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Source: *Journal of Architectural Education (1947-1974)*, Vol. 16, No. 2, ACSA-AIA Seminar, June 1960, Sagamore (Summer, 1961), pp. 8-17

Published by: [Taylor & Francis, Ltd.](#) on behalf of the [Association of Collegiate Schools of Architecture, Inc.](#)

Stable URL: <http://www.jstor.org/stable/1424146>

Accessed: 01-09-2015 04:46 UTC

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THE IMPACT OF TECHNOLOGY

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The central problem which faces us is that we now design buildings in a cultural situation literally without precedent in human history. The architect is confronted with a totally new order of problems. He might draw a little consolation from this fact. It often seems to him that life is difficult; I think it is difficult, more difficult than it ever was before for architects.

The impact of modern industrial technology upon contemporary architecture can be easily traced at every level — theory, practice, finished product. The effect is most clear and most poignant at the theoretical level. Nineteenth-century technology set in motion among architects a whole train of speculation as to its significance, its probable course of development and the possible responses of architecture to it. This speculation spread in steadily widening circles, involving all the theoreticians of the past century and a half. Greenough, Pugin, Ruskin, Viollet-le-Duc; Sullivan, Wright and Geoffrey Scott; Le-Corbusier, Gropius and Mumford: all these men were activated by the shock waves of the impact of technology. Nor have these speculations ceased. On the contrary, the implications of technology for architecture are, in many ways, more ominous and obscure today than they were a hundred years ago.

These successive waves of speculation are also revealed with great clarity in the architecture of the period. Each has left its deposit and these the historians can trace as easily as the geologist reads his core or the archaeologist his trench. It is a stratigraphy of unparalleled confusion. For though technology, by its sheer mastery of external nature, has made possible unprecedented advances in architecture it has, by the same ironic token, made possible more bad architecture than the world has ever seen before. And this, I think, is our central problem; that for every great building technology has given us, it has given us five million so much worse than was ever possible before that it is not even funny. Architecture — unlike the fine arts — is at once the prince and the prisoner of the kingdom of necessity. It can never escape the iron laws of physics: indeed its greatest examples are precisely those in which these laws have been most scrupulously observed. The majesty of such constructions as Hadrian's Villa or Chartres Cathedral springs from the most exact and elegant knowledge of the limits and potentials of masonry vaulting. Acceptance, not defiance, of the laws of statics was the basis of all pre-industrial architecture. Because modern technology has so extended man's power over external nature, modern architects have often acted as though these iron laws had been repealed. The result, for perhaps the first time in all history, was bad architecture — ugly to look at, unsatisfactory in use.

One of today's basic assumptions is that architecture, thanks to modern technology, has made great advances in the past century. In many respects, of course, this is true. But the implication is that these advances have been steady and continuous and that we stand now at some pinnacle of accomplishment. Unfortunately for our complacency, this is not the case. The great germinal structures of the past hundred years are not evenly distributed throughout its span; on the contrary, they fall in clusters, and rather closer to the beginning of the period than to its end.

If, for the sake of brevity, we simplify the historical record, then we may take Joseph Paxton's Crystal Palace (1851) as marking the opening of an era. Here was the first western structure which clearly demonstrated the arrival of a new period. It not only used the materials of the new technology — iron and glass — but it used them in an explicitly novel way, purged of all reliance on historically determined form.

It is a moot question whether we have advanced a jot or a tittle past Joseph Paxton's accomplishment of 110 years ago. We do not find this new architectural idiom immediately adopted by the West. On the contrary, four or five decades elapse before we find a statement of equal clarity and vigor in Sullivan's use of steel and glass in the multi-story Schlesinger Building of 1899; here was a perfect understanding not only of steel cage construction but, even more important, of the esthetic expression of its essen-

*Technology is only a crutch for meaningful
composition today.*

ULRICH FRANZEN

tially static non-directional quality. Four years later, in 1903, we find in Tony Garnier's *Cité Industrielle* an equally mature understanding of the structural nature and esthetic potentials of an even newer material — reinforced concrete.

But these seminal structures had in the United States no immediate progeny. Half a century elapses before we find the idiom picked up again in such buildings as van der Rohe's Chicago apartments or the Lever House of Skidmore, Owings and Merrill. Thus, it has taken us better than a century to stabilize, refine and bring into general use an architectural idiom expressive of the new technology; and this despite the fact that, in a very real sense, it was perfected at the very start.

Why has this paradoxical state of affairs been true?

It is largely due to the fact that, while architecture has been exposed to the full blast of technology, it has been only obliquely touched by the sciences which lay behind it. With a few notable exceptions, architects have always stood outside the scientific tradition. Traditionally pre-occupied with problems of esthetics, they were completely unprepared *theoretically* for the emergencies with which industrialism confronted them. Their only contact with science was through technology; and advances in this field came so rapidly, and were of such earth-shaking magnitude when they came, that they occupied the architect's entire attention.

Moreover, many of the most significant advances were in the field of pure structure. And since the expression of structure is always geometry, they tended to focus architectural attention on that most formal and abstract of scientific disciplines. For this, contemporary architecture has paid a heavy price.

True, the march of science has amply confirmed that there *is* order, rhythm, law in Nature. But, as a system, Nature turns out to be infinitely more complex than appeared even to that contemporary of Paxton, Charles Darwin. And for this new perspective of Nature, geometry turns out to offer a very inadequate representation. The essential qualities of Nature, life and movement, and time — the dimension in which they both occur — are precisely the qualities which geometry cannot describe.

Now, I do not mean to suggest that actual buildings can avoid geometric form, any more than growing tissue can be organized without the cell. But for architects, geometry has inherent conceptual dangers of which they should at least be aware. The principal one, of course, is formalism — that is, interest in the form to the neglect of its content or function. If modern science teaches us anything, it is the danger of formalism. A module never got an airplane off the ground. The Golden Mean never helped to discover the arrangement of the molecules of penicillin. And architecture can never fully discharge its tasks so long as the geometry of its forms is considered as an end rather than a means.

In saying that the architecture of the last hundred years has shown rather less forward movement than we often assume, I do not mean to suggest that this course of development has been "bad," still less that it has not been historically necessary. But any honest assessment must recognize that there is little qualitative difference between Root's Reliance building of 1895 and our most "advanced" skyscrapers of today. Nor can we honestly argue that any upperclass house of the Fifties represents a qualitative advance over Frank Lloyd Wright's Coonley House of 1908. We have, in short, made far less use of our resources than did either Root seventy years ago or Wright fifty years ago. We have, instead, been coasting on the momentum generated by these men.

If this is true, two questions immediately arise: how did the situation come about? And how can it be corrected in the future? I think it came about because we have been too concerned with the formal qualities of our work and too little with its behavior and performance in use. We are fond of assuring ourselves, nowadays, that we are aware of this. We are

The social content of the early modern movement has disappeared in the United States; and empty aesthetics has replaced it.

ROGER MONTGOMERY

What we call architecture is rendered drawings.

WALTER SANDERS

Technology provides an additional order rather than a strictly new one. You mention Alberti as an advocate of formalism. I disagree; one of the most important things Alberti ever said was when he was describing proportions of windows: he described a window as being something one person would like to look out, but he'd like to have another person join him. So the idea of how many people might be at his window was a matter of the size of the window. Now this is a kind of function which isn't going to change. It is a kind of function you have to pay attention to. This is a technical way, a logical way to approach a building.

DONALD JACKSON

quick to criticize the formalism of Alberti and Palladio, of Charles Follen McKim and Stanford White; but we are oddly blind to exactly the same tendencies in van der Rohe's campus for Illinois Institute of Technology or Corbusier's *Unité d'Habitation* in Marseilles. They make just as many concessions to preconceived ideas of facade as ever did Palladio. But we will correct this weakness in our architecture only when we cease to confuse mere technology with science, when we rid our theory of gadgetry and illuminate it with truly scientific thought.

In a purely formal sense, of course, the forms of modern architecture are often extremely handsome. For example. Eero Saarinen's new General Motors Technical Center — with its clarity of line, crispness of color and sharp articulation of mass and volume — is visually very satisfactory — incomparably finer, certainly, than any of the cars which have so far come out of it. But when we try to generalize such buildings into the idiom of the future, we come a cropper. For logic and experience both show us that the problems of architecture, in the tempestuous context of American life and American climate, are anything but simple, crisp and clear. They are, on the contrary, incredibly complex. Do our current esthetic criteria of crystalline clarity and classic repose — do these really correspond to the demands of contemporary reality? Or are they accomplished only at the sacrifice of invisible but very real requirements, sacrifices which only life and not photography reveal? I am afraid, if we are to trust the evidence of our own senses, that many of these handsome structures are neither economical to build, comfortable to live in, nor simple to keep in operating order. Our obsession with pure geometry, in other words, leads us to make of much modern architecture a sort of Procrustean template which falls like a murderous cookie cutter across those living processes which do not happen to conform to its outlines.

This sort of formalism operates to limit the usefulness of many modern buildings. Look, for example, at its current use of glass. Now glass is a wonderful material and its availability in hitherto unheard of sizes has been one of the principal factors in the creation of our own architectural idiom. But—pictorial evidence notwithstanding—glass does *not* simplify the design process: on the contrary, it complicates it quite unbelievably, especially when it comes to constitute the entire wall. This glass wall is very complicated, whether viewed from the angle of physics, physiology or psychology. It requires a massive assortment of auxiliary devices, if it is to be genuinely successful at any level higher than that of the picture books. These devices are necessary to provide for ventilation, privacy, insect protection, weatherproofing, insulation, light and heat control. However, because of the extreme variations of our seasons, all these devices must have a high degree of flexibility.

Here, then, is the paradox. Transparency, as an esthetic criterion, dictates certain formal qualities in architecture—simplicity, structural clarity, repose. But transparency, at the biological level, often raises exactly contrary demands—complexity, opacity, changeability. How are these two contradictory sets of values to be reconciled? By meeting the requirements of the whole man? Or by imposing a merely visual order based on *a priori* conventions drawn largely from the field of painting?

Currently, the protagonists of an architecture of pure geometry offer two sorts of apology for it. The first is actually an old and familiar one—i.e., that beauty in architecture is, in the last analysis, more important than “mere” creature comfort. The other is that, thanks to the miracles of modern technology, the problems raised by their crystalline geometry can be solved by exclusively mechanical means.

Both of these arguments are, in the final analysis, fallacious; and a detailed analysis of the glass wall offers a good opportunity to demonstrate the fact. The first proposition, for example, sets up a false conflict between esthetic satisfaction and physical well-being, implying that the two are *always* antithetical in any architectural system. Yet modern physiology and

psychology alike indicate that the two are in reality only opposite sides of the same coin. The esthetic enjoyment of an actual building (as opposed to a mere photograph of it) is not exclusively a matter of vision but of *total sensory perception*. Thus, to be truly satisfactory (that is, to be truly beautiful), a building must meet the demands of all the senses, not just those of vision alone. It is not the eye but the whole man who reacts to architecture.

Yet, even on this purely visual plane, much of our architecture seems to me to display either contempt for or ignorance of, optical reality. Under normal daylight conditions, most glass is as opaque as granite when viewed from the outside. (As a matter of fact, glass is always opaque unless there's more light on the other side of it than on yours. I'm sure all of us know this but we don't always act as though we remember it.) The same glass under the same conditions may prove intolerably bright and glarey when viewed from the inside of the building. At night, conditions are reversed: then, externally viewed, the glass is really transparent, but by the same token, it is opaque from the inside. But this night-time opacity distorts the luminous balance of the room. I think it only fair to say that you see very few modern rooms, at least I see very few modern rooms including the rooms I've designed, which are as satisfactory at night as they are during the day. All these rooms are obviously designed by architects with vision—you couldn't design if you didn't have eyesight; and all of them are based on an optimum set of luminous conditions—a bright June day. Very seldom do we ask ourselves, how is this same wall going to behave at night? These areas, conceived of as being light sources, are now actually jet-black, light-absorbing areas. In real life, in short, glass behaves in a quite complex fashion.

I do not argue that these paradoxes cannot be overcome by good design. I am merely pointing out that they very seldom are. Thus even if architecture were exclusively a matter of vision, a wide range of extremely subtle problems in optics are raised. These can only be solved by a truly functional analysis and their solution will almost certainly dictate all sorts of eyebrows, *soleil-brisé*, curtains and blinds. And these would certainly complicate the architecture of pure geometry. In other words, if you really made this glass wall satisfactory on every level and every plane, you'd have to give up your pure geometry. I have had occasion elsewhere to say that Mies is a great figure, a very great figure. But Mies designs for the climate of Plato's Republic and he builds in Mayor Daley's Chicago: that's the dilemma. Mies is an authentic utopian, an incorruptible majestic utopian. For him there are no flies, no dust, no snow, no wind, no ice, no rain, no hail, no insolation, no ultra violet rays, no infra red radiation—he builds for Plato. A lot of people behind Mies' walls suffer as a result.

The second argument—that modern technology can, single-handedly, compensate for the deficiencies of the glass wall—seems to me even more hazardous. Technology has indeed greatly extended the range of our control over such various environmental phenomena as temperature, humidity, light and sound. But the limits, even here, are real and obdurate. The amount of solar energy or chilling winds which act upon a given building is of a high order of magnitude, even in these days of atomic energy. And it is dangerous nonsense to argue that, with modern airconditioning, the architect can now ignore this fact—dangerous both technically and, if I may say so, philosophically.

Henry Wright has recently shown that “for every 100 square feet of unshaded, unfavorably oriented glass used in a tall building in most parts of the United States, an additional ton of airconditioning must be provided.” Now there may be occasional budgets in which such costs are unimportant, or certain building sites where poor orientation is unavoidable. If you have a commission from the United States Army to build a radar station at the North Pole, it's very unlikely that you would find a favorable orientation, in which case obviously you'd use the whole massive

array of available technology. In such a case, we could have no quarrel with the use of extra airconditioning. But the danger is that we generalize such exceptions to become the rule. For the fact is that most budgets *are* affected by such costs and that there are few planning problems which inexorably dictate poorly-orientated glass.

But the problem goes deeper yet, especially if you look at it from the standpoint of human comfort. Cooling the air behind such glass gets you nowhere. Anyone with a black body thermometer—or, for that matter, an ordinary house cat—can convince himself that the solar energy transmitted by a sheet of glass is primarily radiant. Such heat is not stopped by any combination of blinds or shades inside the glass; nor can it be directly absorbed by any conventional cooling system. Such heat can only be deflected *outside* the glass. Thus, in the final analysis, no optimum solution to this problem is possible by purely mechanical means, no matter what the budget. It can only be solved at the highest level by the proper adaptation of the building to its site, exposure and microclimate; by external shading devices, whether they be trees, vines or *soleil-brisé*; in short, by architectural means. Only when all these means have been employed, can the glass and the cooling system be expected to operate at maximum efficiency.

One of our more imaginative airconditioning engineers has recently complained that many architects “handed him raw space and expected him to make it habitable.” He put his finger on a real and present danger to architecture, our tendency to use technology merely as a means of correcting basic errors of design. There are a few architects left in America who appreciate the proposition that a tree gives shade and the sun gives heat, but that is a proposition that is not very fashionable any more. This tendency, carried to its logical conclusion, leads to nothing less than the architect’s abdication of his historic responsibilities.

We have, fortunately, some recent buildings which demonstrate that this tendency is not universal. One of them is the handsome Fifth Avenue branch of the Manufacturers’ Trust in New York. This steel-and-crystal cage has been justifiably praised by many critics as being a very successful building. But none of them, to my knowledge, has called attention to the central factor which makes it successful—makes it, one might almost say, possible at all. That factor is its orientation. The building not only faces north and east; it is also shaded to the east, south and west by very tall skyscrapers. Obvious and simple though it is, this single fact spells the difference between success and failure for the building. Rotate it so that it faces south and west; remove the sheltering neighbor buildings and this crystal cage would be uninhabitable for a large part of the year, with or without airconditioning. The architects here have acted correctly. They have made fundamental decisions of an architectural nature; and these, in turn, have placed any subsequent use of mechanization in its proper reference frame. Thus, airconditioning in this building is not employed merely to make a bad building habitable but to make good architecture even better. And that, it seems to me, is the true function of technology—the true reference frame in which the architect ought to keep it.

I discuss this question of glass because it indicates in the most poignant fashion the dilemma that we face today. And that is whether we’re going to be the masters of the tools, the instruments, which technology has given us or merely the blind victims. There is no use kidding ourselves, the way we operate today we are as a rule the blind victims, not the masters of technology.

With your permission I should like to carry this discussion of the curtain wall, the glass wall, and the way it’s used on skyscrapers even further. For all our boasted competence, the typical skyscraper today (and this applies not only to Mies’s work but to all our work) is a free-standing monolith whose curtain walls are identical on all its facades. This represents a purely formal response to the facts of climate. The build-

ings are designed as though for an environmental vacuum or—at best—a stable and unchanging set of environmental conditions. In actuality, of course, few climates in the world (and none in the Continental U.S.A.) offer anything approaching this state of affairs. The only place in the world where you would find the kind of climate that all American skyscrapers suggest would be an island climate like Hawaii. Because we're confronted with such a fantastic variety of conditions in the outer world, you would expect our skyscrapers (or at least their curtain walls) to offer a wide variety of treatment for different climates and exposures. In other words, you would expect the western exposure, the western face of the building, to look quite different from the eastern. You would also assume that a skyscraper in Tucson would have quite a different visual impact from one in Bangor, Maine. But of course this doesn't happen at all. You find the same prototype, the same monotype all over the country. If you examine this phenomenon from any point of view, you find that it is only possible in a country like America where energy and material are relatively cheap. Only a country like America can be so profligate with steel, with electric energy, with compressors, with electric motors. Our wealth makes this kind of a thing possible, but it is very difficult to defend this approach either from the standpoint of human comfort or that of mechanical efficiency.

It's very hard, as a matter of fact, to argue any more that ours is moral architecture. In my opinion, the engineer is correct when he says that that column is best which does the most work with the least material. This is a fact not only of structural significance but actually of ethical or moral significance. The way we use the curtain wall and air conditioning denies this principle. We expect it to maintain undeviating criteria—that is, we expect each floor to have an air temperature of 72°, a relative humidity of 50%, and such and such an air movement throughout the enclosed volume of the building. Yet around the periphery of this volume conditions would vary immensely. Thus, on a cold, bright, windy day in December, the north wall—chilled by the wind and untouched by the sun—would have the climate of northern Canada. At the same time, the south wall of the same building—protected from the wind and exposed to the sun—would have a climate like that of South Carolina. On a hot July afternoon, the west wall would have the climate of the Arizona desert while at the same time the east wall would have the climate of Massachusetts. Thus the thermal extremes within which the airconditioning is operating might be more properly expressed in thousands of miles than in tens of feet. The proper way of describing the United Nations Building on an August afternoon would be to say that the west wall is 1830 miles away from the east wall; or that the south wall lies in the latitude of Miami and the north wall in Manitoba. That would be the correct way to dimension the building in terms of thermal fact.

It seems to me that this kind of designing cannot be extended in American architecture if it is ever ultimately to be truly great. Truly great architecture can't be erected on this kind of a premise—no matter how many horse-power you have at your disposal. I'm not arguing against curtain walls, I would certainly be subversive to argue against the skyscraper. But even this problem is susceptible to a much more sophisticated approach. I think we should demand a great deal more of this curtain wall—incomparably more. A technology which can achieve a thermonuclear bomb and put a rocket on the moon could certainly give us a curtain wall which would behave, say, like the epidermis of an animal body. That would be a good criterion for a curtain wall: a building skin which reacted actively and automatically to change in its external environment.

It is not too difficult to imagine such a wall. In the first place, it should have a capillary heating and cooling system built into it, much like the skin of any warm-blooded mammal. The function of these capillaries

would not be actually to heat and cool the interior volumes of the building so much as to provide a thermal symmetry inside which the air conditioning could more effectively operate. A building with such a capillary system would then find its sunny walls cooled with circulating chilled water, even on the coldest winter day, while the solar heat thus picked up would be used by the system to heat the much colder walls on the shaded side of the building. Protected by such a skin from the continuously shifting pattern of external thermal stress, the air conditioning system could much more economically and efficiently maintain a set of stable and uniform conditions. Your design criterion then, would be drawn from biology, not from geometry; and you'd have the opportunity to develop a wall which would work with moderate efficiency and yield the kind of internal conditions which our technology leads us to think we're entitled to.

We can imagine still more efficient and sophisticated building skins than these. For example, in all but polar and sub-polar latitudes, enough solar energy falls upon any free-standing building during the course of the year to power that building, i.e., heat, cool and light it. The problem, of course, is to trap and store that energy against the hour of need. So far, most solar heat and storage devices are very inefficient, or limited to regions of intense insolation, or both. Though many of these devices could be vastly improved, a new contender—the solar battery—offers interesting possibilities. Assuming that their efficiency could be even modestly increased, solar batteries might be imagined as forming the outer membrane of sunny walls; they would then pick up sunlight, convert it directly into electrical energy to power the building, storing any surplus of power in conventional storage batteries. Even this system might prove inadequate, however, for the long sunless periods of cloudy climates like that of Seattle, or high latitudes like that of Manitoba. If men ever master Nature's process of photo-synthesis, we might imagine architectural tissue, built on an analogue of the vegetable, which manufactures starch and then stores this energy in the stable form of alcohol for fuel. A whole range of such possibilities lies theoretically open; by exploiting them intelligently, buildings might be made to approach the animate world in their operational efficiency.

Of course, some technological break-through of a quite higher order may override such developments. For example, if the thermonuclear reaction is finally domesticated, it will supply the energy for a whole new order of environmental control. We can then think of air conditioning the whole island of Manhattan, the whole county of Westchester, the whole Michigan peninsula; with such energies at our disposal we could change the climate of whole regions.

One thing should be apparent from all this: for better or worse, science and technology have forever altered the scope of the architect's task. They have catapulted him into a new and higher order of responsibility. Design has become a matter of manipulating, not raw materials like bricks and 2x4's but entire systems of highly specialized prefabricated elements. Supervision involves not merely masons and carpenters but whole schools of extremely literate specialists. The new architect, in short, must specify environment, not mere materials and equipment. It is he who must establish safety, not fluorescent tubes, as the criterion of good industrial lighting; comfort and health, not copper-finned radiation, as the objective of school heating; intelligibility, not accoustical tile, as the standard of measurement of a good auditorium. If the architect does not assume this crucial responsibility, who will? The engineer cannot be expected to: he does not deal with the whole client, only some specialized part of him.

Does this mean that the architect should "take over" the work of the consulting engineer? Not at all. To begin with, he couldn't: these fields are by now complete disciplines in themselves, with a higher proportion of post-graduate degrees than in architecture itself. In the second place, he shouldn't. Detailed competence in any one speciality could only be

won at the cost of over-all architectural wisdom. What the architect should become is the arbiter of the conflicting demands of these specialists and their systems. Each has his own set of demands and criteria of judgment and—from the very nature of the problem—they will not coincide. These conflicts and contradictions must be resolved at the highest possible level, not merely of appearance (though that too is important), but of total behavior or performance. This implies operational standards; and these can only be derived from the needs of the actual users of the building. The architect, then, must arbitrate not between one machine and another but between all machines and man.

How is architectural education going to reflect these new conditions? What will the schools teach and how will they teach it? As to subject matter, there is little in any curriculum that is actually redundant: most of the subjects are essential to a mastery of the field. In another sense, all curricula are the prisoners of the state licensing boards, since the degree is so strictly tied to the license to practice. So the schools are going to be compelled to stick pretty closely to existing curricula, whether they like it or not. But even with the subject matter fixed, a wide spectrum of approach and emphasis is possible.

Mechanical equipment, for example, should not be taught to architects as it is to mechanical engineers: it should be taught to them in terms of environmental control, not of system design. They should be given a fundamental understanding of the forces that act upon their buildings, of how the buildings manipulate these forces and—most importantly—of how their clients inside these buildings are affected by this manipulation. To demonstrate this new approach, we need more than new textbooks; we need a new kind of laboratory-classroom whose physical characteristics can be altered around the class itself, while the class is in session. This would permit more than a merely verbal exploration of the umbilical connection between esthetics and function, between “beauty” and well-being (or “ugliness” and discomfort). With such a laboratory at our disposal we could show the student that our total response to architecture is a function of the total organism. We could introduce a little hydrogen sulphide into the airconditioning system; raise the noise level from 30 to 200 decibels; drop the temperature from a nice 68° above to a difficult 8° below; in short, manipulate all these environmental forces to show the connection between physical status and esthetic response. Then we could demonstrate to the student that problems of beauty in architecture depend on more than purely visual phenomena and cannot be separated from the whole matrix of physical experience.

Another subject which could stand radical revision in emphasis at the undergraduate level is that of architectural history. It is unnecessary here to stress its importance—in the last analysis, the greatest resource of the human race is the record of its accumulated experience. But it is necessary to point out that few students in our schools will ever become full-time professional historians. For maximum utility to the young architect, it seems to me that history should emphasize concept, not chronology. For example, it should show him how much he can learn from the primitive building, the folk architecture, of the world. An architectural history of *this* sort would show him that an Eskimo igloo is, conceptually, anything but a “primitive” structure. It would show him that, when examined at even the most clinical level, the igloo is revealed as a first-rate piece of functional design: it would be hard to conceive of a formula better adapted to resisting the impact of the Arctic climate, on the one hand, while providing for human comfort on the other. This ability to live in the far north is a matter of more than esoteric interest to the American armed forces today. Yet, so far as I am aware, military technicians have made no use of native experience. No one suggests that the American army be housed in iced domes—what is significant here is the general principle of Eskimo building, not its specific results. History could illumi-

Art should manifest itself under any conditions.

STUART WILSON

nate such areas for the young architect, acting like a Geiger counter in exposing the wealth of distilled experience in the architecture of the past.

Architectural history should similarly show him that when the Indians of the American Southwest seized upon mass mud masonry as the way to build, they selected the wall with precisely the right thermal characteristics for a desert climate with its immense diurnal fluctuations—i.e., intense daytime heat alternating with cold nights. No graduate physicist, researching thermal insulation for Johns-Manville, could do a better job of analysis than the Navajo builder. Adobe and terre pisé gave him walls with high heat capacity—walls which absorbed an immense amount of daytime heat and then reradiated it slowly into the interior at night. Sweet's Catalog defines the problem no better today. Obviously, you cannot build a 20-story skyscraper out of terre pisé: but against a Phoenix, Arizona, sun you could not do better than measure modern insulation materials against it.

History should teach the young American architect to live with his own immediate past. One of our richest regional architectures, for example, lies in the deposit of Eighteenth Century buildings in and around New Orleans. It has been fairly well explored and documented by historian and antiquarian alike; and many an important building has been preserved, in either records or reality, because of their efforts. Yet the significance of these buildings for contemporary student and practitioner alike goes largely unremarked. Several years ago, while directing the Climate Control Program of *House Beautiful* magazine, I had the good fortune to work with the climatologist and geographer Paul Siple. We gave him the task of analyzing fifteen American climates (of which the Gulf Coast was one) from the standpoint of human comfort. On the basis of this, he wrote a series of "climatic specifications"—that is, performance specifications for a house for each region.

Without his being aware of it, Dr. Siple's Gulf Coast specifications exactly described the 18th Century Louisiana plantation house. He said that the ideal Louisiana house should have elevated living floors, for maximum exposure to prevailing breezes as well as protection against pests and floods. He said that the house should have a huge parasol-type roof, light in mass and well ventilated, to shed sub-tropic sun and rain; and that the building should be surrounded by continuous porches or galleries to protect the walls from slanting sun and driving rain. These overhangs, moreover, would permit windows to remain open for maximum ventilation just when heat and humidity would normally be at their most oppressive. He said that doors and windows should be large and openable from floor to ceiling for maximum ventilation; that walls should be white or light-colored for maximum heat reflection; that masonry materials would be desirable for resistance to rust, fungus and insect attack. In short, using the most advanced tools of modern research, the climatologist merely confirmed the findings of all those anonymous builders who had only intelligence to guide them.

The characteristic features of this architecture show a deep understanding of the local relationship between climate and comfort and a most intelligent use of a limited range of simple materials and technique to manipulate this relationship. Neither the climate nor the people of this region are much changed today, a century and a half after the Louisiana Purchase brought an abrupt end to this particular architectural idiom. There has been a lot of subsequent invention, both social and technical. But to what sort of use has it been put in the New Orleans - Gulf Coast region? Can we honestly say that the level of contemporary architecture there measures up to its historic precedent? Unfortunately, we cannot. Instead, we find a qualitative deterioration in standards. The antiquarians mimic the *forms* of the past, with no real comprehension of their content and function. The younger men display a hostility to the parasol roof and the wide overhang, the balcony and the jalousie little short of psy-

chotic. And the average level of domestic architecture is lower in grace and amenity than it was in Napoleon's day.

It is currently argued that modern technology has made obsolete the principles on which this earlier idiom was based. But this is patently untrue: the Louisiana sun shines with undiminished ferocity and a moment with a slide rule should convince any architect that an air conditioning system requires a cool roof and shaded walls even more urgently than he does. Such a vulgar underestimation of the value of tradition and overestimation of the powers of technology is exactly what explains so many current American failures.

The curricula of our schools should be revised to reduce this kind of failure in the future—revised so as to help the student overcome the dreadful discrepancy between theory and practice, between visual appearance and multi-dimensional reality. It will not be an easy task. An authentic mastery of the new technology is bound to alter the appearance as well as the performance of our buildings. The areas in which a highly individual personal taste can freely operate will undoubtedly be circumscribed. Circumscribed not merely by structural necessity—that has always been the case—but by our vastly increased knowledge of man's physiological and psychological requirements, as well as by the new technological means he employs to meet them. This in truth will demand a new order of esthetic competency.

Education is synthetic experience. Design can be based on this synthetic experience, or it can be based on direct experience. The primitive bow, developed by direct experience, that is, generations of trial and error, is an elegant *structure of minimal material*. It is also an aesthetically satisfying artifact. The natural order in the landscape is also responsive to the requirements of both construction and structure. A tree, for instance, takes its form on one hand from the organization of its cells and on the other hand from the forces applied to it. On simplest terms, each branch gets progressively thicker as it becomes longer and has more load applied to it. Such principles establish the order of the natural environment.

I will suggest two propositions for technical training. First, *it is the purpose of the technical courses to identify the technological forces that order architectural design*. These courses are, therefore, concerned with the study of the philosophy of architecture. Two principle conditions for aesthetic pleasure in architecture are the clearly stated resolution of the natural forces acting on the building, and the clearly stated expression of the demands of construction dictated by materials and technology.

(Parenthetically, some would contend that an emphasis on techniques can dehumanize architecture. But all art involves communication and artists and laymen can communicate only on the basis of mutually shared experiences. Every layman understands the forces of nature. He experiments with these forces each time he takes a step, picks up a rock, or fans his brow. It follows that an architecture based on an understanding of natural forces will be an architecture to which human beings can respond. In short, it will be a humanistic architecture.)

Second, in determining where the emphasis in the technical courses should lie, decisions should be based always on the proposition that the techniques we teach our students will be out of date before they have an opportunity to use them. If for no other reason, *we should concentrate on principles rather than technique*. Mathematics and physics are fundamental to an understanding of natural forces and should be emphasized. In the study of structures the emphasis should be on Statics, Strength of Materials and Analysis, rather than on design. In the study of mechanical equipment the emphasis should be on the principles of thermodynamics

A MANIFESTO

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If you waste time teaching specs and working drawings you are criminally negligent.

DONALD BARTHELME