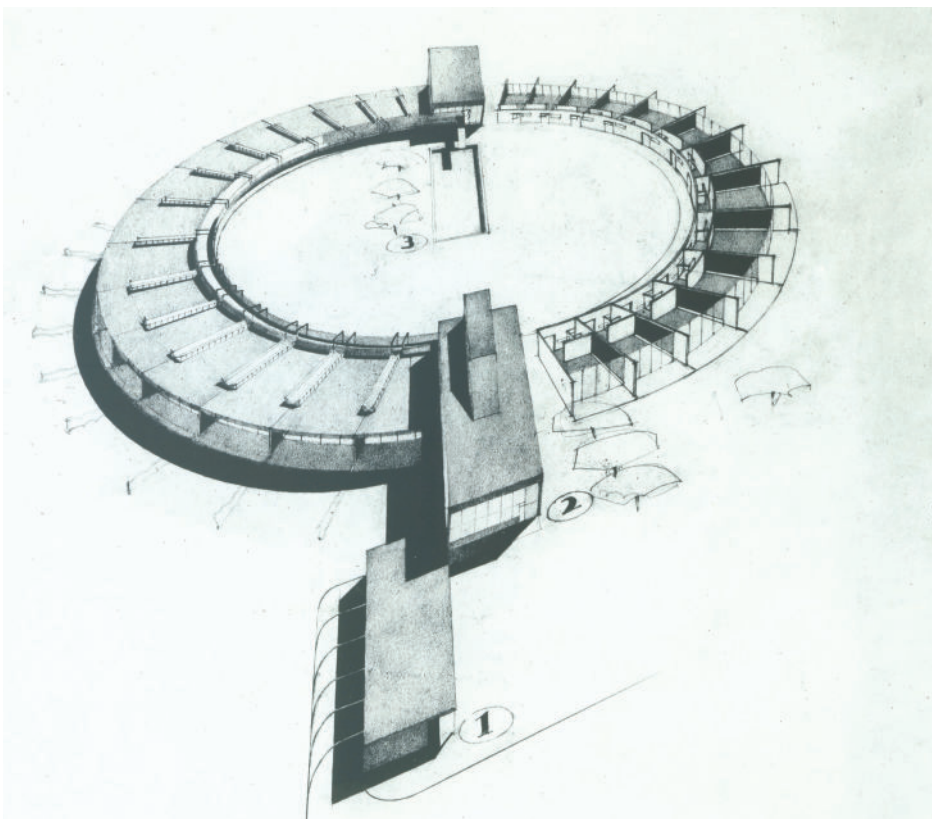
It is strange that human beings have hardly ever been studied with regard to their vital needs and care, the way rooted plants are studied in order to aid the agronomist in *his* work. Little information of this kind has been collected in practical handbooks printed for the architect and the designer.[1] The sort of investigation spoken of here is not at all revolutionary in itself. Only its application to design has so far been rather fragmentary. The most specifically human endowment to be studied is a nervous system fused to an upper brain of extraordinary volume and complexity.

1. "Professor Lee R. Dice of the University of Michigan has called attention forcefully to the 'importance of co-operative studies of the biology of man,' and indicates that 'no investigation or group of investigations now in progress is in my opinion sufficiently comprehensive to secure anything like a complete picture of man the animal, as he exists in this constantly changing world.' … "Professors Brozek and Keys of the University of Minnesota have called attention to the Laboratory of Physiological Hygiene which exists at their institution and the importance of 'interdisciplinary research in experimental human biology.' …

Officially, 'physiological psychology' dates back to Wundt.[2] The measuring of nervous responses received great impetus from Féré[3] and his psycho-galvanic scaling of their intensities in 1888. Since this work, acoustical intensities and pitch, tactile impacts and pressure, gravity pull, and so on, have been investigated in their role as stimuli and measured in an orderly fashion. There is no reason why all influences of our surroundings – be they accidental or of our own design – should not become gaugeable similarly, as, for instance, the effects of the thermal and other physical or chemical properties of the air that surrounds us are measurable in physiological terms. We have to breathe air continuously and we have to suffer the harms that come from its pollution. But air is only the prototype for that overall agent, the much more complex, ubiquitous, and perpetually effective agent that we call our physical environment. This environment of ours is largely an artifact. In our technologically advanced state of affairs, it is a pile of often incoherent fabrications and constructions interfering with life processes and adulterating them.

Systematic observation and legislation tend to govern the traffic in foods and drugs. But the effectiveness of design in all kinds of small and large single commodities and in constructed environment as a whole is powerfully at work on senses and nerves. It often reaches down as close to the core of our life as the diet, the stimulants, and patent medicines that we swallow under the pressure of clever advertisement.

The far-reaching influence that a new biological knowledge must have on design is quite obvious. While such research would perhaps have seemed fantastic a few decades ago, it is now common enough to be put into the service of the consumer. It will enable us to receive a fairly clear picture of the pathology of design, of the ill effects caused by design miscarriage, even if they are not conspicuous or easily



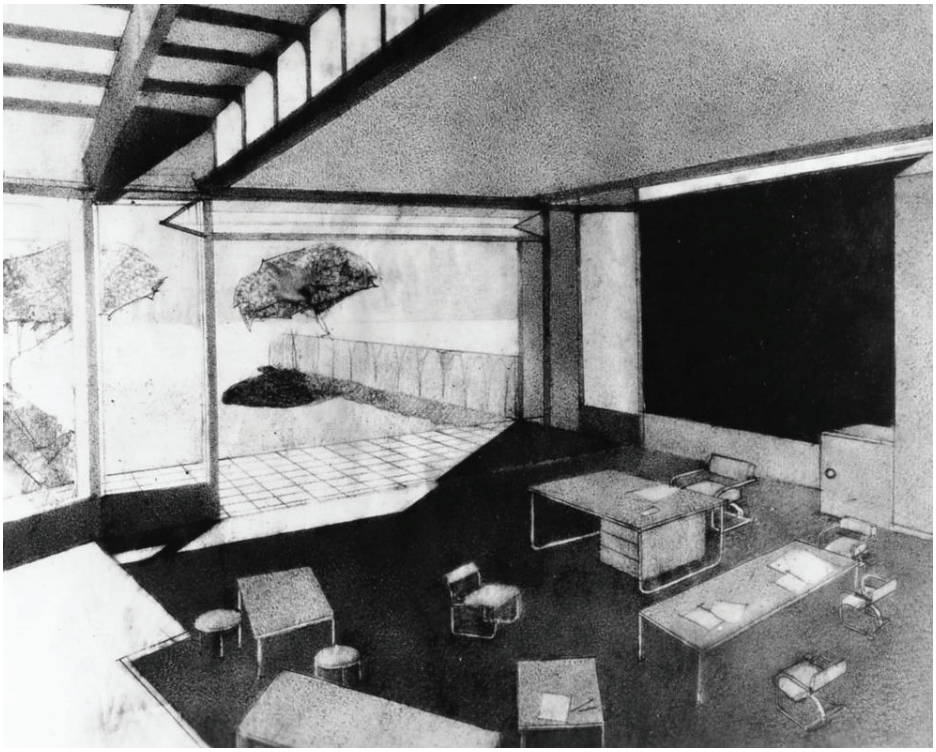
Ring Plan School conceptual rendering, 1928.

(cont.) "No proposal to study human beings scientifically and comprehensively has as yet received any substantial public support. In spite of all the moves that have been made and all the ideas and proposals that may have been entertained or set forth, we can say that to date there has never been developed a study of human beings which even remotely approximates comprehensiveness.…

"…We may assert without fear of argument that human beings are incomparably more complex than wood. Yet success in the field of wood technology has required the work of large laboratories with well-trained staffs for many years. If we are to understand human beings – a problem incomparably more important – we must be prepared to put the requisite amount of money and effort into the task. Fortunately we can reap benefits as we progress." Roger J. Williams, *The Human Frontier* (New York: Harcourt Brace, 1946), pp. 171–74. [Ed. note: Roger J. Williams (1893–1998), American biochemist; Lee R. Dice (1887–1977), American geneticist; Josef Brožek (1913–2004), Bohemian-born psychologist; Ancel Keys (1904–2004), American physiologist.]

2. Wilhelm Maximilian Wundt (1832–1920), German physician, experimental psychologist, philosopher. Critical catalyst for Neutra's immersion in research on the senses. [Note added this edition.]

3. Charles Féré (1852–1907), French physician, observed changes in body's electrical resistance under impact of sensory stimulation and emotion. [Note added this edition.]



Ring Plan School, classroom interior rendering, 1928.

detected. Through the sensory functions or irritations that design elicits, it often disturbs many inner balances and thus manifestly affects our individual well-being. It has its meaning for the development of a generation of growing, still pliable children, and particularly through this circumstance, for the survival of the race. The investigation may, as said, lead to an appraisal of injuries due to design that are as yet unknown to the designer himself. The potential consequences of such a state of ignorance may well make us feel uneasy.

. . .

A great many general disturbances due to sense impacts are measurable and have actually been measured. They range from metabolic troubles and irregularities in the distribution of oxygen to deficiencies in the production of endocrine substances and enzymes.[4]

A vast array of normally balanced inner phenomena seems to be potentially and mediately affected by sensory impulses conducted toward the brain. These do not simply terminate in our perception but they become trans-brain influences with greatly ramified flow lines and effectiveness.

A striking example of this has been given in D.B. Harmon's research, which takes its start well confined to the visual conditions in the classrooms of school children, and from here diverges broadly to many phases of life, growth, and handicaps. Unfortunately, a study like this is still a rare event in architecture, and human beings are usually not granted this much attention by those who undertake to construct their surroundings.

A high organism such as ours stands in a subtle relationship of sensory response to what happens outside. It has always been known that our 'vegetative functions' are not truly and fully removed or isolated from those of the senses. They are not really

4. Types of general disturbances derived from sensory sources concern such widely diversified or intimately connected phenomena as oxygen deficiency or diminished supply affecting brain cell chemistry and degeneration of brain tissue; the incomplete combustion of the lactic acid content of the blood; the creatinine-phosphate-sugar and urea equilibrium between plasma and lymph; the glandular production of mutually activating endocrine substances; enzymes; various catalyzing processes of inner chemistry in both directions, or toward the attainment of equilibrium and a median level; hormones; the modifications in urine formation and chemistry; the speed rates or velocity constants of various secretions and absorptions; the curdling or coagulation of blood.

autonomically governed by a special nervous system. Their connections to the spinal equipment and the brain are so manifold that a mutual influencing is perpetual.[5] For instance, since Cannon's[6] work of 1915, the effectiveness of emotional states on all vegetative functions has been scientifically confirmed.[7] The gall bladder, liver, and intestines have long been known to be affected by what is seen and heard and our feelings about it. Everyone is aware that shocks, such as a frightening sight, may upset intestinal functions.

Cannon's studies, which show the sympathetic system as an *instrument of automatic adaptation to routine change* of the environment, are highly interesting to the designer because he is perpetually concerned with what adaptation to his design an individual or the public as a whole can accomplish. Such an adaptive process will rarely be conscious and voluntary.

We must not forget that 'aware and willful' activities are relatively few and are directed from the motor areas of the frontal lobe. *Through design, however, man can, mediately or by a planned roundabout way, extend willful events to his innermost realms where responses were formerly almost uncontrolled.*

. . .

We must get over the notion that design deals only with external objects. Once we recognize that a product of upper brain power called design affects ever-greater portions of the innermost human being, related responsibilities begin to loom before us.

First with curiosity and later with more profitable absorption, the designer will follow information about how the inner equilibria, such as distribution of venous and arterial blood, the pressure in and the dilation of our vessels, and so on, are measurably affected by outside stimuli that man himself can devise. While at this point the topic may be highlighted only briefly by mentioning a few general physiological test objects, it will become clear again and again that sensory stimulation is no innocuous play with

Insular Home for Girls, Instruction on classroom patio. San Germán, Puerto Rico, 1944.

5. According to Langley, the nerve fibers efferent or leading out from the seemingly segregated string of sympathetic ganglia have their special job. They supply the plain, involuntary muscle tissue of heart, viscera, and glands, and are engaged in those processes that formerly were called vegetative and later automatic. But a great deal of preganglionic fibers, *rami communicantes*, and other conductive bridges intimately connect the central spinal system and this autonomic system to make it really one interdependent unit. [Ed. note: John N. Langley, British physiologist (1852–1925).]

6. Walter B. Cannon (1871–1945), American neurologist and physiologist. [Ed.: Note added this edition.]

7. These influences have been found to be mediated through centers in the spinal cord and the diencephalic region, called the hypothalamus. Stimulation of it evokes adrenalin secretion, a consequent rise in blood pressure, cardiac and vascular effects; in short, it meddles into everything that traditionally ought to be 'autonomous.' For example, detailed observations leave little doubt that emotional disturbances caused, say, by sensory stimuli will actually hasten bowel movement or again dull and retard the rhythmic contractions – regularly six per minute or so – of the little muscular projections called villi, which line the lumen, the hollow of the intestines, and, according to Brücke, act as minute pumps to suck in and absorb nutritive juices. [Ed. note: Ernst Brücke (1819–1892), German physiologist.]

forms and colors, but that it has a great many important extrasensory consequences.[8] Since the inner physiological equilibria are so significant for these life processes and for survival in general, they must be patiently observed. They must be checked under all possible impacts of experimentally imposed sensory stimuli. Under such exposure, deviations from the normal must be quantitatively noted in proportion to the measured magnitude, frequency, or duration of these stimuli.

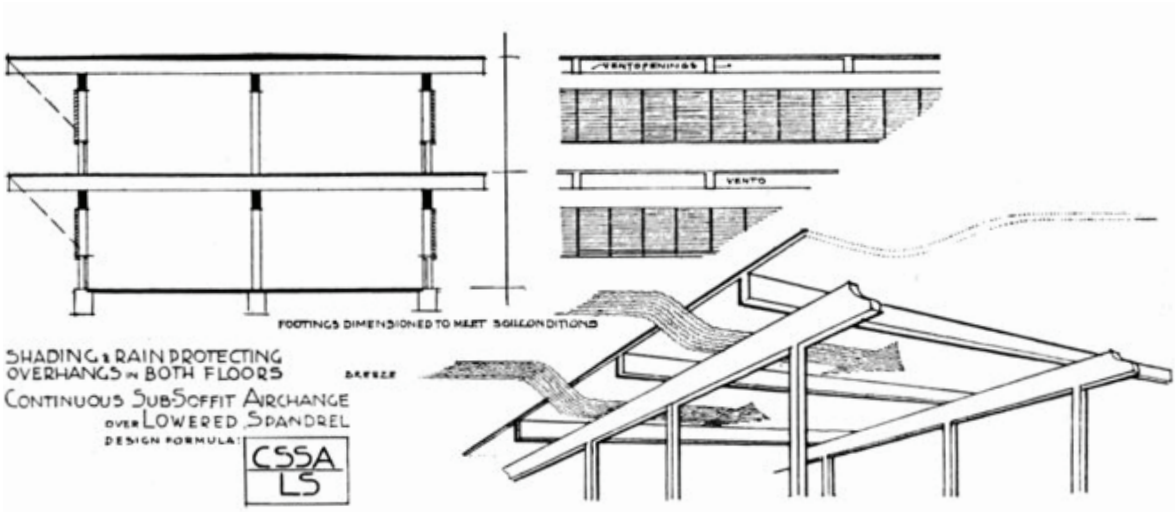
Certain businesses have become interested in this field of benefit or harm to well-being. For example, producers and sellers of heating and ventilating equipment found it profitable to invest in careful studies and experiments on subjective comfort, physiologically analyzed. A ventilating engineer now knows that a two-year-old child, in proportion to its body weight, uses up three times the quantity of oxygen an adult would need. Computed on the basis of skin surface, the rate per unit is one and a half of what the grown-up consumes. The anesthetic effects of various air pollutions, the humidity of air, its relationship to temperature, its passage over our perspiring skin surface covered with minute moisture particles secreted by each innervated sweat gland, and so on – the sensory concomitants of all this have been carefully examined and interpreted for practical application. Yet, where subsidized research is involved, as in this case, it may always be necessary to keep a close watch for the borderline beyond which intentions of more lucrative trade may begin to color the results.

For 'natural' ventilation that happens not to require the purchase of a mechanical contraption, desirable data, circumstantial interpretation, and guidance will come to the designer much less easily. There he will find himself promptly foiled by the commercial sources of instruction. Often enough he is left with his own subjective sensory experience, with such of his feelings and such scraps of inner evidence as he can muster by himself. Much less data seems readily available here and, of course, there is no manufacturer to mail us a free handbook when we send in a request stub in response to his national advertisement. *Natural ventilation is no subject for such an ad*.

. . .

There may be nothing to sell, nothing to advertise, and still there may be a maze of significant facts to know and to investigate. Let us take an example that is somewhat

8. There are such equilibria worth watching when sensory stimulation is added. They are of many and various kinds. Frequently they are functionally and specifically linked, such as that of venous arterial blood distribution and pressures in connection with items of, say, the general cardiographic investigation already mentioned. Further items may be observable as vascular effects, perhaps dilations of capillary diameters, changes in permeability of tissue in cellular partitions, in unbroken maintenance of colloid osmotic pressure, of plasmatic viscosity, of concentration in hemoglobin perfusates, inactivation and oxidation of internal adrenalin by a number of significantly elicited and developed enzymic systems, and so on. The good work already done in general physiology and in specific fields of it is immense and grows daily. The forecast is safe that coming decades will still greatly multiply and refine its methods and objectives.

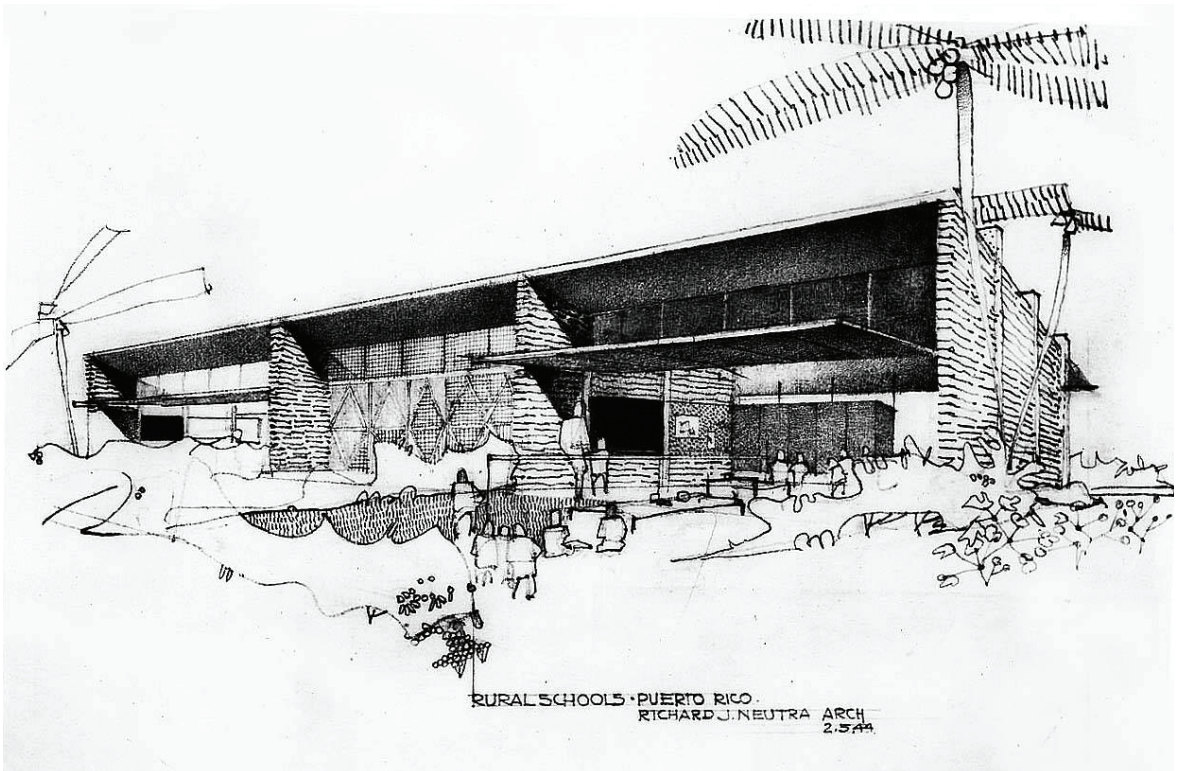


Rendering detail of ventilation design, "Continuous Sub-Soffit Airchange over Lowered Spandrel."

removed from our own scene, so complicated and biased by expensive gadgets. But even in the face of comparative simplicity, strange quandaries will be caused by the intimate interlocking of varied and devious design arguments that no specialized salesman or manufacturer would worry about. This complexity is nevertheless the order of the day in conceiving a serviceable building anywhere and so may be described as generally characteristic for the process.

I was called in to devise the layout and structure for simple, rural classrooms on a tropical island. Obsolete ordinances, borrowed from the Continent many years ago, required a legal 'minimum' of static air storage per child in the room. Most of this stored air consisted in a volume stagnant under the ceiling, while the windows were ordinarily placed much lower down, all on one side of the room, with disregard for cross-ventilation. Warm, moist air, practically stationary, saturated with airborne bacteria, and recirculated through many lungs, had made tuberculosis endemic, spreading from one child to another in the locality.

On the one hand, rigid economy was exercised by keeping the floor area small and crowded. On the other hand, attention and money were expended on making the school building high and on providing a vertically extended store of air. But tall classrooms with a small floor area create special problems of construction, especially when the forces of high winds, hurricanes, and earthquakes have to be taken into account. Walls and footings must be reinforced more heavily, and in order to lend added strength to the walls, the most useful and refreshing openings, windows and doors, must be reduced in width so that the amount of dead masonry can be increased for a greater lateral resistance. The result of all this is that costs go up far in excess of being merely proportional to the height and bulk of the building.



Rural classrooms design, Insular Home for Girls. San Germán, Puerto Rico, 1944.

Corona Avenue School in Bell, California, 1935.

Cost, structural safety, and pathology, the manifest spreading of disease, are, however, not the only things we cope with through design. We are also concerned with sensory comfort and with general well-being – concepts badly in need of physiological understanding. West Indian sultriness, an object of complaint, can be mitigated by opening up the buildings and orienting them into the very steady trade winds, which are equally West Indian and a glorious asset to the climate. We must give the air a chance to pass over our skin, where it dries the millions of precious tiny sweat droplets and causes a delightfully cooling sensation. It can be shown that this is really more important here than reducing the chemical pollution of the air.

Severe economic limitations may not permit us to increase the cubature or the structural bulk of a building. This does not defeat us. We can save money by making the edifice less tall if only at the same time we think of turning it into the breeze and opening it to the great outdoors – to all the natural blessings free of charge.

And so we did proceed. The structural concern about elevating the building high, up into the dangers of occasional heavy wind attack, was reduced. Yet ventilation by salubrious breezes was increased through orientation and opening. Wisely taking stock of natural circumstances, instead of working against their grain, turns them into helpful agents.

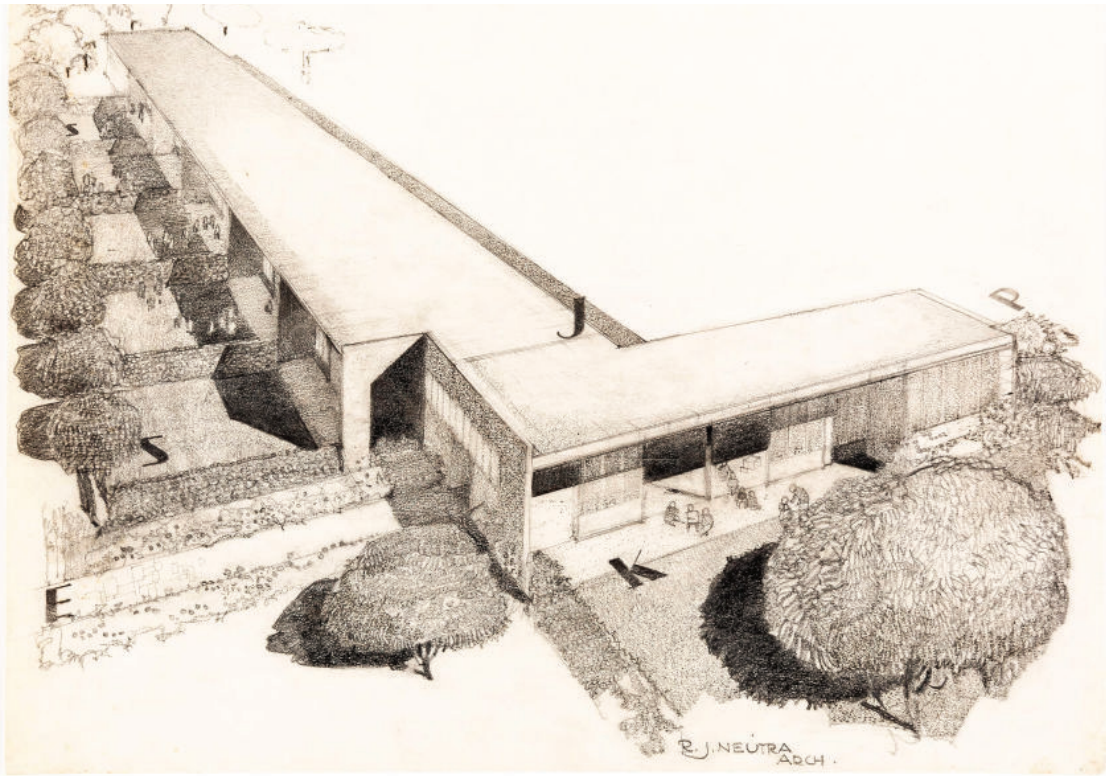
My design solution assumed a normal 100-feet-per-minute velocity of air currents in the direction of stable trade winds. Such a velocity is very small and proved available during practically all school hours. It produces an impact on the forehead and face which is hardly more noticeable than if one were to pace slowly up and down in a fully protected room. While on a really hot day we might yearn for speedier passage of air, even this velocity, almost below the threshold of awareness, nevertheless gives us about *four changes of the entire air volume per minute* for a 25-foot-deep classroom,

whose ceiling may be no higher than the window height. It is an effect of amazing magnitude if one remembers that costly artificial ventilation may furnish no more than ten air-changes *per hour*, or one twenty-fourth of what we accomplished naturally. The air moves in freely from one broad open front and makes its exit through the other. Airborne bacteria no longer hover in the classroom but steadily move sideways and are spilled out into the sun. Expectoration dries promptly, quickly diminishing in contagiousness, and all the while evaporation cools the skin.

The most difficult part of the assignment was to overcome the ordinance in force and to deal with habituation and the established bureaucratic forces backing it. But after all, classrooms are for children and for education; with this concern in mind our new layout offered a great many advantages.

It must not be called a mere accident if in the process of our design the relation of child to classroom, the child's 'feeling' in the allotted space, improved steadily. While working on all those other problems, I remained aware of the fact that a lower room under the tall tropical trees may be, as a shelter, in much better scale with the child's stature and in more suitable proportion to it. Projecting roofs and broad fold-up doors now helped to extend the room outward through a wide opening onto a classroom patio and augmented the floor area for the horizontal expansion and activity that is so welcome to normal children as well as to modern teaching processes. And all this was possible when *air storage* was replaced by *air passage*.

A very involved combination of motives and considerations, from *cost* to *earthquake loads*, and a way of *learning by doing*, went to produce our decisions. Healthfulness, practical size, and outward expansion of schoolrooms were accomplished without a corresponding increase in price, so as to fit an overall capital improvement program of an entire system of Public Education.



Experimental unit of the Corona Avenue School in Bell, California, 1935. Pencil on paper.

De Schulthess House, Havana, Cuba, 1960.

The design problem of a schoolroom has been used as an example earlier, but there purely from the point of view of vision. Here it serves equally well to demonstrate how various problems may be unrolled, starting with ventilation. These two approaches are of course not mutually exclusive but rather in need of correlation. They have to be brought into harmony with a great number of other considerations. Not least, they have to be reconciled with social complications – tradition, habits of the community, prejudice. Formal elementary education, where a novelty, is not immediately convincing. Even if it were successfully accomplished, it is first doubted by poor sharecropper parents in rural backwoods – and not just in tropical ones. It needs gentle introduction without social irritation and complaint. Disease spreading through the school may lead to just that and in fact may prove in any circumstance too high a price to pay for education.

We have dwelt here on an exemplification of how complex design motivation tends to become as our technical and social purposes increase, and how little orderly and convenient literature exists to guide us on the primary physiological level.

One fact already stands out in the total scene of mixed design considerations: a 'timeless,' static sort of design concerned with space alone will be an error. In the instance of a classroom it became clear what air flow reckoned in time must do for living beings who themselves are physiological clocks also operating in time. Our kind of ticking is the pulsing of our blood, our breathing or inhalation-exhalation cycle, and all the many rhythmical processes that go on simultaneously within our bodies. It is through these processes – much in need of accommodation in suitable space-time – that we live and survive.

REVIEW

by Sibyl Moholy-Nagy

When Richard Neutra participated as an invited speaker in the Bicentennial Festival of Columbia University, he found himself frustrated by the dreary "twenty minutes per say" routine of all roundtable discussions, and by the interference of an all-too-clever chairman. He finally threw up his hands and summed up the lifetime philosophy of an architect with: "In order to build the best possible polar bear cage, one has to become tremendously interested in polar bears."

This new book by Richard Neutra is a tremendously learned paraphrase of this statement. It represents, among many other original tenets, the conviction that architects are intellectual people, and that they are willing to see their work in the largest possible context of man between amoeba and pure spirit. Anyone who has had close contact with practicing architects will doubt this premise, and as a consequence will see the greatest sphere of influence for Mr. Neutra's thoughts among teachers of the humanities in general, and of all forms of design in particular. For these specialists of the human soul *Survival Through Design* offers an extraordinary range of ideas.

It is not an easy book to read because there is no index [now added for 2023] or guiding theme, beyond the vast one of natural and man-made environment; and the structure reveals itself only after one has actually read the whole volume. But it is an uncharted voyage worth the effort. The key to the many thought cells, stretching page after page, is handed to the reader approximately in the middle of the book:

"Inner distribution of force and stress within our nervous system are the real aim of all outer design ballistics." "It is in this era of brain-physiological research that the designer, who wields the tools of sensory and cerebral stimulation professionally, can perhaps be recognized as a perpetually and precariously active conditioner of the race and thus acquire responsibility for its survival. He acts, in a way, as a guardian of such survival, and students, as practitioners, will gain in moral stature when they come to consider what is entrusted to them."

With this declaration of a goal, transcending in importance all contributions of the specialist of technology, Neutra proceeds to analyze the many approaches to this goal. What is natural environment versus man-made environment and which one is adequate for man? The only gauge for the validity of constructed environment is "a high provable index of livability – a bearable individual and communal living space." Is planning possible, or are we – with St. Augustine – resigned to the belief that grace alone can save or condemn us? After a brilliant dash through the philosophical development of the free will–predestination controversy, Neutra concludes that "there seems really one thing left to do: that is to bypass speculative issues quietly, take heart, organize the procedure, and confidently attack the stupendous ubiquitous problem of design with an eye on tried inductive method." "From a baby carriage to a metropolis" we are given the essentials of design for survival: performance versus the handicraft ideal of quality; structure as style and not symbolism as ornament; uniformity and not monotony; calculated amortization versus miscomprehended eternity. The designer must accept measure as the ordering principle of communal living and within the measure achieve variety through design. There are exciting analogies in this

book between the biological and social habits of plant, animal and man, which are summed up in the 13th and 14th chapters, which seem the most relevant ones for the current transition from the first to the second phase of twentieth century architecture. Here Neutra analyzes the overquoted dictum that "Form follows Function" and proves that just as often function is the result of form – from the brilliantly colored petals of a flower to the form-color perfection of the peacock's tail. Beyond the serviceable core of the house, that is the designer's prime responsibility; he must comprehend the supra-rational appeal of sheer aesthetics. "Architecture is a matter of composite perception, an affair of many senses."

There follow chapters on the impact of design on all of these senses: the sense of space, for instance, conceived throughout history in such varying theories as Euclid's infinite, Newton's absolute and Einstein's relative space. For the designer of today, Neutra concludes, no such easy labeling is possible. We know of space as vertical, horizontal, enclosed, unrestricted, frontal, etc., and we become increasingly aware of its subtle relationship to the fourth dimension of time. The basic guiding principle must be "the ratio of surface to volume," the creative and wholesome balance between "proliferation and articulation in man as well as in the human city." It is quite impossible within the limited space of a review to touch on all the crosscontacts made in this book. Its historical significance for teachers and students of design lies in the revival of an ideal, as old as Vitruvius, that "architecture is an art for all men to learn because all are concerned with it," but that here for once more is attempted than a mere statement of urgency. Richard Neutra furnishes proof why and how all of us are the concern of the designer. In concluding his analysis of design reality versus design ideal, he arrives at five main objectives of architectural research and with it of architectural training:

1. To ascertain the force of influences of environment affecting the organism generally.
2. To clarify data on specific sensory responses.
3. To study the relation of such sensory stimulation to an inner somatic equilibrium, which is fundamental to our immediate well-being and our ultimate survival.
4. To study with care conditioned and associated responses elicited in our brain by simple design elements.
5. To investigate with ever greater refinement and dependability the interrelations of all responses.

If this biological-psychological approach is carried through – embracing, as Neutra never tires to point out, all the intricate aspects of technology, city planning, and the age-old problem of authorship-ownership tension between designer and client – then

> "We may hope to design and build more soundly for the multitude of human beings who cannot extricate themselves from the confines and the vastness of contemporary industrial environment. Step by step we must thus erect a safe stairway leading to more wholesome and more spacious levels of man-conditioned existence – even if the topmost landing and a panoramic view to reward the long ascent may never come into our sight during our own brief span of life."

—SIBYL MOHOLY-NAGY, Pratt Institute

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