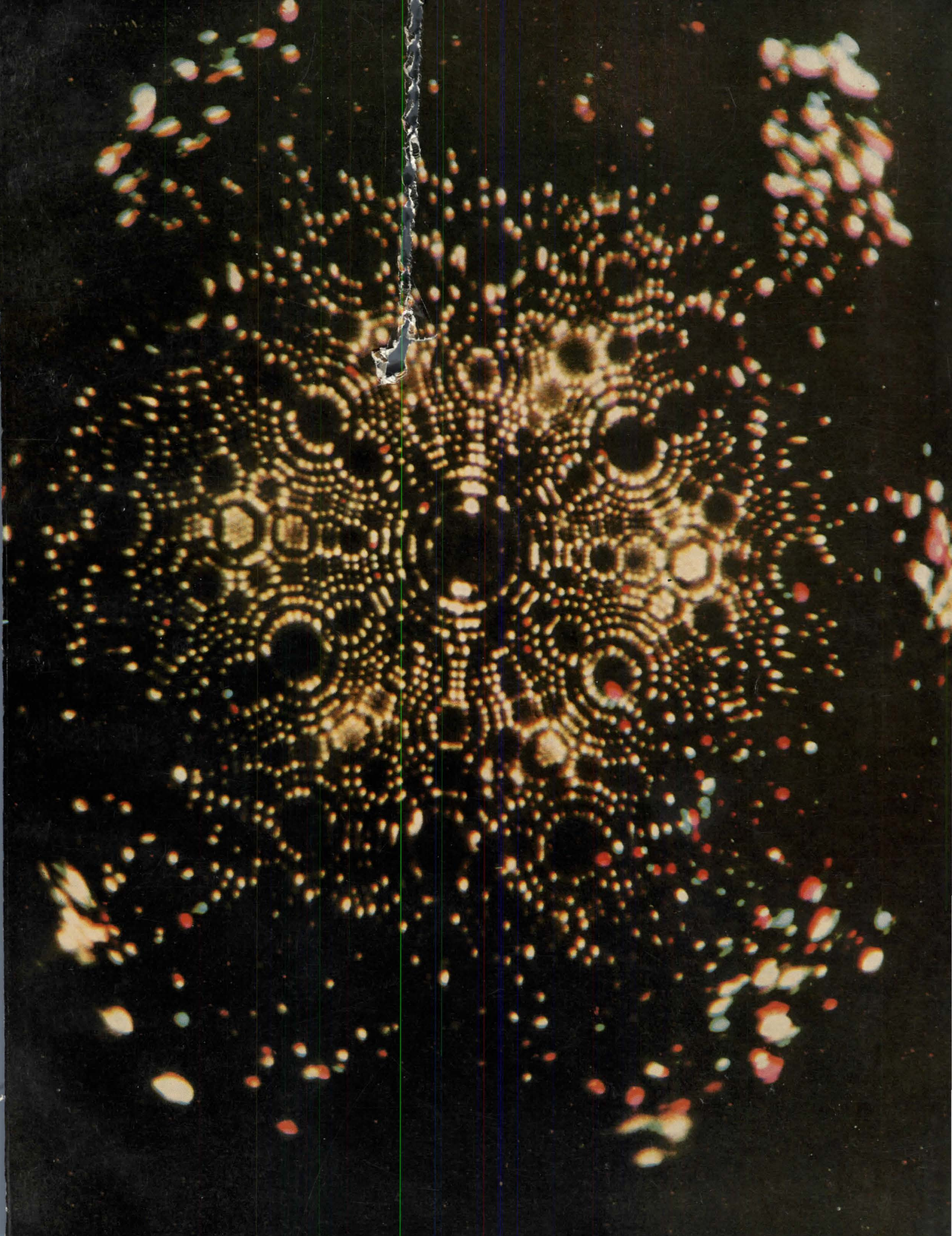
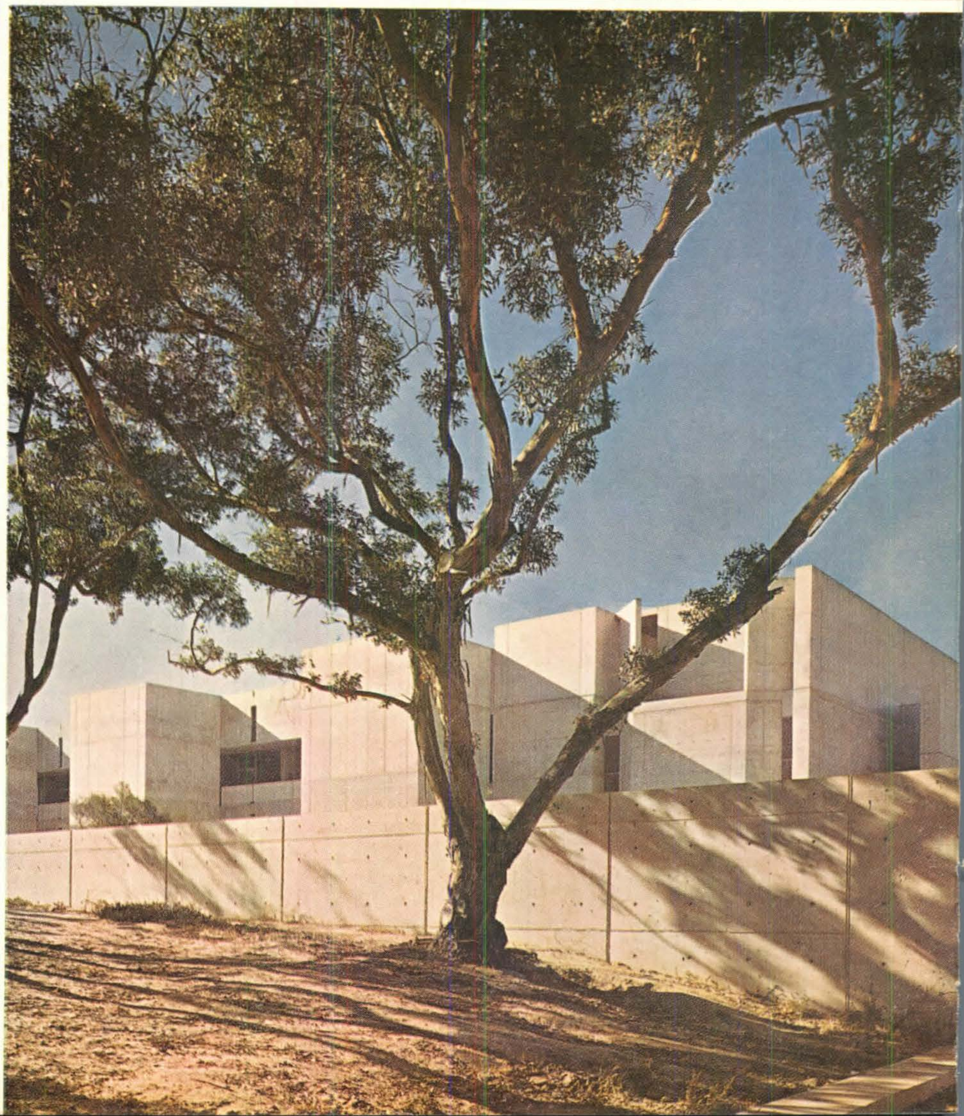
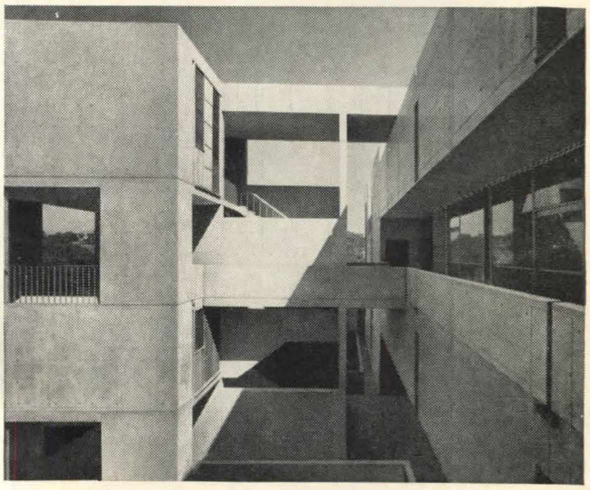
PROGRESSIVE ARCHITECTURE December 1966





Armstrong offers the widest variety of resilient floors. The best one is the one that suits your design.

Salk Institute for Biological Studies, Torrey Pines, California. **Architect:** Louis I. Kahn, Philadelphia, Pa. **General Contractor:** George A. Fuller and Company, Los Angeles. **Flooring Contractor:** D. M. Hoover Company, El Monte, California.



At the new Salk Institute for Biological Studies, the best floor is Tessera Vinyl Corlon.

Architect Louis I. Kahn needed a combination of properties in the floors at the Salk Institute. The project required a top-quality floor that would be good-looking, durable, yet economical. In addition, virtual clean-room conditions underfoot also were required.

The preference was Tessera Vinyl Corlon by Armstrong. It has a handsome mosaic design of vinyl cubes that met esthetic requirements. A heavy gauge, .090″, sheet vinyl floor, it could be counted on to give many years of service. And long 6′-wide rolls of Tessera meant installation with a minimum of seams. What seams there were could be sealed, making it impossible for dirt to collect anywhere in the floor.

The problem was fitting premium-grade Tessera Corlon and its installation costs to the budget. The new Armstrong Perimiflor Installation System provided the solution.

The Perimiflor Installation System drastically cuts labor time and costs over conventional installation techniques. With this method, adhesive is applied around only the perimeter of each floor area and where seams fall. At the Salk Institute, the Perimiflor System allowed the use of 6,000 yards of premium Tessera Corlon instead of a less desirable flooring material.

Because Armstrong offers the widest variety of resilient floors, your Armstrong Architect-Builder-Contractor Representative can make an objective recommendation on the floors best suited to your design. For information on any Armstrong floor, call your Armstrong representative, or write Armstrong, 312 Watson St., Lancaster, Pa. 17604.

SPECDATA, TESSERA VINYL CORLON. **Design:** colored vinyl chips inlaid in translucent vinyl all the way to the backing. **Type and gauge:** sheet material, 6 feet wide up to 90 feet long; .090″ gauge. **Performance:** excellent durability, ease of maintenance, resistance to heel damage; superior grease, stain, and chemical resistance. Has moisture-resistant Hydrocord backing. **Installation:** above, on, or below grade. Suitable for installation with Armstrong Perimiflor Installation System. **Load limit:** 100 lb. per sq. in. bearing surface.

FLOORS BY **Armstrong**

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THIS MONTH IN P/A

Progressive Architecture® December 1966

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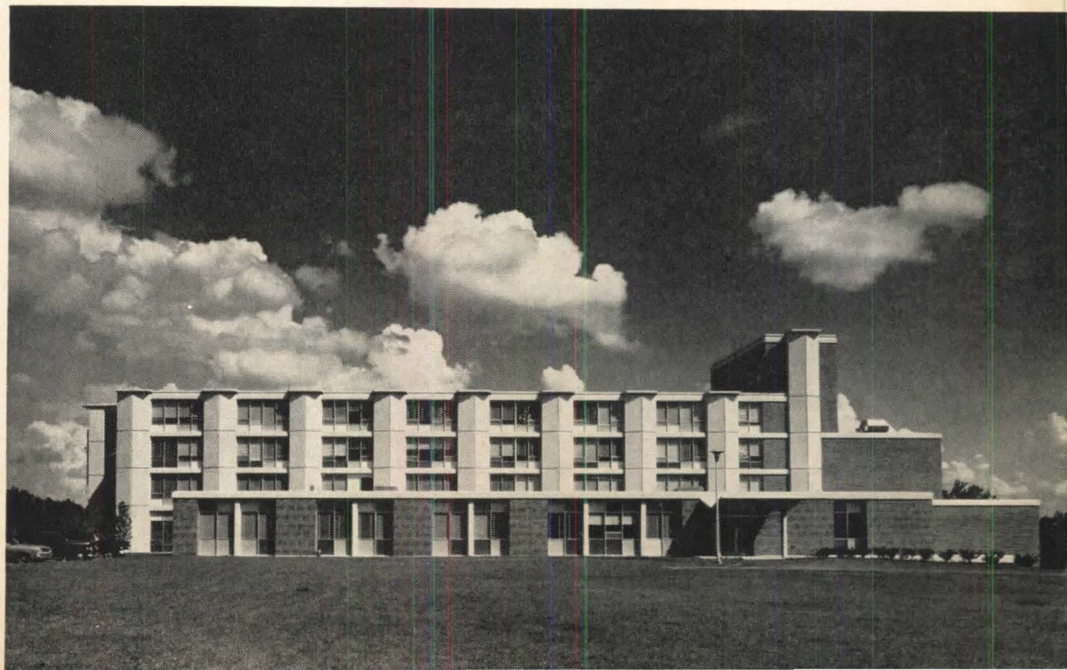
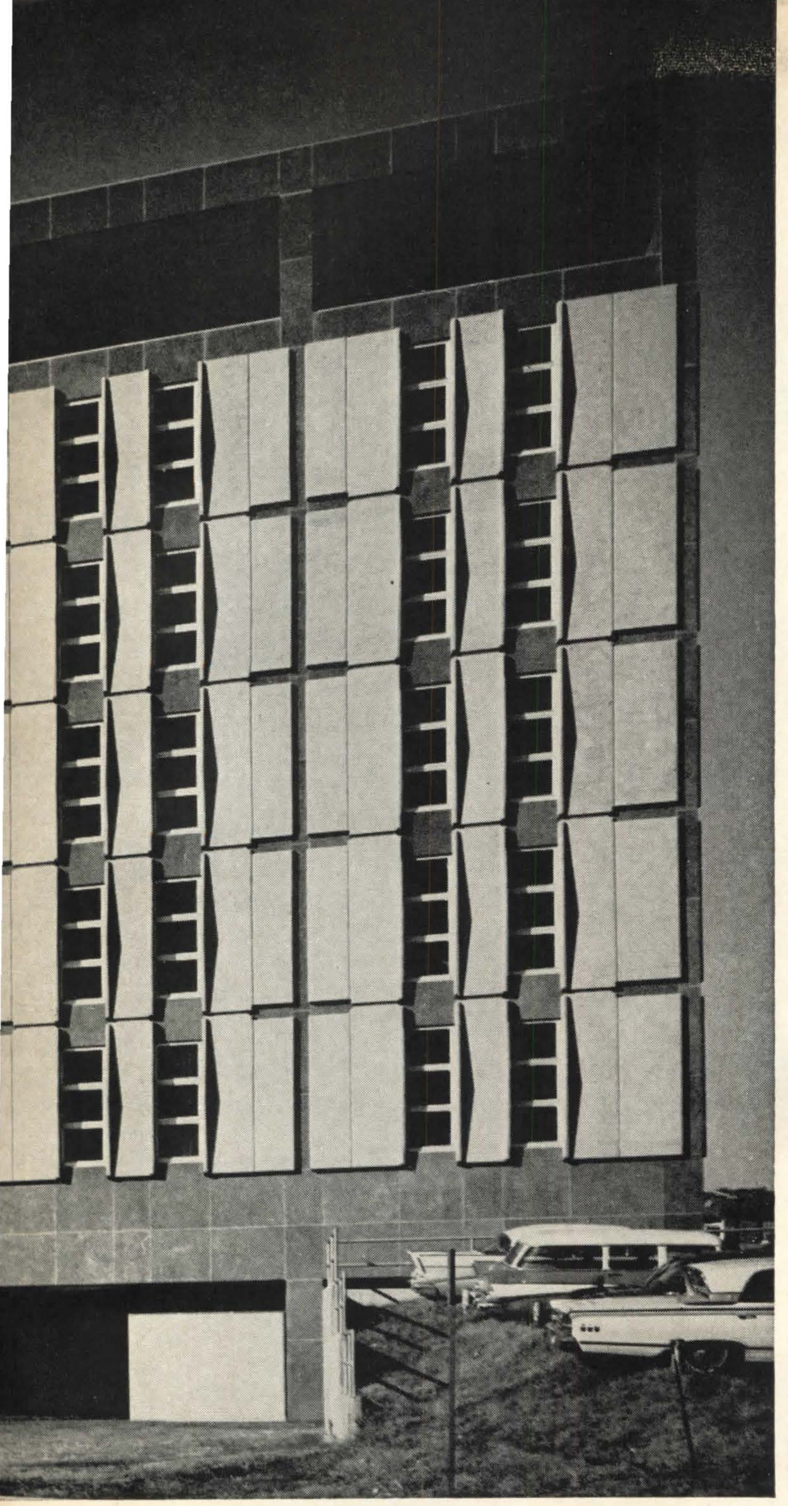
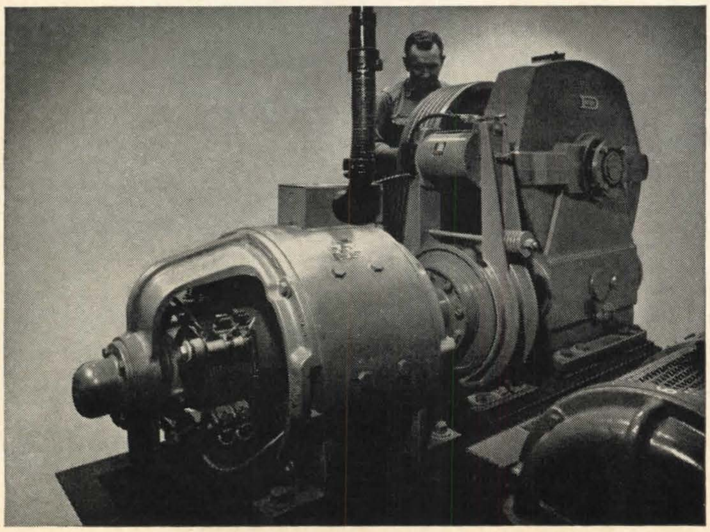
 INDEXED IN ART INDEX, ARCHITECTURAL INDEX, SECOND-CLASS POSTAGE PAID AT NEW YORK, N.Y. VOLUME XLVII, NO. 12.

ABOVE: William F. Bowld Hospital and Dobbs Research Institute, Memphis, Tenn. *Architects:* Eason Anthony McKinnie and Cox, Memphis. *General Contractor:* J. A. Jones Construction Co. Four Dover Geared Elevators, 4000 lbs. capacity, 350 FPM; installed by Dover Elevator Company.

RIGHT: Holy Family Hospital, Atlanta, Ga. *Architects:* Aeck Associates, Inc. *General Contractor:* Beers Construction Co. One Dover Geared Elevator, 4000 lbs. capacity, 350 FPM; one Dover Oildraulic Elevator, 4000 lbs. capacity, 200 FPM; installed by Dover Elevator Company.







VIEWS

More Creativity, Less Fear and Guilt

Dear Editor: I heartily join the editors of P/A in putting down Mrs. Sibyl Moholy-Nagy (VIEWS, OCTOBER 1966 P/A). To say that fear and guilt are "natural restraints" is to praise the sterile architectural monstrosities that surround us, and to applaud the moribund and inhuman conditions of our cities, for these are surely the products of minds ridden by fear and guilt.

It seems to me that the degree of one's creativity is dependent on the amount of fear and guilt one has eliminated.

DONALD DIXON
New York, N. Y.

Memo from Bethlehem Steel

Dear Editor: We read with interest your article on the Chicago Civic Center in the OCTOBER 1966 P/A.

However, we came across an error on p. 247. It is in reference to the material used in the window frame sections for the building.

The actual material utilized in the Chicago Civic Center's special window sections is Bethlehem Steel Corporation's Mayari R weathering steel.

It was Bethlehem Steel's roll designers who worked to the architect's specifications in designing the special bar section for this project.

M. D. POST
Manager of Press Relations
Bethlehem Steel Corporation
Bethlehem, Pa.

[*Information for the article was taken from the architects' description, which named Cor-Ten. This is perhaps becoming a case where the industry should agree on a brief general term for an increasingly used product in order to eliminate such confusion*—ED.]

Antonin Nechodoma

Dear Editor: I am both delighted and somewhat bewildered by your recent article on the Puerto Rican work of Antonin Nechodoma (SEPTEMBER 1966 P/A). To be able to come across a fascinating and neglected figure such as Nechodoma is a delightful and rewarding experience. That this architect produced a number of buildings that entail a strangely mixed potpourri of ideas is all too evident—even in the limited number of photos you show. It should be noted, though, that the houses you illustrate do not in any way show any direct influence of Louis Sullivan, either in the basic form of the building or in the ornament itself. All the houses you illustrate are, of course, basically Wrightian (a mixed salad of the Dana House of 1903, the Thomas House of 1901, and several others). The only other direct influence, which is certainly apparent in these houses, was derived from the published work of William Gray Purcell and George Grant Elmslie. Nechodoma was much more catholic in his taste than your selection would indicate. He borrowed equally from the brothers Charles and Henry Greene, producing a number of quite creditable California bungalows, including his own house at San Juan, Puerto Rico, while other work mirrored the designs of Irving Gill of San Diego and George Maher of Chicago. Nechodoma's work was reasonably well published and his name was known to the members of the Prairie School. Enough has actually been published about his work, so that with a little diligent research it should be possible to form a reasonable picture of his work.

What I find bewildering about your article is not only what has been left out about Nechodoma and his work, but even more the errors in fact that you manage to cram into a few brief paragraphs. I assume, for example, that by the name William Gray you mean William Gray Purcell, and by George Elsie you mean George Grant Elmslie? When by accident I first came across an example of Nechodoma's work in 1953, I asked the late William Gray Purcell what he knew about him. He was familiar with Nechodoma's work through publications, but he never recalled having met him, nor was he aware that he had ever worked for any of the Prairie Architects in and around Chicago. Certainly Nechodoma never worked for Purcell, nor had he worked in the Sullivan office under Elmslie's direction (1894-1909). Much of the chronology you mention in your article is at best confusing. It is possible that Nechodoma was in Chicago in 1908, but if he was, this was *after* he started designing and building in Puerto Rico and after he had built several Prairie-like houses. Whether the architect acquired his knowledge of the Prairie houses, the California bungalows, and Gill's version of the Mission House through direct contact or indirectly through publication is still unknown, but these and the other facts could be established with a minimal amount of effect. Since P/A has had a tradition of presenting serious, well-written articles devoted to architectural history (those of Leonard Eaton come to mind immediately), it is even more difficult to understand how such an amateurish, inaccurate article such as this could be published.

DAVID GEBHARD
University of California
Santa Barbara, Calif.

[*The article was not meant as a serious dissertation on the work of Antonin Nechodoma, but a quick glimpse at what appears to be worthy of a further and more thorough study. In spite of Mr. Gebhard's claim that, with "a little diligent research," one could find out all about Nechodoma's work, the picture is much more complex. P/A's research, diligent or not, revealed lack of information and contradictory statements. For instance, Puerto Rican architect Thomas Marvel, who is making a study of Nechodoma, wrote P/A: "Nechodoma's having worked with Frank Lloyd Wright has been documented by his daughter-in-law only. Try as I have, I have not been able to find any record of Nechodoma in Chicago, except for that which people have told me." Yet we found a San Juan Star Magazine article by Ricard Fisher, which stated: "In 1905, American Institute of Architects records show him practicing in Chicago." So let others straighten out the story. We merely opened the box. As to "William Gray" and "George Elsie," we do not know what happened, except that it appears there must have been lots of gremlins in P/A's offices when the article was being processed.*—ED.]

Dear Editor: It was with great pleasure that we read your brief but interesting photo essay, "The Prairie School in Puerto Rico." The work of Antonin Nechodoma has long been of great interest to scholars interested in the Prairie School of architecture. We are planning to devote an entire issue of *The Prairie School Review* to Nechodoma's work sometime in the near future.

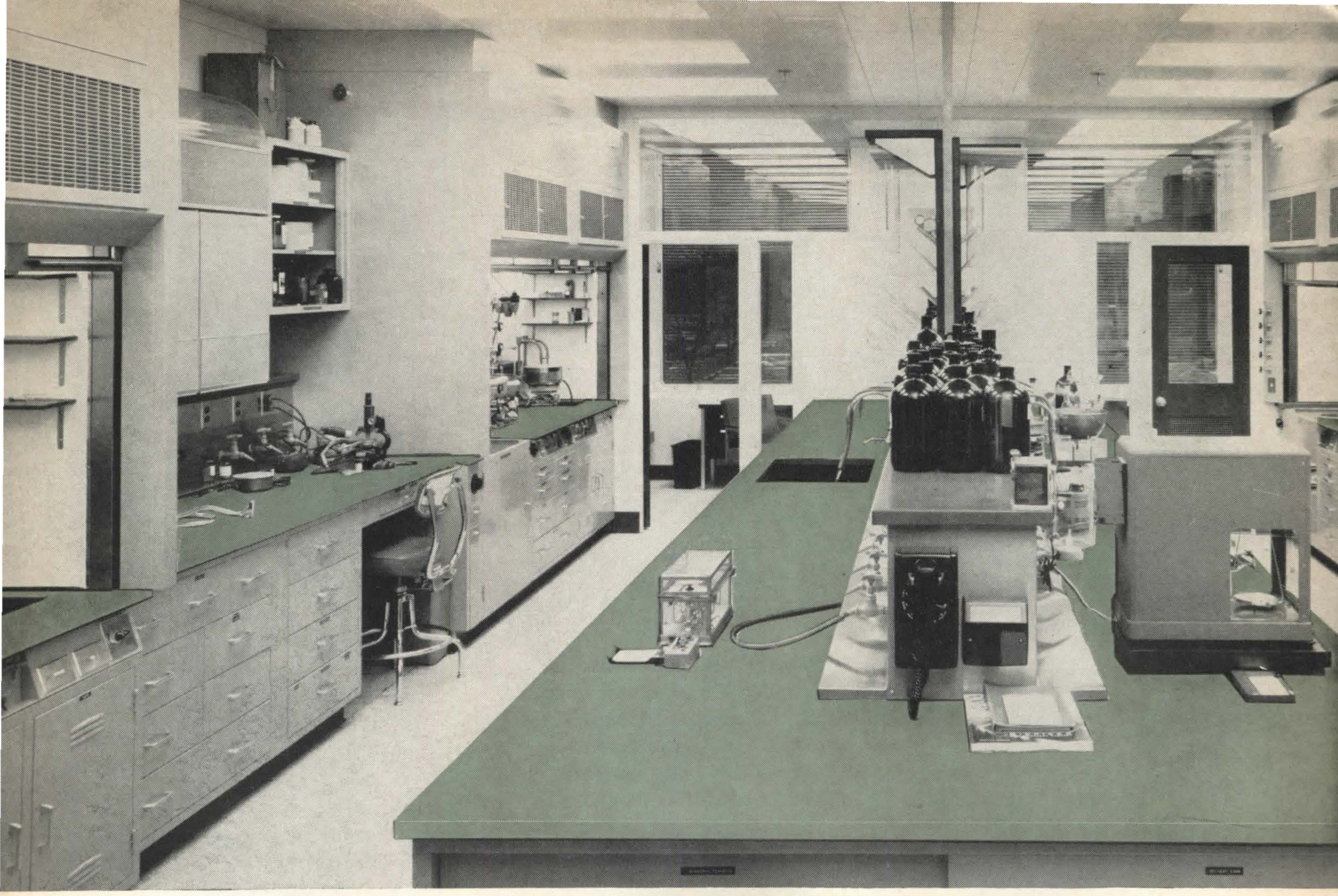
We would appreciate hearing from any of P/A's readers who may have additional information concerning this most interesting man and his work.

P/A is to be congratulated on maintaining its continued editorial excellence. The history of architecture must, of course, be included in any magazine devoted to the contemporary scene.

W. R. HASBROUCK,
Editor, "The Prairie School Review"
Park Forest, Ill.

Another Modest Proposal

Dear Editor: I have read with much amusement your magazine's "Modest Proposals" for improvement of various important places (P/A OBSERVER, SEPTEMBER 1966 P/A). But your inventive Senior Editor has been one-upped by a young man from Chicago, Ill., who proposes to place a library museum on the



cliff above the ruins of Mesa Verde. Only this fellow is not kidding. For his efforts, he has been awarded the Le Brun Travelling Fellowship for promising architectural students by the New York Chapter, AIA.

Perhaps next year the Travelling Fellowship can be given by the AIA to enable a student to go to Athens to design a second story for the Parthenon to house a Museum of Ancient Greek Architecture. At least he will have a rationale for his design. He can unify the Acropolis with the Hilton Hotel nearby.

BARRIE GREENBIE
Madison, Wis.

Architects' Offices: Pretty?

Dear Editor: The SEPTEMBER 1966 P/A provided a behind-the-scenes look at architects' offices. As an outsider to the profession, the view isn't pretty, and the cheapness of the offices is cause for alarm. Is it really true that men trained to provide intelligent, creative comforts for others would use slabs of plywood on wooden horses as drawing tables?

With the high cost of professional talent, is it an inverted status symbol *not* to use drafting machines or any ergonomic adjustments on the tables?

Sorry, P/A, but your people are not progressive. Cute Japanese lanterns and bent wood chairs do not an architect's office make, but instead, indicate a gross lack of real world human engineering understanding.

Aren't your people being trained in office management, or the economics of proper tools to do a proper job? It's one thing to read articles by architects who strike poses of grandeur about space, time, and motion, and then design all-glass houses to be built in the deserts.

And it's sad to contemplate that, if they can't be rational in their own offices, what are they going to do with their clients' projects?

MARK. K. WALLACH
Grand Rapids, Mich.

South American Architecture

Dear Editor: Your article on South America was interesting to read and in some respects very penetrating (SEPTEMBER 1966 P/A). The desire on the part of architects and town planners to face problems realistically is new and noteworthy, but very frustrating in face of the existing economic and social unbalance. Architecture especially can only be expected to reflect the great difference between the rich and poor, and, as you mention in your article, this is always something that irritates and confounds Americans, and everyone else who travels there, but it cannot be otherwise unless the structure of society changes fundamentally.

JOSE A. OBREGON
Barcelona, Spain

Surprised

Dear Editor: I have been a P/A subscriber for several years and I consider the magazine a leader in presenting original architectural solutions.

For that reason, I was very surprised, while looking through the AUGUST 1966 P/A, to find (on p. 175) that the roof of the Library Institute for Advanced Study, Princeton, N.J., by the well-known firm Harrison & Abramovitz, is an imitation of a roof solution I devised for "El Centro de Estudios Hidrograficos" de Madrid, in July, 1960.

MIGUEL FISAC
Madrid, Spain

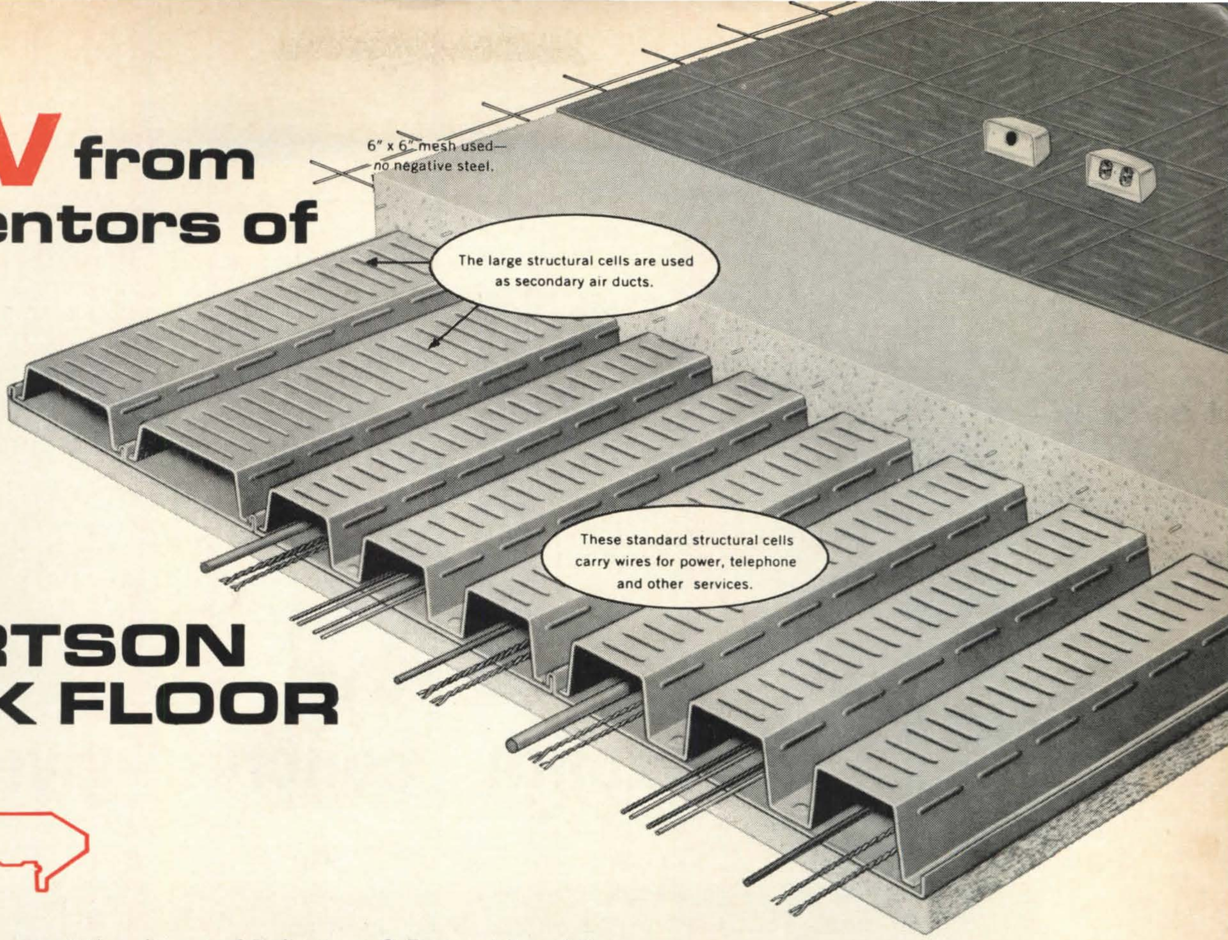
Reston Reconsidered

Dear Editor: Rereading your review of the Village Center after having visited Reston, Va., I appreciate your article (MAY 1966 P/A) as a timely, early critique, but lacking both breadth of outlook and depth of insight.

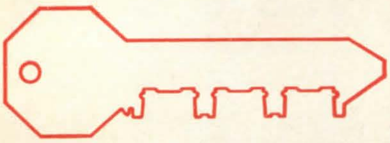
I mean this quite literally: By taking a broader look (a few hundred feet west

Continued on page 16

NEW from the inventors of cellular steel floor



ROBERTSON Q-LOCK FLOOR

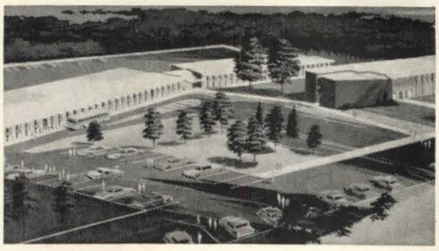


New Q-Lock Floor possesses all the virtues of Robertson Q-Floor while adding some new ones of its own. When concrete is poured over Q-Lock Floor, the scientifically-designed indentations and embossments rolled into the steel structural elements develop composite action. Therefore, this new design locks together the structural properties of both materials in a tight grip and results in a more efficient and economical use of both materials. Use the coupon or write to Robertson on your letterhead for literature.

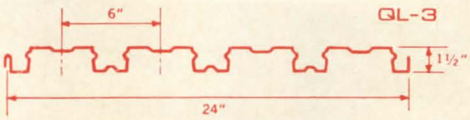
RECENT Q-LOCK INSTALLATIONS

Crocker-Citizens National Bank, Los Angeles, Calif. William L. Pereira, Architect; Brandon & Johnson Assoc., structural engineers; William Simpson Construction Co. and Dinwiddie Construction Co., general contractors.

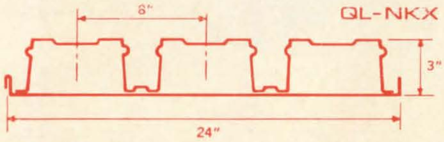
Atlanta Gas Light Tower, Atlanta, Ga. Edwards & Portman, Architects; J. A. Jones, Construction Co., general contractor.



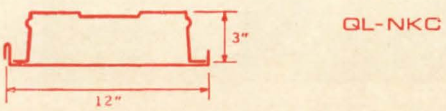
Vocational School, Springfield, Ohio. John L. Kline, architect and structural engineer; Fry, Inc., general contractor.



This is a highly economical deck where long spans are not necessary. Can be used with studs weldable through deck as a part of composite frame construction with further economies (often a reduction of 1 pound/sq. ft. in framing of structure of building).



With the welded bottom plate this style provides electrical raceways.



This wide structural unit (used in pairs) also functions as a secondary duct for air conditioning.

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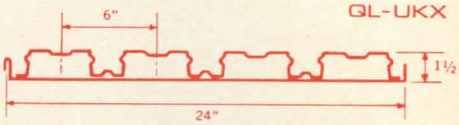
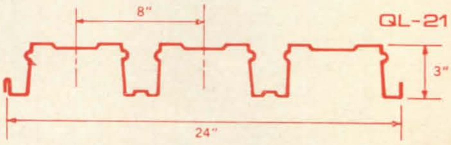


This type is similar to QL-3 except that the flat bottom section gives it greater span capacity. It can be used electrically.



This is a heavy-duty deck which will take considerable load when working in combination with concrete.

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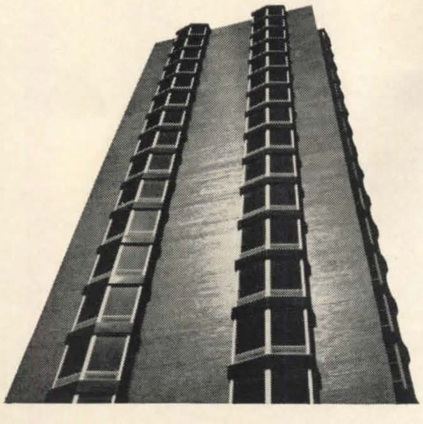
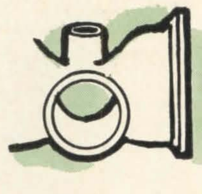
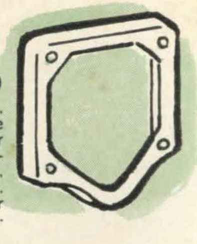


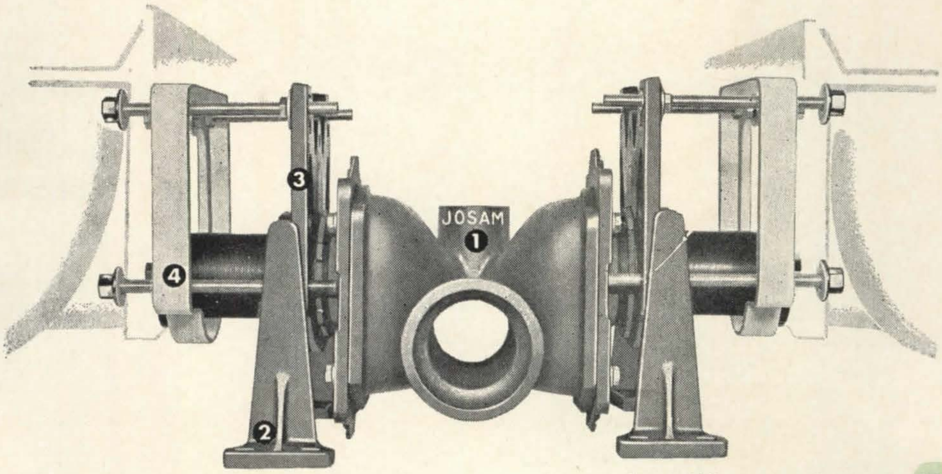
WHAT MAKES AN OFF-THE-FLOOR INSTALLATION COST LESS?



common vent (1)
Saves chase space . . . substantially reduces the number of connections required in a battery of toilets

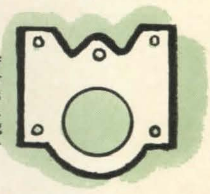


positioning frame (4)
Simplifies alignment... Saves one or more hours of labor per bowl* . . . saves fixture breakage . . . saves call-backs . . . acts as template for wall finish, saving tile-setting time.



buttress foot (2)
Short Bulldog feet do not interfere with any type of finished floor . . . saves installation time

fitting and carrier are separate
provide more adaptability to meet changing conditions of installation . . . save revision time and labor



invertible carrier body (3)
Fits all types of toilets, blow-out or syphon jet . . . saves handling time . . . eliminates stocking and ordering of different carriers.

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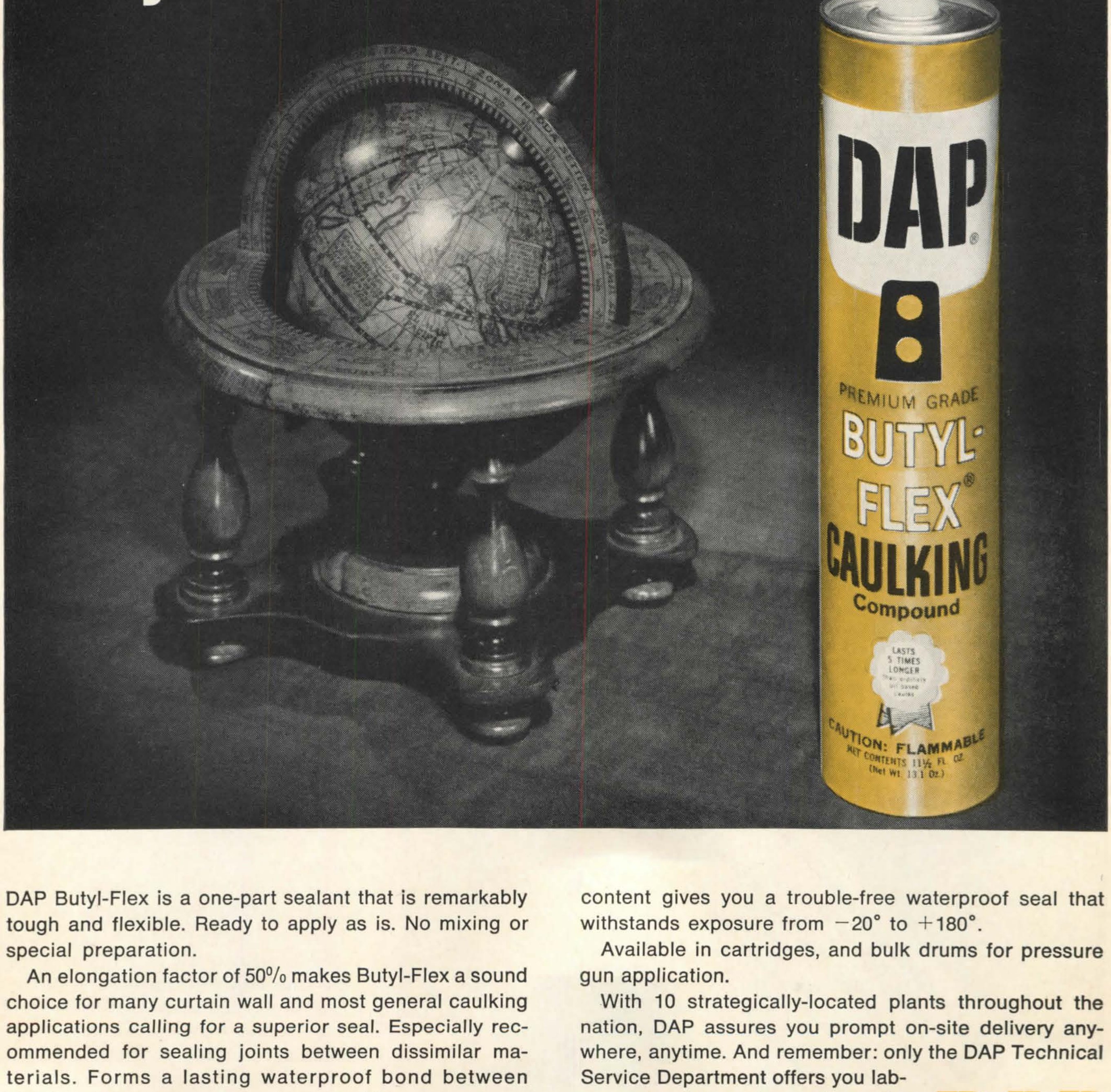

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Continued from page 8

of the Center), one discovers the tennis courts tucked awkwardly among townhouses, and the swimming pool and deck perched uneasily on a hillside. Obviously intended to be part of a full complex of leisure activities at the Center, they are difficult to locate or recognize as central functions, and are not integrally expressed as central design elements.

Poor coordination of large elements such as this is more significant and disturbing than the poor coordination of scale or detail treatment that concerned your reviewer. And it gives the lie to the criticism that the Village is overplanned. Indeed, much of Reston seems to contain a normal share of unplanned elements, including—aside from the above—uneven building groupings, miscellaneous signs, awkward street alignments and intersections—and unplanned potholes. The planning and design that *is* exhibited in the Village Center is, in my view, of a high order, achieving coordination, together with a sense of spontaniety. It is, to be sure, a carefully calculated spontaniety, yet the real test may be not an early judgement, but how well this degree of controlled design wears upon its residents over the years.

The overplaying of the lake as a focal point disturbs your reviewer; but again, shifting to a broader outlook, other activities come into view and the lake is recognized as simply one among several facilities of the entire Center. For comparison, look at Joppatown, northeast of Baltimore, where the larger waterways, ample-size docks and bulkheads are scaled to serious large-craft boating, and a more genuinely contemporary nautical style begins to emerge.

A wide range of leisure activity *is* present, and reaches many age and interest ranges. But *should* leisure activity be taken so positively as a focus for community spirit and town planning? Is leisure activity and its facilities the most suitable medium for expression of the community? Perhaps a richer expression of both community and architecture could come from incorporating many more elements—work, education, entertainment—in the central complex. These are the tantalizing questions of *meaning of design*, which your article appears to ask by implication, but quickly by-passes. Would not this deeper question of the leisure-centered life as a basis for community sense, and its architectural expression, provide a topic for an article?

STEPHEN W. OSBORN
Senior City Planner
City Plan Commission
City of Detroit
Detroit, Mich.

tomor

row?

Most of the problems that this futuristic office design solves are here today. Most of the solutions could be. Work stations with all important elements built in. Televised information retrieval. Hideaway seating. Modular floors with rise-up storage and refreshment units. And a unique ceiling system—precisely tailored to the functional requirements of the room below, yet flexible enough to permit almost instant rearrangement. ■ Fact is, that ceiling *is* here: the C-60 Luminaire Ceiling System by Armstrong. And there's a lot more to it than virtually limitless layout possibilities. Or boldly original appearance. ■ Because Luminaire combines lighting, air distribution, acoustical control, and rated fire protection in one easy-to-install system, it can save up to 60¢ a square foot over the cost of installing separate systems. ■ Efficiency? Luminaire stands out again—providing unusually uniform, draft-free air distribution (at rates anywhere from 1-5 cfm per sq. ft.) . . . lighting to desired levels (anywhere from 5 to well over 200 fc) using fewer lamps and less wattage than a conventional system . . . providing superior acoustical control. ■ Fact is, Luminaire is already hard at work in hundreds of installations coast to coast. Helping to create dramatic, uniformly comfortable environments. Adding unusual flexibility. Saving money. ■ Like to see some specific examples? Installation illustrations, application-engineering data, and guide specifications are yours for the writing. Address: Armstrong, 4212 Watson St., Lancaster, Pennsylvania 17604. Or circle No. 300 on Readers' Service Card.

LUMINAIRE CEILING SYSTEMS BY

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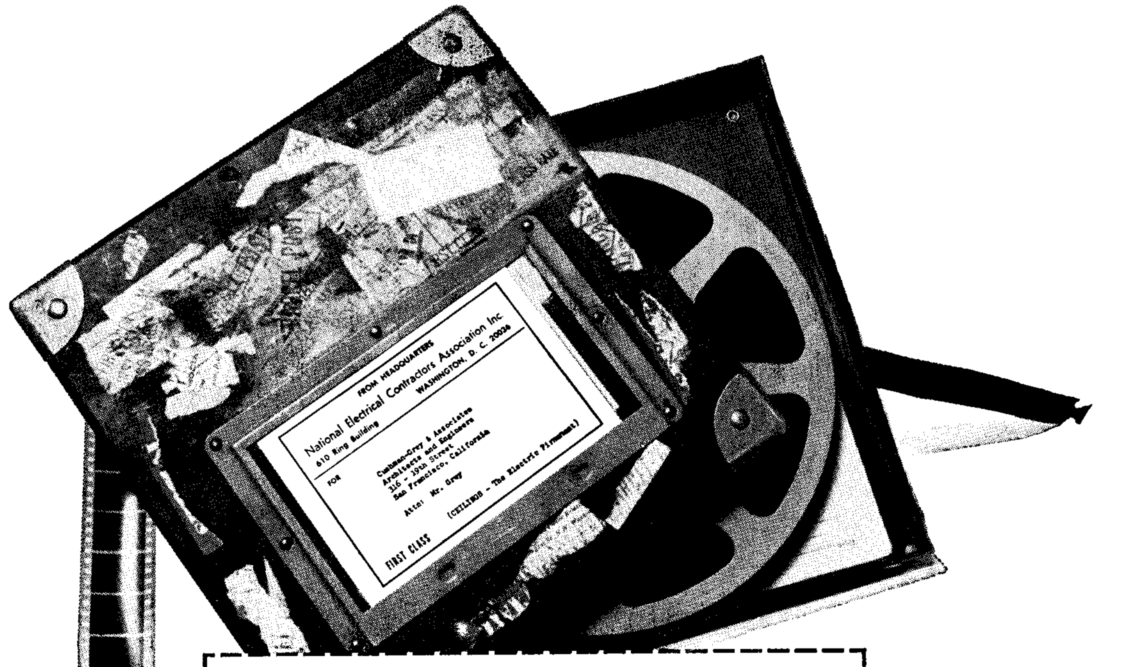

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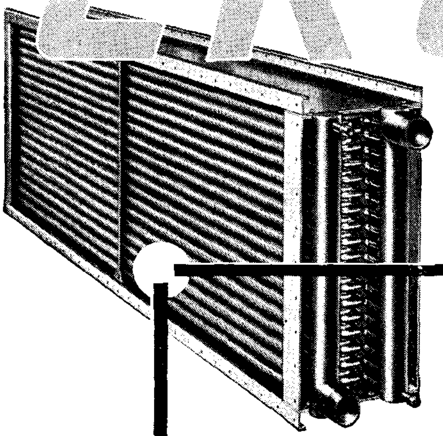

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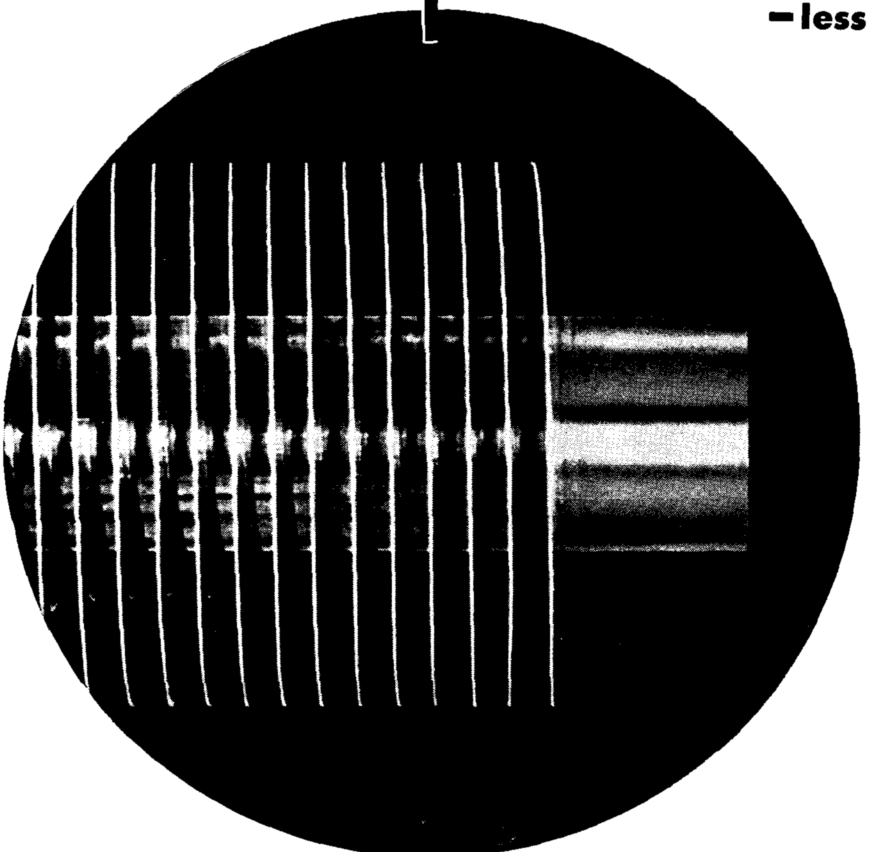

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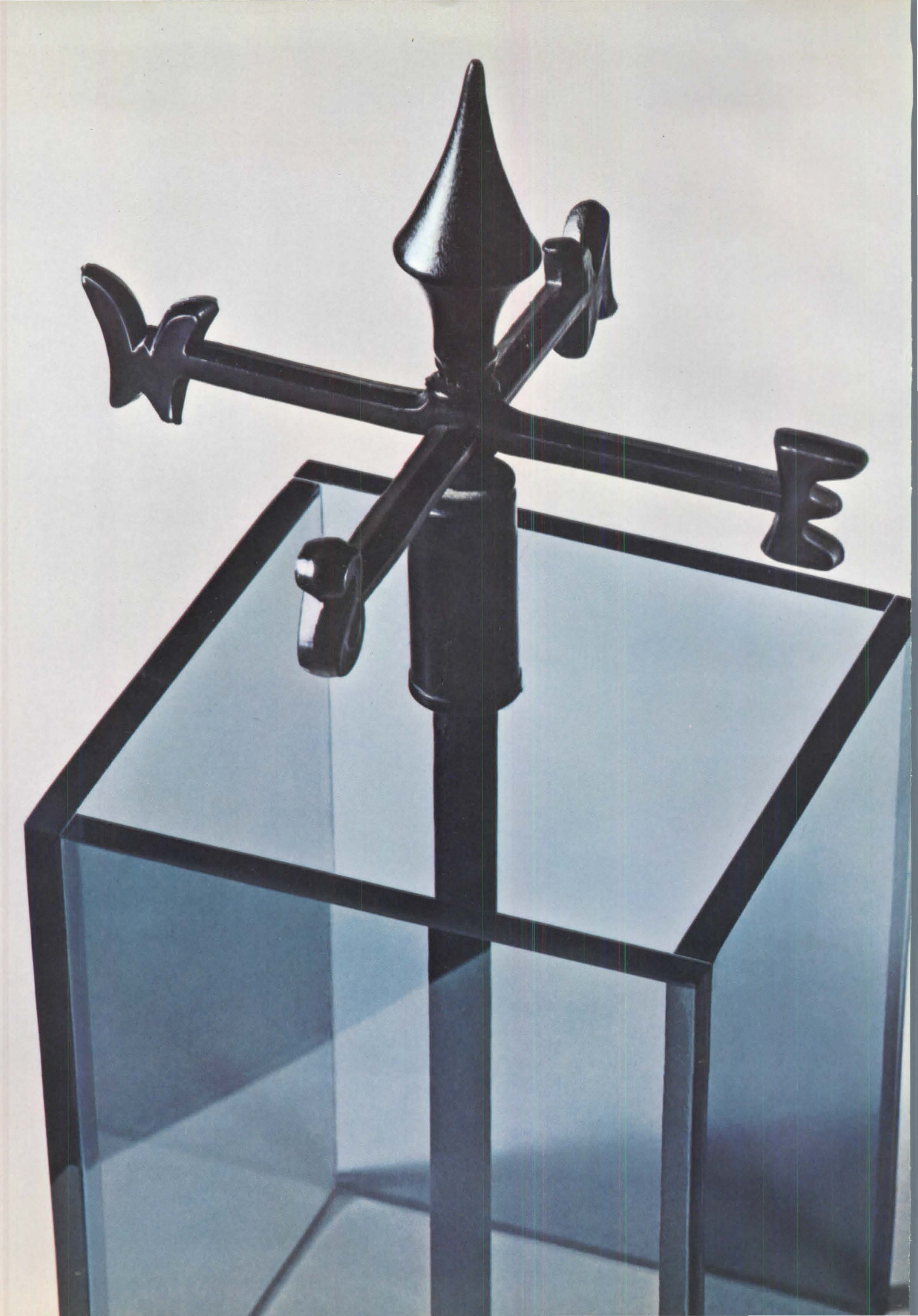


An environment for creative excellence

Armstrong Cork Company
Engineering Building
Lancaster, Pa.

An architectural report from Bethlehem Steel

An environment for creative excellence

From the earliest stages of its planning, Armstrong Cork Company's Engineering Building was visualized as a stimulating environment for creative achievements by a staff of engineers, architects, and other technical people.

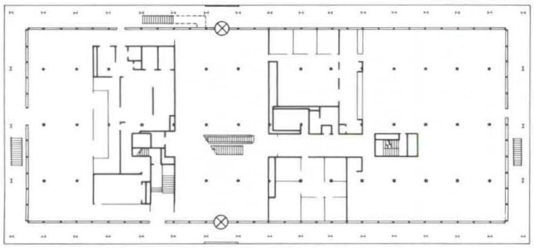
Moreover, it was conceived to be a showcase of Armstrong's architectural products—ceiling systems, flooring materials, wall coverings, roof insulation, and pipe-covering insulation. These requirements, plus provision for future structural expansion, led the designers to the classic concept shown on these pages.

Owner: Armstrong Cork Company; *architects:* Skidmore, Owings & Merrill; *associate architect:* Charles S. Conrad, Jr., of the client; *structural engineers:* Severud-Perrone-Fischer-Sturm-Conlin-Bandel; *general contractor:* Turner Construction Company.

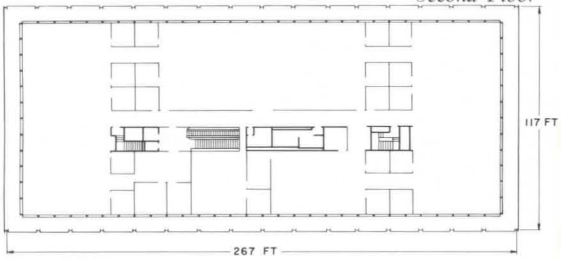
Elegant in its simplicity, the building rises from a concrete podium, its slim columns establishing a rhythm repeated in the spandrel stiffeners and the window-wall mullions. The entire facade is black-painted steel and grey-tinted glass. The 8-ft overhang shades the interior, thus reducing air-conditioning loads, while contributing to the architectural effect.

The building rises two stories above a full lower level below grade. Each floor provides about 25,000 sq ft of usable space. Bays and exterior column spacing are based on a 4-ft 2-in. module.

First Floor



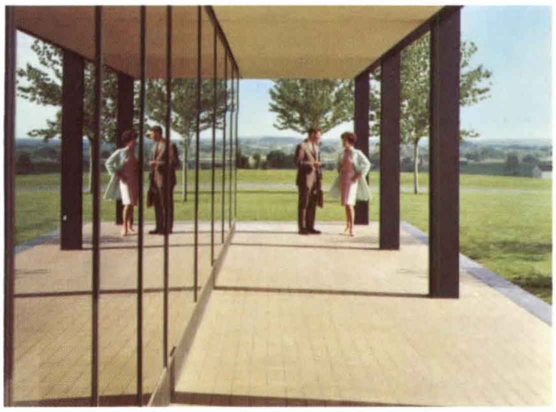
Second Floor



Structurally, the building is sixteen bays long by four bays wide, typical bays measuring 29 ft 2 in., by 16 ft 8 in. The upper level, however, is virtually column-free.

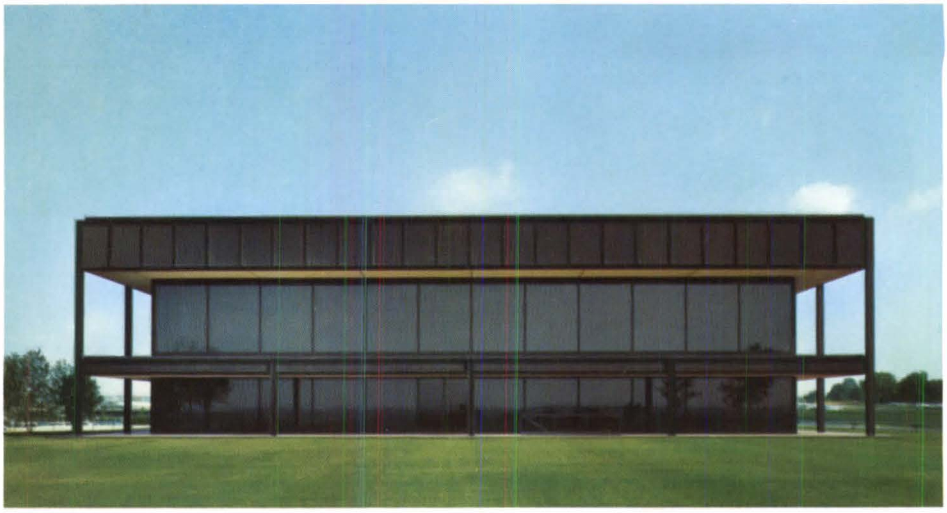
Formed steel decking, topped with concrete, was a crucial factor in the structural economy. Cellular decking, used in all office areas, provided long spans plus flexibility in the planning of electrical and communications systems.

All visible connections are continuous, fully fillet-welded and ground smooth. The exterior steelwork was sandblasted before painting.

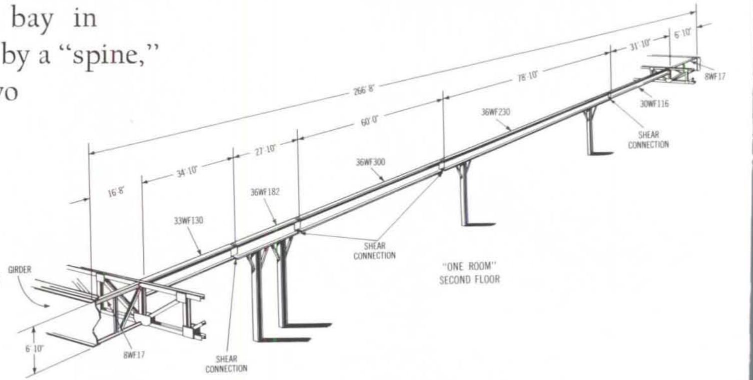


BETHLEHEM STEEL

Seven-ft-deep plate girders span the entire 117-ft width between corner columns. In addition to adding visual drama, this design avoids the need for intermediate columns which would be undesirable in the event the structure is extended. Actually, most of the structural load is carried, not by the fascia girders, but by roof trusses indicated in the accompanying sketch.



In order economically to achieve a virtually "one-room" upper floor, the designers evolved an ingenious structural scheme. Longspan trusses are located one bay in from each end of the building. These trusses are connected by a "spine," slightly off the longitudinal center line. It consists of two main WF beams which are continuous over columns, concealed within the stair and elevator towers. Cantilever arms support suspended beams that complete the spine. All transverse beams frame into this major structural element. This design, plus widespread use of Bethlehem's lightweight 10BL11.5 sections, produced substantial weight savings.



A custom-designed system of sunshades extends around the building perimeter. Made of 20-gage steel, the top-hung panels are highly effective, yet easy to see through. They slide at a touch, nest compactly.

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BETHLEHEM STEEL

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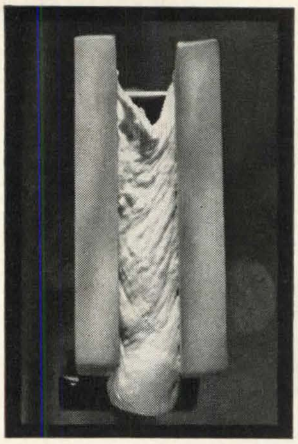
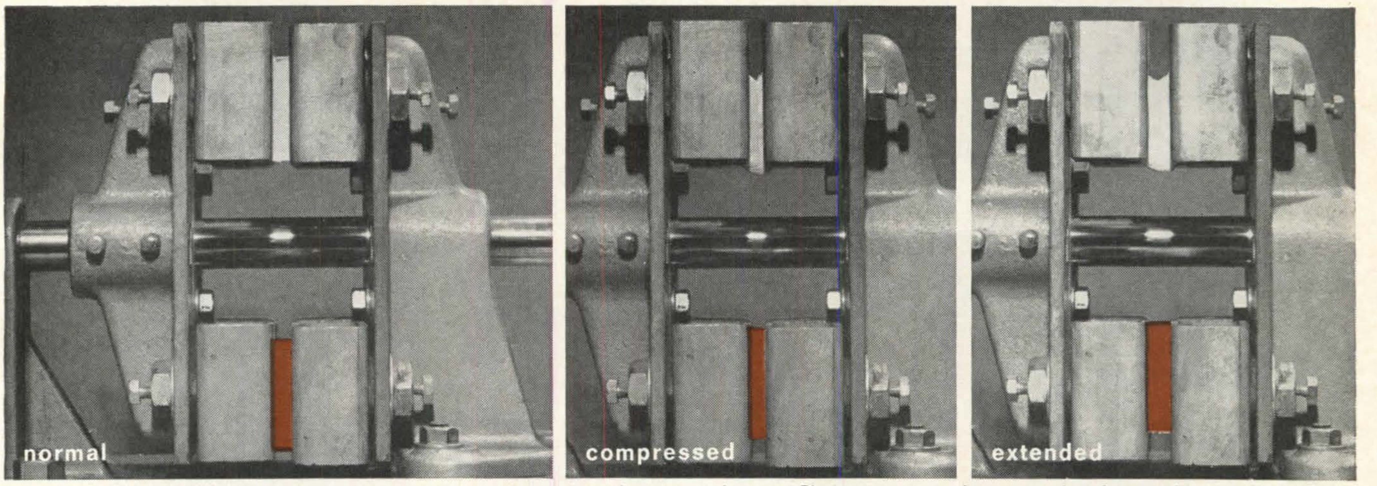


Acrylic sealant after 30 cycles in Joint Movement Simulator. Pumped out of place.



Joint Movement Simulator. Laboratory device permits simultaneous evaluation of sealant compounds. Cycled through compression-extension motion, movement duplicates physical stresses met by installed sealants as dynamic building joints are subjected to natural thermal and structural changes. Photo sequence shows sample of reputable acrylic material (sample at top) and an LP® polysulfide base compound (sample at bottom) at start of test, and comparable behavior as test progresses.

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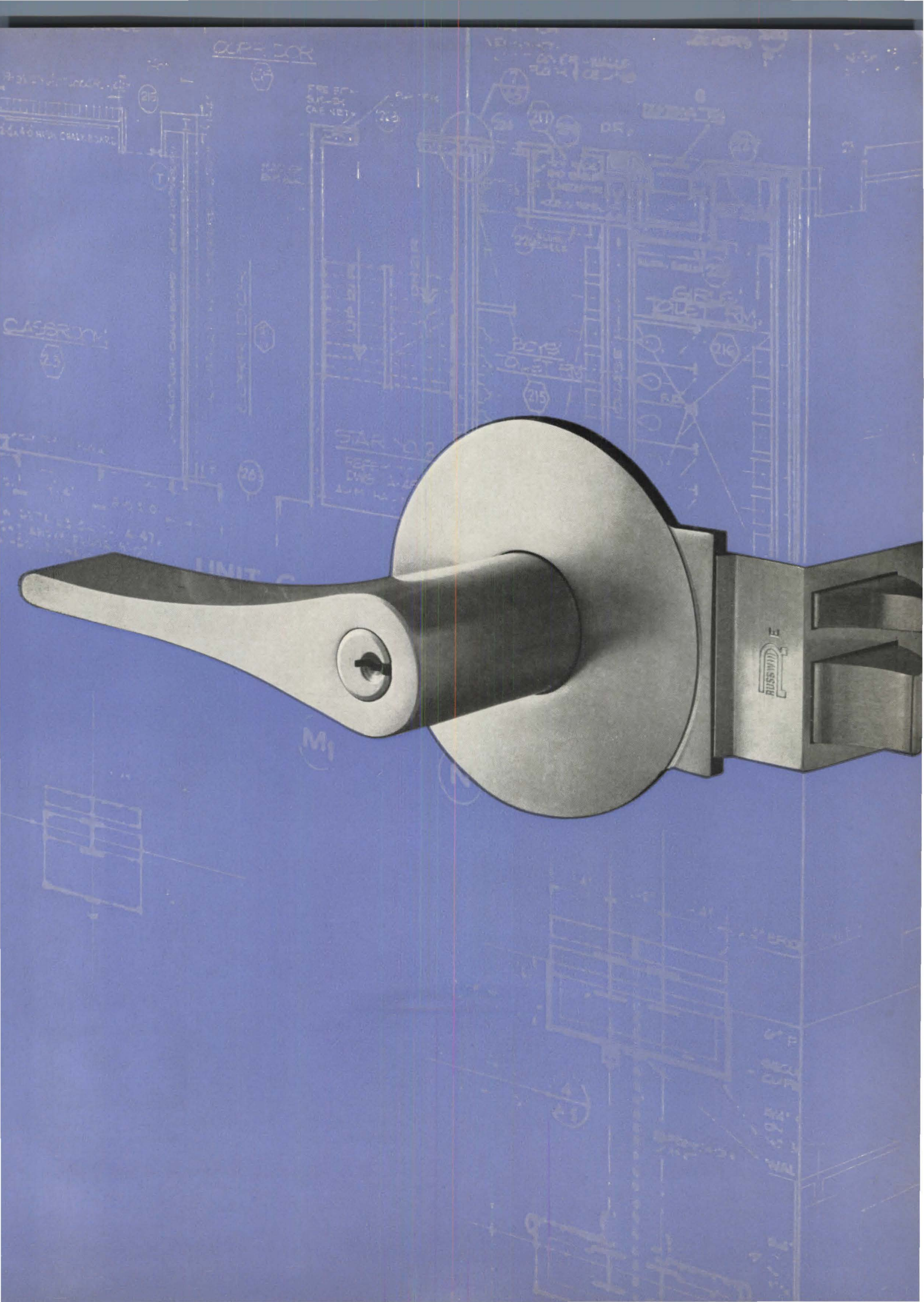
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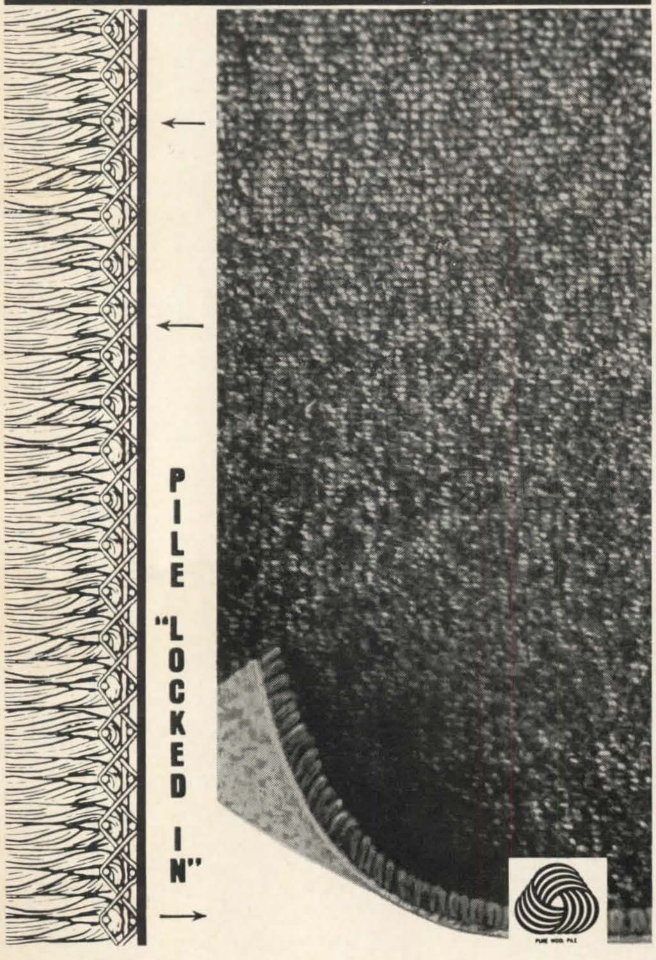

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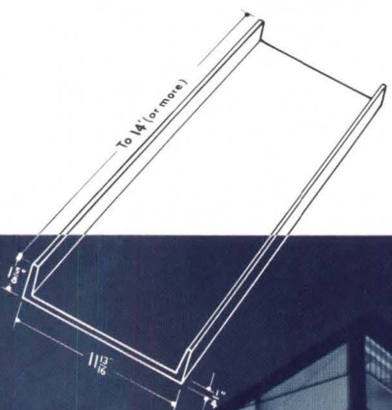

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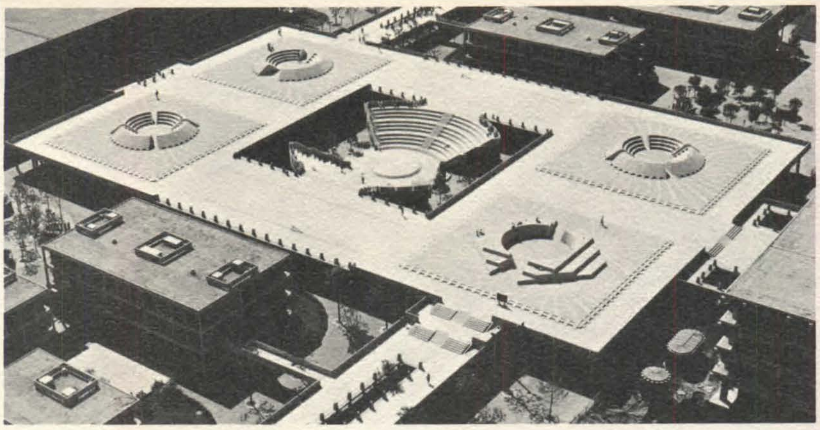
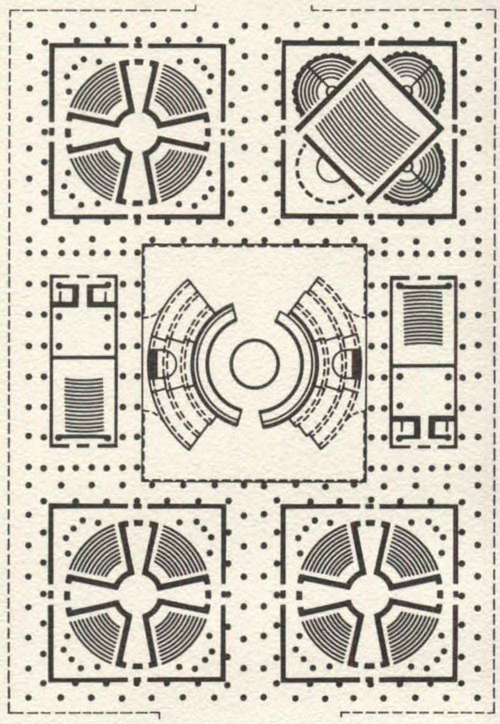
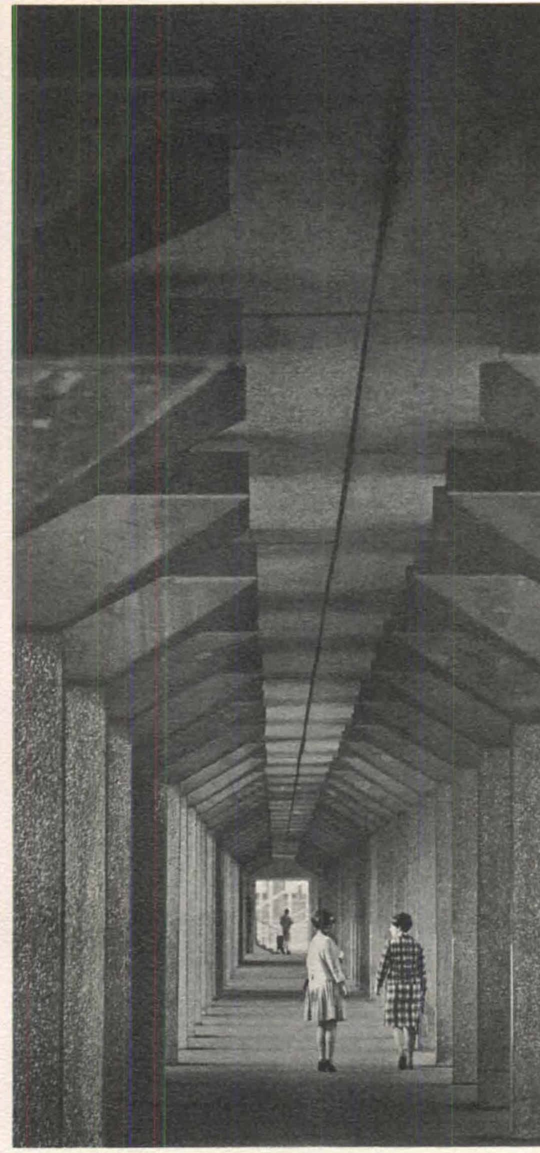
DESIGN IDEAS '67





Plan shows 21 lecture halls below plaza roof



Architect: Skidmore, Owings and Merrill, Chicago, Illinois

Open-air amphitheater above–Lecture hall complex below–Coal tar pitch waterproofing between

A former Chicago slum area has been handsomely converted into the Chicago Circle Campus of the University of Illinois. In February, 1965, 5,415 students entered the school, and with completion of a second stage of construction early in 1968, Chicago Circle will have about 15,000 students. Ultimately, an enrollment of over 25,000 is planned following additional expansion in the 1970's.

The architect, in designing for the site, had to achieve maximum utilization of space while providing for expanding enrollment and future construction. The solution was the design of single purpose units to serve a specific function instead of multi-purpose structures according to traditional college discipline. For example, there is no "chemistry building," with lecture hall, classrooms, chem lab, and chem library. Instead, faculty and students move from building to building as instruction changes from lecture to class to lab. Fifteen buildings have been completed to date, seven more are on the way. Each is protected top and bottom and sometimes in between with coal tar pitch from Koppers.

Of particular interest is the Great Court, 300′ x 450′, which features an open-air amphitheater and serves as the roof for a six-building, 21-lecture hall complex. Surrounding the amphitheater are multi-level patios which provide outdoor forum and study facilities. Special attention was given to the vital and critical waterproofing requirements.

A lightweight insulating fill was applied over the poured concrete deck. On top of this is a 5-ply Koppers coal tar pitch waterproofing membrane, followed by 1 layer of ¼″ protection board. Thirteen inches of gravel were then placed on top of this system to provide drainage and protect the wiring system from squirrels which like to chew wiring's insulated covering. Concrete setting blocks, positioned on the protection board surrounded by the gravel, support the precast concrete walking surface.

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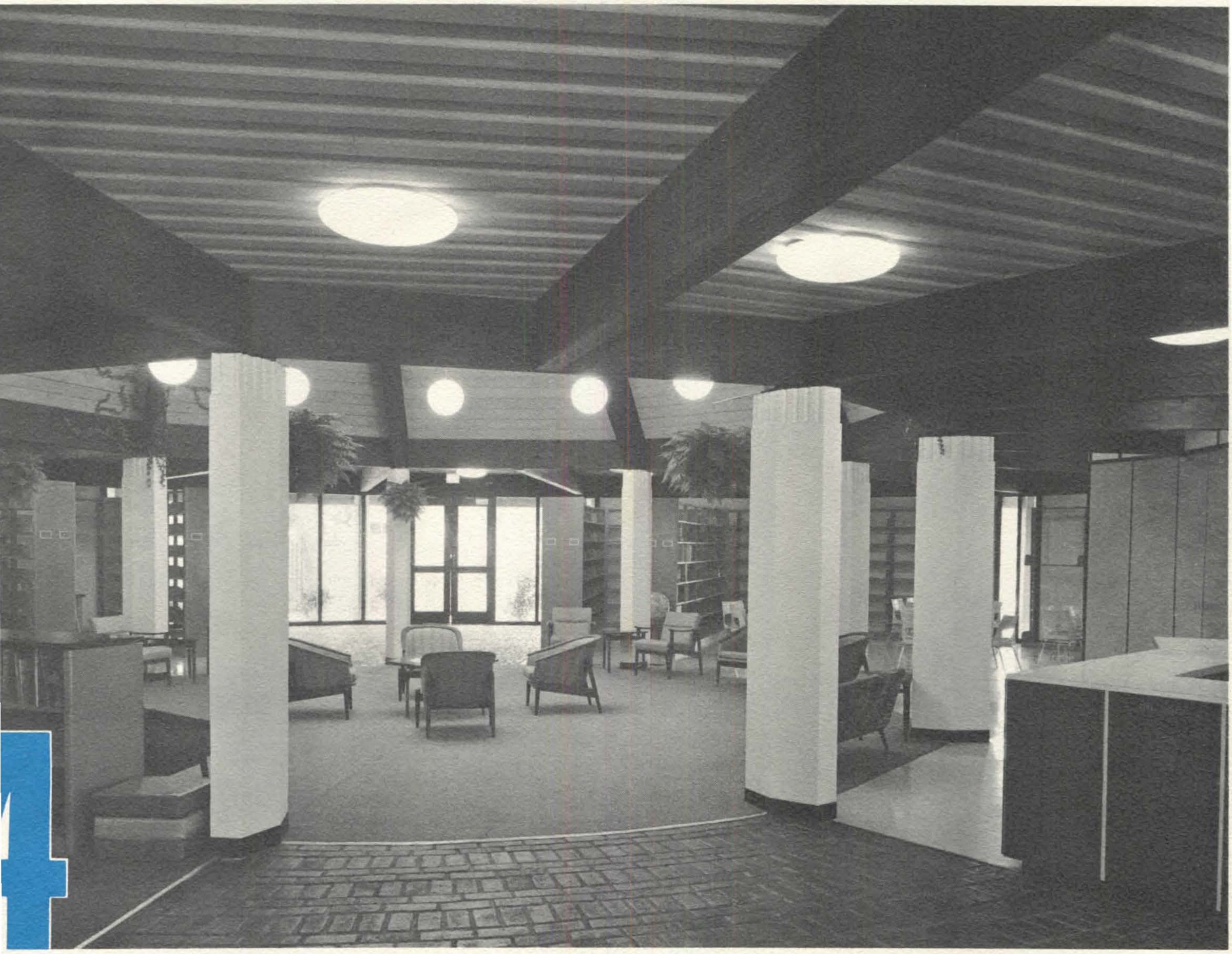
Laminated wood beam library can double in size without "growing pains"

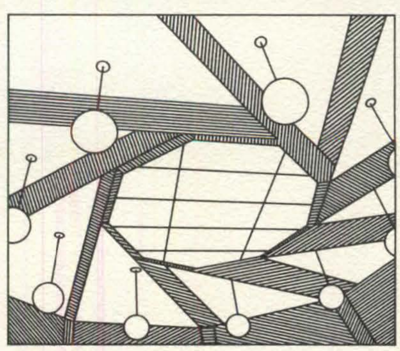
Future expansion was a prime consideration in the design of the 5,000-square-foot Dunedin Public Library in Dunedin, Florida. To facilitate that expansion without sacrificing the design integrity of the original structure, the architect conceived



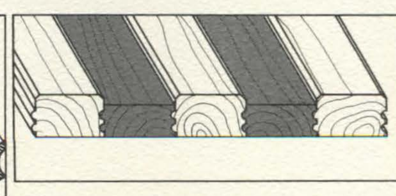
a circular, 40-foot diameter, 18-side building, with exposed laminated Southern Pine beams, Western Red Cedar decking and wall panels.

The library can be doubled in size simply by erecting another perimeter of 27 columns some 16 feet from the present perimeter wall. The laminated beam roof structure and decking would be extended, and the present wall panels brought out to the new perimeter, with only nine additional panels needed for the enlarged circumference. This expansion would cost less than the original $12 per square foot cost of the building.

Other materials had been considered for the library, but in the words of the architect, "We came back to wood because of the ease and simplicity of beam installation, the minimum of waste in roof decking runs, the re-use of the wall panels, and the savings in facing and decorating costs. Exposed wood gave us the warmth and atmosphere we wanted here." Check the coupon for more information.



Architect: Fasnacht & Schultz, Dunedin, Florida



9-sided, 25′ diameter skylight was possible with laminated beams. One hundred and thirty-eight laminated beams went into this library, ranging in size from 5¼″ x 11⅜″ x 4′9″, to 5¼″ x 14⅝″ x 29′1″. The ceiling and wall panels were made from alternate 3″ x 6″ and 4″ x 6″ double tongue and groove decking as shown in the drawing.

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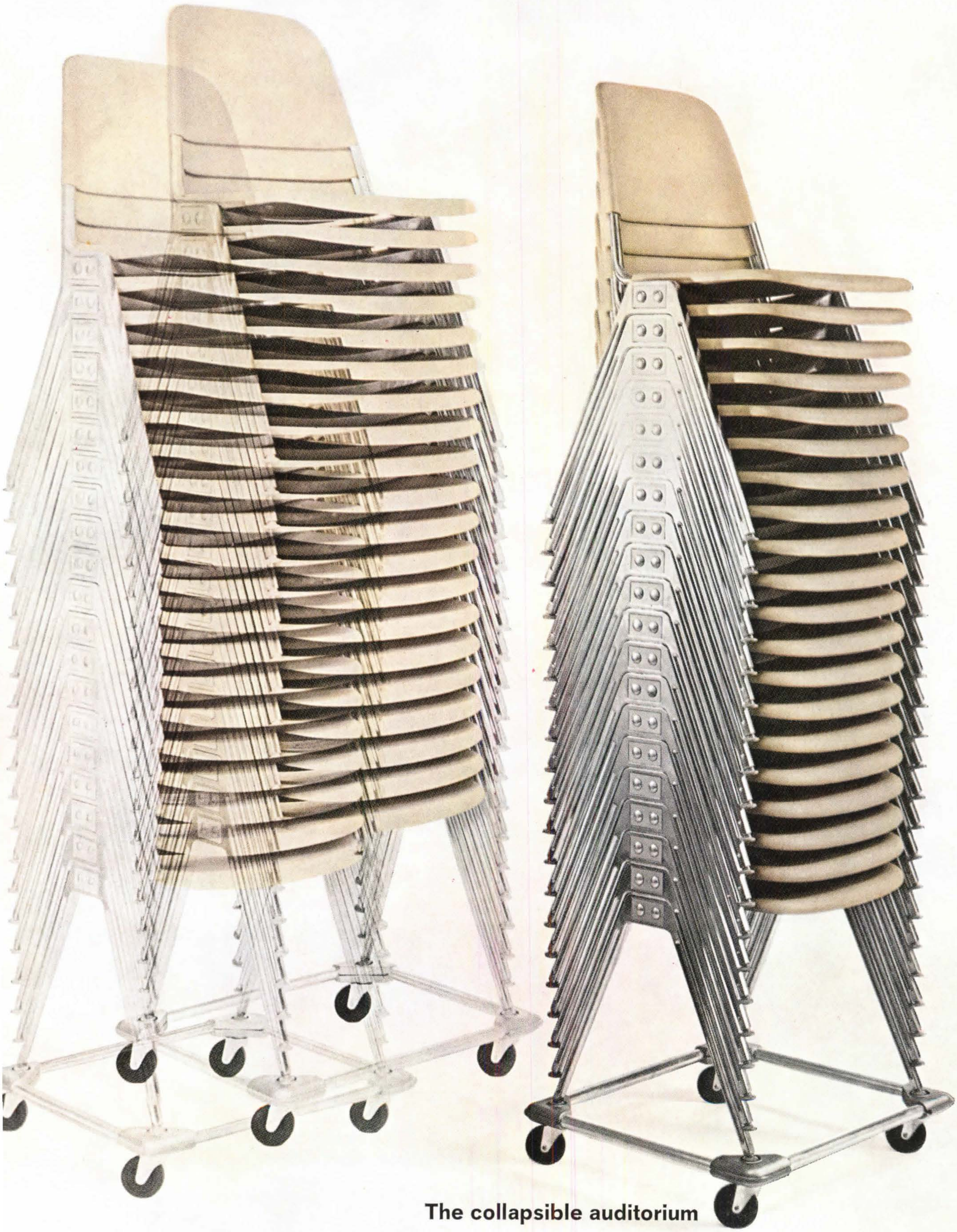


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P/A NEWS REPORT

Progressive Architecture's Monthly Digest of Buildings, Projects, People and Products December 1966

CONTRIBUTIONS SOUGHT FOR NEW AIA HEADQUARTERS

WASHINGTON, D.C. Under a newly devised arrangement, corporate AIA members are being asked to help raise, through donations, $900,000 for a new national headquarters. Donations will go to the American Institute of Architects Foundation, Inc., a tax-exempt foundation set up in 1942 to do educational and research work. With these funds, the Foundation will purchase the Octagon House, present AIA headquarters, from the AIA, and will oversee its renovation. Purchase price is expected to be $600,000; renovation, $300,000. This purchase transaction is subject to reconfirmation by the 1967 convention. With funds gained from the sale, the AIA will then construct a new building, being designed by Mitchell & Giurgola of Philadelphia. The new building will fit an enlarged site behind the Octagon, including land purchased next door (the Lemon building tract, approved by the 1966 convention). Architect G. Harold W. Haag is chairman of the fund-raising drive. Contributions are tax-deductible.

KAHN DESIGNING MUSEUM IN SOUTHWEST

FORT WORTH, TEX. Louis I. Kahn, who is currently working on a master plan for the capital of East Pakistan, is also designing a museum for the Kimball Art Foundation of Fort Worth. To be located on Amon Carter Square in downtown Fort Worth, the museum will comprise more than 100,000 sq ft of space on a 9-acre site. The museum will house the extensive art collection gathered by Mr. and Mrs. Kay Kimball — primarily 18th-Century English painting. Associated with Kahn on the project is Preston M. Geren, Fort Worth architect and engineer.

COMPUTER PROJECTS FUTURE BUILDING TRENDS

NEW ORLEANS, LA. For architects and planners who want to know future housing and commercial trends in a given U.S. city, a computerized service now makes these projections available. Allied Chemical Corporation's Barret Division has available reports on 161 metropolitan areas that can be purchased for a nominal fee of $100. "Projectiron," as the service is called, uses two computers to process more than 1000 pieces of information about a given city, and produce a comprehensive report giving trends in demand for office and residential space, locations, and price ranges. Barret points out that a report of this type would normally cost anywhere from $250 to $20,000. "In most cases," says a company spokesman, "these reports will eliminate the need for field competition studies, consumer research, and the like."

For example, a report prepared recently for the New Orleans area predicts that the city will absorb an average of 5986 for-sale units annually from 1970 to 1975. Though apartment construction there is currently concentrated in the rent range of $135 to $190 per month, the largest demand is, and will continue to be during the next 10 years, for units in the $100 price class.

The reports are prepared for the Barret Division by W.R. Smolkin & Associates, Inc., New Orleans housing-marketing consultants.

SPACE, SCALE, AND SICKNESS: THE EFFECTS OF HUMAN CROWDING

Photo: Pictorial Parade

"Man seems likely to relapse into his 19th-Century plight of being the prisoner of the city, and, this time, with no possibility of escape. This is a formidable outlook for us, because the imprisoned town dwellers of the past have been apt to develop an ugly temper. The imprisoned proletariats of Athens, Alexandria, Rome, Constantinople Paris, and Leningrad have, each in turn, been prone to break out into mob violence. An inescapable city cannot be a seed-bed for vegetables or cereals, but it has often been a seed-bed for riots and revolutions."

ARNOLD TOYNBEE

Like thousands of young girls before her, Nancy Wells came to New York to work. She found a job teaching in a junior high school in Brooklyn, and set up housekeeping in a one-bedroom Manhattan apartment with two other girls. "We have no space," said one of her roommates recently. "We're always bumping into each other." Nancy sleeps on a couch in the living room, waits in line for the bathroom, squeezes into the tiny kitchen, where two are a crowd. Dressing in the morning, with everyone looking for stockings, becomes a flurry of arms and legs. Once out of the apartment, Nancy goes underground, pushes or is pushed across a crowded subway platform into a packed subway car, where she clutches a strap for the 45-minute subterranean ride to Brooklyn. All day she teaches in an overcrowded schoolroom. Her classes average about 40 stu-

dents. And she has six classes. At night she squeezes back onto the subway for the 45-minute ride to her apartment.

Late one night a month or so ago, Nancy's roommates heard a crash in the living room. They found her sprawled on her back on the floor, eyes wide open staring at the ceiling, unable to move or talk.

The doctor said she had low blood pressure, and, after a more thorough examination the next day, said she had all the symptoms of hyper-anxiety. "Where do you come from?" he asked her. When she mentioned a small town upstate, he named a cure. "Have you ever thought of going back there? Some people just can't adjust to New York."

In the midst of a rash of talk by architects, planners, and population experts about high-density living, Nancy's plight has far-reaching implications. Already New York City has one of the highest population densities in the world (75,000 per square mile on Manhattan) and a psychiatric study done three years ago showed that 23 per cent of the people in a six-block East Side area had severe neuroses. Obviously, high-density living has an effect on people. It has to.

But planners and population experts, blithely predicting a world population 10 to 20 times greater than it is now within 100 years, lack knowledge of the effect a population of 20 billion will have on individuals. Their ignorance is understandable, if hardly commendable, for a surprising dearth of scientific knowledge about human crowding exists. Psychiatrists, psychologists, and sociologists are just now starting to study the problem.

What will the United States be like 100 years from now, with a population *of 1 billion?* Some planners say that even now we have the physical means for handling that large a population. Last month, however, ABC television's "Stage '67" took a frightening look at the world of 2067. (We should point out that although the program distorted probability by projecting simply one factor — population growth — at the expense of many other variables, the mere possibility of such overcrowding is unnerving.)

An hour-long drama, "The People Trap," told of a land race for the last 20 acres of undeveloped land in the United States. By this time, according to the drama, the Government was assigning space to people in already crowded urban apartments. People could have babies only by Governmental decree; unlicensed mothers were arrested for pregnancy and put in detention camps. If an unlicensed baby was born, it was frozen; its "development was arrested." Winners of the land race were to be given an acre apiece in Yosemite Park, and each was to be licensed to have one child. Everywhere the camera looked in this world of 2067 there were mobs of people, as if the earth were a giant Macy's post-Christmas sale. The hero had to race (through these mobs) from some point in what was once New Jersey into Times Square. Everywhere he had to push through motionless crowds. To travel a block took hours. At one point, he had to scale a 200-story windowless apartment house. But he won. And he and his wife were shown — and, by then, it was a relief to see — skipping hand in hand across an open meadow with trees; one acre seemed like the Eden of a menthol cigarette ad. Sunlight shone through the leaves. Then, suddenly, the camera panned behind them to a chain-link fence. Against it was pushing a crowd of those milling, faceless, ubiquitous masses.

The mere possibility of such overcrowding as pictured in these fictional terms is frightening. It has led population experts, such as Kingsley Davis, to issue strong warnings. Writing in *Scientific American* for September 1965, Davis stated: "It seems plain that the only way to stop urban crowding and to solve most of the urban problems besetting both the developed and the underdeveloped nations is to reduce the over-all rate of population growth. Policies designed to do this have as yet little intelligence and power behind them. Urban Planners continue to treat population growth as something to be planned for, not as something to be itself planned. Any talk about applying the brakes to city growth is therefore purely speculative, overshadowed as it is by the reality of uncontrolled population increase."

But what effect does the crowding already besetting us have on humans? Psychologists, trying to answer the question, can point only tentatively to work done with lower animals. In lower animals, crowding past certain defineable limits produces physical and psychological changes. Shrimp studied at the California Current Resources Laboratory showed that a growth in male populations led to fewer pregnancies in females. On an island in the St. Lawrence, where a population of Sika deer could expand in number but not in area, a population of more than one per acre was reduced in one sudden wave of death to about one for every three acres. Autopsies showed that their adrenalin glands had increased in size as much as five times. This enlargement is a familiar sign of stress, and biologists theorized that the animals died of insulin shock. Researchers also found two cases of death from hepatitis and believe that the prolonged stress brought on a susceptibility to disease. Rats tested by ethnologist John Calhoun soon broke up into a kind of feudal aristocracy. A king rat with a small harem took over a large bit of controlled space. The rest, forced into a relatively small area, became anxious and irritable, nipped at each other's tails, and showed a strange breakdown in sexual activity.

Psychologists are not yet certain what implications all this has for humans. Being an animal, man will show some similar patterns. But psychologists point out that man's intelligence, his reasoning ability, his communication through language and other media, and his culture will offset some of the immediate effects of overcrowding found in rats and deer. Psychologist Robert Beck points out that a certain kind of person is *attracted* to high density areas, such as New York, or London, or Paris, or even Pittsburgh. That's where the action is. "The lights are much brighter there," Petula Clark tunefully reminds us. And some people not only adapt well to these situations but seem to thrive on them. Moreover, there are cultural differences among people. Italians and Japanese, for instance, who have for years lived under more crowded conditions than those found in the U.S., seem to have a higher tolerance for crowding than do Americans. Psychiatrist Humphrey Osmond, in *Who Designs America?*, puts it this way: "How much space and what sort of space does a man need? The aristocrat feels overcrowded if he can see any sign of human habitation from the topmost battlement of his castle; London slum dwellers, on the other hand, complained of the bareness, emptiness, and eerie quietude of the English countryside when they were evacuated during the bombing in 1940. There are New Yorkers who hate leaving the canyons of that megapolis, just as much as the northern trapper fears the thunder and rush of the city. . . . We can be sure that man, like every other creature, has certain spatial requirements, just as he needs certain conditions of heat, light, oxygen, water, and terrain to survive."

Robert Beck was, until recently, an advisor to the Regional Plan Association in New York, a group trying to outline future expansion in the New York metropolitan region. He is quick to point out the vast gaps in his, and other psychologists', knowledge of crowding. But planners he worked with felt his contribution was valuable, merely because he could raise questions about density and related stress that they might not think of. Unfortunately, the budget would not support his position. On November 1, Beck was forced to give it up.

In a still unpublished paper written for the Regional Plan, with architect-planner Rai Okamoto, Beck cautioned that density itself may not be the real enemy. "It may not be the population density, *per se*, that is the issue here, but rather the way in which the density is organized. That is, areas where there are low standards of mental and physical health do have high densities but also have little *order or system* to control the density. Order and chaos become two kinds of density to study."

In one of the only general

books published on the subject of human population density, *The Hidden Dimension*, anthropologist Edward T. Hall makes a strong plea for research into and consequent understanding of man's spatial needs. These needs are determined by how man reacts to space, and this reaction in turn is determined by all the senses: sight, hearing, touch (including a sense of body heat), taste, smell. Different cultures react differently to these senses, and only research will show how much space each person needs. Hall cites the work of a French husband and wife scientific team, the Chombard de Lauwes. They compiled data on crowding and its consequences in urban housing. Using an index that measured the number of square meters per person per unit, they found that, when the available space was below 8 to 10 meters per person (about 25′ by 25′), the incidence of social and physical illness doubled. Surprisingly, the Lauwes found that the incidence of illness also increased when the space available rose above 14 square meters. They were hard pressed to explain this latter finding, and could only theorize that the families in the second category were upwardly mobile and devoted more time to work than to their families. But the important fact is that, as Hall points out, "Illness, crime, and crowding were definitely linked." With typical scientific caution, Hall goes on: "There is nothing magic about 10 to 13 square meters of space. This figure is only applicable to a very limited segment of the French population at a particular time at a particular place and has no demonstrable relevance to any other population. . . . It is absolutely essential that we learn more about how to compute the maximum, minimum, and optimum density of the different cultural enclaves that make up our cities . . . I think it will ultimately be proved that *scale* is a key factor in planning towns, neighborhoods, and housing developments. Most important, urban scale must be consistent with ethnic scale, since each ethnic group seems to have developed its own scale."

At a time when architects talk increasingly about the need for help from other disciplines, the time has come for less talk and more action. Dr. Hall spoke recently at the Conference of the California Council, AIA. Although this is an encouraging step, it is not enough. Psychologists, anthropologists, and ethnologists should be made consulting members of the design team. The plight of Dr. Robert Beck is unfortunately both common and unique. Few planning agencies have the kind of professional consultants Beck represents. To have had one and to have lost him is defeat on the brink of success.

NEW OFFICE BUILDING FOR GUGGENHEIM

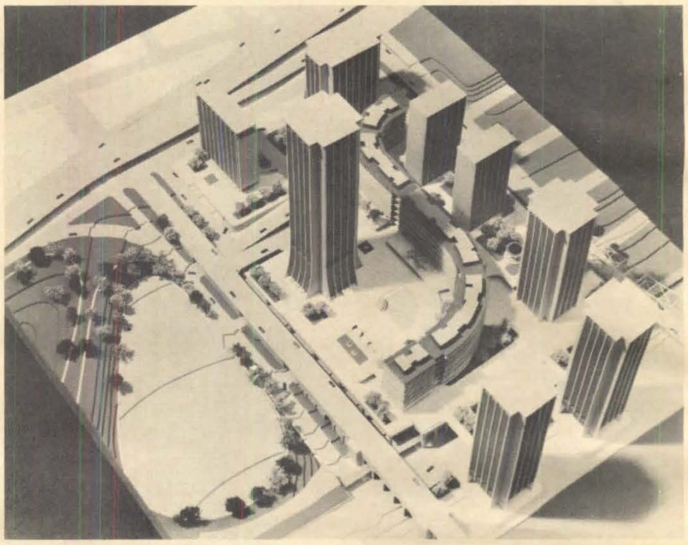
NEW YORK, N.Y. An attempt by local residents to halt plans for the construction of a three-and-a-half-story addition to the Solomon R. Guggenheim Museum, designed by Frank Lloyd Wright, has been only partially successful. The new structure was planned and approved by New York's Board of Standards and Appeals in 1963, despite protests by a group led by Mrs. Martin Opperman, a resident of the neighborhood who holds a degree in architecture. Now, however, most neighbors of Wright's Museum have been placated by the announcement that financial considerations have induced the museum authorities to alter the plans,

Photo: Courtesy, Solomon R. Guggenheim Museum

building only a two-story structure. According to spokesmen for the museum, this should still provide sufficient space to house all administrative facilities, freeing the top two ramps of the main building for exhibits. The cylindrical administration building that now adjoins the museum will contain the Justin K. Thannhauser Collection of impressionist and 20th-Century paintings. Exhibit space will be increased by one-third.

Designer of the addition is William Wesley Peters, one of the foremost disciples of Frank Lloyd Wright and Chief Architect of the Frank Lloyd Wright Foundation. Peters says his design conforms to Wright's own ideas for the museum as he originally conceived them. The annex will rest on 13 pylons on the northwest corner of the museum site. Shown is the model of the structure originally planned; except for the height, the revised design is essentially the same.

ARCH ENEMY



Photos: Schwarz & Van Hoefen, Architects

ST. LOUIS, MO. Just upstream from Eero Saarinen's Gateway Arch is a 22.5-acre site that will be bought up for renewal. The developers, the River Center Redevelopment Corporation, are following the best precepts of current urban renewal theory. They are making use of the waterfront, and they are providing a multiuse community in a downtown area. Unfortunately, they are not following these precepts well, for the plan they released in late October has little to distinguish it architecturally. Although the plan calls for open spaces between buildings, the spaces lack adequate definition, and are in danger of being uninviting, if the plan is executed. The buildings themselves, varying in height from 12 to 51 stories, are spaced with little imagination, and tied together by an S-shaped 12-story apartment building that snakes through the center of the site, as if some giant hand had accidentally dropped a huge Studebaker emblem in the midst of a housing development.

According to the developers, the project would increase by 100 times the city's tax base for the area. They selected the plan as the "most desirable of five basic urban renewal concepts." "Most desirable" to whom? If the project goes ahead, there will be 3578 apartments to fill, a performing arts theater, cinema, art gallery, bowling alley, supermarket, interdenominational chapel, skating rink, library, and off-street parking for 5000 cars. All commendable; given some architectural value it might be worthwhile. Acquisition of the land is expected to take two years. And the $100 million cost of land and construction is expected to be carried by Federal and private funds, with no dependence on the city.

Architects are Schwarz & Van Hoefen.

INFORMATION SOURCE ON ART-ARCHITECTURE COLLABORATION

DELFT, HOLLAND. Professor A. M. Hammacher of the Department of Architecture at the Technical University in Delft is compiling international documentation on the relation between art and architecture. He hopes to provide a clearing house for information in this field, and urges contributions from both architects and artists.

With the scope of architecture enlarging, Hammacher feels it is increasingly important that architect and artist should better understand each other. "There must be research into the influence of art on space," he states. "Every new chance to realize this relation and to clarify it can be seen as an individual case in the collaboration between artist and architect." Specifically, he is seeking: information on projects in the design stage; photos and exact data (measurements, materials, dates) on completed projects; names and addresses of architects and artists who have worked on related projects. Hammacher's address is: Technische Hogeschool, Afdeling der Bouwkunde, Oude Delft 75, Delft, Holland.

FLOODS SULLY ITALIAN ARCHITECTURAL HERITAGE

FLORENCE, ITALY. As the rain-swollen waters of the River Arno receded last month after a week-long rampage through Florence, they left ruin and despair in their wake. Architectural landmarks that had stood unmarked for centuries emerged ravaged and bruised. More than 600 paintings were stained by mud and water. "The destruction is incalculable," noted Piero Bergellini, the mayor of Florence. "Not even the war, not all of the last war, wrought so much destruction on Florence as the water of the Arno River." Superintendent Ugo Procacci of the Uffizi Gallery and his close friend Carlo Ludovico Ragghianti, curator of the Palazzo Strozzi, were in tears.

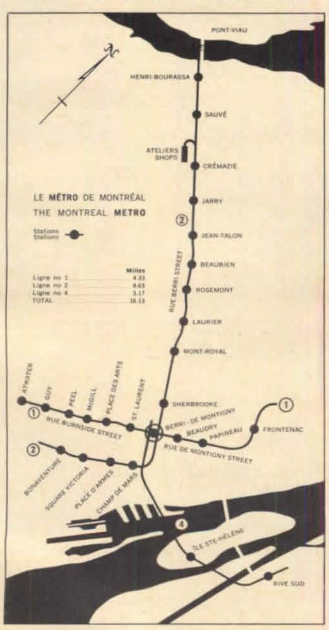
At the Uffizi Gallery, Giotto's "The Wedding of St. Catherine" and a Botticelli triptych will have to be restored, together with about 50 other paintings. More than 200 paintings will have to be cleaned.

Among the architectural works damaged were the Baptistry of St. John, the Ponte Vecchio, whose picturesque shops will have to be replaced, and the church of Santa Croce. In the Baptistry, the Pisano doors were badly cracked, and five of the ten scenes on Ghiberti's "Door of Paradise" must be either repaired or replaced.

But Florence was not the only Italian town struck by the deluge. Throughout northern Italy, more than 100 persons were killed, and total damage was estimated at $2,400,000,000. Venice had tides 7' above normal.

Offers of help came from all over the world. The U.S. sent a team of 16 art-restoration experts to give temporary aid to the work, which, according to Ragghianti, "will take many, many years." A Committee to Rescue Italian Art is being formed, and is headed, in this country, by Professor Bates Lowry of Brown University.

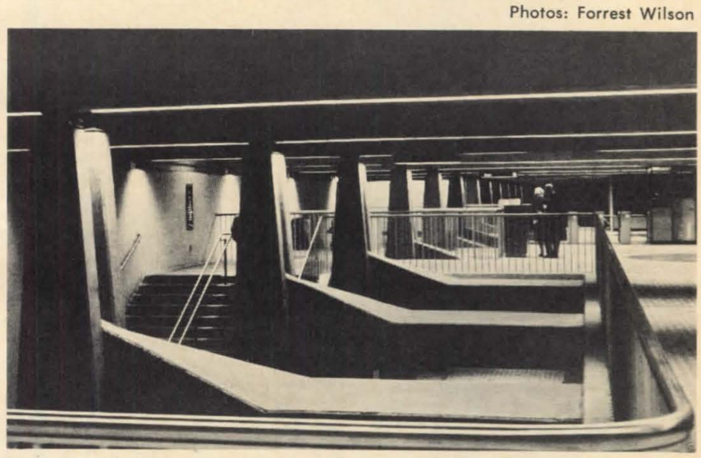
HOW TO BUILD A SUBWAY

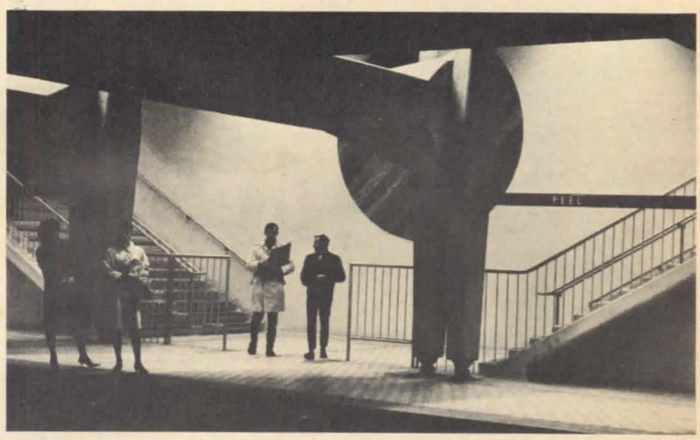


MONTREAL, CANADA. Montreal has been talking about building a subway since 1910. In October 1966, two of three proposed lines of the Montreal subway opened for business, and some North American cities that have talked about installing subways for almost as long are looking carefully at the new system. Several features make it worth watching: For one thing, its station stops were designed by architects. Sixteen sections are the work of local architects; 10 more were done by the city's architectural department. Stations are spacious (most are two stories high) and well lit; each has a different décor. For another thing, the system's newly designed trains run on rubber tires.

When Jean Drapeau became Mayor of Montreal in 1960, he pledged construction of a subway. From that point on, things happened fast. In November 1961, the City Council gave its blessing to the plan and appropriated $132 million for the first two lines. Workmen broke ground in May 1962, and the lines started carrying passengers in October of this year. By the opening of Expo '67 next April, the subway's third line (line 4), connecting the fair to the city, will be in operation. A fourth spur, running under Mount Royal, will open at an as yet unspecified date.

Photos: Forrest Wilson





On a typical weekday, the subway is expected to handle 400,000 passengers. (As a result of the new transportation system, the city recently sold 100 used trolley buses to Chicago.) Passengers now using the system report a quick, quiet, clean ride. Escalators take passengers to and from station platforms when the platform-to-street distance exceeds 12'. In general, the use of rubber tires on the cars permitted station construction close to the surface, because the rubber-wheeled trains can negotiate a steeper grade than their steel-wheeled counterparts. From the stations, subway tracks lead downward at angles up to 6% through tunnels that are farther below ground than the stations. Above ground, all entrances are built into existing or planned structures, eliminating a need for unsightly kiosks.

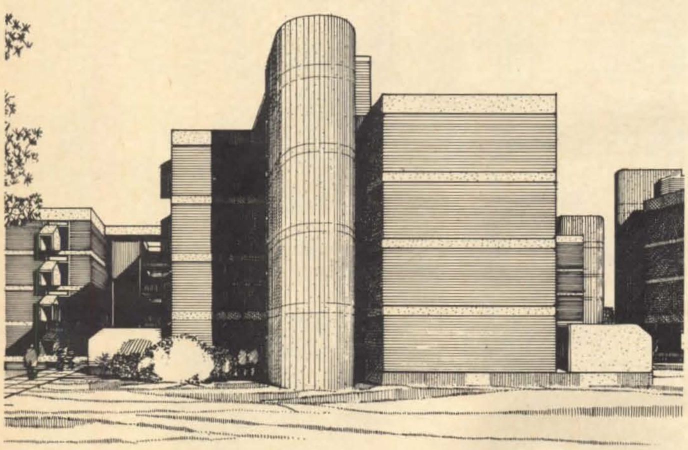
French engineers who were consulted on the project talked the city into using rubber tires. Although still a matter of controversy, Montreal engineers feel these tires provide a quieter, more stable ride, that the stopping efficiency of trains is increased, and that they allow trains better to negotiate sharp turns. Evidently, the tires squeel on turns, but the noise level never approaches that of steel on steel.

All financing of the system so far has been done by city loans. At three successive meetings, the City Council appropriated \$213,700,000 — \$153,000,000 for tunnel construction and track work, and \$61,700,000 for rolling stock and accessories.

Mayor Drapeau has provided Montreal with the sort of leadership that might well be envied by his counterparts in the U.S., who tend to devote more time and energy to talking than taking effective action.

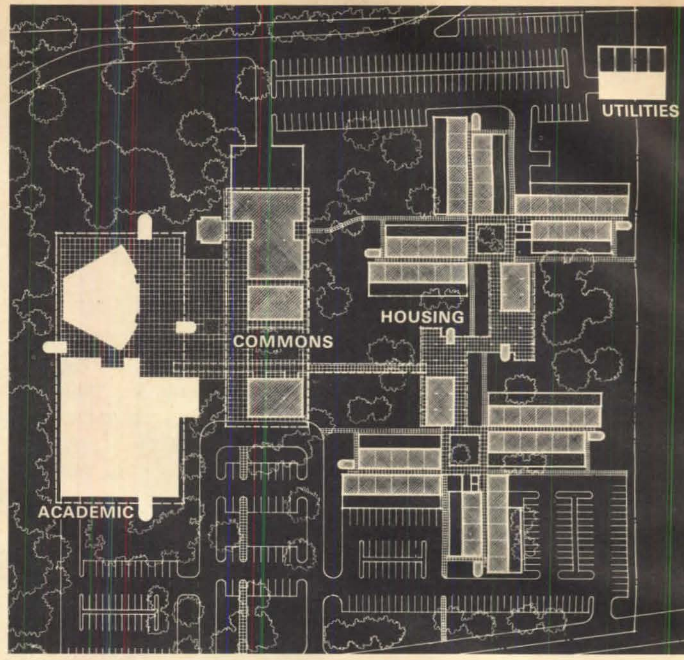
Montrealers are pleased with their Metro. At the polls in October, they elected Mayor Drapeau to a second term with 95% of the vote.

LAW CENTER FOR FLORIDA UNIVERSITY

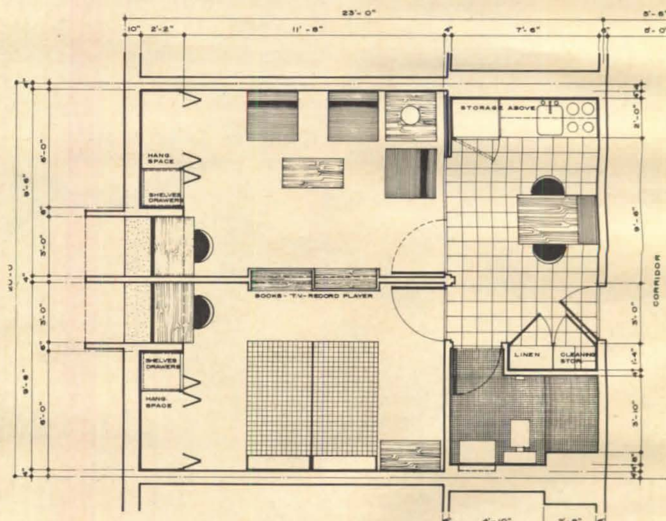


GAINESVILLE, FLA. For years, Miami architects Pancoast, Ferendino, Grafton, and Skeele experimented with educational facilities. They conducted seminars, interviews, did research, and wrote reports on the use and arrangement of classrooms and school buildings. Putting their research into practice, they built many schools in southern Florida. But their work was merely a preparation. They never had a project in which they could incorporate everything they had learned. Never, that is, until they gained a commission to design a Law Center for the University of Florida. Earlier this fall, their design won an Honor Award from the Florida Association of the AIA.

The University of Florida expects its law school enrollment to double by 1968, and, accordingly, the law faculty was given a wooded site on the northwest corner of the campus for a center that would combine facilities for housing, teaching, and research. Architects Pancoast, Ferendino, Grafton, and Skeele designed a plan that avoids the clichés of campus arrangements. Essentially,



their law campus is composed of three parts: an academic structure with library, classrooms, auditorium, and faculty offices; a commons facility with dining room, bookstore, and snack area; and housing. Parking is provided on the east and west sides of the site. In the center, between the parking areas, are the buildings that make up the law campus, isolated from the automobile, surrounded by trees, and connected by walkways. At the heart of the site are the commons buildings, a focal point of activity and a beacon of constant central light at night. Between the commons and the academic buildings is a paved, central courtyard, flanked by covered galleries. In these buildings, the stair towers are articulated of a textured concrete. Concrete framing is left exposed, running in bands through the building's red brick walls. Just to the south of the commons are two groupings of housing, each consisting of four buildings arranged in radial arms around a central open area. Each dormitory room, complete with bath and galley, can accommodate two students or a married couple (see plan).

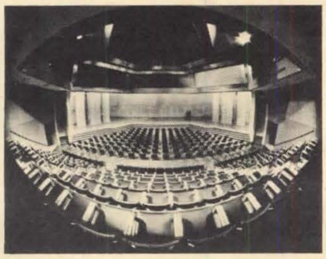


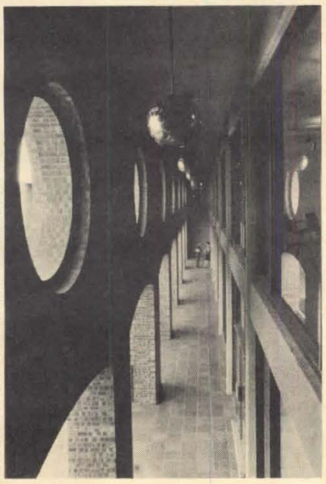
TYPICAL UNIT FLOOR PLAN

Most noticeable results of the research the architects have done in classroom planning is seen in the auditorium. When sliding panel walls are closed, the auditorium becomes seven classrooms, two seating 75 students, four seating 100, and one seating 200 When the panels are pulled aside, varying combinations of auditorium-classroom space become available. The architects see the use of this space being determined by computer. The 200-seat portion of the auditorium will be furnished as an appellate courtroom, and each student in this section will sit in a swivel seat at a fixed work desk.

It is already apparent that the years of planning have paid off. The budget for the academic building, which will be the first to go up, was $19 per sq ft. Bids went out in late October, and the low bid came in at $18.90 per sq ft.

THEATER ON THE SKYLINE





Photos: Authenticated News International

SAN ANTONIO, TEX. The Ruth Taylor theater, opened on the Skyline campus of Trinity University here in late October, is called by its managing director, Paul Baker, "the first truly American theater." Designed by architects O'Neil Ford and Bartlett Cocke, it has six levels, taking advantage of a hillside site, and three distinct stage areas. Largest of these theaters is the 412-seat Theater One (middle photo), with a total frontage of 110'. Its horseshoe-shaped stage surrounds three sides of the auditorium floor, where 140 swivel chairs are located. A spectator in any one of these seats can swivel to follow the action as it moves from one area of the stage to another. Behind these seats are 186 seats fixed on risers and in the balcony are 86 more.

The second theater, Attic Two, seats 108 persons for smaller productions. And the Cafe Theater seats 100 for after-show entertainment. In addition, the building's 55,000-sq-ft house classrooms, diction booths, a costume shop, study halls, set design shops, dressing rooms, offices, rehearsal rooms, a children's theater area, art room and ticket booths.

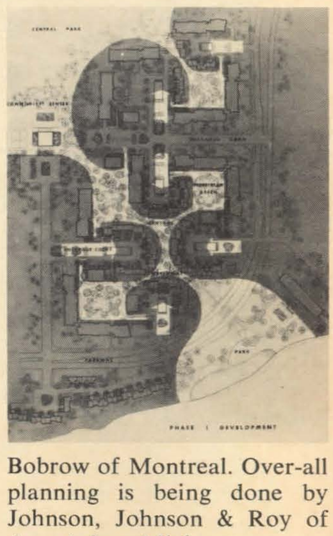
Under construction for two years, the theater is the third building in a fine arts complex at Trinity. Already in use are the Ruth Taylor Music Center and the Ruth Taylor Art Building. And it is the thirty-eighth structure built on the Trinity Skyline campus since 1952.

Funds for the $1,300,000 theater were donated by the Ruth and Vernon Taylor Foundation.

PERSONALITIES

Richard H. Tatlow, III, will hold the position of president-elect of the American Society of Civil Engineers. Tatlow, who is president of the architectural firm of Abbott, Merkt & Company, New York City, will be the first to occupy this office . . . President of the Philadelphia Chapter of the AIA for 1967 is **Louis deMoll,** partner in the Ballinger Company . . . Newly elected president of the New York State Association of Architects is **Fay A. Evens, Jr.,** who is a practicing architect in Troy, N.Y. . . . **Howard Morgridge,** a principal in the firm of Morgridge, Richards & Coghlan of Los Angeles, is to be the new president of the California Council, AIA . . . The presentation of an Achievement Award to **Mrs. Lyndon B. Johnson** for her national beautification program was the highlight of the National Convention of the American Society of Registered Architects, held in Cleveland . . . A jury of five has been selected to judge entries in the AIA's 1967 Honor Awards Program. Members are **James M. Hunter** of Boulder, Colo., chairman; **R. Max Brooks** of Austin, Tex.; **Vladimir Ossipoff** of Honolulu; **Joseph N. Smith** of Atlanta, Ga., and **Philip Will, Jr.,** of Chicago, Ill. **David N. Yerkes** of Washington, D.C. will advise the jury . . . **Morris Ketchum, Jr.,** past president of the AIA, has received the French government's highest honor in the field of humanities. He is the first American architect to be named a Chevalier de l'Ordre des Arts et Lettres . . . The East Bay and northern California chapters of the Women's Architectural League have honored **Norman K. Blanchard** of St. Helena, Calif. He founded the league 25 years ago . . . The Library of Architecture and Allied Arts, Los Angeles, Calif., has elected its immediate past president, **David J. Witmer,** to the office of chairman of the board. Witmer, member of the firm of Witmer & Pidgeon, architects, was honored for his contributions to the library by the board of directors.

A NEW TOWN, WITHIN A CITY

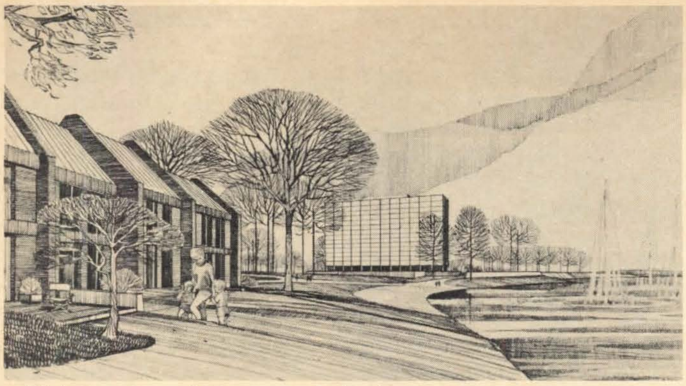


MONTREAL, CANADA. As Montreal's Expo '67 gets underway next spring on an island in the St. Lawrence River, another island just upstream will become the scene of construction activity, which may have just as much effect on the future of Montreal. On Nun's Island, a 1000-acre area just 10 minutes by car from the downtown business district, work will get underway on the first stage of what will become a community of 50,000 persons. A Chicago real-estate firm, Metropolitan Structures, Inc., has a 99-year lease on the island; and a recently completed bridge, linking Verdun, a Montreal suburb, with the south shore of the river, cuts across the island, making it a prime spot for development.

Initial work will concentrate on 800 town house and apartment dwelling units to be designed by Mies van der Rohe and Stanley Tigerman of Chicago, and by Philip David Bobrow of Montreal. Over-all planning is being done by Johnson, Johnson & Roy of Ann Arbor, Mich.

Until 1957, the island was occupied by the Sisters of the Congregation of Notre-Dame. In 1956, it was purchased by the Quebec Home and Mortgage Corporation, Ltd., who leased it to Metropolitan Structures.

Eventually, Nun's Island



will be a city within a city, complete with schools, shopping facilities, industry, and recreation areas. What makes it different from other new towns throughout the world is its proximity to an established metropolis. Few other cities still have 1000 acres of open land so close to the city limits. Obviously, this juxtaposition was a boon to the developers, for the city of Verdun is running water, sewage, and telephone facilities to the island, and will also provide schools and other public facilities. Furthermore, Metropolitan Structures is getting a complicated tax incentive from the city.

Development of the island was discouraged until recently, both because of the lack of a road link to the island off Montreal and because of flooding. Ice jams forming downstream had backed up river water each winter, but construction of a $14 million ice-control structure has stopped this. Even so, the upriver end of the island, set aside for golf courses, parks, and other recreational facilities, will be diked.

Concept for the first cluster of housing shows both high- and low-rise structures grouped around central greens. Mies has designed the high-rise apartment. Tigerman is responsible for the low-rise, cluster-type town houses. Wisely, the planners have situated houses along the riverfront, and meandering roads are planned that will keep the automobile from intruding upon the community. Roads are being financed by a Verdun municipal bond issue.

When completed in 15 to 20 years, the project will have cost Metropolitan Structures about $300 million.

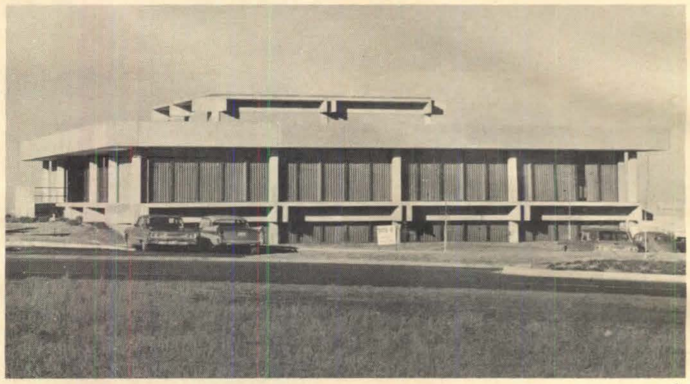
CALENDAR

The Winter Meeting of the **National Society of Professional Engineers** will be held January 4–7, 1967, in the Americana Hotel, San Juan, P.R. . . . **The Architectural Aluminum Manufacturers Association** has planned its Committee Week for January 23–27, 1967, at the Chisca Plaza Motel, Memphis, Tenn. . . . Management and Technology will be the theme of the **Plant Engineering and Maintenance Show** and Conference to be held in Chicago, January 30–February 2, 1967. This year, a special area will be devoted exclusively to products and services for the building industry, and all evening sessions of the conference will concern the industrial building industry. For registration and other information, write Clapp & Poliak, Inc., 341 Madison Avenue, New York, N.Y. 10017 . . . Also on January 30–February 2, the **18th International Heating and Air-Conditioning Exposition** will be held at Cobo Hall, Detroit, Mich. Write for further details to E.K. Stevens, International Exposition Company, 200 Park Avenue, New York, N.Y. 10017 . . . A series of **five one-day seminars** will be held by Bolt, Beranek & Newman, Inc., at BBN's offices in Cambridge and New York. Sessions include one on lighting, in Cambridge, Mass., January 7, and in New York on January 21; one with the theme of "structures," to be held in Cambridge on February 4, and in New York on February 18; and one on computers, in Cambridge on March 4, 1967, and in New York March 18. Details are available from Bolt, Beranek & Newman, Inc., 50 Moulton Street, Cambridge, Mass.

JOHNSON IN POLITICAL FORAY

NEW CANAAN, CONN. Architect Philip Johnson waged a losing battle last month for a seat in the Connecticut General Assembly. Running here in his heavily Republican home town, Democrat Johnson polled only slightly more than a third of the votes cast. His reason for running was "to make the Democratic party more palatable" in New Canaan. But his campaign had one note: the need for planning in Connecticut. He pumped hard for controls on water and air pollution and better use of open space. He hoped to find out whether these things were of interest to general voters. "Obviously they aren't," he told P/A. "Voters are more interested in things like the PTA." One fears that this interest — or rather lack of it — carries far beyond the land of New Canaan.

WESTERN MOUNTAIN AWARDS



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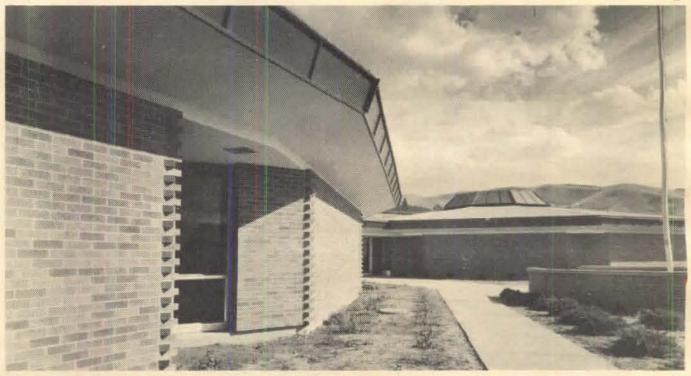

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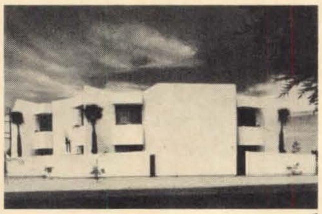
SANTA FE, N. M. At the first joint conference of Rocky Mountain architects and interior designers held here October 12–15, architectural awards went to six Western Mountain Region firms. States represented in the Western Mountain Region of the AIA are New Mexico, Arizona, Utah, Colorado, Wyoming, and Montana. Honor award went to the Denver firm of Moore & Bush for the Resources, Inc., office building **(1)**.

Architectural merit awards went to: Scott & Louis of Salt Lake City for the East Elementary School building in Tooele, Utah **(2)**; the firm of Harvey S. Hoshour, Albuquerque, N.M., for the First Unitarian Church of Albuquerque **(3)**; the firm of Charles A. Haertling of Boulder, Colo., for the residence of Dr. Robert Willard in Boulder **(4)**; Cain, Nelson & Wares of Tucson, Ariz., for the First National Bank Building in Tucson **(5)**; the firm of Bennie M. Gonzales of Phoenix, Ariz., for the Rush Memorial Medical Building, Phoenix **(6)**.

An award for interior de-

4

5



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sign from the American Institute of Interior Designers went to the Denver architectural firm of Dick Heraty for The Seven Levels Inn, a ski lodge at Teton Village, Wyo.

CALIFORNIA ARCHITECT TURNS THESPIAN

SAN FRANCISCO, CALIF. *Crazy Quilt,* a very funny, low-budget movie, filmed in and around San Francisco, is notable for, among other things, the cinematic acting debut of Robert Marquis, current president of the Northern California Chapter of the AIA. Marquis plays a dancing psychiatrist who strokes his beard, looks lecherously at his voluptuous patient, and gambols with her in the park. His performance is delightful, and so is the movie.

Crazy Quilt is the first full-length film of John Korty, a 29-year-old San Franciscoan who adapted the script from a short story, "The Illusionless Man and the Visionary Maid," by Allen Wheelis. Korty produced, directed, photographed, and edited the film himself. And as if that weren't enough display of talent for one family, he persuaded his brother, Doug, to play the roll of Falbuck Wheeling, an unwashed, unshaved motorcyclist who talks only in monosyllables and only about his motorcycle.

The story, which is presented as a fable and is narrated by Burgess Meredith, tells of the love and the lack of it in the marriage of a man (played by Tom Rosqui) who has no illusions, and a maid (Ina Mela) who quests for love and warmth and affection. The man is a termite ex-

terminator, turned construction worker, who builds several of his own houses, any one of which is enough to make an architect nod in amused understanding. Let it be said that the night we saw the film, the lady next to us couldn't stop laughing.

In a letter to P/A, Bob Marquis wrote: "Be sure to see my debut in this new and promising career; urge your staff and friends to see it also (especially since I own stock)." We doubt that Marquis, principal in the San Francisco firm of Marquis & Stoller, is actually contemplating a new career, but, as a hobby, his acting is a happy pursuit. It reverses a California trend in which one is supposed to be an actor first, then take up another career.

Imagine being able to turn from the T-square to a romp across the grass with someone as winning as Ina Mela.

WASHINGTON/FINANCIAL NEWS

BY E. E. HALMOS, JR.

The final session of the 89th Congress enacted five or more pieces of legislation that promise to have a broad impact on the profession. Several of these deserve study:

The legislation created the new Department of Transportation; set up further aids to construction of educational facilities; aids for construction of libraries; amendments to stream-pollution control measures; the controversial "Demonstration Cities" program; cut-backs in tax-deductions for new construction.

(The Demonstration Cities bill — see last month's column — survived a bitter attack on some of its provisions; the tax cut-back also was modified to allow for smaller buildings and pollution control works construction.)

Effect of creation of a new **Transportation Department** will be somewhat indirect for architects — more on the level of policy making than actual control of activities and planning on the site. Obviously, consolidation of agencies such as the Bureau of Public Roads, the Coast Guard, Federal Aviation Agency, and others under a single administrative tent will probably result in an attempt to impose a uniform policy on architectural and engineering services involved.

One thing should be clear at the outset: As set up by Congress (PL 89-562), the Department is potentially an administrative impossibility, and moves will certainly be made next session for changes. Problem centers around the fact that, in order to placate dissenters, Congress set up the heads of the formerly independent agencies as Presidential appointees (with Congressional consent); thus they could, in effect, thumb their noses at the new Secretary. (This is the same situation that forced consolidation of the semiautonomous agencies that constituted the former Housing and Home Finance Agency.)

Big field for architects under the new agency will be in planning functions — attempts to merge efforts in urban planning, mass transportation, highway-air-rail safety into some sort of a coherent whole.

On returning from his Far Eastern tour, the President named Alan S. Boyd Secretary of the new department. Boyd moves up to the new post from his position as Under Secretary of Commerce. He is also former chairman of the Civil Aeronautics Board. Boyd's new job is obviously not an easy one. Only a strong-handed administrator can bring cohesion to a many faceted department that, at birth, has some 100,000 employees and more than $6 billion in appropriations.

Huge sums of money for construction and planning are included in the group of **education-aid measures** enacted: $300 million for construction of graduate facilities under the Higher Education Act; $310 million for library services and construction (through 1971); $105 million over five years for grants to improve medical library facilities and services; $1,400,000,000 for elementary and secondary education aids — including construction, as well as other purposes.

Amendments to existing **stream-pollution control laws** upped spending for construction loans and grants to $3,400,000,000 over four years, provided for broad-gage area-wide planning, called for a number of studies of pollution and possible control measures. Most significantly, the Interior Secretary is also instructed to study incentives — including tax deductions — for industry.

Architects' Fees — The running battle between the Federal Government and architects and engineers over current 6% limitations on fees hasn't quieted down with Congress' departure from the capital.

Reason: Before packing its bags, Congress ordered its fiscal watchdog (the General Accounting Office) to look into the fee situation on a Government-wide basis, and to come in with some recommendations next year.

Architects and other professionals have long argued that the now 27-year-old 6% fee limitation is obsolete and is in fact detrimental to the professions as well as to the Government. The current investigation by GAO is an outgrowth of these complaints, strengthened by new battles over fees allowed by the Farmers Home Administration.

Taking the lead in the discussion, the AIA last month submitted a "position paper" to GAO, urging repeal of the limitation on fees, arguing that: (1) cost of architectural services has risen faster than costs of construction, because of complexity of modern buildings and component systems; (2) with the low fees, architects can't allow as much time for research and design as a project should have; (3) increasing probability of financial loss — due to low fees, frequently long time-lapses between conception and completion of projects — "works against the best interests" of the Government because of loss of interest among architects in Federal projects.

Engineers have made similar comments.

Prospects are that GAO's report to Congress next year will suggest increases, or some sliding scale for such fees. Whether Congress goes along depends, to some extent, on its new composition (after last month's elections), and how Congressmen read the trends on need for further economy in Government.

Who's to Blame? — The influential Associated General Contractors has taken a carefully noncommittal official view of AIA's revisions to its "General Conditions of Contract for Construction," after AGC's directors failed to endorse the changes (Document A201) at a recent meeting.

Bothering the builders were the provisions of the new document that would require the contractor to "hold harmless" the owner and architect of all legal claims for injury to an employee or member of the public, or for damage to properties near the construction site, if such damage is caused in whole or in part by any negligent act or omission of the contractor or subcontractor [see IT'S THE LAW, OCTOBER, NOVEMBER, DECEMBER 1966 P/A].

AGC carefully advised its members of the board's failure to endorse the new document; and suggested that contractors (1) check legal effects of the document with their attorneys; (2) review the provisions with their insurance carriers; (3) push local chapters to "obtain cooperation of local architects in removing or modifying the objectionable 'hold harmless' clause."

Cautioned AGC: "Many local architects are not fully aware of the wording and legal effect of the revised Form A201."

Financial — Biggest factor in the financial picture for construction — and most other business activities — for the coming year was the final total of funds appropriated or authorized for the coming year by Congress. Best estimates put the figure at more than $120 billion for all purposes — a far cry from the President's $102 billion budget last January. The enormous spending total (bolstered by mounting costs of war in the Far East and numerous "Great Society" programs) had to presage either a cutback in spending next year, a tax increase, or both. (The Budget Bureau has already said it will try to chop $3 billion out of public works spending next year, despite Congressional actions.)

☐ With the huge spending increases, construction costs kept mounting. Best indicator in Washington is the Bureau of Public Roads' quarterly index on highway construction prices, which jumped another 1.7% in the third quarter, to reach new all-time high (at 115.6% of 1957–58 prices). Since the beginning of 1966, the index has risen a total of 8.3% — far and away the biggest cost rises since the index was started.

☐ Beginning to show the effects of tighter money and higher prices, total value of *new construction* put in place for September was set at $6,700,000,000 — 1% below a year ago, the first time the Census Bureau's figures have shown any decline at all for more than two years. Housing continued the weakest spot, running at a rate of 1,073,000 units for September, down 2.6% from August of this year, and 15% under July.

KING COUNTY MEDICAL SERVICE BUILDING; Architect: GRANT COPELAND & CHERVENAK; General Contractor: BAUGH CONSTRUCTION CO.; "Incor" Cement Precast Units: OLYMPIAN STONE CO. (All of Seattle, Washington)

Mass produced or one-of-a-kind —precast concrete with Incor® 24-hour cement

Two brilliant examples of precast concrete in Seattle are the King County Medical Service Building, above, and the Library Building at Seattle Pacific College, below.

The use of lightweight concrete saved 150 tons of facing weight in the precast window wall units for the new Medical Building. These 844 precast units are each one story high and three feet wide, and have built-in grooves for the window frames.

The College Library shows the visual impact of concrete murals, designed as an integral part of the structure. The specially designed precast concrete units have an exposed surface of Steilacoom pebble aggregate.

Lone Star's performance-proved **"Incor,"** America's *first* high early strength portland cement, was used exclusively for both of these outstanding precast jobs. Lone Star Cement Corp., 100 Park Ave., New York, N.Y. 10017.

SEATTLE PACIFIC COLLEGE LIBRARY; Architect: DURHAM, ANDERSON & FREED; Sculptor: HAROLD BALASZ; General Contractor: BRAZIER CONSTRUCTION CO.; "Incor" Cement Precast Units: OLYMPIAN STONE CO. (All of Seattle, Washington)

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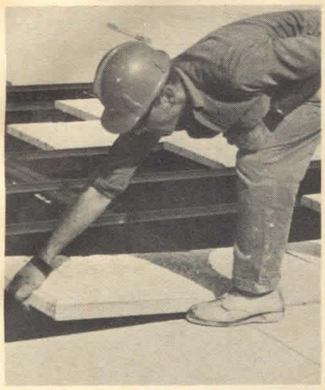
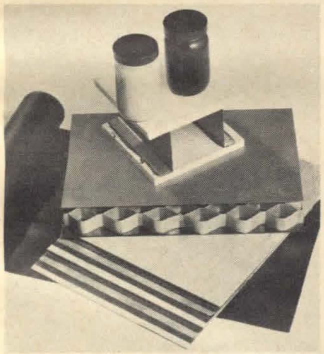
PRODUCTS

CONSTRUCTION

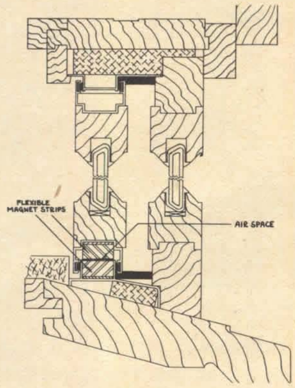


Perlite lightens roof panels. High strength and low density of reinforced concrete roof slabs made with perlite aggregate are said to offer good insulating and acoustical properties. "Tuflon" panels, 2′ x 4′ or 24″ x 32″ in varying thicknesses, provide an interior surface that may be painted or left exposed; top side has smooth surface ready for conventional roofing. Illinois Brick Co., 228 N. La Salle St., Chicago, Ill. 60601.
Circle 100, Readers' Service Card

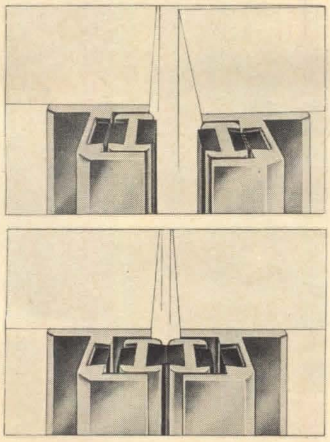


Adhesive family. A group of thermoplastic and thermosetting adhesives, with tensile shear strengths up to 3000 psi, solve the "cost, critical cleaning, and sensitive handling problems which up to now have inhibited metal-to-metal bonding." The thermosetting adhesive will adhere to lightly oiled steel, according to a company spokesman, who adds that one of the outstanding characteristics of the new adhesives is their compatibility with galvanized steel. Photo shows (top to bottom) bottles containing two-part thermosetting adhesive, steel studs bonded to gypsumboard (this application has met with Federal Housing Administration approval), sandwich panel, plywood and steel panel, and roll of thermoplastic adhesive. United States Steel Corporation, 525 William Penn Place, Pittsburgh, Pa. 15230.

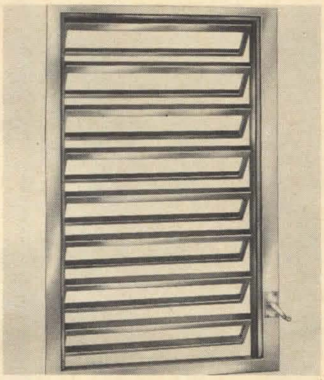
DOORS/WINDOWS



Magnets repel. Windows slide horizontally on an air cushion formed by the repelling force of two magnetized plastic strips — one installed in the sill, the other on the underside of the sash (see drawing). The strength of the magnetic field floats "Kushion-Aire" double-glazed, 28-lb wooden window a fraction of an inch above the track; thus, there are no moving mechanical parts and no maintenance, claims manufacturer. The company is also developing a sliding patio door to operate on the same principle. Weather-Seal, Inc., Barberton, Ohio.
Circle 101, Readers' Service Card

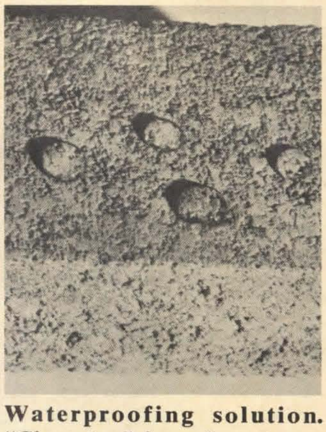


Magnets attract. Floating plungers, faced with magnetized vinyl, form weatherseals for doors. "Magnetic Astragals" align themselves automatically, says the manufacturer, and provide a firm weatherseal that adjusts itself upon installation and during any subsequent variation of door alignment. Plungers are said to separate quickly when door is opened, thus keeping friction wear to a minimum. Available in satin anodized aluminum and Duranodic finishes, the Magnetic Astragals may be used with magnetic aluminum and stainless-steel thresholds to form a complete weatherseal. The Michaels Art Bronze Co., Inc., Erlanger, Ky.
Circle 102, Readers' Service Card



Escape-proof windows. Awning-type ventilators for penal institutions operate by a single, removable hand crank. Windows open a maximum of 45°, and hinge on tool-resisting pivotal bars spaced 6″ or 7″ apart. The William Bayley Co., Springfield, Ohio 45501.
Circle 103, Readers' Service Card

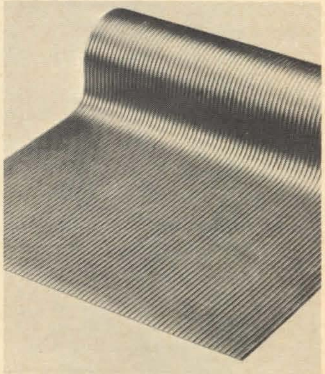
FINISHES PROTECTORS



Waterproofing solution. "Chemstop" is a clear, transparent solution of chemical solids in a hydrocarbon solvent. Because it contains no silicones, manufacturer says it will not affect glass, nor etch or cloud polished surfaces; and paint can be applied over it without any special preparation. Liquid penetrates concrete and masonry surfaces, becoming a part of the material treated. Spray-on application. Suitable for above and below grade. Tamms Industries, Paint & Building Products Div., 8000 Joliet Rd., Lyons, Ill. 60534.
Circle 104, Readers' Service Card

Glass coating. Two-part solventless-type epoxy coating contains very fine glass "flakes." Sprayed onto interior masonry or concrete walls, certain hardboards or blasted steel, it is said to form a surface that looks and feels like tile, but is less costly. A coat as thick as 6 mils can be applied in one operation. Suitable for schools, shower rooms, laundries, ships, hospitals, etc. Armstrong Paint & Varnish Works, Inc., 1330 S. Kilbourn Ave., Chicago, Ill. 60623.
Circle 105, Readers' Service Card

FURNISHINGS

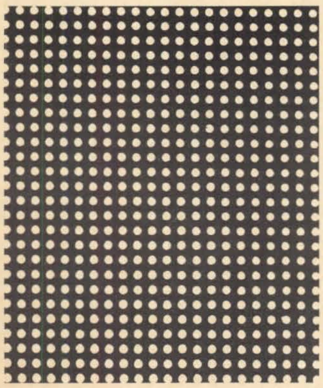


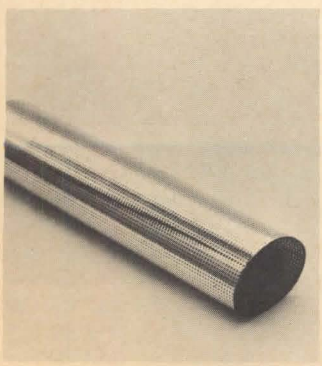
Ezykleen spike-resistant matting of Koroseal vinyl protects floors subjected to spike shoes and any other rough treatment (locker rooms, pro shops, bars). It is grease- and oil-resistant, as well as spike-resistant. Matting has a wide-spaced rib surface. The material is ¼″ thick and made in 25 yd rolls, in 24″ and 36″ widths. Colors available: black, brown, red, green, beige, gray. The R. C. Musson Rubber Company, 1320 E. Archwood Ave., Akron, Ohio 44306.
Circle 106, Readers' Service Card

DuPont's "Tontine" window shades, of vinyl-coated canvas, now come in three new colors to fit institutional needs. The washable, flame-resistant, color-fast shades come in widths up to 70″. Among possible installations are combination "pull up" and "pull down" shades, to prevent both glare and distraction.

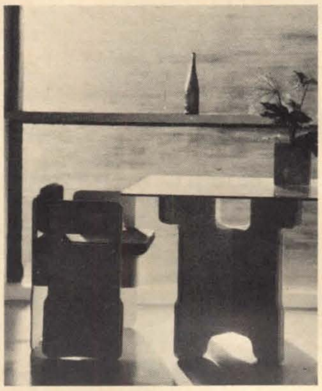
E.I. du Pont de Nemours & Co., Inc., WT 902, Wilmington, Del. 19898.
Circle 107, Readers' Service Card

Side-by-side refrigerator-freezers have "Instant Cold" systems for fast recovery of food-keeping temperatures, and "Power Saver" to make "No-Frost" units as economical to operate as comparable automatic defrost models. The unit has 12 cu ft of refrigerator volume and an adjacent 7-cu-ft freezer that holds 245 lb. Other larger models offer ice-makers. All have fronts available in three simulated wood grains — walnut, birch, maple — or 150 Formica patterns and colors. Philco-Ford Corporation, Tioga and C Streets, Philadelphia, Pa. 19134.
Circle 108, Readers' Service Card





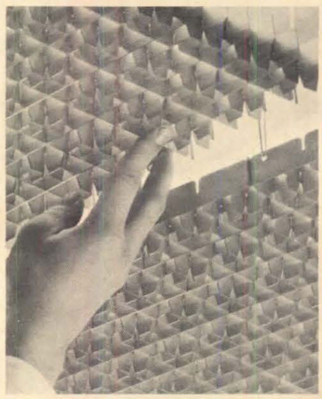
The McCordi Sun-Screen, a metalized mylar film, comes in patterns that permit varied degrees of light transmission. The sun-screen can be applied directly to windows, using a water-activated adhesive, or can be used to make light-controlling screens or shades. Exterior metallic side conceals a room interior, but, from the inside, one can distinguish outside colors. Custom patterns available upon request. The McCordi Corporation, 707 Fenimore Road, Mamaroneck, N.Y. 10544.
Circle 109, Readers' Service Card



British furniture invasion. Engineering craftsmanship enhances design of furniture from England. Sturdy lift-up writing table attached to backs of lecture-room seating operates on a pleasingly simple principle: table slides to horizontal position on heavy-duty pins and is held steady by fitting up under the brackets. Comfortable seats (designed by Peter Dickinson) get their tilt-up action from counterbalancing, rather than spring mechanisms. Dining group by architect Max Clendinning (chairs surprisingly comfortable) is part of a painted plywood line. All pieces, including sectional sofas and easy chairs with colorful puffy foam cushions, can be shipped knocked down. Normal delivery on the lecture-room seating; two to three months for other designs until factory gets into full production. All designs are from Race Furniture Company, to be manufactured under license in this country by JG Furniture Co., Inc., 160 E. 56th St., New York, N.Y.
Circle 110, Readers' Service Card

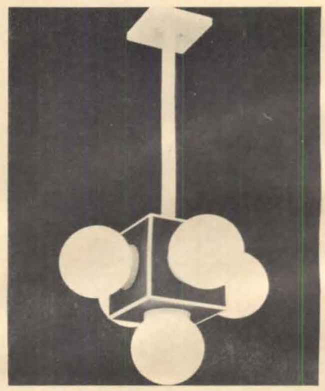
Ornamental translucent panels for outdoor applications come in acrylic — or polystyrene for indoor use. Each is available in a choice of three patterns: leather-grained "Morocco," ice-crackled "Glacial," and textured-roundel "Bottle Bottom." Patterns are executed in shades of amber, ice blue, and olive green. A fine-tooth saw effectively cuts the material to fit cabinets, entrances, bathrooms, suspended ceilings, etc.; standard framing materials, adhesives, or screws will secure the panels. Leigh Products Inc., Coopersville, Mich.
Circle 111, Readers' Service Card

LIGHTING



Tweedy ceiling. Over-all louvered pattern of luminous ceiling is uninterrupted by divider strips or hanging grids. Hanging runners (see photo) integrate with 2′ x 2′ panels, since louver blades and runners are both fabricated from the same white-enameled, .032″-thick aluminum. "Infinitex" is said to install easily around columns and other irregular shapes. Designed for use with standard fluorescent strip fixtures, the panels are noncombustible, smokeless, and nonyellowing; they may be removed for cleaning and relamping. Integrated Ceilings, Inc., 11766 W. Pico Blvd., Los Angeles, Calif. 90064.
Circle 112, Readers' Service Card

Hidden housing. Recessed, low surface brightness fixtures are designed to produce a fairly high level of illumination from inconspicuous light sources. Specular black anodized cones may be relamped from either above or below and are available in four sizes for lamps between 100w and 300w. Fixture is one of a group of new designs by Swivelier. Swivelier Co., Inc., Nanuet, N.Y. 10954.
Circle 113, Readers' Service Card



Lighting geometry. Translucent 5″ globes combine with cubes (shown), three-dimensional triangles, and other shapes to make fixtures for surface and pendant mounting. Finishes for both outdoors and indoors combine painted or metal-finish housings with vinyl-film panels of cherry or American walnut grain. Omega Lighting, Inc., 99 Park Ave., New York, N.Y. 10016.
Circle 114, Readers' Service Card

6606

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It's the Steel Joist Institute's practical working handbook of everything you need to specify joists to carry uniform loads on spans up to 96 feet.

The 1967 Edition covers the following joists: J-SERIES, joists made from 36,000 PSI minimum yield strength steel; LJ-SERIES, longspan joists compatible with the J-SERIES; H-SERIES high-strength joists with chord sections made from 50,000 PSI minimum yield strength steel; LH-SERIES high-strength joists with chord and web sections designed on the basis of 36,000 PSI to 50,000 PSI yield strength steel. Send coupon for your free copy of this valuable handbook.

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Please send me a complimentary copy of the 1967 Edition of Specifications and Load Tables.

NAME ____________________

COMPANY ____________________

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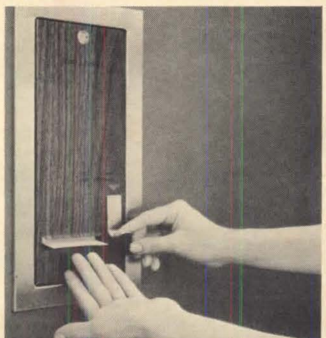
On Readers' Service Card, Circle No. 385

SANITATION PLUMBING

Electronic faucet. Flow of water starts automatically when hands are held beneath tap. Concealed antenna detects the hands and electronically actuates a valve starting the water; water stops when hands are withdrawn. Manufacturer states that safety is insured by using 12v d-c, maintained by a rectifier. Good for hospitals, doctors' offices, public restrooms, etc. System comprises faucet, antenna plate, electromagnetic valve, and rectifier unit for about $65. Jud Williams Associates, Inc., Box 262, Califon, N.J. 07830.
Circle 115, Readers' Service Card



A new leaf. Washroom accessory dispenses thin leaves that are all soap — instead of soap-coated paper. Leaves are said to withstand 105° temperatures and 95% humidity. Steel dispensers are available in eight styles for recessed or surface mounting, and will hold 1000 soap leaves. Accessory Specialities, Inc., 42–14 Astoria Blvd., Long Island City, N.Y. 11103.
Circle 116, Readers' Service Card

SERVICES

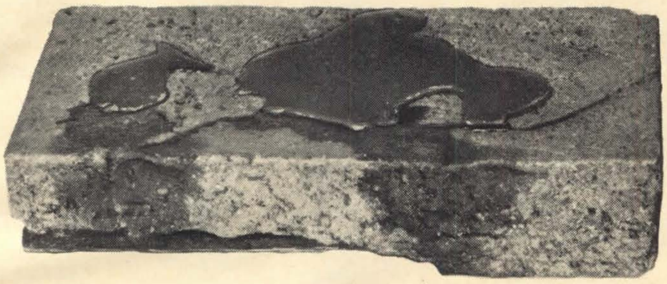
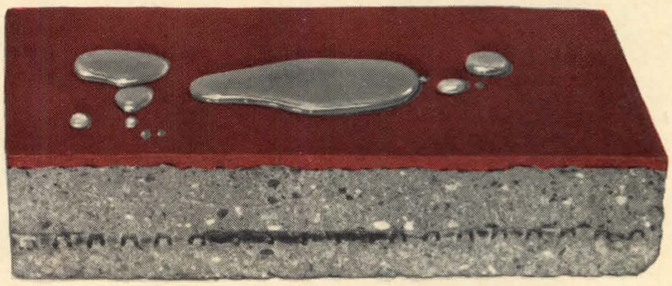
Up and down staircases in concrete or terrazzo can be built from manufacturer's prefabricated steel forms. Standard components allow flexibility of design; curved, circular, and standard stairs are manufactured and installed to architects' specifications. Various types of risers, nosings, stringer designs, and rail and newel post mountings. Stairbuilders, Route 66, McCook, Ill. 60525.
Circle 117, Readers' Service Card

SPECIAL EQUIPMENT

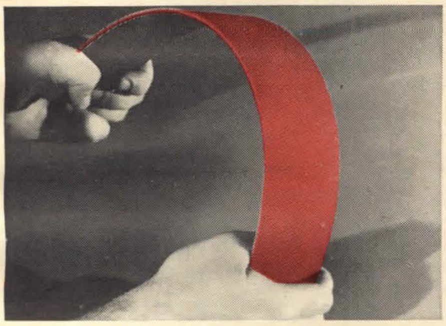
Masonry scrub-down. Liquid cleaner loosens excess mortar and job dirt while controlling vanadium stains on brick, stone, tile, and exposed aggregate. Studies on the cause and control of vanadium stains were the basis for the "Vana-Trol" formula. The Process Solvent Co., Inc., P.O. Box 4437, Kansas City, Kans. 66104.
Circle 118, Readers' Service Card

Dual projector compares drawing changes. The "Graphic Comparator," a specially designed, two-part microfilm viewer, superimposes "before" and "after" photo-transparencies or microfilms of plans for checking deletions, additions, or other differences. Lines remaining the same on both drawings show white on the composite image; lines which are on the first card but not on the second (deletions) appear red; and lines which are on the second card but not the first (additions) are green. Controls are provided for size adjustment and vertical, horizontal, and skew alignment of the two images; and the two projectors may be independently focused and dimmed. Unit, 26¼" wide x 30" high x 32" deep, is manufactured under license of General Electric Co., at a list price of approximately $2500. ISES Corp., 1560 Trapelo Rd., Waltham, Mass. 02154.
Circle 119, Readers' Service Card

G-E Silicone Traffic Topping permanently hides unsightly surfaces, permanently protects new ones.

Waterproof. Traffic Topping prevents water penetration and moisture retention damage in concrete and other flooring construction materials. Protects against freeze-thaw cycles. Repairs previous damage. Ideal for outdoor ramps, platforms, walks, and traffic bearing roofs.



Permanently flexible. Made of silicone rubber, Traffic Topping keeps its resilience indefinitely. Won't harden, soften or become brittle, even at –65°F or 300°F. Provides a cushioned walking surface as it protects.

Wear resistant. Traffic Topping withstands wear and abrasion of shoes and vehicles. It's a superior surfacing medium for parking areas, garages, promenade decks, and light duty industrial floorings.

Quick, easy application. Traffic Topping adheres securely to most clean flooring construction materials, old or new. Needs no costly equipment. Cures to a tough, weatherproof surface. Looks great too. Six colors available.

Skidproof, too. Even when wet, Traffic Topping's textured surface assures safe, sure traction where it's needed most: pool copings, laundry rooms, public walking areas, tennis courts. And it even makes non-skid stair treads.

Fights chemicals. Because Traffic Topping resists many chemicals, organic acids, alkalis, salts and oils, it is an ideal surfacing medium for food processing and similar plants, where such materials present a problem.

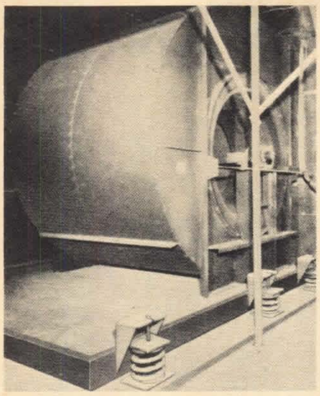
For complete information and your distributor's name, write Section Q12248, Silicone Products Dept., General Electric Company, Waterford, N. Y. 12188

GENERAL ELECTRIC

On Readers' Service Card, Circle No. 405

MFRS' DATA

ACOUSTICS



Vibration study. Protecting lightweight structures from the noise and vibrations of mechanical equipment is a serious problem, especially when equipment is installed on the rooftop close to premium top-floor rental spaces. Laurence Eberhart, author of the study, states that the solution is primarily a matter of designing so that equipment will be out of resonance with the structure, and of selecting effective vibration isolators. Following a discussion of theory and various kinds of noise problems, Eberhart details two practical solutions: floating slabs and concrete inertia bases (shown). Drawings, tables, graphs, and photos illustrate the article. Consolidated Kinetics Corp., 249 Fornof Lane, Columbus, Ohio 43207.

Circle 200, Readers' Service Card

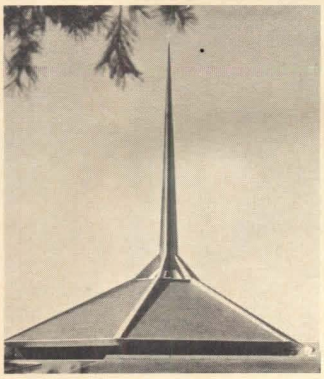
CONSTRUCTION

Wood beams lend personal warmth to any structure, and the impact of their color and texture is probably felt nowhere more quickly than in an institution. How laminated wood beams can be used in schools is described and illustrated in a booklet entitled "Your Dollar's Worth of School Building." It is interesting to note that, despite its title, the booklet does not discuss costs. It discusses almost everything else about beams and trusses manufactured by Timber Structures, Inc. 16 pages. Color. Timber Structures, Inc., P.O. Box 3782, Portland, Ore. 97208.

Circle 201, Readers' Service Card

Slide-rule type calculator. Design tool aids in figuring amount of expansion, and estimating width of construction joint for polysulfide base sealants. Accompanying 8-page leaflet explains use of calculator, describes polysulfide-base sealant capabilities, and provides guide tables for estimating sealant coverage. Thiokol Chemical Corp., 780 N. Clinton Ave., Trenton, N.J. 08607.

Circle 202, Readers' Service Card



"Copper, Brass and Bronze in Architecture" illustrates the use of these metals in buildings. Color photos and architectural details show how copper, brass, and bronze have been used in window frames, curtain walls, and a Saarinen church spire (shown). Booklet describes finishing processes (mechanical, chemical, and applied coating), joinery and maintenance, and also includes metallic color samples. 24 pages. Copper Development Assn. Inc., 405 Lexington Ave., New York, N. Y. 10017.

Circle 203, Readers' Service Card

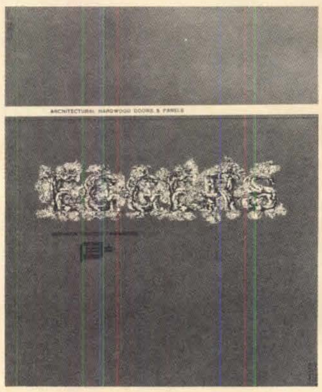
Hardwood plywood directory lists mill locations of 61 manufacturers. Tables indicate each mill's panel size limitations; equipment; species of wood; and types of product manufactured. Products listed include doors, block flooring, wall panels and school "components" among others. Hardwood Plywood Manufacturers Assn., P.O. Box 6246, Arlington, Va. 22206.

Circle 204, Readers' Service Card

Hand-made brick. Traditional flaws and color irregularities of colonial days give texture to interior and exterior surfaces; folder illustrates with color photos. 4 pages. Glen-Gery Shale Brick Corp., Dept. H, P.O. Box 206, Shillington, Reading, Pa. 19607.

Circle 205, Readers' Service Card

DOORS/WINDOWS



Doors with solid cores are described in a fold-out chart giving sizes, Federal and commercial standards met, finishing, detailing, guarantees, and cutaway views showing construction of the five flush types. A number of hardwood veneers are available and are also charted by species under sawn, or rotary and plain sliced. Plastic faces may also be specified. Fire and acoustical doors are detailed and also lead- and copper-shielded doors. "Architectural Hardwood Doors and Panels" includes sections on hardware preparation (this may be done at the factory), specifications information, veneer matching, and custom-fabricated doors. 34 pages. Eggers Hardwood Products Corp., Neenah, Wis.

Circle 206, Readers' Service Card

Tri-coated steel. Window-wall units are galvanized, bonderized, and coated with baked enamel in one of eight standard colors. Manufacturer also offers to match any special color specified. Folder contains specifications, color samples, and series of traceable detail sheets for "Spectra-Guard" window wall, Series 365. Carmel Steel Products, 9738 E. Firestone Blvd., Downey, Calif.

Circle 207, Readers' Service Card

FURNISHINGS

Design Ideas with Tiles are explored by Peter Muller-Munk Associates, industrial designers, in a 24-page catalog illustrated with color drawings. Tile, with its old qualities of cleanliness, durability, and low maintenance, is shown in new applications; for instance, to incorporate directional information at eye level, to define wall space in bold contrast to window areas, or to create a visual feeling of wall height with vertical arrangements. Good browsing material for architects. Natco Corporation, Construction Products Div., Box 628, Pittsburgh, Pa. 15230.

Circle 208, Readers' Service Card

Naugahyde's "Posh." Newly introduced fabric has a pigskin-like texture backed with a stretchable, knitted fabric. Manufacturers claim it tailors easily and is cleaned effectively with soap and water. Swatches of 20 colors are included in a brochure, together with addresses of distributors across the country. UniRoyal — U.S. Rubber Co., Koylon Fabrics & Coated Seating Dept., 407 North Main St., Mishawaka, Ind.

Circle 209, Readers' Service Card

George Nelson's "Work Organizer Desk." Unit utilizes a simple tabletop as an L-desk, supported on one end by polished chrome H-legs and on the other end a two-tier storage cabinet. The cabinet accommodates horizontal and

THE PRESCON MEMO NEWS

THE PRESCON CORP.: 502 CORPUS CHRISTI STATE NATIONAL BUILDING — CORPUS CHRISTI, TEXAS 78401

SCHOOLS POST-TENSIONING ENCOURAGES DESIGN FLEXIBILITY WITH ECONOMY

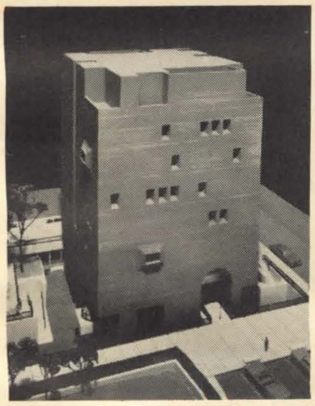
School design problems have been solved by many architects and engineers with the Prescon System of post-tensioning for prestressed concrete. Examples near you can be pointed out by a Prescon representative.

The multiple-award winning Estancia High School, Costa Mesa, California, features a "Great Court" surrounded by academic areas all under one roof. The 200,000 square foot roof was a post-tensioned prestressed waffle slab on a 5-foot square module. The waffle slab is 23¾″ deep using 8″ joist stems and 20″ deep pans. Spans varied from 25′ to 35.′ The roof system was designed for zero deflection under dead load.

Design criteria called for (1) 2,000 student capacity (2) departmentalization (3) flexibility in number, size and organization of departments and teaching stations. All exterior and interior walls are non-bearing demountable throughout the academic areas. Building costs were $1,586.00 per student.

Architects—William E. Blurock & Associates; Structural Engineers—John A. Martin & Associates; General Contractor—Robert E. McKee.

At Bishop College (Dallas, Texas) where all buildings are permanent type, post-tensioning was widely employed. The Prescon System was used in classroom, dormitory and library structures. It contributed to economy in materials, forms and construction speed. (The men's dormitory was occupied in 8 mos.) The flat plates are 8″ thick and cantilever 4′ in all levels of several structures. Bays are 24′ x 26′, with columns 12″ x 20″ and designed for 50 lbs. live load, plus partitions. The Zale Library on the campus has slabs 9½″ thick, with 4½″ drop panels at columns. The first and second level slabs are designed for 150 lbs. live load, plus partitions. Cost, including library furniture, less than $13.50 per sq. ft.



Roy E. Larsen Hall, Harvard University. Architects: Caudill, Rowlett & Scott; General Contractor: Wexler Construction Company.

E. D. Mayes, structural engineer, pointed out that among advantages of post-tensioning were: (1) elimination of deflection in the slab to reduce partition placement problems; (2) use of thinner slabs for reduced floor-to-floor height resulting in lower material costs. Flat plates allow easier mechanical distribution, and ceiling finish can be applied directly to under side of slab.

Architect—Donald B. Kleinschmidt; Consulting Engineers—Mayes & Brockette.

A Ft. Morgan, Colorado, school utilized four structural systems, all post-tensioned: (1) two-way waffle slab; (2) one-way joists and one-way zee·type sections; (3) folded plates; (4) haunched slabs.

Watkins Overton High School Gymnasium with classrooms, Memphis, Tenn. Architect: A. L. Aydelott and Associates; Structural Engineer: S. S. Kenworthy and Associates; Contractor: Sam P. Maury Construction Company.

Estancia High School, Costa Mesa, Calif.

Prescon coated, as well as grouted tendons were used. The library is a 65′ x 90′ clear span area; the auditorium has 90′ maximum spans with the balcony framed of post-tensioned cast-in-place concrete to eliminate the need for columns.

Architect—Wheeler & Lewis; Structural Engineer—Russ Kostroski; Contractor—Hensel Phelps Construction Co.

The Student Union Building, Southwest Missouri State College, Springfield, is a four-level structure with 55′ clear spans. The second and third floors, and roof have 4″ slabs with 6½″ ribs on 3′4″ centers. Floor construction depth is 2′7½″ and 2′11″ for the roof.

Field measurement of camber indicated a variance of ¼″ — from a minimum of ⅝″ to a maximum of ⅞″. In addition to being more economical than the original design, post-tensioning provided the benefit of creep and shrinkage control. Post-tensioning sealed the slabs so well that water standing on the upper portions showed no moisture evidence on the undersides.

Architects—Harold A. Casey & Associates; Engineers—Saul A. Nuccitelli; Contractor—Dondlinger Construction Company.

Today's school design and construction requires ingenuity and creativity to meet the evolving educational concepts, yet remain within budgets. Often post-tensioning will enable you to achieve these demands. Remember the Prescon System — post-tensioning with positive end anchorage.

These are but a few of the hundreds of school structures using the Prescon System. For more complete examples and technical information, write for literature, or contact a Prescon representative.

The PRESCON Corporation

General Offices: 502 Corpus Christi State National Building
Telephone: 512-882-6571 Corpus Christi, Texas 78401

 J 66

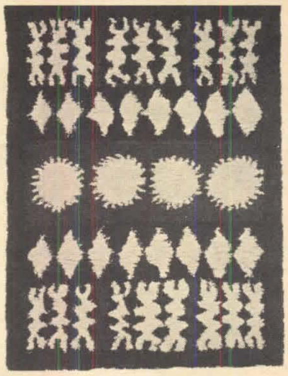
On Readers' Service Card, Circle No. 373

vertical compartments, file drawers, shelves, pull-out plastic laminate writing surfaces, an off-the-desk built-in panel telephone, space for a dictating machine on a sliding shelf, and a concealed waste basket. Manufacturer claims the cabinet's 43" height is conducive to privacy, when cabinet is used as a partition. The unit comes in walnut wood veneer. Unfolding brochure also describes, with photographs and specifications, other pieces of office furniture. Herman Miller Inc., Zeeland, Mich. 49464.

Geometry forms tables and lamps. Strong, simple forms mark a line of useful furniture designed by Neal Small. One table is composed of a plastic sphere of a lamp trapped within a transparent glass base that is covered with a glass top. A floor lamp consists of a slender polished chrome stem on a baked black steel base topped by a plastic ball; the adjustable stem can be tilted to incline the lamp at angles with the floor. In a folder pamphlet, nine pieces are illustrated and specifications are given. Neal Small Designs, 556 Broadway, New York, N.Y. 10012.
Circle 210, Readers' Service Card

Utilitarian economical swivel chairs and stools, shown in a 12-page brochure, include various bases (tubular, footring, cast, wing-bracket), and seats (plywood, glass-fiber, vinyl upholstered). Illustrations explain the adjusting mechanism for seat height. Prices and specifications are given. Ajusto Equipment Company, 515-525 Conneaut Street, Bowling Green, Ohio.
Circle 211, Readers' Service Card

Ceramic tiles are illustrated in a 31-page brochure. Also included are floor plans for bathrooms and suggestions for complementary towels and fixtures. Tiles come in 20 solid colors, 4 stipples (peppering of one color on a plain background), mosaics (plain and in buckshot patterns), and patterns. United States Ceramic Tile Company, Canton, Ohio 44710.
Circle 212, Readers' Service Card



The Tapa Group, a new addition to Bigelow Custom Carpets, are reviewed in a 28-page, color illustrated catalog. The group comprises six rugs designed by Dorothy Liebes, whose interest in Polynesian motifs of ceremonial mats and Tapa bark cloth inspired the geometric designs. Executed in subtropic colors of palm green, burnt orange, beige, ginger brown, black, and white, the rugs are of 100% wool, and are hand-hooked with a shaggy, cut-pile effect. Bigelow Custom Carpets, 140 Madison Ave., New York, N.Y. 10016.
Circle 213, Readers' Service Card

LIGHTING

Fluorescent lamp ballasts for indoor and outdoor commercial, industrial, and residential applications are listed in chart form giving electrical and physical characteristics, lead lengths, and wiring diagrams for each ballast. 32 pages. Universal Mfg. Corp., Dept. RO, 29-51 E. 6 St., Paterson, N.J. 07509.
Circle 214, Readers' Service Card

INSULATION

"Comparison of Foamed Insulation Materials" is an article on the insulating properties of expanded polystyrene and polyurethane by E. Y. Wolford, a Pittsburgh plastics consultant. The discussion is pertinent for refrigerated warehouses, cooler rooms, and other environmental facilities, and includes sections on cost, corrosion, and permanence. The final section is

GET YOUR PERSONAL REPRINT OF P/A's OCTOBER "CONCRETE" STORY

A limited number of reprints of the editorial section of the October issue of PROGRESSIVE ARCHITECTURE have been set aside for our readers.

This was the issue that explored the subject of Concrete from top to bottom. It looked in depth at the uses and mis-uses of concrete in office buildings, houses, hospitals, saloons and state capitols. It gave cogent answers to the question: "What is the future for this most promising yet controversial of building materials?"

Comments and critiques on concrete were supplied by experts from all sides of the building industry — architects, designers, engineers and builders.

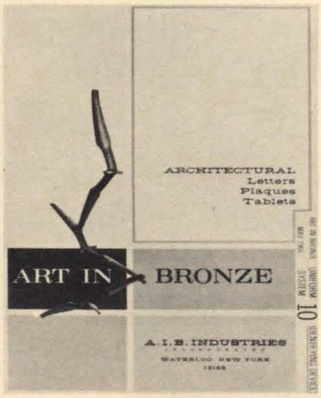
Get your own personal copy (or copies) at $1.00 each of the October Concrete reprint by checking #420 on the Readers' Service Card at the back of this issue. We'll bill you later.

devoted to miscellaneous characteristics of the two plastics, and the study concludes with a strong recommendation for foamed polystyrene. Sinclair-Koppers Co., Koppers Bldg., Room 947, Pittsburgh, Pa. 15219.
Circle 215, Readers' Service Card

SPECIAL EQUIPMENT

Walk in and cool it. Freezers, walk-in coolers, and refrigerated warehouses maintain "K" factor of 0.118 by using foamed-in-place urethane insulation between metal skins in fabricating components. Detailed loose-leaf "Working Data Catalog" gives architectural specifications, and includes sections on doors, floors, accessories, and sizes/capacities. Bally Case and Cooler, Inc., Bally, Pa. 19503.
Circle 216, Readers' Service Card

Du Pont does not make building products. It does, however, make elastomers used for window gaskets, flooring, roofing, fasteners, and sealants. The company has published 18 data sheets covering uses, advantages, limitations, and installation details of applications of architectural elastomers such as neoprene and "Hypalon." Each subject is covered on one sheet, and includes recommended ASTM tests to establish performance requirements for each compound. Elastomer Chemicals Dept., Du Pont Co., Wilmington, Del. 19898.



Cast bronze and aluminum letters range from 1″ to 24″ in a variety of type faces. "Art in Bronze" catalog also covers architectural plaques and custom designs, stainless-steel letters, and letters with plastic faces. Photos, installation details, and size charts. 12 pages. A.I.B. Industries, Inc., Dept. C-18, Waterloo, N.Y. 13165.
Circle 217, Readers' Service Card

SURFACING

Original forest product covers interior paneling. Shunning the printed grain veneers of real birch, walnut, pine, cedar, oak, cherry, elm, or pecan are bonded to flakeboard backing in a union that is said to last forever. Panels, 4′ x 8′ x 1/4″ thick have a burnished finish. Folder suggests uses. Color photos. 4 pages. International Paper, Long-Bell Div., Longview, Wash. 98632.
Circle 218, Readers' Service Card

Ceramic tiles are presented with illustrations of suggested uses in a 15-page catalog. Glazed, crystalline, scored, and decorated tiles as well as quarry tiles come in a selection of sizes and shapes (1″ squares to 4″ octagons). Choice of 50 solid colors, 70 designs. Colors are keyed to bathroom fixtures by "popular manufacturers." American Olean Tile Company, Lansdale, Pa.
Circle 219, Readers' Service Card

Spray-on acoustical ceiling finish and a fireproofing finish are covered in two leaflets. "Blaze-Shield" includes table of fire-retardant ratings and specifications. 4 pages. "Sound-Shield '85'" gives specifications, description of properties, and table of sound absorption coefficients. 4 pages. United States Mineral Products Co., Stanhope, N.J. 07874.
Circle 220, Readers' Service Card

PROGRESSIVE ARCHITECTURE
NEWS REPORT

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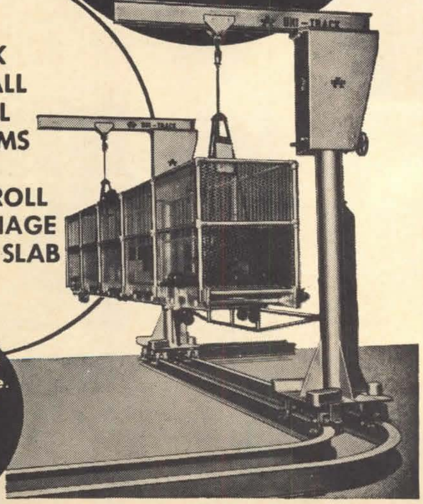

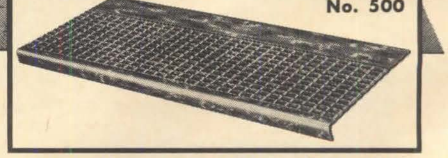

NEXT MONTH IN P/A

Winners of the 14th Annual P/A Design Awards Program as selected by David Crane, Edward Dart, Sepp Firnkäs, Charles Moore, and Joseph Passonneau.

If you are interested in pace-setting design and planning developments, this issue is imperative reading. If you're not, forget it.

To receive the January Design Awards P/A and 11 more issues packed with ideas, excitement, controversy, and ways to better architecture, tear out, fill in, and mail the Subscription Card (see Contents Page for location).

Why are Bradley Washfountains the people's choice?

Because . . . lavatories are fine at home, but in employee and public washrooms, people want wash fixtures that are truly sanitary, quick and easy to use, and require no fussing. Only one wash fixture fits that bill — a foot-operated Bradley Washfountain.

Management also insists on Bradleys. Washfountains save 25% or more on floor and wall space. And they serve up to 8 people with one set of plumbing connections, cutting installation costs as much as 80%. They also save water and reduce maintenance time.

What's more, Washfountains give you a wider choice of colors and compositions than any other type of wash fixture. So, for plants, commercial buildings, schools, institutions — *all* modern buildings — specify Bradley Washfountains!

For complete details, see your Bradley representative. And write for latest literature. Bradley Washfountain Co., 9141 Fountain Drive, Menomonee Falls, Wisconsin 53055.

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On Readers' Service Card, Circle No. 366

Salk Institute for Biological Studies
La Jolla, California

Architect: Louis I. Kahn

Powerful new laboratory looks seaward through ASG's Starlux plate glass

Salk Institute is a vigorous and orderly composition of powerful forms. Built on a headland overlooking the Pacific, it is richly textured without, austerely functional within. The architect has skillfully combined rugged, exposed concrete, weathered steel, mellow teak wood, and 50,000 square feet of ASG's Starlux® twin-ground plate glass. □ Large single lights of Starlux have been used to glaze the Institute's angular, semi-detached study towers (opposite page), where they bring in natural illumination and give each study a view toward the ocean. Similar lights, set in wooden sliding windows, open the exterior of the Institute's two main wings. In these three-story wings, runs of Starlux up to 240-feet long (upper left) enclose laboratory areas. They help relieve the mass of concrete and transmit reflected daylight to work areas. □ Your ASG distributor can show you the luster and visual fidelity which make Starlux the perfect glass for large-area glazing. It's ASG's premier product, precision twin-ground and polished in the most modern plate glass plant in the country. For more information on Starlux, write: Dept. **E-12**, American Saint Gobain Corporation, P.O. Box 929, Kingsport, Tennessee 37662.

Starlux twin-ground plate glass by . . . ASG

CREATIVE IDEAS IN GLASS


How big is a washing machine?
American Laundry Machinery Industries is the only manufacturer equipped to supply laundry machinery to schools, motels, hospitals, hotel chains and armies and never bat an eye over a size or capacity problem. No matter what your situation, the American Sales Engineer will have the right equipment to do your work efficiently, by the highest quality standards and at the lowest operating cost. *They are the men who know how big a washing machine really is.*
These same sales engineers from American are factory trained to be of assistance in helping you, the architect, lay out the laundry facilities needed to do your particular job. Only American offers this professional service.
You get more from American
McGRAW EDISON
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World's largest, most complete line
of laundry and dry cleaning equipment

Look!..

Beneath the surface beauty is the "Hidden Value" of Southern Pine...

Architects know the importance of quality in framing lumber for integrity of design and security. That is why so many are specifying Southern Pine. Pre-shrunk to *full* American Lumber Standard sizes, with engineered strength, Southern Pine is rigidly graded under highest standards of the lumber industry. It lets you plan boldly, with assurance of economy in construction and minimum maintenance during years ahead. All-purpose grading permits use of standard grades for trussed rafters, cantilevered or continuous beams without special grading. Southern Pine lumber also lends visible distinction to your designs in many intriguing forms—durable decking, striking patterns of paneling and siding, exquisite trim.

SPECIFY SOUTHERN PINE FROM THE MEMBER MILLS OF THE SOUTHERN PINE ASSOCIATION, P. O. BOX 52468, NEW ORLEANS, LA. 70150.

On Readers' Service Card, Circle No. 383

Why do we make a chair with 2 right arms?

Same reason we make the same chair with 2 left arms.

So the arms can be switched if the upholstery shows wear.

Practical? Very. You see, getting in and out of your chair a thousand times a day is bound to affect the fabric. Particularly the top inside edge.

That's why we got together with Knoll (the most honored designers in the field) and came up with a 4 arm chair.

If the fabric does begin to wear, you simply switch the right arm to the left side. And vice versa. Quite a saving over the years.

Everything about our chair is made the way office furniture ought to be. Furniture that looks beautiful and works beautifully —a solid investment for the management who pays for it.

ART METAL INC
JAMESTOWN, NEW YORK


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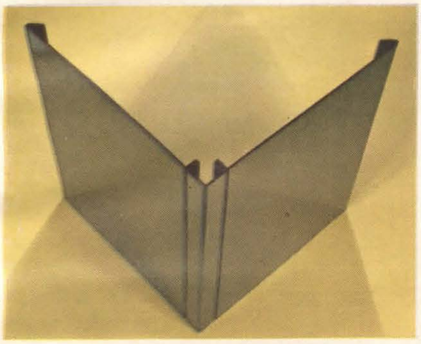
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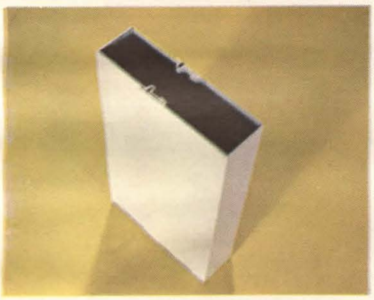
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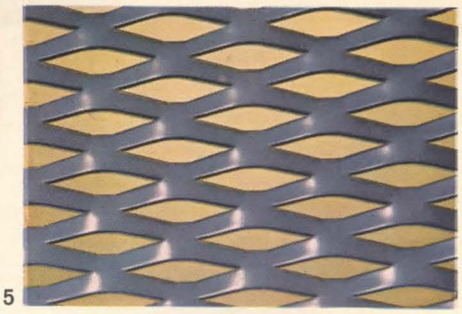
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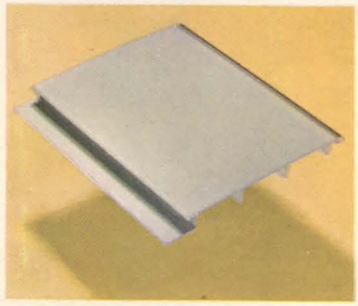
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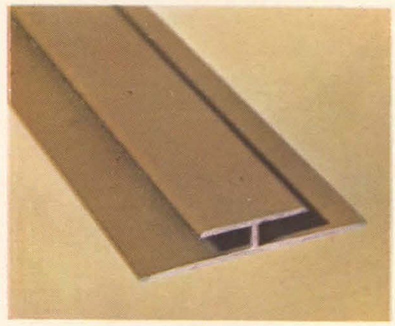
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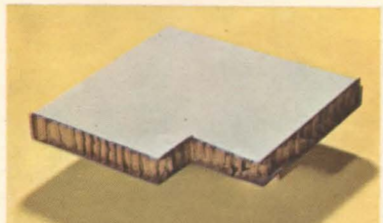
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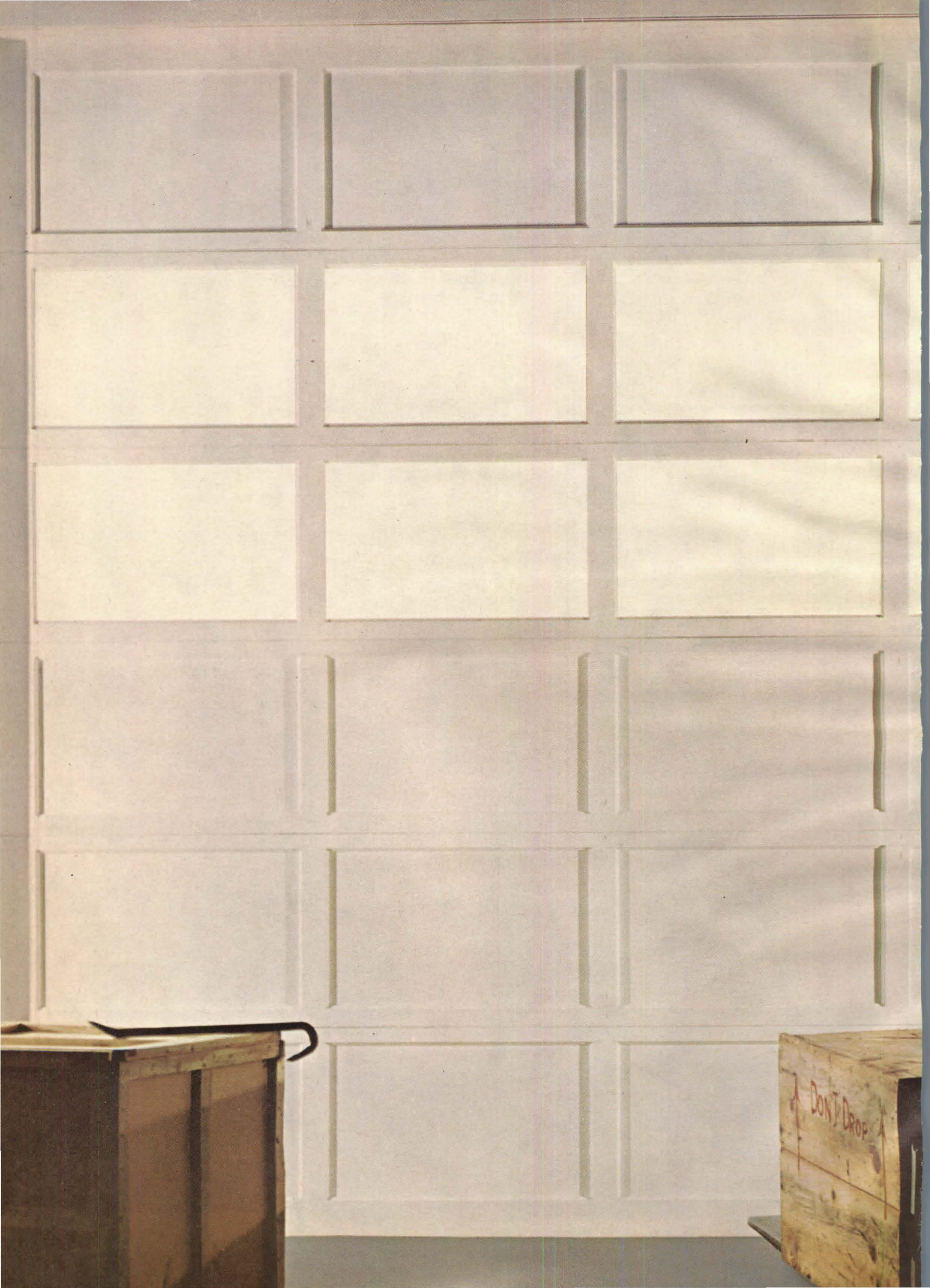
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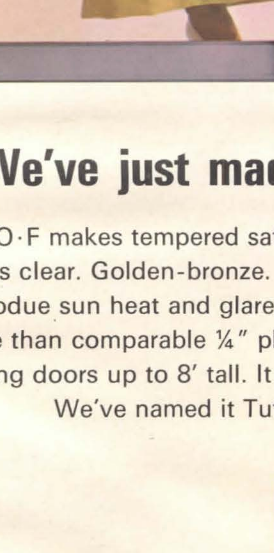

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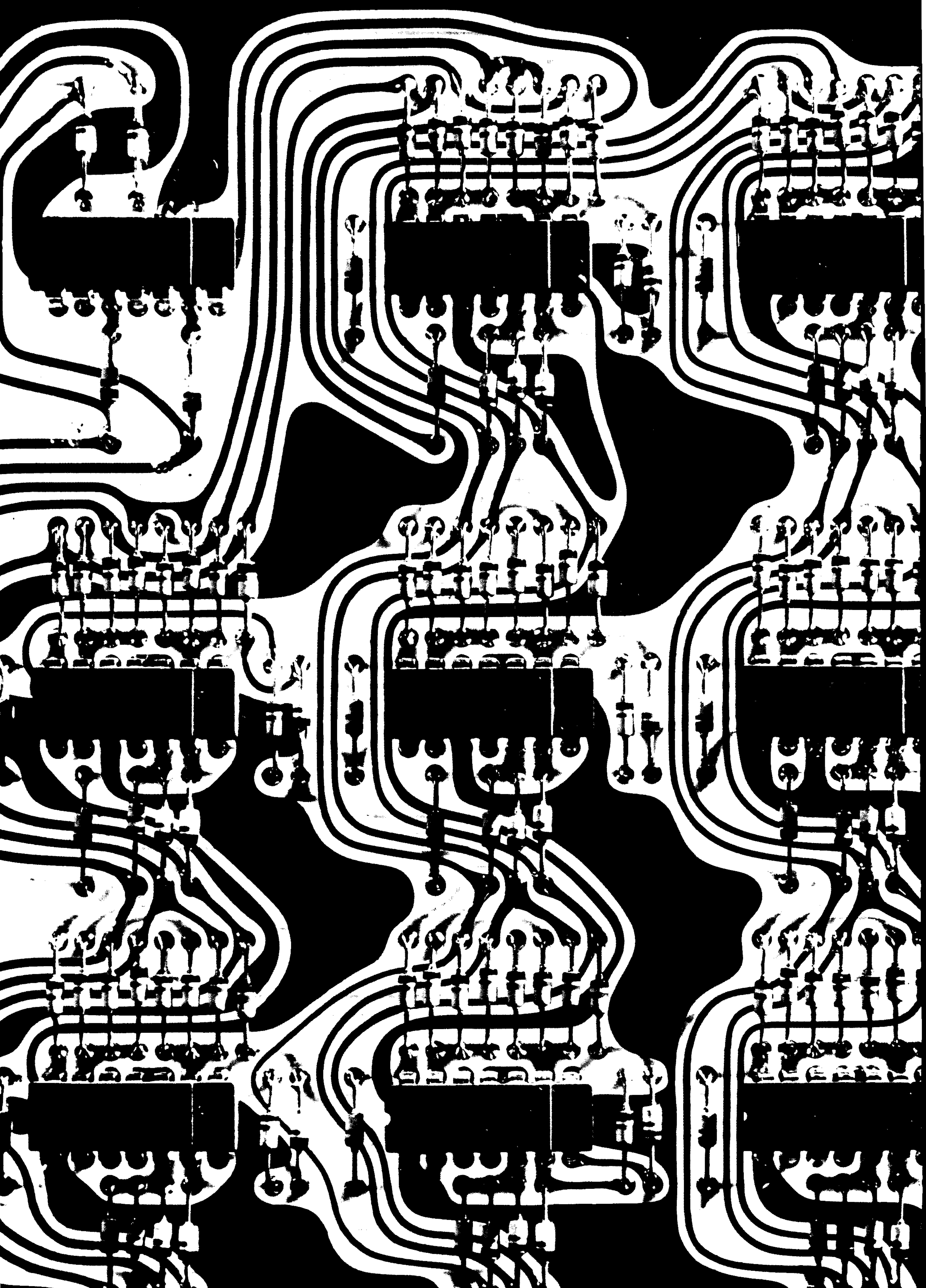
On Readers' Service Card, Circle No. 388

December 1966 **PROGRESSIVE ARCHITECTURE**

"The artist is always engaged in writing a detailed history of the future because he is the only person aware of the nature of the present."

WYNDHAM LEWIS



EDITORIAL

When thinking about the future, one has to think of the present. Without knowing what is, speculation about what will be is not possible. Yet many statements, official and unofficial, that attempt to chart the future course of the architectural fraternity are a result of much wishful thinking but little understanding of today's conditions of man and of society. If architects are artists, and if Wyndham Lewis is right in saying that artists are the only people aware of the nature of the present (see p. 87), it should follow that architects must be more aware of the present than most of their contemporaries. Otherwise, how can they "interpret the present and set the stage for the future" (my words in last month's Editorial), or "engage in writing a detailed history of the future," as Lewis phrases it. And, in any case, whatever an architect is—be it technician, businessman, administrator, or anything else that is part of an architectural practice—he cannot hope to be in a position of leadership unless he has a better understanding of the world around him than those whom he would like so much to lead. Because, after the fluff is picked off, credibility cannot be sustained when only still more fluff is exposed to view.

What is true for architects is also true for those involved in reporting about architecture. In an age of no commonly acceptable standards, no rules, no ultimate ideals, no gilt-edged solutions, the old editorial criteria fall by the wayside. Today, a scholarly discussion about proper, or improper, proportions of windows on a façade of a façade-less building is as meaningful as a pious lecture about "proper" decorum to a mob of youthful swingers. Since times have indeed changed, everybody must also change if they do not want to be left behind as interesting relics of an age that is no more.

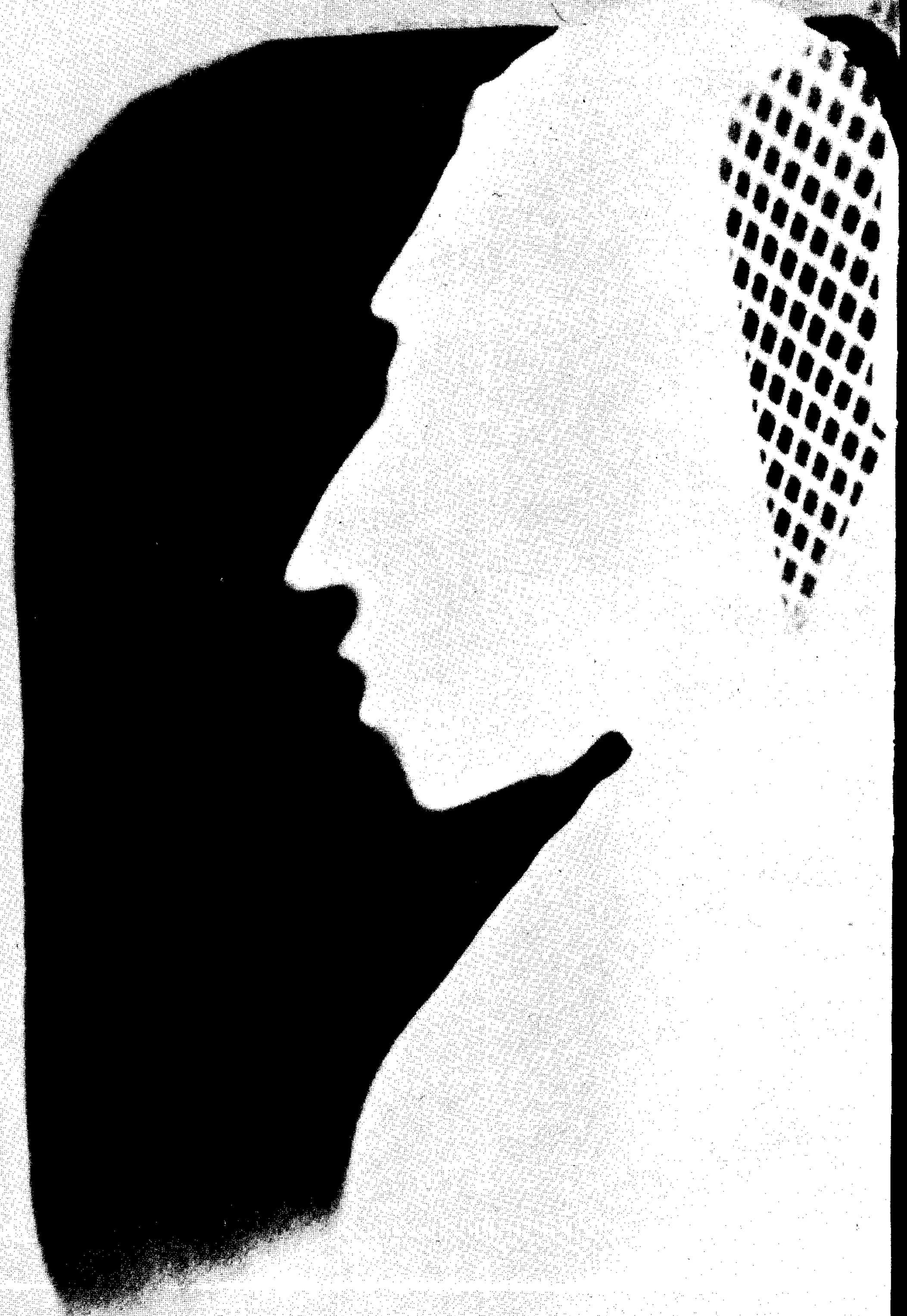
The study on the future, presented on the following pages, resulted from an attempt on our part to undergo a re-education process: We tried to learn what is and what might be, so that we could abandon traditional thinking, which inevitably revolves around what was and what one wishes might have been.

Soon after our research began, it became apparent that one cannot understand the forces acting on architecture without a knowledge of the changes taking place in all the other disciplines. That an understanding of these changes is not beyond the comprehension of any reasonably intelligent person is supported by the fact that all the text that follows was written by P/A's editorial staff, except for one part of the discussion about the future of engineering. Although it took many months, we did manage to digest what appeared at first to be an insurmountable wealth of material, often in fields alien to us.

As the editors progressed with their studies, the cross-pollinization began to take place and many preconceived but cherished ideas were shattered in the process. Among the overlap and criss-cross of the several disciplines under study, similarities were discovered that enabled one to distinguish more clearly what is wheat and what is chaff, and also to discover that there is no inherent good or evil in any new development. The possibilities for good are always there; it is up to us what we make of them. ■

Jan C Rowan

TOWARD THE



THIRD MILLENIUM

"If you do not think about the future, you cannot have one." John Galsworthy

Galsworthy's cautionary statement, aimed at a world changing from the 19th to the 20th Century, is still apropos for the same but infinitely more complex world now on the threshold of the 21st Century. It has been said in other ways elsewhere, but bears repeating in our particular terms, that a child born as you read this will be emerging as a practicing architect (if that will be the designation) at the turn of the century. To cast back an equal number of years, Wright, Mies, Gropius, and Le Corbusier had made their major philosophical statements by 1932, and the impetus to "modern architecture" by Sullivan, Richardson, Jenney, and others had long been given. Young talents now emerging will be elder statesmen in 2000 A.D., as Gropius is now. What is the architect doing to prepare himself for the future? Do his thoughts continually wing out to snare wild and joyful possibilities, or is he intimidated by the sheer open-endedness of the horizon? We know from other disciplines that the future, in the hip expression, is what's happening now.

Architects—and others in related fields—should, by their very nature and training, be able to comprehend a personal idea of the future at least in visual, and perhaps in technological terms. It becomes more and more apparent, however, that this kind of advance perception is not enough now and will certainly not be adequate in coming years. The always increasing complexity of life, the ever-more intricate interweaving of all the factors that form the structural framework of society—sociology, politics, science, technology, humanism, ethics, the list is endless—are making the architect who designs the individual building, the author who writes the interior novel, the scientist who does research disconnected from society, the anachronisms of our day. The umbilical chords of all kinds of "media"—political and social as well as electronic—force us more and more into a togetherness never dreamed of by Madison Avenue. In this gigantic invisible space capsule, we are plummeting into a very different future at constantly increasing speed. Architects and their allies in design and planning will have to adopt a kind of knowledgeable tabula rasa, for lack of a better expression, in order to cope with things to come. This means the ability virtually to erase the mind of today's (and yesterday's) influences and leave it open to what can be; not to become mindless, but to be able to perceive the possibilities available to man and to seize them and use them to man's benefit. This requires, of course, the dropping of countless built-in preferences, prejudices, and preconceptions. The classical way of looking at things architecturally—at single buildings, groups of buildings, cities, regions, countries—will change, will take on so many added dimensions spatially, sociologically, and otherwise, that the heightened perception and acceptance of the mind will be necessary not only in order to be a good architect (one must use terms that may not be current in the future), but, more importantly, in order to be a cogent, aware, functioning person.

The wrench that a complete view of the future in these terms is likely to produce in many architects—the individual-building designer and the planner, the indifferent talent and the pacemaker, the hip and the square—will be painful, no doubt. Safe and comfortable ways of thinking will have to be abandoned for unfamiliar realms. Even those most intrigued by the challenge of future decades may feel somewhat shaken by the full impact of this kind of necessary openmindedness. Conceivably, there will be a period (maybe we are in it now) when a transition will occur, when architects as well as scientists, technologists, and those concerned with the body politic will undergo a sort of philosophical sea change, when the search will be the reason for doing things, with concomitant mistakes and successes. In such a period, when an alienation both inter- and intra-professionally is likely to take place in the development process, a set of guidelines, monitors, reminders of where we are and where we are probably going to go, what the outlook is in related fields—and there are likely to be no unrelated fields years hence—should serve to help focus the architect's mind on the problems and possibilities of the future. This issue of PROGRESSIVE ARCHITECTURE is intended to serve that purpose, and to begin a serious inter-professional exploration of what is to be.

As we suspected when planning this issue, many professionals view the future through rosy, unfocused, or even opaque glasses. The future to them might appear a glut of promises, a desert of inhumanity, or a technological fortress. This indication that architects, while generally intrigued, are without moorings when thinking about the future leads us to title the first chapter . . .

CORNUCOPIA, UTOPIA . . . OR MYOPIA?

In the autumn of 1966, when P/A was questioning architects about their ideas on the future, it was evident that their thinking generally followed what could be called classical lines. There are those who, when confronted with a question of what future society or science or technology will be like, resort to fantasy and/or humor. While this may be a perfectly legitimate means of expression (cf. Swift, H. G. Wells, George Orwell), one suspects that it conceals a tentative, subconscious rejection of the future, compounded by a kind of morbid fascination with the cobra of time, intrigued but drawing back under the cover of laughs or Flash Gordon fantasies. The concern of another group of architects is that future developments may tend to dehumanize mankind. They worry about how to provide sufficient amenity for living in an overpopulated world: how to prevent boredom resulting from living in a superservice state; how the architect can continue to be "inspirational" to the existing social structure; and directing science and technology purely to the "betterment of mankind." There are, next, those architects who think mainly of the future in terms of extensions, refinements, and new developments of current science and technology. These are the predictable forms of mass-rapid transportation, desalination, undersea living, laborless housekeeping, and other physical and planning developments. Then there are architects who, in the Bucky Fuller tradition, develop plans or systems illustrating their own philosophical or technological ideas of how man must or should live in decades to come.

It can be seen from the opinions and ideas that follow that architects are interested, intrigued, and frequently speculative about the future, but there is seldom the kind of attitude mentioned heretofore: **an informed open-mindedness.** The past and the present are closely felt in most of the comments; the prevailing Judaeo-Christian ethic of this era strongly influences most of the moral and social predictions. It is as though the future in all of its aspects is submerged just below the consciousness of many people, ready to be brought out and examined in a serious (as opposed to a flashy consumer magazine) manner. Architects seem willing to explore intellectually, professionally, morally, sociologically, politically, scientifically—but need a bit of a catharsis in that direction.

Fantasy and Humor

"Early in the 21st Century, the major contribution of science to architecture was the development of a remarkable new material, Unistuff," writes Edward D. Dart. "Developed as an accidental by-product of atomic fission in the laboratory of B. Rickmaster Fuller, Unistuff is without question the perfect building material. It is elastic with a simultaneous resistance to great compressive loads, can be made translucent or transparent or opaque, has fantastic insulating value, great resistance to heat, cold, and weather, shrinks and expands only to the most minute degree. Perhaps the greatest quality of the material is its ability to attach itself. No fastenings are required; slap two pieces together and in an hour a homogeneous link is achieved. It is very lightweight and can be cut up into blocks with a knife or handsaw or applied by spray, brush, or in sheets."

Hugh Hardy fantasizes that man's disconnection will grow: "The relation of man to his universe has profoundly changed with the introduction of Von Leeb's Theory of Stellar Inconsequentiality. Having conclusively proved that man is an inferior species of life in the universe, Von Leeb has set in motion a refutation of the established goals of progress. Coupled with the growing use of the hallucinogen LUG, it is feared that the basic involvements of our society are becoming too internal and regressive." A symptom of this is envisioned by Hardy: "The establishment of government-operated suicide parlors, while a great success in the lowering of taxes and the prevention of population excess, is causing confusion within the family unit. The large number of teenagers taking Sleep-Bys makes many parents ask 'What is the point of raising children?' Great pressure is being brought on Washington to raise the suicide age limit to 35 years. Opponents, however, point out that this would be discriminatory and that teen-agers who now have the right to vote should also have the right to commit suicide."

Victor Gruen writes a letter dated August 1, 2166, from the Saturn branch office of his firm "Shapers of Galaxy Environment," where he is preparing "a 'comprehensive redevelopment report' for the Planet Earth for IHUD (Interstellar Housing and Urban Development Department) on Venus. The report will conclude with the recommendation of total clearance, with the exception of some buildings which are between 300 and 6000 years old. It will involve not only the demolition of all Earth cities, but also of 6 million miles of freeway structures, which have brought Earth's communications to a standstill."

"A militant world state ruled by a U.S. military junta," is fantasized by Malcolm B. Wells. He writes a letter on "Day 91, 2061 A.D.," telling of "replaying an old datacube containing a forecast of the world's future written just 50 years ago. Someone back in those days (1966), an architect apparently, had tried to anticipate the state of the world today. . . . Listen to what was said:

By the year 2000 A.D.

1. World domination by the Chinese, or, at best, a nuclear holocaust.
2. Slow starvation as the population exceeds the food supply.
3. Exhaustion of natural resources.
4. Nature destroyed.
5. Cities below the sea and on the polar ice-caps.
6. Man made expendable by automation (their word for our Control).
7. Brainwashing by some central power (they never considered the possibility that minds focused on fixed lines of fact might give us a better world).
8. A loveless, urbanized, anonymous, code-numbered populace, made weak by lack of work and exercise. (As if nothing could be better than the way we used to hold ourselves erect all day! True, people then lived longer lives than we, but what insecure, worried lives they had. Before life schedules started, no one had the slightest idea what he might be doing at any given moment 10 years hence, and immense energies were frittered away in random, aimless struggles for what was called creativeness or individuality.)
9. Privacy lost through surveillance devices (as if privacy were some inviolable right).
10. Shallow, valueless people, made immortal by body freezing.
11. Education to assume greater and greater importance and consume more and more of our life spans. (Education then was still a matter of generalizing for years and years, then specializing only in the last few.)
12. Faster and faster aircraft, hauling greater and greater numbers of (sweating and praying) human bodies from one place to another.

"The only prophecy that this long-dead architect really got right was the survival of his urban grandchildren, though he didn't see them as sole heirs of a great world order, nor did he even suspect they'd have to depopulate four continents in order to make room for themselves. And he certainly never guessed that his own profession would have so completely disappeared."

As you can see, more than a little cynicism threads through most of these fantastic forecasts, as though many persons are infected by the fear that man and his "extensions" can only continue to brutalize the earth and its inhabitants. It is a fear sometimes shared, but with greater hope of a happy outcome, by many of . . .

The Humanists

. . . who seem to be in the majority among architects thinking about the future today. These are the people who look into the future and see that "the perfectibility of man and his world is still the goal," as John J. Desmond says. There will be constant factors, in the opinion of I.W. Colburn: "We will move faster. We will be able to exchange ideas more quickly, more completely, and more directly. We will live longer, but our relationship to one another will be the same as it always has been, for man is made up of a series of constant factors. These factors never change, although the materials he has at hand change, and the knowledge he has at hand changes. Man used his materials and knowledge in the same relationship in the beginning as he will in the future. These are **constant factors**: (1) The pursuit of happiness. (2) The collection of goodies. (3) The search for an absolute. (4) The stimulus of excitement. (5) The instinct for self-preservation.

"Time comes and goes, the casts and props change," Colburn continues, "but the problems are always the same, no matter what comes about. Space inhabited by man is limited by the Grace, Glory, Aspiration, and the worms of man, and they will be forever constant."

"Freedom in the broadest sense still remains our major goal," Fred Bassetti says of the future, "particularly long-range wireless transfer of power, which would promote freedom in the physical sense. Genuine objectivity and the scientific method still have not triumphed.

"The space program has allowed us to find out that the building lie does not exist on other inhabited planets," he adds. "Maybe now integrity will be recognized as the first essential characteristic of good buildings."

Flag-waving still gets attention in some quarters. The Canadian John B. Parkin, for instance, writes: "The first great impact of worldwide communications has gradually lost its impetus and the news media are much more selective. Mankind, therefore, no longer finds it necessary to wallow in a slough of rape, shooting, murder, violence, and destruction. Having had a large portion of this tremendous load lifted from his shoulders, man is now able to concern himself with developing an individual serenity that heretofore escaped him. With this will come a realization of the ineffective quality of humanistic thinking and, who knows, may even lead us back to a renewal of one of the establishing principles of the American way of life—'In God We Trust.' "

Ronald Beckman believes that "The idea of self-denial for the sake of society has given way to a demand for greater personal freedoms. This is coupled with a belief in a moral obligation to serve others, for the gratification it brings one's self. A minority realize the responsibility to serve.

"Affluence is the common condition," he adds. "There is great boredom among the majority, those who cannot find an animal challenge in life. An educational struggle to change the attitude of masses of people from dependence to creative, independent thought is underway."

John Lautner foresees that moral problems will be to keep concepts of behavior "based on human values, rather than money or pressure or tradition—otherwise [life is] not worth living." He thinks the problems of society are "to keep the infinite variety of individual life within some kind of total world based of human value and growth."

"Man, being a creative animal, would continue to improve upon his physical community," says Don M. Hisaka. "His values may become more abstract, aspiring to a new morality that is infinitely more complex and at the same time more subtle. This morality, however, continues to require man to evaluate his deeds in terms of individual concepts of right and wrong. Man's struggle for a more perfect society will continue."

John Desmond elaborates on his views: "Democracy has become more socialized; individual freedoms are guarded but subjugated to the common good. The theological thought that leads others is the one which has been built on the highest respect for mankind as an individual and has engaged in helping him realize his highest potentials. The scientific community in world society has held its respect, but the leadership remains with those people who best define and direct mankind toward humane and spiritual goals."

Paul Rudolph provides a footnote in his comment, "Our commitment to individualism is partially a reaction to growing conformity in the 20th Century, but, more importantly, an excitement when we sense magnificent new forces and their possibilities. There are too many new worlds to explore, too many new problems crying for solutions, for there to be a universal outlook (every critic implores the gods to make us the same) in an age of profound transition."

If man will indeed be the constant, he will affect and be affected by innumerable scientific and technological changes in forthcoming decades. These changes are the main concern of . . .

The Extrapolators

. . . architects who can take current developments and philosophies, and those that are in embryo, and parlay them into full-fledged future facts and influences. Existentialism, McLuhanism, God-Is-Dead-ism, consciousness-expanding techniques, supersonic mass transportation, bionics, advanced electronics, all and many more are grist for the mills of their imaginations. The difference between these imaginers and the fantastics is that these men usually extrapolate from known qualities and quantities.

Danforth W. Toan holds that "Marshall McLuhan's media will be dispensing their messages in such a fantastic way that 21st-Century man could well be far better and more widely informed about the total existing body of human knowledge than in any previous century. Abused, these media could reduce us to mass idiocy, a schizoidal crumbling of the psyche. We will be universally overexposed to our world. Sensory experiences will undoubtedly include ones generated internally: psychoanalysis, psychedelics, hypnotism, E.S.P. The unconscious may become the superconscious." He thinks that "Science will have produced: energy from the earth's core; desalination by means of rain (weather control our best technique); eternal life, genetic control; interplanetary travel; exploitation of gravity for energy and flight, etc.; thought-transference; antimatter. I foresee that all forms of locomotion (submerged, airborne, land), wavelength communications, and energy can be miniaturized and augmented incredibly." The technology of the 21st Century, according to Toan, will be fully automated and released from the requirements of military production, and will therefore offer the "means of abundance to mankind. Basic distribution, without competition, will be universal. Molecular chemistry will produce new raw materials. Energy sources (tides, earth's core, atomic, etc.) must be developed that do not exhaust the inhabitable earth. Technology will conserve and rehabilitate the depleted areas."

Cautioning that we cannot assume that today's problems of race, war, conflict between cultures and technologies will be resolved within the next 50 years, Cesar Pelli concentrates on the sensory factors of the future. "I see here," he says, "a total integration of electronics and biology, so that we are able to do away with the intermediate equipment and send and receive instructions directly by just willing it. In this way, we will communicate with men and machines. This will be, I believe, the new technology. It may also do away with individuals as we understand them today."

"The arts have practically disappeared," Morris Lapidus prognosticates. "Engineers and scientists have become the fifth estate and the elite. . . . Our homes are marvels of efficiency—no more cooking, no more washing, no more cleaning. Everything is either disposable or electronically produced or controlled. . . . Creating new methods of nourishing the thickly-populated world is the major problem. Every form of waste—human and manufactured—is reconstituted for consumption and re-use. Our oceans are dotted with man-made islands, and with factories that process food and chemicals from the deep."

"Assuming that coming decades will not find us standing in a pile of rubble trying to fix axle to wheel," John Carl Warnecke comments, "the possibilities for the future test the imagination. For example, it has taken some 50 years to reduce the travel time across country from days to a few hours. All that stands between us and instantaneous transportation is five hours of the fourth dimension. It is not inconceivable that revolutionary concepts in physics will be developed to break that barrier taking us into an entirely new dimension and permitting travel to the far reaches of the universe.

"We have not even begun to utilize the total capacity of the mind. We know that people can be taught to read at a far greater speed than the average and with greater comprehension and recall. Children can be taught this technique most easily and have been able to read at speeds of 10,000, even 20,000 words per minute. The only real limit, theoretically, is the speed of light. The teaching possibilities for an instructor faced with a class that could discuss 100 books instead of the usual four or five are enormous. . . . The entire educational system would be revolutionized.

"With more knowledge at the individual's command," Warnecke concludes, "and a longer life span to utilize his increased capabilities, man will still be faced with the problem of expression. What we know has already outpaced our ability to express what we feel, and the role of the architect as a visual interpreter of the nature of the times will become infinitely more complex." Thus do humanism and the pragmatic view of the future coalesce.

Vincent G. Kling also is aware of the two horns of the outlook. "In the year 2000," he thinks, "airborne vehicles will be powered from remote ground and airborne power stations and travel automatically along a system of air routes. Travelers, after selecting routes and power sources, will travel quietly, secure from power failure, free to see where they are going and to enjoy their trips. The by-products of the power sources will no longer be contaminants." But: "Having run through the violent search for com-fort and fun into which they fling themselves all over the world, people will rediscover the joys of a smaller orbit with fewer people and clearer situations better explored. People will have reacted to the horrors of quantity by achieving a much higher qualitative society. They will have found the moral and religious answer to the general explosion of the population; the birth rate will be on a descending curve."

Leo S. Wou also sees instantaneous communication at will, and predetermined, high-speed travel mixed with greatly improved current means (commuter helicopters, for instance). With the tremendous increase in population, he says, "a boom in the development of the chemical food industry is seen. One can consume pills for existence, and physical starvation is left only for the adamant demonstrators." Although fresh food is no longer a necessity, he adds, "people still patronize restaurants for this luxury." Wou wonders about man's "spirit" in this environment, however. "Monetary poverty is no longer a social ill. However, after struggling for decades to reach space, concentrating all efforts on scientific exploration, men have suddenly discovered themselves starved for culture. Once again, patronage of the arts becomes prevalent in society. Boredom becomes an even more common social problem. People's search for excitement causes the advanced development of many forms of drugs that are sold not in pharmacies but in bars, since liquor is now considered a more passive form of enjoyment."

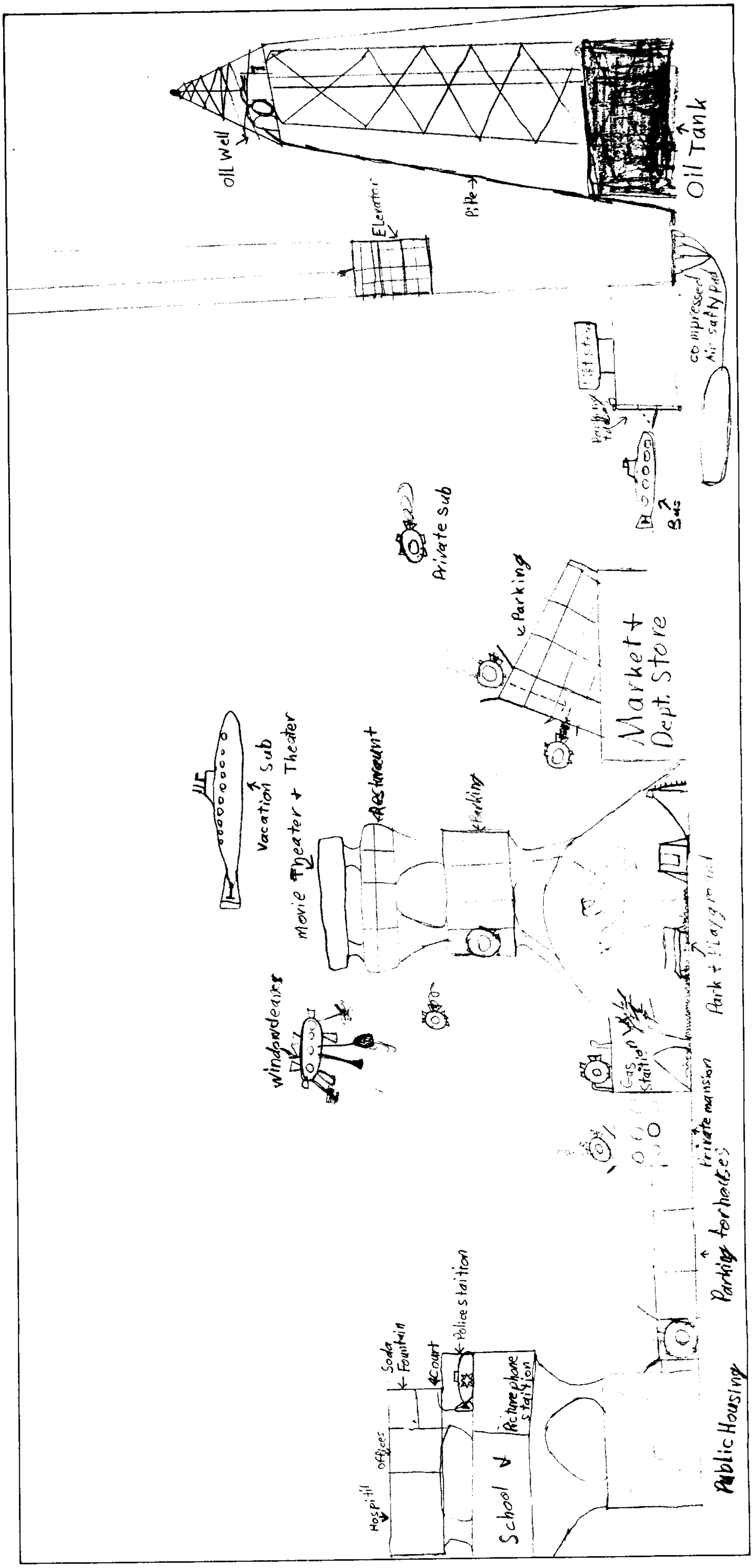
"Since electronics has become a commonplace and instantaneous audiovisual communication is our tool, together with greater mobility," points out Serge Chermayeff, "we are entering a 'global village' world in which everything is present all the time, on a more complex and more generalized scale, but an equivalent of the old tribal environment which every member of the tribe knew very well, had little incentive or need to talk about but had to see, smell, hear, and touch to survive. We are indeed becoming part of a global village and require all necessary sensual and mental awareness to enable man to move freely in an environment which is actual and not merely described."

What About The Architect?

As many varied disciplines become more aware of each other and even tend to merge to become other, more sophisticated pursuits, what will become of the practice of architecture? Will there be an architect as we now know him in 50 or more years? "It is certainly true that, in the future, architects might lose control over many architectural occurrences," opines Manfredi Nicoletti. "But it is the architect's scale that is changing and not his function. There will always be a need for an interpreter of necessities and hopes for a more dignified and 'human' way of life." According to Frei Otto, "Architectural problems of the future will be so extensive that architects must collaborate with and study the work of others to enable them to comprehend and to cope with the population explosion and related tasks."

But will there **be** an "architect"?

"The 21st Century's architect will be the ecologist of land and habitation," in the opinion of Toan. "He will be the environmentalist. His



training, talents, and sense of humanity prepare him for this role. Hopefully, he has the sense of humor and delight to spare his fellow man from environmental tedium. To do this, he will have had to abandon his parochial 19th-Century preoccupations of 1966 style per se and the single building and plunge into a vast new scale." Pelli thinks the architect will still be in existence, "but probably directed into some sub-fields. The sub-fields will have to do with the areas of operation. The main ones will be: politics—the architect-planner; technology and industry—the master builder; and aesthetics—architecture as an art form, assimilating all the arts."

"Architecture no longer exists," says Lapidus. "The scientists and the manufacturers mass-produce structures. With an exact computerized form of planning and programming, our endless belts of habitations wind through the country as once did those ridiculous old superhighways." Kling believes that "The age of the specialist will have died. We will have good generalists; in the vanguard will be architects who will come again to lead us. The artist will return and the poet will return and the scientist will no longer captivate the imagination of the world."

"Master architects" are foreseen by Wou: "The individual building designer of the mid-20th Century is now almost nonexistent. Instead, he is now closely associated with product designers. A new professional practice has developed. Many 'Master Architects' capable of thinking in a comprehensive scope have established themselves to provide leadership to diversified architectural and planning specialists, including sociologists and economists, etc., in order to engage in large-scale environmental planning." Beckman comments, "The architect has been replaced by social planners, theologians, and engineers. His former [1966] role of enhancing material values is now of little social use. The enhancement of naked ideas is the quest of the 21st Century. Mathematics, verse, pure abstraction is the occupation of the arts."

"The best architects have finally realized that their long-sought goal of 'beauty' is an outgrowth of two things: a sensitive response to the **conditions** affecting a design, and an effective application of this enduring principle of good design everywhere to which the human eye and mind still respond," says Bassetti. "By this I mean a judicious balance between order and disorder, rhythm, balance, harmony, etc. Fitness, order, and proportion still rule, fortunately." With the possible great changes in scale and nature of human habitation coming in future years, William Breger thinks that "The seminal problem of the architect as artist would generally seem to be the real challenge. I believe, as we see in art today, that the traditional barriers separating the arts will break down. Architects will go the way of the arrowhead designer, but the existential problems of feeling, experience, and delight will, now that material problems have been solved, be more primary than they are today, and just as controversial."

P/A asked San Francisco architect Robert Marquis for his views on the future when this issue was being prepared. Perhaps he begged the question, perhaps he did the logical thing, but he turned the topic over to his son David Marquis, "age 10, whose ambition is to be the architect of the future."

MARQUIS: How will people live in the future?

DAVID: People will migrate under water even if all of the space isn't taken up [on earth]; it will be an exciting space with more room.

MARQUIS: When will this migration take place?

DAVID: It will take at least 70 years in the Pill and Capsule Age; people will live there permanently and come up on earth for vacationing.

MARQUIS: Can you describe this city of the future?

DAVID: There will be two types of dwellings—a series of domes, or one large dome five miles wide. There will also be underground-underwater [cities]; these are under the floor of the ocean.

MARQUIS: What type of architect will design these cities? How will he do this?

DAVID: I think it will take teamwork or a new type of architect-engineer.

MARQUIS: What else do you foresee in decades to come?

DAVID: I think these cities will be built on the Continental Shelf. We will grow meat so you don't have to kill animals; farms for animals take up too much room. Factories will be underwater.

(David's rendition of his underwater city is reproduced on the facing page.)

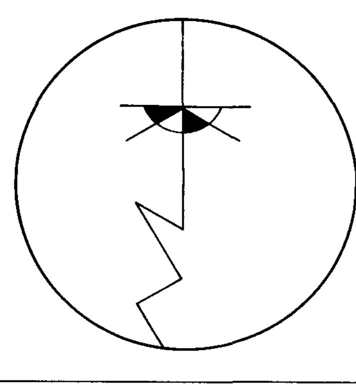
Mind Opening

Whether David Marquis has all the answers only time will tell. There currently exist innumerable paths to follow, countless facets to examine, multitudinous philosophies to study, in trying to arrive at a viable picture of the future. The increasingly complex interdisciplinary "mix" will require ever closer attention from the architect who cares about keeping **au courant** in what is to come. We hope that this issue of P/A, examining as it does a number of the major facets of the future, a selected group of opinions, facts, presages, will serve to help all interested architects in achieving that necessary attitude of "informed open-mindedness" about the future referred to at the beginning of this article. The professional and cultural atavism that can beset us all when trying to peer ahead will hopefully be diminished somewhat by the following pages, the horizons become clearer, and the invisible frontiers infinitely inviting.

To be able to begin thinking about the world of tomorrow, one must understand the world of today. In this chapter, therefore, we present a brief review of changes that have taken place in recent years in man's beliefs—both religious and secular—about himself and his relationship to the world in which he lives. No doubt, we are all living today in a period of . . .

THE PHILOSOPHICAL REVOLUTION

If architecture used to be the "mother of the arts," then the matriarch of the vast body of knowledge and research loosely banded together under the name of science was certainly philosophy. Philosophical inquiry into the why and wherefore of man's existence has produced its counterpart in physical, or scientific, investigation, dating back to the time of Aristotle. Until recent decades, the postulations of philosophy often served as springboards for scientific search and discovery. This free exchange of ideas on both sides, which became most fruitful at the time of the Industrial Revolution, continues. Today, however, there is a widespread feeling that science and philosophy have become divorced; that the scientists, with more and more answers to the basic questions of man's physical nature, have become ascendant and no longer need the philosophers. Conceivably, there will come a time when no further scientific investigations will be possible; all the questions will have been answered. The physical reality of man will be written large for all to see. What the role of philosophy will be at such a time it is not possible to foresee. It is, however, possible to try and assess the state of philosophy today: In the eyes of some, it is a discipline of dwindling influence and importance; in the opinion of others, recent philosophical positions have moved out into the market place and have become the way of life for many people—this in an extraordinarily short time, since the end of World War II. Either attitude considered, it constitutes a philosophical revolu-



tion. If philosophy is dead, man might ask the recent musical comedy question, "Who Can I Turn To?" If people are living out the precepts of the existentialist philosophers in their own lives, then it would seem that philosophy is far from dead, but very much alive and swinging.

The Sources

Those who see in science the danger of the dehumanization of man consider that its ascendance will bring about the death of religion, the death of philosophy, the death of "democratic" society. Aldous Huxley and George Orwell were among the most prominent in prophesying the imminent death of individuality, man's soul, personal freedom and privacy. Man, they theorized, was certain to become a robot victimized by a brutal totalitarianism without the safeguards traditionally provided by the Judaeo-Christian concept of life and man, and without the watchdog of philosophy to soothe the harsh, mechanized voices of the future.

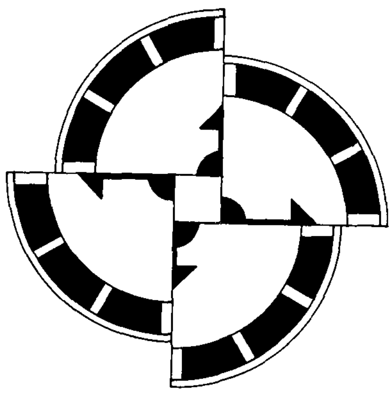
If we turn to the past to seek there a conflict similar to the one that exists today between traditional religious ideas and philosophy and science (or technology), we find the dialogue between Hume and Kant that preceeded the Industrial Revolution. Hume was moved to skepticism by his age, proclaiming that there was no observable reason for believing in cause and effect —the cornerstone of philosophy **and** science until then—and that the mind was nothing more than a series of sensations, structurally linked like atoms and molecules, bumping into one another causing "ideas," that there was no reason to accept the idea of a human soul, that the burden of proof for miracles fell on the producer and believer in those miracles, that the idea of God was unnecessary, that morality was strictly equatable with good manners. Hume concluded that it was impossible to **know** anything beyond what is immediately perceptible to the senses; that there was thus no assurance that an outside world even exists, and that to assume our perception of the world conforms to the world in reality was an unfounded and presumptuous.

As a religious storm whirled around them, Kant replied to Hume that the human mind is such that it cannot help but see things as causes and effects, that even though we cannot **prove** the world is as we see it, it remains that we cannot help but see things in certain ways—that things seem to have shape, color, size, quantity, etc. He postulated that there are two distinct worlds: "phenomena," the world our senses perceive, objects as they appear to us; and "noumena," the world of objects whose properties our senses either distort or do not even register. It was as though the human mind occupied a box whose top had round holes punched in it through which all information registering on man's consciousness passed. Things too big or too oddly shaped to pass through the holes would not reach awareness, because our senses would not pick them up. This world, as postulated by Kant, we cannot know, and it was this epistomology that strongly influenced subsequent philosophies.

Almost a century earlier, the French philosopher and mathematician René Déscartes (who helped Galileo formulate the new science of physics) propounded one of the most influential and ambitious theories of the nature of man and the universe. His method of defining reality is one that has had great influence on today's existentialists: He decided to doubt everything he could think of until he arrived at something he could not doubt. This something proved to be his own doubt, leading to his famous **Cogito, ergo sum** ("I think, therefore I am"). Déscartes decided that he knew he existed because he was aware of himself sitting in his chair, pondering his existence. He conceived that God must exist also, so that his thinking could take place. The essential perspective of modern thought is marked by Déscartes first assuming man's existence— specifically, his thinking self—and then assuming God's existence as a logical and necessary precondition. Thinkers ever since Kànt and Déscartes have been more preoccupied with phenomena and the "I" that thinks than with God.

The other event crucial to the development of philosophy **and** science at the beginning of the 18th Century was the work of Galileo and Newton, who both challenged religious doctrine about the nature of the universe and the earth's place in it, and who brought about the beginnings of what we now call physics—the systematic description and analysis of the physical universe. In a sense, they can be called the first scientists, since their findings were the first to be proven by experiments. As a result, the efficacy of the scientific method was established, and the beginnings of the modern "scientific attitude" can thus be roughly assigned.

From Déscartes until the existentialists, philosophy was divided between the rival schools of the empiricists, who maintained that knowledge



has psychological origins, that all our ideas derive from impressions, sensations, experiences of objects in the material world, and the rationalists, who considered themselves super-geometers, super-physicists, proceeding on logic and reason alone, ignoring sense data and experience.

Toward Existentialism

In the two centuries since the formulations of these four great "natural philosophers"—Kant, Déscartes, Galileo, and Newton—the rift between organized religion on the one side and philosophy and science on the other has tended to become deeper and deeper, as new systems of philosophy and new discoveries of science have challenged traditional religious ideas and concepts. Three developments have brought about the alienation between the three realms: one, the rise of science became a direct challenge to religion; second, religious tradition by and large remained monolithically unchanged, despite vast social changes, tending to separate people from their religion; and third, recent developments in philosophy, having their seeds in the 18th and 19th Centuries, have transformed philosophy itself and made of its precepts a way of life for many people, with a resulting influence on many other aspects of life, including religion and science. (Today, for instance, ecumenicism and other movements are seeking to "modernize" older religious ideas.)

In the past—excepting perhaps the earliest days, when philosophy was a major and immediate force on the lives of the people—though dealing with the stuff of life, philosophy tended to be removed from life, with new attitudes and ideas coming "down to the people" only after some years of cerebralization on rather exalted levels. The current "acting out" of existentialism is of a very different order. In the relatively short time since World War II, many people, consciously or not, have seized on the teachings of Sartre and the existentialist thinkers and made a **modus vivendi** of them. Thus did a philosophy and the temper of the times coincide perfectly to furnish a way of looking at man and his world at a time when one was badly needed.

Although Déscartes has been called a precursor of existentialism, it took the Danish minister and philosopher Soren Kierkegaard, in the 1840's, to pronounce the extremely personal views of man's existence and search for truth that led, in their translations into French in the 1930's, to the founding of existentialism. Another profound influence on existentialism was the German philosopher and mathematician Edmund Husserl, who, influenced by the early empiricists, sought to explain life as consisting of both intentions and meanings. He thought that a science—which he called phenomenology—could be formed by examining consciousness itself without any preconceived prejudices. To reveal the primary origins of experience by free examination, he thought it necessary to wipe the slate clean, to start again with what one is conscious of at each separate moment. After World War I, two German philosophy professors, Karl Jaspers and Martin Heidegger (who is still alive), developed the actual outlines of existentialism. After translation of both Heidegger and Kierkegaard into French, World War II provided the catalyst for the philosophy to become a living force, and there emerged the leader of this new wave of thought, Jean-Paul Sartre.

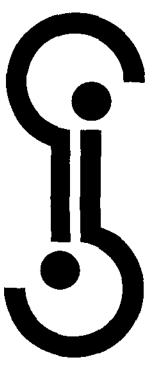
The essential difference between existentialism and previous philosophies lies in the relationship of man to the world. Previously, in the tradition beginning with Déscartes, it was thought that there were two opposing realities: mind and matter, conscious thought and inert matter. This was a great advance over the old cage of cause-and-effect that had tended to imprison thought for centuries, but it still set boundaries on man's philosophical aspirations. The mind and body of Déscartes' philosophy became a little more liberated with the "phenomena" and "noumena" of Kant, but not much. With Sartre came a synthesis of the two ideas: there is still consciousness (mind) and objective world (matter). His recognition is that consciousness **is** man's world, and that it constitutes his only world. That is, in awareness we know exactly what the world is like. Things seem to be the way we sense them, so that is the way the existentialists say they are. The ultimate reality is consciousness itself, and since that is all we have, that is the way man exists—as consciousness. This is the synthesis of the split into the unified—through the membrane of consciousness. The world is the phenomena—the "process"—and consciousness is the series of images reflecting and showing it like a film (as though Plato's cave has been replaced by an underground movie-happening).

There is no rigid distinction here between mind and matter. That split is just something else perceived by consciousness. This becomes a personal thing, of course, producing personal, subjective feelings and awareness that are outside the body of scientific description because the scientific pursuit is itself outside this kind of awareness, observing objectively and rationally.

Existentialism has indicated its viability today by being the philosophical basis of thought for both atheists (Sartre and Heidegger), and Christians (Paul Tillich, Jacques Maritain, Nicholas Berdyaev), and Jews (Martin Buber). The distinguishing trait of existentialism, whether religious or atheistic, is its concern for the individual, the refusal to submerge him and his problems into alien cages of logic, metaphysics, and other outdated beliefs. The existentialists, like the "God-Is-Dead" theologians, seek to unfetter man from dated, unworkable ethical bonds, and to set him loose in the world without crutches, as a conscious, aware being. He is alone, but he is able, though his increased awareness, better to suffer his solitude and seek the ultimate openness of his consciousness (atheistic existentialism) or a personal state of grace (religious existentialism).

It's Happening Now

Although existentialism has been dismissed by some as passé, a creature of the unsettled post-war years, it seems, on closer study, to have settled itself into the spirits of the people. What are freedom marchers if not men abandoning a frame of mind that might sympathize but not act for an attitude of overt concern and willingness to experience hardship for man? What is psychoanalysis but the intense, personal examination of one's mental life? What are "happenings" but the complete opening of the senses to the vagrant play of multiple stimuli? What causes the current interest in LSD and other psychedelic agents but a growing desire for a more intense consciousness? What characterizes the "bopper" generation but a new-found impulse to live life for its immediacy—certainly the thing Sartre told them to do. What prompts people to suddenly announce to high authority, "You are wrong; I can **feel** it"? Even in science, there is a growing sense of irrationality, of the limits of "objective" logic. This is certainly living out the basic precepts of



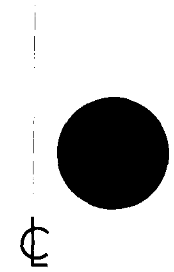
existentialism. If the philosophers have not come up with another way of thought, it is incumbent on them to do so. Right now, the dread and anguish of the 1940's seems to be dropping away, to be replaced by a more balanced experience of life. The pessimism of early existentialism has given way to the attitude: "That is the way it is. Experience it, absorb it into your consciousness." Man simply confronts his own self and everything around him. This is neither dread nor joy—just life.

Philosophy is something that cannot be "forecasted"; it is just there in the minds of men. The year 2000 may—undoubtedly will—bring a philosophy to suit that age. Right now, the existentialist way of thought seems to fit the temper of our world. What the German philosopher Ludwig Feuerbach said about religion can perhaps also be said about philosophy in the 21st Century: "What yesterday was still religion is no longer such today; and what today is atheism, tomorrow will be religion."

Scientific discoveries form the groundwork for the technology of our time. But scientists have also been instrumental in changing all concepts of what man thinks about himself and the world around him. We cannot, therefore, understand the present, or think of the future, without understanding the salient points of . . .

THE SCIENTIFIC REVOLUTION

It was not until the beginning of the 19th Century, more than 300 years after the birth of Copernicus, that his discovery that the earth was not the center of the universe was accepted,



and it will be many more years before the central ideas of Einstein's relativity theory are understood or accepted. This is not because Copernicus and Einstein were impossible to understand, but because their conceptions of the universe man inhabits were radically different from that of their contemporaries. To grasp Einstein's ideas is to change one's conception of the world, to alter habitual ways of thinking, to see things in a new way. Many writers accentuate the effect of technological advances and applied science and engineering on modern life; this article concerns recent advances in "pure science," whose effects are even far more deeply felt; they will eventually alter our ideas about what life means by altering our idea of what life is. To understand the nature of the world is one step toward understanding man's place in it, and it is the researches of today's physicists into matter, today's astronomers into the universe, and today's biologists into the genetic code that will provide future man with his information about what his world is. Perhaps it is because science is so ultimate in this sense—that it **can** tell us what things are—that people sometimes fear it. It is well-known, for instance, how much trouble Galileo had to get even his fellow scientists to look through the first telescope; they simply did not want to know anything that would upset cherished beliefs.

The number of scientists working today represent a total of 90 per cent of those who ever lived, and they are working on ideas barely 30 years old. The scale of the things they work on extends from the farthest known object in space —8 billion light years away and receding at 81 per cent of the speed of light—to the smallest particles of high-energy physics—the neutrino and the photon, which have no mass and no electric charge (and are presumed to have a size smaller than 10^{-15} cm). Some of the work will eventually be applied to man's control of nature; molecular biology may eventually become genetic engineering, or fetal therapy. The investigations of astronomy and physics seem to have no applications—but, then, neither did relativity.

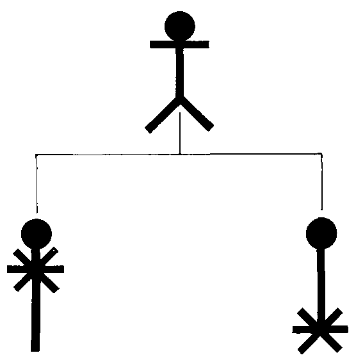
Scientific Method

Science will never reveal what life means, only how it works. Einstein wrote:

"With the help of physical theories, we try to find our way through the maze of observed facts, to order and understand the world of our sense impressions. We want the observed facts to follow logically from our concept of reality. Without the belief that it is possible to grasp the reality with our theoretical constructions, without the belief in the inner harmony of our world, there could be no science. This belief is and always will remain the fundamental motive for all scientific creation."

Is it even imaginable that a minister, a business executive, an architect, a writer, a sculptor, or even a philosopher could write those sentences? To organize observed facts logically is the daydream of intellectuals and architectural critics; no one has conceived an acceptable unifying theory for modern architecture, modern philosophy, modern religion, or even modern culture. Science is the one domain of substantiated, universally accepted ideas.

Einstein's remark indicates not only the essence of what science is, but also the much misunderstood "scientific method." It is on this method, arrived at in the 16th Century after centuries of philosophical speculation as to the nature of meaningful knowledge and the means of gathering it, that science rests. It has been one of Western civilization's most brilliant contributions to thought; it may eventually change man himself.



Einstein does not say that the scientist's perception of reality follows logically from the observed facts; he says the opposite—that the facts follow logically from the perception. It is always a theory that is verified by facts and experiments, not another fact. Many think that scientists go around labeling, measuring, categorizing objects until an order is perceived in the objects and then the scientists spell out the order and that is their theory—thoroughly vouched for by facts. Actually, no theory is thoroughly backed up by facts, only "universal laws of nature" are, like the speed of light in a vacuum. Whenever that speed is measured, the result is always the same—2.9979 x 10^{10} cm per second. But this is only called a law because there is no known exception. Theories are different; there is no theory in science today that does not have exceptions unaccounted for by the theory. They are explanations of the facts, and, as such, they govern the search for new facts. This is why theories always predict facts unknown at the time the theory was made, although known facts provide the springboard for the theory. The ultimate criterion of whether a new theory is acceptable or not has nothing to do with whether it interprets the observed facts logically; that, of course, has to be done. The ultimate criterion is that the theory must be elegant, simple, and beautiful, because scientists not only believe that nature has an "inner harmony" but that all the processes at the basis of this harmony are simple, elegant, and beautiful. Therefore, theories must share these three qualities and explain all the facts or they will not qualify as answers, or even as theories, although they may become "working hypotheses." Einstein spoke of this "inner harmony" of the world in which all scientists, and especially physicists, believe; they would not try to explain observations with logical theories if they were convinced that the innermost machinations of nature were random and illogical. Thus we see the germinal idea of all science: Man's logic corresponds with nature's; man can know and understand and predict as well as nature, and, ultimately, improve nature. No provision has ever been made for mysteries, until the present.

Matter

The present period in science can be compared to the one in the 16th Century when Galileo peered through the first telescope. His discoveries opened up new aspects of the knowable universe and altered patterns of thought that had pre-existed for centuries by exhibiting to man that the universe was larger than anyone had dreamed, the earth tiny in comparison to the vastness of space.

An example of the kind of pandemonium that exists in science today, largely as a result of the relativity theories propounded by Einstein in 1905 and 1918, is the current belief that the nature of matter cannot be known, except mathematically. In other words, one can write an equation that describes an atom's behavior, but a scale model of its structure cannot be built, since it is not a rigid structure of particles but one of energy states and "resonances." A structure can be described mathematically, but the equations are not to be taken as in any way standing for physical objects.

The traditional picture of an atomic nucleus surrounded by orbiting electrons is now antiquated; it has been replaced by a description in which the location of electrons is unknown, although probable locations can be predicted mathematically. For instance, the probability that

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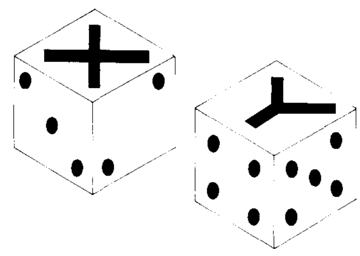
any electrons at any given moment are inside the nucleus is near zero, which means that they somehow "go around" the nucleus. The shape of the region that electrons are likely to be found in—the "electron cloud"—is sometimes spherical, sometimes bagel-shaped, and sometimes dumbell-shaped.

It was not until 1913 that physicists were convinced that atoms existed; quantum mechanics and quantum electrodynamics, the two theories (explained below) besides relativity that physicists now use, were clearly formulated in 1927 (mechanics) and 1947 (electrodynamics). The "Principle of Uncertainty," conceived by Werner Heisenberg (also in 1927), which outlines the unobservable property of nature, says specifically that it is impossible to determine simultaneously both the position and the momentum (which is mass times velocity) of a particle. Even if an ultramicroscope were powerful enough to pick up a subatomic particle (inside the nucleus), the impact of the minimum quantity of light required for viewing the particle would change its direction and velocity. It follows from this principle that the future course of a particle cannot be predicted because both the velocity and position at a given moment are unknown—which is nothing more than saying that you cannot know where you are going unless you know where you are and how fast you are going in a given direction at any given moment.

As a result of the principle, causality is indeterminable and had to be partially abandoned as a scientific concept in physics. Instead of saying that x causes y, it is now simply stated that x precedes y, or that x and y usually occur simultaneously. The concept of relative probability is used instead—the probability of this versus the probability of that—and predictions are accurate because large numbers of particles are treated statistically. The Principle of Uncertainty, then, is a good example of how physical discoveries can change patterns of thought; it is difficult to think of an idea more ingrained in thought than that of cause and effect.

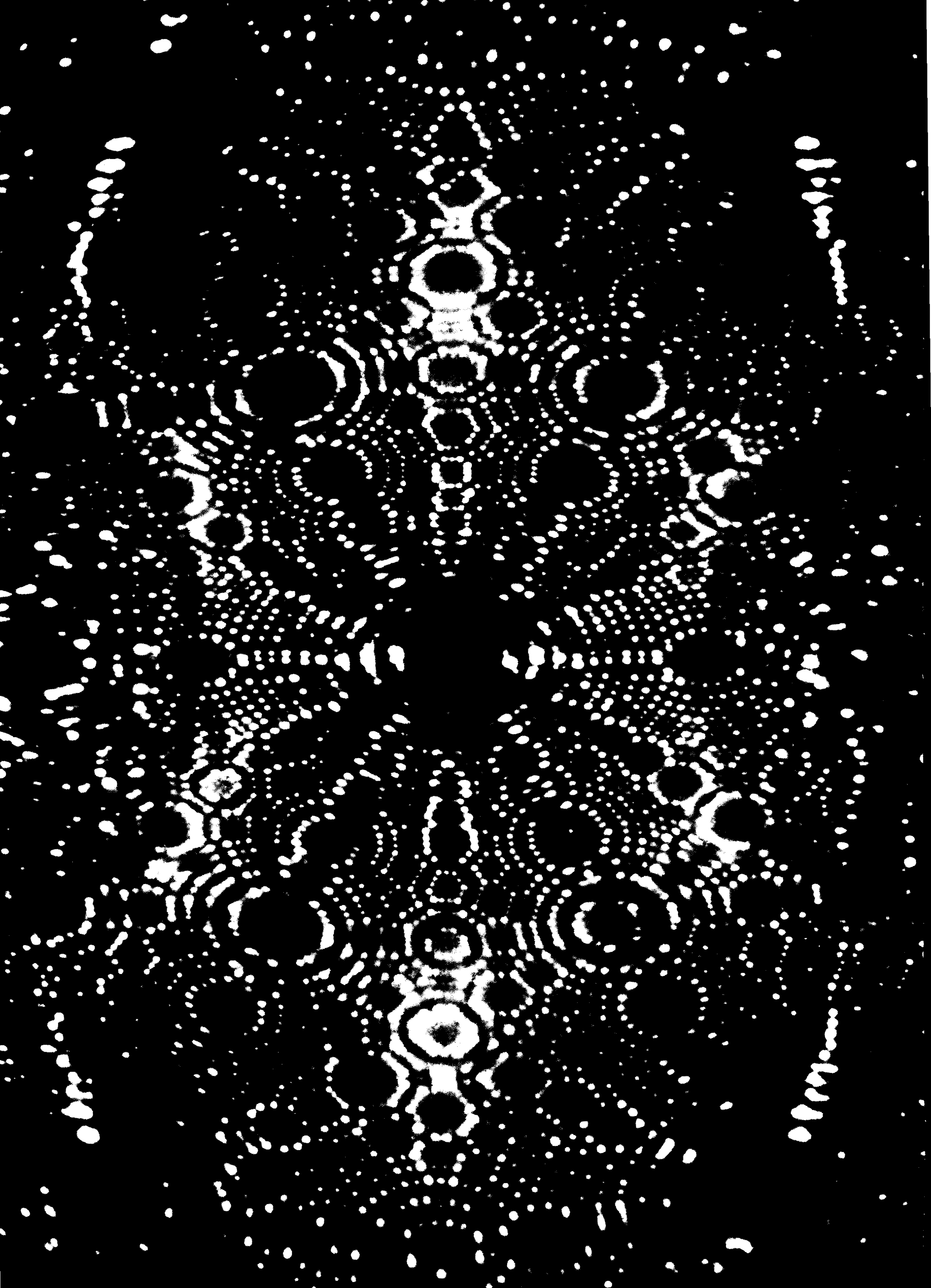


Until recently, it was commonly assumed that all matter was composed of elementary or fundamental particles that give matter all its properties, and that there were certain basic, indivisible constituents of matter that combined to form all other matter. Today, however, the atom, previously thought to be this elementary constituent of matter, is now known to contain not only protons, neutrons, and electrons, but, in addition, about 100 other "elementary" particles (or "resonances") concentrated mainly inside the nucleus. Moreover, the entire concept of elementary particles is in doubt, since none of the 100 particles can justifiably be characterized as more "elementary" than the others. To add to this confusion, they are called "resonances" because their life spans are so short—billionths of a billionth of a second—and they rapidly disintegrate, changing mass and charge spontaneously and constantly. Finally, the basic laws of physics have been severely shaken by very recent experiments indicating that nature may be asymmetrical, at least in its treatment of subatomic particles. J. Robert Oppenheimer has predicted that something comparable in revolutionary importance to Einstein's development of relativity will occur in science within the next decade.

A Triple Revolution

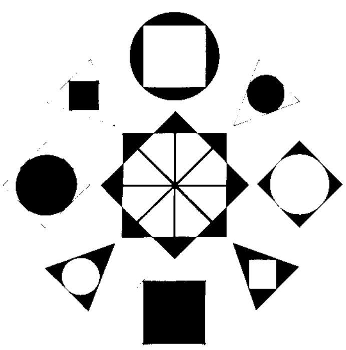
Since the beginning of the 20th Century, physics has undergone major revolutions every 10 years. Like the social revolution's triple revolution of computerization, civil rights, and weapons technology, there is now a triple revolution in physical theory.

The first of these that is relevant to the most recent events in physics began in the late 40's, with the discovery of the first subnuclear (inside the nucleus) particles (in addition to the proton and neutron, which were already known), and emerged as a revolutionary development when the systematic study of these newly discovered particles was undertaken in the mid-50's. The new particles, called pi-mesons (or pions), are the simplest of the subnuclear particles. They are emitted when ordinary matter is bombarded at high energies by protons, for instance. It was shown that the pi-meson exists in no less than three different forms, of essentially the same



mass but of different electric charge. This confirmed the "isotopic spin concept," which, ever since, has been a prominent feature of nuclear theory. Basically, it means that particles can exist in several different internal states, and that in each state they have a different electric charge. From this concept was derived the general rule for arranging particles into groups, or families.

The second discovery, also in the mid-50's, was that of the nuclear antiparticles. It was shown that for every particle there exists another particle of exactly the same mass, except that all its other characteristics are exactly the opposite. For many years, this was considered to be an absolutely universal law of nature; it was even supposed that there might be an entire universe made up of antimatter, indistinguishable from our own, that, if it collided with ours, would annihilate both.

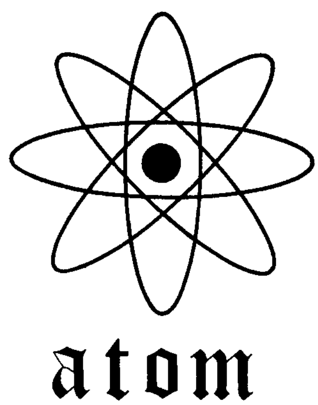


The third sequence of discoveries began in 1947 with the discovery of the Lambda particle. It is one of a group of similar particles called "strange" because they were totally unexpected and had very mysterious properties. Their "strangeness" is a property somewhat analogous to electric charge: They are produced very rapidly and in pairs, but they decay very slowly. No other particles had previously been found that exhibited this behavior. The investigation of the strange particles led to the proliferation of nuclear particles; 100 have been found so far, others are predicted, and no one can even guess as to how many more will be found. This proliferation of nuclear particles has led to the rejection by some scientists of the concept that any one of the particles is more elementary than any of the others. This is potentially the most revolutionary event in the history of matter, and, according to Geoffrey Chew, one of the leading contemporary physicists, it shakes the foundations of all science. Moreover, it has changed the basic attitude of physical scientists, and reshaped their thinking in ways that will be explained later.

The Glue in Atoms

The entire endeavor of science can be summarized as the search to discover what the world is made of and how it works—the physical world of stars, mountains, insects, people, and every other object perceived. The common assumption has always been that larger things are composed of smaller parts bonded together. What holds the small parts together has been a mystery since the time of the ancient Greeks, who thought that atoms stuck together as if they were sticky pieces of gum. Today, it is known that there are four different kinds of forces that bind matter: the nuclear force, which holds the nucleus of the atom together; the gravitational force, which holds the universe together; the electromagnetic force, which holds electrons in their orbits around the nucleus and thus holds atoms together; and the weak force, discovered in the past few years, whose precise function has not been determined. Much of the current work in physics is concerned with the weak force.

To understand the new picture of matter that is beginning to emerge, one must have an idea of the old picture. Basically, it is the familiar one of a little ball, the nucleus, in the center of atoms surrounded by a cloud of electrons. Inside the nucleus are protons and neutrons, of positive and neutral charges; the proton charge equals the amount of charge of the electrons, which have a negative charge. If there are four electrons, there must be four protons for the atom to be stable and uncharged. (The number of neutrons is determined by the balance of forces within the nucleus. See **Nuclear Force,** below.) This is what is meant when it is said that the atom is held together by electrical energy: The nucleus holds on to its electrons by the attraction of its positive charge and the electrons hold on to the nucleus by the attraction of their negative charge. If the atom lacks an electron, it will seek one from surrounding atoms, forming molecules, in which two atoms share an electron. This is the basic mechanism described by the mathematical equations of quantum mechanics. It is the theory (firmly established around 1930) utilized in chemistry and molecular biology. The basic idea, to state it simply, is that all electrical and chemical phenomena are the result of the movement and exchange of electrons between atoms.



Although this relatively old picture is essentially still basic to modern chemistry, it is no longer basic to physics. This will perhaps clarify one of the interrelations of two large fields of science: The chemical and biological fields operate at the molecular level, while physics operates at the atomic and subatomic level. Chemistry and biology probe into the interactions between groups of atoms and molecules, whereas physics probes into the internal workings of the atom itself, to discover why it behaves the way it does. In other words, atoms at the molecular level are stable and unchanging; inside the atom, however—inside the nucleus, particularly—chaos reigns. This is the realm of high-energy physics—the study that requires multimillion-dollar cyclotrons and synchrocyclotrons that can accelerate atomic nuclei to great speeds, which is roughly comparable to heating them, in order to activate the particles inside. It is like shaking the feathers out of a pillow—the harder you shake, the more feathers fall out.

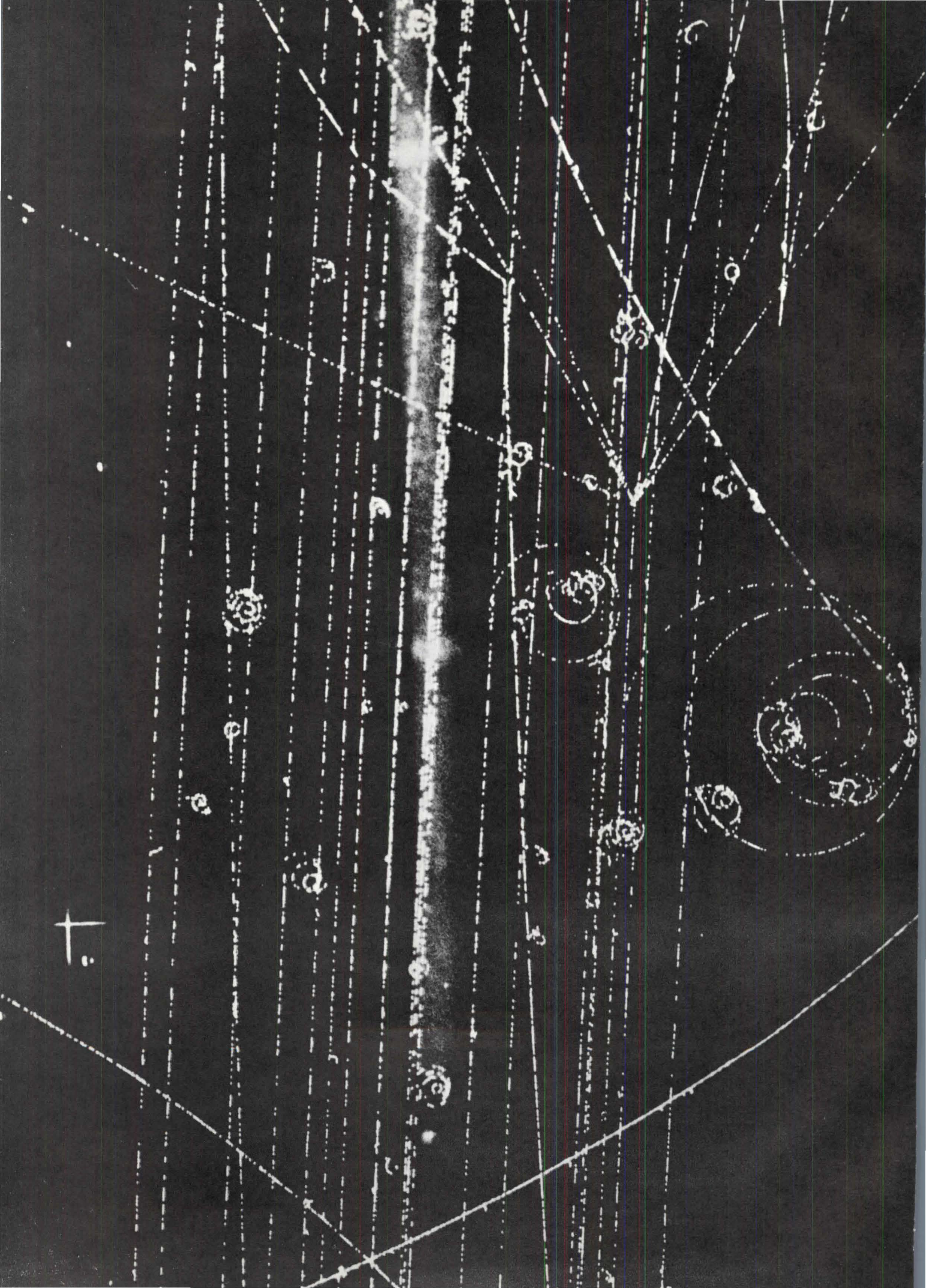
Reflection Symmetry

Much of the current research on the subnuclear level concerns another of the traditional theories that appears to have been violated. This is the law of parity conservation, or mirror symmetry, which states that the mirror image of a physical system will behave identically with the system itself, obeying the same physical laws, except that right and left are reversed. This is readily understood if you imagine yourself in front of a mirror. You hold up your right arm; the mirror shows you holding up your left arm. If you were drugged and had no sensation in your body, you would assume that, by looking in a mirror, you could tell which arm was up. If it showed your left, you would know it was your right. You assume that the mirror gives you an exact **reflection** of reality.

In 1956, this law was shown not to hold for certain kinds of physical systems, specifically some that occur inside the nuclei of atoms. The following is a much simplified, but conceptually correct, explanation of one of the first experimental violations of symmetry: An atom was placed at the center of a ring of particles that revolved around it. A mirror was placed perpendicular to this system. In the mirror, the ring revolved clockwise, and in reality the ring revolved counterclockwise. As the ring of particles circled, the atom in the center began to spin, so that its spin was lined up electrically by the circling ring of current. Then two particles, an electron and a positron, jumped out of the atom. The electron jumped in the direction of the atom's spin and the positron jumped in the opposite direction (because it has the opposite electric charge). In the mirror image, however, it was the **positron** that jumped in the direction of the atom's spin, while the electron jumped in the opposite direction. Thus, the experiment and the mirror image differed substantially. This difference is called the violation of parity.

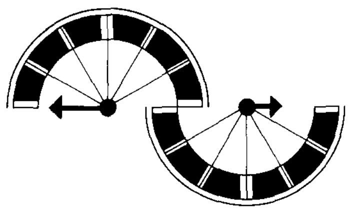
Another classic experiment revealed that one of the "strange" particles referred to earlier decayed in two different ways: One way it ended up as two particles, and the other way as three. The parity rule implied that it could end up as either one or two particles, but not both. Therefore, if parity had to hold, there would be no explanation for the decay. The idea that parity was being violated was the Nobel Prize winning contribution of Drs. Lee and Yang in 1956.

The violation of parity has been shown by experiment to be true of many of the weak forces, whose function is not yet known, and it has led to the abandonment of the idea that nature is symmetrical—an idea as old as civilization; one which implies, for instance, that if the mirror image of a man existed, he would look and function exactly as we do. It might be the case that the weak interactions have no effect on biological processes, but, if they do, the lack of symmetry in them would ultimately reshape molecular theory.



There are two additional forms of the symmetry laws: one called charge conjugation and one called time reversal. They both involve essentially the same idea explained above: that nature is symmetrical. Charge conjugation symmetry concerns the antiparticles: It simply holds that all particles have antiparticles of the same properties but with the opposite charge, as stated earlier, and, moreover, that when a particle appears in nature, its antiparticle appears along with it. When they collide, they annihilate each other and produce radiation or other forms of energy. This symmetry law fell in 1957, during the investigation of the weak force.

Time reversal symmetry was discredited in 1966. It had previously been thought that there

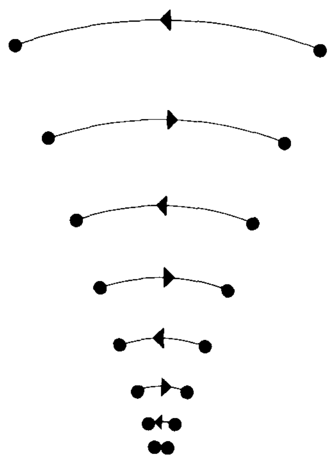


was no preferential direction of time in microscopic reactions, that it did not matter in what order a sequence of microscopic events occurred, because they could occur in exactly the reverse order and still involve the same sequence of events. On the other hand, at the macroscopic—that is, everyday physical events—level, the direction of time does matter, as everyone knows. On this level, if you saw a movie of a car collision run backward, you would realize that something was wrong, that time seemed to be moving in the wrong direction. Thus, for macroscopic events, physicists "know" which way the arrow of time points, because the movie run forward shows an overwhelmingly more probable sequence of events. The time reversal symmetry law stated that, in microscopic collisions, it did not matter which direction the movie ran in, that both directions were equally probable. It is one of the results of relativity, for instance, that mass can be converted into energy (as in the atomic bomb) and energy into mass—the reaction can run in either direction. This is another way of stating time reversal. Still another way is: A reaction of particles that began in the past and produced certain end products can be reversed to produce the original particles. This has been considered a basic property of matter, but today it is thought by some experimenters to be incorrect: When the reaction is reversed, not the original particle but totally different ones sometimes seem to appear.

The consternation perpetrated by the violation of the symmetry laws was enhanced by the fact that it was only in the newly discovered weak interactions that the violations occurred. Physicists therefore devised three different forms of each symmetry, one for each of the three forces—electromagnetic, weak, and nuclear. However, it was shown in June 1966 that the electromagnetic forces have asymmetries also and it is being predicted that the nuclear forces will be shown by experiment to violate some forms of even the revised symmetry laws. (Not enough is known about the gravitational force to determine whether it violates the symmetries or not.) This is a major theoretical and experimental problem today. The ultimate goal is to unify the four forces in nature that account for the energy and structure of all matter—the weak, nuclear, gravitational, and electrical—in one comprehensive theory. But this lies far in the future, although some of the relations between the forces are known today.

Mediation by Particles

It is currently believed that particles have one thing in common: They all may be mediated by the exchange of some particle. (This is the basic idea in quantum electrodynamics—a simple idea indeed to go with such an extraordinary title.) A good illustration of how this idea explains the phenomena of the forces is that of two ice-skaters playing catch on a frozen lake. They start out skating close together, throwing the ball between them. When the ball is thrown, the skater recoils slightly, and the skater who catches it is also thrown back slightly. So as they skate, throw, and catch, their velocity and direction gradually change. If you were a scientist sitting on a hill nearby, too far away to see the ball, you might guess that they were playing catch; thus you would have understood the theory of quantum electrodynamics.



One more concept is needed to grasp why you would guess a ball was being thrown between the two skaters, instead of thinking they were holding onto a rope, or some other explanation. This is the basic idea of the quanta. A quantum is a unit of energy, and the quantum theory states that these units come in discrete, indivisible packets—not continuously, like a current, as it was previously supposed. This means that there cannot be one-and-a-half units of energy, because half a unit does not exist in nature. It is either one or two. The quantum theory, then, is the idea that all matter (which is a form of energy) is composed of discrete bits added together—an idea very similar to the old picture of atoms.

The Electrodynamic Force

Every one of the forces, then, according to the quantum electrodynamic theory, is mediated by the exchange of discrete units of energy—here referred to as particles. Electricity is the easiest one to understand, because it is so familiar. Most people know, for example, that an electric current is a stream of electrons; when you heat up an electron, out comes a photon, and the photon is the basic quantum of light. The eye is sensitive to photons as light, and radios are sensitive to them as radiowaves. Physicists therefore say that light is a shower of photons. In the electromagnetic forces, then, photons are exchanged between atoms, and the attraction between photons and the nucleus is thought to hold the atom's internal structure together, as explained above (in terms of the electron). Extensive theoretical knowledge exists about these electrical phenomena because photons are easy to produce and detect; research on them has led to the theory that unites modern chemistry—quantum mechanics. Chemistry as a whole is based on this fundamental understanding of the electrical forces in atoms.

The Nuclear Force

The neutron was not discovered until 1933; thus the nuclear force remained undiscovered until then. This is the force that holds the nucleus together. In 1935, Hideki Yukawa predicted that the nuclear force can be explained by the exchange of a particle he called the meson. There would be an exchange, according to quantum electrodynamics, of a meson between the proton and the neutron inside the nucleus, just as two atoms exchange electrons in the electrical forces. Then the meson was discovered in 1947, as Yukawa had predicted. (He won a Nobel Prize in physics for this work.) But today there are many known mesons. And the neutron and proton are themselves only members of a much larger class of particles and hardly unique.

There are currently two theories to account for this nuclear proliferation: one is the idea that there are three as yet undiscovered fundamental particles responsible for the nuclear force. These three have already been named, in case they are ever found, and their name is derived from James Joyce's novel, **Finnegan's Wake.** As a side excursion from this complicated tale of nuclear structure, we will now adjourn to a committeeroom in Washington, to hear Murray Gell-Mann, one of the world's ranking nuclear physicists and the co-originator of the name, discuss its literary origins. The name he invented was "quarks." Here is his testimony and a Congressman's comment:

GELL-MANN: "**Finnegan's Wake** by James Joyce is usually interpreted as being about a bartender's dream. Humphrey Chimpden Earwicker is the bartender. Occasionally in the book he seems to come to the surface. This usually coincides with the striking of a clock. There are some numbers usually mentioned in connection with this which may be connected with the hour, the number of chimes. At one point he sort of comes near the surface and mumbles to himself, 'Three quarks for Master Hark.'

"The words in **Finnegan's Wake** are mostly portmanteau words like 'humpty-dumpties' and **Through the Looking Glass**—or is it **Alice in Wonderland?** In this case, my personal guess, and this has not been verified by any accredited scholar of James Joyce, my personal guess is that the quark is made up of quart and hark. Hark, because he is being awakened by the clock and quart because when he hears a number like three in his profession it usually comes with a word like 'quarts' after. So, from three quarts and hark, perhaps he makes up three quarks. Three quarks: if there is anything at the root of the strong interaction, it would be three quarks."

CONGRESSMAN: "Let us say that it is more literate than the origin of the term 'barn.' "

(The testimony was part of a hearing held by a Congressional committee charged to find out why physicists want the 330-billion-electron volt cyclotron. They need it to find out if the quarks exist, and if the graviton, the particle that mediates the gravitational force, exists, as has been postulated.)

If quarks exist, they would be stable and have sensational applications, since they would be the index to the control of nuclear fusion.

Some theoreticians, however, do not think the quarks will ever be found; their conception is called the Bootstrap Theory and it rejects the idea of "elementary particles" altogether. The theory is based on the fact that all nuclear particles have a great many excited levels of different energies, and many different forms. The Bootstrappers say that instead of being activated by certain elementary particles, the forces inside the nucleus are produced by **all** of the particles acting in concert, and that the presence of the forces accounts for the presence of the particles, and vice versa. Dr. Gell-Mann put it this way: "The particles pull themselves up by their bootstraps in constituting one another in a wonderful manifestation of self-consistency." Support for this theory exists in the peculiar natural groupings that occur among the particles according to their spins, "strangeness," charge, and mass; families of eight particles (called the Eightfold Way, after an aphorism attributed to Buddha), families of tens (the tenth member of which, termed the omega-minus particle, was predicted on the basis of the other nine by Dr. Gell-Mann) and families of three have been identified in accordance with this conceptual scheme.

Initiated in 1959, the Bootstrap Theory is the first physical theory of matter in history to be based on the idea of self-consistency, of self-determination, and self-generation if you will.

Gravity

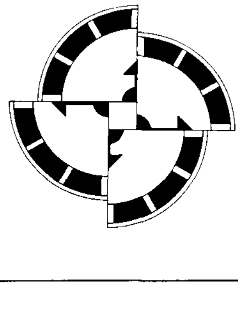
The gravitational force is the most mysterious of all. It is thought to be caused by the exchange of a particle called the graviton, which has not been observed yet, but research on the particle is underway at the University of Maryland and at Princeton. The observation of radio galaxies and quasars has raised the possibility that physicists may be able to witness in these celestial objects the basic gravitational phenomena. They might perhaps be systems in which gravitational effects are very strong; on earth, these effects are very weak. Because the graviton has so little energy, the nucleus will have to be accelerated to much greater energies than are now producible in cyclotrons, which is why, in addition to the search for quarks, the Government will probably build the 330 billion electron volt machine physicists asked for.

Finally, the enigmatic weak forces. They are thought to be mediated by the exchange of a W meson, but it has not been observed yet either. Neutrinos, which in Italian means "little neutral ones," a name invented by physicist Enrico Fermi, are fascinating particles that participate in the weak interactions. They have no mass, no charge, and move with the speed of light. They interact only rarely with other particles because they pass so quickly through them; a neutrino can travel through 100 million miles of lead without bumping into anything. When they do finally collide with something, the result is another particle, called a "mu meson" or "muon," which exists for only millionths of a second (which is enough time for it to travel through several thicknesses of rock). Some 500 billion neutrinos pass between the atoms in your hand every second, unseen and unfelt; each neutrino crosses the visible universe 100 billion billion times before it finally collides with an atom. It is believed that they come to earth from the interiors of the sun and stars, which is why they are valuable to scientists studying the elements and the composition of stars. Experiments with neutrinos helped violate the symmetry laws: It was shown that the mirror image of a neutrino is not another neutrino, but an antineutrino.

Time, Relativity, and Space

The layman's confusion about the theory of relativity stems in part from the fact that it is not needed to account for events that occur in everyday life. Classical concepts of space and time still hold for ordinary objects, but for subatomic and astronomical events relativity is required. Another reason for the general quandary about the relativity theory is that it altered not only traditional modes of perception but also completely changed the meaning of four abstract concepts basic to one's conception of the world—space, time, matter, and motion.

The foremost difficulty in explaining relativity is that human beings are the wrong size to understand it easily. If they were neutrinos, so that their incessant movement were more obvious to them, they would understand more readily. It would also be easier if their perceptions were as accurate as those of microscopes, rulers, and clocks. If they were, one simple experiment would make the entire concept of relativity clear: Suppose you were on a train, happily munching on some apple pie. You have a stopwatch and you time the exact instant your fork goes into your mouth. There is a man standing on the platform, also with a stopwatch. He clicks it at the exact instant he sees the fork go into your mouth. One would think that his measurement of the second the fork went in and yours would agree, assuming you had synchronized your stopwatches earlier. But the measurements always differ. If you add also that the measurements would still differ if the man were as close to the event as you were, to discount the speed of light, you begin to grasp the idea of relativity. And neither your measurement nor the man's would be the "right" answer for when the fork went into your mouth—both would be right, because each of you is in a different reference frame; each of you is in a different state of motion.



To clarify the idea of a reference frame as it is used in physics, again imagine yourself inside the train. All the objects sitting on the shelves of that train are at rest relative to you. Suddenly the train stops; all the objects fall off the shelves. Remembering the law of inertia, can you still say they were at rest? Quickly you decide that they were at rest relative to the train, but in motion relative to the immovable earth. But perhaps the earth was in motion relative to the stationary objects. The man standing on the platform says that, for him, standing in a fixed position on the motionless earth, they were in motion, and that the train's deceleration only changed the direction of those objects' motion. Again, who is right? Everyone is right.

For most events on earth, we use the earth itself as a fixed frame of reference—something at rest by which we measure whether other things are moving. Thus we can understand what is meant by "motion." But physicists have to be more precise; they tried for centuries to find something at rest so that they could uphold with Newton the idea of absolute motion, which carries with it the notions of absolute space and absolute time. Absolute space was Newton's reference frame for all things that moved, since clearly everything we can measure in life moves constantly. In order to tell whether anything moves, one has to measure against something that does not move, something at rest, but that something was never found. Most people still have an intuitive knowledge of what "space" means: to them, as to Newton, space is an invisible air that fills the gaps between objects and all objects exist "in space," like pinpoints or dots on a clear background. This is the classical notion: after many centuries, physics undermined the notion because it is immeasurable and useless, and replaced it with relativity, which says that space is any reference frame you choose at any moment you want to. Then, for you on the train, space **is** that train. In the back of your mind always is the "immovable" earth, your permanent reference frame.

Absolute time is the classical way to refer to everyone's idea of what time is: something that moves "forward" relentlessly, uniformly, irreversibly, like a current. Relativity has shown, however, that time cannot be measured apart from events; therefore, time must be understood as another dimension that shapes and determines events— not as an abstract frame of reference that events take place **in**. Time is nothing apart from the number of minutes or seconds that elapse during an event, as recorded by a clock; when the event stops, so does time. (The clock keeps going because there are many events during the day that one wants to time; the entire day is an "event.") Moreover, time is a limiting dimension, and thus a condition, for every event, since nothing can happen faster than the speed of light. Going back to the example mentioned earlier: According to your watch, you had your fork in your mouth at 3:52, whereas the man on the platform clocked the event at 3:53. There are as many "times" as there are different states of motion. One more simple example may clarify the relation between motion and time that is responsible for the disagreement between you and the man on the platform. Particles at rest in the laboratory take a certain specifiable length of time to disintegrate; when the same particles are accelerated, their rate of decay **slows down**, and the faster they are accelerated, the longer it takes them to decay—relative to the immobile position of the observer. Similarly, the faster your train is traveling, the longer it will take you to eat a piece of pie—from the perspective of the man on the platform.

The philosopher Immanuel Kant, in 1781, adduced absolutely conclusive logical arguments for both the existence of absolute space and time and their nonexistence. He concluded from this exercise that the human mind simply could not know whether there really was space and time, but that we could not conceive of things other than in spatial and temporal terms. Heisenberg's Principle of Uncertainty (see above) was saying essentially the same thing, only in physical terms, when he stated that, if nature operates mechanistically, like a machine, we cannot observe it; therefore, we have to abolish the mechanistic concept from physical theory; moreover, all quantities that cannot be measured should not be part of physical theories. This essentially is what relativity did—abolish space and time because they could not be measured independently of particular events in which measurements differ from observer to observer. Perhaps the idea of simultaneous events can clarify this.

Simultaneous events are those that happen at the same time, at the same point "in" time but at different points "in" space, to use classical jargon. Einstein asked: How can we tell whether two events are simultaneous? The answer was that it is actually impossible to tell, because it takes time for light to travel between the two events, just as it takes time for sound waves, radio waves, or electronic waves to move between two points. Of course, the differences are too small to matter in everyday life, but they exist. Simultaneity had to be abolished also, since it is simply another form of absolute space and time.

Matter = Energy

Relativity forced physicists to change their concept of matter also, by proving that matter and energy are different forms of each other. When a particle and its antiparticle collide, for example, they are instantly converted into radiation—that is, they cease to be little masses of matter and become energy. Relativity theory defines the mass of a photon (the quantum of light) as its energy divided by its velocity. And energy is proportional to frequency—the shorter the wavelength (frequency), the more energy in the wave. But frequency is also relative: As you move toward a light source, it gets brighter, and as you move away, it grows faint. So if you know the energy, you know something both about the observer of that energy (how close he is to it) and about the photon.

The velocity of light is the upper limit of velocities in the universe; it is one of the few absolute quantities known, because measurements of it never vary. This velocity provides another cornerstone concept in the relativity theory. Perhaps the explanation of the famous $E = mc^2$ will make this clearer: E stands for energy, m for mass, and c^2 for the velocity of light squared; therefore, both energy and mass (which are interchangeable) depend on the properties of light. In the laboratory, it is possible to observe particles as they become energy, ceasing to exist as particles, and then become mass again when the energy level changes as a result of their changing velocity. The velocity of light, or photons, is the only nonrelative quantity known; it is the same no matter where the observer is in relation to the source of the light.

Further evidence supporting the relativity theory is that mass increases with velocity, matter and energy are interchangeable (confirmed by the A bomb—atomic fission), objects contract in the direction of motion, and the rate of clocks ("time") slows down as velocity increases (not through any deficiency of clocks, since all clocks, and hourglasses, exhibit this property).

Mechanical models could be presented to illustrate classical ideals of space, time, matter, and motion; this cannot be done with relativity, except with a four-dimensional geometry of space-time in which the order of events can be located by space and time coordinates. Material particles can be charted by one-dimensional lines along these coordinates. A good example of the fusion of space-time is the unit of measurement — the "light year." Since light travels at 186,300 miles per second in a vacuum, a light year is defined as the distance (space coordinate) light travels in a year (time coordinate). It is neither a spatial measurement (in feet, miles, yards) nor a time measurement (in minutes, years, or seconds); it is both. A planet is not a certain number of miles away, but a certain number of light years away—depending on how long it takes that planet's light to reach earth. And the time it takes to get here depends of course on how far it has to go. Time and space are thus limiting dimensions for the event—our "seeing" of the planet—not abstract frames of reference. They are **part** of the event; this is the essence of relativity.

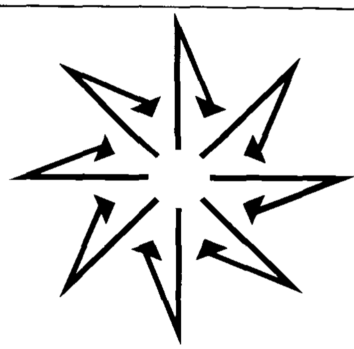
Einstein's General Theory of Relativity of 1918 has not been incorporated into the body of physical laws, as has the Special Theory discussed above. The General Theory was an extension of the Special Theory intended to explain gravitational force. Although its general validity has been proven by many observations that conform to the theory's predictions—for instance, that light passing near the sun is deflected from its straight path—there are several interpretations of the fundamental ideas of the theory. One interpretation (or possibly combinations of several) will have to be verified before the theory can be integrated into the body of physical laws. One interpretation holds that physical bodies like the earth and sun make curvatures in space, which form gravitational fields, so that light passing near the sun is curved by the curvature of the space it passes through. Another interpretation, however, maintains that the light is deflected by the sun's gravitational force alone, not by any curvature of space. Both interpretations explain what is observed, so that it is not known whether Einstein's contention that space is curved is correct or not.

The theory predicted also that the spectrum lines of substances would be shifted toward the red end of the spectrum, the famous Doppler Effect (see below), which seems to have been spectacularly confirmed in recent investigations of quasars. Finally, deductions from general relativity say that the universe is finite but expanding—although some physicists have a different interpretation of the theory that does not predict this—a result recent astronomical studies seem to confirm.

It is difficult not to speculate about the relation of physical abstract concepts like space and time to the cultural atmosphere. Perhaps the fixed, classical expression of space and time corresponded to the fixed, classical framework of morals, the religious view of life, and traditional social patterns. For Newton, there was a magnificent order, not only of space and time, but of basic mechanisms of nature that were observable, quantifiable, and static. Relativity, formulated in the 10 years preceding its publication in 1905, spelled the end of the classical view of the natural world, although physicists still believe that nature exhibits an inner harmony that mind can know, even though today there is little semblance of harmony in the inner structure of the nuclei of atoms or the pulsating gyrations of the universe. Future research will reveal whether classical scientific ideas of nature's comprehensibility, as revised in the 20th Century, will need even further revision to a concept of nature as chaotic and incomprehensible. This further revision might be analogous to the drastic reformulation necessitated by Heisenberg's Uncertainty Principle, explained above, only much wider in its implications. Physicists are already speculating about this possibility—that nature may be irrational (in human terms). If it is true, science itself will assume a very different character in the future.

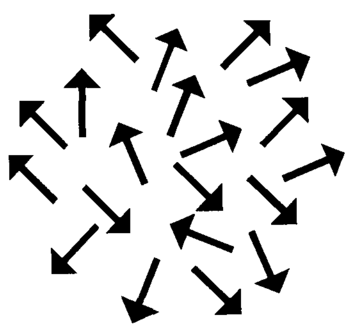
Universe

Cosmology is the study of the nature of the cosmos. The old questions—why are we here, where are we going, what is the universe, where did it all come from and where will it go, how old is the universe, how long will it last?—are cosmological questions that formerly were answered by religion and some ancient philosophies but that are now being investigated by astronomers armed with man-made satellites, radio telescopes, and the theories provided by physics. For the first time, man has a chance to find answers to some of these questions. One tentative conclusion reached by many astronomers is that the universe began with an enormous bang about 10 billion years ago, and that it will

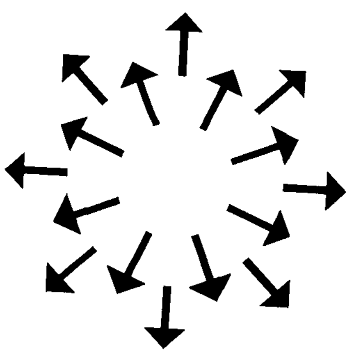


end, and then be born again, 70 billion years from now—a cycle of 80 billion years. The answer to how the explosion occurred, and why, has not been found, and it is doubtful that astronomers can answer "why" questions anymore than physicists can. In the 21st Century, there may be no discipline like cosmology, since all the questions may have been answered except the "why," and these might become quite meaningless because they will never yield to scientific probes. They are not physical questions in the sense that they have no "scientific" answer. The question as to why the universe—and man in particular—exists cannot have a mathematical formula explaining **how** it arose, or a Darwin explaining man's evolution, as an answer. There are some thinkers who believe that these non-physical questions, which cannot be answered scientifically, have no meaning. It should be borne in mind that this a **philosophical** position—an illustration of the dependence of science on speculations as to the nature of meaningful knowledge, referred to earlier.

Forced to choose between instant creation with a bang and an infinitely self-destroying universal system, some astronomers accept neither. They prefer, for aesthetic reasons, another theory that also explains why all matter is rushing farther and farther out into space. This is the steady-state theory, which posits no First Cause (or Big Bang) but simply the constant, continuous creation of matter. Dr. Hoyle, after a gallant struggle to uphold his steady-state theory, was recently forced to amend it: He now concedes that that portion of the universe observable to astronomers was probably born through a Big Bang, but he continues to maintain the steady-state position for those celestial systems that lie outside the range of our telescopes. Although recent evidence slightly favors the Big Bang, both theories manage to account for all the presently known facts.



Both theories are also based on the same facts, which were demonstrated in 1929 by the great astronomer, Dr. Edwin Hubble, that the galaxies, billions of them, are rushing away from each other. To the Big Bangers, it is logical to suppose that the energy required for this giant dispersal came from an enormous explosion of some "primeval atom." Some go on and postulate that ultimately gravity will overcome this initial outward thrust and that all galaxies will collapse again into the center, once more becoming a primeval atom and begin all over again by exploding. They even think there is no way of knowing whether we are on the first or the millionth universal bounce. It is as if their universe were a giant paddle-ball system, where the rubber band is gravity pulling the ball back to a hypothetical invisible paddle. Other Big Bangers, however, do not hold with this bouncy cosmology, contending that the universe exploded, that it banged in the beginning, and that it will simply go on forever spreading out infinitely into space.



The steady-state model also postulates an infinite universe. As recently spelled out by Hoyle, the expansion and contraction that seem to take place in our section of the cosmos is only a "local" occurrence. The entire universe is like a sea that has been here eternally, spreading out continuously, gradually creating new matter to fill up the spaces of old matter pushed farther out into space. There are bubbles in the gigantic sea, and we are in one of them; within our bubble, our local universe, we expand, oscillate, and explode every 82 billion years—just a neighborhood occurrence.

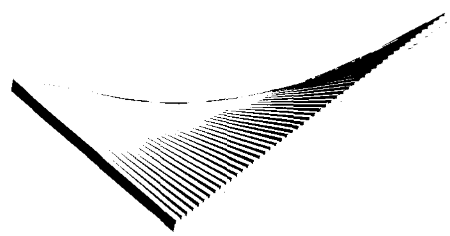
Galaxies

Our galaxy is the Milky Way; it rotates around the "galactic center" that is screened from our sight by heavy clouds of dark interstellar material hanging in space. Billions of stars comprise our galaxy, of which the sun is only one. It was not until the beginning of the 19th Century that this idea was fully accepted, even by scientists, because the Church had always opposed it. It takes the sun 200 million years to rotate around the galactic center; thus, if the stellar system is 5 billion years old, then, during its entire life, the sun and its planets have made approximately 20 revolutions. Following the terminology of the terrestrial year, the period of solar rotation is called a "solar year"; thus our galaxy is only 20 years old.

The nearest galaxy to ours is the Andromeda Nebula; since it has a spiral structure, it is called a "spiral nebula." The shape of the Milky Way is unknown, since it is hard to judge the shape of something unless you are in a position external to it. Many stars pulsate regularly, and as they pulsate their brightness changes. Small stars may pulsate every few hours, whereas the giant ones take many years to go through one pulsation. By measuring the brightness of the stars, it was discovered that the Andromeda is 1,700,000 light years away—a distance that exceeds the diameter of the Milky Way. All the galaxies are in various stages of evolution, as revealed by their different formations—some are spherical, some elliptic, and some spiral. More galaxies can be seen through a large telescope than stars by the naked eye. It is the great number of other galaxies that has led many mathematicians to believe that some form of life must exist on planets other than our own. The probability that out of the billions of suns and planets ours is the only one to generate intelligent living organisms is zero. However, there is also zero probability that they are in the same stage of evolution as we.

Galaxies are scattered through space more or less uniformly, and as far out as the most powerful telescope can see—1 billion light years. There are occasional clusterings of galaxies; our own is clustered with three spiral nebulae, six elliptical, and four irregular nebulae. The average distance between two neighboring galaxies is about 5 million light years, and the visible horizons of the universe contain several billion individual stellar galaxies.

The question that naturally arises from considering the enormity of the universe is: Does it extend infinitely, so that, no matter how big the telescopes are, new regions of space will open up? Or is it that the universe occupies some immense but finite volume and is explorable down to the last star? First, it must be understood that "finite" does not mean that future voyagers in space will encounter a blank wall at the "end" of space. It simply means that no matter how long and how far they travel in a straight line, they will end up back where they started—just as if you were to travel in a straight line around the earth's circumference you would end up where you started out, since the earth is a closed form. Space may also be finite without boundaries, simply curving around and closing in on itself. (Einstein's General Relativity theory predicts this.)



The Curvature of Space

If space is finite without boundaries, it is positively curved, like a circle. If it is infinite, as in the steady-state conception, the curve is negative, shaped like a saddle, and thus open. One of the methods astronomers are using to discover the curvature of space is to count the galaxies, finding out whether they are uniformly distributed through space, which would indicate the steady-state conclusion, negatively curved, or whether there are fewer galaxies farther out, which would indicate the finiteness of space. This method is based on a physical law that, in a closed space, the number of uniformly scattered objects (galaxies in this instance) falling within a given distance from the observer (earth) increases more slowly than the cube of the distance. Results of this counting process have been contradictory.

Another method of determining the curvature of space is to find out whether the galaxies' speed of escape from the galactic center is faster or slower now than it was billions of years ago. If it is slowing down, then it may collapse back on itself, indicating that the Big Bang theory is correct. Since light takes so long to reach earth from even the nearer galaxies, when you look at the light from a star 100 million light years away you are looking back in time 100 million years. Therefore, to see the way the universe was billions of years ago, it is necessary to find the remotest galaxies in space, because the farther away they are, the longer ago you have been seeing them. The trouble was that the biggest telescope could not quite "see" back 2 billion years, and, because the difference in speed the astronomers were looking for is so small, a period of more than 2 billion was needed.

So astronomy was at a standstill until the invention of radio astronomy—a result of the advances in electronic equipment achieved during the war—and the identification of numerous sources of radiowaves coming from outer space. It was thought that the radio signals came from galaxies, but it was discovered in 1960 that they came from single stars instead—small, insignificant stars previously thought to be on the edge of our own galaxy.

The spectrograph was then applied to these strange stars. (The spectrograph is used to detect the famous "Doppler Effect" predicted by Einstein; it spreads light from a star into a spectrum, like a prism. The farther away the star is, the faster it is receding, and the larger the Doppler Effect is.) The radio stars were found to be 2 billion light years away, not in our galaxy, but on the outermost limits of the known universe—receding at a rate of 27,000 miles per second. For their light to appear bright enough so that astronomers took them to be in our galaxy meant that they had to be the brightest objects in the universe. One of the radio sources (called "quasi-stellar radio sources," shortened to quasars) was found to be an incredible 4 billion light years away and receding at 54,000 miles per second. Some quasars emit the same amount of light as 100 galaxies of 100 billion stars each. (The names of these fantastic spewing bodies are quite unimaginative, compared to the ingenious names physicists give to particles. The two quasars referred to above are called 3C-273 and 3C-48, from their listing by radio astronomers in the third Cambridge catalogue of radio sources.)

The above explanation of quasars was not arrived at until 1963, by Dr. Maarten Schmidt. Today, physicists are still trying to understand how the quasars could emit such stupendous amounts of energy. There is no known atomic or nuclear reaction that could produce the quantities of energy in quasars; the answer to this mystery—possibly a new force—is yet to come, probably in the not too distant future. Investigations of quasars may provide the answer to the origin and destiny of the universe. The light from the farthest quasar, 8 billion light years away, left it billions of years before the sun or the earth was born, when the universe was only a third as large as it is today. And Dr. Allan Sandage, the key astronomer at the Palomar Observatory in California, has said: "We can now see about half of the way back to the creation of the universe."

The Evidence of BSO's

Dr. Sandage, in 1965, discovered another new natural phenomenon—the BSO's, or Blue Stellar Objects, which are very similar to quasars except that they emit no radio waves. Some astronomers think they are old quasars that have simply lost their radio voices. They are 100 times more numerous than quasars, which has led Dr. Sandage to assume that they are quasars in the process of evolution—from quasars into galaxies, containing stars, planets, and perhaps life. Thus they may contain the key to our galaxy's evolution. From observing the BSO's, Sandage has thought that they indicate the universe is finite, expanding, but slowing down, and that it pulsates every 80 billion years—placing him squarely in with the Big Bangers. And it is the evidence from the BSO's that has made Dr. Hoyle retract some features of his old steady-state idea. The evidence clearly indicates that the earth was born 10 to 13 billion years ago—at least, the earth in its present state (for there is no indication whether or not this is the first bounce). It seems to many astronomers that Hoyle's placid, infinite, eternal universe, with galaxies scattered evenly like trees in an apple orchard, might have to bow to the idea of a Cosmic Zero Hour after all.

In the same year, 1965, radio waves that were generated, some think, by the original explosion of the primeval atom were detected by an antenna built to pick up signals from Telstar. (At first, the strange noises coming in were confused with the noises made by pigeon-droppings on the antenna.) The idea is that, if the explosion of genesis took place, a gigantic flash of brilliant light would have accompanied the outburst of energy. It would have filled the surrounding space, and, as the light emitted traveled in waves throughout space, its frequency would have slowed down until it turned into radio waves (since light and radio waves are simply different wave lengths of electromagnetic energy). Thus the crackling detected on the Telstar antenna may be the whimpers of the original Big Bang that started it all.

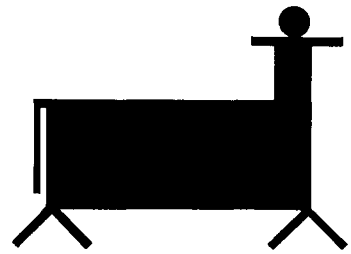
Astronomers are now working on the enormous job of counting that must be done to determine the distribution in space of the BSO's and quasars. This should confirm the steady state or the Big Bang theory of the universe, but it might also indicate that neither is adequate.

The Government's space program is aiding astronomy in basic research with the launching of four Orbiting Astronomical Observatories (OAO's), whose mission is to collect data on cosmic radiation that cannot penetrate the earth's atmosphere. Gamma-ray detectors on board search out the sources of these high-energy cosmic rays, which contain nuclei traveling at speeds closer to the speed of light than particles in any atom-smasher. The first OAO went up in April 1966 but failed to send back any information. The next attempt will be made in late 1967 or early 1968.

The Genetic Code

If the atom is in some sense the basic unit of inorganic matter, the cell is the basic functional unit of living organisms. The cell's nucleus is composed of a great collection—10,000 or more—of diverse hereditary units, called genes, which are strung together in a sequence of four different chemicals (termed bases) to form tiny threads of chromosomes. These chemical strands are linked together in a helical structure, forming a giant polymer molecule of deoxyribonucleic acid (DNA). It is this substance and its ribonucleic acid (RNA) copies that are the subjects of nearly all biological and biochemical research today. Knowledge about DNA and its activity in cell growth and differentiation has increased greatly every year since 1953, when it was realized that DNA carried the genetic code, which is responsible for the growth, and reproduction of every living cell on earth.

DNA is a helix; it looks like a ladder twisted in a long continuous spiral. The individual bases that form the rings of this chemical ladder are arranged in different sequences; the code of these sequences accounts for the differences between all living things—from tomatoes to humans. The interactions of the chemicals produced by the genes with the other parts of cells determine the composition and structure of organisms. Complete understanding of the genetic information in the cell could lead to the most fundamental changes imaginable in man as a species. His body, his brain, his personality, his character, his diseases, his life-span, his reproductive capacities—all conceivably could be drastically redeveloped once the process that governs cell growth and differentiation is mastered. Before the advent of molecular biology, drugs were being developed to treat symptoms; drugs are now being developed to alter cellular production and function and thus eradicate the disease itself. If the implications of drugs like LSD scandalize some people, the implications of mastery of genetic information, which is certain to come, should overwhelm them.



The genetic code, which directs the entire process of growth, has been cracked. It is known what the messages are that travel from the DNA molecule to the cells; it is even partially known what message goes for which protein. One of the great scientific achievements of our time is that ribosomes, the manufacturing plants of the cell, have been isolated, kept alive, and fed different chemicals that cause them to manufacture predictably different proteins.

The genetic content in human cells has been the same since the Stone Age—for the 50,000 years man has existed as a distinct species. It has only been since the 1950's, when Linus Pauling discovered the helical structure of proteins, that molecular biology has burgeoned into one of the largest fields of pure research. James D. Watson and Sir Francis Crick visualized the structure of DNA and built their famous model in the 50's. And the clue to the genetic code was supplied by a nuclear physicist, George Gamow, in 1963. Fundamental discoveries about the fantastically complex workings of the code have come forth every year since Pauling's contribution.

Since there are many excellent and clear books on the subject, the best of which have been written by Dr. Gamow (the "Mr. Tomkins" series), the complete details of molecular theory need not be given here. What follows are the basic essentials.

The individual chemical bases that form the spiral staircase of the double-stranded DNA molecule are four chemicals, called adenine, thymine, guanine, and cytosine (abbreviated to A,T,G,C). These four are repeated in 64 different sequences along the molecule: It is their order that constitutes the *genetic* code, and it is their order that determines what proteins will be manufactured in the cells. (Proteins are the basic material in cell growth and reproduction.)

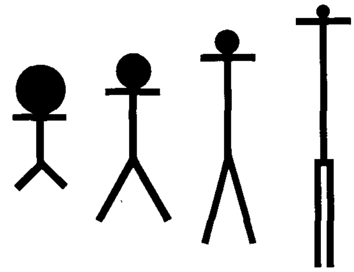
There are 20 different amino acids that, depending on their arrangement and combination, form the various proteins. The first job of DNA, then, is to dictate to the cell which amino acids to make and how much of each should be made. The code for this information comes in combinations of three of the four chemicals A,T,G,C. This was Dr. Gamow's contribution—that it was a triplet code—and he figured it out during a poker game by noticing that, on playing cards, there are only four suits, just as there are only four letters (A,G,T,C); using only three of the four each time, exactly 20 different combinations can be made. And there are exactly 20 amino acids. Thus if there is, say, a combination of A,T, and G, one kind of amino acid will be made, and, if there is another combination, a different amino acid will be made. A sequence of amino acids strung together forms protein.

How does the manufacturing site within the cell get this information from the DNA molecule in the nucleus? First, the DNA makes a short strip of another acid, called ribonucleic acid (RNA), which contains the exact replica of the triplet of letters required for the amino acid DNA seeks. This strip of RNA, called "messenger," then drops off the DNA, floats out into the cell, and is "reeled up" on a ribosome, something like a bicycle chain on a sprocket. It then directs production of simpler forms of RNA that bring amino acids back to the ribosome assembly line for protein production. For each protein to be made, a different strip of "messenger" is sent to the ribosome. Thus, if DNA is the architect of the body, the messenger RNA is the working drawings and the simpler forms of RNA are the shop drawings.

All the possible 64 triplets have been identified, and nearly all of them have been related to the amino acids they code for. A sequence of these triplets corresponds to a sequence of amino acids —in other words, a protein. Moreover, the same triplets stand for the same amino acid in every species of living organisms; thus, it appears to be universal. The genetic code, then, is 2 billion years old, going back through evolution to the lowest form of organic life—bacteria.

Recent Advances

Although there is some controversy about whether DNA can directly determine character traits, many biochemists think that it may happen indirectly, by determining man's responses to the physical and social environment. To a certain extent, environmental stimuli cause certain genes to be *activated* and not others, so that character is as much a product of the environment as it is of heredity. The most important stimuli are those received during childhood: Children receive sense impressions constantly, and before they learn words and ideas to organize these impressions they are as real to the child as concrete objects. Moreover, the effects of these early stimuli and the patterns of responses of the individual to them commonly persist through life. René Dubos, Professor of Microbiology at Rockefeller Institute, has called this concept "Biological Freudianism," because "socially and individually the responses of human beings to the conditions of the present are always conditioned by the biological remembrance of things past." Thus, as Dubos has written, "The child is truly the father of the man."



Other developments have taken place in the laboratory: Human and animal cells have been merged with those of mice, rats, rabbits, frogs, and chickens. Some of the hybrid cells formed propagated normally by cell division for months. This has been done to further the understanding of cell differentiation — the process by which cells, in a developing organism, use their genetic instructions in different ways to grow into different organisms. To understand cell differentiation is to know what makes human beings grow from a fertilized egg into hundreds of types of specialized cells, thus offering ways to alter that growth, correcting mistakes (mutations) that cause diseases like schizophrenia, and improving on nature (both goals involve inducing mutations). Man may eventually participate in his own evolution, ultimately by fetal, ovarian, or sperm therapy.

Molecular biology has also shed light on the causes of cancer. Cancerous cells differ from normal cells in that the former replicate themselves uncontrollably, whereas normal cells reproduce only when needed for growth, maintenance, or repair of other cells. Biochemists are now at work figuring out the triggering device that DNA utilizes to start and stop cell division. Other researchers have found that certain enzymes contained in the lyosome of cells seem to be able to dissolve parts of cells—specifically, DNA and RNA. When this happens, cells begin to behave as if they were cancerous. It is believed by some that the cure for cancer will be found within 10 years.

Future Directions

Joshua Lederberg, a leading biochemist, thinks that future research will follow any one of three —or possibly combinations of all three—of the following lines: One is "algeny" (or genetic alchemy), which involves changing the DNA code in fertilized egg cells and altering individual genes, correcting hereditary defects, and producing "desirable" characteristics. (It is one of the severe social problems fostered by molecular biology that someone may eventually have the power to decide what characteristics are "desirable," which involves deciding what man will or should be like.) Another direction research will take is termed "euphenics," which will involve changing man not by dabbling with the code itself but altering its processes with enzymes, hormones, or other chemicals, such as brain-enhancing drugs, to make up deficiencies or get entirely new effects. Another direction, which has already begun, is "somatic or body-cell genetics"—the "art" of growing human tissue or body cells in cultures. This could work in two different ways: One is to manage tissue cultures so that "desired" gene combinations are fixed, reset, or reordered, and then grow them into whole organs and organisms. The other is the hybridization of cells from mixed human and animal sources. It may be possible by this method to derive subhuman or superhuman creatures more grotesque than those in mythology.

Mind

Probably the most revolutionary development in molecular biology is the effect it has had on brain research. Some biochemists think that DNA and RNA not only determine the growth of cells in the body, but also govern chemical reactions in the brain's nerve cells, determining its structure, development, and capacity. Some even think that RNA may be the key to all brain processes, like learning, thinking, and even the emotions, since they originate in the brain. Evidence linking RNA molecules to brain activity is far from conclusive but there has been enough to provoke widespread controversy.

For many years, brain research was dominated by electroencephalographs and the planting of electrodes in the brain, on the theory that the basic activity of the neurons in the brain was electrical. It was discovered, for instance, that there is present in the brain a steady, low-voltage wave, called the alpha rhythm, which changes pattern with alertness, drowsiness, concentration, and sensory stimulation. Sleep, dreams, and epilepsy are currently being investigated in depth by electrical apparatus. Other recent achievements of this avenue of research have been the mappings made of speech, visual and auditory centers, as well as built-in responses like aggression, fear, and rage; pleasure centers have been pinpointed physically in the brain also. And the speech control location, associated with the highest thought processes in man, has been discovered.

The phenomenal growth of molecular biology saw the advent of biochemists who thought that the neurons must build protein, grow, and decay like other cells, to the end of producing nerve impulses. The neurologists debunked this "brain hash" chemistry, until chemists isolated a number of important chemicals in the neurons, including serotonin and acetylcholine, which are involved in the organization and speed with which information is translated from sense data to conscious information. The chemists then found some of the hormones involved in brain actions. This led to the development of some of the widely known "consciousness-enhancing" drugs such as LSD. The implications of the fact that chemicals influence brain reactions are tremendous. Among other things, it might mean a cure for schizophrenia and other mental diseases thought to be caused by malfunction of brain chemicals.

Recently, chemists and neurologists have joined forces and today the operating theory is that the brain's activity is electrochemical. Much of their work now concerns relating what happens chemically and electrically in the brain to actual word storage, or memory, and instinctive drives, like sexual behavior, hunger, etc.

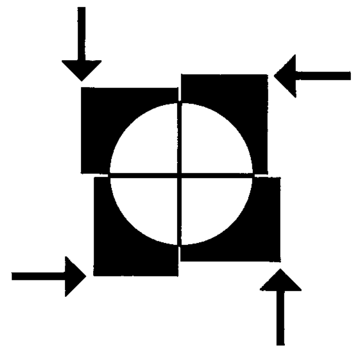
Some idea has now been formed of what memory is. Several years ago, it was thought that memory was electrical, that, as impressions traveled between neurons, they left traces or pathways and eventually established reverberating circuits for later recall. But this was disproved. Today, there is a three-level theory of memory: short term (three seconds duration, primarily of sensory stimuli); medium-term (a few minutes up to a few hours, used for exam-cramming, telephone numbers); and long-term, in which the cortex sifts through all incoming data and preserves some of it because of its vividness, interest, or later use. The idea is that short- and medium-term memories are electrical, but that long-term memory is permanently incorporated into the brain's chemical make-up, since it cannot be dislodged by strong electric shock as the other forms can be. If the shock is administered before the 24 hours are up, memory is impaired.

DNA: The Ultimate Architect

The brain location of long-term memory is a mystery. It was discovered that it is apparently diffused over the entire brain, that each half of the brain has the same capacity for long-term memory. One theory is that the DNA code controls the growth of the millions of fibers involved in word storage, dictating to them which way they are to hook up with each other. This would account for the precision of sensory systems, but not for later additions made as individuals learn from experience. The brain presumably does not grow more connections as it learns new things.

However, molecular probes of brain tissue have revealed that the optic, emotional, and motor centers of the brain are direct products of the genetic code. Stimulation of the brain increases the rate of RNA production and protein manufacture in brain neurons. Furthermore, the RNA produced by brain stimulation in trained animals appears to be chemically different from that produced in untrained animals, which would indicate that learning somehow becomes coded into the RNA, making it different. Finally, it was found that during the **process** of learning, RNA changes chemical composition. Partly this resembles computer storage systems, where information is punched on cards; the cards might be compared to RNA molecules, and the holes are punched by DNA acting on RNA, so that memory may someday be termed "molecular information storage and retrieval." Supporting this theory of memory are experiments that have shown that brains nurtured in stimulating learning environments are actually heavier and chemically different from brains of animals born in "deprived" environments. And a chemical has been found to speed learning and enhance memory; it has worked on rats and is now being tested on humans. It is not a "memory molecule," but a chemical that acts on the key enzymes that stimulate the production of RNA.

After human beings reach the age of 35, 100,000 brain cells deteriorate every day. Again, the possibility exists that a drug can be found to prevent the wholesale degeneration of brain neurons, thus prolonging the brain's youth. The chemical deficit has already been found for Parkinson's disease. Molecular biology will probably lead eventually to a general rise in IQ of entire populations. (The possibilities of molecular biology are spelled out in "The Social Revolution.")



The ultimate puzzle is, of course, consciousness. It has been prized by man for centuries as his unique characteristic; in the third millennium, if not sooner, we may discover that consciousness was a simple mutation in the genetic code, like other characteristics of man. However, the miracle of consciousness remains the same, whether it is created in a test tube or in the human body. Human consciousness may someday be the result of the fusion in a test tube of two cells that are afterwards provided the correct chemical nourishment and environment for growth. But if consciousness is produced by "artificial" means, it will still be a mystery, because the mystery is not so much how it is created, or what it is made of, but simply what it is. The mystery of the development of a consciousness that thinks about itself, and, if consciousness is chemical, of chemicals that can think about how they are interacting to produce the thought they are thinking, remains the same. It is perhaps not irrelevant to point out in this connection that Timothy Leary, the apostle of LSD, has said he can see his cells working when he has taken LSD.

That consciousness itself—the ultimate sanctuary of the human mind—should stand at the threshold of scientific understanding must strike some people as frightening, as if our cherished notions of "soul" and "spirit" were about to be violated and reduced to mere working parts of a mechanistic universe. Yet knowledge has never disarmed man, and the world that the new science is revealing to us is one to whose structure and experience we must stand open. As biochemist J. Bronowski has written:

"We live in a world which is penetrated through and through by science. . . . The dream of H. G. Wells, in which the tall, elegant engineers rule, with perfect benevolence, a humanity which has no business except to be happy, is the picture of a slave society and should make us shiver whenever we hear a man of sensibility dismiss science as someone else's concern. The world today is made, it is powered by science; and for any man to abdicate an interest in science is to walk with open eyes toward slavery."

Vast and fast developments in technology, that immediate offshoot of the scientific revolution, are already transforming the world. Technological advances will continue at an accelerated rate, bringing with them ever-increasing changes in life patterns. Here are some examples chosen from the immense subject of . . .

THE TECHNOLOGICAL REVOLUTION

It is as easy to predict the state of technology in 2000 A.D. as it is to pick the first three horses in next year's Derby. Many wise men try, but none know for sure what is going to happen.

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Imaginative scientists forecast sweeping changes in transportation, communication, underwater living, power supply, food sources, and medicine. Others, with their feet firmly planted on earth, have difficulty in raising their sights beyond 1968, despite the demonstrable acceleration in technological progress during the first two-thirds of this century.

Why does the depth of focus differ? Mainly because scientists are human, and, like the rest of us mortals, are prone to optimism, pessimism, and occasional myopia. Also, scientists are employees conforming to the rules of business, which dictate that one industry does not develop technology that will cause obsolescence in another industry, because threads of finance tie them together.

Finance, however, breathes life into technological progress more often than it kills it. Many obstacles to advancement could be removed with a big fat research and development appropriation. But money is not all things to all men. Technology for technology's sake is frowned on by many scientists. Their attitude is: Will man benfit from this line of progress? And, if the answer is negative, they reason that it is not in the best interest to pursue it.

Nevertheless, whatever interest is best served by technology, heavy financing is usually the only way to advancement. Fortunately, governments around the world funnel vast sums of money into defense budgets that keep all sorts of technological research alive. Think back to the difference in airliners at the beginning and end of World War II to see how an unlimited transfusion of money can accelerate an industry.

Money, purpose, and vision, mixed in the right proportions, result in technological progress. The limits are unknown; the limitations are manifest.

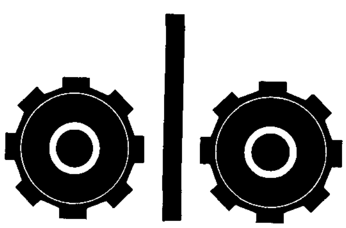
However, despite human limitations, technology is rushing toward the next century. In 2000 A.D., we will be able to look back nostalgically at the 1960's and wonder why some techniques seemed difficult; just as we now look back and laugh at the prophecy that the horseless carriage was a passing fancy.

The areas of technological research that we report on in the following pages represent, of course, only a portion of the various fields being mined to shape the technology of the future. As a cross-section of the total picture, however, it will give readers a sense of what to expect.

Computers As Thinking Machines

To call a computer, in 1966, a "thinking machine" is misleading. What is usually being referred to is only a new and improved method of programming. Whether a "thinking machine" can become a reality by the year 2000, as quantitative differences change to qualitative ones through the interaction of man and machine, depends upon our definition of intelligence. A very thin line seems to exist between man's deductive processes and the functioning of the sophisticated machines of the future. Indeed, some scientists insist that this line does not exist at all.

Compactness of storage and speed may lead to the creation of thinking machines that are much brighter than the smartest human, according to Dr. Jerome B. Wiesner. To document his contention, he pointed out that machines will soon rival the human mind in compactness,



through advances in miniaturization, and that they already far outstrip it in speed. Neurons respond at the rate of 100 times per second, whereas electronic switching operates in excess of one billion times per second.

Dr. O. G. Selfridge and Dr. J. L. Kelly, Jr., have declared, "We believe it is certainly logically and physically possible for a digital computer to do any sort of information processing that a man can. This includes thinking or inventing, regardless of how they are defined." And Dr. Marcel J. E. Golay has pointed out, "Stupid computers of today may be transformed into thinking machines." Dr. W. Grey Walter of London is also in agreement: He pointed out that the complexity of the computer may emerge from a difference in degree to a difference in kind of intelligence.

There are reports of machines that have learned to play checkers and to beat their creators—which, of course, might merely mean that their inventors were not particularly talented contestants; but the evolution of a chess-playing computer that will commit to memory its own moves and mistakes is not beyond possibility. This makes it theoretically possible for a machine to someday wear the crown of champion chess player of the world.

A mechanical turtle has been devised by Dr. Walter that propels itself on wheels and possesses sensors that direct it to outlets, which allows the turtle to refurbish its own electrical power units, thereby far surpassing the limited intelligence of the automobile. Professor J. G. Kemeny has devised a self-reproducing machine. Although both of these gadgets are at present extremely simple, one must not forget that today's computer was a primitive instrument only 15 years ago. The evidence seems to indicate quantitative differences, as stated by Dr. Walter, which may force man to re-evaluate his definition of a thinking machine by the year 2000.

Present-day computers, by lowering the cost of calculation as compared to experimentation, have indicated a shift toward calculation in many fields where once only experimentation and comparatively direct measures were practical. Scientists point out that a physical theory, when notated in mathematical symbols, often becomes a dynamic theory when rewritten in computer language. It is as an active rather than a passive participant in scientific thinking and research that the computer is most likely to have its profoundest effect.

In this area, the computer as a measuring instrument has allowed science to travel paths it has not trod before. The analysis of protein molecules and chromosome examination are in reality entirely original measuring techniques, without human precedent, that were evolved by the computer.

Computer simulation is another one of the really new research techniques that computers have made possible. An an alternative to performing difficult and costly experiments, it is now possible to program a simulation when a researcher thinks he understands his project sufficiently. He can thus test the truth of his hypothesis in partnership with the machine, prior to its resolution.

By the year 2000, the architect and engineer will not have to discard what he may now disparage as a "flight of fancy"; he will be able to simulate an idea to find out if it is a brilliant intuitive insight or a future drawing-board fiasco.

Through this ability to test ideas for their inherent worthiness, the designer's range will be immeasurably widened. With the perfection of the "transparent computer," which can be communicated within the vernacular and provides instantaneous response, a dialogue will emerge between designer and computer that will rival the ease of office-party conversation. Indeed, the designer of the year 2000 may take to social sessions with his computer and end up with much more than a hangover.

Computers As Knowledge Banks

"Progress in many critical areas, including research, business planning, education, medicine, and government, is running into an information barrier. We lack a quick economic access to large amounts of information and the means of processing this information." These problems were outlined by Dr. Arthur Bueche, vice-president, Research and Development Center, General Electric Company, as he indicated the probable direction of the next breakthrough for the computer.

All of those involved in either science or technology have echoed Dr. Bueche's statement. As important to the computer revolution as distribution of goods was to the Industrial Revolution, is the dissemination and ready accessibility of accumulating knowledge. If the knowledge revolution is to consolidate its startling gains, then this problem must be solved. From the steps already taken, it is certain that it will be —and that knowledge banks will form the cornerstone of technical progress by the year 2000.

In many large research laboratories and universities, "knowledge banks" and time sharing —the shared use of a computer, via telephone hook-up—are already proving their potential worth.

The three years of experience with the Compatible Time-Sharing system at M.I.T. foreshadows some of the possibilities. The computer has enabled them to build upon one another's work. More than half of the commands now written into the M.I.T. system were written by the users rather than the programmers charged with inaugurating the system. This continuous dialogue with the computer as the users' assistant, and the uniting of groups of investigators in the cooperative search for the solutions to common problems, has made this machine an intellectual public utility.

Dr. John McCarthy of Stanford University, writing in **Scientific American,** has predicted the installation of computer consoles installed in every home and connected to master or public utility computers. He states that this is possible even at the present state of computer development.

Dr. McCarthy envisions a console, comprising a typewriter keyboard and a television screen, that can display text and pictures, with each subscriber owning his private file space, which can be consulted at any time. "Given the availability of such equipment, it is impossible to recite more than a small fraction of the uses to which enterprising consumers will put it," he pointed out.

The uses of the computer in the year 2000 may implement and give meaning to Abraham Lincoln's admonition never to overestimate the public's information nor underestimate its intelligence.

It will give the general public ready access to all available information, and provide them with a "thinking machine" to augment their intelligence. Hopefully, for once, the harassed consumer may find it possible to make an accurate evaluation of his gas and electric bills and income tax and have a machine that will, if not beat the system, at least allow him to stand on equal footing with it.

Dr. McCarthy also predicts a variety of public utility services marketable through the computer, such as searching through manufacturers' catalogs and comparing their blurbs with the reports of organizations such as the Consumers Union. The entire contents of the Library of Congress, as well as the local racing form, will be more accessible to the public-utility computer user than they are to today's librarian or racing tout.

The value to medical science of making instantaneously available a comprehensive body of data is inestimable. Records can be kept of all diseases, their symptoms and cures. By the year 2000, the medical histories of all the world's citizens could form part of this crucial data.

The New York Times of October 24, 1965, featured an article describing the present marriage of medicine and electronics in preserving life and spawning a $350-million industry. This represents a tremendous increase over the use of electronics in 1960. The article also stated that three Boston hospitals are currently using the computer at M.I.T. for diagnostic purposes.

In our shrinking world, the increased use of the computer for the treatment of disease is a necessity. Ever-increasing speed in transportation makes such a universal medical bank a necessity. In a world in which one infected man can circumscribe the globe during the virulent, contagious stage of a major disease, the traditional concept of quarantine is ludicrous.

Industrial Knowledge Banks

C. G. Suits, vice-president and director of research, General Electric Company, states that factory control will be computerized—a system whereby the computer will accept inputs of management policy, customers' orders, and the pertinent economic facts—inventory, time schedules, size of labor force, etc.—of the factory-supplier. The system will do engineering design of products, order materials and maintain a warehouse, schedule and control production, and supervise individual machines and processes necessary for production. It will also prepare necessary reports, although one wonders, with a machine this competent, just to whom these reports would be issued.

For management control, Suits adds, the system will make available to each executive within the company instantaneous reports on the state of his business and that of the company as a whole. It will also allow him, through the construction of models, to simulate the marketplace and foretell the effects of his decisions on the company, the particular industry as a whole, and lastly, the national economy.

Suits also predicts that the computer will have the authority to make many types of management decisions, some of which today are reserved for executive management. "To soothe his executives," as Suits put it, he noted that the computer will never make really important executive decisions, although the nature of what constitutes such decisions might well change.

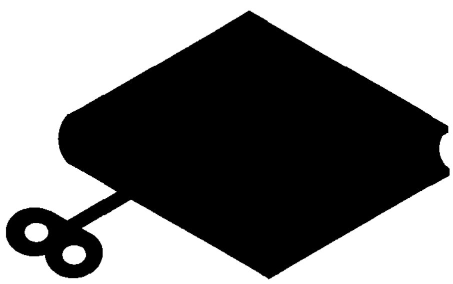
Present developments point to the increasing role of the computer in human affairs by the year 2000: the communal designing of systems to perform various functions—intellectual, economic, and social. On the other hand, the system will have profound effects in shaping the patterns of human life. The coupling will be so strong that the community itself will become part of the computer program.

According to Dr. Edward E. David, Jr., of Bell Telephone Laboratories and Dr. Robert M. Fano of M.I.T., the average husband and wife will use a computer as casually as the automatic washer-drier and power tools in their basement today. Unless they do so, according to these two scientists, we may not survive the increasing complexity of our society.

The Computer and Education

The present state of computer development allows their use as invaluable teaching aids. The future development will depend on how we wish to train our young within the computerized society that will evolve.

Computer programming is already being taught in high schools and universities as a discipline as logical as mathematics. Thus the dialogue between student and machine has begun. A recent issue of **Engineering News-Record** described a program to stimulate investigation by allowing engineering students to make their big mistakes on magnetic tapes rather than with building materials. The machine was loaded with cost figures and design data to simulate a bridge design problem. Also, to give the student a taste of reality, it had small teasers, such as quixotic announcements that the cost of steel had been reduced, or that orthotrophic bridges had just been approved.



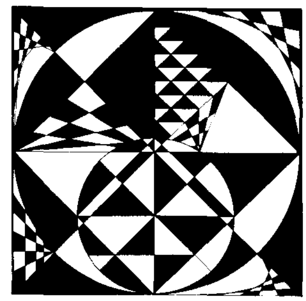
By the year 2000, the great advantage of the computer will lie in furnishing individual instruction, which is the major stumbling block in contemporary education. Computers could be programmed to keep up with student progress and allow him to maintain his own pace in learning, thus putting the program under the control of the student rather than the teacher.

The student could decide whether he wanted to read an exposition or solve a problem. He could also use the computer to test his own ideas, to build his own systems, to develop his own programs, and, in so doing, test the directions of his own thinking and interests.

The Computer and Art

The turn of the century will find the computer well established as an active participant in artistic circles in the realm of the graphic arts, music, and literature. Scientists belie the fear that the computer will usurp our civilization, but they warn that we must be prepared for some rather "sophisticated" uses of the machine—ones that might be upsetting.

An augury of this prediction turned up recently in the pages of **The Saturday Review**—a rather droll account by Sir Francis Crick of a plausible psychoanalytic encounter between a young lady and a computer.



Dr. John R. Pierce, an executive of the Bell Telephone Laboratories, stated at a computer conference that "The know-how and experience obtained in using computers to make scientific drawings and to generate sounds for psychoacoustic experiments can be made available with very little extra effort to artists for their use in producing music and pictures." Dr. Pierce further commented, "What artists learn in using new techniques can be valuable to scientists and engineers."

As an additional reason for his proposal, he cited the hope that such a use of the computer might reassure the public as to the computer's function. However, given the present state of art, one wonders if it might not be more reassuring to the scientists and the rest of the public to contain the present riotous state of the arts with the computer—to assure us, the public, of the artist's function.

Music and graphics have already been produced by the machine, and there are some who declare that programming itself is a literary art. Based on the music so far created by these means, we might anticipate that, with continued improvement on the part of the computer and heightened appreciation on the part of the 21st-Century listener, such music might prove satisfying. However, few would deny that, based on present performance, computer art does not compare favorably with Op art. But it is in the realm of literature that the computer might be expected to make the most startling innovations.

The present concern of the Bell Telephone Laboratories with the perfection of a new language, called FASE, threatens to eliminate verbal ambiguity. It is doubtful that literature can withstand such a blow. This language, research on which is being conducted by Dr. Lee E. McMohan, a psychologist studying ways of improving communications between computers and people, would eliminate the basic building block of the writer's art. This type of programming would condemn to obscurity some of our most cherished literary giants—James Joyce, T. S. Eliot, as well as several members of the P/A staff.

The Computer and Language

Scientists talk computer but computers do not yet talk science. According to one scientist, pro-

grammers have perfected almost ideal ways to make themselves understood by the computer from the computer's point of view.

The function of the computer is to accept information from its environment, combine this information according to the program and information stored in its memory, and send back the combined data. The process has induced basic transformations of the institutions and enterprises in which it has been installed. Whether the changes are due to the speed with which the computer works, or the phrasing and consequent thinking within the language of the computer, has presently not been determined.

Every question implies its own answer. In the process of tailoring questions to suit the computer's convenience, has the nature of the problems to be solved been limited by the computer's answers? The present concentration on a breakthrough with wider input and output form for the computer is an attempt to deal with this problem.

The Rand tablet enables the computer to interpret human sketches by putting diagrams and sketches into the computer directly, avoiding the time-consuming process of reducing them manually to numerical coordinates. Thus, a direct language relationship with the computer is established. Concerted efforts are also being made to develop a system whereby the computer will accept the spoken word, thus allowing direct communication. Although these efforts are still quite new, there is a growing belief that important new insights will be gained from their use.

The process of writing a program is primarily intuitive rather than formal, according to one scientist. We shall be more concerned with guiding principles that underline programming than with the particular language in which the program is to be presented to the machine, he concludes.

The complexity of the spoken and written word has historically represented the dividing line between civilization and barbarism. In our present halting attempts to communicate with the computer, we may, by the year 2000, look back these 34 years to see ourselves as Ogg the caveman. It does not seem impossible that we will not only be communicating with the computer in the sophisticated language of a university don, or the argot of a street urchin, but we may have gone one step further in direct communication. Words were adequate for the Industrial Revolution; perhaps, in the Thinking Revolution, we will communicate directly with our thoughts.

The Computer: New Laws

Looms were burned at the beginning of the Industrial Revolution not because they were looms but because they symbolized a social condition that threatened to enslave the weavers. The protest was against the social change that transformed the "Yeomen of Merry England" to Marx's downtrodden proletariat.

The computer—the symbol of our intellectual revolution—could be burned as a potential brainwashing device, but it could also be used to reverse the trends toward mass production and uniformity that were so necessary to the Industrial Revolution. Thus the computer could be used to help solve the most urgent engineering, social, and political questions of the next generation.

"The speed, capacity, and universality of computers make them machines that can be used to foster diversity and individuality in industrial civilization," writes Dr. John McCarthy in the September 1966 issue of **Scientific American** "as opposed to the uniformity and conformity that have hitherto been the order of the day. Decisions that now have to be made in the mass can in the future be made separately, case by case."

Dr. McCarthy proposes the following bill of rights for a computer age.

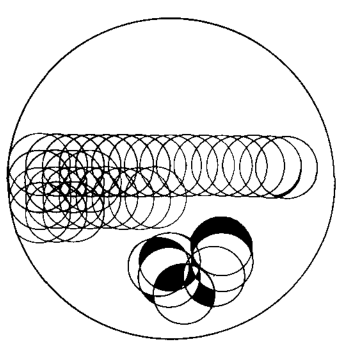
- ☐ No organization, governmental or private, is allowed to maintain files that cover large numbers of people outside the general system.
- ☐ Rules covering government access to the files are specific and well-publicized. The program that informs these rules must be open to any interested party, including the American Civil Liberties Union.
- ☐ An individual has the right to read his own file and contest the entries. He is informed when someone else consults his file.
- ☐ The right to keep people from keeping files must first be invented, then legislated and actively enforced.

The necessity for the type of legislation Dr. McCarthy proposes has been highlighted many times in television extravaganzas to further doubtful political careers, using scripts largely pilfered from security files.

Whether the year 2000 will find us in an age of degredation and hopelessness, such as was suffered by the early victims of the Industrial Revolution, or as free men enlightened by new capabilities, may well depend upon whether or not we heed Professor McCarthy's warning.

The Polymer Revolution

A visiting European scientist recently declared that the United States had entered another revolution: the Polymer Revolution. He may be right, because technology can make polymers for reproducing almost anything by juggling around the molecular structure of organic compounds. When science is thus in a position to produce better results than nature, this will obviously lead to a complete change in our present values.



Precious stones, for instance, will become much cheaper when mass-produced, and therefore will no longer be precious. Industry can now manufacture sapphires and rubies with better crystalline structure than natural stones, so how can man attribute greater value to the natural jewel?

By polymerizing—rearranging the molecules—of natural materials, technologists create more usable products. Paper and rayon are polymers of wood. This year, the paper industry started manufacturing paper dresses that retail for as little as $2. This is probably the thin edge of a wedge that will split the textile industry. Paper can be made to look like almost any textile, and far-sighted managers in the chemical industry confidentially expect to be wearing disposable shirts in a few years' time.

Polymers also will lead to more serious creativity, such as relieving hunger in the underdeveloped nations. Food can be synthesized from petroleum products into a compact form containing all the ingredients essential for a well-balanced diet (see "Food," below).

Super-Strength Materials

Polymers are widely used today. The commonly used plastics are polymers mixed with fillers and curing agents. By definition, a polymer means many segments, and this causes the chemical compound to have high molecular weight, which increases the strength of the physical properties.

Water, for example, is a polymer because its two gaseous constituents, hydrogen and oxygen, are closely bonded into molecules that form a liquid. This bonding is easily broken by heating the liquid so that the water molecules are distilled. Conversely, the molecules are made into a stronger polymer when cooled enough to turn the liquid into a solid—ice.

The key to synthesizing is the ability to take simple molecules and combine them into polymers with the desired physical properties. Polystyrene is a common polymer that is cheap to produce but is limited in use because of its brittleness. Eventually, technology will transform this cheap material into another form by juggling its molecular structure.

Plastics will also form the matrix of super-strength composite materials reinforced with crystals of pure elements. These crystals, called whiskers, are capable of great strength: The General Electric Company has produced iron whiskers with a 1,900,000-psi tensile stress. In crystal form, these elements are at present difficult to manufacture, but, with determination, technology will find a way to make a marketable quantity.

Life will not be completely controlled by plastics, however, because some of the properties of other materials will be hard to replicate at an economical cost. Cement may be replaced by another substance, but stone aggregate may stay around for a long time. Reinforcing steel could be replaced with filaments containing iron whiskers, but large rolled-steel sections could stay competitive.

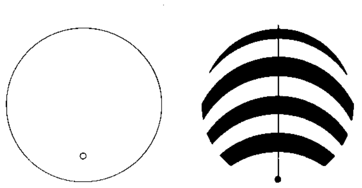
Metal powders will simplify casting processes and by-pass some of the manufacturing steps in making the parent metal. Thus it will not be necessary to make steel and then turn it into a powder for casting; instead, the steel maker will atomize molten steel before ladling it into ingots, and the powder will then be blown through pipelines to casting companies.

Powder metallurgy holds an added incentive to technologists, for many metals will combine in powdered form, even though they will not do so in a molten state. Metallic and nonmetallic particles can be distributed throughout the structure of an alloy or composite material in any combination chosen by the producer.

Food

Natural foods or substitutes—which will the teeming millions of the 21st Century eat? Two diametrically opposed solutions are being proposed today to solve the problem of mass starvation that faces the world within the next 15 years.

Increased production of natural foods through education and self-help in the underprivileged, underproductive areas of the world, or the manufacture of food substitutes as by-products of industrial functions are the alternatives presently proposed.



Will the anticipated world population of 8 billion by the year 2000 set a table of plenty with their traditional foods, or will they sup on such exotics as kelp, reconstituted waste, or hydrocarbon carbohydrates? The latter suitably flavored, of course. (See, "The Sensory Revolution.")

Natural Food

The dedicated scientists feverishly working against the specter of world starvation generally believe that it is possible to feed the world's hungry millions through existing technological means.

Impressive gains in meeting the problem have been made in situations where research, local cooperation, and adequate funds have been available. Mexico represents an inspiring example. A little more than 20 years ago, the Mexican government had to pay $50 million to import and mill wheat. To deal with the problem, the Rockefeller Foundation established a $5 million, 10-year research program in Mexico to improve the output of dietary mainstays. In that 20-year period, although the population has doubled, an adequate supply of home-grown wheat and adequate corn and beans has been available for everyone. In addition, Mexico has trained 700 specialists to spread its newly gained agricultural knowledge throughout South America and parts of Asia and Africa.

The Rockefeller and Ford Foundations teamed up to finance an International Rice Research institute in the Philippines. Within a period of seven years, the Institute had developed a new variety of rice that promises to increase rice production enormously. This new variant is impervious to certain diseases and to the destructive stem-borer; and it has produced greatly increased yields in 85 days—less than half the time it takes other varieties of rice to mature.

It has generally been said that the main problem involved was educating the farmworkers in the use of new methods and techniques but, according to F. F. Hill, vice-president, International Programs, Ford Foundation, this is not true. "The attitudes and unsubstantiated opinions of elite groups, including government policymakers and administrators, rather than the attitudes, beliefs, and customs of farmers, constitute the principal human roadblock to agricultural development in most developing countries," he notes.

As an example, he cited Japan, where rice yields increased 25 per cent between 1880 and 1900. "I have not seen or read anything that leads me to believe that, in the early stages of development, it is impossible to achieve substantial increases in agricultural output until such time as the majority of farmers have a grade-school education," commented Hill.

He calls for a "special and vigorous effort" to greatly speed up and develop testing and diffusion of substantially improved production technology for food crops. He suggests emergency teams to supplement, not replace, existing teams concerned with the less-developed countries. The difficulty is that these institutions are not being developed quickly enough to prevent the possibility of acute food shortages developing within the next 10 years in a number of countries with rapidly increasing populations.

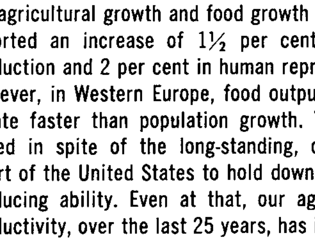
Hill believes that rice varieties developed at the International Rice Research Institute in the Philippines can be used to help revolutionize rice production in the tropics. Among the developing countries, Mexico, Israel, and Taiwan have made important progress in increasing crop yields since 1950. All three countries have good research organizations.

The U.S. Department of Agriculture, in reporting agricultural growth and food growth for 1965, reported an increase of 1½ per cent in food production and 2 per cent in human reproduction. However, in Western Europe, food output rose at a rate faster than population growth. This happened in spite of the long-standing, concerted effort of the United States to hold down its food-producing ability. Even at that, our agricultural productivity, over the last 25 years, has increased 109 per cent—more than twice the 50 per cent population increase. The less-developed countries, by comparison, increased their food-producing ability by only 8 per cent.

By the year 2000, it should be possible, through a concerted effort, to make the entire world as food rich as the U.S.

Inorganic Food

On the other hand, by the turn of the century, man may be existing almost entirely on synthetic foods—ones indistinguishable in taste or texture from those he has been accustomed to from the beginnings of recorded history. Industry is devoting extensive funds and research to the



development of by-products of their conventional processes to help feed the world.

The General Electric Company reports it has developed a simple means of producing one of the most important "building blocks of life"—the amino acids. The process can produce all 20 of the known amino acids, which are the substances that combine to create protein molecules and are essential to nutrition and other chemical activities of the human body. Not only has G.E. developed these, but it has done nature one better by producing acids not found in nature.

In human nutrition, the proteins in food are broken down by the digestive process into amino acids. The body then reassembles them into proteins needed to supply new tissues, muscles, and body chemicals. The single protein molecule is made up of a combination of the 20 acids, their sequence determining the identity and function of the protein.

Amino acid synthesis could lead to the creation of food supplements to economically upgrade low-quality diets for undernourished populations, and super-foods for those engaged in activities with specialized requirements, such as astronauts and long-distance runners. The process requires only inexpensive materials and simple procedures.

Synthetic amino acids, reports G.E., may also prove valuable in the study of enzymes—those forms of protein that are catalysts, promoting chemical reactions without themselves being changed by the reactions. Enzymes allow living cells to carry out the chemical reactions necessary for life—enzyme chemistry being, essentially, the chemistry of amino acids.

Through amino acids, food is reduced to its basic components, and then reassembled as needed by man for any particular human need, taste, or function.

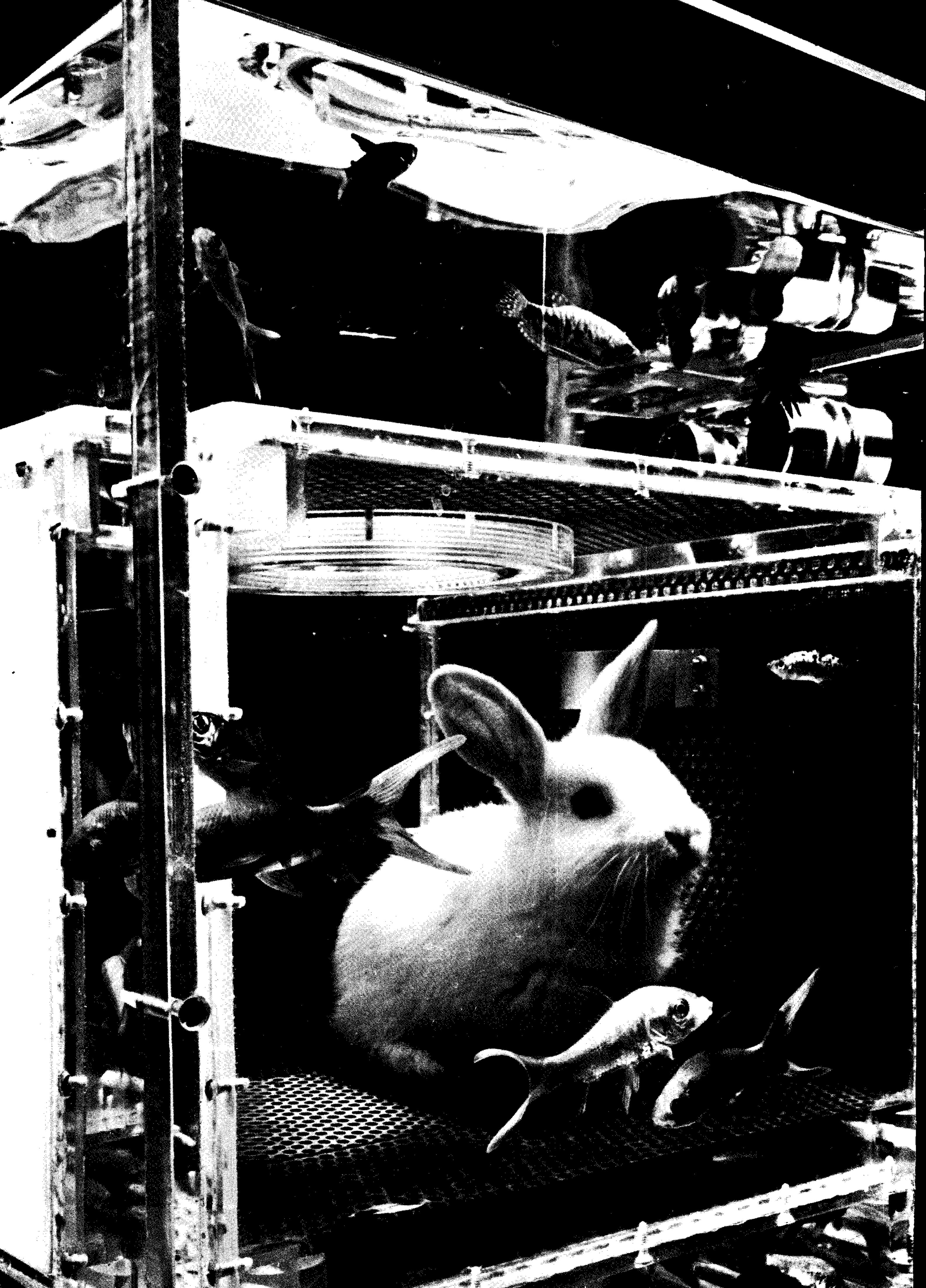
A less glamorous food source was announced in a business weekly this year, under the subheading of "Food from Waste." The magazine reports that North American Aviation harvested high-protein algae from sewage waste water. The company raised a flock of chickens on the algae mixed with ordinary feed, and believes it has discovered a cheap, easily obtainable source of food for "underdeveloped countries."

The Bureau of Mines of the United States Department of the Interior announced a year ago that coal is a potential source of high-protein food. The Bureau feels that this high-vitamin substance will help satisfy urgent nutritional needs of the world's rapidly growing population.

Standard Oil Company (New Jersey) and the Nestle Alimentana, S.A., announced a research program to develop a new protein-rich food source through a process in which yeastlike organisms are nourished by high-purity hydrocarbons. The company confidently asserts its potential ability to supplement conventional food sources, independent of the availability of arable land and the vagaries of weather.

Petroleum and natural gas interests are becoming more and more certain that the specter of world-wide hunger promises them a second untraditional market. **Engineering News-Record** reports that these companies, having staked out shares of the vast fertilizer field, are now turning their researches with increased attention to the concept of using hydrocarbons directly to produce protein-rich food supplements. Large installations that will produce such concentrates in Nigeria and India have been announced by two French-based petroleum groups.

One company official admits that winning public acceptance might be difficult, but adds that it should not at all be impossible to come up



with a food of suitable consistency and taste.

As major corporations invest sizable sums and involve large numbers of their research personnel in such projects, it seems that the distinction between edible and inedible substances will disappear.

A Union Carbide executive, when discussing the process, likened it to the wonders of a soybean steak he had enjoyed in Hong Kong—one that was indistinguishable from the real thing. However, this does not seem to be the direction that will be taken by the new food substitutes.

The tastes in foods may follow our present attitude toward plastics by the year 2000. The plastic substitute, derided in 1945, has risen in public acceptance: Today, it is widely acknowledged that man-made synthetics are often far superior to the natural product. The gourmet of the 21st Century might well appreciate these new exotic foods for their natural flavors.

Harvesting the Oceans

By the year 2000, the continental shelves will be recognized as operable and food-producing extensions of the continents. Their mineral wealth and potential food-producing value have become more and more attractive, inducing increased Government spending and accelerated industrial research in their exploitation.

As the hunter and trapper of the seas, man will become a farmer of fish. He will seed areas and harvest them with underwater machinery, perhaps keeping them caged with sonar devices.

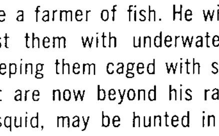
Fish that are now beyond his range, such as the giant squid, may be hunted in jet-propelled vessels. In the domesticated dolphin, man may have the equivalent of the horse for a helpmate.

An executive of Union Carbide pointed out that the shark is potentially a much richer food source than the cod. The food-hungry nations surrounding the Indian Ocean, a body of water that he described as "a fluid with sharks in suspension," could, he contends, be fed from this source.

At the ocean's edge, floating factories or underwater processing plants could convert fish flesh and sea plants into food and fertilizer.

It is predicted that, by 1972, underwater vessels will be operational at 6000 ft. There are presently under design four research submarines capable of descending to 20,000 ft, making accessible 98 per cent of the ocean's bottom.

Perhaps the most startling discovery is one made by General Electric in its development of



a membrane that will allow man to function underwater without the use of protective armor, by breathing oxygen directly from the water in a manner similar to the operation of a fish's gills.

A new polymer, a permeable membrane that permits the flow of gases on a selective basis, has been developed. Oxygen can be drawn from sea water and carbon dioxide discharged. The application of this material to supplying submarines and underground cities with air drawn from sea water is a distinct possibility.

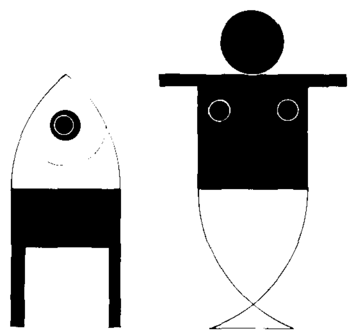
Angelo Dounoucos, project engineer for G.E., described fitting a man with gills made of this membrane, which he could utilize by simply unhooking his jugular vein, rerouting the blood through the gill, thus by-passing the lungs, which would be filled with liquid to withstand the ocean's pressure.

Experiments have been made which show this is feasible. Both a parrot and a hamster have lived happily underwater in membrane cages in the G.E. laboratory, and dogs have had their lungs filled with liquid and survived.

The membrane system has the virtue of allowing man to live and work underneath the oceans on equal footing with the fish and returning to land without the danger of the dreaded bends.

When news of the discovery was published, Dounoucos says that several skin-divers volunteered to be the first mutants.

Underwater cities in the year 2000 will probably be self-sufficient, taking their air from the sea water, being supplied with power through the harnessing of the ocean currents, and working and supporting themselves through ocean harvesting and ocean mining.



Desalinating the Seas

The desalination of ocean water will be an economic operation by the turn of the century. The Westinghouse Corporation has informed a Congressional committee that it is willing to undertake, at a firm bid, the construction of plants capable of desalinating 50 to 150 million gallons of sea water a day.

There are at present approximately 200 desalinating plants in operation, with the largest producing only 1 million gallons per day. Westinghouse claims that, to make the process economically feasible, larger plants must be constructed.

Food and Climate

A solution to the mystery of climate, like the problem of gravity control, does not seem slated for solution in the near future. However, accurate weather prediction and climate control will undoubtedly have a noticeable effect on world agriculture.

An automatic meteorological station is now a reality, as well as satellite scanning and observation. Computerization permits collection and analysis of data, which, although it does not control weather, does do the next best thing by much more accurately predicting it.

Computer memory and analysis will create a body of knowledge that will facilitate weather prediction, making it possible to make forecasts for weeks and months ahead. However, it seems likely that the ultimate science will still rest on probabilities, as it did in Mark Twain's time, awaiting the solution of the mystery of what makes weather.

British scientist Sir Graham Sutton predicts that weather modification will remain the greatest mystery of all, and that much more time and knowledge is needed to effectively change its patterns. He concludes that it is safe to prophesy that British weather will be much the same as it always has been for a long time to come. But rather than conclude on this dreary note, let us examine some of the factors that will effect climate and land fertility in other parts of the world.

Dr. Roger Revelle suggests a fanciful solution to eliminating hurricanes: By spreading a thin layer of reflective material on the sea surface, excessive heating and evaporation of ocean water would be prevented. However, his science-fiction solution rests on no new technology but two factors that might be within our grasp: The development of a low-price reflecting compound, and international cooperation. The former is obviously more easily obtainable than the latter.

Present techniques—cloud-seeding and attempts to induce rain—are not economically feasible. However, this does not mean that the tremendous research presently being undertaken by the chemical and allied industries will not produce such substances, cheaply, in the very near future, long before the turn of the century.

It may be possible to influence climate through harnessing underwater currents as new power sources. Rerouting existing ocean currents might change climatic patterns, converting now-arid areas of coastline into verdant paradises. There is also a possibility of heating the ocean as a by-product of huge nuclear desalination plants.

Food: A Summing Up

Fortune Magazine (June 1966) quotes a statement by Professor J. H. Fremlin, a physicist at Birmingham University in England. Speculating on how people might be fed in future years, he commented: "Waste products could, in principle, be changed back into food compounds with the absorption of little more energy. Cadavers could be homogenized."

Although the good professor's solution seems to give a certain scientific plausability to Jonathan Swift's "Modest Proposal," there still remains the question of whether mankind will be able to stomach such developments in the 21st Century.

Medicine

The highly sophisticated mechanical and electronic equipment employed by medical men to preserve, maintain, and extend human life today may be changing its essential definition in the future.

The last hurdles in the successful transplanting of human organs seems on the verge of solution. Advances have been made in counteracting the immune reaction and impressive gains have been made in surgical techniques for performing transplant operations. Some doctors are reported

to have predicted that, within five year's time, it should be possible to graft all human organs successfully except those of the central nervous system. (See, "The Social Revolution.")

The possibility of growing a complete human organ from a somatic cell has been described by Robert Ettinger in his book **The Prospect of Immortality.** He cites the fact that complete organs have been maintained outside the body of animals for varying lengths of time; thus, the creation of test-tube grown organs requires no great stretch of the imagination. He reminds us that adult humans can regenerate many tissues, but not organs. He proposes that we preserve living sections of ourselves when we are young, to be cultivated later into replacement components as needed.

The collection and storage of replacement parts seems to be facing greater problems than their successful use. An Organ Bank, in which organs can be stored, has been successfully operated at the University of Michigan. The collection and preservation of human organs faces legal problems governing the disposal of dead bodies, which, as a legal rather than a technical problem, is not as readily solvable, since the law is not easily swayed by scientific or reasonable considerations.

The qualitative rather than quantitative change occasioned by scientific medical technology seems more likely to occur in the grafting of electronic aids directly connected to the human body. In the year 2000, the manipulation of living organs may prove, in retrospect, to have been a stopgap measure awaiting the successful development of sophisticated mechanical replacements—replacements that will not only preserve the human body but extend and enlarge its functions.

Today, there is in existence an already imposing list of inventions to perform biological functions. Breathing is assisted by respirators of various kinds, oxygen masks, pressure chambers, and iron lungs. Hearts are aided by electric pacemakers, some of which can already be implanted within the body. Pumps can be connected to the circulatory system, and machines can take the place of both the heart and lungs in aerating the blood.

Electronic devices have been used to activate the diaphragm, operate the kidneys, and help guide the arms and legs of paraplegics. It is possible, with a miniaturized computer, to produce the various leg and arm motions, and, with constant correction, to allow these members to be operated as motorists drive their cars. The possibilities are also being explored of harnessing superfluous muscles, such as those used to wiggle the ears, to help operate mechanical limbs.

Dr. B. H. Scribner of the University of Washington has perfected a machine to take the place of a missing or diseased kidney. He removes the blood, purifies it, and returns it to the body. Theoretically, people without kidneys could live indefinitely at the present time.

Dr. Lee B. Lusted of the University of Rochester was quoted in Robert Ettinger's book as having predicted that, within 50 years, it would be possible to replace nearly all body organs with compact artificial organs having built-in electronic control systems.

A small fuel cell immersed in the appropriate body fluids could generate enough power to perpetuate a heart "pacemaker," or other body organs, according to George D. Watkins of General Electric. Watkins maintains that some of the desirable features of the living-cell circuit would be the self-healing aspect, the extreme miniaturization and the efficiency. The unique power supply required (nutrient) would also offer some possible advantages. For instance, as a surrogate organ, a living-cell circuit might be planted in the body and live off the body nutrient with no additional power supply required.

Research in the fields of biophysics and biochemistry is making possible the development of living-cell amplifiers, computers, and power supplies. It may be possible in the future to isolate, develop, and breed strains of living cells that perform simple, logical functions. The role of the new bio-electric engineer would then be to synthesize from these basic units larger organisms that could perform extremely complex operations.

The concept of growing machines from living cells to perform useful human tasks is almost as radical a departure from what we might term classic man-machine relationships as the incorporation of electronic instruments in the living human body that feed upon it.

By the year 2000, then, we can anticipate that man's sensibilities will have been extended by the machine, and that his work will be done by cultivated growths. Such a development represents a qualitative change, the accomplishment of which may require that we submit our present prejudices to the healing machinations of the computer.

Power

Assuming that some future form of energy does not make electricity redundant, technology can take two routes: It could develop a power supply small enough to serve individual buildings and thus eliminate distribution systems, or it could develop a highly efficient system for transferring power from central sources.

Fuel cells are considered a possibility for installation in houses during the next five years. These cells, at present being developed by the American Gas Association, would convert natural gas into electrical energy. They have the drawback, however, of requiring an underground pipe network to supply the gas. The system could be improved if a fuel lasting several years could be dropped into the fuel cell and eliminate incoming as well as outgoing pipes or wires.

At present, the Martin Marietta Corporation is one company that sells nuclear-powered generators for remote sites, and these units provide power for five years without refueling. No doubt this technique will influence the development of power supply for individual urban buildings.

The alternative to miniaturization is central plants with improved methods of transferring the power to consumers. Such plants would probably generate electrical power by converting the energy of nuclear fusion. Fusion has not yet been achieved on anything but a demonstration level, but scientists pursue it because its offers efficiency and a refreshing lack of side-effects, such as fall-out. Fusion would produce a "clean bomb," if destruction remains a goal.

Nuclear fission is now "old hat" in the field of power-station design; the next step is to fusion. The obstacle confronting scientists is heat. Fusion requires the atoms to be heated to 100,000,000 C—a condition that technology is incapable of meeting.

This temperature problem is reversed in the problem of transferring power at greater efficiency than so far realized. Scientists have shown that electrical power can be conducted with zero loss of current, which means that power would flow endlessly through a conductor.

Unfortunately, the proposed conductors, called superconductors, function only at temperatures close to absolute zero. To achieve such a low temperature reading, the conductor would have to be constantly refrigerated, and, until technology develops another way of supercooling, the cost of superconductors is likely to be prohibitive.

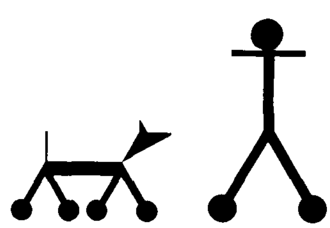
When superconductors are installed, the effects could be delightful: Refrigerated transmission lines buried underground would eliminate a blemish on the countryside and remove a hazard to air-cushion vehicles. By the middle of next century, transmission towers will probably be seen only in the Smithsonian Institution.

An alternative to superconductors is now being researched at Stanford University. The idea is to convert electric current into microwave energy and relay it in a manner similar to radiowaves. But instead of passing through the air, these microwaves would be guided through underground pipes. At the receiving end, the microwave power could be converted back to conventional electricity or fed directly to equipment developed to run on microwave power.

Transportation

In the next century, going to Venus will not be any more difficult than going to Outer Suburbia, and the chances are that there will be less reason for returning.

Earth transportation may prove more difficult than interplanetary travel, since more people will be going to more places more frequently than today. If technology does not accelerate faster than the population, man will be slowed to a walk.



We now live in the Golden Age of the Automobile. In another 50 years, it will have passed. Scientists predict that the individual modes of transportation of the future will involve vehicles of two types: For intercity travel, automobiles will run on automated highways that control the vehicle through electronic computers. Speeds may approach those of Grand Prix performance, but, except for taking the vehicle to the highway, the driver will become obsolete.

For intracity travel, the gasoline engine will be replaced by an electric motor in a vehicle much smaller than Detroit now prefers to manufacture.

Personal vehicles of both these types are far from being a mere gleam in a scientist's eye. General Motors has already built a model of an automated track that controls speed, maintains constant distance between vehicles, and diverts them to required exits. The Allis-Chalmers Company has developed a tractor powered by fuel cells. Other *manufacturers* are working on both these developments. Two months ago, when the Ford Motor Company announced a new battery system to power small cars, it added that it expects to be in the electric-car business within 10 years.

Although technological systems can be developed that will automate highway travel, the cost will be enormous. Cars and roads will require *electronic equipment*, and the public may be reluctant to have the Government spend large sums of money on a program that will offer only a reduction in the accident rate, and increase the capacity of highways by running high-speed cars at short intervals.

Both ideas emphasize reducing the number of auto deaths: one, by eliminating highway accidents; the other, by eliminating exhaust fumes from urban environments. The desire for personal longevity may spur future taxpayers to support Government spending on automating highways, and may help overcome any reluctance on the part of petroleum-oriented industries to develop electric cars.

In Britain, for example, there is already a strong belief that gasoline-powered automobiles will be banned from cities in the daytime, and such legislation would give impetus to the development of electric cars.

These types of vehicles may only be a transition until the air-cushion ship now in service is adapted to land use. Air-cushion ships, riding a couple of feet above water, are ferrying passengers between England and France, Oakland and San Francisco. If rights-of-way are established on land, this type of vehicle could supersede trains and buses.

It would be impractical to maneuver air-cushion vehicles over open country, since trees, houses, or transmission towers would obstruct them. But routes could be built simply by leveling trees and bushes without the expense of foundations and slabs required for highways carrying wheeled vehicles. Think what it could do for the country's beautification program if throughways were sodded.

Men will also get a lift from personal rockets mounted on a belt. For a short cross-country trip, rocket belts would provide the most direct door-to-door transportation. They may, however, turn out to be the equivalent of the present sportscar, and appeal to the same sort of driver. A year ago, the U.S. Army gave Bell Aerosystems a $2-million contract to develop a turbojet power plant mounted on a man's back, with two jets at shoulder level to provide thrust.

Family-size air transport appears to be difficult to control. Unless the intelligence of the race rises astronomically, there is not much point in *multiplying* current road-driving hazards in airborne travel. Automatically controlled flights are conceivable, but if a country has millions of planes, the apparatus to control them becomes unmanageable.

Longer journeys will undoubtedly be made in super-size airliners. Assuming we learn to disperse the shock-waves leading to supersonic booms, planes will move regiments of people between countries at lightning speed.

A much higher percentage of the passengers will go on pleasure trips than at present, because more business will be conducted via television. This will enable men to stay in their own office while looking at a new product or piece of real

estate in another state or continent.

Although the airplane, or its descendents, will link continents, travel within a continent may go underground. An American engineer, L. K. Edwards, published a scheme in **Scientific American** ((August 1965) for moving trains through tunnels at 500 mph. Air would be evacuated from the tube in front of a train, and air introduced at atmospheric pressure behind the train would be sufficient to propel it forward.

Given a small miracle of technology, tunneling could lead to intercontinental tube travel. Since the earth is a globe, tunnels would offer the shortest route between two points on the surface. The short route will also be the fastest because gravity would pull a vehicle to the deepest section of the tunnel, and, if the system were frictionless, the impetus would carry the vehicle forward to the end of the tunnel. All that technology needs is a miraculous means of overcoming the fantastic heat encountered a few miles below the earth's crust.

Submarines offer a cooler route for moving bulk cargos. Nuclear-powered submarines, many times the size of present naval subs, would make ideal freighters that would be unaffected by surface storms. They might tow bulk-filled or liquid-filled, sausage-shaped containers made of a fabric that can be rolled up and carried in the submarine when empty, writes Arthur C. Clarke in his book, **Profiles of the Future.**

Thus, the sweeping changes that the technology of the future would effect—through changed modes of transportation, new sources of power, of food, major advances in medicine, sophisticated uses of the computer, and other means—promise radically to change the shape of the human environment. What these changes will mean to man in the third millenium, how they will affect the shape and direction of society, is the subject of the following article.

The impact of the technological revolution, and changing concepts evident in the philosophical and scientific revolutions, will inevitably affect the relationship of man to man. How people will live together, what kind of society we can expect, is the subject of the next chapter, called . . .

THE SOCIAL REVOLUTION

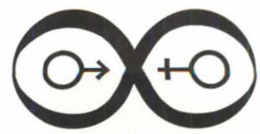
Various people have been trying to predict the ways in which we will use the new scientific discoveries and the unfolding technology, and the ways in which our lives—individually and collectively—will change. Some thinkers are optimistic; others are pessimistic. The future may conform more to one view than to the other, but we cannot know to which one. For present reading and future pondering, here are various thoughts about the human condition as we may find it some years from now.

Population

The population of the U.S. in the year 2000 is variously estimated at 331 million (by Resources for the Future, an organization supported by the Ford Foundation) and between 291 million and 362 million by Roger Revelle, Director of the Harvard University Center for Population Studies and participant in the Commission on the Year 2000. With present rapidly falling birth rates, however, Revelle believes that the low projection is the more probable one.

Even by conservative estimates, world population will increase markedly. On the low side is the Rand Corporation forecast—5,100,000,000 by the year 2000, and 7 billion by 2050.

According to U.N. forecasts, the world population will stand at 7,400,000,000 by the turn of the century, with birth rates continuing as at the present. With birth rates declining, world population would be between 5,290,000,000 and 6,830,000,000. More than half will be Asians. About 80 per cent will be from the less-developed areas—Asia, Africa, and Latin America—as compared to 71 per cent in 1960.



Frederick Lundberg, social philosopher and author of **The Coming World Transformation,** sees a world census of 6 billion in 2000, or double what it is today, and up to 50 billion in 150 years.

Is there a limit? Harrison Brown, a geochemist at the California Institute of Technology, has said that crowding together and eating unaccustomed foods would make 50 billion a reasonable figure; growing new types of foods, perhaps on algae farms, 100 billion; and existing on low caloric intake, as high as 200 billion. Lundberg doubts that these theoretically possible numbers are attainable, because of the lack of facilities and resources for such a population.

The Rand Corporation offers no doubts, not having ventured out on a Lundberg limb, and merely suggests factors that would affect the total: not only the advances in the production and distribution of food, but also the rate of further medical progress and the degree of acceptance of birth control. Of these, they judge the latter to be the least predictable.

The present rate of population growth, for the world as a whole, is about 2 per cent a year. Had this rate obtained for the past 2000 years, we are told, the population of the world would have increased by a factor of about 7×10^{16}; in other words, there would be about 20 million individuals in place of each person now alive, or 100 people to each square foot. For this fancy footwork we are indebted to the Committee on Science and Public Policy of the National Academy of Sciences.

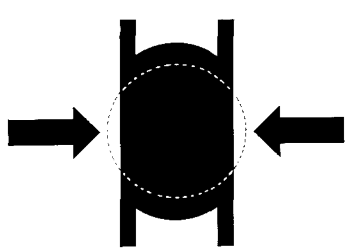
Mathematician and engineer Theodore Gordon, in his book **The Future,** foresees this possibility:

"Imagine a world so crowded that a birth certificate becomes more than a record of birth, it becomes a permit for birth. Births . . . are not permitted unless an old life is taken out of circulation. Each person is entitled to the right to a life. This is the new Bill of Rights. Upon death, this right forms part of a man's estate, perhaps the most valuable part."

He suggests, however, that "in its first joint act" the world will limit its population, perhaps to 12 billion.

Population Control

Control of numbers is increasingly possible, at least technically, and is considered by many to be increasingly necessary. Aldous Huxley, one of the pessimists, suggested that the coming era would be known not as the Space Age, but as the Age of Overpopulation: "In the race between



human numbers and human resources, time is against us." He foresaw overpopulation as contributing to the continued worsening of the lot of the average man, and to the growing spread of totalitarianism.

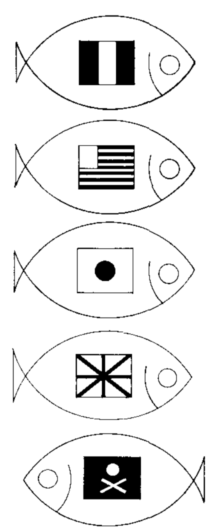
Another grave warning came from Eugene Black, former president of the World Bank, in his 1961 annual report to the United Nations: "Unless population growth can be restrained, we may have to abandon for this generation our hopes of economic progress in the crowded lands of Asia and the Middle East." John Fischer, Editor of **Harper's,** comments: "He might have added Latin America; and he should have noted that, in the next generation, these hopes will be slimmer still."

Death control can be provided by even the poorest government, by a few technicians, Huxley wrote in 1958, in **Brave New World Revisited;** but birth control, by contrast, must depend on the cooperation of an entire people. (And in 1958, he could write, " 'The Pill' has not yet been invented.") It was in his own **Brave New World,** however, that population of the world was calculated and maintained at a fixed figure—just under 2 billion, incidentally; or what it was in 1932, when that book was published.

We are closer to **Brave New World** today than Huxley suspected. In 1966, a World Methodist Conference in London found itself viewing with alarm such dreaded solutions to the population explosion as a massive sterilization by a police state, or such politically expedient measures as adulterating an enemy's water supply to prevent births for several decades. (In fact, it has been suggested that, in India, contraceptive agents be added to a widely used staple, such as grain or salt.) At the conference in London, however, one theologian urged that the Christian churches "find one voice to say unequivocally that all the children of man were equally entitled to sit at God's table."

In the eyes of some, however, if there are more people in this world, it will only permit more of them to stand on God's breadline, or, in poorer countries, to starve outside God's empty granary. Technical means for food production seem to be possible; but distribution is another question. It is Buckminster Fuller's thesis that the world's resources, if properly harnessed and distributed, could feed 100 per cent of the world's people, not 44 per cent as at present. (His **World Resources Inventory** assumes a world population of 6 billion by the year 2000.)

Theodore Gordon, in **The Future,** suggests that completely synthetic food is a possibility; the Rand report states that ocean farming will be-



come so important that the ocean bottom may be colonized and annexed as territorial property by the nations of the world. Gordon predicts a "central hunger-control agency" to assimilate all data for predicting world-wide food requirements, production, and availability; Rand suggests the likelihood of state-operated "missions" guaranteeing the right to eat.

Death Control

Quite simply, there will be more mouths to feed because more of those born will live longer. Recent medical advances, remarkable as they are, will be pale compared to the bright dreams and expectations of the future.

John McHale, a colleague of Buckminster Fuller's, estimates that more lives have been saved from premature death in the past 30 years "than have been lost in all the wars in all history." And Fuller leads off a list of future trends with the prognostication that medical science will develop the "continuous" or "deathless" man, whose diseases are curable and whose organs are transplantable.

Age-old diseases will give up their secrets, and their threats. Cancer will very likely be solved by 1984 (a somewhat arbitrary prediction, to be sure—a date that commemorates Orwell's novel and was used by the magazine **New Scientist** when it asked symposium participants to discuss **The World in 1984**).

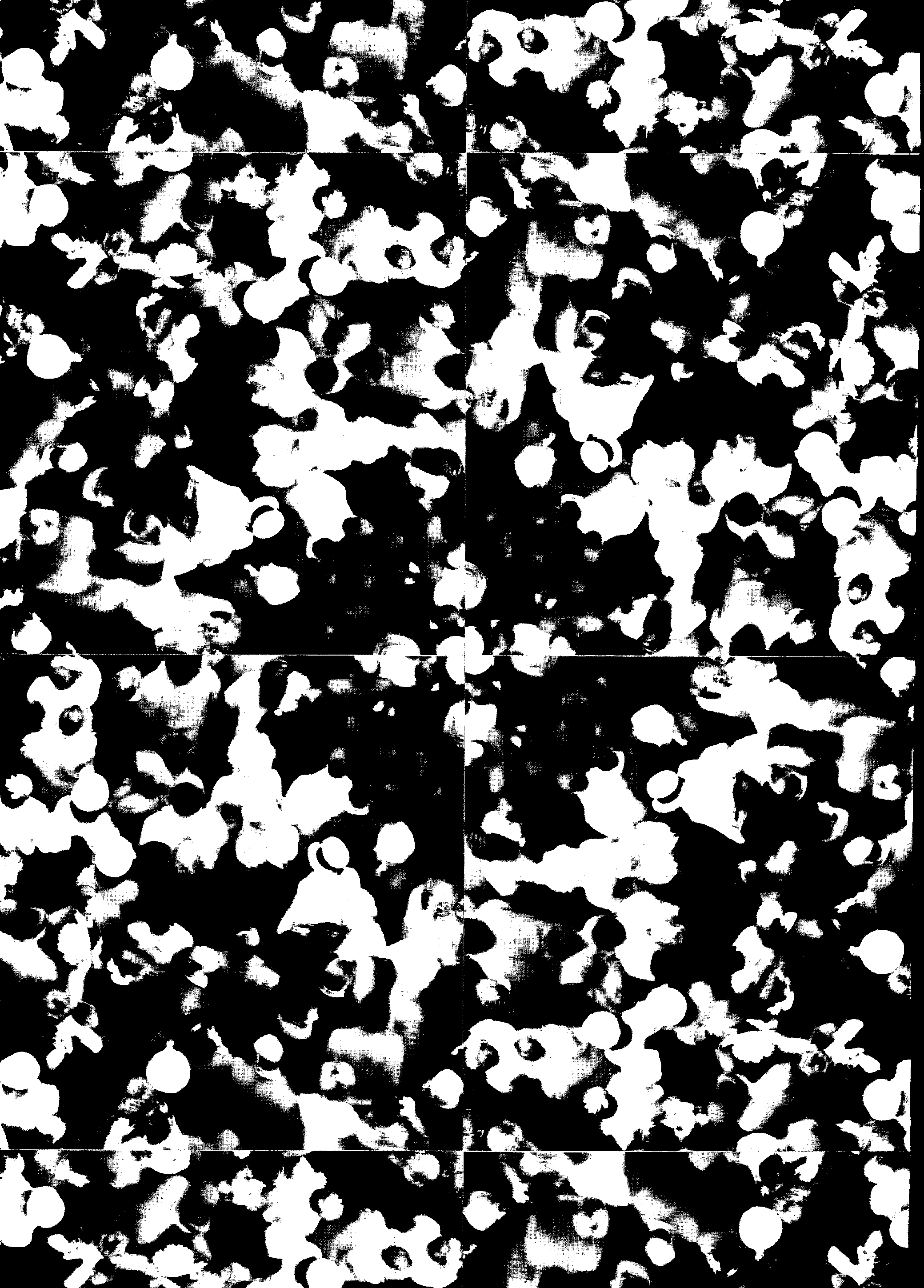
What will happen when the natural equilibrium between man and viruses is disturbed? Antibiotics can create new pathologies, writes the physiopathologist Zenon Bacq in **The World in 1984.** The finding that bacteria are indeed learning to fight antibiotics was announced in the summer of 1966—affirming what researchers had suspected as early as 1959. Among other hazards of the future are the dangers of increased insecticides and fungicides, of increased radiation, and of increased industrial pollutants in the water and atmosphere.

There will be increasing open-heart surgery of the type that made medical history in Houston in 1966. Replacement of organs will be commonplace, limited only by the availability of undiseased replacements. A shortage of organs is inevitable, says Zenon Bacq. How will the scarce items be distributed, asks the economist Robert Theobold. Who will be entitled to the prolongation of life? Artificial organs made of plastic or electronic components will be likely within 10 or 20 years, predicts the Rand panel. And Theodore Gordon makes this startling statement:

"If scientists are correct about the universality of the [genetic] code [that is, that the same code holds for all organisms from the largest sequoia tree to the smallest virus] . . . spare hearts or livers can be grown in the laboratory and adjusted for compatibility with any body. Amputees may grow new limbs."

Old age will become one of the greatest medical problems. Perhaps degeneration is not "natural" but is due to extraneous causes, speculates Sir John Charles, Consultant Director of the World Health Organization. One-quarter of those involved in the long-range forecast by Rand expect that, by the year 1995, there will be chemical control of aging, and a life span 50 years greater than now. Or, if not by chemical means, then by freezing or by drugs it may be possible to trick the human metabolism into a slowed-down state resembling hibernation, to slow the aging process so that bodies would age, for example, only one year for every 10.

Freezing, in fact, is an extremely potent weapon of the future against disease—perhaps against death itself. There have been experiments in which animal brains were revived after near-freezing storage, having been isolated from any living body for six hours; to the researchers, this



suggests at the very least a breakthrough in the possibilities for brain surgery (at normal temperatures, brain tissue cut off from the blood supply begins to deteriorate after three minutes).

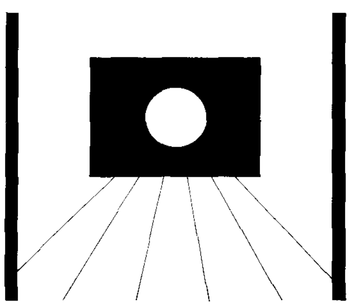
There is already a Cryonics Society of New York, Inc., which enlists members ($25 initiation fee, $10 annual dues) who wish to be frozen in liquid nitrogen at a temperature of −320 F immediately following clinical death. Their belief is that bodies so frozen can be reanimated sometime in the future, using the then-greatly-advanced techniques of medical science. Immortality would seem to be just over the next hill. And the hill is a long way from the hill of Calvary, where Christ gave up the ghost.

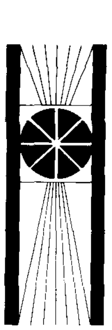
How are we to think of death? The legal definition has already been revised, according to the findings and potentialities of medical science, from the cessation of heartbeat to the cessation of electricity production by the brain. And the physical definition of death now includes three levels: clinical or medical death, which is the cessation of heartbeat and breathing; biological death, which is the degree of damage from which a body cannot be revived; and cellular death, which is the irreversible degeneration of individual cells (a state not usually complete—at present—until at least two days after clinical death).

What will be the attitude of men toward a death that is perhaps less likely, less threatening, less necessary? What new freedoms will life permit? What new license? At the very least, a man will consider himself deprived of the most basic of his rights, if the advances of medicine and the life sciences are not universally accessible.

Space for All?

Is there room for a vast increase in numbers? Or are there unbearable tensions and unmitigable hostilities that would be unleashed by overcrowding? Experiments on rats who suffer under the stress of overcrowding should give us pause. The breakdown of the human personality as we know it, the breakdown of the social order as we know it, are suggested from such experiments.





Robert Ardrey, in his book **African Genesis,** tells us that the instinct to gain and protect territory is powerful and persuasive among animals. It is a thing apart—separate from the instincts of sex, protection of the young, defense against the predator, struggle for a food supply—and is almost universal among animals. There might be lessons here for man, who is evolved from animal, and who, in Ardrey's words, can never fully "deny, suppress, or abandon" the instincts that constituted "a part of the original human bundle."

It can be argued that there is plenty of room for a vastly increased population to indulge in its varied drives to maintain and defend territory. The interior of Australia is almost unsettled, for instance; so is northern Siberia. But will man settle willingly in great numbers in such inhospitable places? As the fabric of society grows more complex, the large existing centers may well become the larger geographical centers of our lives.

Centers of population need not be tied to waterways, as in the past, of course, or to agriculture, or even to fresh water supply, as man learns to desalinate the sea, grow his food apart from the land, and find new ways of transportation and communication. Theoretically, man could live in the southern desert, in the northern tundra, in the polar regions—and underwater. We can assume that the technology will soon permit his subsistence in even the most hostile environment. Whether he will actually be subjected to hostile or unusual environments depends, if he is free to choose, on his adventurousness and on the lure (or repulsiveness) of existing centers relative to unborn cities; if he is not free, it will depend on the persuasiveness or forcefulness of those who control him. In any case, the drive for territory of his own, breathing space for the individual and his group, can be expected to continue to play an important part in the affairs of men.

Is it possible that man, acting like the muskrat, would exile surplus members from the homeland to insure his own survival? Will the moon become a colony for the world's misfits, criminals, adventurers, heretics? According to the Editor of **Harper's**: "Other planets? No. None in our solar system will support human life, and not even the most imaginative scientist has ever suggested that we will ever be able to export people in substantial numbers to other solar systems." Many such a categorical statement in the past, dropped from greater heights than "The Editor's Easy Chair," have been proven wrong.

Work

Another crisis is upon us—one that involves not an increasing population and the means of feeding them, but the problem of providing them with the economic means of self-support. Just as the Industrial Revolution brought with it a new view of man as an economic and social animal, so the Technological Revolution will be equally or even more profoundly disturbing to individual and social values. "The machines are not simply a technological fact but the stuff of a spiritual crisis as well," comments Michael Harrington, author of **The Other America** and **The Accidental Century,** and chairman of the board of the League for Industrial Democracy.

"The U.S. will have the capacity to install a productive system based primarily on **machine** power and **machine** skills within the next two decades," writes economist Robert Theobold, in **Free Men and Free Markets.** Automation has already taken its first steps. A survey of manufacturers disclosed that, in 1963, 19 per cent of all new investment was for automated equipment, while in 1959 the figure was only 12 per cent. In the past, a worker could be replaced at a cost of about three times his annual wage; at present the cost is, in many cases, only a fraction of one year's wages. And automation will come of age despite all efforts by organized labor to forestall it. In fact, says Theobold, their efforts will probably act ultimately in favor of automation; a reduction in hours worked—in the hopes of spreading the remaining work around—will increase the payment per hour, and thus tend to favor investment in machinery. Labor-management strife will also hasten industry's investment in machinery; a machine may suffer a breakdown, but it does not decide to go out on strike.

Among the many developments due in automation:

☐ Macy's is reported to be trying out its first electronic salesgirl; she dispenses items and makes change, and is fairly courteous.

☐ "Much of what now appears to be creative barrier-breaking 'research and development' is, in fact, routine work done by mediocre scientists and engineers." These too, will be replaceable, states Donald Michael in **Cybernation: The Silent Conquest,** a report for the Center for the Study of Democratic Institutions.

☐ Medical testing will be automated, with computers spotting irregularities among thousands of electrocardiograms, for example, and bringing these to a specialist's attention.

☐ A centralized Government dossier, the news of which raised such a furor this past spring, will contain all relevant facts about an individual, and perhaps some that are not so relevant.

☐ Cash will no longer be used in transactions of the future, Gordon suggests, being supplanted by a single, centralized record system.

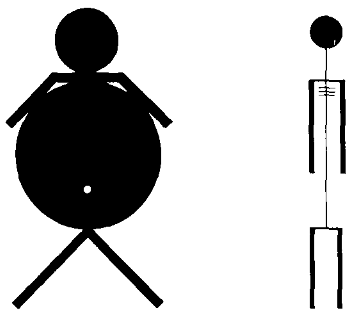
☐ The business of government at every level will become the business of computers, predicts **Life** magazine. With computers, "a great many of the unused facts that pile up in a bureaucracy are suddenly becoming usable and accessible."

All this, of course, is in addition to the automation of production, of which we now see only the beginnings; it has been estimated that the steel and auto industry, if fully automated today, could increase output 100 times. And the automation of clerical services, also only in its infancy, will increase a hundredfold the quantity of items we are honor-bound not to fold, spindle, or mutilate. In general, computers will be used to manipulate all kinds of symbols—words as readily as numbers, even fingerprints. It is true that computers can do only what they are programmed to do, but they can be programmed to behave adaptively, and to improve their programs on the basis of their experiences. In other words, they can learn.

Automation and Unemployment

Where does this situation leave the average worker? Very possibly out of his job. The glittering world of the push-button future is not all gold. It is " a deformed prosperity," says Michael Harrington, "benign for corporations, malignant for millions of workers."

It could mean a "complete breakdown of our present socioeconomic system, with a growing percentage of the population exiled from the abundant economy," writes Theobold. Unemployment and under-employment are rising in the poorer countries, too, he points out.



Is automation a threat or a promise? There is disagreement about the nature of the potential unemployment problem. On the one hand, Theobold foresees a future in which 2 per cent of the population, at the upper administrative and executive levels, could produce all the goods and services needed to feed, clothe, and maintain society. Dr. John C. Fischer, of TEMPO (General Electric's Center for Advanced Studies) says that, before the end of the century, more than half of the voting population will be "unemployed." But **U.S. News and World Report** predicted (in 1963) that the U.S., by the year 2000, will have two times the present number of job holders, working an average work week of 31 hours. (Their population projection was 350 million.)

The facts of the present day are these: The Federal Government in 1964 estimated that automation wipes out 35,000 jobs a week, or 1,800,000 a year. (It takes 35,000 fewer workers each week to turn out the same amount of goods and services as last week.)

There are far fewer agricultural workers today than ever before; 90 per cent of the work that would have been done by men in 1900 was being done by machines in 1965. And it is estimated that this human labor, too, will decline. There were 4 million farmers in 1960; Roger Revelle, writing for The Commission on the Year 2000, estimates that there will be less than 2 million farm workers at the turn of the century, cultivating less land and growing more. (It has been suggested that agricultural work of the future may be done by domesticated and trained animals such as monkeys; these are tasks that need little intelligence but cannot be done by machine.)

The theories about unemployment are varied. "It is possible," argues Robert Solow, "that any particular burst of technological progress will carry along with it the extra demand necessary to keep extra unemployment from appearing. It is also possible that it will not. An increased capacity for output is not the same as an actual increase in output." Automation will **not necessarily** increase unemployment.

Peter Drucker, Chairman of the Department of Management at NYU's Graduate School of Business, goes further. Automation will **not** cause unemployment, he writes in **The Promise of Automation.** "Men will be needed behind the scenes in new, highly skilled jobs—as machine builders, machine installers, repairmen, controllers of machinery and of its performance, and programmers. . . . Mass production upgraded the unskilled laborer of yesterday into the semiskilled machine operator of today—and in the process multiplied his productivity and income. In the same way, automation will upgrade the semiskilled worker of today into the skilled and knowledgeable technician." As Norbert Wiener, the author of **Cybernetics,** stated, automation will lead to the "human use of human beings"—man using his ability "to think, to analyze, balance and synthesize, to decide, and to act purposefully."

Opposing this view is A. J. Jaffe, Director of the Manpower and Population program at Columbia University's Bureau of Applied Research. Automation does not require that workers have more schooling; the number of jobs that dropouts can do is increasing more rapidly than the number of dropouts. As of 1960, he reports, high-school dropouts comprised at least half of the employed labor force. Theobold disagrees with this view. The unemployment rate of the unskilled is **not** declining he says; they are simply dropping out of the labor force and turning up in the vast increase in welfare cases.

One-third of the Rand panel expects that automation will bring social upheaval, but the majority feels that countermeasures, whether preventive or therapeutic, will forestall severe social disruptions. Their countermeasures are of special interest, particularly in the discrepancies between effectiveness, desirability, and probability.

The prospect of new jobs, which is the top consideration on the Rand list, is mentioned by many other commentators. "Our scarcity is one of market-supported jobs," says Theobold, "not of work that needs to be done." And from Theodore Gordon comes the thought that, "With increasing automation, man won't sit idle in hedonistic leisure" (not if Gordon has anything to say about it); he will look for new tasks to perform. As work recedes from the direct confrontation of man and nature, it proceeds along a defined scale, says Michael Harrington. The primary activity is agriculture; the secondary level is industry; the third, services; the fourth, training and human care. The "striking aspect" of the 1964 report of the Senate subcommittee on Employment and Manpower is "the idea that the human care of human beings is an economically significant undertaking." It is a fairly new idea, says Harrington; the subcommittee called it "a manpower revolution."

Theobold sees three main areas of work in the future: (1) politics, and the development of a good community (we will still be as "cussed" as ever, and our problems of group living will be able to use all the attention we can give them); (2) care of the human being—his life-long education, for example, and true entertainment; and (3) all the aid that undeveloped countries can absorb.

An "obvious solution to unemployment," comments Donald Michael, a social psychologist and Resident Fellow of the Institute for Policy Studies in Washington, is a public works program, supported overtly by Government. (Covert support is now given to the weapons industry, he contends, since there is no other market for their projects.) Another approach: Export blue- and white-collar workers to nations needing their talents, a proposal that parallels the "WPA-type" programs of the Rand report.

Many others have come forward with the other suggestions on the Rand list, and to some extent there is already serious discussion of early retirement, sabbatical leave, longer education (and later entry into the labor force), and periodic retraining as means of making do with a diminishing number of jobs. Some suggestions are on the order of Chrysler's recent action: By raising relief time (breaks in the workday) from 34 to 36 minutes, 1000 new jobs were created.

Work is not actually being abolished, according to Michael Harrington, but the possibility suggests itself in the "middle historical distance." Economist Robert Heilbroner agrees. Longer education and shorter work weeks are only palliatives; eventually human labor will be "redundant."

An Elite

But before mankind settles back on its haunches, there are other aspects to the problem. By 1975, argues Theobold, "If you do not have direct access to a computer, you will not be in the decision-making circuit." Harrington is very much concerned about the effect this will have on society; he discusses the danger of totalitarianism in a dictatorship of the programmers, and the absence of any dialogue between a highly educated few and the passive consuming masses.

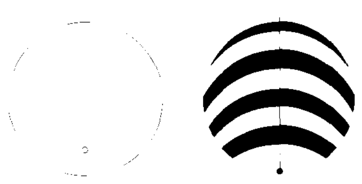
We will have a "new middle elite: the engineers, operations researchers, and systems analysts," says Donald Michael, when middle-management work is done increasingly by computers. Eventually, the whole social pyramid will be standing on its head, or twisted completely out of shape, with the middle at the top and no one at the bottom. Goals will be set by teams of specialists. The thinking of scientific and technical experts will become increasingly incomprehensible to the man in the street. (See, "The Technological Revolution.")

The leadership of the new society, according to Daniel Bell, sociologist at Columbia University, "will not rest with the businessmen or the corporation as we know it (for production and most other elements of industry will have become routinized), but with the research corporations, the industrial laboratories, the experimental stations, and the universities."

There will inevitably be an "upper labor force" and a "lower labor force," thinks Lundberg. We have always had an elite in America, whether we have formally acknowledged it or not. Instead of the present elite, though, which he defines as including "stars, experts, big shots, champions, and heroes," the average man of the future may find himself facing an elite consisting of people he can neither understand nor identify with. Even their language will be different.

Abundance and Security

In the new world of abundance, further social change is imminent. Our existing socioeconomic system is outmoded by abundance, Theobold feels. The constraint on what we produce is not our inability to turn out more goods and services, but our unwillingness to allow people to buy them. The 1960 census revealed that 20 per cent of families in the United States received only 5 per cent of the total income—annual incomes below $2800. Unless we abolish poverty, we may destroy prosperity. The traditional penalty for severe overproduction—a world-wide slump—is possible within a brief period of years, thinks Theobold. He recognizes in Henry Ford's historic and revolutionary $5 day the change from the principle of paying a worker the lowest possible wage, to the idea of regarding him as a consumer who will buy more if his income is sufficiently large.



With this in mind, Theobold proposes that distribution of income no longer be tied to work. A large proportion of the population must have resources even if they are not carrying out a conventional market job. He suggests a guaranteed income as an absolute Constitutional right, as an economic floor under each individual. He could get more if he were willing to get a job, Theobold argues—assuming he could get a job. Or he can "opt out of the consumption race and do what he believes important" (as long as not too many opt out). In addition to this proposal, which he calls Basic Economic Security, Theobold offers a system for Committed Spending, whereby middle-class people whose jobs are computerized would receive a somewhat higher income.

Architects at this year's AIA convention in Denver heard the same basic theory from another economist. John Kenneth Galbraith urged that the time had come "to reexamine our Calvinist approach of only helping people to help themselves. The one prompt and effective solution for poverty is a minimum income provided to everyone." And W. H. Ferry, vice-president of the Center for the Study of Democratic Institutions, comments, "Abundance may compel social justice as conscience never has."

The Protestant ethic is doomed, *it would* seem; having helped to create the most productive system the world has ever known, it could now destroy that system. Michael Harrington sees another paradox in the Protestant ethic: UNESCO has just declared that everyone has the right to work; and thus, according to Harrington, "The Protestant ethic becomes decadent at the very moment when it has finally conquered the world."

Meaningful Work

Does man have the right to work, the right to meaningful use of his energies and talents and to feelings of pride and gratification in that work? Demasculinization of jobs, according to the World Health Organization, is one of the principal factors in the rise of juvenile delinquency in the industrial world. In the present phase of industrial society, writes Peter Ritner in his book **The Society of Space,** a man "knows perfectly well not only that his own contribution to the product is tenuous but also that the product itself is contemptible." What will happen in the future—for that matter, what is happening right now—when there is nothing he can do that is worth anyone's money to pay him for? It is a new idea in our economy that a man may be paid just for being alive, not for being actively productive. The man himself may not believe it.

We are caught in a dilemma. In **Free Men and Free Markets,** Theobold warns: "The revolution of rising expectations, increasing population, and consequent social unrest does not allow us more than 40 years to achieve a reasonable standard of living in the poor countries of the world, and this goal will only be reached if we take advantage of cybernation." It is becoming increasingly apparent that the situation within our own country offers the same prospect, and the time span may be considerably less. The dilemma is that the concomitant upheavals **caused** by cybernation will make the present and future abundance a trying time for many.

Leisure

Not the least problem will be leisure. For centuries, we have been told not to "waste" time. What will happen when all we must do is spend it? According to Michael Harrington, "It will take more ingenuity to live with freedom than it did to subsist under necessity."

There have been numerous suggestions for using the new freedom, and numerous comments on whether the new leisure will be a Good Thing or a Bad Thing.

Among the possibilities:

□ Sex will continue to be a major pastime, soon aided by a variety of drugs: drugs to increase the pleasures of sensation, other drugs to eliminate the possibility of pregnancy, still other drugs to make possible sexual energies that do not diminish with age.

□ Drugs will also be used as escape and enlightenment. Recalling the "soma" of his **Brave New World,** Aldous Huxley considered it to have four aspects—vision-producing, tranquilizing, stimulating, and increasing suggestibility. There are already drugs that can cover each of these aspects. Yet the "ideal stimulant"—powerful but innocuous—still awaits discovery, he wrote in 1958, in **Brave New World Revisited.** Laws against various drugs would seem to be virtually ineffective as means of controlling their use and misuse.

□ Man's "almost infinite appetite for distractions," according to Huxley, will bring a whole new series of pastimes into being: In **Brave New World,** for example, there were "feelies" and "centrifugal bumble-puppy." There are new distractions today, and there will be more tomorrow. Games and gambling are expected to increase.

□ Home entertainment will reach new heights in voltage; it is not unlikely that whole families will sit together, each plugged into a different medium that can be heard, felt, smelled, seen, and/or tasted by him alone.

□ Exploration will challenge the adventurous, especially with the new equipment that will make expeditions less risky. Mountaintop, ocean-bottom, desert, jungle, and icecap will be visited, sounded, photographed, carried off, tamed.

□ Voyages to the moon will be commonplace. Werner von Braun foresees lavish excursion hotels on the moon, and a regular transport system between earth and the other planets.

□ For those who stay at home, there will be a renewed interest in handicrafts, believes Theodore Gordon, as human products become more valuable in comparison with the products of a machine culture.

Bleakness or Blessing?

Paul Goodman, in an essay titled "The Mass Leisure Class," regards the new leisure as less than a blessing:

"We cannot understand the problem of our leisure in isolation from the work that it is leisure from. We must remember that when people had less leisure, they had different jobs that gave them a different attitude toward what leisure they did have. . . . For most men, there is no man's work, and also therefore no man's play."

The one goes with the other; for Goodman, the Calvinist ethic is essentially true, and the Beat Generation illustrates the pattern of work and leisure when one of the terms has vanished. The Beats are only at leisure—"They are On Strike with blank sandwich boards." Mass leisure, according to Goodman, threatens us with a grave problem. The Greeks, sensibly, had more than one word for it, he says; leisure was defined as a serious activity without the pressure of necessity; another word was needed to describe playful amusement to pass the time.

Dennis Gabor, British electronic physicist, is also worried. In his essay "Inventing the Future," he suggests that work which is not necessary to sustain life may have to come back as occupational therapy. He views with alarm "the nightmare of a leisured world for which we are socially and psychologically unprepared."

Michael Harrington, too, sees the possibility of "a degrading leisure, as society's substitute for a degrading work."

Marya Mannes, another social critic, writes that "the more people attain the good things of life, the less good resides in these things. Easy access to wilderness spells its ultimate taming. The multiple sharing of privacy and natural beauty foretells their erosion. We have created too many people and taught them too little, and this is one way we pay for it. Our children will pay even more."

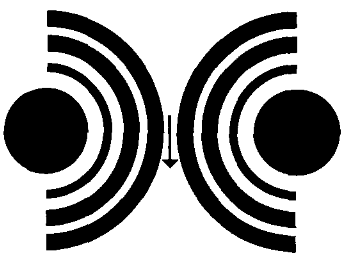
In an overpopulated world, where will man go for solitude, one of the basic necessities of any true regeneration? No one has an answer. Few even raise the question.

But there are optimistic thinkers: Richard Farson, Director of Western Behavioral Sciences Institute, in La Jolla, California, sees the "Right to Leisure" as an important part of our new Bill of Rights. Play will be different though; it will have to be fulfilling. Economist J. K. Galbraith wryly suggests that we cannot be sure idleness is quite as demoralizing as has always been imagined: "Are we certain that abundant leisure is bad for the poor but good for the comfortably well-to-do?" To S. Chandrasekhar, Indian physicist writing in **The World of 1984,** "Leisure breeds a certain amount of healthy skepticism, which is necessary for the stability of a good society."

Will everyone in the society be entitled to the same leisure? Donald Michael suggests that at least one group will have no more leisure than now—the professionals—and that the elite of society will have to forego its leisure, sacrificing it for the title of "social servant" and for the other rights and privileges of that class.

Herman Kahn, the mathematician and founder of the Hudson Institute, whose book **On Thermonuclear War** has brought the expression "thinking about the unthinkable" into our vocabulary, suggests that, in the year 2000, Americans will be living an aristocratic form of life, training children to enjoy themselves, to dance, to eat, to sing, to play music (and not, presumably, to think about anything— thinkable or unthinkable).

"There will be lights everywhere, except in the mind of man, and the fall of the last civilization will not be heard above the incessant din," writes Sir Herbert Read.



Education

The full promise of leisure will depend on education. And education, in fact, will be one of the leading pastimes. The Rand Corporation consensus is that education will become what it calls a "respectable leisure pastime" sometime between the years 1974–85.

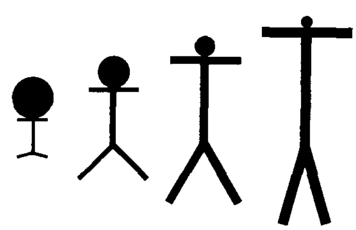
To many thinkers, education in the computerized world will not be simply a pastime but a necessity. Says Theobold: "The uneducated soon may not only be unable to get jobs but also unable to function in the society." According to Michael Harrington, in **The Accidental Century,** "The idea of a continuing and liberal education is no longer a special utopia of the intellectuals. It is a necessity of the society." He sees education as becoming a basic industry, as central to the political economy of the future as mass production was to the past. Peter Ritner, in **The Society of Space,** suggests that the Technological Revolution is "another way of saying that a great many men are going to have to go to school their whole lives long. . . . Modern life is a school in a sense that simpler ages never needed to understand."

The tasks are enormous. In the world as a whole, according to UNESCO, 40 per cent of the children have no schooling at all; 700 million *adults* are *illiterate.* In our own country, nearly one-third of our youth are without the high-school education that the skill-level of the society now requires as a minimum. Allan Cartter, vice-president of the American Council on Education, estimates that the college-age population in the U.S. in the year 2000 will be three to four times what it is today, with junior-college enrollment accounting for a large one-third of the total. According to one educator, universities will be larger, and the largest will have become self-contained cities, with up to several hundred thousand students. In the view of others, education will be a life-long experience. With the accelerating rate of change, man may have to retrain and adapt to a new life several times during his new, longer life. Education will be highly differentiated between professionals, skilled technicians, and the unskilled, believes Donald Michael. The lines will be drawn earlier in life, and the demarcations may perhaps be permanent.

Different Attitudes

By the year 2000, the attitudes toward education may be totally different from what they are today. Richard Farson lists one of the basic rights of future man as the "Right to Study," and suggests that we will study not as preparation, but as experience; in recent years, the emphasis in education has been entirely on the cognitive side, but in the future we will have to have human development—education in the affective side of life. Alvin Eurich, President of the Aspen Institute for Humanistic Studies, believes that the economy of abundance will make us less concerned with strictly professional or vocational aims in education. The year 2000 will see less time spent on acquiring skills and factual knowledge; more on developing wisdom and dealing with ideas.

By then, we can expect to know a great deal more about how knowledge is acquired. The startling conclusion of Benjamin S. Bloom, in **Stability and Change in Human Characteristics,** is that half of all the growth in basic intelligence takes place between birth and age four. The next 30 per cent increase in intelligence is made between the ages of four and eight. Between eight and seventeen, when the child is of school age, intelligence increases only about 20 per cent. In other words, as much intelligence develops in the first 4 years of life as in the next 13, and there is very little growth after 18. John McHale suggests that, with this knowledge, we would do well to reverse our present input of personnel, funds, and energy, directing them toward the early years of childhood. He suggests that mothers (or other persons in charge of the education of the very young) should perhaps be paid more than college professors.



Less new and startling, but equally important for educational methodology, is the knowledge that control through punishment is far less effective than control through reward. Aldous Huxley understood this well, in the insidious subtleties he imagined in **Brave New World.** And B. F. Skinner, professor of psychology at Harvard, created his controversial **Walden Two** entirely on the principle of reinforcement by rewards rather than punishments. The experiment he describes in this utopian novel, which combines science with benevolence toward human beings, is not far from a system that uses science for tyrannical ends.

New Techniques

Specific techniques in education are certain to differ quite radically from those prevalent today.

□ Educational TV will be commonplace, and "correspondence courses" via radio and TV will increase vastly. Live lecturers will be as dead as the dodo bird.

□ Libraries will be mostly on microfilm, and probably "computer-linked."

□ Programmed learning will be widespread, enabling the individual to study independently at his own rate, to learn a subject according to a well-established system, to participate actively and responsively at each step, and to know immediately whether or not he is right. Teaching machines at present teach only specific knowledge, but eventually, according to one psychologist, people will sit before equipment that teaches how to make a decision quickly, how to handle a committee meeting, and how to improve—or worsen—a family quarrel.

□ One manufacturer, Electronic Futures, Inc., sees the development of a "home learning center" for the new instruction aids. McHale anticipates this too, and finds nothing new in the concept. "The home/family dwelling for most people, in most of recorded history, was the prime educational environ, and remains so for almost all people in their earliest and most crucial years."

□ It is feasible that we may have our own family newspapers, printed from vast central storehouses of news, with only such information as is immediately pertinent to our needs. We can expect to see numerous attempts to handle the "communications overload" as it steadily grows more serious.

□ Because of the negative acceleration of rates of learning, as expressed in the findings of Benjamin Bloom, there will be increased attention to infants. Charles DeCarlo of IBM suggests that, "Because later learning rates can be improved by early sensory stimulation, there is need for nursery equipment that will help the infant to develop those senses. This development could be accomplished by a controlled program of sensory stimulation, one which would involve the infant gradually and gently and with cautious concern for his well-being." In particular, DeCarlo suggests "a TV-like unit, with appropriate programming, for the one-year-old and the attending adult. Such a unit could encourage the child in the identification of objects and aid in the beginning of speech." **Newsweek** magazine reports that a talking typewriter is already in use, and suggests that four-year-old children can write sentences with it. The developer of the machine believes that children as young as two-and-a-half could be receptive to this technique.

□ Aldous Huxley cataloged a series of techniques in **Brave New World Revisited** that are on the horizon: subconscious persuasion (which works best on children and the sick), subliminal projection (which he neglected to include, he confesses, in **Brave New World**), hypnopaedia, or sleep-teaching (which works about as well as hypnosis—that is, it is successful on about one-fifth of the population). What is learned under the stress of "brainwashing," he reports, cannot apparently be deconditioned. "Universal infant conditioning is still a few generations away," he wrote in 1958. ☐ Only a little more than one generation away —or by 1997, according to the Rand forecast—is the 50-50 chance of having information recorded directly onto the brain.

Is there a limit to the knowledge man can acquire? It is a tempting question. Peter Drucker, in **Landmarks of Tomorrow,** writes: "There is no danger that man will ever run out of ignorance; on the contrary, the more we know, the more we really know how little we know—in all areas of knowledge, in all sciences and all arts." He continues with this cautionary statement: "We cannot say any longer, 'Knowledge is truth,' or 'All power corrupts.' We must accept new propositions: Knowledge is power and power is responsibility."

Human Nature

A recent ad in a scientific magazine shows a little boy studying. The copy reads, "He has three times as much to learn as you did; can he learn three times as fast?"

This raises various questions about the nature of the human being. Can the physiological and psychological processes involved in learning, for example, be changed? What is man's relationship to the animal world, from which he has evolved? And what is his relationship to the machine, which he himself has created?

There is much research now going on into the physiological and psychological nature of man, the sapient animal. It is more than likely that man's thought processes, as well as his instinctual processes, will be capable of being controlled to a significant extent. The agents of control are various—drugs, electronics, and such new sciences as "behavioral engineering."

Research into Behavior

Holger Hyden, a Swedish neurobiologist who has microanalyzed single brain cells, poses a molecular theory of memory and learning. He has found that, when the brain is stimulated by some form of learning exercise, the rate of RNA production is greatly increased. (RNA is ribonucleic acid, which, with DNA, or deoxyribonucleic acid, is one of the two intricate chemical compounds found in every living cell; DNA transmits genetic inheritance, while RNA appears to act in shaping some 100,000 varieties of proteins, the essential constituents of all living cells.) Further, some of this RNA differs chemically from RNA in the neurons of unstimulated animals. Newly acquired learning seems to be encoded in these different protein-making molecules. (For a discussion of RNA, see, "The Scientific Revolution.")

David Krech, psychologist at the University of California, has demonstrated in experiments on rats that, when exposed to a stimulating learning environment, their brain structure differs in physical and cellular make-up from those not so exposed. He suggests, "When the final story of the role of the brain in learning and memory is written, it will be written in terms of both chemistry and anatomy."

In a controversial series of experiments in 1962 by James V. McConnell, a psychologist at the University of Michigan, worms that were taught to avoid an electric shock by contracting on a signal from a flashing light, were chopped up and fed to control worms; learning, apparently, could be transferred by feeding the RNA-enriched brains to untutored animals. A similar experiment between rats and hamsters suggests that learning may be transferable from species to species. The conclusions have been contested, however, by other scientists who have repeated the experiments and have not obtained the same results.

Abbott Laboratories has developed a simple chemical compound that speeds up the production of RNA in the brain; initial reports on animals are favorable, with treated rats learning four and five times faster than untreated rats. The drug is currently being given to a group of pre-senile humans. A memory-enhancing drug would seem to be a possibility, although experimenters are hesitant to predict its precise effects. The possibility exists, however, that the general IQ level might be raised considerably and the aging process decelerated similarly.

Drugs, in general, will be widely used in the control of human behavior. B. F. Skinner writes: "In the not too distant future, the motivational and emotional conditions of normal daily life will probably be maintained in any desired state through the use of drugs." An article in **Life** magazine, entitled "The Chemical Mind-Changers," itemized the existing drugs under headings of hallucinogens, euphoriants, depressants, cataplexogenics (drugs causing muscles to disobey), disinhibitors, chronoleptogenics (drugs distorting one's sense of time), and confusants. A surprising discovery with certain antidepressants was that, when administered to depressed patients, the drugs had the expected effect; but when given to healthy people, the drugs produced a sharpening of mental faculties, with a greatly reduced need for sleep—in other words, a great increase in "psychic energy" resulted.

Electronic brain research by Dr. José Delgado, a physiologist at Yale, has uncovered the areas of the brain controlling fear and the sexual drive. In one experiment involving a bull, he placed electrodes deep in its brain, and, using a remote-control transistor radio, he controlled its actions in the bullring. And, using this same remote control device, he has "turned off" aggressiveness in monkeys and altered their behavioral patterns.

In an address at the American Museum of Natural History, in 1965, Dr. Delgado reviewed recent findings in the entire field. Brain stimulations during surgery, or with electrodes implanted for days or months, have blocked the thinking process, inhibited speech and movement, or in other cases have evoked pleasure, laughter, friendliness, verbal output, hostility, fear, hallucinations, and memories. He summarized: "Individual and social behavior, emotional and mental reactions may be evoked, maintained, modified, or inhibited, both in animals and in man, by electrical stimulation of specific cerebral structures. Physical control of many brain functions is a demonstrated fact, but the possibilities and limits of this control are still little known." Experiments can be expected to increase apace, despite the resistance that Delgado mentions:

"From its beginning, wiring of the human brain aroused emotional opposition even among scientists, while similar wiring of the heart or of the bladder has been received enthusiastically. The difference in attitude was no doubt related to a more or less conscious personal fear that our identity could be attacked and that our mind could be controlled."

Mind control is nothing new, of course, but it is now being "raised to a science," in the words of Aldous Huxley. Manipulation of the instincts and emotions has long been possible on a small-scale basis; but with our new techniques, we can now manipulate on a large scale—anything from retail advertising to wholesale brainwashing.

Peter Drucker, in **Landmarks of Tomorrow,** writes:

"It is common belief today that the sciences that deal with man's behavior, such as psychology, have lamentably failed to keep pace with the advancement of the physical sciences. This, alas, is delusion. We have not, it is true, acquired the knowledge to make man better. We have not learned much, if anything, to enable man to control himself. But we have learned how to make man worse."

He cites the various methods man has used, and will use, to control or dehumanize others—terror, indoctrination, lies, thought control, and systematic manipulation in terms of reward and punishment.

Peter Ritner, in **The Society of Space,** mentions another method—a situation of "sustained stress" that can cause a normal person to become utterly incapacitated.

Raising behavior control to the degree of science, B. F. Skinner constructs an elaborate society in his novel **Walden Two.** Through "behavioral engineering," it becomes theoretically possible for a utopian society to breed citizens entirely without frustrations, without unhappiness, with full control of their own aggressions, and deriving full satisfactions from their most pleasant social relations. They want only what is good for them. Critics of Skinner's theory suggest that it may sound ideal but it does not sound human.

Our present knowledge of brain chemistry and behavior is undoubtedly still at a primitive level; so says Sir Francis Crick, British biochemist and co-discoverer of the spiral stairway pattern of DNA. We are "approximately at the stage of the four humors in medicine or of bleeding in therapy." What is psychoanalysis, he suggests, but "mental bleeding."

Future of the Machine

The machine, which has been around a much shorter time than the human brain, is another unknown quantity. As the machine develops, we can expect to revise a number of our basic values relative to it.

Sir Francis Crick discusses a possible "symbiosis between machines and men, in which the main function of the men will be to reproduce and to tend the machines. I myself doubt whether we shall reach quite such a stage; nevertheless, I am convinced that during our own lifetime we will come to associate with very complicated and sophisticated machines, and it is going to be quite upsetting." He concedes, however, that, at present, we do not yet hold conversations with

machines, and the machine can so far play "only very average chess." (See discussion of computers, in "The Technological Revolution.")

Herbert A. Simon, of the Carnegie Institute of Technology, in his book **The Corporation: Will It Be Managed by Machines?** argues that computers behave like morons only because we have not learned to communicate with them in anything but a moronic language. They can do much more than what we have thus far set them up to do.

In our hands, machines will multiply—and at an exponential rate. Buckminster Fuller foresees a total of 22 million computers by 1970, 8 billion by 1985. He sees no immediate competition with man's brain, but finds it "not inconceivable." The Rand report mentions, as one of the surprising forecasts of the study, that computers will be thought of as "colleagues" rather than as servants or slaves. Rand conceives of a man-machine symbiosis by the year 1990, enabling man to extend his intelligence by direct electromechanical interaction between his brain and a computing machine. Arthur Clarke, noted for his science fiction as well as books on science in general, anticipates the "cyborg" (or cybernetic organism), a body with machines attached to it or built into it, by 1990.

Will the machine replace man in intellectual ability? Marvin L. Minsky, professor of electrical engineering at MIT, and author of the article "Artificial Intelligence" in the September 1966 issue of **Scientific American,** illustrates how computers can set up goals, make plans, consider hypotheses, recognize analogies. (He describes one computer as being not just concerned with a mathematical solution but with deriving from the language the equations required to solve it. The mind-boggling example: "Mary is twice as old as Ann was when Mary was as old as Ann is now. If Mary is 24, how old is Ann?") And he concludes his article with this thought:

"It is reasonable, I suppose, to be unconvinced by our examples and to be skeptical about whether machines will ever be intelligent. It is unreasonable, however, to think machines could become **nearly** as intelligent as we are and then stop, or to suppose we will always be able to compete with them in wit or wisdom. Whether or not we could retain some sort of control of the machines, assuming that we would want to, the nature of our activities and aspirations would be changed utterly by the presence on earth of intellectually superior beings."

Herbert Simon is another who sees the changes that machines will make in our conception of ourselves:

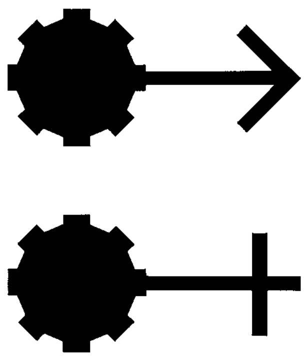
"It is only one step from the problem of goals to what psychiatrists now refer to as the identity crisis, and what used to be called cosmology. The developing capacity of computers to simulate man—and thus both to serve as his substitute and to provide a theory of human mental functions—will change man's conception of his own identity as a species.

"The definition of man's uniqueness has always formed the kernel of his cosmological and ethical systems. With Copernicus and Galileo, he ceased to be the species located at the center of the universe, attended by sun and stars. With Darwin, he ceased to be the species created and specially endowed by God with soul and reason. With Freud, he ceased to be the species whose behavior was —potentially—governable by rational mind. As we begin to produce mechanisms that think and learn, he has ceased to be the species uniquely capable of complex intelligent manipulation of his environment.

"I am confident that man will, as he has in the past, find a new way of describing his place in the universe—a way that will satisfy his needs for dignity and for purpose. But it will be as different from the present one as was the Copernican from the Ptolemaic."

Genetic Future

In the future, man himself may quite possibly be different. Although some scientists doubt that eugenics will be applied on any appreciable scale in the near future, H. J. Muller, professor of zoology at the University of Indiana and Nobel Prize winner, speaks of "germ-cell banks" and "controlled implantation" and "a replacement of our long-ingrained proprietary attitude that takes it for granted that the children one brings up should carry one's own genetic material." Within a hundred years, Muller believes that foster pregnancy will be accepted as natural. The union of productive cells will take place under a microscope. Cells will preferably come from the long-deceased, to free those concerned from pressures of prejudice. Offspring will be able to obtain hereditary equipment entirely from one individual,



with whom the child would then be genetically identical. Skin color will cease to be a defining factor among humans, believes Theodore Gordon, once scientists have learned the secrets of heredity. Skin color would function as a cosmetic, and he suggests that people might select pink, blue, lavender.

It may be possible in the distant future to synthesize new genes, or to graft genes into our beings, says the geneticist J. B. S. Haldane. Since astronauts do not make active use of their legs in space flights, for instance, he suggests that a drug like thalidomide could be used to breed men well adapted to space travel. He anticipates that, in the future, perhaps within 10,000 years, there is the real prospect of our species dividing into two or more genetically different types, with capacities either specially suited for life on different planets, or for different human possibilities on this planet. He foresees the possibility of their misunderstanding each other, though, and of warring.

But nothing leads more rapidly to extinction than becoming genetically uniform or homogenous. Any planning that is done, therefore, urge geneticists, must aim at the maximum genetic variability in man. And with any "genetic engineering" or "selective sterilization," one must wonder who will make the decisions. And more important, **Quis custodiet custodes?**

Human Relations

"The way men govern themselves, the way they form families, their moral values: these will all change, as well they should," writes Theodore Gordon, in **The Future.** "Not one among us would say that man has yet found the optimum form of government or system of morals."

How will the Scientific and Technological Revolutions affect our present framework of human relations—the individual's relation to his fellow citizens, to the state, to mankind in general?

Individual to Individual

Among the basic rights of the individual of the future, suggests Richard Farson of the Western Behavioral Sciences Institute, will be the Right to Be Different, the Right to Sexual Fulfillment, the Right to Intimacy, the Right to Privacy.

Predicting the future from a different orientation, Richard L. Meier speculates that social interactions will become briefer and shallower, although more frequent. Bonds between human beings will be weaker. With walkie-talkie and closed-circuit TV, the need for face-to-face contact will be vastly reduced. We will also have more difficulty communicating with each other: We have different views of reality according to our fragmented specialties, and we soon will no longer be able to communicate. The suggestion that there will someday be a single language throughout the world, for instantaneous and unambiguous exchange, does not get to the root of the difficulty. We already know that it is possible for men to use identical words and yet be incapable of understanding each other.

As the world grows "more impersonal and difficult to understand, as bureaucracy and specialization extend their hold," the home may come to be regarded as the ultimate retreat. "The autonomy of the home stands in increasingly marked contrast to the lack of autonomy outside the home," writes Dr. Michael Young in **The World in 1984.**

Some feel that the home and family will be radically altered. **Walden Two,** which is fiction, to be sure, but perhaps not so far removed from fact, suggests that there will be three generations in the time in which we now have two; marriage will take place at age 16 or 17. Home will no longer be the place to raise children, since group care can be shown to be better in many respects than parental care. Husband and wife will have separate rooms, for "health, convenience, and personal freedom."

Ferdinand Lundberg, who describes himself as a social philosopher, feels that the family as an institution is "near the point of complete extinction." To remedy the situation, he suggests a series of programs that seem to be, at the worst, meddling, at best, piddling. Among his suggestions: education for marriage, complete with a manual that must be read and on which the parties to the marriage will be tested; and social psychologists who would report children whose behavior indicated "subnormal" home conditions.

There is also talk of "intelligenic marriages," arranged so as to obtain the brainiest offspring. And there are computerized dating arrangements —Data-Date, The Match Box, and Click—already flourishing. We are in love with the machine, it would seem.

Integrity of the Individual

It is 18 years since Orwell's **1984** was published, and another 18 *until that* fateful year itself arrives. Historian John Lukacs, in an article "It's Halfway to 1984," writes:

"We ought to think deeply not so much about the growth of the public sectors of the public economy at the expense of private enterprise (which, at any rate, is no longer very 'private'), but rather, about the cancerous growth of the public sectors of our existence at the expense of the private autonomy of our personal lives."

We must ask now how to preserve integrity of the individual, Aldous Huxley has said. A generation from now, he predicted gloomily, it may be impossible to ask the question. Motivation experts have already pin-pointed our most deep-seated wishes and fears; children are no more than "television fodder," and political merchandisers appeal to the weaknesses of voters, "guaranteeing that the electorate never hears the truth about anything." Huxley recommends "education for freedom," and mentions the now-defunct Institute for Propaganda Analysis that thrived briefly between 1937 and 1941. He suggests legislation against sleep-teaching by public officials, against subliminal projection in public places or on TV, against antirational propaganda in election campaigns. This will not help for long, though; overpopulation and overorganization, he feels, will soon change democracy and freedom into a nonviolent totalitarianism. We will still have elections and parliaments, but the show will be run by an oligarchy and its highly trained elite. "Nothing has ever been so insupportable for a man or a society except freedom —nothing except the absence of freedom." But there seems to be no good reason why a thoroughly scientific dictatorship should ever be overthrown, he continues; men and women would grow up to love their servitude.

Men have always been controlled by other men, to be sure. B. F. Skinner runs through a list that includes "the charlatan, demagogue, salesman, bully, cheat, educator, priest." But it is likely that the manipulation of men will grow as our technological means grow. Mass communication is not inherently evil, of course, but like many other technologies, it can be used to attack and manipulate individual integrity. One very real problem concerns surveillance. How does one suppress or limit use of surveillance by government (and private parties)? The legal world may come to consider privacy a fundamental norm instead of a residual norm; now, only those things that are not for some reason public are, by default, private.

Totalitarianism and Democracy

Huxley wrote that, by 1978, it would be a "safe bet" that all of the world's overpopulated and underdeveloped countries would be under some form of totalitarian rule. Lundberg thinks dictatorships "highly likely" because of the population explosion.

But even the democracies may have their own brands of totalitarianism—being ruled by one elite or another. There is talk of "the manufacturer of consent"—of "voting simulation" in which a small sample of voters is selected by machine to represent the entire electorate. Theodore Gordon asks if, in the future, elections may be decided by "key electors only, chosen in advance by impartial computers as the representatives of national opinion?" In fact, when computers predicted an election result several years ago, before the polls were closed, many people stayed home, feeling that their uncast vote was of no importance. Could a biased use of computers be used to swing an election—just as some public-opinion polls, one suspects, are prejudicially used by some campaigners? On the other hand, could an electorate get sufficiently, irrationally, mad at the mechanical prediction-makers, and defy them even to the extent of cutting off their own noses to spite their faces? But just as there are possibilities of a narrowed electorate or a mindless one, there are also possibilities of a broadened and immediately responsive one. The telephone could become a voting station, able to transmit public opinion or votes instantaneously from the voting public to a central government.

Government

Who will govern? Lundberg suggests that the politician of the future will be no greater than the sum of his expert advisers.

Decisions made with the help of computers would be based in good part on computers programmed with more or less confidential information, thinks Donald Michael, a condition that already exists today in military matters. Another prediction is that government may tend to recruit authoritarian personalities, those who are less tolerant of ambiguity and the less logical aspects of society, who emphasize the logical and ignore what cannot be handled statistically (such as the social and psychological reorganization following a nuclear disaster).

One possibility, according to Don K. Price, Dean of Harvard University's Graduate School of Public Administration and author of **The Scientific Estate,** is that, as scientific discoveries become too complicated for politicians to comprehend, scientists may form the new governing clique, a cabal of secret advisers. (At present, though, many scientists take little interest in politics, and show little concern even for the ways in which their own discoveries may be used.)

Roger Revelle sees the possibility of the government of the future being operated infallibly by computing machines. How long, he asks, before politicians will become obsolete?

The political issue, says Michael Harrington, is not **whether** society in the future will be collective but **in what ways:** The dominant social trends today are collectivist and therefore anticapitalist; bureaucratic and elitist, and therefore antisocialist. We are moving toward a bureaucratic and collectivist order that is neither capitalist nor socialist, Harrington argues in **The Accidental Century.** Aldous Huxley also saw the ultimate convergence between "East" and "West"; to his thinking, modern technology has led to the concentration of economic and political power, and to the development of a society controlled—ruthlessly in the totalitarian states, politely and inconspicuously in the democracies—by Big Business and Big Government. In order to survive, we must in the last analysis **not** compete, according to the psychologist B. F. Skinner. The individual will have to abandon competitiveness.

He may have to abandon individualism, too: "Even the job of simply preserving a **going** society will take a level of planning far exceeding any of our previous experiences with centralized control," writes Donald Michael in **Cybernation: The Silent Conquest.**

Morality and Religion

What of man's relation to anything beyond himself and his own creations? Religion will change vastly with the full advent of the Scientific Revolution. The "God Is Dead" crisis is only the beginning of vast changes in religion. (See, "The Philosophic Revolution.")

As man becomes more able than ever before to build a heaven on earth, a gradual decline in religiosity can be expected. This dimming of religious outlook will be in favor of "the scientific and secularly philosophic," according to Lundberg, as we learn more and as our feelings of helplessness decline—unless, he adds, there is "a particularly destructive war."

Man can hardly make himself his highest value when he feels himself problematic, says Michael Harrington. "He will vegetate as long as that is permitted; he will turn to new irrationalities in time of crisis." David Riesman suspects that there will be poor morale within a system that has no religious base and no transcendent aims, no other goals but its own further advance. Harrington offers this warning: "If religion sees a spiritual leveling-down as the only consequence of abundance and is therefore hostile or indifferent to the social task of mastering technology, it has signed its death warrant. The exaltation of man is not a blasphemy against religion; it is religion's only hope."

Sir Francis Crick, British physicist, makes this comment about religion:

"The old, or literary culture, which was based originally on Christian values, is clearly dying, whereas the new culture, the scientific one, based on scientific values, is still in an early stage of development, although growing with great rapidity. It is not possible to see one's way clearly in the modern world unless one grasps this division between two cultures and the fact that one is slowly dying and the other, although primitive, is bursting into life."

He notes that, although statutes still exist in some states in the South that prohibit the teaching of evolution, he suggests that "science in general, and natural selection in particular, should become the basis on which we are to build the new culture." As to whether man has a soul, Crick says, "I myself, like many scientists, believe that the soul is imaginary."

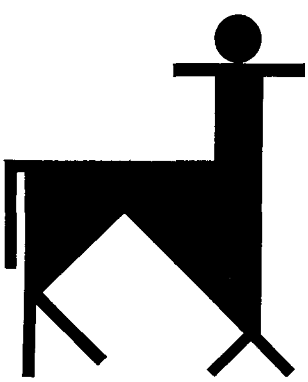
Robert Ardrey, the playwright who has written so poetically about the natural sciences and about man's evolution, writes:

"If man is unique, and his soul some special creation, and his future is to be determined by his innate goodness, nobility, and wisdom, then he is finished. But if man is not unique, and his soul represents the product of hundreds of millions of patient years of animal evolution, and he approaches his crisis not as a lost, lonely, self-deluding being but as a proud creature bearing in his veins the tide of all life and in his genes the scars of the ages, the sentient man, sapient at last, has a future beyond the stormiest contradiction."

Ardrey speaks of "the keeper of the kinds":

"Who is he? We do not know. Nor shall we ever. He is a presence and that is all. But his presence is evident in the last reaches of infinite space beyond man's probing eye. His presence is guessable in the last reaches of infinite smallness beyond the magnification of electron or microscope. He is present in all living beings and in all inanimate matter. His presence is asserted in all things that ever were, and in all things that will ever be. And his command is unanswerable, his identity is unknowable. But his most ancient concern is with order."

Buckminster Fuller contends that, through scientific discovery, we are coming to see the "comprehensive nature of the universe." This may in turn develop "a regeneratively inspiring faith in the order and integrity of the universe . . . and because the complexities of the universe are only intellectually comprehensible, recognition of an intellect greater than and anticipatory to our own intellections is inexorably emergent in the integrating totality of scientific exploration." Thus, Fuller goes on to say, there will be "personal first-hand discovery by increasing numbers of people of a nonanthropomorphic God—the great intellectual integrity of universal evolution."



Human Potentialities

What shall we make of ourselves? What shall we make of our future? John McHale writes, "The least predictable element in calculating man's possible future is man himself. His future is determined, not only by what is probable and possible, but by what he determines as necessary, allowable, and ultimately desirable."

Human potentiality has always been great; it has been estimated that man is now functioning at only about 10 per cent of his potential. "Human potential is not just what it is, but it is also determined by what we believe it to be and want it to be," says Richard Farson.

Will we follow the avenues that are opening, accepting the potential for creativeness in ourselves and for abundance in our world?

Sociologist Daniel Bell, writing in the magazine **The Public Interest**, talks of the possibilities of predictions coming true: "The social systems and the relationships between them are bound to change, and these changes, more than the technical feasibility of any of the breakthroughs, will determine the possibility of these breakthroughs being realized."

There may not be enough "politically-approved money" to pursue all areas of advance, says Donald Michael. "In order to advance some types of progress, there will be growing control and sometimes inhibition or scientific and technological efforts in areas deemed of lesser priority."

"The real barrier to a better world," says Farson, "is our own resistance to change." And some groups are more resistant than others. Donald Michael predicts that the differences between the "haves" and the "have-lesses" and the "have-nots" will increase, even though the conditions of the latter two will improve somewhat as compared to present standards. The gap between the concerned and the indifferent is likely to grow, he feels. And the "growing disparity between the haves and have-nots seems destined ultimately to bring the affluent society down to ruin," writes L. V. Berkner, President of the Graduate Research Center of the Southwest, in **The World in 1984.**

Science itself is impartial; Aldous Huxley has predicted that "drugs will probably both enslave and make free." Similarly, he writes, man has the power to respond to reason and truth; also, to unreason and falsehood. We have the power to act in our own best interest, or self-destructively.

And we are now at a point when we have both unlimited productive power and unlimited destructive power, says Theobold. Which way shall we go, or will our future be a continuation of both of these forces?

Our "unprecedented abundance," according to McHale, "renders obsolete the weaponry systems which are predicated on the preindustrial marginal survival alternatives of 'your side or my side.' Now, even in world terms, there can be more than enough to go around—for the first time in human history."

The Rand report, however, while conceding a position of eventual abundance, questions whether this abundance can keep ahead of population expansion or be equitably distributed. It is on the solution to these problems, states the Rand report, that peace or war will ultimately rest.

Peace or War?

What is the likelihood of a major war? How would it be likely to happen? And what are the prospects for preventing war? There are many different views. Those that follow are not necessarily in the context of current and specific political possibilities, but are intended as a more general and long-term discussion of the problem.

The Rand consensus predicts a 10 per cent chance of war in 10 years, a 25 per cent chance in 25 years. Even these odds, they comment, are "clearly intolerable." The chief means by which we would become involved in a war would be escalation. Rand feels that the chances of war by inadvertence or surprise are, by comparison, relatively minor. The report concludes by noting "the absence, on the one hand, of significantly new ideas for the prevention of war, and the confidence, on the other, that the application of what may be called traditional proposals could reduce the probability of war significantly."

Herman Kahn finds it "hard to imagine" what it will mean when 50 or more nations have access to nuclear bombs. "Many people just don't believe a nuclear war can take place. I do. I would judge it to be as likely as not that a thermonuclear device will be fired in anger before the year 2000." He says that we already know how to build doomsday machines (one such, for instance, would pump radioactive gas into stratospheric currents) but he does not think it likely that they will ever be built. His "Escalation Ladder" has 44 steps, from lowest level of crisis to the highest; but even the top level is not utter destruction. (Vietnam is not even on the ladder, because, according to the Hudson Institute, the U.S. is not facing a major nuclear power in this crisis.)

Perhaps the optimum offensive weapon of the next war will be a computer-killer, suggests Theodore Gordon. Other possibilities: currents of air to keep rain from falling, creating deserts and famine; small radio stations—so small they would be hard to locate—distributed by the millions, for the purpose of transmitting constant propaganda; drugs capable of imposing one nation's will on a submissive neighbor, or used to achieve drastic birth control.

Even if all existing weapons were destroyed, Gordon suggests, there will still be war unless the causes for wars have been eliminated. It is an oversimplification to say that battles are fought for self-preservation, continues Gordon. There are also elements of "group psychosis, chauvinism, pride, glory, and mysticism." Successful elimination of war must be based on a solution that satisfies the intrinsic drives that cause war. With this in mind, he foresees a special kind of war in the future: Fighting would only result when nations disagree with the decision of a world court; they would do battle, but on a battleground chosen by the uninvolved nations—perhaps the moon, or deep space—and the battle would have referees. The loser would accept the will of the winner according to previously specified conditions.

Is war inevitable? Buckminster Fuller believes that peace will be achieved by eliminating the physical wants that underlie wars.

Peter Ritner writes, "My friends are producing children whose children will live on Mars, because in the depths of their nervous and cellular structure they can no longer tolerate that the fate of man should dangle exclusively upon the existence of this one small planet."

Man may need war, says Gordon. "There are 8000 years of data that suggest that, in some unholy way, civilization and war are concomitant."

"If we listen to history . . . we can reach no conclusion other than that war has been necessary because we are human. This a startling conclusion. It implies that arms, control, deterrence, creation of buffer zones, political alignments, are only stop-gap measures. It implies that the control of war is a human, rather than a technological or legal problem, and control must be found in terms of a human solution. A human solution is possible. It will have its birth in psychology, which is not fully a science today. It will have its adolescence in the development of the sciences, or government, economics, and group dynamics. These sciences will provide the understanding of group needs and drives, and methods for satisfying them. The human solution will realize maturity in world law which, newly codified, will embody the principles of these sciences of the people."

In **On Aggression,** Konrad Lorenz, the naturalist, writes that war has become an institution, and "being an institution, war can be abolished." To remedy this, he does not recommend the genetic elimination of man's innate aggressive drive, because aggression could not be eliminated without changing life completely. Instead, as preventive measures, he suggests the investigation of the various possibilities of discharging aggression; the entering upon various forms of sublimation for the relief of aggressive drives. Sport, is, of course, one of the primary means of discharging aggressive urges; space explorations and polar expeditions offer the same release. Above all, he suggests that we arouse militant enthusiasm on a world-wide basis for the "three great human enterprises, collective in the truest sense of the word": He itemizes the three as art, the pursuit of beauty; science, the pursuit of truth; and medicine, the attempt to mitigate human suffering. He has little use for the national or political enthusiasms that are currently used to enlist men's allegiance on both sides of the Iron (or Bamboo) Curtain. Instead, he suggests increasing bonds across national boundaries. No man is able to hate, wholeheartedly, a nation among whose numbers he has several friends, or among whom there are others like himself, dedicated to art, science, medicine. The personification of evil, Lorenz believes, leads all too easily to "the most dangerous kind of war: religious war."

The skepticism with which young people view most ideals today, Lorenz writes, is largely due to the fact "that there have been and still are so many artificially contrived pseudo-ideals 'on the market' calculated to arouse enthusiasm for demagogic purposes." He puts his faith in laughter, which, like militant enthusiasm, is instinctive and derives from aggressive behavior. To Lorenz, humor is "the best of lie-detectors, and it discovers, with an uncanny flair, the speciousness of contrived ideals and the insincerity of simulated enthusiasm." Humor tends to make the world more honest. He is optimistic about the future because humor is rapidly developing in modern man. "Humor and knowledge are the two great hopes of civilization."

And Robert Ardrey, pointing to our descent from predator apes, writes, in **African Genesis,** that "war has been the most natural mode of human expression since the beginnings of recorded history, and the improvement of the weapon has been man's principal preoccupation" for almost one million years.

But, for Ardrey, there is . . . "the paradox that our predatory animal origin represents for mankind its last best hope. Had we been born of a fallen angel, then the contemporary predicament would lie as far beyond solution as it would lie beyond explanation. Our wars and our atrocities, our crimes and our quarrels, our tyrannies and our injustices could be ascribed to nothing other than singular human achievement. And we should be left with a clear-cut portrait of man as a degenerate creature endowed at birth with virtue's treasury whose only notable talent has been his capacity to squander it.

"But we were born of risen apes, not fallen angels, and the apes were armed killers besides. . . . The miracle of man is not how far he has sunk but how magnificently he has risen. We are known among the stars by our poems, not our corpses.

"No creature who began as a mathematical improbability, who was selected through millions of years of unprecedented environmental hardship and change for ruggedness, ruthlessness, cunning, and adaptability, and who in the short ten thousand years of what we may call civilization has achieved such wonders as we find about us, may be regarded as a creature without promise."

Our five senses—hearing, taste, smell, touch, and seeing—make us aware of our surroundings. Since mind and body do not work in isolation but as a team, sensory responses influence our thoughts as well as our feelings. For a designer of the human habitat, it is important to know whether the many changes that have taken place are resulting in what might be called . . .

THE SENSORY REVOLUTION

In our one-world age of no-distance, no-time, all-space, the constant overlap and interplay of our perceptions has produced a really mixed-up age of ambiguities. In the arts, paintings are sometimes half sculpture, and vice versa; the ugly is beautiful; the accidental is art; the absurd is significant; and happenings are things where nothing much can be expected to happen.

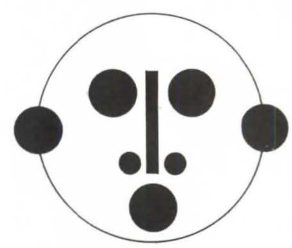
Elsewhere in our culture, other things have turned seemingly upside-down or inside-out. Pop art has opened our eyes to the banal vulgarities of commercial industrialization. Dances are again discontinuous. Clothes cross sexes. Saratoga used to be horses, as one theater man exclaimed, now it's tutus. In architecture, if, formerly, less was more, now, Nothing Is All.

The question begging to be answered is: What is the new order, the new discipline underlying this topsy-turvy situation?

Is it that our basic senses—long considered as instinctive and constant—are being changed?

Is there a Sensory Revolution?

Do the anomalies indicate a dehumanization of our senses? Have our thresholds—of detection, of recognition, of pain—altered from the traditional, instinctive levels of the past?



How do we get sense back into the senses?

A Fearful Earful of Hearing

With all the constant, blaring, high-decibel penetration of intercom systems, of announcements, of piercing hi-fi and stereo sets, with the insane near-drunkenness that comes from the super-amplified wrack-and-roll of the discothèques' electric guitar bands, isn't permanent damage being done to the tympanum? Has the acoustical threshold been changed by the constant new stimulant of noise, noise, noise all the time?

Our young mods and pre-mods seemingly cannot do without noise, music, acoustical company—as is apparent from the ever-present transistor radio on the bus, at the beach, on the street, held to the ear. Noise is the contemporary opiate. Perhaps it is the cheapest opiate man has yet devised.

Yet isn't it expensive if our "normal" sense of hearing is affected by this constant exposure, much of it at high-decibel levels? Jets and helicopters, subways, buses, diesel trucks, pneumatic drills, the sporadic insistence of the telephone bell, the honk of horns, the incessant loud hum that is called by the double-think term "acoustical perfume"—all these keep a constant din in our ears in the city. Even in the country, the harvester and the reaper, the truck noise wafted from the new highway, the cicada-like chirruping of the high-tension lines must alter our accustomed sense of hearing.

Even in our deserts, which stretch preserved for unspoiled spectacular miles, the on-coming shriek and shrill of the jet destroys the deafening silence. When it comes to town, will sonic boom shatter Lever House, as well as our ears?

Lip Service to Taste

And now that our food is subjected to pasteurization, purification, homogenization, refrigeration, cyrogenization, dehydration, and canning; now that our water is filtrated and desalinated, with additives of fluoride and chlorine, is our sense of taste not changed in some way or ways? If we can sprinkle charcoal flavor from a bottle onto our infrared-cooked hamburgers, if we can brush with toothpaste flavored with scotch, bourbon, or rye, and rinse with any variety of delectable mouthwashes, what artificial levels do our taste buds rise or shrink to?

And what are the changes that people suspect in our other senses?

The Smell of Decent De-scenting

"We are removing the sense of smell from our society," claims Louis Bettica, coordinator of the Anne Sullivan Macy rehabilitation service for deaf-blind persons in The Industrial Home for the Blind. "The smell of roses, even, is all gone in favor of providing visual beauty. They would sacrifice the sense of smell for the look of the hyacinth."

Dr. Jean F. Caul of Arthur D. Little's Food and Flavor Division observes, "Now, instead, we have scented sprays in bathrooms, kitchens, and in every room—at least in the homes of people who never open the windows because they have air conditioning."

In the old days, the old folks never smelled it that way.

Although odorous miasma from swamps no longer is thought to be the cause of malaria, NYU immunologist Dr. Zoltan Ovary fondly remembers a nurse "who was about 80 years old and blind, yet had developed such an ability that she could diagnose croup better than anyone around merely by smell. My grandfather," he adds, "could diagnose 11 different diseases by smell. In those days, doctors developed an extremely acute perception."

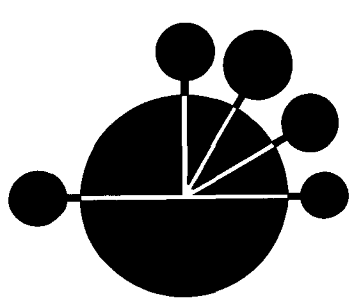
Marshall McLuhan relates that the Orientals had measured time by graduations of incense, until they were introduced to clocks. "Not only the hours and the days," he says, "but the seasons and zodiacal signs were simultaneously indicated by a succession of carefully ordered scents."

The sense of smell has been thought to be the root of memory.

Today, however, an old wreck of an automobile can be sprayed with new-car smell spray; onion and garlic can be dismissed with a quick application of the chlorophyll pill or spray. Memories are shorter now; what of our sense of smell?

A Feeling of Losing Our Touch

"Americans have very little appreciation of touch," observes Louis Bettica of the Industrial Home for the Blind. "Children love to touch and to cuddle, but if a grown-up goes over to feel a wall, people think that he is crazy, or at least inelegant. Nothing on exhibit is to be touched: There is always glass that says 'Don't Touch.'



"Even the deaf-blind whom we work with," Bettica continues, "find difficulty in accepting the use of the hands in their manual alphabet. They are ill prepared to face their future because of the lack of good tactual experiences."

Perhaps our most frequent tactile experience is stimulation to heat or cold, but now there are glasses that can permit or prevent drinks from feeling colder or warmer. And just about everything is smooth that industrialized Americans touch. For most Americans, things have to run smoothly.

If plastics can look like leather, or wood, or silk, or glass, or burlap, or metal, yet give the same tactile sensation from each, are we really in touch with the world? The question is, Are we missing much?

"All Looks Yellow to the Jaundiced Eye"

And what can be said about vision, the primary sense of our culture, the sense that architects are most familiar with? What is happening to our sight with the constant barrage of Op art effects, of flashing strobe lights in the psychedelic discothèques, or of car headlights on the freeway and klieg lights aimed at the theater audience? Do vibration and fusion effects reveal colors to us or confuse us? Does the omnipresent practice of dyeing and printing everything brighter, more "real," greener—flowers, vegetables, fruits, meats, fabrics, photography—alter our physiological vision? And do our ever-present sunglasses and polaroid windshields, our tinted glass windows, and tinted contact lenses, even, give us an eyeful of our world that is different?

The Noble Sensor of the Golden Age

Many philosophers hold that our spontaneous primitive archaic responses are lost, that contemporary man is constipated when it comes to a spontaneous response to his senses. The further we get from our natural roots—the more deracinated we become—the less sensitized we are in our sensory perceptions, it appears. The lure of Thoreau's philosophy not withstanding, exposure to undisturbed nature attunes us to its delicate timbres and its fierce rhythms. Culture deracinates us—almost by definition.

Conversely, it is no meaningless cliché to reiterate that constant exposure and repetition dulls appetite, interest, and concurrent sensitiveness.

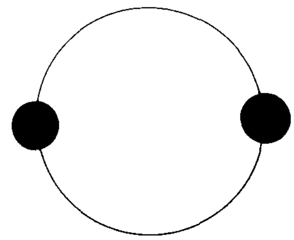
The old world is gone, our pastoral senses are shattered, we no longer sense anything at all, this new nihilism says romantically.

That would be too negative a view, however, for so obviously an alive period. As editor-teacher Dennis Sutcliffe used to remark, "Things aren't what they were—and they never have been." Today there is a Sensory Revolution, but not all is lost. It is a new everythingness, a new all-at-onceness that comes with the cross-over of ambiguities in our daily culture, with the mixed-up gestalt of all our disciplines. Instead of a new nihilism, our day is presenting a New Consciousness, a New Perception that is as alive a scent of feeling as was ever on the tip of the tongue.

What has physiological research revealed about the thresholds of our senses?

Current Research: Hearing

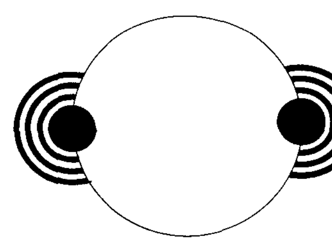
Dr. Theodore J. Schultz, of Bolt, Beranek & Newman, comments, "Apart from hearing damage in persons exposed to excessive noise levels, there isn't any significant, intrinsic change—certainly not one that would **extend** our auditory perception. I don't think that, for instance, we are becoming responsive to wider frequency ranges. What changes do occur are due to personal extremes and seem to be restrictive: They are losses rather than gains. Thus, one of the principal current goals of acoustical science is to establish international standards that represent which reasonable amounts of exposure to noise levels over long periods of time can be endured without permanent hearing damage."



According to Schultz, the difficulty of establishing such standards is that we have as a norm "only a statistical average of measurements made on members of a single culture—all of whom have been exposed to rather high continuous noise levels."

We know, for example, that in our own society, long exposure to high levels of noise impairs the hearing comparatively early. But the question is, does this happen to all people at all times in all places, or does it come only from the fact that we live in a fairly noisy environment? To test the question, Dr. Moe Bergman, of the Hunter College Speech and Hearing Center, and Dr. Samuel Rosen went to the untypical Sudanese tribe, the Mabaans, who live so unexposed to noise that they are unfamiliar even with drum-beating, and found that their hearing was so aboriginally acute that they can hear pins drop at 80 yards.

Schultz asks, "Should this 'aboriginal acuity' be the norm for our society? The cost of attaining such quiet would be staggering. Would the gain be worth it? Indeed, how to measure the gain at all? Quantitatively, after establishing the threshold of hearing for a fresh subject and then exposing him to loud noises over a period of minutes or hours, his threshold is temporarily raised several decibels—that is, he is temporarily 'deafened,' if only slightly. Fortunately, the time required for recovery of his normal hearing is brief. Moreover, there appears to be a strict relation between this temporary hearing loss and the permanent damage that would occur if the subject were exposed daily to the same noise level over a period of years. This fact, indeed, constitutes the humane tool with which to establish permissible, (i.e., nonhazardous) long-term noise exposure."



We know that our sensitivity to high-frequency sounds diminishes with age so that, as Schultz points out ironically, "By the time you can afford the extra hundred dollars for the latest refinements in a hi-fi system, your ears may have

degenerated to the point where it doesn't matter. Society today appears to be tolerating increased rate of permanent threshold shift," Schultz observes, "though it seems improbable that this trend can go on indefinitely. People are certainly more conscious and more critical of the noisy environment, and codes and restrictions are being formulated, however slowly."

But the study of hearing loss in a real population, as opposed to laboratory subjects or aninals, is difficult today, because of the secrecy imposed by many industries that are concerned about possible compensation claims for damage to hearing from industrial causes. Even when a company wants to maintain or institute some control of noise levels in a factory, they have to pretend they are not doing it, so as to conceal the suspicion that there might conceivably be some concern. Current settlements of compensation claims for loss of hearing due to industrial exposure are said to average between $2500 and $3500.

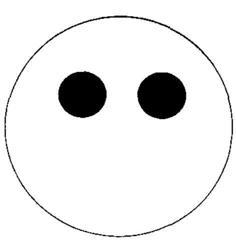
"I take exception to your use of the term 'acoustical perfume' as 'double-think,'" Schultz continues. "When things are arranged so that one is not annoyed by intruding sounds, this is arranged by masking these intruding sounds with something else going on in the ear. In absolute silence, this would be the 'neural static' present in every hearing mechanism. In nature, sounds of wind, surf, and rustling leaves form a neutral background that masks everything except what our ears notice.

"Silence is something that, practically speaking, a technological community cannot afford. You can't build windowless pyramids 80 stories tall. And silence is the last thing they want, because it is not quiet. Absolute silence is not only economically impossible, but practically impossible to endure. It is an unlivable, untenable situation, and no office or apartment building could have privacy if there were absolute silence. Some sound would get through and intrude. When **quiet** is achieved, it is as much due to the masking noise as to the attenuation of the intruding sound.

The absolute silence that Schultz speaks of has been created under laboratory conditions for purposes of research, and space mission endurance tests may have produced some data, but it is not yet thought that, in the foreseeable future, this will affect the entire population, and thus its auditory perception.

Sight

According to Dr. Carl Pfaffmann, physiological psychologist at Rockefeller University, "Sight and vision is the area in which some of the most

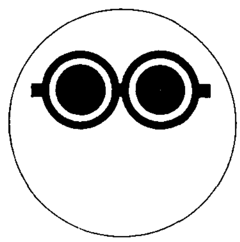


interesting discoveries have been made, particularly in the primary projection systems of vision. For example, it has been shown that if you put electrodes in the nerve fibers of the eye, the nerve cells in the retina respond to color or noncolor, to brightness or darkness, to moving or not moving. But if you put an electrode in the cortex, the cells respond only to angles or to moving only left or right or horizontal. That is, the cells there discriminate more minute and sophisticated indications.

"This research has been done in the last 10 years," Dr. Pfaffmann explains, "and is strong indication that our perception of form has an innate physiological basis.

"So scientists now believe that the physiology of the senses has not changed very much—except as there might be some kind of damage to the systems from onslaughts. There has not been any change in the receptors.

"In the case of damage, the nerve cells may



be less efficient, but the exclusion of visual experience does prevent the response to visual forms. I have tried to pin down the source of change, for example, from disease. In the case of an attack on the adrenal gland, which might produce a deficiency in salt, the observation seems clear that the person can detect salt in lower concentrations, but we find no evidence that the receptor itself is any more receptive. And when damage causes a greater sensitivity, we find that it is nonspecific—that is, other sense organs than the one damaged also become more sensitive. To be more explicit, in Addison's disease, which produces a deficiency in the adrenal hormone, one can detect sights and sounds and smells more acutely. And the general indication is that the brain physiology has been altered somehow.

"The cerebral surface is like a projection," Dr. Pfaffmann continues, "with each thing placed in a context. And Gestalt psychologists have made a big play that what we see is not merely a single item but a total picture including the things around it. 'The whole is greater than the sum of its parts,' is one of their big tenets. Op art and the moiré patterns are capitalizing on the dynamic interactions; they are Gestalt field effects.

"The big question today," Dr. Pfaffmann concludes, "is how does the cerebral sheet put a single experience in this context." Only when we learn this will we know fully how our sensory mechanisms operate.

Taste

"Nobody knows how we taste things. We are farther away in this matter than research on how we see." So says Dr. Jean F. Caul, physiological chemist with the Food and Flavors Division of Arthur D. Little, Inc.

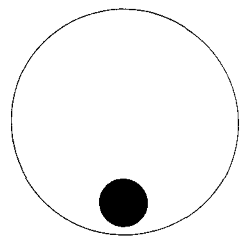
"Actual neurological and physiological work is being done on how we taste and smell—what the actual mechanism is," says Robert Swaine, another of Arthur D. Little's chemists. "We make assumptions that it is molecular. But that is an assumption."

"It appears," Swaine continues, "that odor and taste are actually chemical senses, that there is a brain cell activated by a group of odors or tastes. And it might be that it registers in the brain and always hits the same cell."

Taste, as the layman thinks of it, is really, according to scientists, a complex of reactions that make up flavor. They include: taste, odor, texture, trigeminal sensations (such as the coolness of menthol), and appearance.

Of these, taste is the easiest to define, according to Dr. Caul, "since, for humans, it is generally agreed that there are only four kinds of tastes: sweet, salty, sour, and bitter. Like all sensations," Dr. Caul continues, "taste has not only qualitative aspects but also quantitative aspects. Intensity of a taste will vary directly with the concentration of the taste-stimulating chemical."

"Taste thresholds have not changed for hu-



mans in general," Robert Swaine states. "However, there are things that will change the personal threshold. Certain compounds, such as quaternary materials, for example, which are used as antiseptics in mouthwashes, knock out the salt threshold."

To accommodate this unchanged threshold, the applied tastemakers work on the foods of today and tomorrow. New foods of the last 50 years include: frozen and concentrated, sugar-coated cereals, and, most spectacularly, Metrecal.

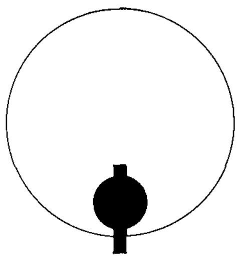
In the future, according to science fiction writer Arthur Clarke, as well as The Rand Corporation, our population may exist primarily on sea life, as they once did in primordial ages. Fish will be herded like cattle in undersea corrals; kelp, plankton, seaweed, and microscopic sea plants, which will be grown by diver-farmers living in deep-sea dormitories, will provide the staples—if not the only foodstuffs—of our future daily diet. Oilmen now know how to make low-cost proteins and B vitamins from hydrocarbons derived from petroleum. First, these proteins will be used for livestock; later, as a human dietary supplement competitive with yeast and fish protein concentrates. (See, "The Technological Revolution.")

New vegetables will be marketed. Of 300,000 existing plants, we eat only about 30 in significant quantities.

Will people enjoy tasting such treats? In the rice-short countries of Asia, people are learning that they can choke down wheat.

Some scientists, of course, find these predictions superficial. Boston's Dr. Jean Caul says, "Scientists are not saying that we will be eating seaweed, but that ocean crops can be put through a converter to produce foods more like those we are accustomed to. Turkeys, for example, are an efficient converter and can at certain points in their lives convert proteins pound for pound."

This is not to say that turkeys may not come to taste like seafood and therefore mark only an intermediate step on our way toward eating fresh braised seaweed itself. For turkey flavor has already altered from the days when they used to run on the ground to the present day, when they are mass-produced for year-round consumption. "In time, they may taste fishy," Dr. Caul admits.



"Nevertheless," Robert Swaine continues, "We are going to have to have more flavor and the chemist will have to put the flavor back into foods. It is not economical engineering to produce a protein from an animal that eats a vegetable. Because we are outrunning our supply, the steak 50 years from now may come from soya protein or from mushrooms, and the chemists will have to add the flavor. It is much more economical to use the vegetable protein and put the flavor in synthetically. And it can be good flavor."

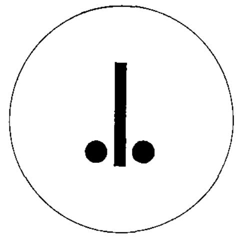
"Today we cannot yet make spun protein taste like steak," Swaine adds. "Also, there is no tomato flavor. If you want ketchup or pizza, you get only the spice flavors and none of the tomato. But the essential oil houses are spending money on research to come up with flavors that are as good as natural ones. They are subjecting steak to very good analytical work and are trying to reproduce the flavor with synthetic chemicals that will be in good supply in the future. This has already been done with raspberry and strawberry synthetics, which have the same taste as the best berries and also are better able to withstand exposure to heat and cold."

In the future, also, we shall probably be eating a number of unconverted foods, such as algae, bacteria, yeasts, molds, and chickweed. Already, the Japanese are farming and eating algae. For years, they have used chlorella, an algae in which the microorganisms have been controlled by science to produce more protein or fats for the Japanese diet.

With all of this careful work and with newly created flavors, Swaine believes that, "In the future, we will become more sensitized."

Smell

As with the other senses, physiological research has revealed, according to Robert Swaine, that "the sense of smell does not change except due to disease, age, personal exposure, and taste. The absolute threshold of people 30 years old today is no different from that of 30-year-olds 10 years ago. We are speaking of 10-15-100 years; 5000 to a million years ago it might have been different."



Different species, of course, have greater acuteness in different senses: the sense of smell in dogs, or butterflies, for example, or of sight in birds. The protective devices of animals usually vary: for one it is bark, for another it is color camouflage, for another it is swiftness of foot, for another it is a poisonous venom, for another a villainous scent, for another a prickly surface. Each fights an opponent's thresholds of pain.

But generally, thresholds are much lower at other evolutionary levels; the gypsy moth can smell a mate even miles away. So if you go through the evolutionary ladder, you can deduce that our sense of smell has deteriorated. Yet, as Robert Swaine says, science cannot determine that it has changed since man became man.

Although the final hook-up with the brain is still a mystery, what science does know about our sense of smell is considerable. It is known that our sense of smell is more acute than our sense of taste. If there are thousands of receptors in the tongue, there are millions in the nose. Human beings can distinguish as many as 10,000 different scents, scientists say. Odorous materials can be detected in the parts per million range readily by the human nose and in certain cases in concentrations of parts per billion, which are really minute quantities.

Yet if smell is more acute, it is also more fragile. The olfactory sense adapts, so that we do not notice an odor after 10 or 15 minutes, sometimes even less.

"The girl who continually replenishes her perfume," Swaine explains, "does so because her olfaction tires and she cannot smell it, but a new person can get the full impact."

"Still, even though it tires faster, olfaction recovers faster," Dr. Caul adds. "Some little fresh air resuscitates the olfactory sensors. In taste, you must get rid of the residual causers."

To measure odors, science has developed gas-liquid chromatography, which determines sensory correlations instrumentally. Yet it is by no means as sensitive as human olfaction.

Using what is presumably a gas chromatography system, the Army has developed a device that can detect unseen personnel in jungle combat areas. It is an extension of our sense of smell.

It seems true, however, that the senses of taste and smell are of lesser importance to higher forms of civilized man.

"We have the ability to smell," Dr. Caul comments, "but many people do not pay attention to what they smell—unless it is offensive."

And that is the basis of the extensive industry in applied odors and in environmental odors today.

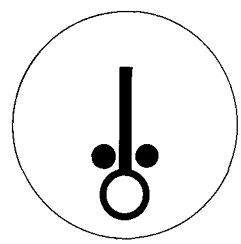
"People want fresh air wherever they can get it," says Frederick Sullivan, environmental odors specialist at Arthur D. Little, Inc. "But what constitutes fresh air?" he continues. "It has odor. If you take out all of the odorous components from the air—as we have done by filtering through activated carbon in our polished aluminum walled test room—the air smells dead. It is not as good as if it were left alone."

"Our species may even have become adjusted to the smell of oxygen in the air," Sullivan continues, "because we are perhaps permanently fatigued by its odor."

Robert Swaine adds, "We don't want lack of odor; we want positive odor."

Some of those positive odors, as experts in air pollution continue to warn, are endangering not merely our olfactory sensors but our entire existence. Half the job of the deodorant specialists is to pull nonodorous impurities from the air. This is especially important in areas that are heavily industrialized, or in enclosed areas such as submarines, which operate solely on controlled air pulled through activated charcoal.

"One of the benefits in exchange for not having fresh air," Frederick Sullivan notes, "is that air conditioning filters out dust and hay-fever pollen."



Several basic methods are employed to prevent odors and to minimize impurities in our air: first, a slight pressure can be put on the air of an area to keep out odors, or, conversely, negative pressures bring in new air; second, complete oxidation can destroy an odor, as exhaust control devices prevent automobile fumes; third, certain odorants that are nose desensitizers can deaden our sense of smell (ionones, ozone, aerylates, and formaldehyde are examples); fourth, masking with other odors.

Masking is the other half of the odor specialist's job. Today, although the biggest market for perfumes is in toiletries, industrial perfumery is enormous. Acceptable scents have to be put into vinyls and rubber backings, into floor waxes and insecticides. The odor specialists speak of "designing" an aroma when they compound it from among the 10,000 essences in an odor laboratory.

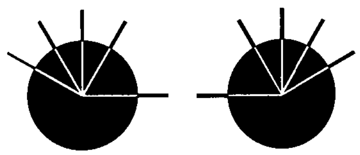
As a last example of the potential future of our sense of smell, one odor specialist pointed out that the Government was once considering introducing changes of odor on space-ships to relieve boredom. Three days of a light scent of pine, for instance, and then, three weeks later, baking odors. They apparently dropped the idea, but the philosophical implications for olfactory perception are myriad.

Touch

Cutaneous and kinesthetic stimulation and perception have come in for some widespread investigation recently, owing considerably to the writings of Marshall McLuhan, who feels that the

U.S. is becoming a tactile society—due, curiously enough, to the audio-visual medium of television.

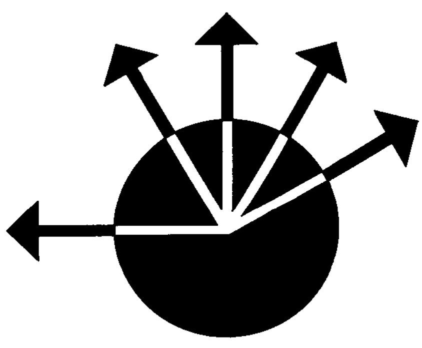
Touch is the only one of our senses that does not have a localized receptor. All points of our epidermis react to the touch of pressure as well as to thermal and vibrational effects. Yet today, there are built-in confusions that make us lose our sense of touch. People used to squeeze breads and rolls to see if they were soft and fresh. "Then food producers got wise," Dr. Caul points out, "and put in softness so that nobody could tell that way whether they were fresh or not." The case of plastics feeling like plastics yet looking like almost anything else is another confusion to our touch.



Louis Bettica of the Industrial Home for the Blind explains, "The deaf-blind rely almost entirely on touch and smell for their perception of the world. And their first problem is to overcome shyness about tactile contact. Methods of encouraging sensitivity are those of practice and the development of the use of the sense.

"But, attitudinally, America does not use the sense of touch as foreign people do," Bettica observes. "And foreigners are generally discouraged even from using hand gestures. How many people can you take by the arm to say 'That is great'? You have to say it intellectually, verbally. The dances of our teen-agers are as they are so that they do not have to touch each other. American feeling about touch is responsible for the fact that they are not so apt to embrace, as in other cultures. Many Americans do not even shake hands. An embrace means something involved. In this country, we are apt to speak things out."

Why this is true as a cultural pattern may have to do with our puritanical background. Yet, according to McLuhan, our times are changing in this respect, and we are becoming an audile-



tactile society. No longer will we be content to buy the screwdriver that is plastic-packaged like a transparent-coffined snow-white. We will soon again insist on feeling the goods, on the tactile pleasure of our contacts. But this aspect is more psychological than physiological, in respect to our sense of touch.

According to the scientists, then, research shows that there has been no physiological change in our sensory mechanisms in perhaps 5000 to a million years.

What, Then, Is the Sensory Revolution?

Changes have occurred, however. What kind of changes they are seems primarily a matter of the interpretative qualities of the brain.

"There are great influences of folkways, culture, and experience in the area of sensory perception," Dr. Caul concurs.

José Vazquez of New York's Board of Education program for Spanish-speaking children gives a telling example: "We have the ability to project and think a dish will be a sensational or a repulsive thing, according to our cultural experience. For example, do North Americans react eagerly to an invitation to 'a most marvelous iguana for dinner'? Many Latin Americans do."

Robert Swaine adds, "We associate odors with experiences. But to recognize that it has Saigon cinnamon and a little clove from Zanzibar and flour that was not milled as well as it should, has to do with further refinements, not in the anatomy of the receptor, but in the intelligence of the interpreter.

Research has revealed that, although the deaf may be made to hear with artificial hearing organs, what they hear does not make much sense to them. We may be able to get the receptors going, but the interpreter in the brain still eludes us.

Harpsichordist Albert Fuller, who has been aware of the acuity of hearing as he changed instruments from the bombastic pipe organ to the harpsichord and then to the whisper-quiet clavichord, observes, "Sensory acuteness is interdependent with experience and discernment. If you have never experienced a sensation before or if your mental acuity is ill-prepared, you probably fail to recognize any but the most elementary implication of the sensations of hearing, smelling, or seeing. Afterwards, extended exposure must enliven that initial impression. It is the continued analysis of experience that is essential to sophisticated discrimination and differentiation."

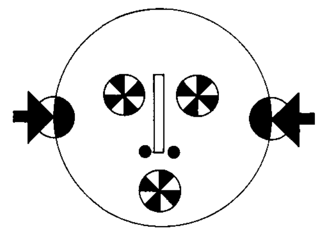
Do we know if animals recognize as dangerous or pleasurable only large classes of odors or tastes or noises? Is it only experience that makes further distinctions? Thousands of leaf-shapes exist. How many does the untrained eye readily distinguish? And what are the greater sensory rewards of experience?

We have been considered a predominantly visual culture, yet educators and critics have long felt that, in the main, our population is visually illiterate, that we most needed education in the visual to reveal to people what they actually see. The implication is that custom and habit have lulled even the optical sense into near blindness. We have sensory impressions without "conducted meanings," without recognition or consciousness. As with pain or piped-in music, we tend to resist or reject the constant to the point of numbness. Perhaps, therefore, it is due to reaction and growth that we are veering toward a tactile consciousness.

"When we say that, as each new noise comes on, each of us dies a little," T. J. Schultz says, "it is not a sensual thing but a matter of how you respond to the sensory stimulation."

The physiological operation of this interpretative faculty is explained by Dr. Pfaffmann as follows: "The connection—the primary neurological pathway to the brain cortex—is scientifically known. What we do not know is all of the sideways or offshoots from this primary pathway. The primary system is concerned with the identification and discrimination of the sensation, but has nothing to do with the pleasure of the sensation. We know almost nothing about the pleasure that the sensation arouses, what people in the applied flavor field call 'hedonic value.'

"How this works, in a simplified explanation, is that the old 'smell' brain, which appears in lower orders of the evolutionary ladder, is important in giving emotional value to the effects of sensory stimulation. This emotional brain, which is also called the visceral, vegetative, or affective brain includes the hypothalamus, which passes information on to the neocortex, the new brain found in higher animals, who can interpret this information in more sophisticated ways.



"We have not solved the problem of how the anatomical brain passes an emotional tone in the quality of our experience. How the brain computer works is the current question in neurophysiology. And electrical computers are being used to analyze these patterns.

"What makes an architect," Dr. Pfaffmann concludes, "is not what he sees at the primary level, but what he does with it beyond that. The blocks are important, but the integration stage is one in which we are woefully ignorant. There may be differences in form perception even at this level, but we do not know."

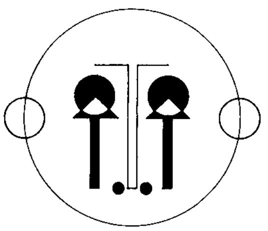
Sensory perception, then, is not merely biological or anatomical. It is the mental interpretation, the informational connectives between sensors and experience, that makes for cultured sensitivity. And these "instincts" were never constant. Rather, refined sensory perception—meticulous discernment of physical sensations—is acquired. Like language, the senses are living, growing, changing things. And so the changes in our senses are changes of taste, of temporary dulling, of interest, and of discernment.

Fashions and Fads: The Sensory Styles

If this is true—and architects can hardly be left unconvinced—we can only espouse wholeheartedly the entire gamut of rich and varied, wildly exaggerated sensory effects of every kind that can go on only to open doors into other exciting—if no longer simple and pastoral—aspects of our civilization.

Each door opened, each road trod, each sensation sated leaves a desire to move on to newer areas and newer sensations. When one decibel level becomes an accustomed thing, a shriller blast is the only successive step. One cannot, within that cultural framework, go back. The pastoral, romantic, picturesque movement is a negative, purgative, abstinent act. We can't go home again.

Yet we can make new houses, build new sensitivities. Among the possible results of our changing sensory perception are, first, that it becomes numbed or, second, that it is in a state of constant expansion, or, third, that it is in a state of *flux—one sensation* being supplanted by another. We can hope only that in the future, the numbness and the expansion will be in balance, perhaps, by having viable sensations supplant the old.



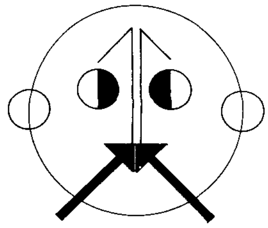
Dr. Pfaffmann says, "There are changes in what we like to see and want to see. But there we really get into sociological and cultural knowledge: how music has changed by hearing different tonal changes, and so on. We don't know much except descriptive information about how this happens analytically. What comments are made in this direction are really generalizations in social psychology that haven't been studied."

We know that colors do not change, but our uses of them, which frequently bring new excitement, have not been analyzed.

Robert Swaine adds, "The revolution is in the public taste," by which he means discretionary, not physiological taste. "I think the pendulum has swung," he continues. "The public is more aware of odors and tastes and is no longer willing to accept inferior blandness.

"In the 20's, year-round availability and freshness were the goals of food producers. That is when they began milling the hell out of flour. In the 30's, freezing started and botanists and chemists were called upon to make food look more glorious than ever, and more easily transported and durable. But they forgot flavor. Now, people are becoming more interested in flavor. The reason we do not like the taste of the tomato is because the producers have not tried to get flavor in. The one tomato from the neighbor's garden will tell you the difference."

"People today accept certain tastes or odors and certain ones are not socially acceptable,"



A. D. Little's Frederick Sullivan notes. "For example, they will accept styrene plastic at low levels now because of large amounts of styrene used in refrigerators.

"On the other hand," Sullivan continues, "we are creating a lot more odors than we had before. We have a wide choice today. There are new objectives and new desires."

Are there, then, or have there ever been, consistent, "traditional" intuitive sensory patterns, or have they changed with each age. If so, what does the new status of sensing reveal about our cultural situation? What are the implications of our new sensory styles?

T. J. Schultz is curious about all those transistor radios at every ear. Regardless of their undoubted educational value, he notes, "There is some implication of the lonely crowd here. The electronic umbilical seems to be necessary. Why are they lonely? What is missing? What is acculturated? What traditional modes have been withheld from them?"

Another change pertaining to our hearing, according to Schultz, raises a profoundly moral question: "The whole business of surveillance is becoming more a matter of interest—both legally and for its G-2 aspects. Privacy is being invaded by clandestine surveillance through audio means. Here is a whole area where people have changed their minds about what it is civilized to do with a sensory percept. Why is it that people now feel free to take liberties in the surveillance world that they previously regarded as protected?" Here is the frontier of that much discussed but seldom defined sixth sense—intuition and extrasensory perception.

The Mod Crossover

The research in sensory perception today, like the ambiguities of our daily culture, is often largely in crossovers between the senses, in intersensory relationships.

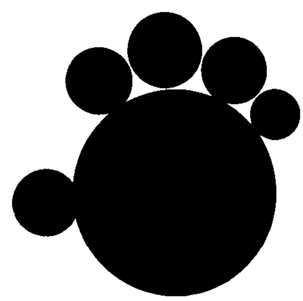
Many of these sensory interactions are so commonplace as to be almost unnoticeable. An interaction between flavor and scent is always constant; so when one has a cold, certain basic flavors vanish. Texture also is a part of flavor, which we consider primarily the sense of taste. Our pleasure at watching fireplaces, as opposed to watching radiators, indicates the interaction of the visual and the thermal-tactile senses; for similar reasons, red lights are added to no-flame electric cooking appliances and to infrared vending machines. Sound has influence on other senses also; for example, a loud noise may entirely prevent our ability to smell or taste, whereas, conversely, soft music is considered an elegant accoutrement for dining, and the crunch of the apple and the celery, the crack of the cracker and the toast are critical to the pleasure of taste. Bone-conduction hearing-aids work on physical vibration, indicating the interaction of the tactile and the audile.

Research reveals more unexpected interrelationships. Subjects have been conditioned by juxtapositions of colors and musical tones to see a color other than the one presented, when it is accompanied by the appropriate tone. A green light thrown on a steak dinner will make even a hungry subject not want to eat. In experiments conducted on the physiological effects of music or rhythm on the human body and nervous system, Dr. Johannes Kneutgen of Germany has shown that the heartbeat of man and animals can be slowed or quickened by the ticking of a clock. Heartbeat evidently reacts emphatically to reproduce the ticking of the clock that can be heard. Squirrels have been found to change their jumping rhythms, and fish to regulate their gills to ticking.

Dentists are now using a diversionary system of ultrasonic noises and music, called "audiac," as acoustical perfume for pain. Audiac in the patient's ear is a sufficient mask for drilling pain to serve as a substitute for other anesthetics.

Other factors also influence our sensory perceptions: for example, heat and cold, time, speed, and emotions such as fear. One research project has shown how tactile sensitivity, hand grip, and movement tracking are impaired at both ends of the temperature scale. Does the speed of the plane flight counteract or correlate with noise of the engines, or can we bear jet noises during flight only because of increased sensory tolerances?

What has speed done to our sense of touch? There is a correlation between acceleration and gravity, as we know from the weightlessness experience of the missile program. We feel weightless when there is nothing to push against. "A force cannot be felt if it has no point of application," Arthur Clarke explains. "You cannot



feel any force when you push against a freely swinging door; nor can you feel any weight when you have no support and are falling freely." He also cites the example of the comparative weightlessness felt as an elevator begins to ascend or descend, and when an automobile starts or stops suddenly.

Can increase of these two effects have some influence on our sense of touch? And, as a crossover with vision, will people ultimately feel differently about their own "weightfulness" when they see thousands of enormously heavy items floating around in the air overhead?

"All sensory inputs to the brain," another research project finds, "influence the quality of perception. Pain fibers from the viscera, fibers from the muscles and joints, as well as sensations from the skin, would contribute to the perceptual field of the gestalts."

Thus, in this crossover age, we reveal our current status linguistically. Scientists "see" the point; electronically we "read out" from the computer; yet visually we get an "impression" and we "grasp" an idea. The language is full of analogous crossovers.

What Does It Mean To Us?

The problem is to utilize these changes and crossovers to expand man's life and consciousness so as to permit him to cope with the rocketing changes of speed, time, space, and the other new disorientations from the more primitive animal states that are extending his senses as never before. How do we use the new-found interpretative thresholds to hook up with the future?

The Role Of The Artist

Marshall McLuhan, the current spokesman for our age, writes, "The serious artist is the only person able to encounter technology with impunity, just because he is an expert aware of the changes in sense perception."

Architect Ben Thompson said recently at Aspen, "As the gap has widened between man and artist in recent centuries, people have grown uneasy because artists are 'different.' What I suggest is that the reverse is true—that people became different and the artist kept in touch with his primitive soul. The artist remains an open-system, emotionally speaking. Impulses flow in, and instead of suppressing them he allows them to flow out. He really has no choice, because he lives what he is. The artist is the man who finds a conversion system, instead of a burial ground for the life of his senses."

McLuhan has said further, "The artist has been the means of vision, the means of knowing the world we live in. . . . When a technology is powerful enough to create a new environment, man is invested with a new set of clothes—the Emperor's new clothes, as it were—of which he is scarcely aware. The artist steps in at that moment to reveal what is otherwise invisible by setting up new modes of perception."

Today's artists, consequently, are investigating the intersensory relationships and the crossovers in our daily lives, as the new art forms reveal. The Happening, for example, is half movement and half painting or sculpture. In the art form of the sense of hearing—music—a visual dimension has been added. John Cage has, for example, scored his musicians to move from desk to desk at specific places in the performance, thereby introducing visual movement into a traditionally aural form.

Furthermore, in a day when there is no quiet left, musicians such as Cage have made silence the content of musical form. In Cage's compositions, the voids between sounds are integral to the musical composition. La Monte Young uses the quiet end of the noise level as his new dimension: the fluttering wings of a butterfly let loose in an auditorium, the gentle crackle of a small fire of paper, the muffled slap of a musician hitting his thigh. Now that silence is gone, these musicians are artful in recording its real existence.

The question is, without such artistry, could we hear silence any more?

On another level of investigation, Stanford University's Michael O. Burridge has developed a recording device for electronic music that records sounds such as the firing of a rifle or the splintering of glass and plays them back at speeds that bring into audible range higher or lower sound frequencies otherwise inaudible to the human ear. The instrument thus produces virtually new sounds unheard by the human ear before.

In the visual arts, Dr. Gerald Oster has investigated Op-art moiré effects and the phosphenes that one sees usually as after-images following pressure applied to closed eyelids. He has, in the main current of his age, reinvestigated under LSD the findings of his moiré effect research. What he concludes is that "all vision has a circular pattern superposed on it," which may be analogous to the mosaic mesh screen of photoengraving, of television, and (if current philosophers are accurate) of our contemporary mosaic gestalt.

But what are the art forms of the other senses —of touch, of taste, of smell? The sense of touch seems never to have been crystallized into an art form. The sense of smell is distilled as perfumery.

Where is the permanent record of taste perception, which is often so intimately bound up with the olfactory sense?

Dr. Caul suggests it is food and cooking—the tradition of Escoffier. One can add Vatel, Carême, and Brillat-Savarin to the list of French culinary artists. One can also add the other great culinary tradition—the Chinese cookery. We can remember the reported feasts of Roman days. But culinary art is not a permanent thing, such as the art forms you can hang on a wall. It is not crystallized, except in cookbooks. As an art form, it is more akin to a performing art such as singing.

"Reproducing a melody or a score is one thing," Dr. Caul explains, "because those actions are physical in nature. But flavor is chemical in nature, and that is a big difference."

Still, there is an enormous new interest among Americans in this craft or performing art, which our puritanical attitudes must have mitigated against in the past.

In addition, arts were formerly for the rich only. Today, they seem to be participated in by all. As expressions of the interpretative brain's appreciation, "Flavor also happens in the mind," Dr. Caul muses. "That is why they are called the senses, I guess."

But perhaps most of all, food and cooking comprise the end result of an art form that is everywhere every day. The art of cooking, surely, has been civilized man's first and continual art form, which has always been revered in what Malraux calls a "museum without walls"—everyday life.

"We have to live art if we would be affected by it," Sir Herbert Read has said. And it cannot be denied that the art forms of taste and smell are lived daily by all the peoples of the world. Not everyone, however, lives at this level of appreciation—a fact that returns us again to the matter of the critical factors of experience and culture.

Aestheticians have puzzled over this affective quality for years. Is the beauty in the flavor or in the head? Is it drunk in the bottle, or drunk in the head of the drinker? Or is the art in both? Is it not the interpretative qualities of the mind working on the chemical or physical properties encountered? But how?

And how guilty are our artists of perverting our sensory perceptions?

The Architect

As artistry intensifies every sensory effect, do our senses become more acute—or are they dulled to atrophy? People complain today about the artificiality of both our everyday perceptual experience as well as about the "scandalous" daring of our artists.

Yet artists have, in other ages, been the shedders of light on the sensual as well as the intellectual aspects of our lives.

Today, are architects as artists bringing a new sensuous awareness of a new environment made possible by new techniques? Are they really expressing a sensory awareness at all? As Oscar Wilde has said, "Nature follows art." And are people — "nature" — following the architect's ideas? How is the architect, as artist, interpreting the sensory perceptions in his environmental machines?

Only when one understands the changing concepts in science, and the possibilities offered by applied science and technology, can one begin to think of what buildings of the future might be like. Here is the vision of one structural engineer who is trying to shed traditional thinking. Pictured on the following pages is . . .

THE ENGINEER'S THIRD MILLENIUM

By Lev Zetlin, Consulting Engineer:

Since progress in the pure and applied sciences, such as various fields of physics and chemistry, is based on observation of natural phenomena, it follows a pattern that could be extrapolated. Thus it is to some extent possible to predict feasible future achievements.

This is not the case in construction. To attempt to predict the nature of buildings in the third millenium would be like trying to predict clothing fashion. Architecture is a field where the applied natural sciences meet with aesthetics and the social sciences—all of which are variable from generation to generation.

In attempting to predict the future of buildings, this article limits itself to the "science of building buildings," defined as building better buildings more economically. Particular emphasis is placed on the future of structural systems: Since these have great bearing on the form and planning of any building, the future of structural systems might indicate how buildings will look, as well as indicating the general direction of the entire construction industry.

Change Comes Slowly

The predictions for the future of buildings are based on criteria proven over a number of years. Building forms, structural frames, and construction methods all conformed to their specific epoch. Generally, the forms of buildings are dictated by the structural systems supporting them. This is true of Roman aqueducts, American skyscrapers, the Eiffel Tower, and industrial plants.

Improvements in the construction field were essentially changes in an existing method of design, concept, structural frame, or construction technique. The improvements were always superimposed one upon another on top of a traditional system or technique. But in other practical sciences, old methods and equipment were

scrapped with each innovation, thus leaving a freer hand for progress. Now we have the paradoxical situation of housing a sophisticated Saturn missile in a building that could have been built in the year 1900.

Inefficient Structural Support

Conservative opinion may wonder why buildings and structural systems should be drastically changed. It may also ask what is wrong with present concepts, construction techniques, and structural systems. The reply is simple: Present buildings are structurally inefficient and are becoming inordinately expensive without any gain in quality or technological sophistication. Structures built today have an extremely low efficiency ratio. They weigh three to ten times the live load for which they are designed. In other words, to create a structure to resist a prescribed load, we design and construct for a load four to eleven times as much. This is as efficient as drinking tea from a lead cup, or wearing armor several times heavier than that of a medieval knight.

Inefficiency also prevails in the technique of building, which leads to rising costs. Unfortunately, costs will continue to rise as long as the industry combines increasing labor costs with outdated building systems, instead of adjusting building systems to modern technology.

This lack of progress in technology results from an absence of research and development programs in construction, and from a lack of motivation in making innovations. The reason for this inertia is that the industry consists of fragmented services for design and construction.

Each building represents an individual, independent entity, with its own financing, design, construction, and user problems. Furthermore, the financing groups in the construction industry know very little about the potentials of the various component sciences in the design of a building. This kind of atmoshpere is conducive to conservatism, and is extremely unfavorable to innovation.

Borrow from Aerospace Research

Real innovations in the science of constructing buildings economically will be achieved only through a concerted research and development effort. Financing such an effort could be done only by large corporations or the Government. It cannot be achieved by individual owners, architects, engineers, or manufacturers of building components.

Research and development in other applied sciences, particularly the aircraft and missile industries, abounds with novel information in the domain of stress analysis and strength of materials. These are prerequisite to innovations in structural systems, and hence to improvement in the science of building buildings. But, surprisingly, the construction industry did not even stretch its arm to avail itself of this information.

It is also surprising to find that this relative backwardness of construction science exists not only in the United States, but in every country that has otherwise made great progress in pure and applied sciences. One explanation for this could be international competitiveness. The upsurge in nuclear physics and space exploration during the last two decades is based on breakthroughs made between the years 1900 and 1930. It was only when one nation started using these theoretical breakthroughs for practical applications, and possible military superiority, that other nations began their great efforts in basic research and development of applied sciences.

Competition May Spur Construction Research

Construction is one of the largest industries in every developed nation, and hence has a significant bearing on the national economy. It is quite conceivable that in the foreseeable future one of the developed countries will put a national effort into research and development of the science of building buildings.

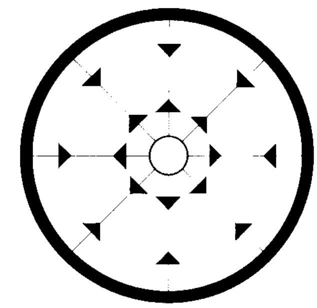
Since the purpose of such an effort will be to build more economically on a national scale, and therefore with a possible favorable impact on a national economy, this will create an impetus for international competition. After this, research and development in construction sciences will catch fire on an international scale and breakthroughs will occur on the same scale as in other applied sciences.

Nevertheless, during the last decade, spontaneous attempts, though isolated and far between, have been made by a few countries to research and develop their construction industry. In the United States, these attempts are spread among several Government departments and among large manufacturing corporations.

The attempt by the large corporations, naturally, is directed toward their own products. Thus, most of the effort in research and development is spent on building components. Unfortunately, very little effort is being made toward innovations of buildings as complete units. Only this kind of innovation will result in significant breakthroughs in the science of building.

Buildings in the Third Millenium

At the beginning of the third millenium, structures will be built with only two major types of materials: high-strength steel (possibly with a breaking strength over 500,000 psi) used only in tension, and lightweight plastic, fibrous, and cementitious materials resisting compressive stresses. These lightweight materials will simultaneously serve the aesthetic and protective role of an exterior skin for buildings.



Lightweight panels, prefabricated on assembly lines, will comprise complete portions of a building and incorporate structural, mechanical, and electrical requirements for a building. Most likely, they will be self-erecting, but if not, they will be speedily erected with automated equipment. Whichever technique is used, the contractors will put little reliance on manual labor for field-welding or bolting.

Buildings will rise to almost unlimited heights, and the interior spaces will remain unobstructed because floors will span great distances between supports. Few structures will be built underground, since this is a slow construction process requiring a lot of manpower.

In urban areas, buildings will start high above the ground, thus creating "cities in the sky." This prediction is based on construction economy, but the concept also satisfies the city planners' plea for more ground space for the exploding population.

Despite the heavy standardization of components, there will be no standardization of buildings, because components will be designed to be combined into a great variety of architectural forms. However, buildings will be aerodynamically stable and designed as complete structures, not as a series of components.

Structural frameworks will incorporate mechanical devices to withstand loads. Instead of brute strength to resist wind, earthquake, or live loads, frames will activate springs or hydraulic devices to compensate for the loads.

Changes in construction will not only be technological. The chain of command will differ from that now in effect: There will be no architects, engineers, or contractors in the sense we know them today. Neither will the changes forecast for construction be brought about from within the industry. This is because today's construction industry is too inert and insensitive to the technological revolutions going on around it.

The major changes in construction will start when companies in other technologies, such as aircraft, machine builders, etc., enter the construction field. Even today one can see the writing on the wall.

How to Improve Structures

Although there is presently no concerted effort for research and development in building science, research in the engineering field is going on in various universities throughout the world, usually undertaken by individuals on their own initiative. The space and aeronautical industries also perform interesting research in the field of structural engineering and strength of materials.

Studies in the fields of geophysics, aerodynamics, and weather prediction offer tools that can be used two ways in building design. They can pinpoint—and hence reduce—the design loads; and they can impart streamlined shapes and forms to buildings that will simultaneously increase the resistance of buildings to, and reduce the intensity of, the external dynamic loads such as wind or earthquake.

The results of lab work are slow to show, because there is about a 15-year lag between the available theoretical knowledge and its application to construction. Nevertheless, the results of research mentioned previously give an inkling of possible future efficient structural systems and forms of buildings. The following factors will determine the structural systems, and hence the form of buildings, in the future.

Stress Distribution Efficiency

Modern science has been quick to discard ideas once they have been disproved. Contemporary building technology, on the other hand, tries to improve antiquated concepts. We are, in effect, applying modern scientific methods to ideas that are more than 4000 years old.

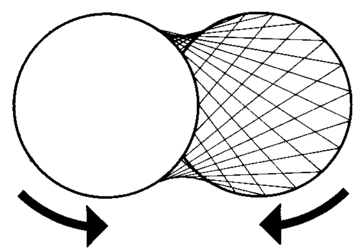
Contemporary architectural construction follows within this time-honored tradition. An obvious example is reinforced concrete manufactured in the shape of steel sections, which perpetuates the lineage of material misuse. Archaic wood construction was translated into marble, marble was translated into cast iron, and now precast concrete uses for its model the rolled-steel section.

We adhere dogmatically to the idea of bending stresses, refusing to discard such an obviously impractical concept. Much of our energy is spent in trying to improve the bending capacity of materials, instead of finding means of circumventing this traditional pattern of stress, which represents a loss of 90 per cent material efficiency.

We need new concepts, new ways of thinking. Science is not standing in our way; we need merely stretch our hands to avail ourselves of discoveries all around us. The space frame, as we think of it today—as a two-way truss—represents an uneconomic use of material. Its failure lies in the waste of labor—in having to assemble thousands of variously sized pieces.

We can produce steel that is many times as strong as our present structural steel, but we seldom employ this improved material, for we think of it in connection with bending stresses. Deflection is a function of I and E, and the E is the same for both mild and high-strength steel. Therefore, when we think of high-strength steel only as a beam, it has no economic advantage.

However, high-strength steel used in sheets for shells or cables offers a maximum advantage,

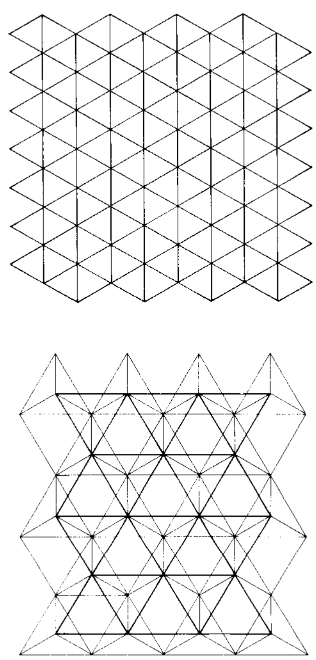


because these structural methods do not depend on bending stresses and therefore full advantage can be taken of their improved properties.

Modern high-strength materials must be used with imagination. They must not be nullified by preconceived, antiquated structural concepts.

Primary and Secondary Stresses

By ignoring secondary stresses, contemporary structural design is imposing on itself a serious limitation.



Primary stresses could be called the "handbook" stresses that we use every day. Strength is assumed because we have built millions of buildings with these methods and know they are safe. It is a theory that states we traveled from one point to another, but tells us nothing about the structural behavior employed in reaching our destination. Such an approach to structural theory is extremely *limiting* to structural development.

Primary stresses are only an approximation. In primary design, we assume that the section does not distort, but it does, and, in so doing, the actual stresses are different from primary stresses. Normally, primary stresses are an envelope enclosing the largest stresses in the section. Actually, many areas within the section, when stressed, are much stronger than those assumed in primary stress design. By confining ourselves to this limiting theory, we curtail our understanding of stress behavior and its creative design possibilities.

We assume homogeneity of material in our calculations, which is contrary to fact. We do not possess a structurally homogeneous building material. The homogeneity of concrete is denied by its composition and is demonstrated every day in the failure of test cylinders. To cover our misunderstanding of concrete, we introduce a safety factor that allows us to consider it homogeneous for design purposes.

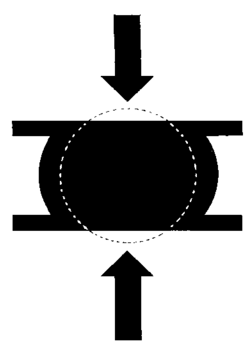
Material failure is caused by imperfections, and is no indication of the material's strength. We assess the strength of building as haphazardly as we assess the strength of materials. If we design a structure with a safety factor of $2\frac{1}{2}$, we probably have, within 98 per cent of the structure, a factor of 8, and the remaining 2 per cent may have a factor of 1.2. Obviously, a chain is as strong as its weakest link, meaning that the building has been designed with an excess of material and a dearth of safety.

The total structure could be designed with a uniform safety factor of $2\frac{1}{2}$, making it more than twice as strong and saving two or three times the material.

Stress and Strain

Another fallacy is to assume that stresses will always cause strain. Hooke's law tells us that any load imposed upon a material will cause a corresponding deformation. But this is not always true.

Laboratory tests on thin steel bars indicate that they will rupture at, say, 50,000 psi. In this case, Hooke's law would apply up to yield point. But what would happen if we took a steel ball of the same material and dropped it into the ocean to a 10-mile depth? The ball would withstand a stress of 400,000 psi without deformation, since it would be contained by hydrostatic pressure, which would prevent its distortion. Since the ball could not deform, there would



be no strain and it would not rupture. As a matter of fact, it can withstand infinite loading under these conditions. Similarily, if we placed a steel ball in a laboratory compression chamber, it would react quite differently than the test samples we usually employ. It would withstand much more stress.

In testing, we are defeated by the geometry of the bar. We already accept this fact, although its potential has not yet been explored. The building codes allow a much greater stress beneath the compression plates of post-tensioned concrete beams. The greatly increased strength of a material when confined against lateral movement is therefore a tool to be used when we speak of potentials.

Flaws in Construction

Steel could in reality be one hundred times as strong as we know it. We know that steel breaks through the grain between molecules. Molecules are held together by ionic attraction. Griffith computed that force and as a consequence found that, theoretically, steel could withstand forces one hundred times those we usually assign it. Why is there a difference between this theoretical strength of steel and its actual test strength?

Griffith found the cause was millions of minute flaws (crevices) introduced during the steel's manufacture.

We have a small indication of this increased strength in comparison of mild structural steel and cable steel, which attains strengths four and five times that of structural steel. Eventually, we will be able to improve our method of steel manufacture so that it will eliminate these flaws and increase the steel's strength.

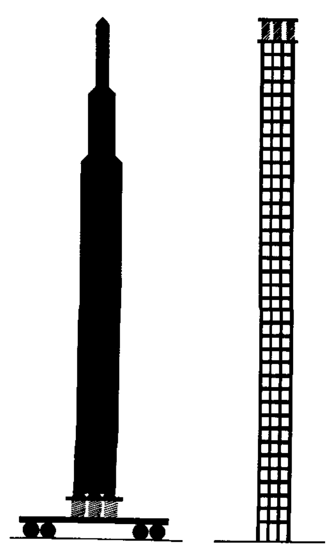
Vertical Stability

It took space engineers only six years to solve the problem of vertical structural stability that has baffled the construction profession since the Tower of Babel. They invented a mechanism to impose vertical equilibrating forces. These springs "that think" eliminate incipient distortion at the instant it threatens to occur.

Seventy per cent of the total material in a high-rise structure is sometimes used to eliminate drift, which would be uncomfortable for the building's occupants and damage brick and glass. This material is utilized for loads that occur only a small fraction of the time. The maximum loads, such as might be imposed by hurricanes, would occur less than 1 per cent of the time. The preponderance of material is added to the structure for these occasional critical loads.

It is obviously more logical to introduce counteracting forces when needed than to build in such a wasteful manner. If we recall the principle of the missile, we find it is possible to introduce mechanisms that will induce strengths into the structure when they are needed.

There is also another advantage. Weight in building is self-defeating. A steel column one-mile high needs all of its strength to support its own weight. At a half-a-mile height, it is utilizing half its strength to support itself. By reducing the weight of the structure, we are returning to the material its ability to help the building, rather than its being in business for itself.



Extruded Buildings

Our present building systems increase in cost as they rise in height. In other industries, high-capacity synchronized jacks have been developed that could be used to help solve this problem. By utilizing 50 such jacks, which could lift 1000 tons each, we could eliminate the expense of building our buildings from the first floor up and extrude them into the air. These would be built completely assembled on the ground and lifted into the air, reversing our present procedure by building the top floors first.

The present lift slab systems only lift the slab (about one tenth of the building's weight) and do not alter the building's piecemeal assembly system. If we consider this lifting system, we should rethink our assembly systems so that we do not apply modern technology to antiquated individual component assembly methods.

Quo Vadis?

The nature of buildings in the third millenium is wide open to speculation, since building construction could take any direction within a wide range of possibilities.

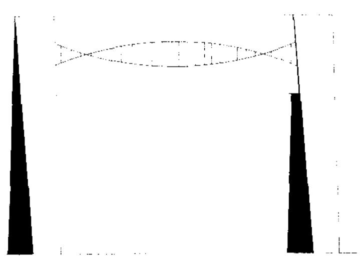
At one extreme, the industry could resist the technological changes of the next four decades, in which case we will still be pouring 5000-psi concrete from buckets into timber forms erected piecemeal by carpenters. At the end of a day, the men would leave in their private air-cars, inside which they would take a dry shower from a miniature sponge, change into stretch-fabric suits which are stored in a match-size box, and then head for a dehydrated dinner 3000 miles away at a speed of 18,000 mph.

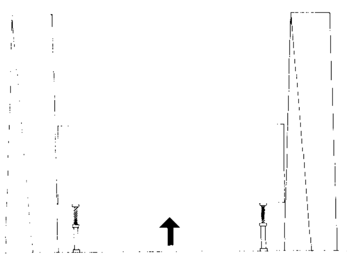
At the other extreme, man may not need any buildings at all. He might eternally live in a space suit that will provide all his needs in life, with possibly a few tubes projecting from the suit for physical contact with other humans. Occasionally, he would get tired of his suit and find himself a cave for a rest. And so another cycle of human civilization will have begun.

The following comments by P/A are extensions of Zetlin's thinking: They represent attempts to anticipate building forms of the third millenium by projecting structural principles already known.

Building Above the Earth's Surface

With the increased need for space for the expanding population, it will be necessary to increase building heights. Zetlin suggests they could begin at, say, 200 ft above ground, forming clusters or towns and cities above the earth. Lightweight materials make this feasible, and we already

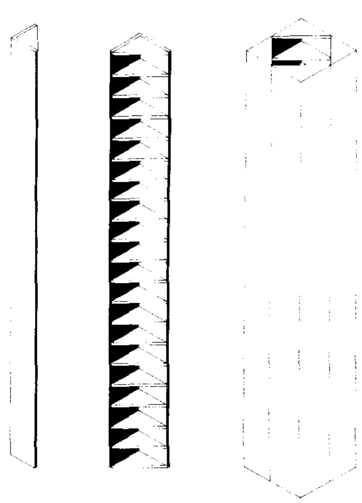


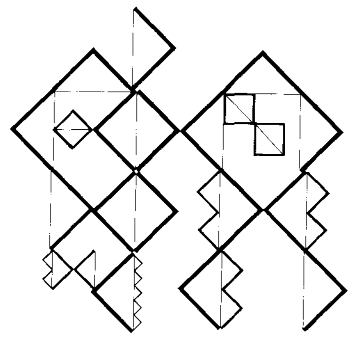


possess jacks that could be developed to lift such sections into place. The clusters would be connected by cable-suspended bridges, thus leaving the ground below free for sunlit parks and gardens.

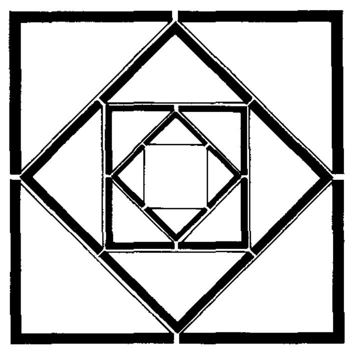
Building Components

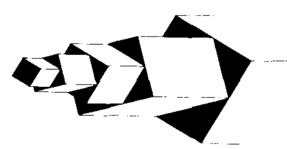
The introduction of lightweight building materials and entirely new methods of fastening indicate the feasibility of fabricating entire sections of buildings. These would contain plumbing and

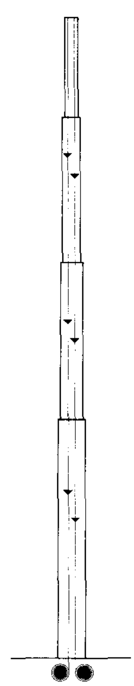




environmental equipment. They could be erected as self-supporting building elements and would be fastened together by further developing several existing systems, such as the gasketry now used for curtain-wall buildings, or a suction system similar to that used in lifting glass and polished stone.





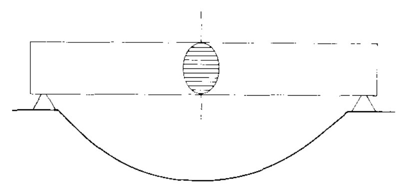


The units would be capable of multiple arrangement and would be demountable for relocation. The possibility of altering their size the same way that naval engineers change a vessel's displacement from 10,000 to 20,000 tons should not be overlooked.

These sections could also be arranged to telescope, say, 7000 ft in the air. Cables used for raising and lowering the building would tension it to withstand occasional severe wind loads and against flutter in the same way as the cables connected to mechanisms in the Milwaukee tower. This principle is already embodied in the telescoping airplane-boarding platform.

The Building Working as an Entity

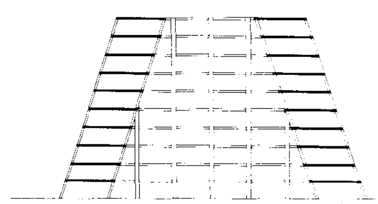
Zetlin speculates that we should be able to construct buildings that span distances, using their own strength in much the same way that an airplane body does.



In little more than half a century, the airplane has developed from an assemblage of structurally individual units covered by a silk skin, to the very efficient structural systems used today. There is no reason why the same principles could not be applied to a building, with the skin, instead of merely being an enclosure, forming an integral part of the structure. "Nothing in nature acts piecemeal," comments Zetlin.

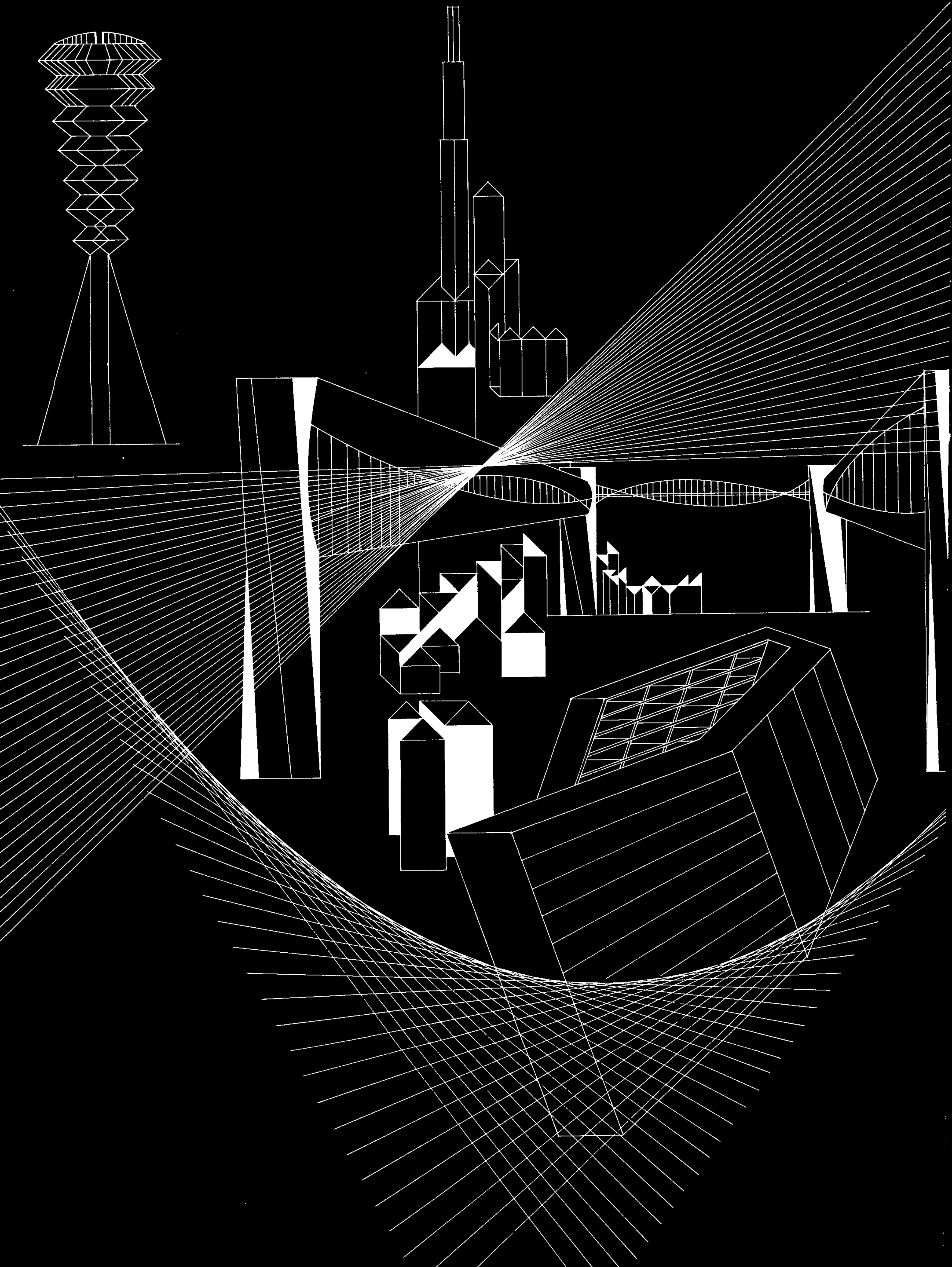
Lateral Stability

"We do not use the reserve strength in our buildings," says Zetlin. He had hoped to test some of the New York World's Fair structures, 14 of which he engineered, to ascertain their true strength.



The possibility exists of adding lateral stability to a structure by designing it at an angle other than a true perpendicular, so that the components of its direction would act as counterforces to horizontal stresses. This method, aside from its obvious architectural advantages in providing privacy and balconies for occupants, would use the columns and floors as integral structural members.

Serpentine forms could also be used to implant lateral stability in structure.



Gyroscope Monitoring Sensors Would Stabilize Tall Towers

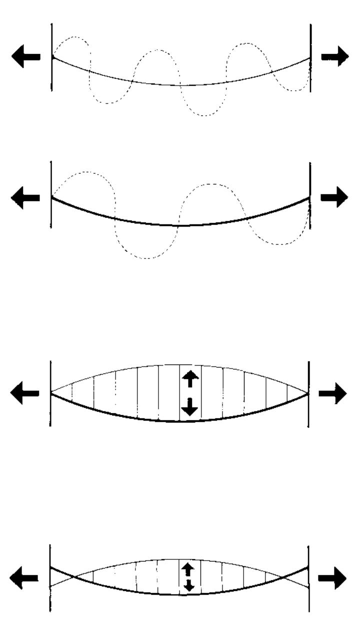
The shock absorber converts kinetic energy. We cannot, of course, build a shock-absorber on this particular *principle* to service a building. It would have to be as large as the building itself. But we can use the principle to counteract stresses the moment they threaten to occur, and only at the point they are needed. Its feasibility has been illustrated by space engineers who have invented devices that stabilize incipient motion while transporting rockets assembled for firing.

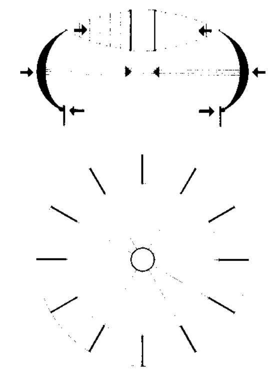
In his engineering design for the Milwaukee tower, Zetlin eliminated 60 per cent of the material usually required for such a structure, and saved more than $3,500,000 by introducing electronic sensors that activate mechanisms to counteract forces that tend to create instability and flutter. The tower has a base-to-height ratio of 1:15, compared to 1:4 of the Eiffel tower and 1:6 of the Seattle tower.

Roof Holding Substructure Instead of Resting Upon it

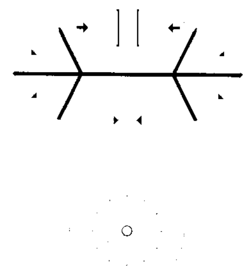
"The cable structure has the virtue of decreasing in cost proportionately as it increases in span," comments Zetlin. In discussing the structural systems for which he is probably the best known, Zetlin explains one of the cable systems he designed.

"The lower cable is connected to the upper by struts. If one of the cables—say the lower one—tends to flutter due to an externally applied dynamic load, and therefore tends to assume a certain geometry at a particular instant, the upper cable, due to its different characteristic, would tend to assume a different geometric configuration. Thus the flow of energy from one cable to the other would dampen the vibration of the other cable in the same assembly. As in a classic shock-absorber, where energy from a vibrating system is transmitted into the dash-pot, the entire suspension roof, consisting of a series of pairs of cables, constitutes a giant internal shock-absorber."

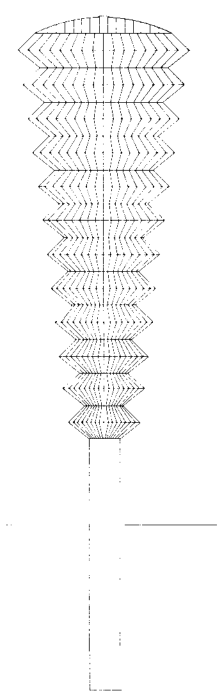




Embodying this principle, the three-dimensional space structure Zetlin devised for the Travelers Insurance Pavilion at the New York World's Fair is here projected to a multistory building.

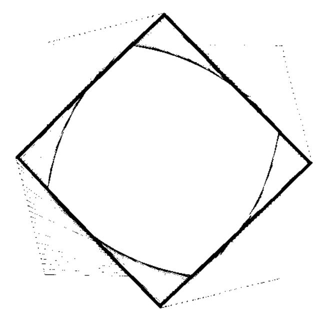


In this structure, the stress pattern is reversed from that of the arch, the conventional gravity structural system. Instead, the dome is in tension and requires little material at its apex. There is no reason why a series of such structures could not be erected—tied together by the pretensioned roof cables "like a keystone." "The arch is dead," declares Zetlin.

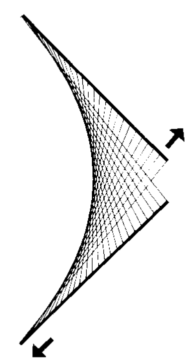


Torsion

Economically fusing support and structure, Zetlin devised a hyperbolic paraboloid shell structure of 4-in. cast-in-place concrete wall sections for Philip Johnson's nuclear reactor at Rehovot,



Israel. The building was designed to withstand the internal torsion stresses of the reactor crane, and the loadbearing walls eliminate ring girders, thus creating an integration of reactor and structure.



Zetlin thinks that torsion principles applied to structure will provide added lateral stability, integral architecture, and economy of structure.

The foregoing remarks are conjectural and should not be taken as predictions of the actual forms of buildings in the third millenium. It is possible, as Zetlin has suggested, that future building form may be no different from what it is today. However, these comments do show what could be accomplished by a dedicated commitment to science, and by using existing technology.

Zetlin has clearly pointed to the limitations in thinking and preconceptions we must overcome if we are to achieve breakthroughs in structural technology: "We have an unfortunate tendency," he remarks, "to think of buildings as components. No one seems to talk of completed buildings. Nonetheless, there are more breakthroughs than we are aware of. . . . The job of the engineer is to create breakthroughs. Enthusiasm for engineering is fine, but it is meaningless if it implies merely the enjoyment of building traditional buildings. Enthusiasm must furnish the impetus to create breakthroughs through original thinking."

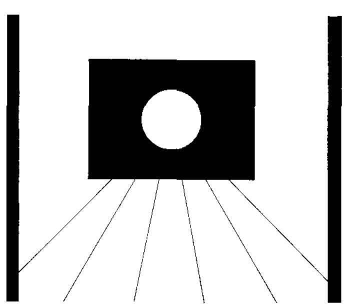
We have so far discussed the revolutions in philosophy, science, and other disciplines. Is there also a revolution in architecture—a new direction and new thinking that runs parallel to those of other fields? Our last chapter is an attempt to trace this unifying cultural substream. Now, finally, we can discuss . . .

THE ARCHITECT'S THIRD MILLENIUM

In the previous pages, we have seen evidence of a "revolutionary excitement" in many different fields. Man's increasing immediacy of contact with his environment in all its sensual, social, and scientific aspects has begun to criss-cross interdisciplinary lines. Scientists, authors, artists, sociologists, philosophers, theologians, even an occasional politician, have begun to talk together and to find that they might be tuned in to some of the same wavelengths. There are indications that the architect and the planner have begun to join this dialogue. The evidences are small so far, but definitely worth documenting as an indication of the direction and thrust of the profession's future.

The Background

Formerly, it was generally agreed that the world was a rational and ordered system. There was



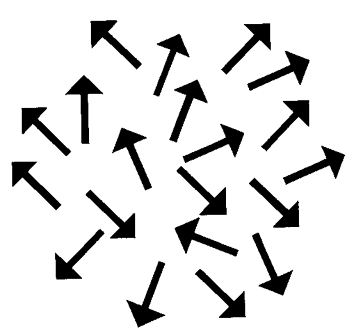
God, or his facsimile—Reasonable Man; there was symmetry and harmony, perspective, orderly space, with a focus to it—a closed, systematic world. Today, many are taken with the idea of perpetual flux. Whereas previously people talked of progress, they now speak of "process"; instead of logical sequence, it is "simultaneity"; destinations give way to "nowness," form to "happenings"; instead of single focus, it is multidirectional "impact"; instead of the ideal, it is the "particular."

From Newton's World to Einstein's

It is convenient (if somewhat contradictory in terms of the "causeless" new philosophy) to compare this change in world views to the differences in scientific concepts: to the shift from a Newtonian universe to an Einsteinian one. The first is ordered; time and space are a uniform matrix in which objects take consistent, measurable positions. Aesthetically, this is the space of a Renaissance painting, with depth, focus, and a perceptible goal. The viewer is moved through a sequence of peripheral events to a climax, through objects in profile to a frontal façade. This is the single-axis, single-focus space of the church with the altar at the end, the theater with the proscenium stage as focal point. It seems very clearly linked to a philosophy of life which sees man moving in a progression of steps toward a full end, of reaching the climax, God, heaven, or a logical solution. It is similar to the structure of the ordinary "well-made" novel or Hollywood movie, where a series of events lead to a climax, a focal point.

The New Consciousness

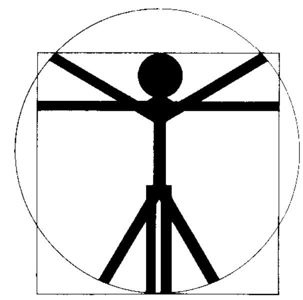
The new attitude, on the other hand, has its roots in the Einsteinian concept of the universe —one that leads to suspicions that space and time are not part of a consistent, uniform matrix; matter may be constituted not of rigid particles but of energy states—a condition not of statis

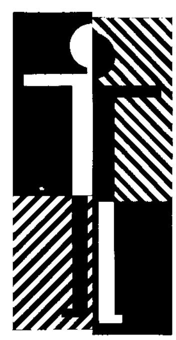


but of constant movement. There is no prime cause and destined end, and probably, given the experiments of Lee and Yang (see p. 101), no fundamental symmetry of nature exists. From this standpoint, each person's time and viewpoint varies; the only reality is the confluence of events at a particular place and time.

Although it is convenient to attribute the new consciousness to scientific discoveries, various disciplines seem to have been working toward the same general attitudes in recent years. Underlying them all is a curious similarity. There is an increased awareness on several levels: Each individual becomes acutely, sensuously, aware of the impact of his particular situation; he is more aware of the particular nature of the time and place that surrounds him; and he considers himself part of a gigantic dynamic process, whose structure is different from every vantage point, and constantly varying.

Other disciplines have contributed to the new view. Much of Western philosophy and religion has moved from the cause-and-effect dogma of Judaeo-Christian thought to today's form of existentialism. Lurking in the wings may be a Westernized version of Oriental thought. When the logical point or purpose of the universe was removed, a whole bevy of concepts died: the Prime Mover, Ultimate Destination, Rational



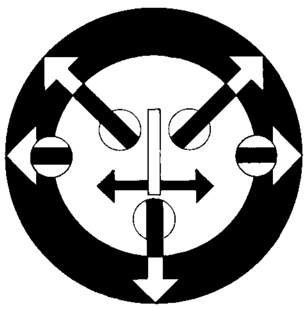


Man. The existentialists painfully revived man, the whole man, head-to-foot man, sometimes rational, sometimes absurd man, loving, hating, selfish, selfless. They laid him bare, and launched him without goals or reason into a world of chance and flux. The existentialist served to help reintegrate the whole man, detach his vision from some far-off goal and expectation, and put him down in the middle of his own mix.

The Influence of Oriental Philosophy

Lately, there has been a move toward Oriental philosophy, which seems even closer to the new concept of the physical world. John Cage, the avant-garde musician, states this view rather concisely in an interview in the **Tulane Drama Review**: "I found, through Oriental philosophy, that what we are doing is living, and that we are not moving toward a goal, but are, so to speak, at that goal constantly, and changing with it, and that if art is going to do anything useful, it should open our eyes to this fact." Given this attitude, no wonder that we speak of situation ethics rather than universal static code, or that

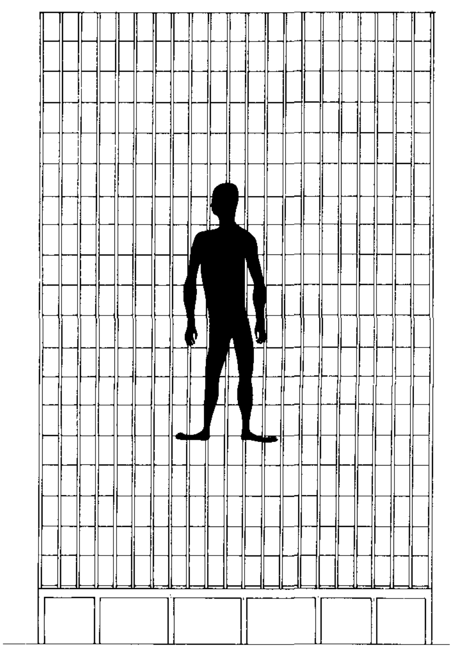
LSD and psychedelic agents, closely linked to Oriental mysticism, are receiving so much interested attention from many people these days. Those who have explored such states of "expanded consciousness" report they experienced

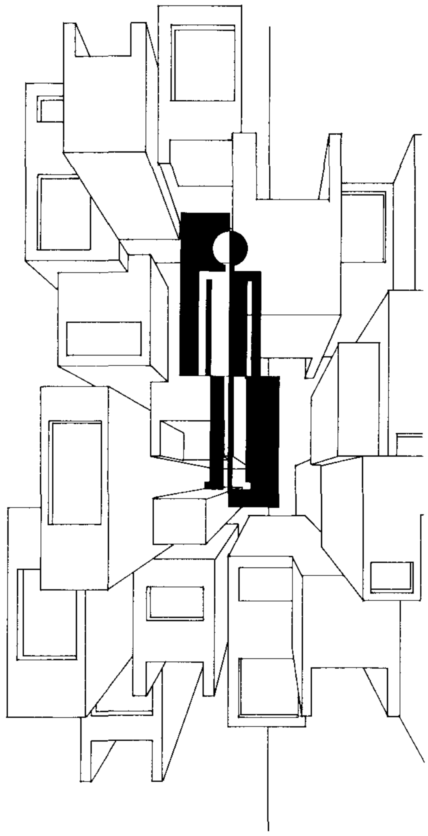


an intensification of the senses, a feeling of being at one with the processes of the world, of complete fulfillment now.

From Sequence to Simultaneity

Sigfried Giedion is fond of relating new space concepts to the shift from perspective to the flat surfaces of Cézanne and the cubists. It is true that, in the former, the goal is a distant point; in the latter, experience is a simultaneous impression, recall, a momentary synthesis. In cubist paintings, objects are brought to the surface of the canvas, multiple impressions of the objects are presented at the same time as instantaneous imagery and recognition of that object. Objects **make** their own space on the canvas; they are not placed **in** space. This brings multiple events to the same important position: It seems related to Marshall McLuhan's point in **Understanding Media,** that for primitive man, time is a pluralism of many things coexisting.





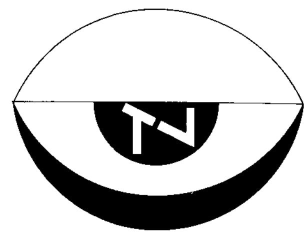
Since, to McLuhan's thinking, modern man is being retribalized, it suggests he may be experiencing the same sensory modalities as primitive man.

Following the feeling of alienation evidenced in the work of the abstract expressionists of the 1950's—a turning away from the external world of nature to the world of the inner man—which may have had a spiritual correspondence to the predominant mood of the postwar existentialists, many artists today have returned to the immediate, concrete, contemporary world. Pop and Op art and their various ramifications have let loose the variety of textures, colors, and symbols of our environment. No longer satisfied with the limitations of "studio" art, the artist uses any method available to convey what he wants people to feel—in some cases it is a multiple-impact container in which the "viewer" is entirely surrounded. Much of the new art seems concerned with juxtaposition, with allowing each spectator to make his own synthesis, allowing things to happen instead of structuring them.

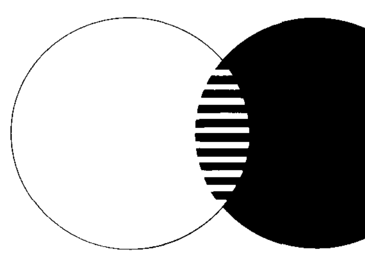
The novel and film have followed somewhat the same pattern. The traditional structure of beginning, middle, and end—of build-up and climax—has given way to an exploration of the ramifications of each moment, of **now.** "If we want to express our age," said Sartre, "we will have to change the novelist's technique from that of Newtonian mechanics to that of generalized relativity, and people our books with half-discernible consciousness, none of which would have a privileged point of view either on events or on himself." The futility of expecting a climax, a point to existence, is classically demonstrated in Samuel Beckett's **Waiting for Godot.** Godot never comes; the only reality is the process, the waiting. In such films as Alain Resnais' **Last Year At Marienbad** and **Hiroshima Mon Amour,** time and events are mixed. The present moment is full of time past and expected futures; the actual future is unpredictible, unimportant in relation to nowness, the open-endedness of life. Both Proust and Joyce delved into the depth of momentary consciousness. (Proust, it might be noted, was inspired to his vast vision by a rather primitive psychedelic experience with a madeleine cake.) Progression or climax is irrelevant; there is no middle, beginning, and end. Consciousness is not so much rational as multisensual—full of smells, sights, symbols. Words are full of images, double or triple meanings, from the context of culture, of the individual. This does not seem too far removed from present-day explorations by the contemporary artist of textures, symbols, references, involvements, etc.

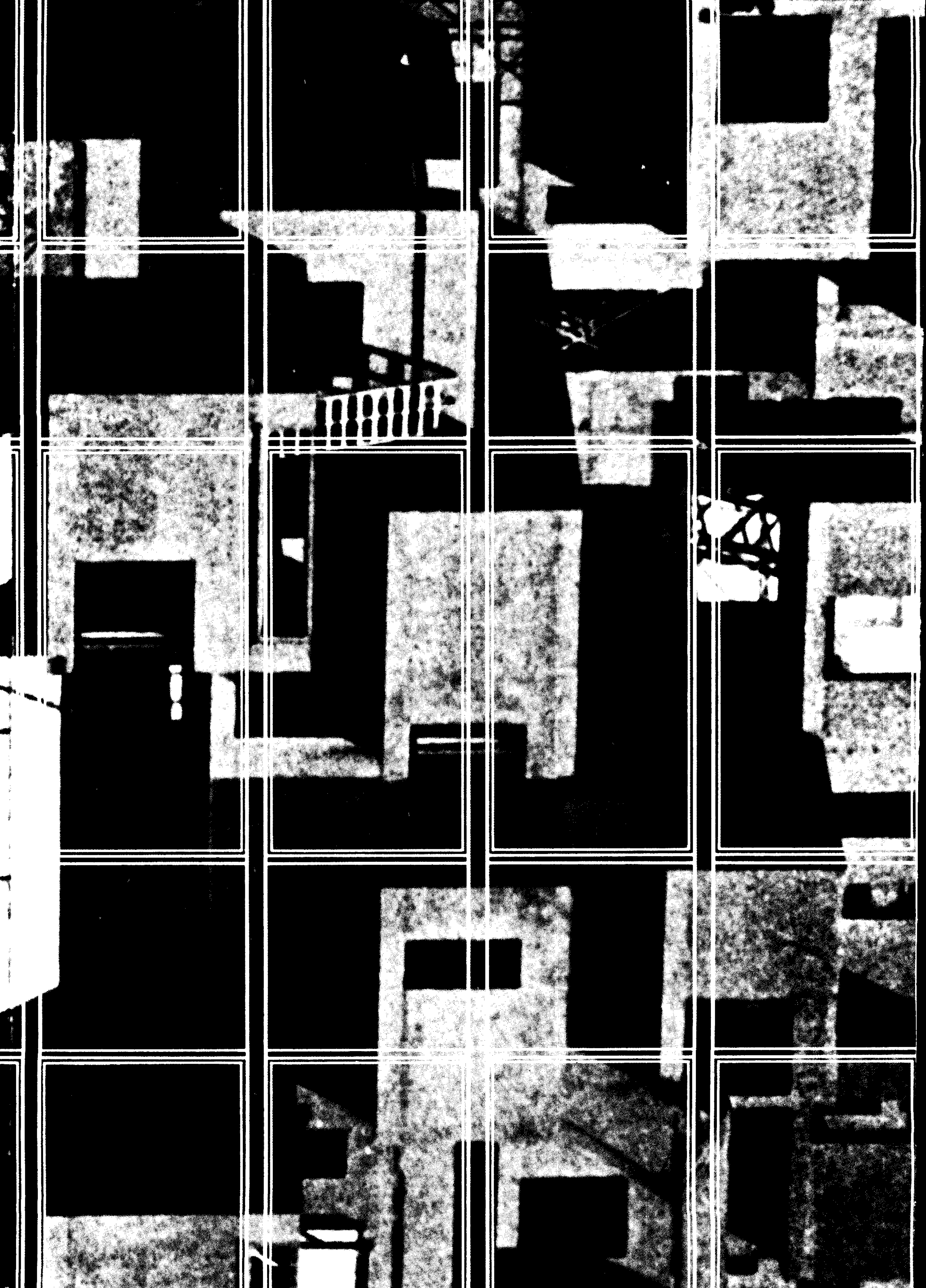
McLuhan's Media-Message

Marshall McLuhan, the media expert, attributes the change in contemporary consciousness to TV. "Our own first TV generation is rapidly losing this habit of visual perspective as a sensory



modality, and along with this change comes an interest in words, not as visually uniform and continuous, but as unique words in depth. Hence the craze for puns and word play." For McLuhan, print is like perspective space—it leads progressively from one point to another in an additive, cumulative, climactic way. Whether or not this is true (James Joyce, for one, overcame it), it is interesting that he thinks of it in these terms. McLuhan would also have it that the new sensuousness, the new need for immediacy, is in great part attributable to the new electronic medium: "The TV image requires each instant that we 'close' the spaces in the mesh by a convulsive sensuous participation that is profoundly kinetic and tactile, because tactility is the interplay of the senses, rather than the isolated contact of skin and object." Where he does seem to hit the nail on the head, for the right reasons, is when he points out that TV is a close-up medium: By the very nature of the media image, we have very direct and intimate contact with the subject.





Again for McLuhan, the social revolution—the shift from mechanization to automation—is explained in familiar metaphors. Mechanization involved linear perspective, specialization, exclusiveness, segregation. With the computer comes implosion, synthesis, the world falls back together again.

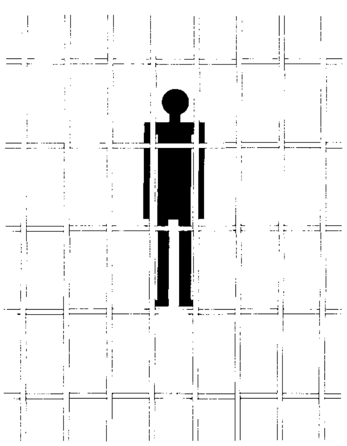
The sociologist and society in general seem to be coming around to the same philosophical viewpoint. Work for centuries has been the focus of man's life, with retirement as the pot of gold at the end of the road and with a corresponding lack of knowledge of what to do with it. Now, when automation is changing the entire character of work, many people may not **have** to work and they are going to have to discover a way of enjoying **being.** This may involve a reintegration of the senses, a reintegration of functions, a sort of multiple simultaneous involvement in the process of living, rather than the long-range suspension of some functions in the pursuit of a distant goal.

Architecture Begins the Search

Until recent years, architecture has been based on the systems of values and techniques nurtured in the last years of the 19th Century and the first three decades of this century. In the last few years, however, it has become increasingly obvious that a change in attitude has begun to take place similar to that in the other disciplines and arts.

Perhaps the profession, contemplating the fruits of its efforts in the 1940's and 1950's, realized a need for a change, just as many artists turned away from abstract-expressionism. At any rate, there has come of late an increased interest in sensual values, of the "sense of place," of architecture being part of the environmental process.

The belief of many architectural leaders of the first half of this century in some sort of "universal solution" was perhaps best summed up in remarks made by Mies van der Rohe in 1924:



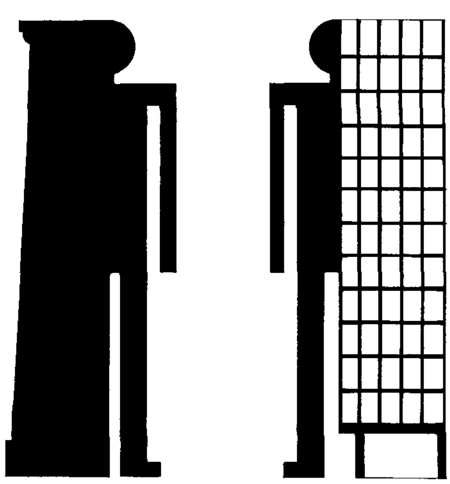
"I consider the industrialization of building methods the key problem of the day for architects and builders. Once we succeed in this, our social, economic, technical and even artistic problems will be easy to solve. . . .

"We are concerned with questions of a general nature. The individual is losing significance; his destiny is no longer what interests us."

There were those who did not follow this creed, needless to say—Wright for one. But it—or its more commercialized translations—carried the day in architecture for decades. In its belief in a universal solution, it is very close to the old concept of morality, with a universal code applicable to all situations. It was an ideal form in the Platonic sense: self-contained, abstract, and basically immutable.

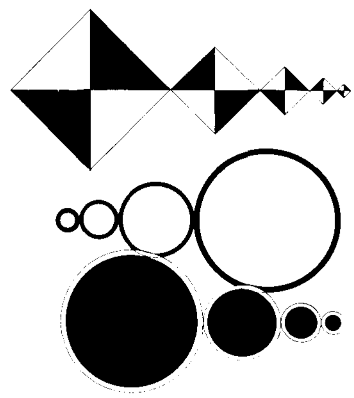
It requires very little observation to see that the commercial applications of Mies's quoted dicta still predominate in structures being built today. But recently, some architects have set forth on a different route. Instead of considering themselves "idealists" in the accepted sense, they think of themselves as "phenomenologists." The lessons of reasonable order and efficiency have not been laid aside by these men, but they have begun to concern themselves with the particular place and time of their buildings; with their contexts, the psychological effects of their functions and spaces. Like other artists, and perhaps like some scientists, they are beginning to find inspiration not in preconceived ideal concepts such as "office," "house," "school," and so forth, but are sparked into creativity by the particulars of each situation, including the time and place of creation and use, the permanence or impermanence of the building—all or in part, the fragmentation of forms and spaces, and the entire reaction and counter-reaction of the building and the environment. According to the new physics, the only reality lies in a particular thing in a particular time and in a particular place. The process of locating this "point" is similar to the new mathematics: Order is a simultaneous equation satisfying numerous differentials, at a common place in space. So it may be with the "new" architecture. In a recent issue of **Landscape,** Georges Matoré wrote,

"Modern man thinks of himself in terms of his situation: he strives to escape the absurd by means of rediscovering some order, genuine or fictitious. For a way of thinking which rejects both routine and chaos, will seek to determine the place occupied by things if they are to have meaning. The French philosopher Gabriel Marcel remarks: 'An individual is not distinct from his place, he **is** that place.' "



This emphasis on **place** has to do with a quickened interest in being part of a dynamic, changing process, of designing from the standpoint of natural and social ecology with their continuous mutability. "Everything is in a state of metamorphosis. Thou thyself art in everlasting change and in corruption to correspond; so is the whole universe." That was Marcus Aurelius in his **Meditations** about 1800 years ago.

The view of some that the building might be part of a changing process is illustrated by the fact that a few architects have begun thinking of differentiation between parts of a structure which are liable to change and those that might be relatively permanent. In such a situation, a



building will not only have a kinetic relationship with its surroundings, but with itself also. It cannot merely be an object to look at, but a part of the environment that causes things, reactions, to happen. If this last statement occasions murmurs of "Frank Lloyd Wright," it is worth noting that many of Wright's ideas of place and environment are finding greater currency today.

Imagery and Allusion

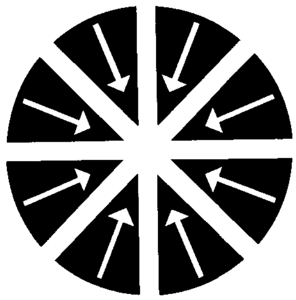
Like much of current art, a recent trend in architecture has been concerned with imagery, symbolism, and allusion. This may be, as McLuhan puts it, "an emphasis on the here and now," although there is also an element of reference to what might be called folk objects or forms in the work of an architect like Robert Venturi that differentiates it from the obvious symbolism of Saarinen's bird-terminals and neo-Gothic colleges. It is in quite startling contrast to much of the "rational" architecture of the past 40 years.

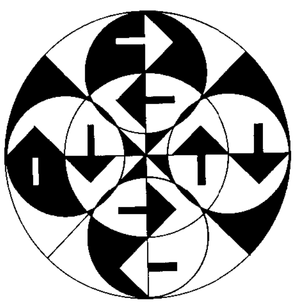
Architects who have designed in these allusive terms so far have found that some aspects can be peripheral, dealing with a passing reference, an aside, a footnote, a throw-away line. This can give it a considerable diversity. Some architects, like John Johansen of New Canaan, Conn., feel that contemporary symbols might be found in the computer, the plug-in, or the discard-this-part, keep-this-part aspect of the trend.

Architect Victor Christ-Janer feels that the allusiveness and cross-references of many arts and sciences can be transmogrified into architecture, that a building can be an exercise like a Robert Motherwell painting, or an evocation of the McLuhan medium-proposition, or maybe both at the same time.

Fragmentation and Sensuality

Much of architecture recently, like the other arts, has returned to a dynamic, tactile, sensual expressionism. If much of it is sheer exuberance at the decision to throw off the "universal envelope," it nevertheless seems to be more





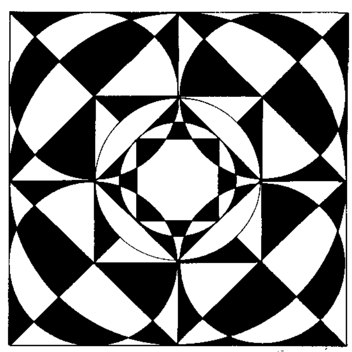
solidly thought out and felt as architecture than the "New Sensualism" of a decade ago, which delighted in fluttery shapes and folded-plate roofs and was essentially cosmetic. The fragmentation of form, shape, and space that many are investigating has to do with the immediate experiencing of architecture: Most of the surfaces and textures invite tactile, instantaneous experience and touch. Our old friend McLuhan wrote: "After centuries of being fully clad and of being contained in uniform visual space, the electric age ushers us into a world in which we live and breathe and listen with the entire epidermis. Of course, there is much zest of novelty in the cult, and the eventual equilibrium among the senses will slough off a good deal of the new ritual, in both clothing and in housing. Meantime, in both new attire and new dwellings, our unified sensibility cavorts amidst a wide range of awareness of materials and colors which makes ours one of the greatest ages of music, poetry, painting, and architecture alike."

Strong words? Perhaps. A bit too wide-ranging, too generalized? Certainly. It is obvious, however, that the architecture of at least the near future will probably be one that will seek an immediacy with both its users (experiencers) and environment (urban extensions) that will be forming a deeper involvement than the more cerebral design of past years.

An Architectural Revolution

At this writing, despite the harbingers of architectural change described above, there is not right now a movement of large enough dimensions to be called a "revolution in architecture," in the sense we have documented social, scientific, sensory, and technological changes elsewhere in this issue. But taking those changes and applying them to the constantly expanding consciousness of an increasingly "open-ended" group of architects, one can see that the future for architecture and planning—or whatever they may be called decades hence—will indeed be different. We can see that the effects of new scientific discoveries, varieties of existentialist thought, "McLuhanism," and heightened forms of social responsibility are at work today.

To repeat the tired cliché that the future belongs to the young does not invalidate it. This magazine has noted before (EDITORIAL, AUGUST 1966 P/A) the encouraging attitude of many young people today toward accepting and enjoying influences and stimuli that their buttoned-up elders view with a shudder. It is easy to imagine this portion of the younger generation being more open-ended about their architecture and environments. Of course, in contrast to this "live" youth, there are other groups that will have some effect in coming years. It is dismal to contemplate the architect who might emerge from the ranks of teen-agers who stone nonviolent demonstrators or rally to the banner of a neo-Nazi organization. It is difficult, but hopefully not impossible in future years, to conceive of architects and planners who might come from the ranks of today's socially and economically underprivileged. Certainly they will have an enormous amount to contribute in terms of personal experience, as have their elders in the literary field, such as Ralph Ellison and James Baldwin. But under the surface of these three groups, the "live," the "dead," and the "depressed," there probably lies a far larger one (as it always does in any age or social stratum)—the "indifferent." Whether the kids who just-don't-care can stay that way much longer in such fast-moving days is doubtful. If some of them plan to be architects or "environmentalists" or "phenomenologists" in the future, they will presumably have to be alert to and respond to more influences and responsibilities in stronger ways than did their fathers.



The increasing interest in the impact of space and light and tactile qualities on the individual sensibility and the attention to his varying needs at different times will probably continue. Wright and Corbusier, of course, were the precursors of many elements of this kind of thinking. Recently Kahn, Rudolph, Venturi, Moore, and other younger men have been exploring the potentialities further. One postulation about the future that could be made would be that this search will take on much huger dimensions, encompassing large neighborhoods, whole cities. Indeed, there are a few who are thinking along these lines right now, without, so far, many actual opportunities to put their aims into practice.

As architecture changes, so too will its tools. Computer technology is already with us, but undoubtedly in only its most primitive forms. When the architect and planner learn to use its potentialities creatively, a great realm of design possibilities will inevitably open. As we have said, the coming interprofessional and interdisciplinary dialogues will affect architecture and planning so profoundly that their precise state, in, say, 2066, cannot be put down in words on this page. It has been said that the future comes at us with increasing rapidity with every new discovery and every changing attitude of man. This is true in our field also, so that, while 2066 is still one hundred years away, its beginnings are **now,** some of them noted in this issue, and architecture is never going to be the same again.

At the beginning of this discussion on the future, we suggested that architects—and others in related fields—should adopt an attitude of "informed open-mindedness" about these developments, because we seem to have entered a period when man cannot any longer operate by a closed, exclusive, cautionary, minutely codified set of precepts, be they professional, social, scientific, or technological; instead, we are in an open-ended age, as many of the examples in the previous pages illustrate. The facts and guidelines we have set forth in this issue are presented, therefore, for what they are worth: for your information and possible assistance toward your "informed open-mindedness." In a way, our study symbolizes the new need to experience and examine all aspects of life all the time.

We at P/A believe that the period leading toward the third millenium could become the most exciting and important time designers of the human environment will ever have experienced. We look forward to it with anticipation. ■

FRAGMENTING THE CLASSICS

Those amongst you who can remember back past Petula Clark and Herman's Hermits might recall listening to Glenn Miller's weeknight 15-minute broadcasts during which he usually took an older composition (Verdi's "Anvil Chorus," von Suppé's "Light Cavalry" overture) and re-arranged it to produce a typically swingy *Mil*ler piece.

Samuel E. Gallo is a New York sculptor who has been doing somewhat the same thing with classical sculpture. He buys a good commercial reproduction of, say, the Venus de Milo, makes his own casts of it, then saws it into pieces and reforms it into fascinatingly faceted fragmentations of the original. His latest versions of this technique, the Venus and one using a classic head of Zeus, adorn the walls of the Trahey and the Fenga & Berkovitz advertising agencies in Manhattan, respectively.

Gallo's interest in using fragmented casts of objects to produce other objects as sculpture began when he was commissioned to produce sculpture walls and panels for the U.S. Gypsum Building, Chicago, in 1963. There he based his design on casts of tools, machine parts, and laboratory equipment used by the company. Later on, he did some of the windows in the notable series of fine displays at Tiffany & Company: in two window displays he applied the technique to the form of a light bulb; and in one Christmas window he used a Gerard David choir screen. He also reworked cheap busts of Mozart to produce an album cover.

The classical cast in Gallo's work is used as an *objet trouvé* or raw material just like stone or metal. The constructions become not simply forms of the material the artist is handling, but artifacts loaded with "a great variety of associations" produced by the original sculpture itself; stylistic, design, and even architectural allusions might be felt. The Venus and Zeus pieces evoked in this observer a memory of some of Wright's decoration, the explorations of some of the Cubists (particularly Braque), and even the sound of Glenn Miller broadcasts past. Gallo himself thinks of the lushness of the Spanish and Mexican baroque, and is currently working on a sculpture using the Zeus heads to create a "Mayan" effect.

The technique, which technically uses polyester resin reinforced with glass-fibers, "sets up some very interesting aesthetic tensions," the sculptor says. "On the one hand you are destroying a classical form—desecrating it, suppressing its volumes, refocusing emphasis, repeating parts of it many times. But, at the same time, in bringing the pieces together in new relationships, you are also forcing on the viewer a fresh confrontation with a work which was already stale and overly familiar to him as a child."

This is an area that some younger architects are presently investigating: taking forms, shapes, or ideas from the body of our architectural and art heritage and reworking them into something that is *of* today but has a tantalizing allusiveness about it that makes the viewer take another, longer look. It is most interesting to see such a search taking place in both fields at the same time.—JTB

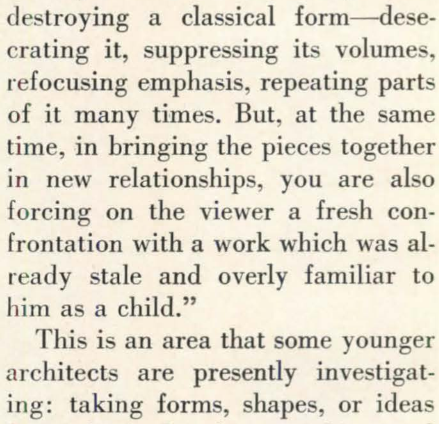
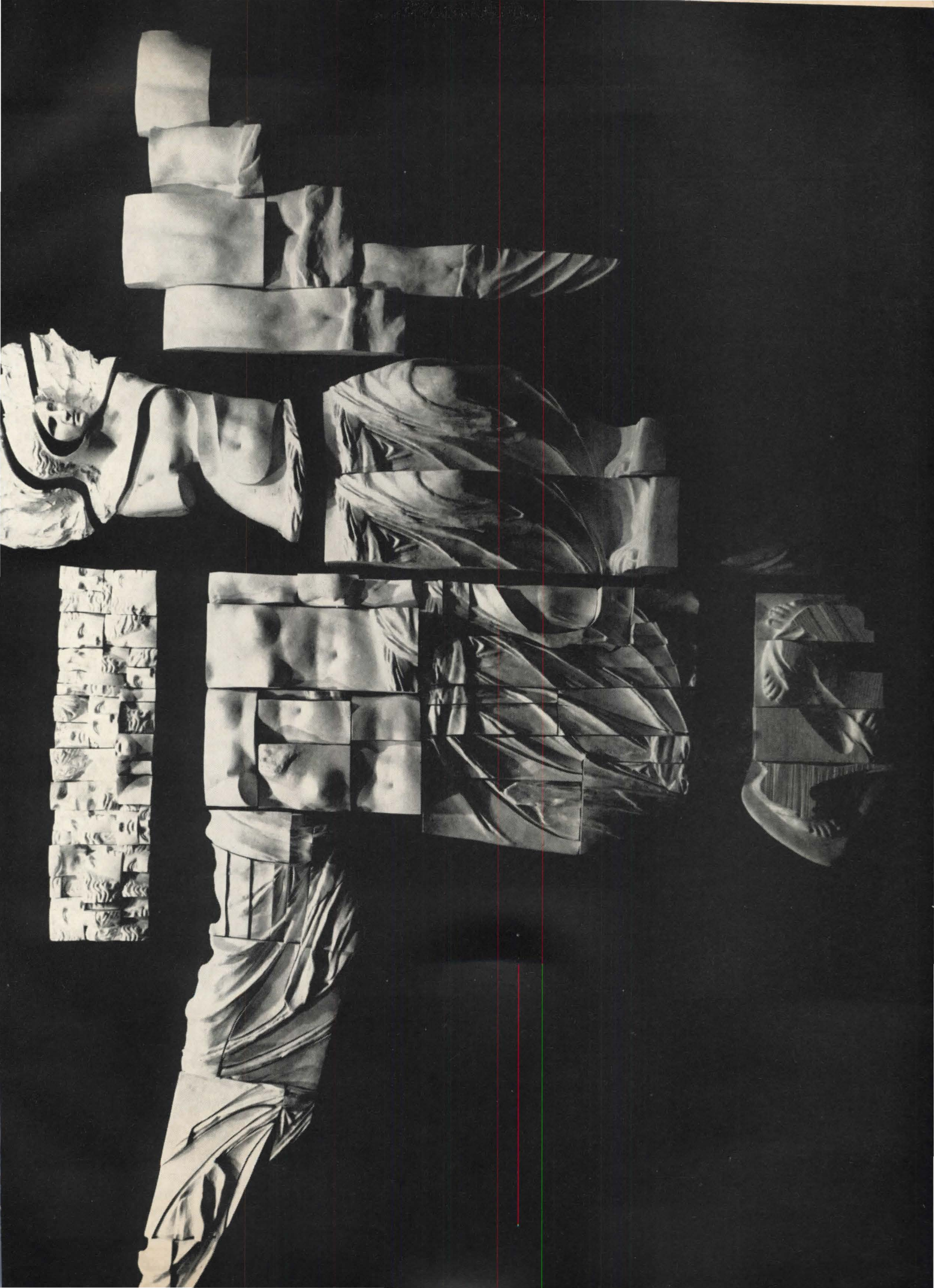


Photo: Lucille McCabe



MONEGASQUE HANGING GARDENS

Since 1964, an artificial peninsula has been under construction below the looming *Rocher* promontory, site of the palace of Prince Ranier III and Princess Grace of Monaco. The tiny (about 370 acres) principality has felt a great postwar need for expanded housing and other facilities, an uncomfortable state of affairs when you are completely surrounded by a big country, however friendly. There remained the sea for expansion, and the new peninsula will support structures to house between 12,000 and 20,000 resident and transient people. Fill material for the new land is held by a 1200-yd-long dam footed 135 ft below water level, said to be one of the deepest underwater dams in the world.

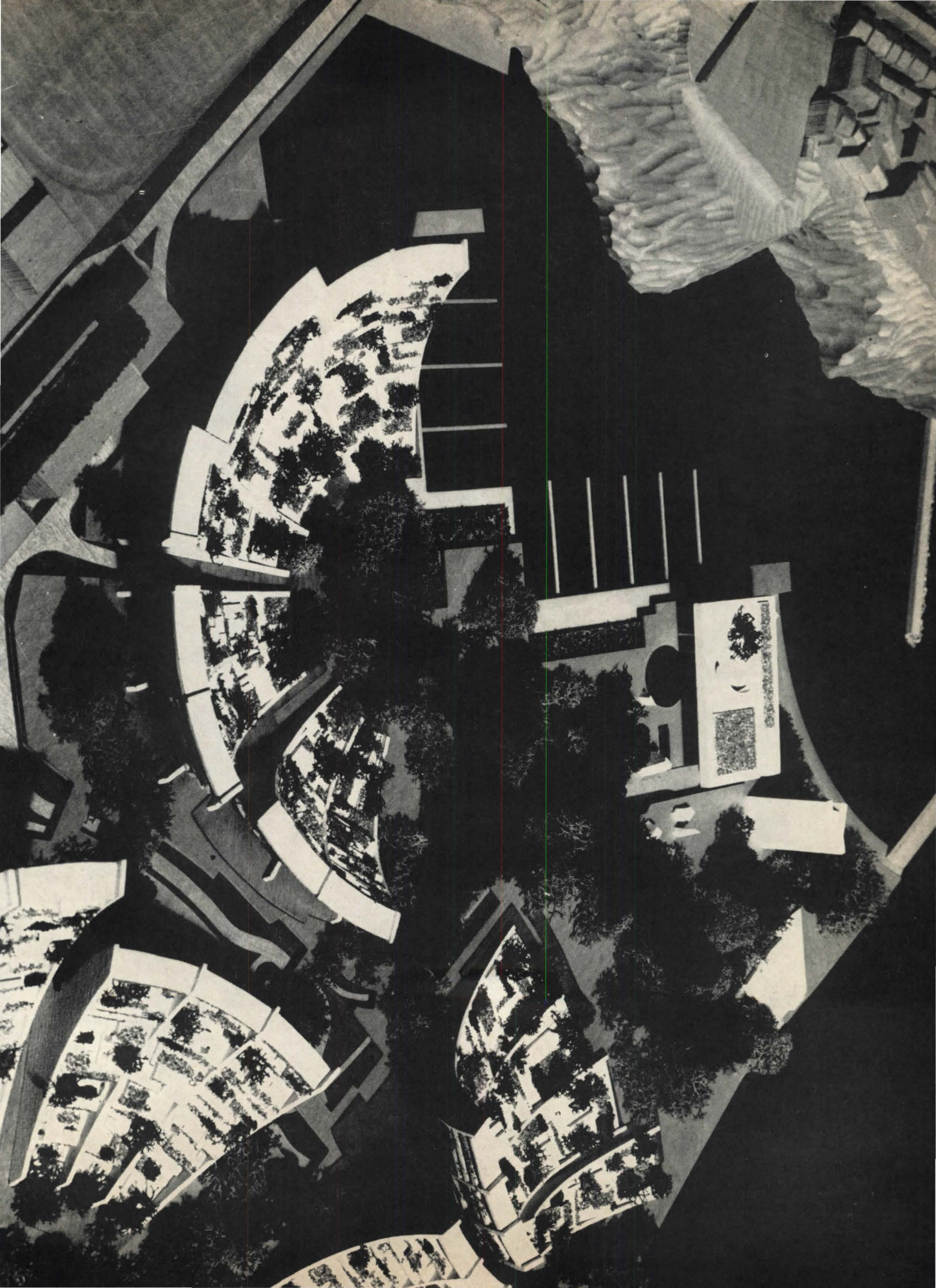
The design of the satellite town to rise from this man-made spit of land underwent a number of changes for five years until this version by Manfredi G. Nicoletti of Rome was approved by the Monegasque Government in August. It will take about six years to finish, following completion of the peninsula in 1969.

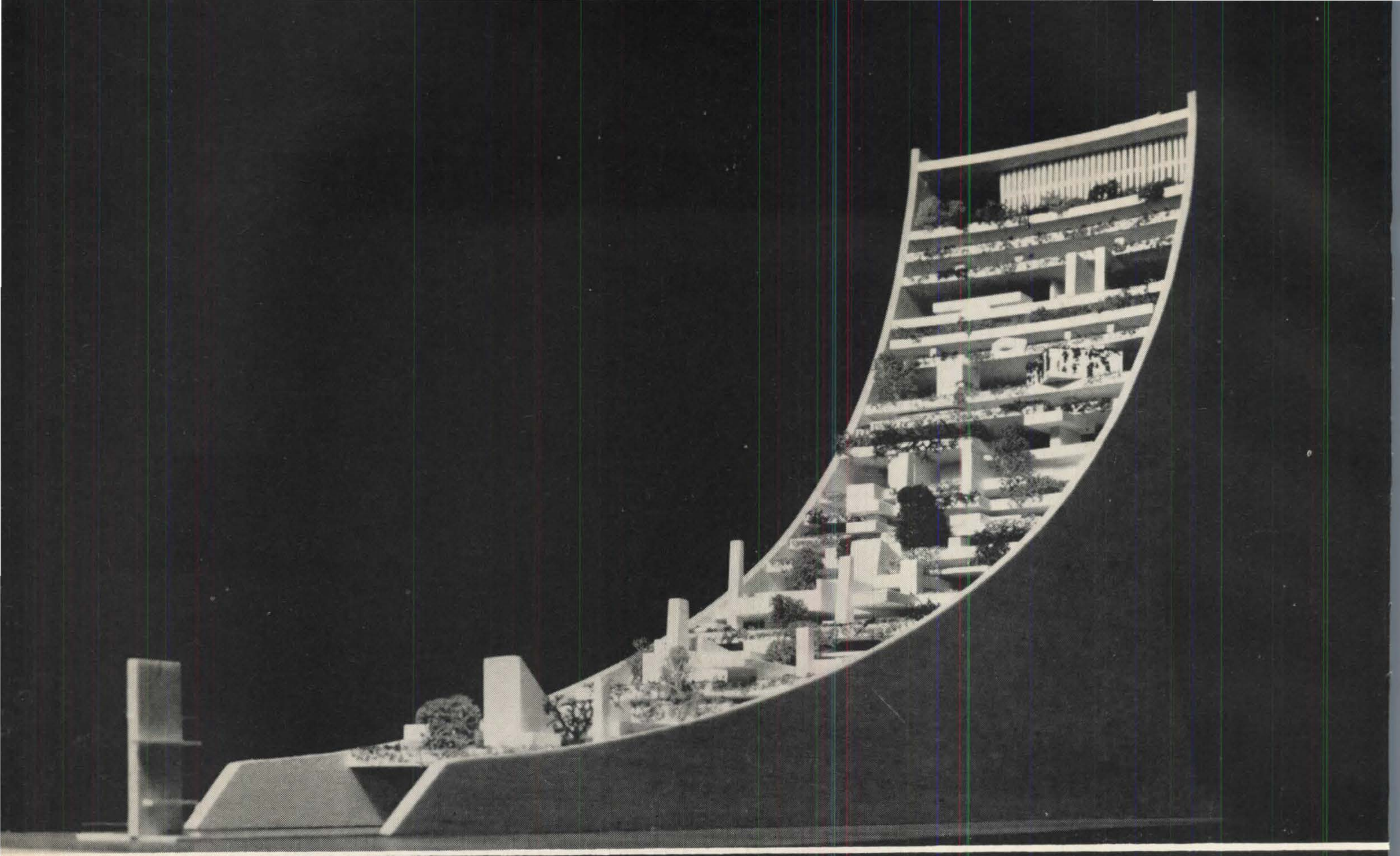
Basic elements of Nicoletti's plan are what he calls "artificial hills"—huge, amphitheater-like megastructures facing the Monegasque and French sides of the peninsula. Upper levels will be reserved for residential units and lower areas for commercial spaces. These structures will be produced by a "large building organization," in Nicoletti's words (the project is being financed by an Italo-French-Swiss group). The secondary structures — stores, shops, homes, apartments—will be individually designed and built, then plugged in to the megastructures. This flexibility of planning and design will, nevertheless, be subject to a certain measure of control concerning minimum amount of green areas, a set range of materials and building techniques, and the amount of useable floor space for varying functions (commercial, residential, hotels, etc.). What the architect terms a "programmatic return to nature" will leave as much open land at grade as possible, which is to be enhanced by the "hanging gardens" created by open green space on the amphitheater-structures as they terrace upward. The solution to the problem of creating a large urban area where there was none before has been solved quite interestingly by making man-made geology (the peninsula) and dominant forms (the "hills") the "control," and leaving the details of individual units to happen on their own when the satellite town begins to grow. To this observer, this seems a wise approach in providing a definite pre-plan of functional and volumetric spaces within which a great range of flexible design and planning can occur over a long period of time.

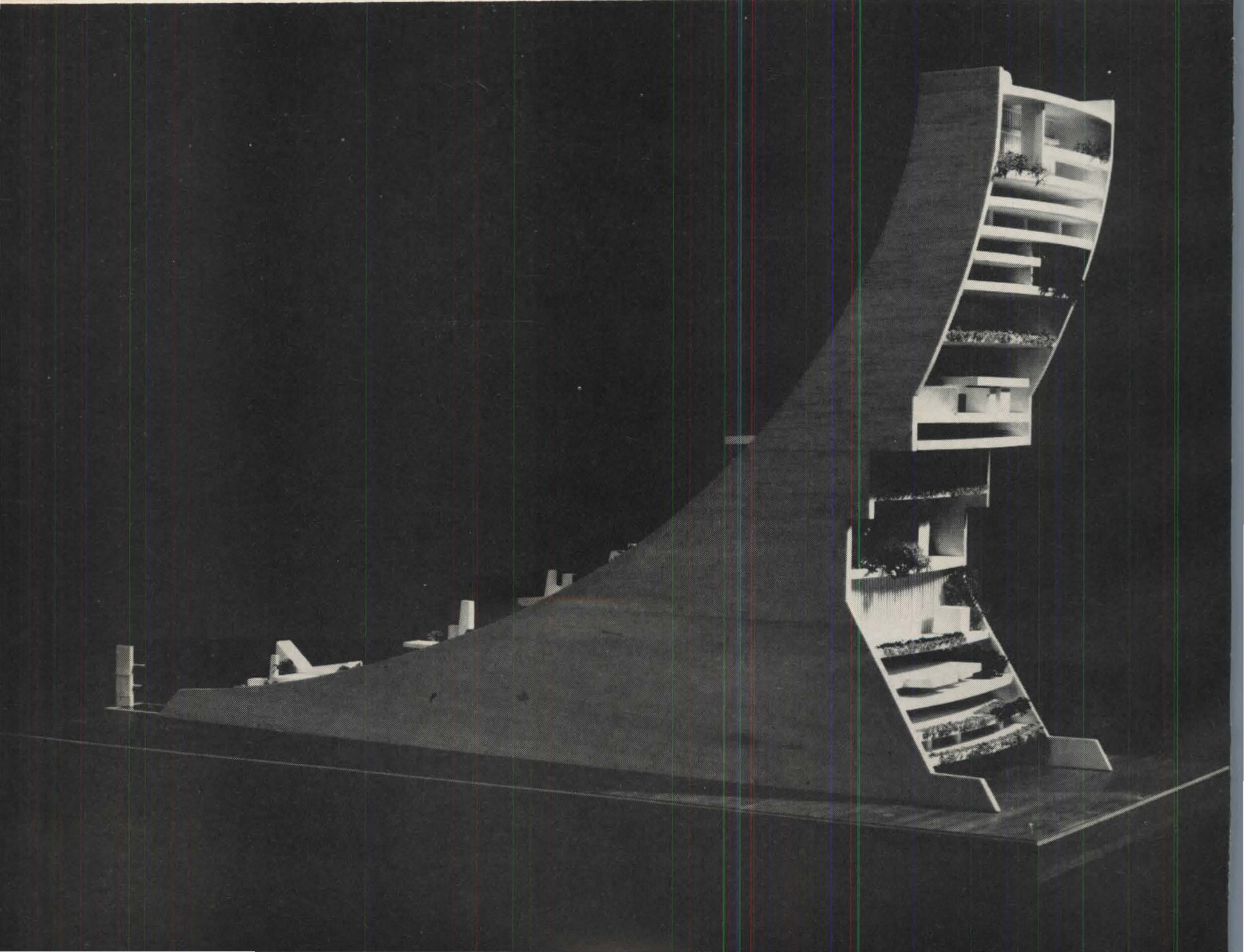
The traffic pattern reflects the architect's concern with keeping the inhabitants as close to nature as possible. Pedestrian traffic is established at 25 ft above sea level, and vehicular traffic occurs between this level and 7 ft above sea level. A two-way automotive spine feeds into the peninsula from the "mainland," servicing the new town and being lodged in two levels of underground parking for 10,000 cars.

Other uses of the newly created land will be: a commerce and light industry center where the peninsula joins Monaco; beaches and sports facilities on the French side; a Trade Center on the northeast side, at the edge of the dam; and a Cultural Center at the east side, below the Rocher. An "ecumenical" church is also suggested.

The elements of scale in this project have two aspects: the "macroscale" of the town itself in relation to its surroundings on the Côte d'Azur, and the "microscale" of human experience within the town itself. On the macroscale level, it can



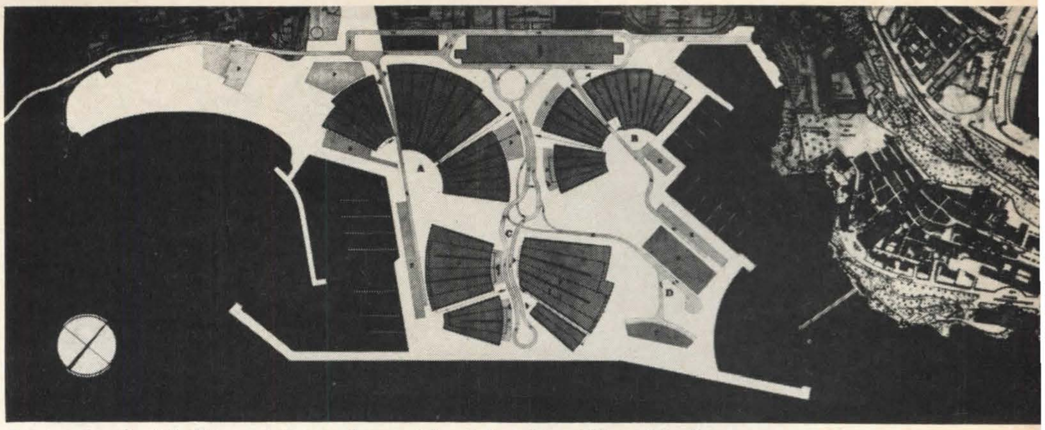




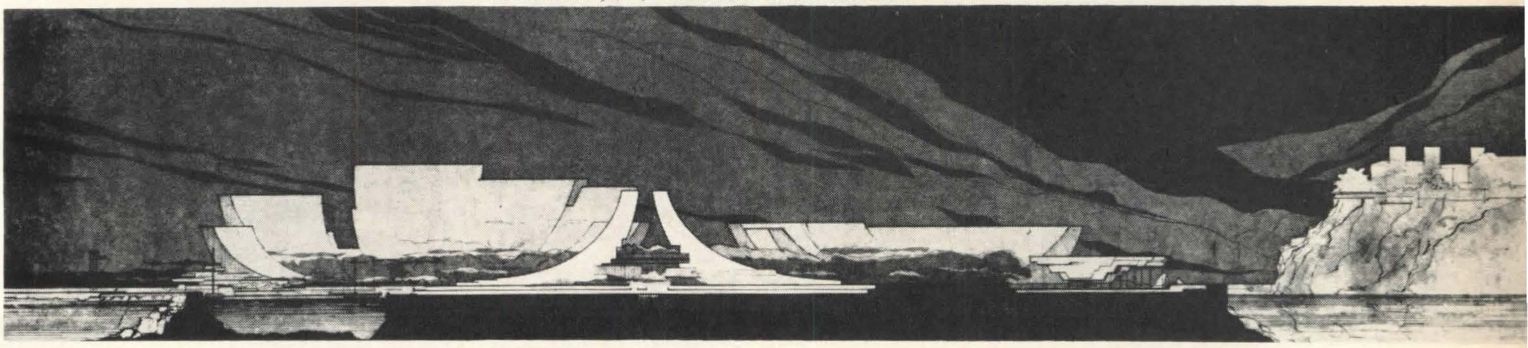
be seen as a complete entity that will combine with the shore, the *Rocher*, and the mountains behind to form a sympathetic composition as seen from speeding vehicles or from the sea. When the varied architecture of the individual units is inserted in the matrix of the major structures, the resemblence to a typical Mediterranean hill town will be obvious.

On the microscale, it is less possible to predict what the individual experiences of open and closed space will be. However, the architect has tried to provide the opportunity for variety and interest here. Nicoletti says the human scale "is enhanced by the great variation of urban spaces, by the many occasions of surprises and diversities, by the continuous interest awakened by the various 'happenings,' and, above all, by the possibility that each inhabitant has to give a personal contribution to the urban organization."

The kind of architecture and planning illustrated by this project and a few others (such as the Sunset Mountain Park project, which won the 1966 First Design Award; see pp. 120–127, JANUARY 1966 P/A), represents, it seems to this writer, a true advance toward the total "environmental" design that everyone is talking about but so few get a chance to do. While it is possible to disagree, as some will, with Nicoletti's forms and shapes (could they be pyramids facing both inland and to the sea, for instance?), the fundamental concept of creating a strong but permissive matrix in which a city can grow and its inhabitants express themselves is an important one —one we wish would gain wider currency in redevelopment agencies in this country.—JTB



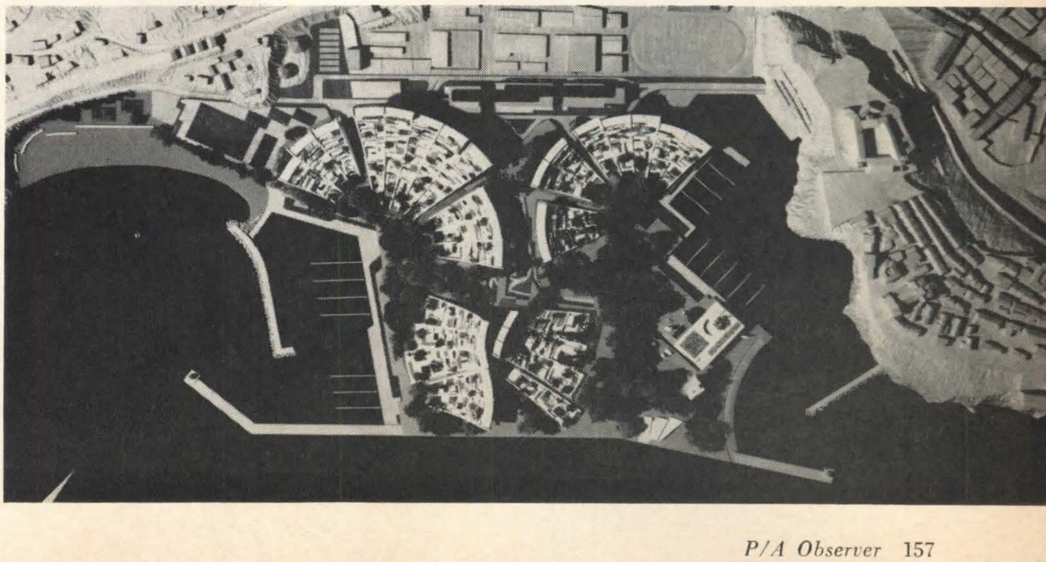
Lower level: (A, B) parking under residential units; (C) vehicular circulation; (D) beneath cultural center.



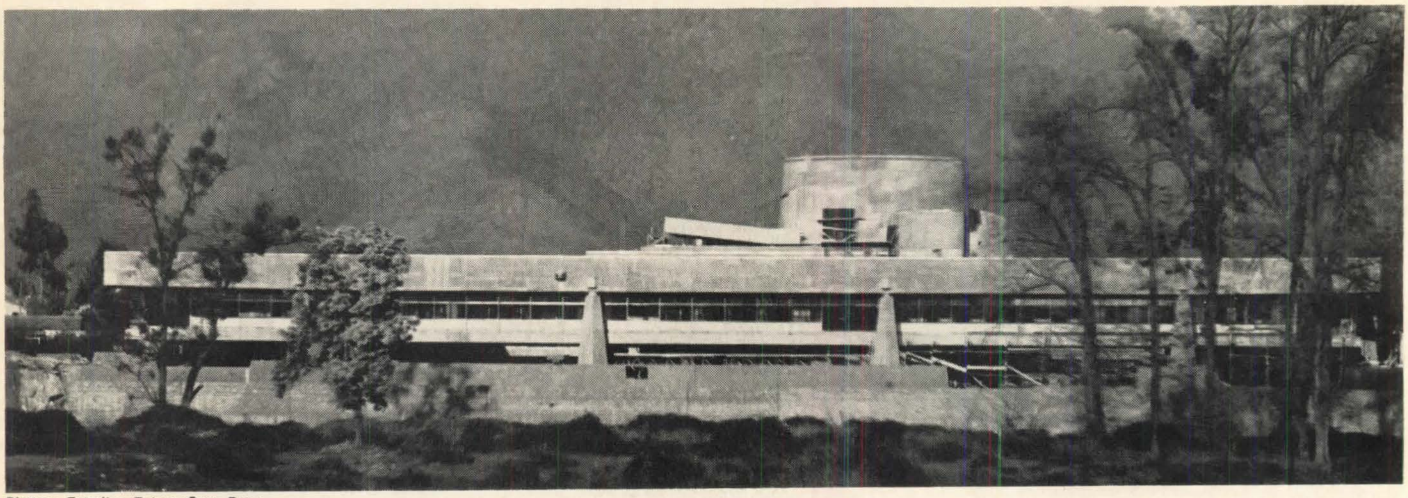
Section from sea.

Upper level plan showing development of open areas.

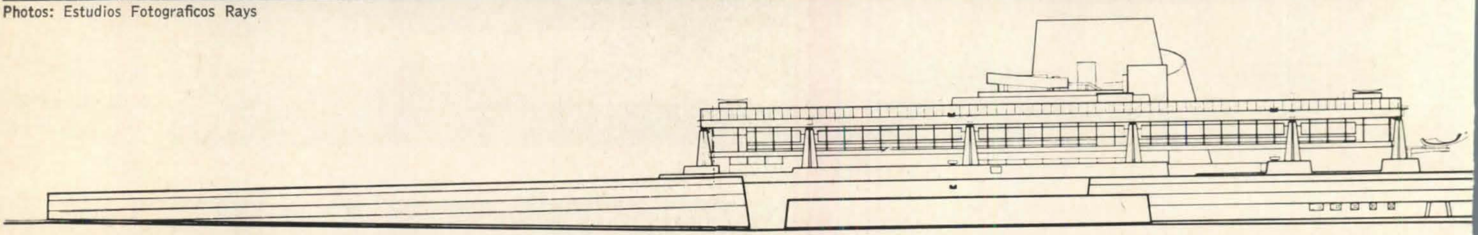
Site model showing relation to Rocher *and French beaches.*

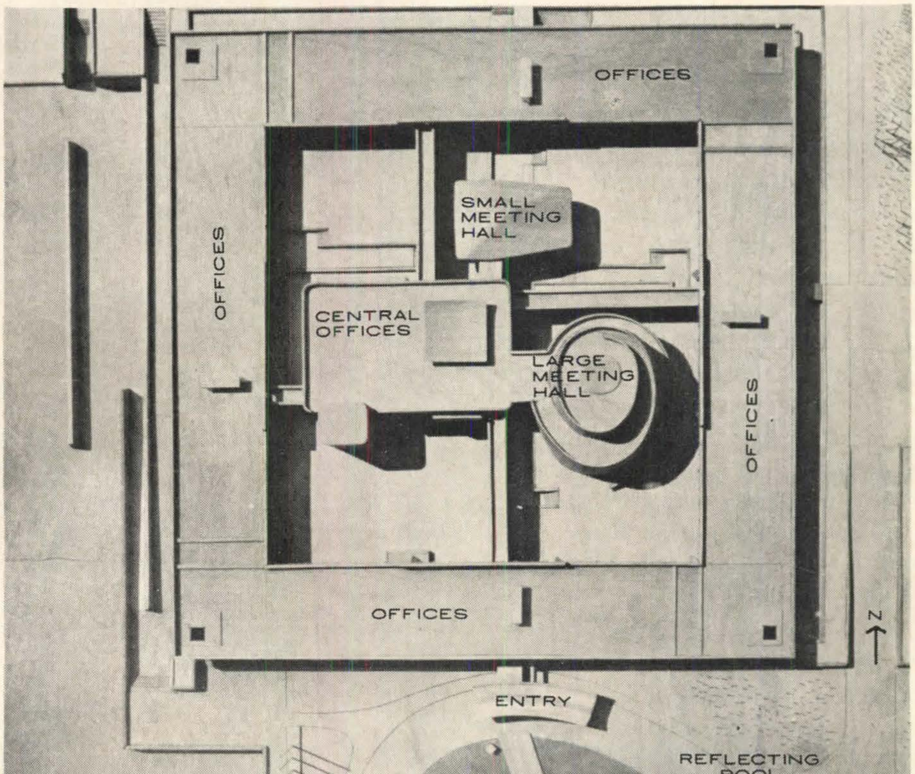


SANTIAGO CARACOL



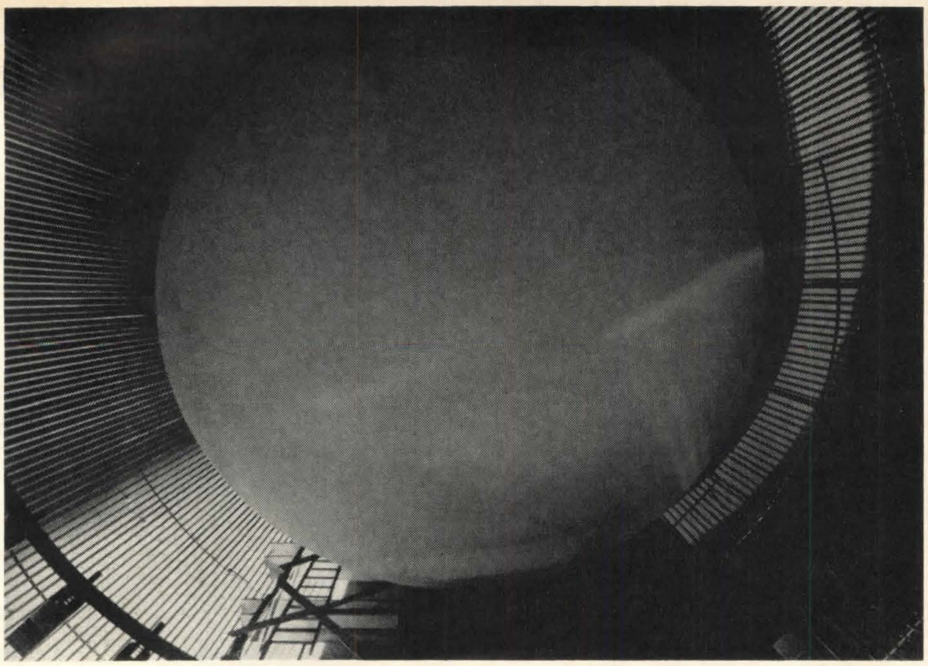
Photos: Estudios Fotograficos Rays

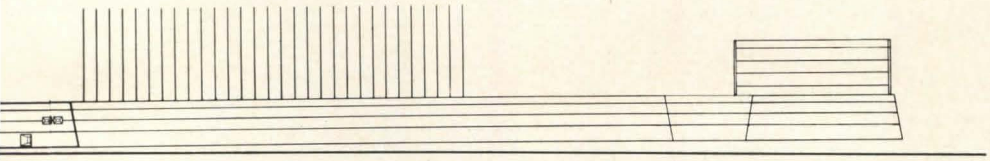


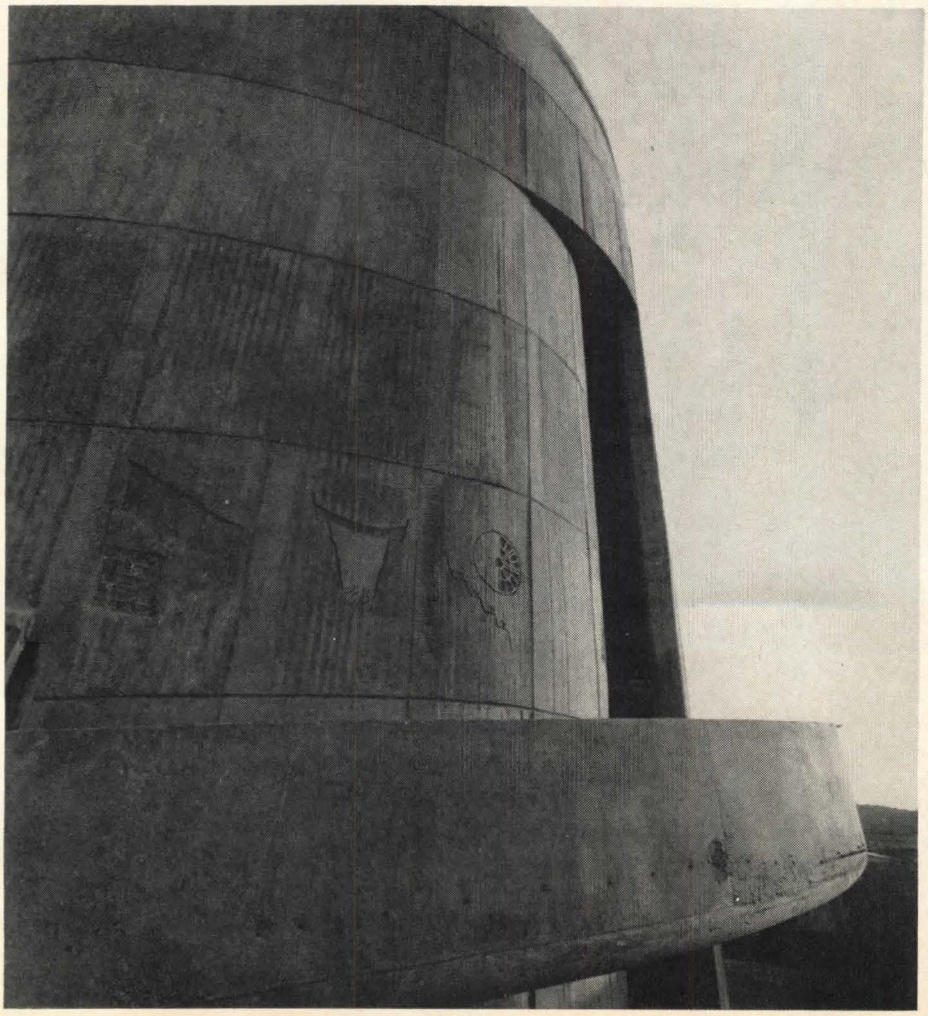


In 1960, an open competition was held for the design of a building to house the headquarters of the United Nations' Economic Commission for Latin America (ECLA) and other regional offices of the world organization. Winner was Emilio Duhart H. of Santiago de Chile, the capital in which the building was to be located. This past September, the completed U.N. building was dedicated by Secretary General U Thant.

The building is another in the generally impressive line of South American buildings that have reflected the influence of Le Corbusier since the Ministry of Education Building in Rio in the late 1930's. It is a long, low, concrete-structured hollow square housing organizational offices and, in its center court, a main conference chamber, a smaller conference room, and a central building. The architect says that the long horizontal silhouette of the building reflects "Chile's architectural tradition and the flat plain of the central valley" where it is located, whereas the spiraling mass of the main conference structure reflects the soaring Andes range that forms an awesome backdrop for the building. Landscap-





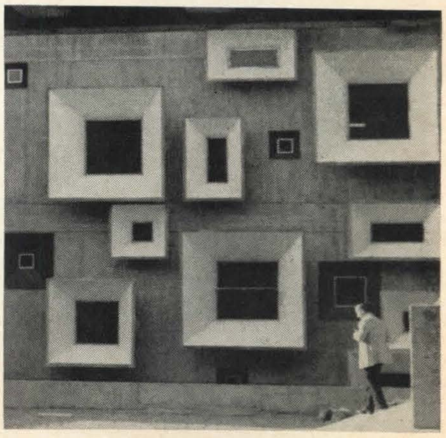


ing, which has been donated by Brazil, is to go forward under the direction of the noted Brazilian landscape architect Roberto Burle-Marx. It has been designed, according to the architect, to provide "a sort of fifth facade clearly visible from the neighboring hills and from aircraft landing at the airport nearby."

Structure is reinforced concrete with perimeter pillars carrying large beams with continuous-edge girders cantilevered at the corners and standard cross-beams of prestressed concrete incorporated with continuous slabs. Upper structure is supported on the massive pillars by articulated joints.

To persons approaching it, the building is seen over a large reflecting pool, which also serves the cooling system. A large sculptural entrance canopy leads under the overhanging upper offices floor. Within the office square, various open areas define themselves between the central structures. Dominant over all is the "Caracol," or main conference chamber, its sides slit by two "gills" admitting light into the interior and its outer walls incised with bas-reliefs dealing with "American Cultures." Within the chamber, a circular movable ceiling of molded glass fiber is used to adjust the acoustics and space of the room as its uses change. The "moon," as its architect calls it, is also used to reflect light into the space.

The entire complex of the Santiago United Nations building seems, from these views, a rather noble and impressive concept; one marred here and there, however, by undigested Chandigarhisms such as the "breeze intakes" in the southwest patio.



the haus of the bauhaus reconsidered

On the birthday of Gropius' Dessau buildings of 1926, some reflections on 40 years of myth and counter-myth about "the" Bauhaus.

By Jane Fiske McCullough, former Editor of Industrial Design *magazine, who is currently at work on a study of the educational ideas of the Bauhaus and their later influence.*

December 4, 1926, Dessau, Germany: A brisk, busy day for the staff and students of the design school known as the *Bauhaus*, a day of double celebration. The sixtieth birthday of the painter Wassily Kandinsky, one of the school's "masters of form." And the first day of dedication ceremonies for the school's shining new home, designed by Director Walter Gropius. Typically, *Bauhäusler* were working together on a festival that would be a suitably avant-garde cultural event. There was to be an outdoor banquet, a design exhibition, experimental films, "total" theater performances directed by fête-master Oscar Schlemmer, tours of the building, and a welcoming speech by the Prussian Minister of Culture. And, of course, an exuberant evening costume ball.

The object of celebration, architecturally speaking, was a building of glass, ferro-concrete, and stuccoed brick, containing teaching facilities for some 200 students, as well as a wing for Dessau's building-trades institute (*Berufschule*). From opening day, the building was widely admired—"an imposing document of contemporary artistic conception," in the words of one German critic, "whose layout is magnificent and convincing." Within two years, it

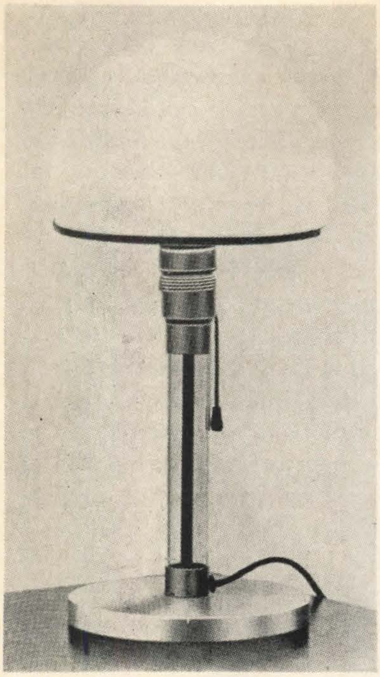
Albers Scheper Muche Moholy-Nagy Bayer Schmidt Gropius

was documented as one of the harbingers of a new architecture, and shortly assumed the role of a "masterpiece." In the architectural histories from Hitchcock (1928) to Banham (1960), few buildings of our time have been so continuously and reverently written about.

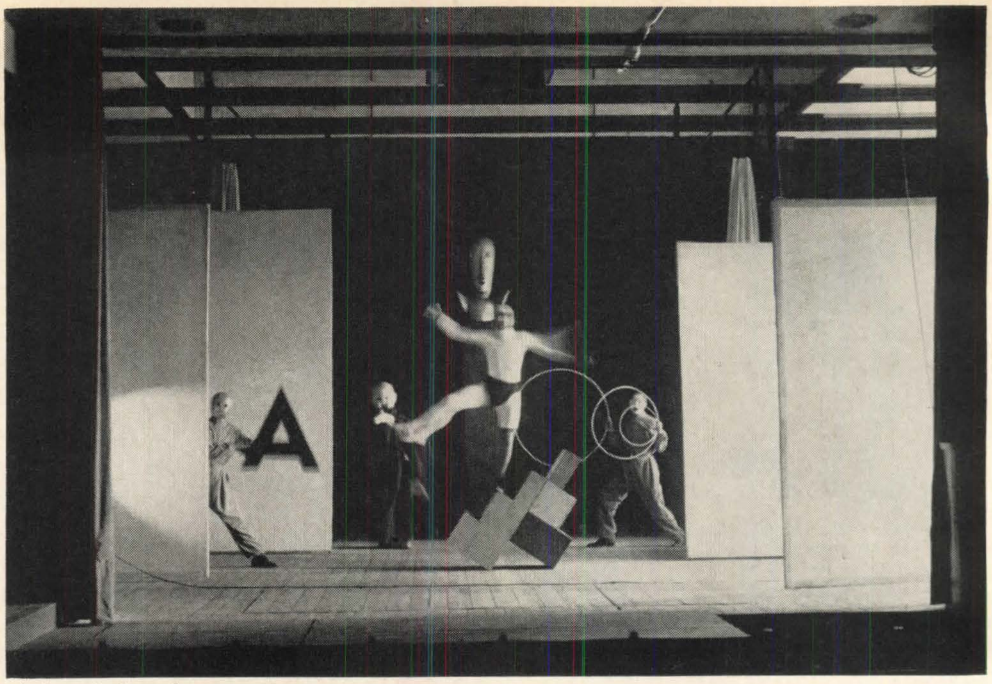
Over the same 40-year period, the physical structure fell from its pristine grace to a state of abuse and destruction during the war, followed by irreverent and grotesque bricking up of walls and windows. Now, the East German government has started a painstaking program of restoration, which will revive Dessau's claim on a major period in German culture and—even empty of student life—a monument of world renown.

Yet, in the same 40 years, else-

Breuer Kandinsky Klee Feininger Stoelzl Schlemmer



Jucker and Wagenfeld: lamp.



A theatrical performance.

where, the name "Bauhaus" has emerged as a kind of two-pronged myth. Offsetting the myth of omnipotence—the Bauhaus as a creative umbrella covering everything valid in the design of our time—there is the Mephistophelean counter-myth that prevails among younger designers and critics today, blaming the Bauhaus (or Gropius) for all the current failures of design *and* of education. Hardly a design conference these days escapes a few pronouncements using "Bauhaus" as a pejorative if not a swear word.

Why this continuing obsession with "Bauhaus—Black or White?" Are we caught in a fruitless Oedipus complex, trying to validate our own identities by altering the evidence of our paternity? Such vigorous struggles to improve the past through opposition, which are, of course, historically inevitable, are likely in the long run to require *building on*, not breaking with, what went before. Perhaps our time has come for reconciliation with immediate history—time to evaluate, select, and move on (like all adolescents) to self-accepting maturity. For that, we must know more than mythology about our specific Bauhaus heritage.

In any event, the question of what the Bauhaus *was* is bothering a lot of people these days. A rash of new writings is breaking out both here and abroad, which, hopefully, could bring us closer to the real, if intricate, story line. It is not a story of philosophical abstractions but of restless, hopeful people, casting about for ways to rebuild their world out of the rubble of defeat. In its metaphoric leaps and its drive for unifying ideologies to heal the rift between science and art, world and spirit, artist and society, it is a particularly German story. It can be understood only in the light of traditions and conditions in postwar Germany, which, it seems, are virtually unknown to a new generation of Americans whose sense of history *begins* only after the little man from Munich shut down the school in 1933.

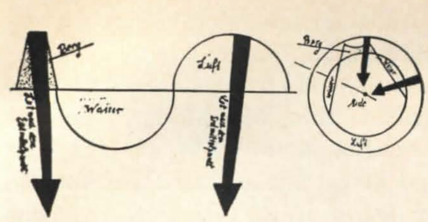
As the Bauhaus debate continues on this side of the Atlantic, it is also well to remember that words do not travel well through time and space; yesterday's European "functionalism" may read as today's "formalism" through American eyes. The Bauhaus might be called a "trimultaneous" event—building, school, cultural movement—and each facet has to be looked at for what it *was* and what it *did* in the 1920's, not what we now wish it had been.

In the Bauhaus, Many Mansions

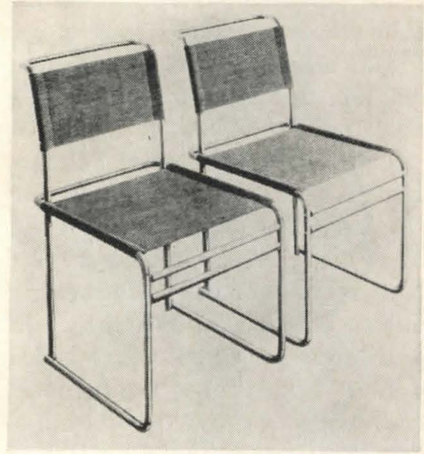
In the minds of each former student (close to 1200 in 14 years), *the* Bauhaus is no doubt the school as he knew it, whether that was in unsettled 1919 or in unsettling 1929. In the collective memory of history, *the* Bauhaus has been focused into a clear portrait of the fertile middle years after the new building opened, bringing with it an enlarged, unified staff, a more ambitious program and a new position of leadership.

On the record, though, the Bauhaus looks not like one school but like five. Three of them, under Gropius (1919-1928) were phases in a changing perspective on what such a school might be; two, under Hannes Meyer (1929-1930) and Mies van der Rohe (1930-1933) were abruptly different in attitude and outlook. Each phase is significant in understanding that the school was not a unified event but a dynamic metamorphosis. Its years were all, in the best sense, formative years.

Thus in zeroing in on the fest in Dessau, it is important not to revere it as a miracle of virgin birth. The five tempestuous, harrowed years in Weimar—often glossed over with the legend of Gropius' "call" to launch a new design tradition "under the crystal symbol of a new faith," or else buried as a somewhat embarrassing throwback to expressionism—contain crucial seeds of what the school was destined to be. Officially, it started as anything but a clean sweep. In a moment of postrevolutionary confusion, Gropius talked his way into control of two leaderless schools (The Academy of Fine Art

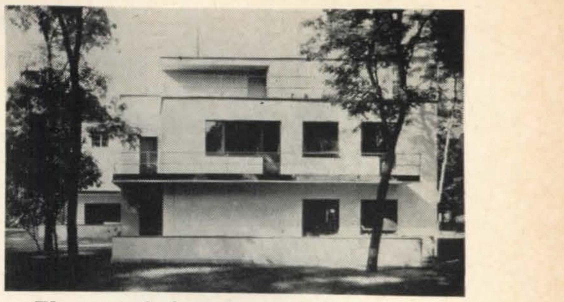


Klee: line and plane.



Breuer: chairs.

Schlemmer: The Bauhaus Stairs.



The master's house.

and The School of Applied Art), two empty buildings, and a staff of five academic artists; in the guise of acceptable reform, he proceeded to revamp them along lines that no one, on paper, had suspected, and that Gropius himself was searching for. The ideal was nothing less than the "rebirth of a sound society through a new kind of architecture," through an all-embracing *Bau* that implied the construction not only of buildings but of ideas and people. Since no one could know what form this new *Bau* might take, Gropius picked not his Berlin architectural colleagues, but a bizarre team of visionaries to help him fabricate the new architect out of whole cloth.

Characteristic of the first Weimar phase was the painter Johannes Itten, whose *Vorkurs* was an inventive ancestor of the aptitude test. Using every purifying method from gymnastics to garlic diets, he sought a "mental house-cleaning" that would erase the imprint of arid historicism and release innate talent, thus screening students for assignments in workshops where, under the joint guidance of certified craftsmen and practicing artists (Klee, Marcks, Feininger), they could search for fresh, sound, creative solutions. The second Weimar phase arrived in 1923, after these important tempests of individualism and postwar eclecticism had been allowed to run their course toward more logical outlook. It was characterized by the appointment of Josef Albers as a student teacher and of Moholy-Nagy to replace Itten, bringing a more cosmopolitan view of industrial collaboration. The third Gropius phase, in Dessau, saw the appointment of "young masters" to head the workshops—Marcel Breuer, Josef Albers, Joost Schmidt, Herbert Bayer, Hinerk Scheper, Gunta Stölzl. They came up as products, and proof, of the school's plan to train versatile artist-technicians. They joined the original form-masters (see photo, pp. 160-161) who had, with one exception, chosen to stick together in the big move that might have ended the Bauhaus in 1925.

Legend has it that the Bauhaus left Weimar because Dessau's progressive mayor, Fritz Hesse, lured them away by offering them a new building. In point of fact, at the end of 1924 the school was plainly doomed by hostile Weimar reactionaries, and the masters realistically decided to close at the term's end in March. Their least disastrous alternative was to be absorbed by the Frankfurt Academy; Gropius agreed to resign, leaving the craftsmen behind in a spin-off "Bauhochschule" in Weimar. Klee actually accepted an appointment while others stalled. Then, in February 1925, Hesse made overtures that would transfer the school intact to Dessau. The skeptical masters investigated, and agreed to try to hold everyone together. Early in March, Gropius went to Dessau and addressed an equally skeptical city council, after which Hesse skillfully managed to persuade them to adopt the Bauhaus, to budget 100,000 marks yearly, and, by combining it under Gropius with the city's school of Applied Arts and Trades, to afford a new building that was needed anyway. On March 25, the motion was carried for five-year contracts. Four days later, the Bauhaus officially ceased in Weimar, and opened in temporary quarters scattered about the city of Dessau.

Dessau Tourist Attraction

Within two months, Gropius presented the city council with a preliminary model: about 113,400 sq ft of space for school facilities, plus adjacent houses for seven masters. After some bickering and revision the plans were approved, and ground broken in September 1925. By March 1926, the framing was up; by summer, faculty houses were occupied. In early autumn, the school moved in—a reality once more—and then the December dedication days turned into a gala event of nationwide repute, as some 1500 visitors from all over Europe appeared on the first morning alone. Sixty journalists came to write reports, noting the new building as "the most optimistic moment" in the life of a school that had struggled seven years for security and recognition.

Security it never achieved, but recognition only increased as architects, educators, and students—as many as 700 in one day—continued to pour through the building. After Gropius' resignation in 1928, the school remained in the limelight through the subsequent upheavals of phases four and five. Hannes Meyer introduced a greater architectural, functionalist, and egalitarian emphasis that ended with his dismissal in 1930; and Mies van der Rohe reshaped the program along strongly professional lines as he struggled vainly against the political suppression of "foreigners, Marxists, and Jews." The school's demise was virtually unmarked in the German press, but, abroad, the chroniclers of modern architecture were already recording the legend of the Bauhaus as the prototype and genesis of the movement's break with the past.

Historically speaking, the Bauhaus building was a long way from Genesis, but symbolically it served as the opening of a new testament. There were several reasons for its immediate giddying impact: (1) It was the largest building, and complex, yet to be realized by a proponent of modern architecture in the postwar years. (2) It illustrated at full scale—not in words, sketches, or models—the potentials of new theories emerging in Holland, France, and Germany. As the butterfly from Peter Behren's prewar cocoon, it *was* the very real breakthrough of a long-awaited new life cycle. (3) As a *type* of building —not a factory, but a school—it broke the bonds of *genre* architecture to show the universality of the industrial style, and, further, its extension through furniture and fittings into a total architecture. (4) It was the single most publicized building of the decade, and not by chance. By 1926, the Bauhaus was the propaganda center of the whole modern movement, extending its own position with an influential series of 14 books by not only Bauhaus masters but such modernists as Oud, Mondrian, van Doesburg, and Malevitsch. The school itself, and its workshop production, were presented in two of the *Bauhausbücher* (1928, 1930), in a multitude of good photographs long to be remembered and emulated.

Indeed, in an age of photography, the building itself, with its forceful linear logotype, became virtually an international billboard, advertising that one generation's social-artistic ideals could be perpetuated for mankind's benefit through the process called education. It was a powerful fusion—perhaps unique since the age of the great cathedrals—of form and content coalescing to *become* the ideal they were striving for. And, educationally, it fulfilled this promise with genuine innovation (more about this later).

How did the building stack up architecturally? Was it significantly original, or confirmatory of developing trends? In retrospect, the answer might be yes on both counts.

Structurally, the workshop wing's long glass curtain wall—a transparent membrane wrapped around the visible concrete skeleton—has been widely cited as the first full separation of bearing structure and nonbearing skin, carrying Gropius' 1911 Faguswerk window-wall to its logical conclusion. The bridge of offices leaping across the road between the workshops and the city's trade school dramatized the spanning power of ferro-concrete as part of a unique multidimensional concept. Gropius' carefully organized pinwheel plan, with its separate "functions" expressed as floating and intersecting volumes, eliminated a fixed symmetrical façade for a kaleidoscopic series of "space-time" views that would be continually shifting around and through the building—indeed, totally comprehensible only from the air. On the interior, he linked the canteen, stage, and lobby into an extendable continuum for special occasions (such as the dedication itself); and, with the collaborating workshops, made imaginative use of built-in equipment to create pure, unified interior surfaces.

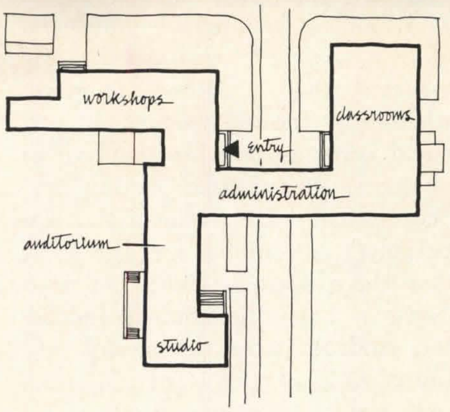
Historically, the building flowed from the architectural mainstream of the century. It might be called the crest of a swelling movement that idealized mechanization as the hope of a better life for all. Gropius expressed this cultural admiration for the machine in a syntax that was both less pure and less rigid than some of his colleagues, while using the elementary forms and man-made materials that had become the vocabulary of a new posteclectic style.

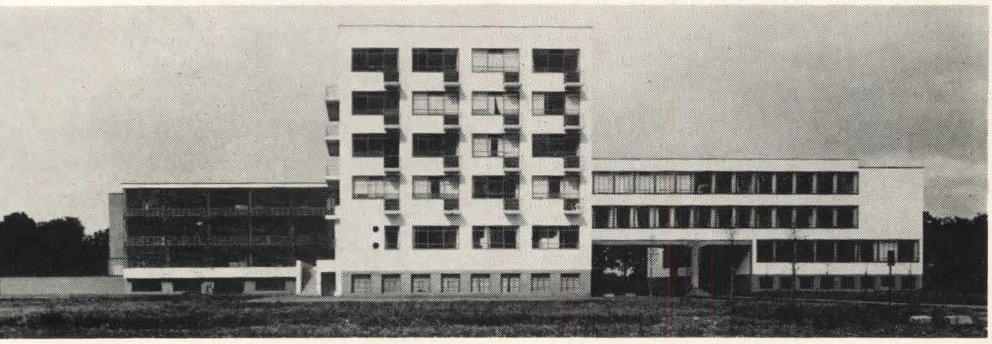
It is no myth that the building had wide influence. It gave impetus to an architecture of the glass cube, which soon followed in even more radical and refined forms. It extended the possibilities, already hinted at in the early work of Oud and Le Corbusier, of an architecture of pure white boxes—here suspended, articulated, and even exploding into sculptured projections. This idiom, misapplied, later proved inhibiting to economical planning and building. Spatially, it dramatized externally sculptured volumes without encouraging plastically sensitive interior spaces.

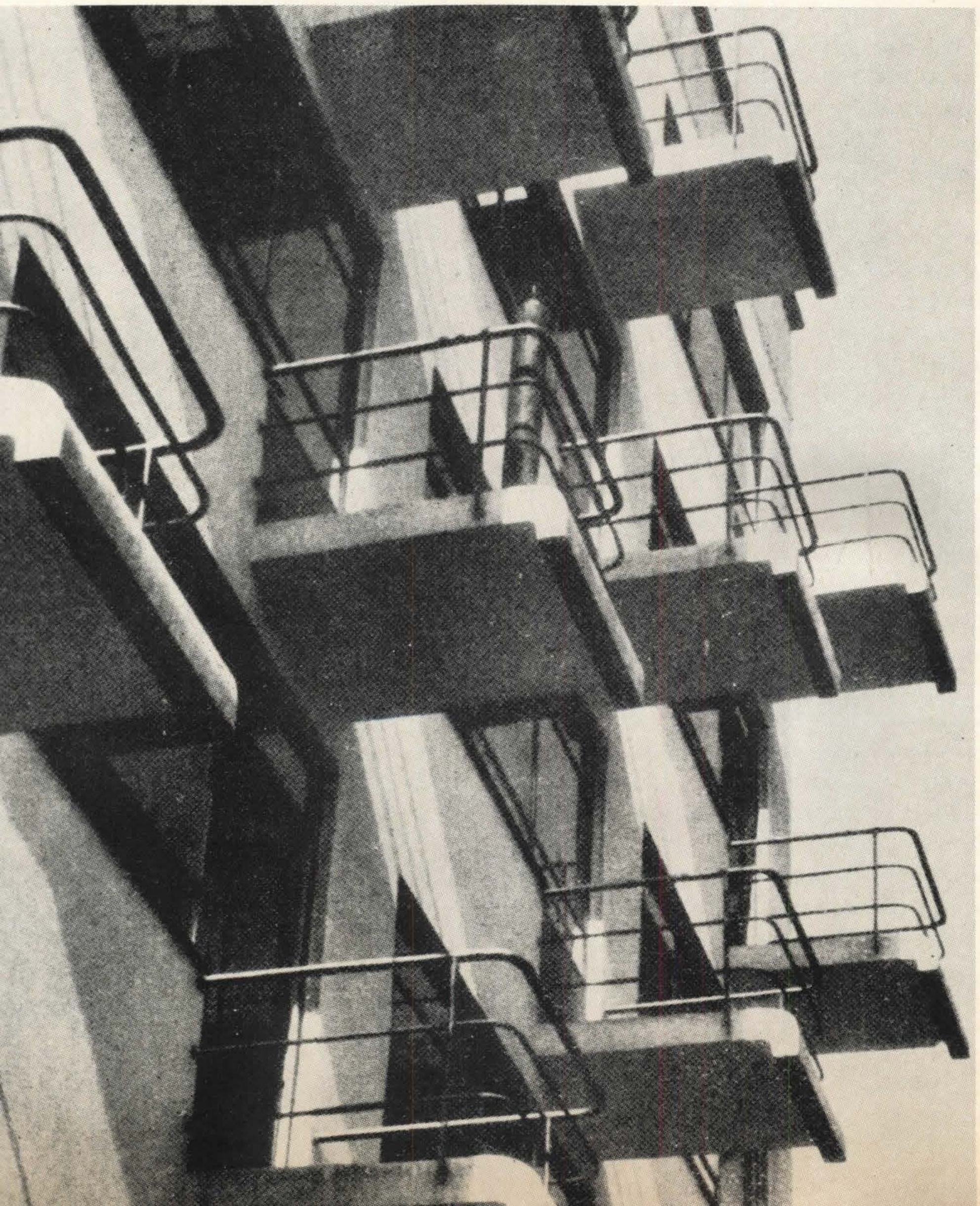
Yet, admitting its influence, there is no grounds for the myth that the Bauhaus building deserves the credit (or blame) for what was labelled ex post facto "The International Style," except by virtue of its subsequent exploitation and canonization by others. Gropius himself, during the Bauhaus years, was neither temperamentally nor theoretically prepared to pose as the Adam of the new style. Believing that a "style of the time" would never emerge by academic imposition, he always resisted aesthetic demagoguery of any persuasion—whether from the expressionist Itten or the neoplasticist van Doesburg. Inevitably, and quite osmotically, a homogenous "house style" did emerge in the workshops after 1923 from both internal and external influences. This might have continued to evolve in Dessau. But now, with a finished building to crystallize many dreams of "Bau" into one clear image, Gropius may have unwittingly made a statement so powerful that it stunted its own potential growth.

At least, it is worth speculating on the effects of this new identity on the building's inhabitants after 1926. Did they perhaps shape their ideas to fit the now visible "crystal symbol of the new faith" that surrounded them? Did Gropius' architect-successors perhaps react to the building's formal image rather than its educational intent? Is there a clue here to what went wrong with the world's dream of deliverance into an ideal century—a too easy acceptance of the seedling for the tree, a too rapid writing of the canons?

Looking specifically at the educational program, we find out more







about Gropius' emerging definition of *Bau*. When he started on his quest in 1919, with the clear support and sweeping hopes of progressive circles in Berlin, he did not immediately plan—or promise—a school for builders. Nor, despite the staff of artists, did he offer a school to train painters or sculptors. Instead, he offered the excitement of breaking the taboos that had long separated prestigious art and mundane utility. ("It is harder to design a good chair than a mediocre painting, and much more useful.") But these taboos were more than philosophical; they were built into the economy and education of Germany. And even after decades of attempted reforms, there was no workable tradition for training the designer he dreamed of. The trade schools were sound but artless; the schools of applied art were struggling away from decorative "paper aesthetics" but still lacked any material basis for honest design; and the fine art academies preached reform but practiced, as they always had, inert decorative art. And as for "architecture"—what was it in 1919? Neither of the former Weimar schools had contained even a department of architecture; in all of Europe, there was not a school to train the artist-technician as a total man. (Many of the early modernists, like Behrens, van de Velde, and Hoffmann, were self-taught emigrants from painting. The second generation came up either as apprentices, painters, or as students of technical institutes, like Gropius and Taut.)

To escape all of these traps and correct the problem at its economic base, Gropius wanted to synthesize the strengths of all three educational traditions. He called for a serious foundation in *manual skill* in its technical aspect, combined with *creative* (form-giving) theory, within the structure of certified trade apprenticeship schools that was still all-powerful in Thuringia. Thus he prescribed a return to "craft" (*handwerk*) as an educative skill and not as individualized decorative art through the three-year apprenticeship program, followed by certification by the Chamber of Crafts and by the Bauhaus masters in design.

And he saw this basis in skill as a discipline that must precede architecture if, as he hoped, it would be transformed from weak intellectual dabbling into a broad creative act.

When Gropius described the architect as the "conductor of the ensemble who must know one instrument well," he meant, of course, a different kind of architect from any practicing then—or now; if means could be found to train him, he must deserve the name "master of the arts." That is why Gropius would not admit apprentices to instruction in architecture—as some schools will not admit undergraduates today. He planned to wait for a group of young people trained as journeymen—firmly based in both the theory and skill needed for further experimental work—before forming the searching party for the new architect. With the required apprenticeship program, this could have happened in 1923 at the earliest. But, despite constant dickering over space and money, he could not finance an architectural section until 1926, when he brought Hannes Meyer to Dessau to head it.

This three-year prerequisite in form theory and workshop mastery of stone, wood, clay, metal, color, or textiles, seems romantic and unprofessional by today's practices. But it should be seen as an early attempt at a liberal-arts requirement that could free architecture from academicism on the one hand, and vocationalism on the other. Whether it was workable is hard to say, for, in Gropius' terms, it was never really tried. But as a concept, it provides perspective on what the Bauhaus was trying to be: a serious experimental effort to break out of the rut of educational method in order to expand the rooting ground of professional practice. As the first, and possibly last, anti-academic episode in German higher education, it could survive only as long as the people in and around it could tolerate the confusion that accompanies experimentation.

Certainly, Gropius had that tolerance to a remarkable degree. Like John Dewey, whom he had never read, he believed empirically that real education must be self-education; that learning involves hands, muscles, eyes, senses, and mind. ("Art cannot be taught"—intellectually; it must be self-learned.) He assumed that a dedicated artist, whether a trained teacher or not, could communicate his standard of quality without routine "testing" and "correcting." He assumed that experience, not results, was the goal; that there must be faith not in a "system" but in the student. Indeed, the students *were* the school—the source of its rebellious, playful, original ambiance; the staff was their resource but never their keeper. (In the years under Meyer and Mies, the program became tidier and less experimental, partly because a later generation of students had different expectations, demanding less exploration through "art" and more serious utilitarian knowledge.)

What really went on in *all* of the Bauhauses is the subject for volumes to come. In sum, we simply suggest that, more than theory or things, it was a matter of people. Gropius especially picked *people,* separating their ideas from their potential for harmonious contribution to the whole. He created some kind of undefinable atmosphere where conflict could exist and mistakes could be made; because he experienced the school as his own voyage of discovery, he expected as much (naively, but not wrongly) from others. For educators who even today find the freedom of the oft-discovered "discovery" approach frightening to contemplate, it provides an interesting example of how much can happen to both students *and* teachers (the latter certainly thrived at the Bauhaus) working without regulation or dogma in the midst of theoretical cross-fire.

The result of this undoctrinaire approach was an explosive mixture of temperaments and theories—a proto-happening, if you will—that blazed like a wild celebration of fireworks between two dark wars. Snuffed out, with nothing but smoky wisps to remind us, we can only ask: Where did it go? What did it leave? Did it really happen, did it matter? Must zestful search always solidify?

Certainly, few people will answer that *the* Bauhaus can or should be made to happen again today. But many would like, on their own terms, the professional thrust that is presumed to have come from a magic "method." Ironically, the school's main pedagogical tool, the unprogrammed flexibility that allowed both a Klee and an Itten to evolve important teaching approaches, has now ossified into the myth of a creative method and a "Basic Course" that can be endlessly reproduced.

If there is any point in reopening the Bauhaus question after all these years, it probably lies in the chance to explode the myths and distinguish the value of human approaches from inanimate systems and styles. The difference, subtle but all-important, is the difference between a laboratory experiment and a treasure hunt; between what the Bauhaus program said on paper and how it was made to work in human terms. There was no secret formula for creativity—only creative people working together in a nurturing environment that was incredibly hard to sustain, or simulate.

This truth is bound to be troubling, as are the lingering questions posed to us by the very existence of a Bauhaus—any old Bauhaus: Can we, in an age of surplus and subsidy, make something challenging and open-ended happen in today's professional education? On our vast bureaucratic landscape, can we give students room for the uncharted course, the uncontrolled experiment? While the multiversity stamps out student participation in the adult world, can we put initiative back in the hands of the learner? Above all, if ever we achieve a creative atmosphere for learning, can we sustain a flexible attitude toward the very approaches that are most successful?

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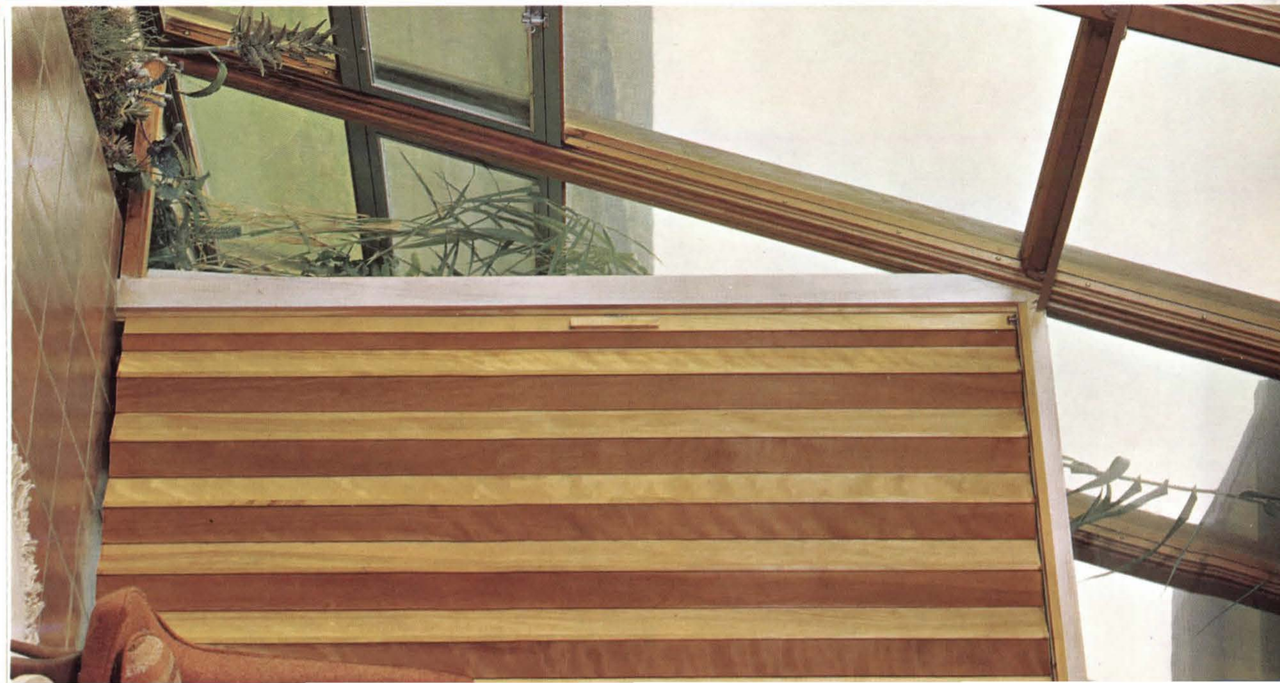

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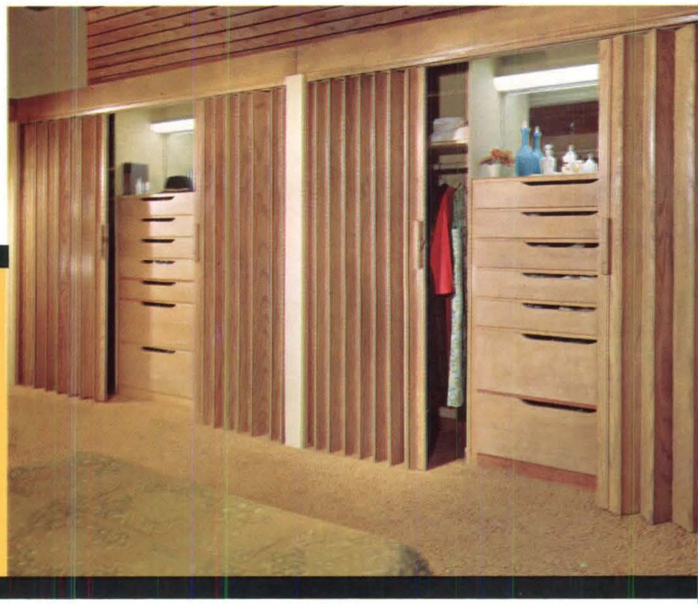

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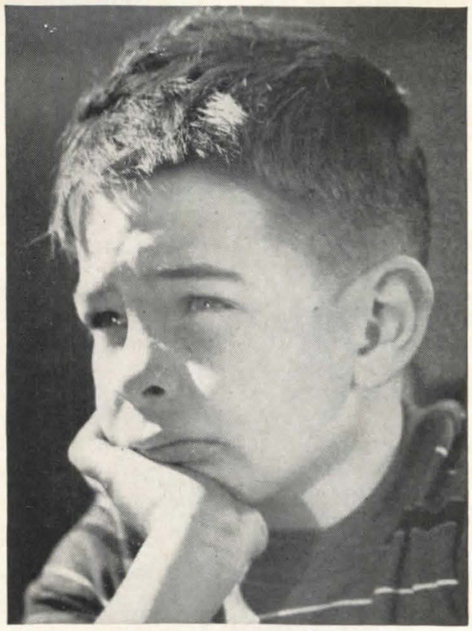

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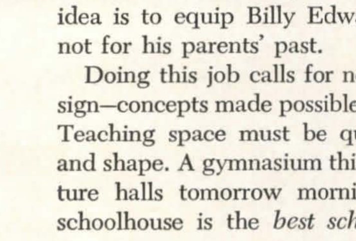
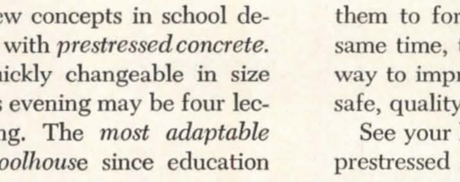
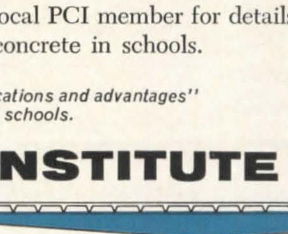


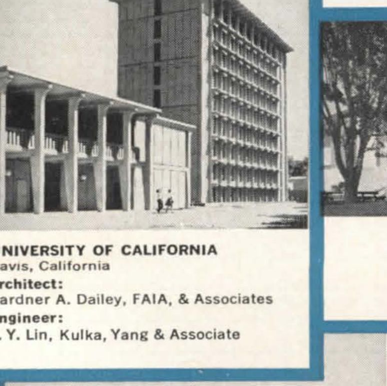
UNIVERSITY OF CALIFORNIA
Davis, California
Architect:
Gardner A. Dailey, FAIA, & Associates
Engineer:
T. Y. Lin, Kulka, Yang & Associate



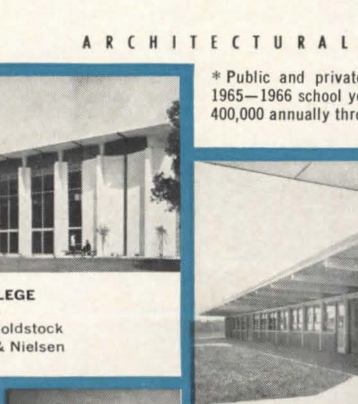
AMBASSADOR COLLEGE
Pasadena, California
Architect: Peter J. Holdstock
Engineer: Johnson & Nielsen



HENRICO HIGH SCHOOL
Richmond, Virginia
Architect:
J. Henley Walker, Jr. AIA



PARSONS RURAL ELEMENTARY SCHOOL
near Salina, Kansas
Architect & Engineer:
Anderson—Johnson AIA



ACADEMY OF THE HOLY ANGELS
Demarest, New Jersey
Architect & Engineer:
J. G. Phelan and Associates

MECHANICAL ENGINEERING CRITIQUE

EMERGENCY POWER FOR PUBLIC BUILDINGS

BY WM. J. McGUINNESS

To prevent power failures in public buildings, generator manufacturers recommend legislation for emergency systems. McGuinness is a practicing engineer in New York City.

When difficulties in central power systems caused a major blackout of the northeastern U.S. on November 9, 1965, this writer spent a pleasant evening as a guest at a student party in a fully illuminated campus building in the middle of a darkened metropolis. The reason for this anomaly is that the building has been supplied by privately generated power since 1900.

The light, of course, could have been used to greater advantage in a hospital, where it might have been desperately needed for vital services. A subsequent survey by the Hospital Review and Planning Council of Southern New York showed that 48 per cent of hospitals in the metropolitan New York area did not even have a generator for partial electrical service during an emergency. Since that time, the American Hospital Association has been active in alerting the management of hospitals to the necessity for stand-by power. Many cities already have mandatory requirements and are reviewing the problem. A framework for state legislation has been proposed.

The need, of course, is not limited to hospitals but exists for all buildings occupied by, or visited by, the public. Good planning for public buildings has always included emergency electrical service regardless of the dependability of the local utility company or its interconnected affiliates. Owners, architects, engineers, generator-set manufacturers and their associations are in general agreement about the selection of the services to be maintained for each building type. With minor variations, the concensus of their thinking is represented by the schedule shown.

Features of the best design include an automatic double-throw switch that operates after a brief predetermined interval of outage. It connects the generator, not to all services, but to the circuits to be kept functioning.

Gas, diesel fuel, and gasoline are the common fuels for generators. Air cooling often suggests generator locations of an open nature. Exposed placement will naturally require such precautions as antifreeze, if fluid cooling is used, and engines to be kept warm prior to use. Mandatory periodic operation and servicing are essential. A brief digest of suggested state legislation follows:

- It is the policy of this state that every building using electric lighting and power and to which the public is invited, shall have an emergency power system.
- Every public building housing more than 25 people and every similar building over two stories high shall have an emergency power system that is automatic.
- Authority for enforcement is vested in the state fire marshal. His advisory board shall include the state commissioner of health and four other appointees.
- The fire marshal is directed to require specific services (similar to those in the table on this page).
- The emergency generator and its wiring shall be subject to the approval of the advisory board mentioned above.
- Automatic systems shall provide illumination within 15 seconds after the normal electrical power source has failed.
- It is the duty of the fire marshal to enforce the provisions of this act.
- The fire marshal shall employ inspectors.
- Protests by the public against inspectors will be heard by the fire marshal.
- Members of the public not receiving satisfaction in disputes with the marshal or advisory board may appeal to the district court.
- Court may remand the case to the advisory board or may enter its own judgment or decree. In the latter case, the decisions shall be as binding as any others of the court.
- The advisory board shall receive per diem compensation.
- Inspection fees shall be paid by persons or corporations subject to this act. The general assembly shall provide funds for administration.

The information in the table of circuits to be kept functioning has been adapted from standards of the Electric Generator Set Manufacturers Association. The articles of the proposed legislation are digested from their recommendations. Technical committees of this association are available for engineering guidance when laws are being written.

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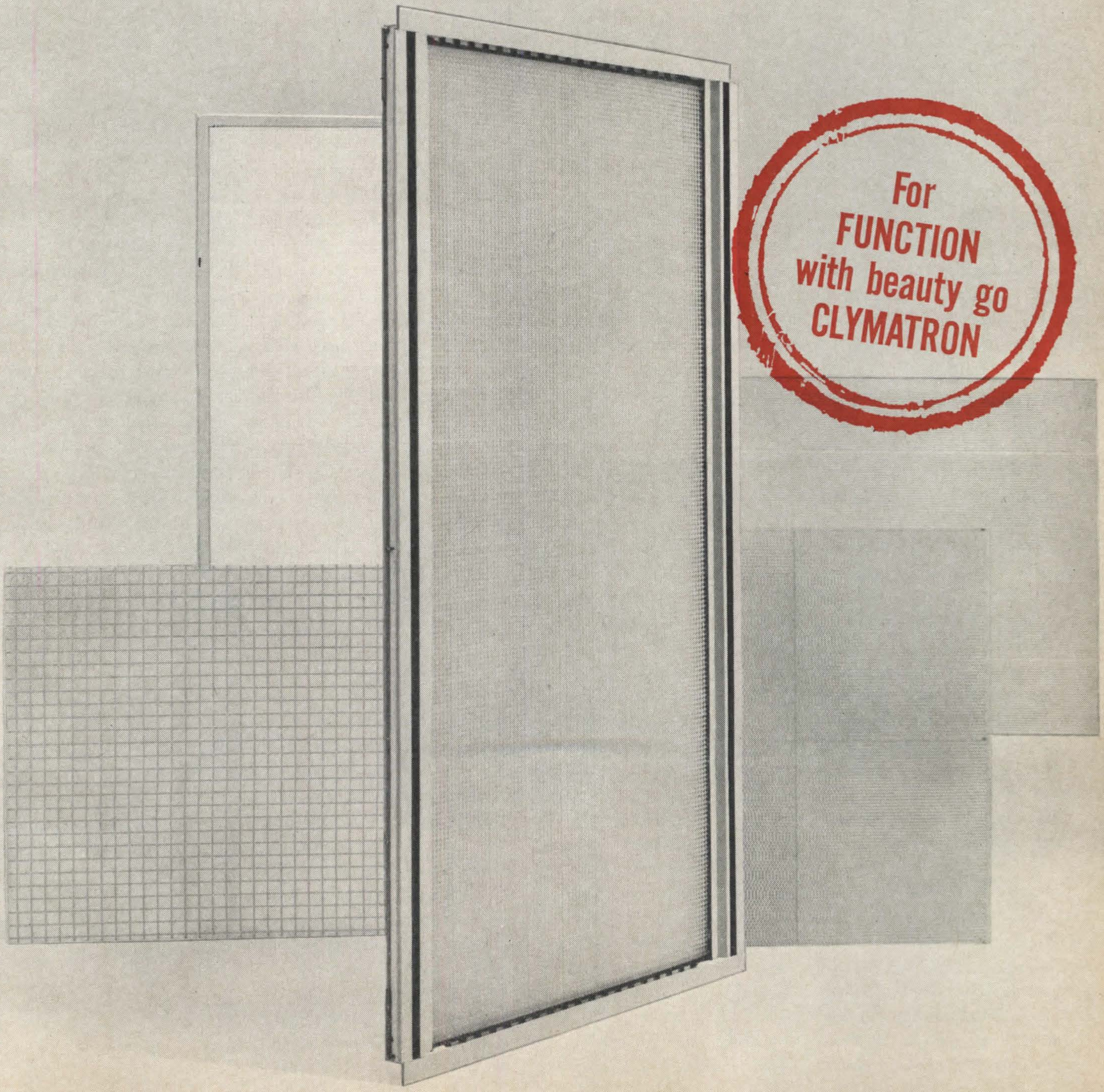


SPECIFICATIONS CLINIC

RUBBERS AND ELASTOMERS: PART 1

BY HAROLD J. ROSEN

The first of two articles on tests for rubber-like materials and elastomers. Rosen is Chief Specifications Writer for Skidmore, Owings & Merrill, New York City.

The increased use of rubber and rubber-like materials for joint sealants and gaskets in building construction requires the architect and specifier to become familiar with terms and tests associated with these products. A better understanding of these terms will also alert him to some of the deficiencies in existing standard specifications for rubber and rubber-like materials, and provide him with sufficient information to speak with manufacturers' representatives.

Rubber: A material that is capable of recovering from large deformations quickly and forcibly. It may be a natural material obtained from a vegetable origin, or a synthetic material produced by polymerization. Examples of synthetic rubbers are butyl rubbers, neoprenes, polysulfides, polyurethanes and silicone rubber.

Elastomers: A substance that returns rapidly to approximately its initial dimensions and shape after substantial deformation by a weak stress and release of the stress. Some polysulfides and polyurethanes are elastomers.

Abrasion Resistance: The ability of rubber material to withstand rubbing, scraping, or erosion. It is measured by ASTM test procedure D394 (for soft vulcanized rubber compounds), or D1630 (vulcanized rubber such as soles and heels). Tests are run under specific conditions of load and speed, and results are expressed as a percentage comparison with a standard composition. ASA Specification A116.1 and Federal Specification TT-S-2276 do not contain requirements for abrasion resistance, although this is a desirable characteristic for joints in pavements.

Adhesion: The ability of a rubber-like material to stick or cling to another material. The strength of the bond or union between a rubber material and any other material is generally measured in one of three ways: by application of a force to cause stripping or peeling; by application of a force perpendicular to the plane of the bond; or by application of a force in shear.

Adhesion in peel test procedures are described in ASTM D413 and D429, Method B, and also in Fed. Spec. TT-S-227b.

Adhesion perpendicular to the plane of the bond can be tested in accordance with ASTM D429, Method A, or by Fed. Spec. TT-S-227b.

Shear tests are commonly used, but no one method has been adopted by ASTM as standard.

Although adhesion tests can be useful in measuring a product's absolute level of adhesion to another material, it can also be used to determine its cohesive strength or internal strength. Fed. Spec. TT-S-2276 describes a durability test that includes adhesion, cohesion, and peel strengths.

Unlike other physical properties, adhesion is not always a function of the composition of the rubber, but depends on the cleanliness of the bond surface and the type of nonrubber surface.

One of the problems of current standard test procedures is that they do not include tests for adhesive properties after aging of the rubber product.

Aging: The ability of rubber materials to resist deterioration by oxygen and ozone in the atmosphere, and by heat and light. Deterioration results in a progressive change in the chemical and physical properties of rubber.

Deterioration by oxygen is described in ASTM D572, and by ozone in ASTM D 1149. Resistance to heat aging is described in ASTM D 454 and D 573. In each of these tests, the tensile properties and hardness of specimens are determined before and after exposure in order to establish the extent and rate of deterioration. Other properties, such as abrasion resistance and resilience, can also be measured.

Fed. Spec. TT-S-227b for joint sealants only includes tests for hardness after heat aging, and weight loss after heat aging. Many properties, such as adhesion, tensile strength, and modulus of elasticity can be affected by aging; but current standards tests do not include these vital test requirements.

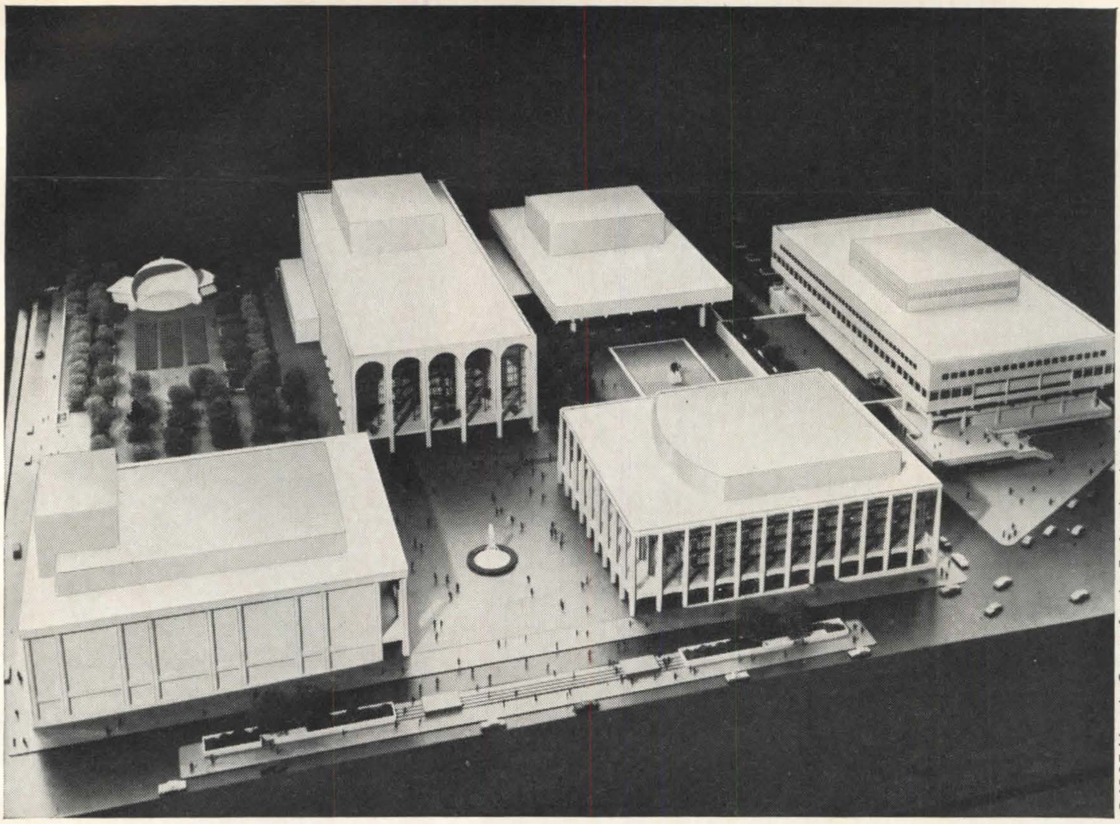
Flame Resistance: A measure of combustibility rather than noncombustibility. Rubber gaskets intended for the support of glass in exterior walls should not support combustion for any length of time, nor should they propagate flame for any distance.

Elastomers and rubbers will be consumed by fire as long as they are subjected to an outside source of flame. In this respect, they are not "noncombustible," as is masonry. A more accurate description of a flame-resistant rubber is that it "will not propogate flame." Although it will be consumed by an outside flame source, it will not itself support combustion and therefore should not contribute to the spread of fire.

A number of industry tests have been developed for measuring the flammability of such specific rubber products as roofing, flooring, and gasket glazing for windows. A standard test for neoprene gasket glazing is described in ASTM Specification C542. This can also be adapted for use with products where no specific flame test requirements exist. It is especially effective inasmuch as it simulates very severe exposure conditions.

In the ASTM C542 flame test, a specimen of the rubber product is suspended in a well-ventilated chamber and is then exposed to a bunsen burner flame for a period of 15 minutes. If, after the bunsen burner is removed, the product exhibits no further flame propogation or progressive glow, it is judged acceptable (i.e., self-extinguishing).

Results of this type of flame test can provide a valid basis for predicting the performance of rubber products when exposed to flame.



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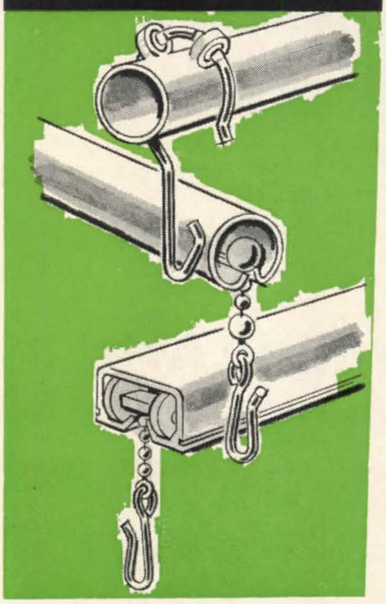

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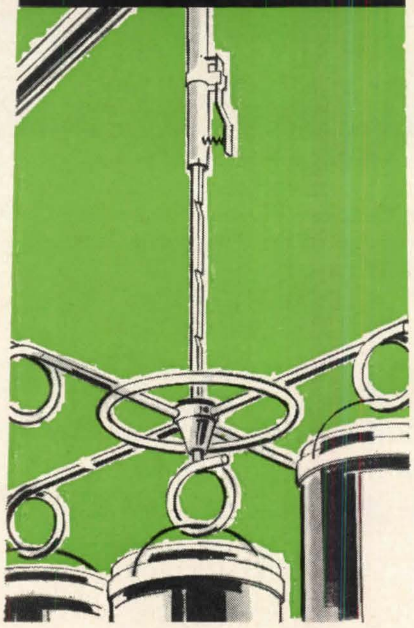

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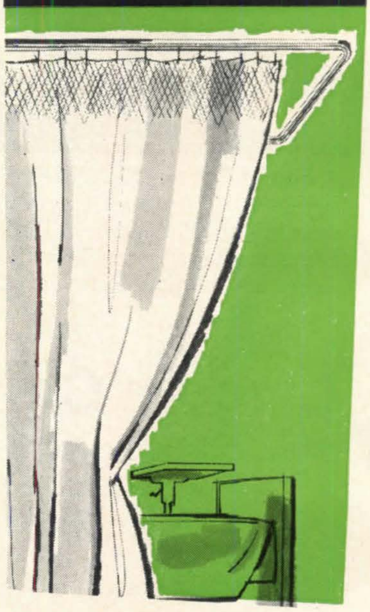

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IT'S THE LAW

THE ARCHITECT'S LIABILITY AND THE CONTRACTOR: PART 3

BY BERNARD TOMSON AND NORMAN COPLAN

P/A's legal team presents the findings of the Supreme Court of Illinois in continuing the discussion of a recent case in which architects were sued for injuries sustained by the contractor's workmen.

The Supreme Court of Illinois, in the case of *Miller v. DeWitt,* has approved the principle enunciated by the Illinois lower courts (see IT'S THE LAW, OCTOBER and NOVEMBER 1966 P/A) that an architect may be held liable for personal injuries resulting from the negligence of a contractor who creates a dangerous condition in the construction of a project, if the architect, in supervising the project, should have been aware of the dangerous condition created by the contractor and stopped the work.

In brief, employees of a contractor were injured when part of a roof collapsed due to inadequate shoring. Suit was instituted against the architects by the injured employees, who alleged that the architects should have prepared detailed specifications for temporary shoring, that they should have overseen and inspected the shoring as used, and that they should have stopped the work. The injured employees did not sue their employer, the contractor, since they were barred from this recourse by the Workmen's Compensation Law of Illinois.

The Illinois Supreme Court, in describing the case before it, stated that it presented a "novel issue of first impression." This issue, as described by the Court, was as follows:

"Stated briefly it is the position of defendant architects, and various associations of architects who have filed a brief as amici curiae, that a supervising architect has neither the right nor the duty to control the methods used by the contractor but has only the duty to see that the construction when completed meets the plans and specifications contracted for by the owner.

"Plaintiffs insist, however, that under the facts of this case the architects had a duty to prevent the contractor from carrying out the work in a faulty manner."

The Court pointed out that it was clear from the evidence that the architects had not prepared detailed specifications for the temporary shoring of the gymnasium roof, that they had not computed the load that would be placed on the shoring, or provided the contractor with a safety factor to be used in the shoring. The Court further stated that it appeared that the architects did not oversee and inspect the shoring as used. It concluded that a finding of negligence on the part of the architects would have to be based upon one or more of these omissions.

The Court rejected the plaintiffs' contention that the architects could be charged with negligence for failing to provide shoring specifications, stating:

"There is no evidence that it is the customary or usual practice for architects to plan shoring or provide specifications therefor. There is no evidence that the contractor relied on the plans or specifications or requested advice of the architects in constructing the shoring. All of the testimony of the architects who appeared as experts indicated that the plans and specifications were sufficient and proper. Only one witness . . . an engineer, but not a licensed architect, testified over objection that a structural engineer should indicate the load to be shored on the drawing. There was no testimony that this was necessary to meet the standard of learning, skill, and conduct ordinarily possessed by architects, or even structural engineers, practicing in the same or similar localities."

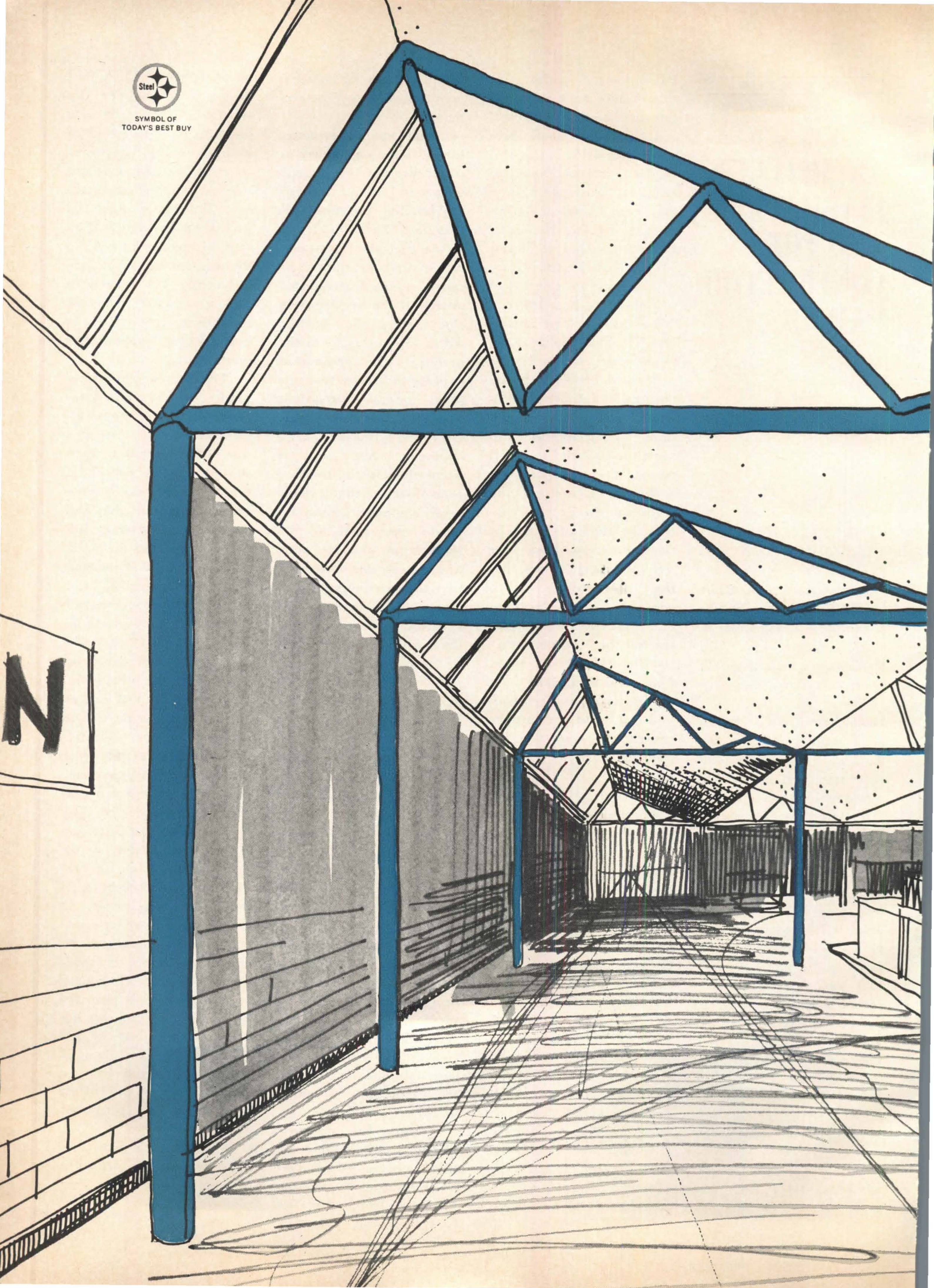
However, the Illinois Supreme Court also concluded that architects may be charged with negligence for failing to take appropriate action if the contractor's method of operation is creating a dangerous or hazardous condition. The Court, although recognizing that "as a general rule it has been said that the general duty to supervise the work merely creates a duty to see that the building when constructed meets the plans and specifications contracted for," nevertheless ruled that an architect has the right and duty to insist on safe and adequate methods of construction. The Court stated:

"Despite the argument of the architects that the shoring here was a method or technique of construction over which they had no control, we feel that under the terms of the contracts the architects had the right to interfere if the contractor began to shore in an obviously unsafe and hazardous manner. We agree with the architects that they had no duty to specify the method the contractor would use in shoring, but we believe that under the terms of these contracts upon a safe and adequate use of that method. . . .

"From a careful examination of the record we conclude that if the architects knew, or in the exercise of reasonable care should have known, that the shoring was inadequate and unsafe, they had the right and corresponding duty to stop the work until the unsafe condition had been remedied. . . . If the architects breached such a duty they would be liable to these plaintiffs who could forseeably be injured by the breach."

A rule of law that charges liability to an architect if he does not recognize a hazardous condition created by a contractor and stop the work, is of great moment and concern to the profession. The manner in which a contractor constructs a project, or the methods he utilizes, has traditionally been thought to be outside the responsibility of the architect. However, under the principles enunciated by the Illinois courts, an architect will ignore such manner and methods at his peril. On the other hand, undue or unjustified interference by the architect in the procedures of the contractor may delay or disrupt a project and subject the owner to claims for "extras" or worse.

In next month's column, we will conclude our discussion of this significant legal decision.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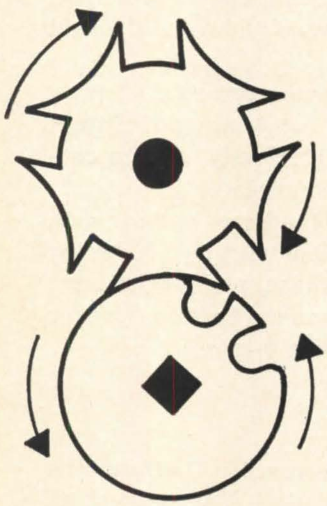

Nathan Silver's suggested redrawing of an illustration on page 107 of the Kepes book showing the Geneva stop, a mechanical intermittent transmission.

BY NATHAN SILVER

THE NATURE AND ART OF MOTION. *Vision Plus Value Series. Edited by Gyorgy Kepes. George Braziller, Inc., 215 Park Avenue South, New York, N.Y., 1965. 195 pp., illus., $12.50.* KINETIC ART. *By Stephen Bann, Reg Gadney, Frank Popper, and Philip Steadman. Published in London by Motion Books. Distributed in U.S. by Wittenborn & Co., 1018 Madison Ave., New York, N.Y., 1966. 70 pp., illus. $3.* THE VIEW FROM THE ROAD. *By Donald Appleyard, Kevin Lynch, and John R. Myer. M.I.T. Press, 50 Ames St., Cambridge, Mass., 1964. 64 pp., illus., $15.* FREEWAYS. *By Lawrence Halprin. Reinhold Publishing Co., 430 Park Ave., New York, N.Y., 1966. 160 pp., illus., $12.50. The reviewer is an American architect presently on the faculty of the School of Architecture, Cambridge University, Cambridge, England.*

"A bald summary of possible movements in kinetic art would be: linear movement along the three axes, rotations around them, and rotations around centers lying outside the object, nine in all. Vibrations are different in kind yet directionally they must be part of one of the nine basic movements. The rotations of wheels, the swing of pendulums, the reciprocation of pistons and the linear movements of cam-followers are special cases within this spectrum."

This is George Rickey of Rensselaer speaking in *The Nature and Art of Motion,* and in his essay the incredible idea of motion suddenly blooms. Among the students of the subject whose papers have been collected by Gyorgy Kepes, those concerned not with the science but the art of motion are the ones who stagger us. In the book, there are the most careful and precise accounts of early scientific attachment to self-conscious conceptions of motion (by Gerald Holton) and the possible meaning for perception of constancy and change in stimuli (by James J. Gibson), and both these essays are fascinating dissections of an artichoke that we can hardly understand just because we see it growing in the sun. Then the artists speak, and the whole purple flower unfolds at once. The legendary printmaker Stanley Hayter explains in 10 pages how the equivalent of motion is possible in graphic arts; his illustrations reveal that direction matters; a soaring line is reflected to become a dying fall. He is as cool as one of the scientists as he accounts for the width of the field and the suggestions of linear figuration, and he admits that he is discussing only effects. But then he finishes by saying that, "with the means at our disposal to transpose a comparable orchestration of color, motion, impulse, and rhythm, one might well devote a lifetime to this project."

A lifetime proves no exaggeration with Len Lye's or Hans Richter's careers considered either. Richter in another essay modestly retraces his own journey and his experiments in painting and the film since before World War I. Though he neglects to say it (Rickey says it for him), it was Richter who decided that his work had meaning beyond the Dadaists, and lay in the origin of a new school: the Movement Movement, as he called it. *The Nature and Art of Motion* is this school's resourcefully catholic manual of instruction. In one of its many future editions, I hope they redraw that Geneva Stop on page 107 so that it works (see illustration).

The book's most thoughtful chapter is a paper by the Harvard art historian James S. Ackerman, on "Art and Evolution." The subject of motion is most broadly conceived here. His account of style change is one of "natural selection," but he brings the familiar Darwinian metaphor for cultural change much further down the line than earlier proponents have done. Selection is adaptation. It simply means "the capacity to stimulate emulation among artists and favorable response in the society at large." But as a theory of change, is evolution to be preferred to revolution? The answer lies among the notes: "There are no revolutions in art. A work of art does not contain propositions and therefore cannot take a negative position." Ackerman's strict, evolutionary analysis accounts for speciation, survival, stability, and even permits him to question the alleged role of taste: "Artists, indeed, provide the essential mechanism of evolution: If they reject an innovation, it cannot be sustained, no matter how many others approve it; if they accept one, it cannot perish, though it have no other sponsors. . . . [On the other hand] art adapted to the prevailing taste may prove to be overspecialized for long-term survival, since taste is one of the most changeable aspects of culture."

The matter before the house—of interest alike to artist and scientist—is motion, which means process, the transformation that is continuous in all nature (or virtually continuous; there are some philosophically disturbing exceptions in quantum mechanics). Scientists often need to isolate in order to describe, but I find it odd, exciting though the subject is, that motion is now being discussed by artists separately from other considerations. Both Kepes' topical approach and that of the four British essayists in their own book, *Kinetic Art,* insist on this. I wonder if isolation is helpful. Since they admit that "virtual" movement (apparent only to the retina) and "actual" movement are alike in perception—these authors all decry the false category of "Op art," devoted to virtual movement alone—the likeness may be extended: Motion itself is not a special subject in art. Why is it profoundly different from form, three-dimensionality, or any other art characteristics that can bear metaphoric or psychological interpretation? E. H. Gombrich thought any of these understandable through perception psychology (though he

Continued on page 182

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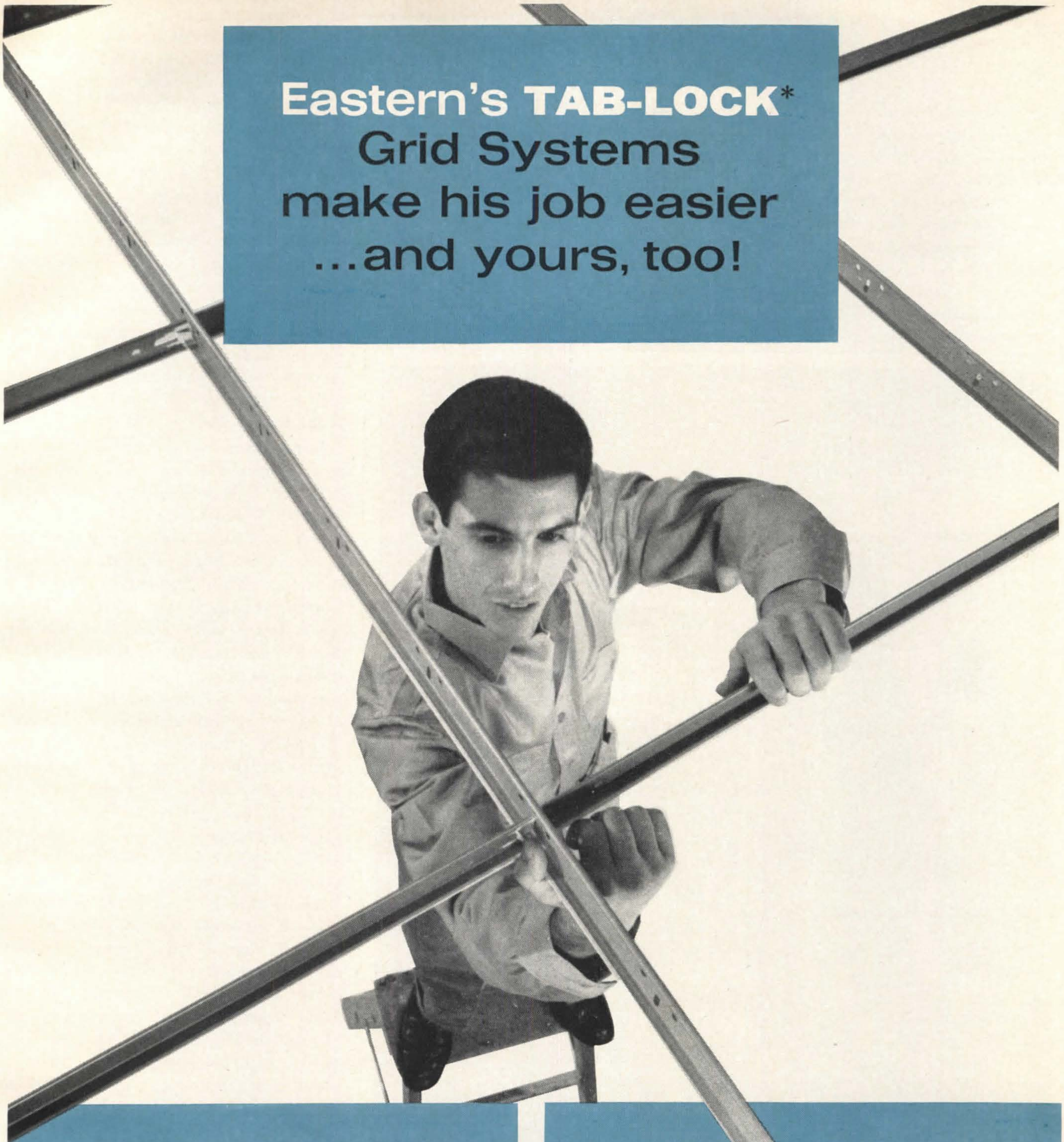

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Continued from page 178
did not specifically treat Kinetic art in his book *Art and Illusion*). The uniqueness of motion is being overstated here, and Rickey proposes what is certainly only a modest aesthetic difference between movement and form: "Being irreversible, sequence is, unlike the other three dimensions, impossible to arrange symmetrically." The Englishman Frank Popper declares flatly that "movement is becoming an autonomous aesthetic element," and his associate Stephen Bann defends the name "Kinetic art" on similarly categorical grounds.

Kinetic Art is also a useful book, however. Though they categorize like scientists, the authors provide a lucid and revealing view of their subject and its history, which is perhaps just a bit unbalanced by Philip Steadman's exclusive attention to "Color Music." This particular account is about moving color and light and Thomas Wilfred's highly publicized "Clavilux" of the 20's (his "Lumia" works are still occasionally to be seen at the Museum of Modern Art in New York). Steadman's apparent enthusiasm is hard to share. The aesthetics of motion as such, as free from formal images as possible, makes art's symbolizing characteristic extremely difficult to attain. This is the not-so-secret weakness of purely Kinetic art. The random colored lights and shadows on screens done by Wilfred or Palatnik, a Brazilian artist, appear to be the extreme of free choice. They only communicate to the beholder releases of energy in the spirit of dreams or drug experiences, and then strictly if one admits this possibility *in the intention*. If not, then it is a bore, as only Kinetic art can be, since it is above all time-consuming. Well, perhaps artists should be allowed to seek deliberately small audiences; to specialize, as scientists have done. The descriptions of work and the self-governed opinions expressed in *Kinetic Art* are at any rate more provocative than those of Katherine Kuh in her essay, "Recent Kinetic Art," in the Kepes book.

If movement has its problems in art, it also sometimes has trouble with life. At M.I.T. (where things are really jumping), Professor Kepes of Visual Design is not more interested in the art of motion than is Professor Lynch of City Planning. With Assistant Professors Donald Appleyard and John R. Myer, Kevin Lynch wrote *The View from the Road*, a book already so influential that it has generated a popularization of the same subject: *Freeways*, by Lawrence Halprin. Highway aesthetics has recently become national policy. The general public that reads *Freeways* is meant to be impressed with a lot of talk about the art of motion before the author gets down to practical matters in landscape architecture as seen by a Californian. The problem that worries him is: Should freeways through town be at grade, depressed, elevated, stacked, tunneled, or on embankments? If one suspects that one has missed the beginning of this particular movie, I would first recommend reading Lewis Mumford's title chapter in *The Highway and the City* (which explains how the U.S. highway program began in 1957) and then go on to Appleyard-Lynch-Myer. Unlike Britain's Buchanan report, *Traffic in Towns*, American communication theories have been deriving not from life studies, but directly from politics and art.

"Highways have special visual qualities if we consider them as art," says the M.I.T. task force, operating under a grant from the Rockefeller Foundation. "We will discuss them from the standpoint of the driver and his passengers, *ignoring the issue of how the highway looks from the outside*. We will also restrict ourselves to the limited-access highway in the city, although much of our material will be applicable to other roads." Lawrence Halprin is a little

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bolder and blunter: "When freeways have failed, it has been because their designers have ignored their form-giving potentials and their inherent qualities as works of art in the city. They have been thought of only as traffic carriers, but, in fact, they are a new form of urban sculpture for motion. . . . In the long run, the design of a great freeway is *an intuitive act* of the most demanding and imprecise kind." (Emphasis mine, thought of course our highway designers long ago got this message.) *View* and *Freeways* both go on from these opening remarks to general considerations of motion, "space," and the elements of attention, fashioning an analytical-picturesque theory in one case and a lyrical-picturesque theory in the other. Both books also contemplate abstract notation of motion and space (see Halprin's "Motation," JULY 1965 P/A). Whereas Halprin turns to sections taken through freeways, the M.I.T. group devotes the last half of its work to lengthwise alignment, diagramming "visual components," as Lynch once did in *The Image of the City*. The professors conclude with an "imaginary design" that suggests a new alignment for Boston's proposed Central Artery. Their program: "The criterion governing this imaginary design has been the visual, aesthetic experience of those driving on the road. The only constraint imposed was that in actual practice other criteria would be of equal or greater importance." Here is a bit of sample analysis: "The official route suffers grave disadvantages in its western portion, since it travels low through residential areas and is consequently 'lost' . . . confused path structure, the dense foreground development, and the lack of any really high viewing points result in oblique views of the city which are indecipherable at the speed of the motorcar. . . . There are advantages in taking the road extremely close to the center: close contact is always exciting."

The "imaginary" nature of their proposal becomes harder and harder to remember, especially when the authors drop their soft design pencils and start jabbing at the official Maguire route. Page after page and diagram after diagram, *The View from the Road* slowly turns, like a game of Truth, from an abstract enthusiasm to deadly earnest. But it is not my intention to claim that a chief aim of the book was to promote the authors' own highway loop for Boston; I cannot prove that. It is enough for me that *The View from the Road*—and *Freeways,* insofar as it follows a similar line most of the way—is playing the game with, let us say, pretense. This is so even after one swallows the outdoor-billboard aesthetic canon and all the rest of those autonomous conceptions of roadscape, designed to satisfy the highway lobbies and perhaps some traveling strangers, but hardly the tired commuter (let alone Melvin Webber, Herbert Gans, or Jane Jacobs). There are two insupportable hypotheses made.

First, the idea of a visual analysis of the highway that ignores "how the highway looks from the outside" is absurd. Quantum mechanics, that irritating discipline, has spoiled this kind of logic in the Heisenberg Uncertainty Principle [see p. 99, "The Scientific Revolution"], which found that whenever we determine one aspect of a physical process we make another aspect more uncertain. Whenever information is measured (a light quantum or road beauty) the very act of measuring inevitably results in an interaction. If a route is determined, the determination radically changes the environment. The "outside" is no outside at all, since the highway on its crashing route changes things forever, even for itself, as surely as a temperature reading of a fluid cannot be made without affecting the temperature by the presence

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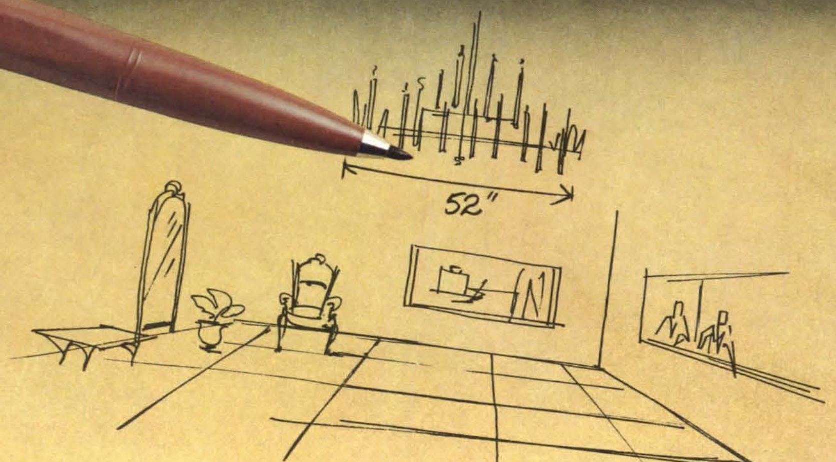

of the thermometer. "The View from the Road" that we see can never really be Boston unless we simultaneously read the view from Boston of the road.

From the science of motion to the art of motion the second nonsensical idea is founded in the sheer conception of design. In Appleyard's essay in the Kepes book on "Motion, Sequence and the City"—a précis of the same subject—he writes: "One day, we may entertain the outrageous idea that every possible journey through the city be part of a total system of sequences. Each path would be shaped to allow for interrupted and reversed journeys. From the foothpath outside the front door, to the elevator and corridor of his place of work, our citizen could have the choice of a stimulating, meaningful, and changing experience. Contrasting alternative routes, urban or rural, intensive or relaxed, classically ordered or loosely structured, would be at his command." This is not only an example of designer's hubris, but its statement (which lies at the bottom of *View's* theory) attests that life is just a work of art, or should be. One feels like being patronizing: "My dear fellow, of course it isn't; it's much nicer than that." What a dreary proposition, that every possible journey through the city be part of a total system of sequences. One can make fun of this idea, since it is not only arrogant—the planner as shepherd—but false: A shepherd need not plan the paths, only the field, taken by his flock.

In a country where the largest sums of public money for cities in the past generation have been spent on urban highways, it would be a national disaster if highway commissions were given license to "act intuitively" about urban aesthetics. This would be so even if the artistic ends proposed in these books were not as shallow as they are. Highways have always been the work of civil engineers and their consultants for the very good reason that engineering is supposed to be a scientific discipline. Any highway aesthetic that steps beyond the limits of *strict economy of means to solve the defined need* is indeed an "outrageous idea" in a city of many paths and purposes. In its random, sloppy way, life states the problem, and the designer complies. I am confident that such a program still offers fantastic scope, since even the mundane accidents of proven necessity submit to mastery. Kepes' essayist Karl Gerstner, in his discussion of "Structure and Movement," explains why and answers Appleyard most beautifully in the same book: "There are innumerable possibilities for groupings; there is a conceivable number of ordering principles; there are a few complex regularities: there is only one 'random' solution. The paradox is to be understood in the following way: the law of chance can vary by throwing dice, drawing lots, playing roulette, according to the telephone book, statistically, according to the whims of a monkey, with the help of a blind person—the result is always the same. We can perceive 1000 different kinds of order: but 100,000 kinds of disorder are perceived as one. And so as not to be misunderstood: I am speaking of structure and movement, of the movement of one and the same structure. I am speaking only of *the abundance on the smallest field:* how big is the world?"

New England Delights

BY EDWARD K. CARPENTER

NEW ENGLAND GALLERY. *By Philip Kappel. Little, Brown & Co., 60 E. 42nd St., New York, N.Y., 1966. 349 pp., illus., $20. The reviewer is an Associate Editor of P/A.*

It is hard to imagine a more charming, informative guide to New England than Philip Kappel. The tour he offers in *New England Gallery* is spiced with history, architecture, humor, and folklore—all seen through the eyes of an outstand-

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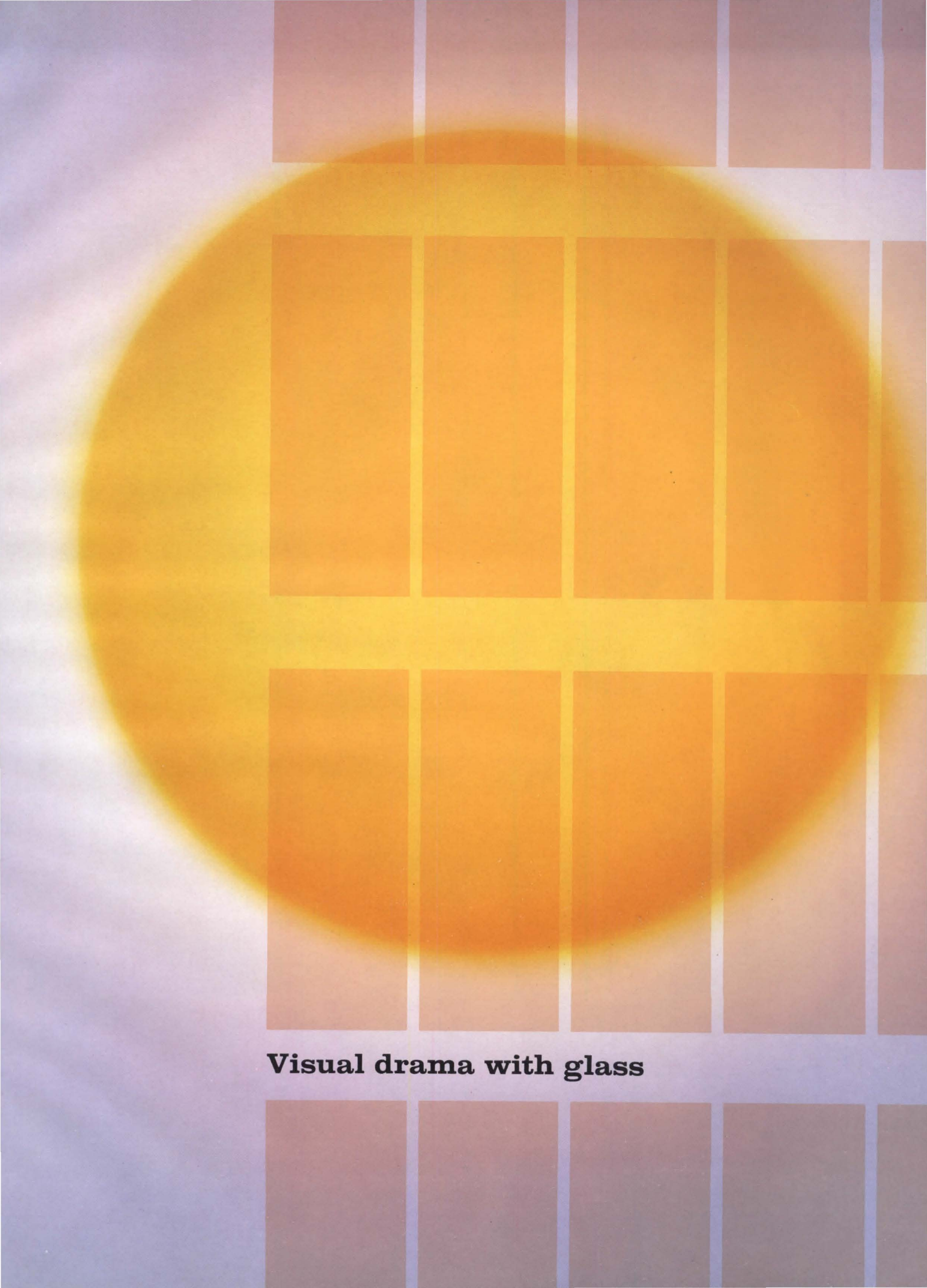
ing artist. Long one of the country's leading etchers, Kappel produced 150 pen-and-ink drawings for his book that catch New England in many of its guises. He shows us a New England of old clapboard houses, village greens, church spires towering above the trees, seaports, shipyards, covered bridges, trout streams, cranberry bogs, and farms. It is a New England disappearing too rapidly beneath the litter and junk of thoughtless mechanization and highway construction. And Kappel's book is nothing so much as a marvelously eloquent plea to preserve what little is left of our New England heritage. His plea is a refreshing one. So many books today that hope to call attention to the continuing blight of the countryside focus on this blight, showing us roadside stands, gas-station signs, overhead wires, housing developments and concrete highways. It is as if we are not depressed enough looking at the real thing. Kappel focuses on the beautiful, the serene, on the trees, homes, churches, and streams that we must preserve. "If we relax and fail to hold what we have inherited," he writes, "what would remain to sustain us during the midseason of man's fluctuating tastes?"

Kappel devotes a chapter to each of the six New England states. His text enlarges in words what his drawings show with obvious taste and care. Opposite a drawing of the village green in Woodstock, Vt., Kappel tells how that town has four churches, each with a bell cast by Paul Revere. And he goes on, "Only eighty-seven Revere bells exist today out of hundreds cast. Bells were necessary adjuncts to village life. Each ring had its individualistic message; a certain ring awoke the parishioners, another urged haste in getting to church. The ringing of the 'pudding' bell served notice to anyone in charge of the kitchen to get dinner ready. The 'passing' bell tolled when villagers died—one ring for a man, two for a woman, and three for a child, followed by one peal for each year of age." Looking at the wonderfully detailed drawing of the Woodstock street, one can almost hear the bells ringing, feel the warmth of the sunshine, anticipate a meeting with an old friend.

The scenes included and the pieces of history related are those that delight the author and they have equal delight for the reader. In writing about Providence, R.I., Kappel tells of Samuel Slater, the founder of the New England textile industry, sneaking into town from England in disguise, because textile mechanics were forbidden to emigrate. Slater car-

Continued on page 196



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Continued from page 188

ried plans for the intricate textile machinery in his head, and within a year (1789) cotton goods were being woven in America. Some of the historical vignettes are well known, such as the first skirmish of the Revolution at Concord. Others are more obscure. He tells, for instance, how Captain Jervis brought the first Merino sheep to Vermont from Spain. Wool was an important Vermont product until President Cleveland removed the duty on it, and the Vermont farmers switched from sheep-raising to dairy-farming.

By far the greater part of the book is architectural. Kappel's drawings include old New England houses, churches, lighthouses, and barns. These are, of course, the most tangible remnants of our New England heritage, and probably in no other single source is the wealth of this heritage so abundantly illustrated. In at least one instance, Kappel's artist's eye leads to some architectural speculation. "There is a possibility that the architect of the spire of the Congregational church in Wethersfield, Conn., was the same person who designed the spire of Trinity Church at Newport, Rhode Island," he writes. "I myself sense the resemblance, having drawn both spires for this book. Furthermore, there is a similarity between the Trinity Church spire and that of the Old North Church (1723) in Boston, which I also rendered as an illustration. This evidence suggests that William Price, who is supposed to have designed the Old North Church, may have been responsible for all three." It is this kind of attention to detail and obvious enjoyment of the subject that make *New England Gallery* a distinguished work.

A Mixed Bag

BY LEONARD K. EATON

THE PEDESTRIAN IN THE CITY. *By David Lewis. Published by D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N.J., 1966. 229 pp., illus., $18.50. The reviewer is Professor of Architecture at the University of Michigan.*

This volume is a useful compilation of current thinking on urban problems. Together with the introduction by the editor, who is Andrew Mellon, Professor of Architecture and Urban Design at Carnegie Tech., it contains 39 essays on various aspects of urbanism, both theoretical and actual. These efforts are generally well illustrated: There are 526 photographs, drawings, and plans. The essays, however, vary considerably in

Continued on page 204

Dome Design: Welton Becket and Associates, architects and engineers, Los Angeles, New York, San Francisco, Houston

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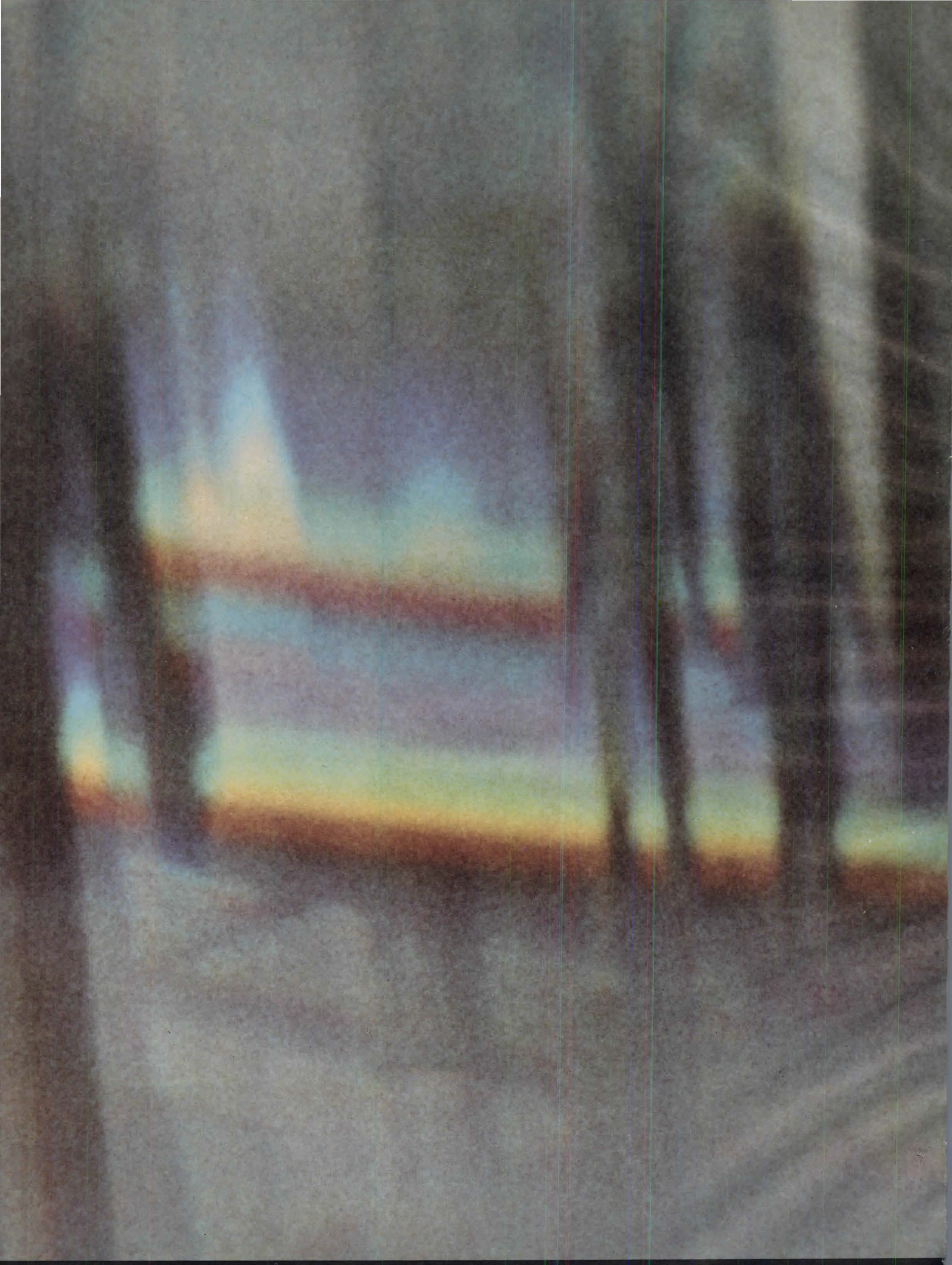
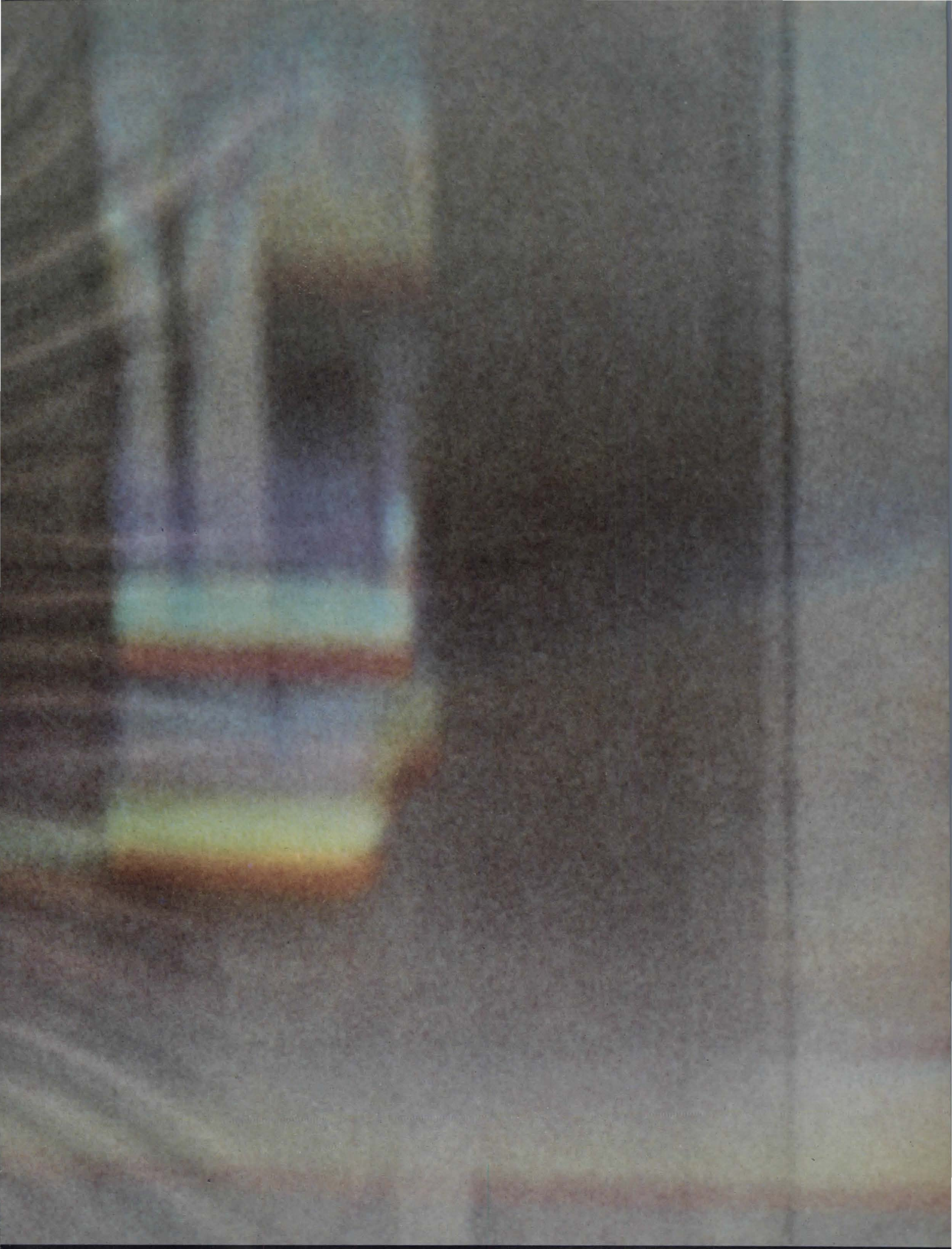
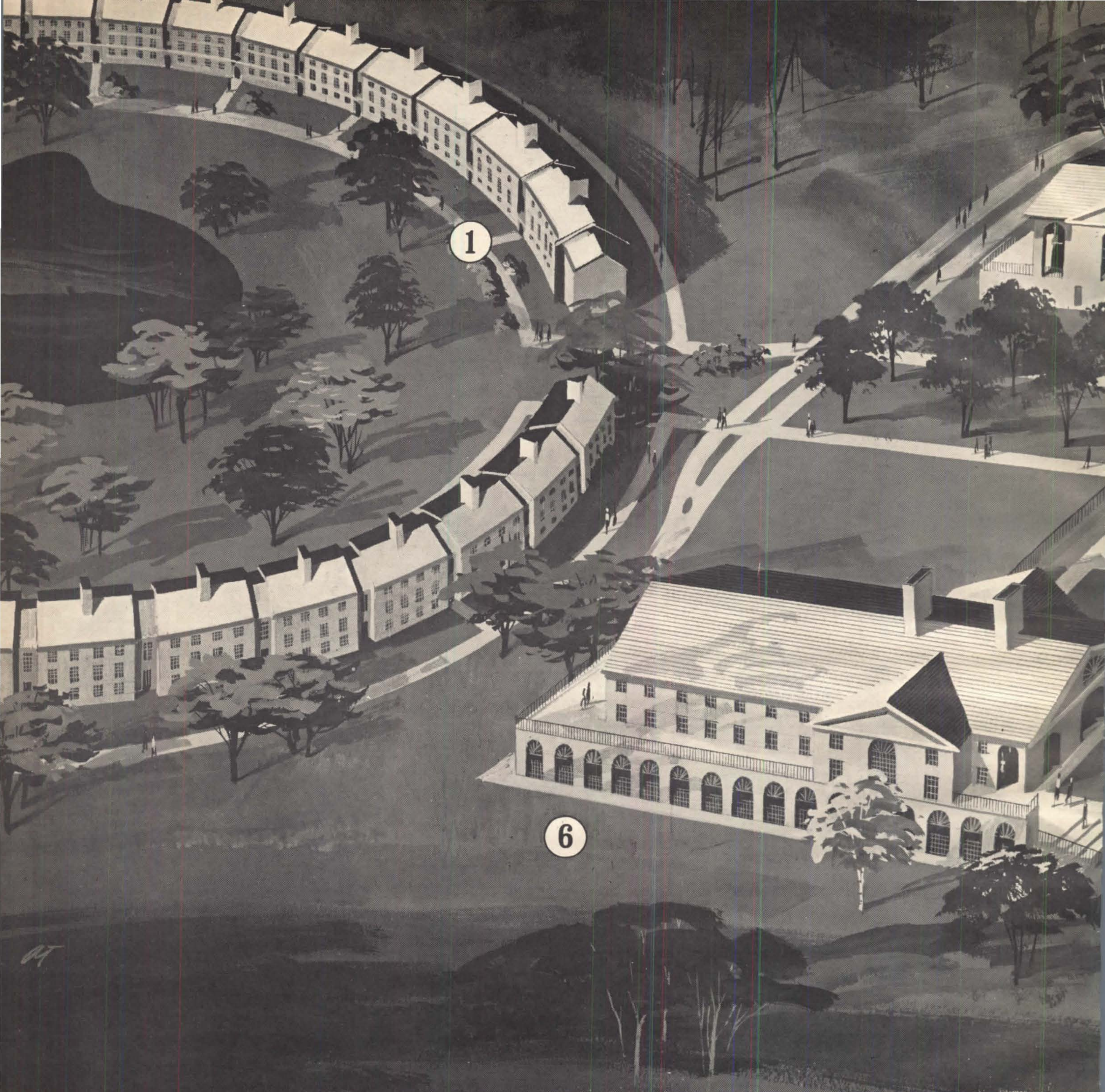






Bentley College of Boston selects all-electric design for new Waltham campus...finds costs competitive, operating advantages conclusive

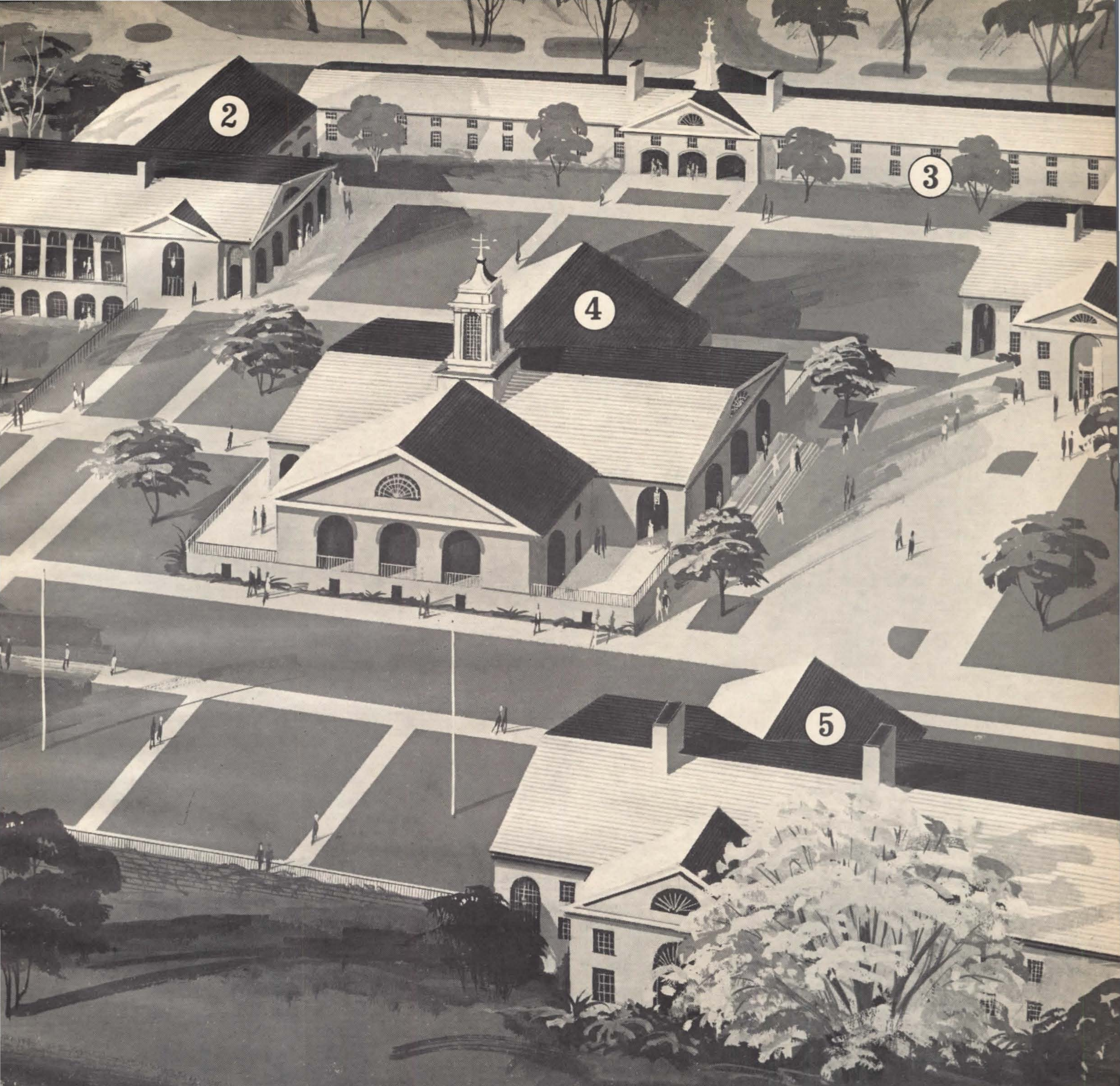
When the Board of Trustees of Bentley College, a professional college of accounting and finance, started planning their new $25-million, 102-acre campus in Waltham, Massachusetts, this was their goal:

> to create an environment which was completely conducive to serious academic pursuits, beautiful to the eye, and thoroughly functional.

Comparison studies with other methods convinced them that an all-electric campus, employing flameless electric heating and cooling, would best meet their requirements.

Quiet operation and individual room temperature controls would provide a better atmosphere for study. The cleanliness of an electric system would mean reduced housekeeping and maintenance costs. Elimination of boiler rooms and bulky equipment would allow building space to be utilized more efficiently.

As to cost, two independent feasibility studies showed that—compared with a fossil-fuel system—annual owning and operating costs for the electric heating and cooling system would be equal, or possibly even less.



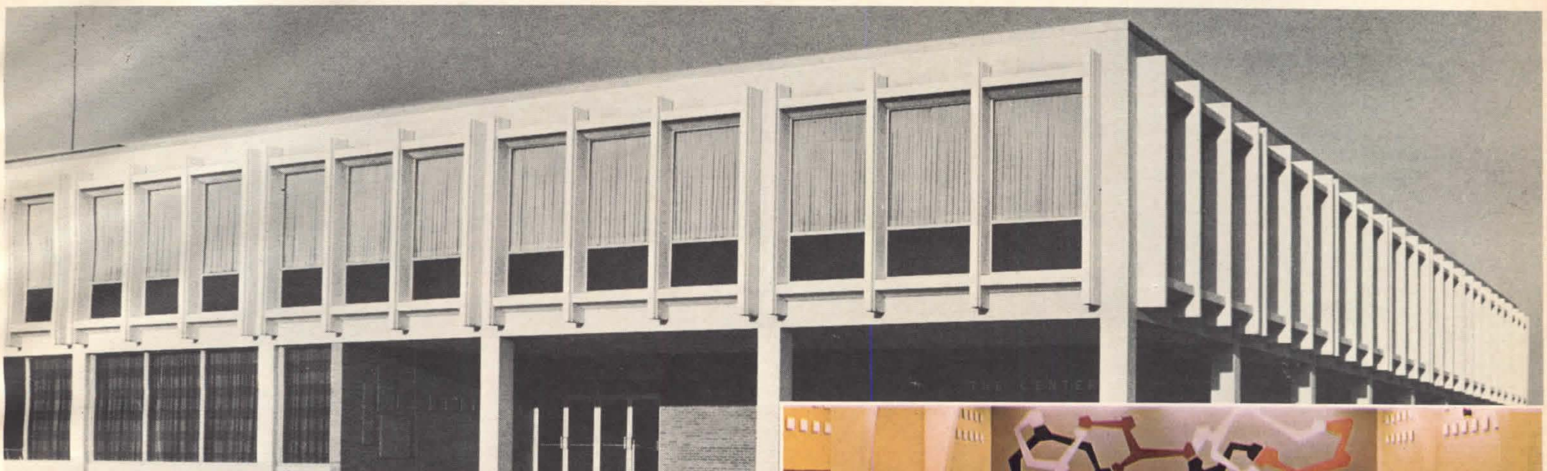
Artist's rendering

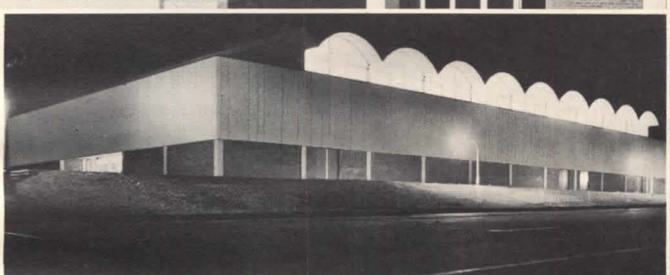
Continued from page 196

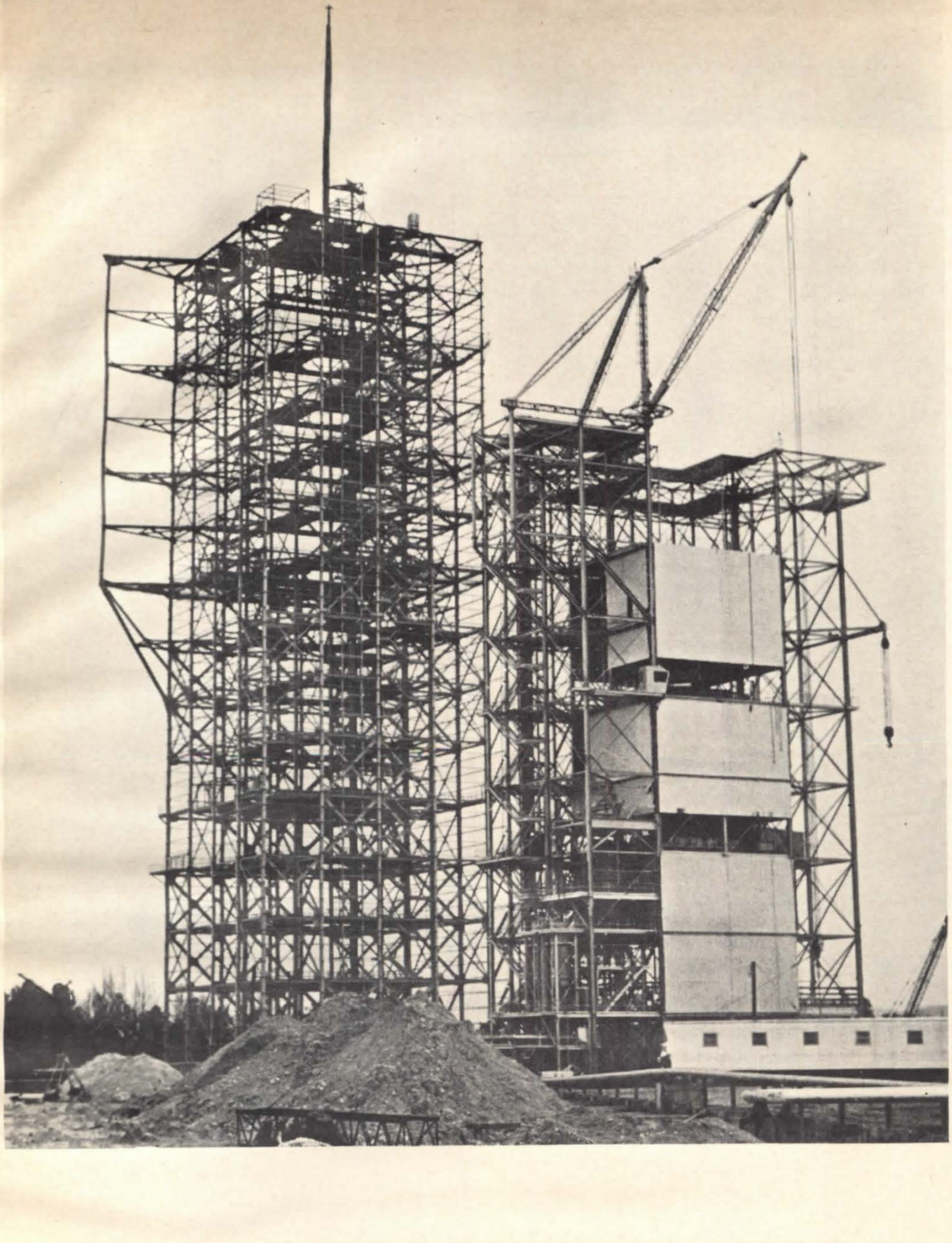
quality and character. Ben Nicholson's is simply four photographs of recently designed reliefs that are evidently intended as free-standing elements in an urban setting. The three contributions by Maxwell Fry, Jane Drew, and Bhanu Mathur, on the other hand, constitute an up-to-date summary of recent developments at Chandigarh, with special attention to the new housing there. Peter Carter reviews the urbanistic contributions of Mies van der Rohe, and Eleanor Smith Morris deals with the greenway system at present evolving in Philadelphia. The coverage is certainly international, and with the exception of certain developments in the Scandinavian countries, such as Aalto's plan for Helsinki, this reviewer can think of nothing of major significance on the planning scene that has been omitted. Candilis, Doxiadis, and Bakema are all here.

As might be expected, the subject matter of these essays is exceedingly diverse, and very often there are no connections between them. In some instances, there is probably too much emphasis on what is merely fashionable. Herman Haan's photographic essay (with accompanying free verse poem on the dwellings of the Dagon people in Central Africa) is for this writer a case in point. Haan falls into exactly the same pitfalls as Bernard Rudofsky in his recent exhibition at the Museum on Modern Art. These "metropoles of clay and stone" may have something to do with contemporary urban problems, but the connection is remote. The whole business points to the conclusion that, at present, it is absolutely okay to like primitive culture in any form whatever. In time, this too will pass. In quite a different vein are Jane Jacobs' harsh but well-deserved criticisms of Victor Gruen's scheme for East Island in New York Harbor. Mrs. Jacobs, who is never afraid to tell the emperor that he is naked, is unquestionably correct in comparing it unfavorably with the same architect's excellent 1956 scheme for Fort Worth. It is interesting to note that she now has words of praise for Gordon Cullen's work on *Townscape,* a book that has appeared since the publication of her own *Death and Life of Great American Cities.* Although Cullen's volume is basically English in its derivation, it seems to have many American applications.

In short, *The Pedestrian in the City* is a mixed bag of contributions on various aspects of the contemporary urban problem. Many of the essays merit the serious attention of those concerned with this overwhelmingly important question.







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Pages 90-91:
Photo: Linich/Factory Foto

Page 96:
Suggestive of the existentialists' emphasis on man searching for a way beyond individual solitude to confront his own self is this group of performers staging a "Dance Action" at the opening of the Lucio Fontana exhibition at the Walker Art Center. (Photo: Eric Sutherland. Courtesy, Walker Art Center, Minneapolis, Minn.)

Page 100 and Cover:
Scientists use atomically clean surfaces to compare chemical behavior at different planes of a crystal. Photo shows tungsten crystal photographed in a field-ion microscope: bright dots represent individual atoms. (Photo: Courtesy, General Electric Research and Development Center, Schenectady, N. Y.)

Page 102:
Further confirming the existence of an anti-particle for every known particle is this liquid hydrogen bubble chamber photograph of an anti-proton colliding with a proton. (Photo: Courtesy, Brookhaven National Laboratory.)

Page 112:
A highly mangnified (650x) section of polyethylene produced by the polymerization of ethylene under intense gamma radiation from a cobalt-60 source, while under high pressure. (Photo: Courtesy, Brookhaven National Laboratory.)

Page 114:
A "boat" full of metal "whiskers" that have just been grown. These hairlike strands of metal are super-strong and free of flaws in the arrangement of their atoms. (Photo: Courtesy, General Electric Research Laboratory.)

Page 116:
An "aqua-rabbit" in a submerged plastic tank is kept alive by an artificial "gill" that extracts air from surrounding water while resisting passage of the liquid. (Photo: Courtesy, General Electric Research and Development Center, Schenectady, N. Y.)

Page 118:
A rocket-propelled Flying Chair used for personal transportation. (Photo: Courtesy, Bell Aerosystems Company.)

Page 122:
Montage that repeats the same photo of a crowd many times over produces a dizzying mosaic suggestive of overcrowding and the population explosion. (Photo: Maude Dorr.)

Page 128:
Symbolizing the genetic revolution is this photo of a plant cell after exposure to X-rays. Fragments and bridges between chromosome groups are typical abnormalities induced by any ionizing radiation. (Photo: Courtesy, Brookhaven National Laboratory.)

Page 131:
Tactility as one of the keynotes of the Sensory Revolution is symbolized in this photo of a group of mannequins' hands. (Photo: Maude Dorr.)

Page 144:
Abstracted representation of possible cityscape of the future based on ideas outlined in article.

Page 148:
Illustrating the shift from the rigidity of the grid to the more free-form, multiform spatial dynamics of Habitat '67. (Photo: H. Keith Oliver.)

NOTICES

New Addresses

Behm, Sullivan & Assoc., Inc., Architects-Engineers, 412 Southview Boulevard, South Saint Paul, Minn. 55075.

William N. Breger Assoc., Architects, 300 E. 42nd St., New York, N.Y. 10017.

Carcaterra & Assoc., Consulting Engineers, 9310 Georgia Ave., Silver Spring, Md. 20910.

Dan Cooper Design Corporation, Effingham Falls, N.H., has moved its New York showroom to 227 E. 56th St., N.Y., N.Y.

Floyd Cranmer, Jr., 1219 Brace Rd., Cherry Hill, N.J. 08034.

Robert Martin Engelbrecht & Assoc., Architects, 12 Nassau St., Princeton, N.J. 08540.

Hillman/Garmendia, Architects, 122 E. 37th St., New York 16, N.Y.

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O'Kelly, Mendez & Brunner, Architects-Engineers, 1500 Franklin D. Roosevelt Ave., San Juan, Puerto Rico 00920.

Siegal Avrin Assoc., Architects, 16825 Wyoming, Detroit, Mich. 48221.

New Firms

Sam Chang & Assoc., Inc., Architects-Planners-Engineers, 1441 Kapiolani Blvd., Honolulu, Hawaii.

Davis & Sands, Architects, 37 W. 38th St., New York, N.Y. 10018.

Gersztoff, Nuckolls & Warfel, Inc., Lighting Designers and Consultants, 207 E. 37th St., New York, N.Y.

Petroff & Jones Associates, Architects, 441 Lexington Ave., N.Y., N.Y. 10017.

Wayman & Fidance, Architects, 1035 Philadelphia Pike, Wilmington, Del. 19809.

Elections, Appointments

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Bechtold Engineering Co., Louisville, Ky., has appointed Ray Lewis equipment specialist for furniture manufacturing.

Eaton Yale & Towne, Inc., Lock & Hardware Division, Rye, N.Y., has appointed John J. Gell manager of manufacturing and R.E. Hargett architectural hardware manager—international.

Continued on page 219

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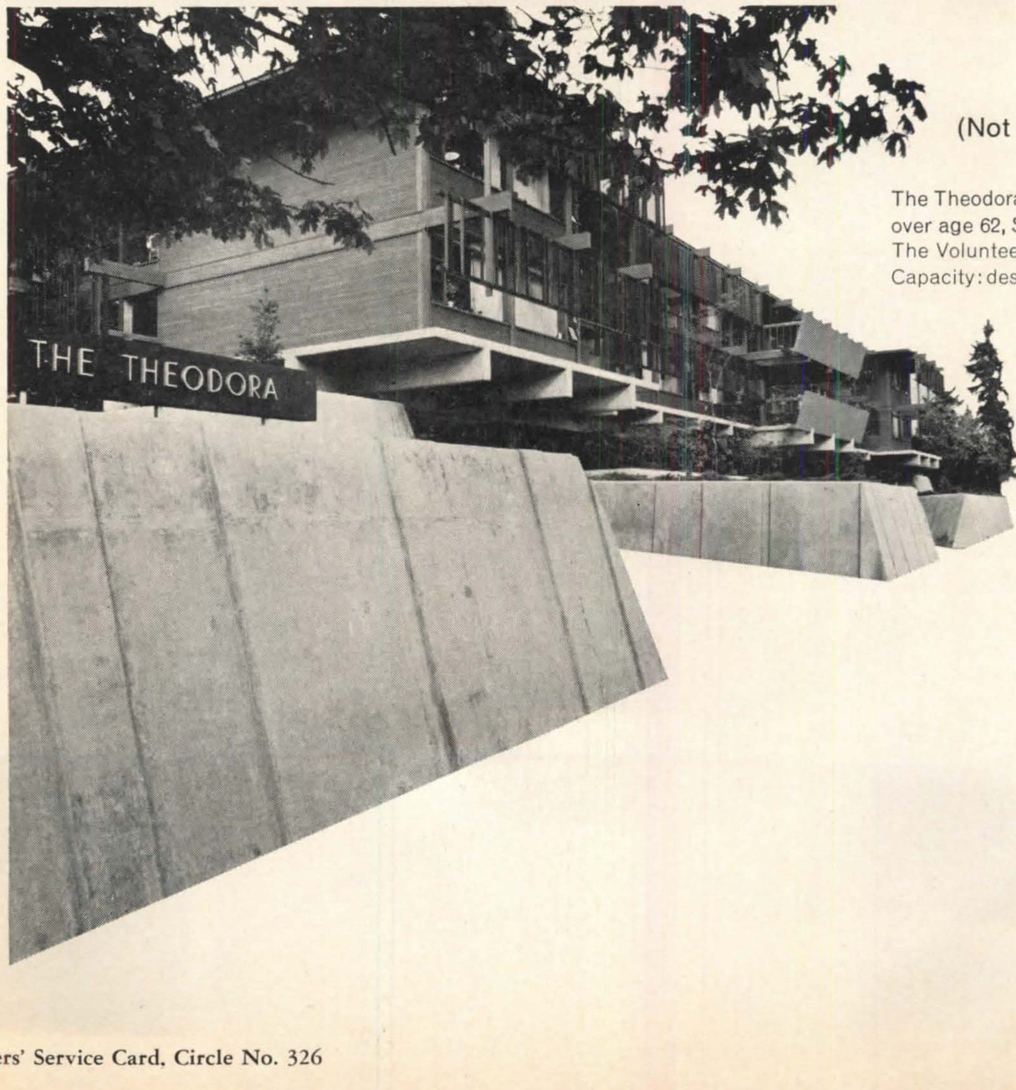

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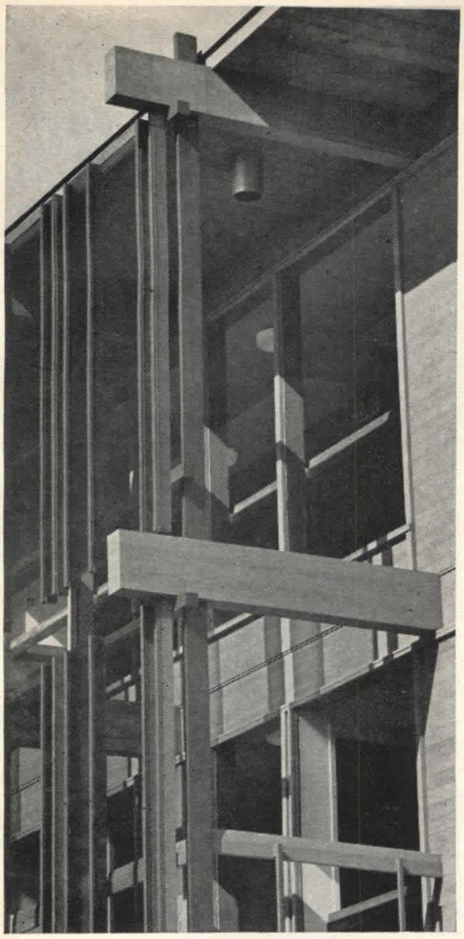
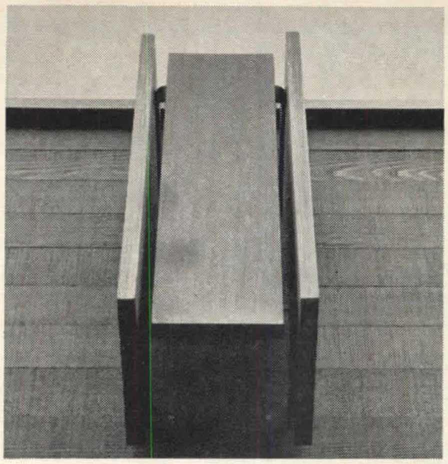
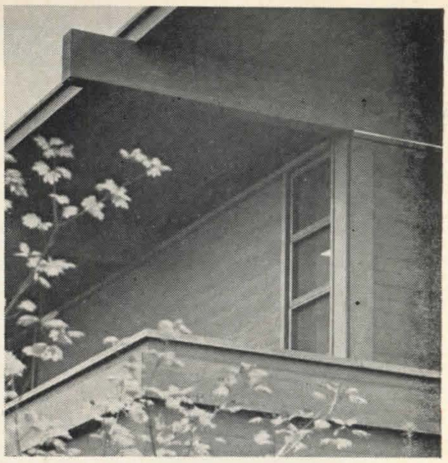
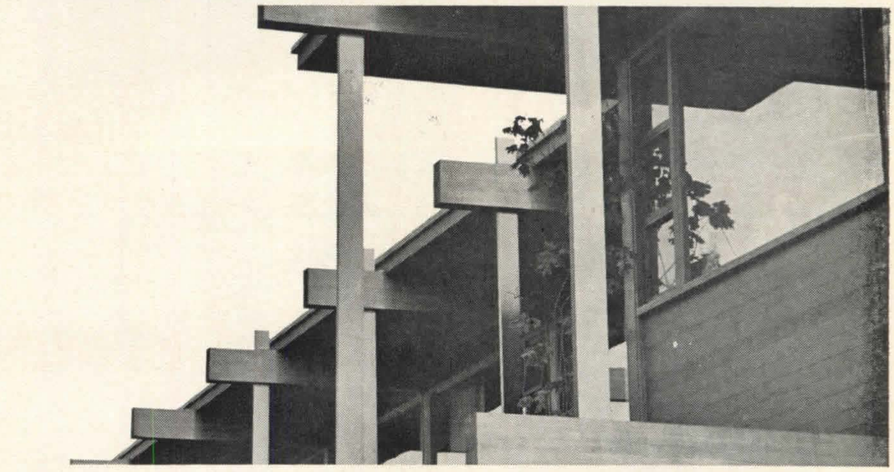


Western Wood's solidity contrasts nicely with reflective privacy screen.







Laminated structural beams of Western Wood also give aesthetic strength to The Theodora.

TOP LEFT/Simple light box blends perfectly with the larger structural elements.

TOP RIGHT/Among the structural systems used in The Theodora is Machine Stress Rated trussed joist construction.

Uncle Sam can be mighty cold and calculating. Especially when laying down the law for projects he's backing. Retirement housing is no exception. The rules demand safe, sound, serviceable, economical shelter. No frills. And that's what the Theodora had to be. But the architects faced a problem of not only creating shelter for its full-time residents, but of establishing an environment that would attract and keep them. And a building which would enhance the surrounding neighborhood. Something extra was needed . . . at no extra cost.

They solved the problem through simplicity of design and Western Wood. The result is evident in the illustrations here. The Theodora management was able to hang up the "sold out" sign even before advertising and promotional materials were prepared. And the structure is accepted by the community as a handsome architectural contribution to the area.

Most important to the residents (who range in age up to 102), Western Wood brings to the Theodora a continuity with the past . . . a warm, familiar environment where they feel proudly "at home" despite the contemporary lines of the building.

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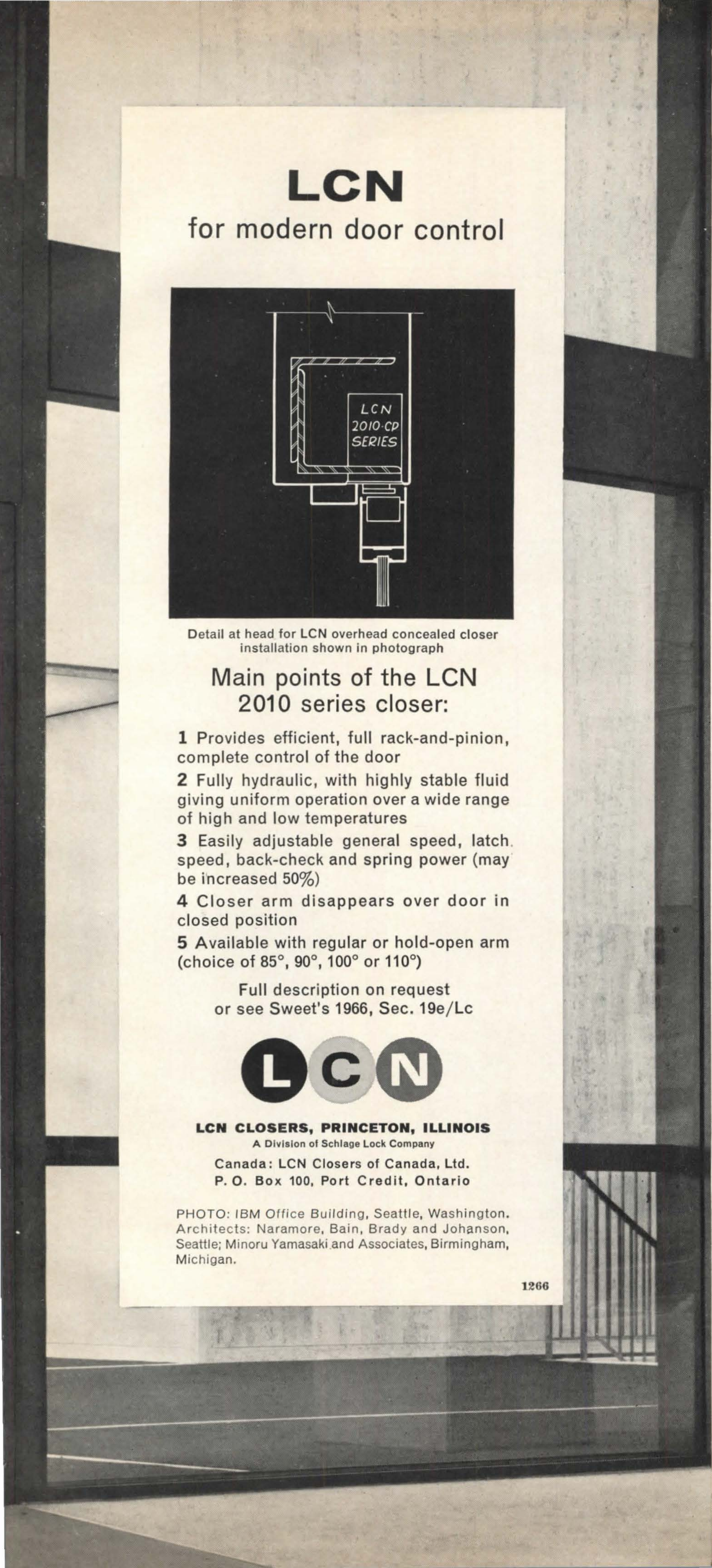

Continued from page 212

Harley, Ellington, Cowin & Stirton, Inc., Architects-Engineers, Detroit, Mich., have elected Malcolm R. Stirton executive vice-president, Paul B. Brown secretary, and Frederick J. Hildenbrandt treasurer.

Manson-Jackson & Kane, Inc., Architects, Lansing, Mich., have appointed Herbert J. Iversen managing architect.

Neal Goldman Assoc., Inc., Architects, New York, N.Y., have appointed Karl A. Crnobori vice-president and director of interior planning and design.

P & W Engineers, Environmental Engineering Consultants, Chicago, Ill., have elected David L. Grumman vice-president.

Stevens & Wilkenson, Architects-Engineers, Atlanta, Ga., have appointed Kemp Mooney a designer.

New Partners, Associates

Berger-Landrum-Field, Architects, Inc., St. Louis, Mo., have elected to partnership Laurent J. Torno, Jr.

Caudill Rowlett Scott, Architects, Houston, Tex., have named 11 new associates: Gale Garth Carroll, Truitt B. Barrison, Joseph W. Griffin, G. Norman Hoover, Robert W. Kirkham, Victor Lasprogato, Robert F. Mattox, John Almont Pierce, Richard Seinfeld, Malcolm T. Tengler, and Donald Travis Wilson.

Lawrence E. Matson & Assoc., Architects-Engineers, have named Tobias T. Stapleton an associate.

Name Changes

Clark & Morgan, Architects, San Francisco Calif. upon the retirement of John F. Beuttler; formerly, Clark & Beuttler.

Seymour Gage Assoc., Design and Construction Consultants, New York, N.Y.; formerly, Seymour W. Gage Assoc.

Miscellaneous

The Partnership of Gas•Gay, Architects, Denver, Colo., has been dissolved. Mr. Gas has joined the firm of James H. Johnson & Associates, Architects, Denver, Colo., and Mr. Gay will continue his architectural practice in his office in Rapid City, S. D.

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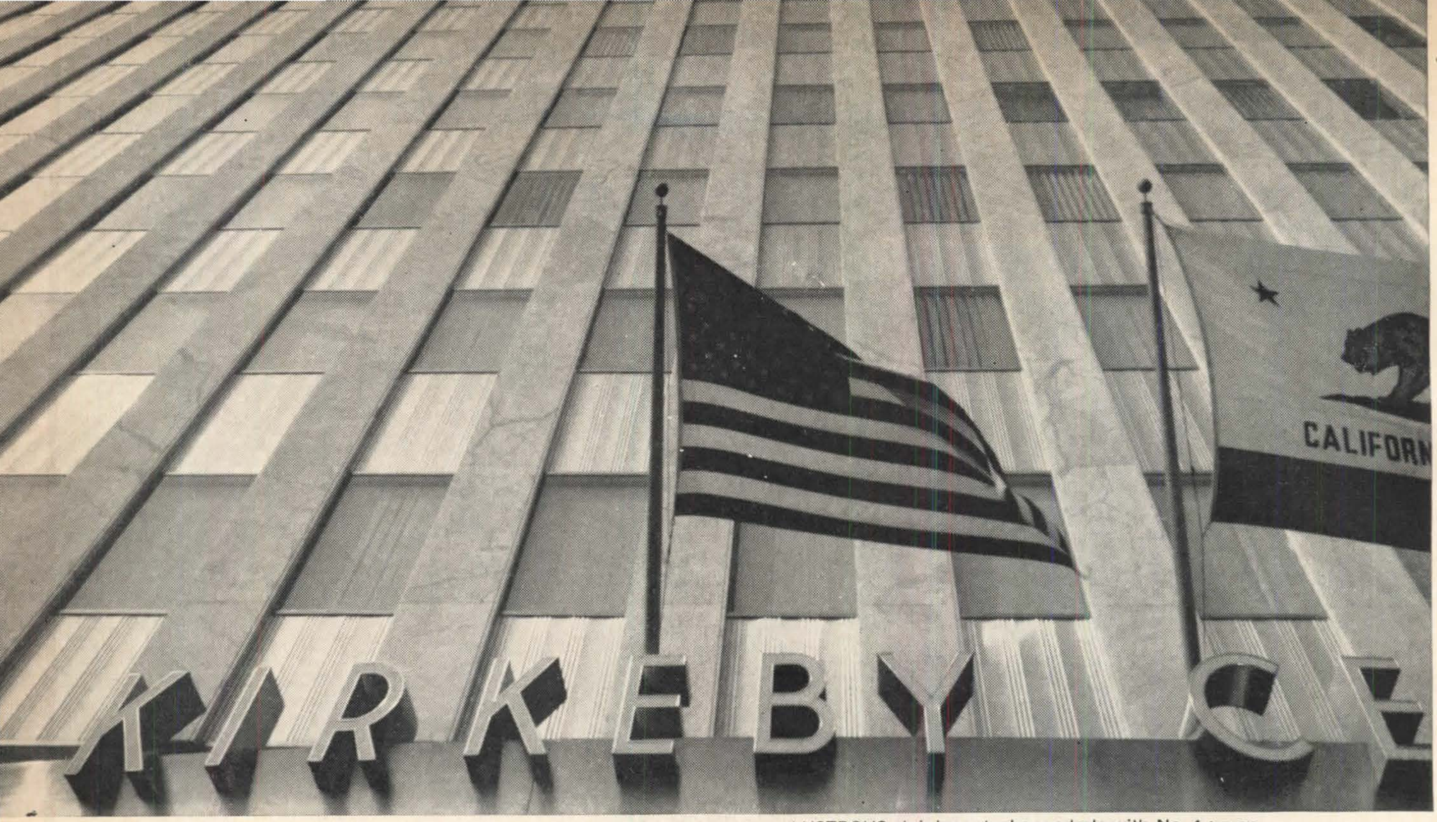
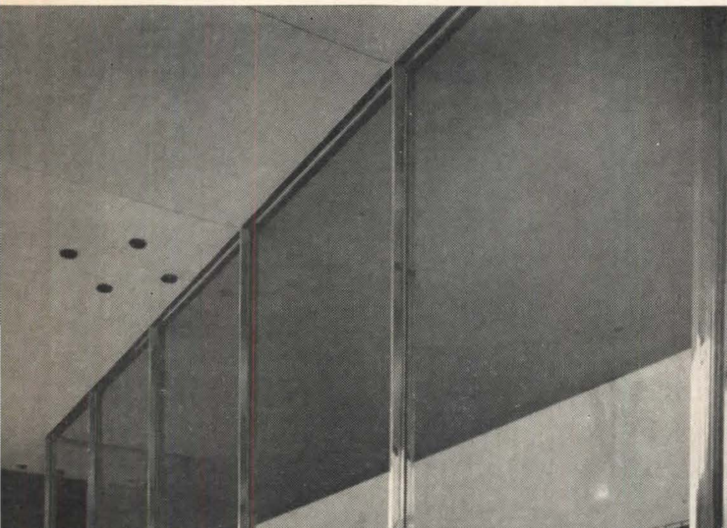
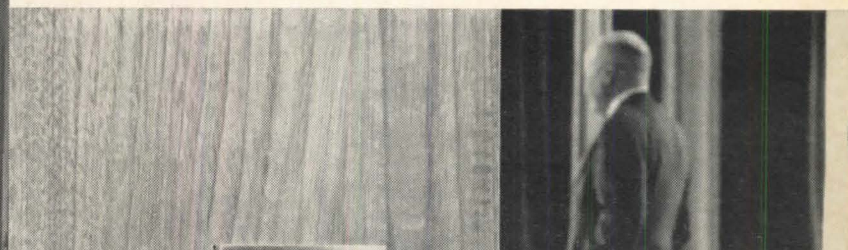


LUSTROUS stainless steel spandrels with No. 4 finish alternate with white marble piers at Kirkeby Center, Los Angeles, California. Architects: Claud Beelman and Associates, Los Angeles, Cal. Spandrels, fluted to provide stiffness and eliminate optical distortion, by Construction Metalwork Corp., El Monte, Cal.



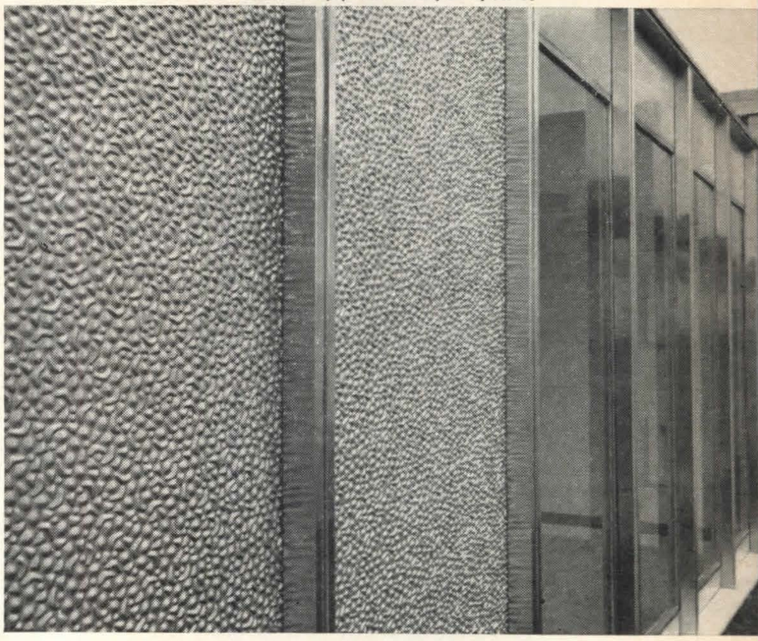


LONG LIFE and maintenance free service were among the reasons for installing 3,000 distinctive, all-stainless steel "Nordic" design locksets in the Equitable Life Assurance Building, New York, N. Y. Architects: Skidmore, Owings & Merrill, New York, N. Y. Stainless steel locksets: Eaton Yale & Towne, Inc., Rye, N. Y.

MIRROR FINISHED stainless steel accents red marble and blast-finished granite and provides durability with minimum maintenance in the Sun Life Building, Baltimore, Md. Architect: Peterson and Brickbauer, Baltimore, in association with Emery Roth & Sons. Stainless steel entrances, column covers and window framing: Allied-Superb Bronze Corp., New York, N. Y.

BOLD USE of stainless emphasizes major structural elements of the Phoenix Mutual Life Insurance Building, Hartford, Conn. Stainless also provided articulation for major mullions of the tower, and was a practical solution for window washing tracks. Architects: Harrison and Abramovitz, New York, N. Y. Stainless steel column covers: General Bronze Corp., New York, N. Y.

DESIGN FLEXIBILITY—Stainless steel curtain wall with rigidized textured panels and stainless steel windows at the Merrit Industrial Park Building No. 2, Fishkill, N. Y. Architect: Louis Battoglia, AIA, Fishkill, N. Y. Curtain wall, panels and windows: United Stainless Window Corp., Woodside, L. I., N. Y.



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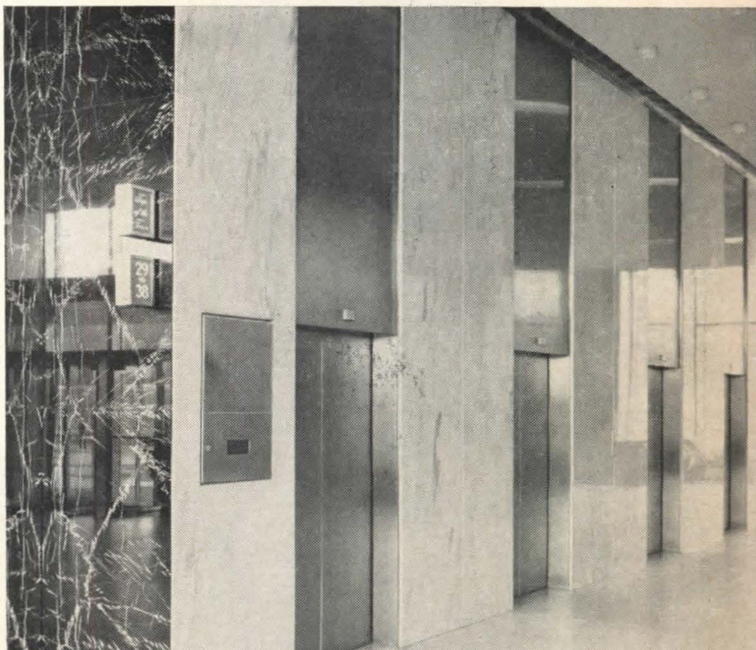

LOW MAINTENANCE in high traffic areas with lustrous stainless steel elevator doors and cabs, at the Erieview Plaza, Cleveland, Ohio. Architects: Harrison & Abramovitz, New York, N. Y. Stainless steel elevator doors and cabs: The Tyler Co., Cleveland, Ohio.

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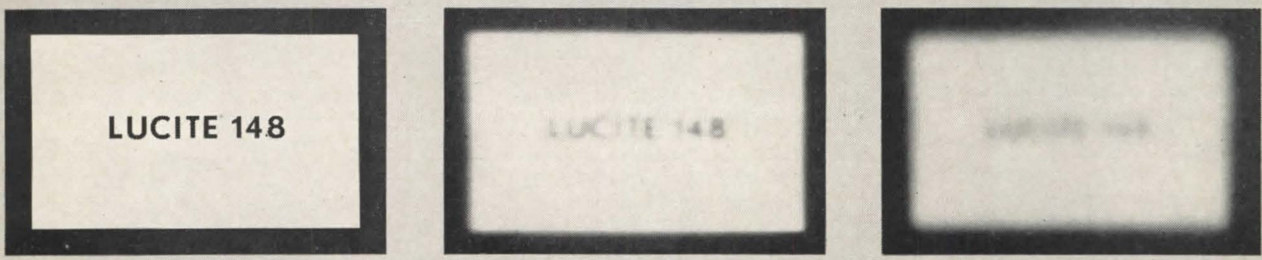

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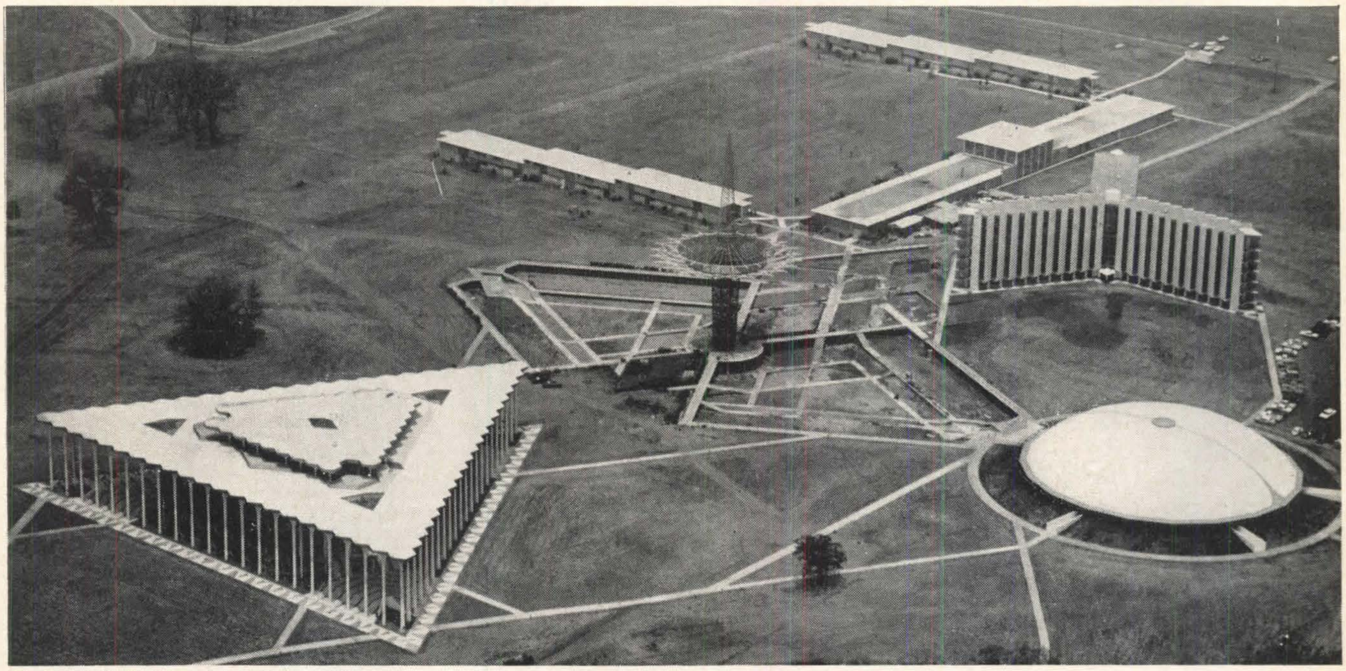

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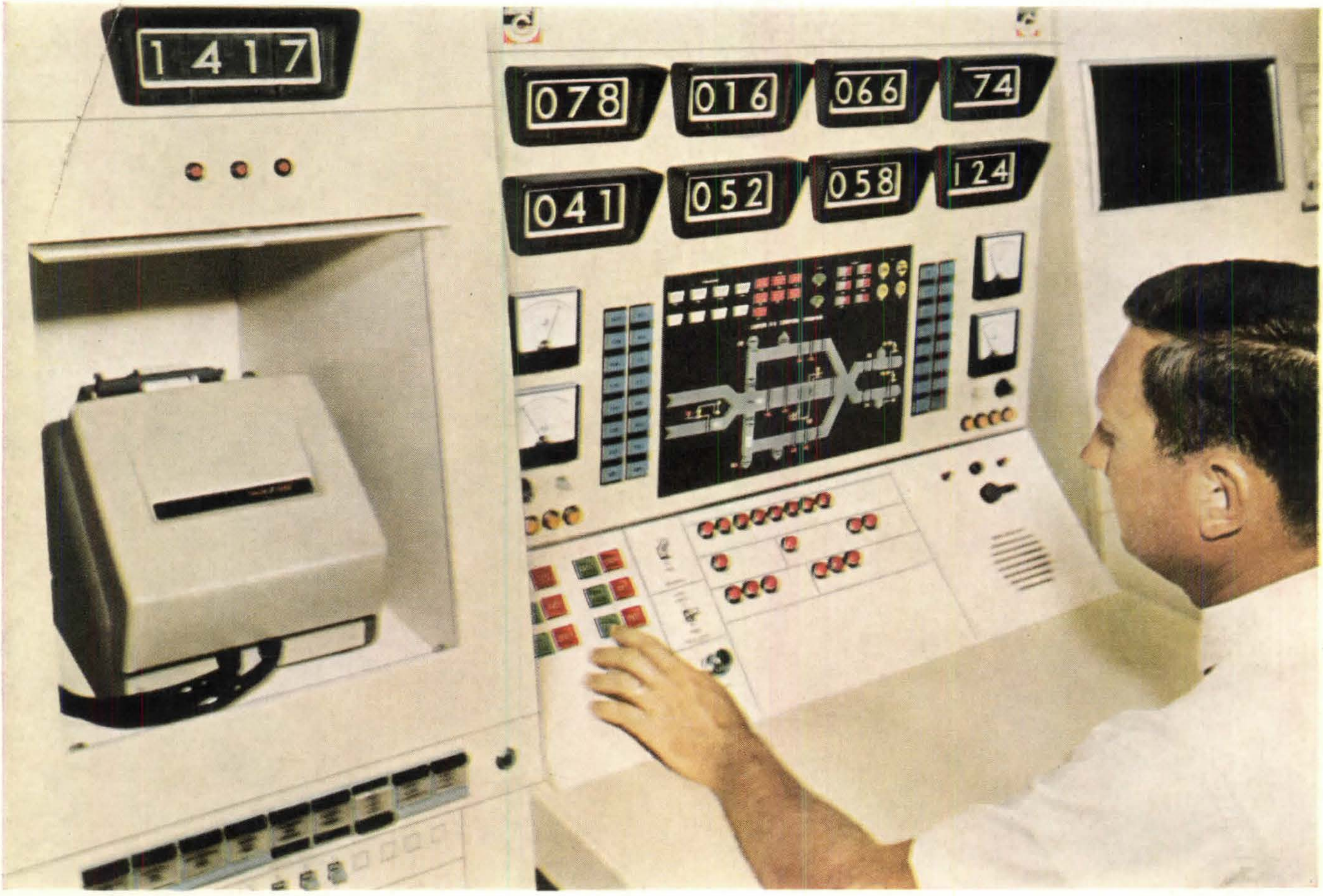

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