ARCHITECTURAL FORUM / JANUARY-FEBRUARY 1972

FORUM

THE WORLD OF BUCKMINSTER FULLER

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I first met Dr. Richard Buckminster Fuller in a basement drafting room in the old Institute of Design, in Chicago, on a Saturday afternoon, in 1947. He was standing on top of a drafting table, kicking his heels and demonstrating some of the steps he had been practicing at the local bebop school; and he explained to me that the beat related, somehow, to a mathematical shorthand that he had just then developed to help him chart his excursions into the universe. He was then in his fifties, and spending a little bit of time on the side, boning up on his football-tackle skills by flinging himself down flights of basement stairs. The next time I saw Bucky he was lightly bandaged, and beaming.

Several years later, after I had become one of his innumerable "dear boys," I found myself with him and a couple of other friends in Red Square in Moscow, taking in the sights. He was, as always, radiant—but slightly more radiant this time than usual, because dozens of Soviet pedestrians were circling him, and beaming back at his beautiful, kind face. "They all know about my dome in Sokolniki Park, dear boy," he said. "They are so well informed—they know exactly what we are trying to do!" I did not have it in my heart to tell him that those beaming Soviets were circling him chiefly because they had never before seen a man with a thick, black rubber band holding up a pair of glasses—the rubber band circumnavigating the wearer's smooth head, equatorially.

In the years that followed, we met in many places—in his unbelievable dome at Expo 67, in Montreal, which Peter Ustinov calls Buckminster Cathedral; in a tacky restaurant at Logan Airport in Boston, with Bucky flying in at noon from Toronto and Trudeau, and leaving two hours later for Uzbekhistan or, more probably, Mars—a steak under his belt, and the memory in his mind and heart of half a dozen of this country's starry-eyed "kids" who had recognized him in the waiting room; and who, immediately, had offered him *their* minds and hearts.

That was about six months ago, after we had decided that the only fitting way to celebrate the 80th anniversary of the founding of this magazine was to devote an entire issue to Bucky. We were enthusiastic and slightly apprehensive at the same time: enthusiastic, because we were as mesmerized by him as everyone else is; slightly apprehensive, because we realized that not even Bucky could have all the answers to the problems of our time.

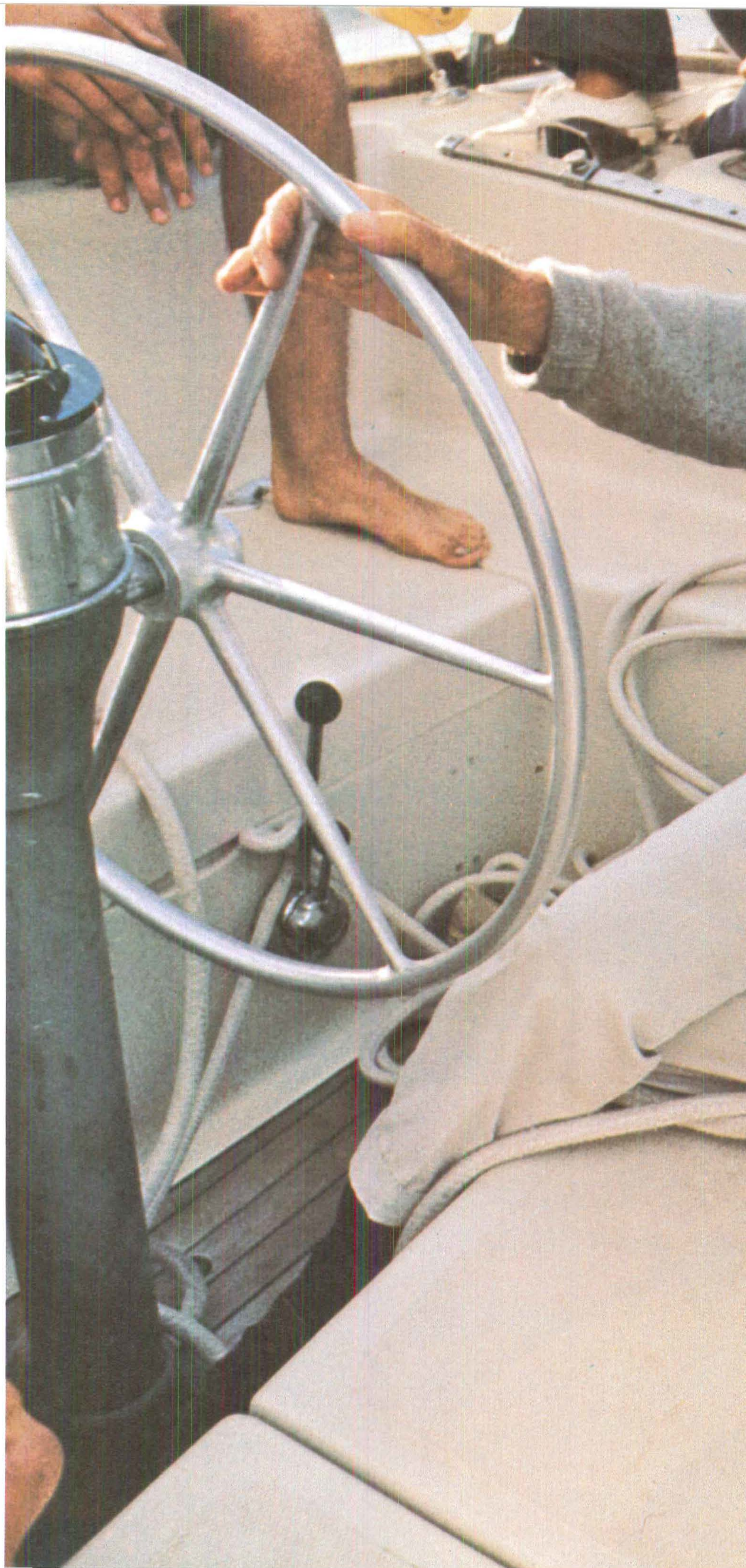
And then somebody said: "He doesn't have all the answers, but he sure as hell has all the right questions!" And, at that point, we suddenly understood that this was precisely what Bucky was all about: he knew exactly how to ask all the right and pertinent and searching and devastating questions. Questions that demand and, therefore, generate significant answers. Questions of the sort that all architects and planners and environmentalists should be asking, and so few do.

That, of course, is what makes Bucky so enormously attractive to all of us, young, middle-aged and old alike. The young, it seems to me, are bored with people who have all the answers—to all the wrong questions. The middle-aged have become skeptical, from experience, about specialists—and Bucky is the generalist *par excellence*. And the old, in America, see in Bucky a wonderful affirmation of traditional virtues—the Yankee skipper, charting a new course in a new world: the adventurous American, respectful of the past, conscious of the present, but preoccupied with the future.

And, so, Bucky is the link that has been missing in recent years—the link between the American past and (hopefully) the American future. His life is a work of art; and what we have tried to do in this issue is to do justice to that life and that work.—PETER BLAKE.

"Here is Buckminster Fuller.
The men of his family
were preachers and lawyers
who attacked the moral
and social problems of a
new world. The New England
that burned witches,
that prayed to a Jehovah God,
that hoped all the while
for Christianity, made of this
son of theirs a young person
capable of such intense
suffering that he must,
in self-defense, refer
to the race of men as the
human family and attack its
problems to forget his own."
From the Chicago Evening Post, 1930.

At right: Fuller in his boat, "Intuition,"
off Bear Island, Maine.
PHOTOGRAPH: Jaime Snyder



MERCEDES MATTER:

His life as a work of art

"I am a perfectly ordinary man," R. Buckminster Fuller is apt to remark when introduced to a cheering audience as the phenomenal one-and-only Bucky Fuller.

Fuller insists that his da Vincian character is merely normal for man who, among all the creatures in nature, is designed *not* to be a specialist. Fish cannot walk, bears cannot fly, but man, by virtue of his conceptual mind, is able to extend himself, to take on wings or leave them at the airport, to adapt himself to the most diverse circumstances. And children ask questions about *everything*, Fuller points out. It is only gradually that their curiosity becomes stifled or narrowed into exclusive directions.

While Fuller is now recognized as a controversial innovator in many fields—as architect and engineer, as mathematician, scientist, philosopher and inventor, as lecturer, author, and scholar, as designer and poet—it is not so much as one of these, but as the whole to which they so richly contribute, that he is a mighty revolution. The Fullerian world is a world so new that it may take many generations to absorb it—if we are granted the time.

In each field there are those who proudly, jealously claim him as their own; yet there are those, who—precisely in their own field—repudiate him, while granting his genius in others.

Fuller is widely acknowledged and loved, yet he can still inspire a sort of resentment. One sees this reflected even among people who know little about him. In earlier years he could be dismissed as a crackpot dreamer. But as his mathematics bear more and more fruit in actual achievements, acclaimed throughout the world, it is no longer possible to discount him. Yet the reluctance to accept him remains. As with other great innovators of our time—Freud, Marx, Einstein—Buckminster Fuller is a *threat*. All vested interests, psychological or professional, are threatened by the uprooting innovation of his thought. In a world accustomed to or demanding of the shockingly novel it is surprising how many cannot accept the new. But for those who are free to live vitally in the present the glimpse of Fuller's horizon is intoxicating.

As an artist I claim that it is the artist in Fuller that dominates and permeates his world, giving radiance to every ingredient of his thought whether it concerns the recycling of waste or the metaphysical function of man in the universe. Every aspect is transformed by the magnitude and poetry of his concept.

To hear Fuller speak is, before all else, an esthetic experience. To follow the luminous progression of his thought, the startling leaps it takes when connecting widely divergent phenomena with the powerful cables of his conceptual grasp, is to be shocked, repeatedly, into new awareness while thrilling to the thought process itself. His talks are notoriously long because he cannot bear to stop before he has sketched-in some sense of full circle. What he has to say is always in a race against time, as each factor hinges on another, and all on a sense of totality which, when projected, is precisely the marvel of the experience.

Fuller's abstract formulations are not speculative games, feeding on themselves, but stem always from his penetrating perception of life.

"The most poetic experiences of my life," he writes, "have been those moments of conceptual comprehension of some of the extraordinary generalized principles, and their complex interactions, that are apparently employed in the governance of universal evolution."

Fuller's relation to nature is profoundly felt and intimate—in an almost Saint Franciscan sense. To hear him speak of a bird—its form, its pattern of behavior—"process bird" as he calls it; or of a tree, the principles of construction that combine to form this marvelous phenomenon, a tree—(he becomes a tree in the describing)—is to see him relate to the bird or the tree with an empathy, an identification such as an artist feels for the object of his attention and inspiration. Each focus of his wondering observance illuminates an abstract principle that finds its place in the vast order of interrelationships forming his inner world. He is able to carry the staggering quantity of knowledge he does, ready at any moment to be spontaneously summoned to mind, not merely because of his prodigious memory but because he has so extraordinary a clarity of concept that each item of knowledge has its place, and is immediately accessible to him when he needs it there.

Fuller draws from history as he does from nature, a fact not appreciated by some of his followers who tend to reject history, to consider it irrelevant or cancelled out by the new. With Fuller, history belongs to the present as part of an evolving process. When he says, "I am not a thing, a noun, I seem to be a verb, an evolutionary process," he places himself in the universe he knows—not, as most of us do, intellectually, but experientially, as a universe without stasis, an interrelating of processes and motions in which past, present, and future form a part. He recounts the history of man from the beginning, again and again, in the context of each subject he presents, pointing clairvoyantly to the future, not through any sort of mystical prophecy but through his empathetic grasp of its shape in evolution. So that every new idea he presents has inherently the density of history and the suggested shape of its continuance.

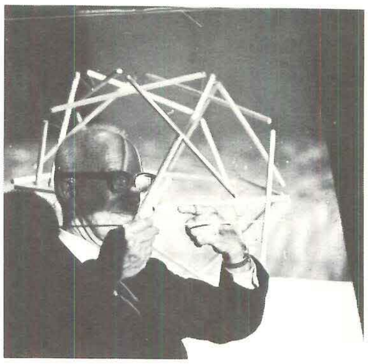
Within Fuller's life and thought I find two main focuses:

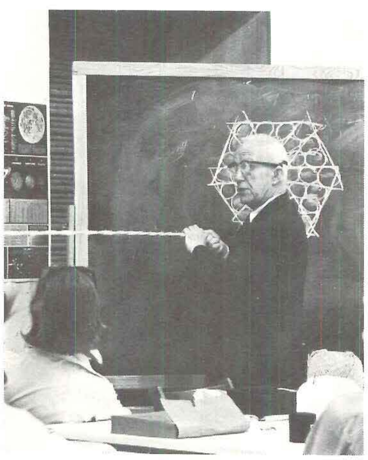
The core of his creative life, the pure realm of conceptual discovery and formulation which finds its most perfect expression in mathematics.

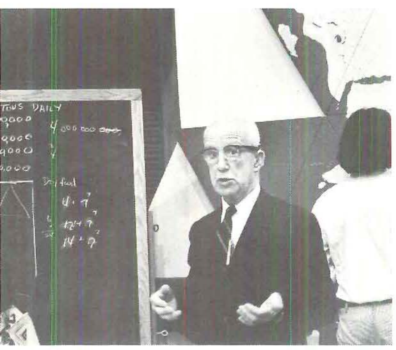
The application of his thought to life, to affecting it on the tiny speck of the universe on which he finds himself, planet Earth.

All Fuller's inventions and designs are but fallout from these central concerns, seeds of his genius that fall in a particular place where he, himself, can scarcely pause; clues, they often are, to future possibilities too far in advance

Mercedes Matter, the painter, is Dean of the New York Studio School of Drawing, Painting & Sculpture.






of current technical know-how to be produced, but depending on predicted developments in which their time will come.

Fuller does not stop long at these because the application of his thought cannot be realized in fragmentary ways. The instrument for its full realization is in what he calls World Game.

I remember going with my husband to visit Fuller in Carbondale, Illinois, in 1968. Walking past the "Moo and Cackle" drive-in restaurant to a nondescript building divided, downstairs, between a hamburger place, a beauty salon and some very ordinary stores, we climbed a modest stairway, and walked down a long, barren corridor to a door at the end. On it was printed:

Inventory of World Resources
Human Trends and Needs
R. B. Fuller

For forty-five years Fuller has been carrying on a vast research. What he has compiled is "the most comprehensive information about the status of planet Earth, which includes all amounts and locations of physical resources on Earth, their rates of consumption and regeneration, as well as the metaphysical resources as represented by man's ideas, concepts, and theories throughout history. It contains trends, known human needs, fundamental behavior characteristics as determined psychologically, anthropologically, ecologically and sociologically. It includes trends in population growth, population migration, birth and death rates, political events, trends and consequences, all socio-economic developments around the whole world." It includes weather patterns, crop patterns, global food production per year, etc, etc.

The concept of recycling waste, of putting to valuable use what is otherwise polluting, was inherent in Fuller's thinking from the beginning. The idea of utilizing generative forces that are free and inexhaustible: the sun, the wind, the tides of the sea instead of spending the Earth's already too-diminished supply of fossil fuels, is a typical outcome of Fuller's research. (Gasoline would cost a billion dollars per gallon when measuring the time Nature takes to produce it.)

World Game is the fruit of this long research and the instrument for its utilization.

It is, first of all, a pool of global information to be continuously updated from every possible source. A new source, "Space Intelligence", provides information from the satellites whose sensors pick up electro-magnetic and thermodynamic frequencies registering specific temperatures of metals, woods, furs, flesh, etc. Thus they can identify, and locate, every head of cattle on Earth, every crop of grain, and so on.

Yet no center of coordination for such global information exists!

World Game proposes to be this center as the framework for global planning, for eliminating the causes of poverty and war, and for protecting and restoring the ecological integrity of planet Earth to the degree this is possible.

Although, in principle, World Game can be played as it was for forty-five years by Fuller himself, without a computer, or, as he says, "longhand", as its proper scale for coordinate use, it will need to employ a vast complex of high velocity digital computers with megabit capacities approaching four million bits each. These will be set up in conjunction with a map of the world visualized as the size of a football field, the dymaxion map being Fuller's unique cartographic projection of the world without visible distortion, the continents projected continuously to form a one-world island in a one-world sea.

On this scale World Game was designed to occupy Fuller's dome at Expo 67, commissioned by the United States government to be Fuller's *oeuvre* both inside and out. As Fuller's research had led him to predict that the United States would have reached its lowest point in world esteem by 1967 he thought World Game might be a redeeming gesture. But the government did not accept it.

Subsequently the state legislature of Illinois allocated $4,000,000 matching funds to construct World Game at Southern Illinois University, but the remaining $12,000,000 were not raised. It seems that we are not ready to pay toward a continuing instrument for peace what we spend *every four hours* on a war.

World Game has not yet been built.

The military of sovereign states utilize computerized war games, played according to von Neuman's game theory of win-all-or-nothing, in order to determine strategies in projected situations of war. World Game, a game in which all or none must win, should ideally be an instrument for international cooperation to determine strategies for peace.

Players can be anyone from students to statesmen. The World Game center will seek to utilize the combined intelligence of the world's best minds in all fields of thought and experience.

Players "will take simulated steps for the designed uses of resources—both virginal and pollutional—to transform the physical circumstances of life which are responsible for poverty, war, and ecological devastation." Any play shown by the computers to lead in the direction of war, or to misuse of the Earth's resources, or to the gain of one part of the world at the expense of another, will be invalidated. Players will not compete to win *against* each other but, in the case of opposing interests, they will not be yielding directly to one another but to the disinterested findings of the computers.

The premise of World Game is Fuller's recognition that "Spaceship Earth" is most beautifully equipped to provide for all mankind with a sufficiency undreamed of by even the wealthiest of the past. The programs that will be selected as being "favorable for all humanity will go far beyond man's ignorant ways of assessing what he *'can* afford'. The computers will demonstrate that he can afford nothing short of the best, which is to make Spaceship Earth a successful environment of man."

Fuller has invariably observed in the many fields of his research that "life tends to behave very well when it has the right environment" and badly when this is inimical to its needs. World Game aims at reforming—not people—(for which there might never be time, even were humanity not on the brink of disaster) but the environment in which they live.

Is there still time? Or has mankind already passed the point of no return in its squandering, pollution and destruction of this planet? Fuller admits it may have. At best, he warns, *time is running out.*

In effect, World Game may be thought of as a last-minute emergency measure to bypass politics and all the seemingly insurmountable human problems of ignorance, prejudice and conflict—ideological, racial, national—to bypass these, to put the facts before the whole world and to attempt to deal with them coherently.

Mankind has so far never attempted, in full consciousness, to take its collective destiny into its hands and shape it. Under the threat of extinction this is what Fuller urges that it do.

Is so grandiose an undertaking merely visionary and unrealistic? Rather, is it not less realistic to continue to think locally, to approach an inevitable end, divided against one another and paralyzed with inertia before the immensity of the task?

In recognizing the full scope of the job to be done Fuller has shown the beautiful audacity to take it on, without hesitation, totally. He has had the courage and energy to initiate it and has lent it substance with the scope of his vision and the practical contribution of his research.

Typical Fullerian concepts—such as "anticipatory design science", "more with lessing", synergy — contribute to the feasibility of World Game.

"More with lessing"—the accomplishment of ever more by means of metaphysical spending (intelligent use of principle) to achieve less material spending, is the very operating principle of the Game. "How much does this building weigh?" is a typically devastating question of Fuller's. Few structures make the grade in terms of economy, strength and lightness as demonstrated by his geodesic dome—an ultimate triumph of principle over matter.

Synergy, which is to energy what integration is to differentiation, is often the mysterious *plus* in a whole, beyond the sum of its parts, in terms of strength or energy. If man would act synergetically to better his world he might perform the miracle that is needed for its survival.

Although World Game has not yet been constructed physically, it already exists, in an important sense, as an attitude, a way of thinking. Today, throughout the country, there are World Game groups, mostly among young people, who find in it a promise of positive action to make over the world they have inherited, to fend off the doom that shadows their lives.

In the summer of 1969 Fuller gave a seminar on World Game at the New York Studio School

where it was played for the first time by any group, though without the aid of computers. This was arranged in conjunction with Herbert Matter's projected film on World Game. Fuller gave to it an extraordinary amount of his time considering the two-year-in-advance schedule he follows of work and travel. The seminar, under the excellent guidance of Edwin Schlossberg, included several students of art who were joined by a group of students majoring in sixteen different fields from universities throughout the country.

These young people brought their particular backgrounds of experience to bear on the reality of now and, as Fuller put it: "This was not merely an exercise nor a learning device but a process of discovery on the actual frontier to man's future, a future with alternatives of unprecedented possibility or extinction."

Confronting these alternatives students were inevitably led to think in terms of world strategy, that is, as world citizens.

They each performed research, in some cases gathering information never documented before as, for example, the existence and location of every power line on the face of the earth. As power is the first step toward industrialization it is interesting that this information had not yet been assembled.

The transformation of these young people within two months was spectacular. Accustomed, in many cases, to expressing their dissatisfaction only through negative protest they now discovered a world of possibility to act on, a credible basis for building.

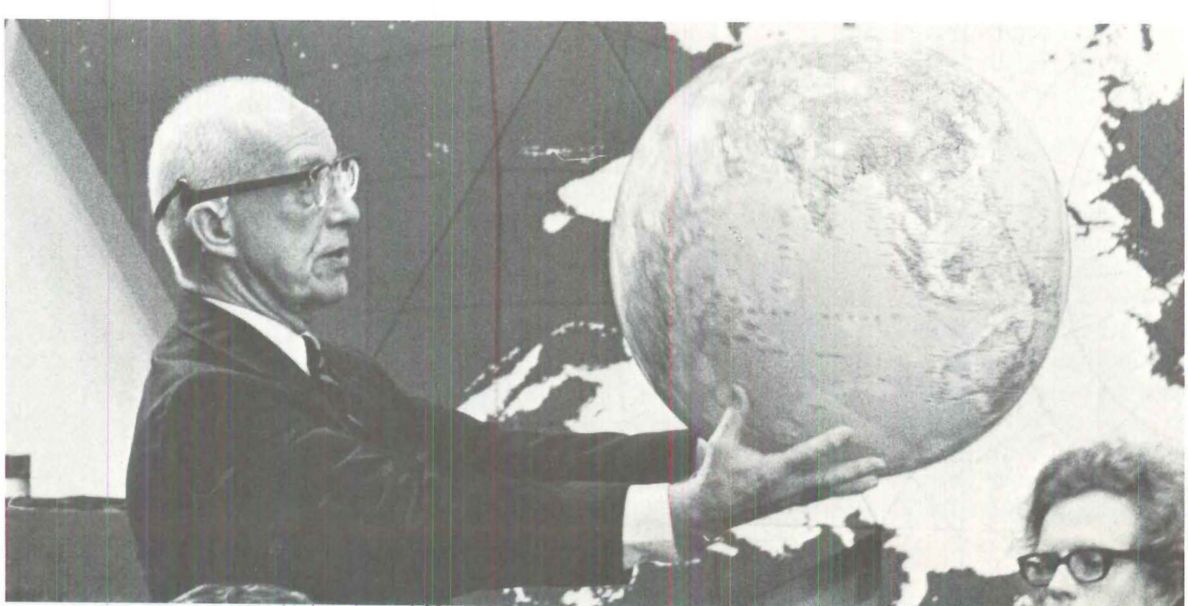
The interrelating of students from different fields confirmed their confidence through the utilization of their particular skills, while extending their horizon through exchange with the others.

This learning, in collaboration, to grapple with present reality and possibly to affect it, created a dynamic I have rarely seen in any educational undertaking. It showed World Game to be one of the most radical innovations in education.

Of course the students had with them the very greatest of teachers. Fuller's characteristic translation of abstract ideas into visual form through mathematical models, maps, charts made his concepts accessible and, in a special sense, to students of the visual arts. But it was particularly his presence, the first hand presentation of his ideas, that was important. This is not at all the same as their representation by others. I have seen World Game, in fact, the entire Fullerian world, disintegrate into pieces of tin, scrap iron and waste, quantities and statistics and costs when talked or written about by others. The magic is lost, the vision which makes of every part a manifestation of the whole.

When I think about Bucky Fuller I visualize him in the midst of this world he has created, inhabited by the geometric configurations which play so important a role in it; toward these—his very dear friends, especially his "old friend the tetrahedron", (basic structural component of universe)—he shows the liveliest affection. And it is here, among these, that he lives. Though he flies from continent to continent—being almost as frequently off Spaceship Earth as on it—his life is not a restless one. It is quite still. The continuity of his thought is not disturbed by the shiftings of his physical self. When he speaks he very often closes his eyes to gaze inwardly at this universe. His words project it to us and in relation to its immensity he appears quite small.

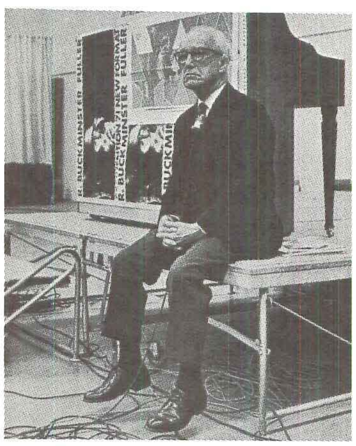
In fact this dauntless figure of Bucky in the midst of his enormous thought world, spending himself beyond the limits of mortal probability on his task, attempting to bring order to a chaotic world in critical condition—this figure cannot fail to move one in a human sense, even if the full import of his thought is not accepted nor enjoyed. For this modest, humorous but indomitable New Englander of seventy-six years is something of a miracle. A schedule of work and travel such as his would more than tax the physical capacities of the young and normally strong. The energy he spends and receives back from it is not to be rationally explained. But we know it to be an energy of love with the tool at its disposal of undoubtedly the greatest conceptual mind in the world today.



PHOTOGRAPHS: Pages 53-56 by Steven Sloman

TIMETABLE:

Some recent weeks in the itinerary of a world citizen



April 21 Drive to New York City, New York
Stay: Beverly Hotel
Work on "Synergetics" Book with Ed Applewhite

April 22 Work on "Synergetics" Book with Ed Applewhite

April 23 Work on "Synergetics" Book with Ed Applewhite
7:00 p.m. President's Dinner at the Salamagundi Club, 47 Fifth Avenue, New York City
Host: Mr. John N. Lewis, President
Stay: Beverly Hotel
Fly from New York City

April 24 Arrive Boston, Massachusetts
Dinner with Charles Haar.
Stay: Somerset Club

April 25 Lecture at MIT, Kresge Auditorium, for charity to Margaret Fuller House.
Host: Robert Brown, President, "The Alliance"
99 Austin Street, Cambridge, Mass.
Stay: Somerset Club

April 26 Drive with Shoji Sadao to Upjohn Laboratories, New Haven, Connecticut — Meet with Mr. Grieve.
p.m. Drive to New York City with Shoji.
Stay: Beverly Hotel

April 27 Fly Via Shuttle from New York to Washington, D. C.
Meet with Harold Cohen, Washington, D. C.
Stay: Mayflower Hotel

April 28 Fly from Washington, D.C. to Hartford, Connecticut
afternoon Press Conference
p.m. Speak at Combustion Engineering Conference at the Hotel Sonesta in Hartford, Connecticut
Host: Richard A. McCormack
Vice President—Field Sales
Windsor, Connecticut
Stay:

April 29 Fly from Hartford to St. Louis, Missouri
Meet with East St. Louis Council regarding "Old Man River" project
p.m. Fly from St. Louis to Carbondale, Illinois

April 30 Speak at S.I.U., for Committee for Future, Carbondale
Host: Alan Ludwig

May 1 Meet with Mr. Chuck Albertson and three Guilford High School Students in Carbondale Office

May 2 Carbondale

May 3 Fly from Carbondale (Dr. & Mrs. Fuller) OZ 841
12:50 p.m. Arrive St. Louis, Missouri (Met by Parker Wheatley)
3:00 p.m. Appear on KMOX-TV (Channel 4) Taped Interview—"Eye on St. Louis" (Color show—wear colored shirt)
Host: Parker Wheatley
Stay:

May 4 Fly from St. Louis OZ 902
3:10 p.m. Arrive Milwaukee, Wisconsin
8:00 p.m. Speak at the Opening of the Annual AIA Convention in Milwaukee
Host: Maynard Meyer
Maynard W. Meyer & Associates
Stay: Red Carpet Inn, Milwaukee

May 5 Participate in the AIA Convention
Host: Maynard Meyer
Stay: Red Carpet Inn, Milwaukee

May 6 Leave Milwaukee N. Central #54
8:30 p.m. Arrive New York City (La Guardia)
Stay: Hilton Hotel

May 7
9:30 a.m. Meet with Governor Rockefeller in the Green Room

10:00 a.m. General Session in the Grand Ballroom (third floor)
Luncheon Speaker at Annual Governor's Conference on the Aging in New York City at the Hilton Hotel.
Host: Governor Rockefeller
James O'Malley
Stay: Hilton Hotel

May 8 Fly from New York City (Kennedy) Am #121
10:13 p.m. Arrive Los Angeles, California
Stay: Pacific Palisades, California

May 9 Interview with Rosa Gustaitis, Free Lance Writer (at Allegra's)
Stay: Pacific Palisades

May 10 Fly from Los Angeles (via BPWC private plane)
Arrive Bishop, California
Speak at the California Scholarship Federation Honor Students' Banquet in Bishop
Host: Mrs. Robert Denton, Chairman
Scholarship Banquet
Fly from Bishop (via BPWC private plane)
Arrive Los Angeles, California
Stay: Pacific Palisades, California

May 11 Fly from Los Angeles
12:00 noon United #8 (steak ordered)
8:10 p.m. Arrive New York City (Kennedy)
Meet Mrs. Fuller
Stay: International Inn

May 12 Fly from New York City (Kennedy) BOAC #
9:50 p.m. Arrive London, England

May 13 London

May 14 London

May 15 London — Marty Andrews' wedding (Fiance — Elizabeth Scott)

May 16 London

May 17 London

May 18 London

May 19 London

May 20 Attend the Annual Dinner of the Architects Industry Group in London
Host: Stuart Bentley
Sutton Coldfield, Warwickshire, England

May 21 Fly from London BOAC 505
3:50 p.m. Arrive New York City (Kennedy)
Drive to Manresa Retreat House with representative of the Catholic Convention.
Stay: Ridgefield, Connecticut

May 22, 23 Meet with Monsignor Bordelon and speak to the Catholic Convention at the Manresa Retreat House, Packova Trail, Ridgefield, Connecticut.
Drive from Ridgefield to New York City

May 24 Fly from New York City (La Guardia) AM 119
3:10 p.m Arrive St. Louis
5:20 p.m. Leave St. Louis Air Ill. 153
5:55 p.m. Arrive Carbondale, Illinois

May 25 (Tentative) Meet with Group of Teaching Assistants in the Department of Secondary Education at S.I.U.
Host: Arthur L. Aikman

May 26 Carbondale

May 27 Marilyn Hylland will pick BF up at Dome.
10:00 a.m. Press and T.V. Interview
11:15 a.m. Informal Luncheon — University River Room, University Center
1:00 p.m. Deliver the University Convocation, S.I.U. Arena, Carbondale.
2:00 p.m. Informal Coffee Hour.

May 28 Visit Brush School, 6th Grade, Carbondale. (Mrs. Vernon Sternberg will pick BF up at the Dome)
6:00 p.m. Summary Speaker at "Alternative 1971" Conference at S.I.U. (Children's Hour) near Arena, outside.
Host: James Sullivan

May 29 Fly from Carbondale Air Ill. 122
11:20 a.m. Arrive St. Louis, Missouri
12:15 p.m. Leave St. Louis Delta 356
1:07 p.m. Arrive Chicago, Illinois (O'Hare)
2:00 p.m. Leave Chicago No. Central 457
2:45 p.m. Arrive Green Bay, Wisconsin
Stay: Beaumont Motor Inn

May 30 Lunch with Chancellor Edward Weidner at his home.
2:30-3:00 p.m. Commencement Address at University of Wisconsin, Green Bay.
Host: Thomas J. Birmingham, Coordinator
Paul Davies Lectures and Fine Arts Program
6:10 p.m. Fly from Green Bay No. Central 294
7:00 p.m. Arrive Chicago, Illinois (O'Hare)
Stay: Sheraton Blackstone

May 31 Work with Ed Applewhite on "Synergetics" Book.
Stay: Sheraton Blackstone

June 1 Leave Chicago (Midway) United 719
3:50 p.m. Arrive Denver, Colorado
Herman Wolf will meet flight
5:30 p.m. Press Conference at Brown Palace Hotel.
6:00 p.m. Attend Reception and Dinner in the Exhibition Hall at the Convention Complex with Kyran McGrath, Director of the American Association of Museums, Denver, Colorado.
Stay: Brown Palace Hotel

June 2 Keynote Address at Annual Meeting of American Association of Museums in the Theatre of the Denver Convention Complex.
Host: Kyran M. McGrath, Director
James M. Brown, President (introduce BF)
Jane Eyster
American Association of Museums
1:30 p.m. Interview KOA-TV
5:50 p.m. Fly from Denver TWA 444
8:45 p.m. Arrive St. Louis, Missouri
9:55 p.m. Leave St. Louis OZ 843
10:43 p.m. Arrive Marion, Illinois
Drive Avis Car to Carbondale, Illinois

June 3 Work with Herman Wolf, Carbondale
3:00 p.m. Meet with Herb Roan of S.I.U. Design Dept.

June 4 Interview with Anne Zimmerman who is commissioned by S.I.U. to write "The Morris Years at S.I.U.," Carbondale.
2:30 p.m.
3:00 p.m. Interview with Michael Sheldrick, Chicago Bureau, McGraw-Hill World News for "Electrical World," "Nikki Business," and "College and University Business" Magazines, Carbondale.

June 5 Drive from Carbondale
Arrive St. Louis, Missouri
Stay:

June 6 Leave St. Louis AM 398
1:06 p.m. Arrive Chicago, Illinois (O'Hare)
1:40 p.m. Leave Chicago AM 392
4:01 p.m. Arrive Toronto, Canada (Mr. & Mrs. Dwyer will be on same flight and will drive BF to Royal York Hotel) Doug Bates also
Attend Reception and Buffet in Ontario Science Center marking Canada's Centennial in 1967.

June 7 Deliver Opening Address (30 minutes) at the 100th Annual General Meeting of the Canadian Manufacturers' Association in Toronto
Theme: "The Future Is Now"
12:30 p.m. Luncheon Feature Speaker at "The Future Is Now" Meeting, (30-45 minutes)
Host: A. G. W. Sinclair, President
The Canadian Manufacturers' Association
Between 4:00 & 5:00 p.m. Mr. Grossman, Minister of Housing, will pick BF up and take on tour of Ontario Place
7:00 p.m. Dinner with Prime Minister of Ontario, Mr. William Davis, Gerald Gladstone, and Ed Murvish
Stay: Royal York Hotel

June 8 Breakfast meeting with Ed
9:00 a.m. Hauben and Marshall McLuhan at Royal York. (Eric and Ed McLuhan will also be present)
12:00 noon Lunch with Henry Strub, and Ed Fitzgerald at Royal York.
2:30 p.m. Visit Warner - Lambert Canada Ltd. to see the wall relief structure of the Dymaxion Air Ocean Projection in Board Room.
Host: Mr. A. Z. Pengelly
Mr. Bilodeau, President
6:00 p.m. Reception in the Ballroom.
6:30 p.m. Join the Head Table Guests and the Prime Minister in Room A for Informal Reception before Dinner.
7:00 p.m. Head Table Guest at Annual Dinner, when Prime Minister Trudeau speaks, in the Canadian Room (black tie)
Stay: Royal York Hotel

June 9 Leave Toronto Mohawk 146
11:56 a.m. Arrive Boston, Massachusetts
2:15 p.m. Leave Boston NE 6
3:03 p.m. Arrive Bangor, Maine
Drive to Mount Desert, Maine
8:00 p.m. Deliver the Graduation Address at Mt. Desert Island High School.
Stay:

June 10 Visit Hinkley's Yacht Harbor, Southwest Harbor, Maine
Fly from Ellsworth, Maine to Ottawa, Ontario

(Tentative)
June 11 Speak to top twenty officers in the Dept. of External Affairs in Ottawa

June 12 Fly to North Dartmouth, Mass.
Stay:

June 13 Room 104 of the Group 1 Building for robing.
2:00 p.m. Attend Southeastern Massachusetts University 71st Commencement Exercises. BF to receive Degree of Doctor of Fine Arts (honoris causa)
Host: Joseph Lee Driscoll, President
The Commonwealth of Massachusetts
Southeastern Mass. University
Attend President Driscoll's Reception in honor of degree recipients at 128 Chase Road

June 14 Drive with Herman Wolf to Fairfield
Meet with Mr. John Martin, Chairman of the Board, Heubline, Inc., with Mr. McGarry and Herman Wolf
Stay: Fairfield, Connecticut

June 15 Drive from Fairfield to New York
12:00 noon Leave New York (La Guardia) TWA 171
1:20 p.m. Arrive St. Louis, Missouri
2:35 p.m. Leave St. Louis OZ 845
3:12 p.m. Arrive Marion, Illinois
Drive Avis Car to Carbondale, Illinois

June 16 Interview with Mrs. Anne Zimmerman
11:30 a.m. Interview with Mrs. Michelle Klaus, of the Southern Illinoisan, for article about future of Southern Illinois, at the Dome.
2:45 p.m. Fly Charter Plane to St. Louis, Missouri
4:00 p.m. Fly from St. Louis TWA 56
7:05 p.m. Arrive New York City (La Guardia)
8:00 p.m. Attend Dinner at Ambassador Rossides' Apartment, 45 East 89th Street, New York
Stay: Beverly Hotel

June 17 Drive from New York to Fairfield, Conn.
Work with Ed Applewhite on "Synergetics" Book
Stay: Fairfield, Connecticut

June 18 Drive from Fairfield to New York City
11:00 a.m. Breakfast meeting with Dr. Martin Meyerson and others. At Beverly Hotel
2:30 p.m. Meet with Gerald Dickler, Ed Applewhite, and Mr. Whitehead of Doubleday.
Drive from New York to Fairfield, Conn.

June 19 Work with Ed Applewhite on "Synergetics" Book in Fairfield
Stay: Fairfield, Conn.

June 20 Drive from Fairfield to New York City
12:45 p.m. Leave New York City (Kennedy) TWA 215
2:29 p.m. Arrive Denver, Colorado (Mrs. Fuller will join BF)
4:00 p.m. Leave Denver Rocky Mountain 100
4:45 p.m. Arrive Aspen, Colorado
Welcoming Party at Hotel Jerome.
Stay: The Aspen Meadows

June 21 Keynote Speaker at the International Design Conference in Aspen in the main tent
Title: "R.B.F.—1971"
Theme: "Paradox"
Host: Richard E. Farson, Dean
School of Design
California Institute of the Arts
Stay: The Aspen Meadows

June 22 Aspen, Colorado
Stay: The Aspen Meadows

June 23 Leave Aspen
Aspen Airway 420
11:25 a.m. Arrive Denver, Colorado
1:15 p.m. Leave Denver TWA 108
4:02 p.m. Arrive St. Louis, Missouri
Drive to Edwardsville, Illinois
Stay: Holiday Inn

June 24 Luncheon Speaker at the National Broadcast Editorial Conference at Edwardsville Campus, S.I.U. (Chancellor Rendleman will introduce BF)
Host: Spencer M. Allen, KMOX-TV
4:00 p.m. Dr. & Mrs. Fuller will fly from St. Louis TW 56
7:05 p.m. Arrive New York, New York (LaGuardia) (For limousine to International Hotel call 995-9000)
8:30 p.m. Interview with Mr. Maotti, Chief Editor of "Les Information" for "World, Where Are You Going?" series (at International Hotel)
Stay: International Hotel

June 25 Fly from New York (Kennedy) Pan Am 118
Stops Paris
(Steak between Paris and Rome)

June 26 Arrive Rome, Italy
Stay: Hotel Nazionale
Tel: 689-251,2,3
12:00 noon Drive to Spoleto, Italy
Stay: Gattapone Hotel

June 27 Spoleto, Italy

June 28 Spoleto, Italy

June 29 Spoleto, Italy

June 30 Drive from Spoleto to Rome, Italy
2:50 p.m. Fly from Rome
Cyprus Airway 317
5:25 p.m. Arrive Cyprus

July 1-8 Cyprus

July 9 Fly from Cyprus Olympic 332
10:30 a.m. Arrive Athens, Greece
Ferry from Athens to Aegina Island (1½ hours)
Stay: ?

July 10 Speak at Aegina Arts Center
Host: John Zervos
Tel: 312/787-1488
Stay: ?

July 11 Ferry from Aegina Island
Arrive Athens, Greece
Stay: Excelsior Hotel
Attend Dr. and Mrs. Doxiadis' reception

July 12-19 Participate in the 1971 Delos Symposium on "Our Buildings (Shells) and the Human Settlements."
Aboard M/S "Apollo"

July 20 Leave Athens, Greece
7:00 a.m. Olympic 291
Arrive London
9:30 a.m. Leave London Pan Am 57
10:30 a.m. Arrive Boston, Mass.
12:45 p.m. Drive Rental car to Amherst, Mass.
Stay: ?

July 21-22 Speak to the Symposium on the Development of Creative Human in Science, Art and The Humanities at the University of Massachusetts
Host: Mr. Theodore Dreier
Mr. Keith Wallace
(Meet with Ed Applewhite re: Synergetics Book.)
Stay: ?

July 23 Drive to Newport, R. I.
Stay: ?

New York Yacht Club Cruise—Rendezvous, Newport, Rhode Island

July 24 Newport Padanaram
July 25 Padanaram—Hadley's Harbour

July 26 Edgartown

July 27 Layover day

July 28 Marion, Illinois

July 29 Queen's Cup-Phinney's Harbour

July 30 To Marblehead

Aug. 1 Astor or Queens

Aug. 2-31 Reserved

Sept. 2 Oceanic Education Conference
Racine, Wisconsin
Sponsored by Johnson Foundation
Host: Gil Slonim

Sept. 5 Fly from
Arrive San Francisco
Leave San Francisco
Arrive Tokyo, Japan

Sept. 6-7 Participate in the Tokyo Conference

Sept. 8 Public three-hour Lecture on Transportation Planning at the Tokyo Conference
Host: Mr. William Marlin
Urban Research Corp. U.S.A. and Center for International Exchange in Tokyo

Sept. 9-22 Tokyo, Japan

Sept. 23 Leave Tokyo Pan Am 800
3:30 p.m. Arrive New York (Kennedy)

Sept. 24 Guest of Honor Speaker at the 1971 Annual United Nations Ambassadors' Dinner

Fall Seminar at Institute for Behavioral Research, Inc. 2429 Linden Lane, Silver Spring, Maryland
Host: Harold Cohen, Executive Director

Oct. 23 Dedication Ceremonies of the S.I.U Religious Center at Edwardsville Campus

Oct. 25 Arrive New Delhi, India

ISAMU NOGUCHI:

A reminiscence of four decades

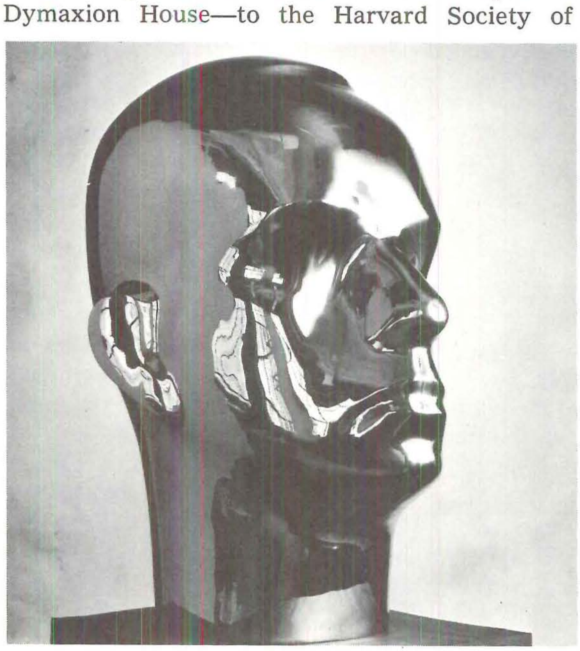
To me it was as yesterday; whenever and wherever I meet Bucky there is a continuation of friendship and mutual interest that started 42 years ago. The conversation and brightness of mind of course were always his, but what strikes me is the deepening of his thought, the never waning memory that seems ever more able to bring data to the proof.

What is even more impressive is the ever-youthful adventurousness of his thought. Brushing aside doubts and side issues that becloud and bemuse most others, he goes straight to the core of any problem, however absurd it might first appear. There is a shock to almost all his proposals, and it is only after reflection that one concedes that yes, ultimately, or possibly in the not too distant future, it may indeed be so.

I first met Mr. Fuller, as I used to call him, at Romany Marie's Tavern in the Village early in 1929. Some time later I got an old laundry room on top of a building on Madison Avenue and 29th Street with windows all around it. By then under Bucky's sway I painted the whole place silver, top, bottom, and sides, to the effect that one was almost blinded by the lack of shadows. There I made his portrait head in chromeplated bronze, also form without shadow.

I had been in Paris for two years prior to this with a Guggenheim Fellowship during which time I had come under the great influence of Constantin Brancusi, and was privileged to work part of the first year with him. But I should say that after returning to New York I was in a sense in revolt against his too-idealizing influence. Bucky was for me the truth of structure which circumvented questions of art. He taught me, but left me free to seek my own way.

My third great influence at that time was Martha Graham and her wonderfully emerging concepts of the dance. I made two heads of her. Indeed I made innumerable heads in those days. Bucky had a Dodge station wagon and we took to traveling together with my heads in back along with the model of his suspended Dymaxion House—to the Harvard Society of Contemporary Art directed then by Lincoln Kirstein and Edward Warburg, to the Arts Club in Chicago, etc.



Isamu Noguchi's work is represented in the collections of major museums throughout the world.

Bucky was in a continuous state of dialectic creativity, giving talks in any kind of situation, before any kind of audience. In fact it did not seem to make too much difference how big the audience. He would talk to me as intently as to a throng, walking and talking everywhere—over the Brooklyn Bridge, over innumerable cups of coffee. Bucky drank everything with equal gusto and would often be in a state of wide awake euphoria for three days straight. Drink did not seem to effect him otherwise.

During the depth of the Depression we often shared quarters together. It might be more correct to say I was his guest, though he did not pay either for that matter. Various hotels like the Carlyle, for lack of customers, would simply give us a bare suite to occupy as we wished. We would move in with our air mattresses and a drawing board and that was it. The less the better was his credo. His *Shelter* magazine was produced under such circumstances.

Due also to the Depression, Bucky, together with Starling Burgess (the designer of the America Cup defender "Enterprise") was able to acquire a factory near Bridgeport, Connecticut, where they proceeded to build themselves a 36-foot boat and where Bucky resolved to revolutionize the automobile with his Dymaxion Car. I did the plaster models for this under his instruction. As is well-known, it had front-wheel traction with a third wheel behind for steering. Eminently rational as is a boat, it simply did not conform to land-based habits of mind.

Bucky's zest for life is part and parcel of his creativity. However, he has the capacity and resolution to come to grips in unknown hours and retreats of the mind to fathom new secrets from the universe. The first came with his jump-off into the Dymaxion World in 1927. During the War years he conceived and patented an omnidirectional geometry based on the hidden tetrahedron within a cube—a unity of two, from which came his geodesic domes.

His determination to shed a third of his weight in later years, the better to devote his energies to teaching us, is another aspect of his total dedication. I have no doubt but that by now every night (he sleeps two hours, now mostly in airplanes) he sees new visions needing to be conveyed for our survival.

His thinking which started out with much the American dream of material progress would seem inevitably to come to question the means by which this has come about. Bucky himself is without acquisitiveness excepting possibly with boats. Believing in man's essential rationality, Bucky remains the supreme optimist—there is a way out. This must be his great appeal to the young. He is a true believer, a prophet for our times. The ultimate machine is no machine—a little black box he calls it—no machine but the knowledge and control of the forces of nature that bind us all in mutual dependence.

NORMAN COUSINS:

The message comes across with clarity and love

I think it was the English historian A. L. Rowse who said that history's great tragedies had one thing in common—people who were involved in those tragedies never really knew what was happening to them.

Bucky Fuller's gift and, I think, his contribution is that he knows what's happening to us. He has a remarkable capacity to look over his shoulder at the whole of the human procession. To see where it has been. Where it's going. Where it gets its energy. What songs it marches to. What causes some people to drop out. And also what factors will enable the procession to reach its goals.

So Bucky is not a formal historian; but he thinks like an historian. He's not quite political scientist, but he knows the art of politics. He's not quite a seer, but he has many of the attributes of a seer. I think the same thing would hold true for any sphere of thought or activity that has to do with that procession.

He is liked by today's youth not because they can diagram exactly what he's saying but because they respond to his spirit.

I've watched him in many parts of the world. In the United States, speaking to businessmen, or to the kids, or the housewives, or the military planners, or to the scientists. I've watched him in the Soviet Union. And to me the fascinating thing is that it's not necessary to know what Bucky's talking about to understand what he's saying. It's not necessary to know precisely what he says to be moved by his message. You may not be able to pass the message along, but you can certainly pass along the effect of the message.

For example, several years ago at the Dartmouth Conference in Leningrad, we had a social evening with both the American and Russian delegations. Someone thought it might be nice to have a sort of intellectual gladiatorial contest. The Americans and Russians were to pit their champions against each other. And the nature of the contest was that each side would put up a man who could talk about the next century, what it would be like, what its challenges would be. The ground rules were 15 minutes for each presentation.

The Russian Academician E. K. Fyodorov spoke first. He told us what the population of the world would be, as the Russians saw it. He talked about the world's food supply, its resources, energy needs, and space exploration. He spoke 14 minutes and 50 seconds.

Bucky then entered the arena and spoke two hours. Characteristic, of course. The Russians, far from resenting the fact that he'd exceeded 15 minutes, didn't want him to stop. Fyodorov was entranced, even though his English was not equal to this. At the end, he leaned over to me and said, "I give up. Fuller wins."

This is amusing. But not really amusing. Because Bucky communicates not just through his words, but through his being. His confidence in the future comes through, even if his reasons for that confidence are not explicitly demonstrated. The fact that he is representative of the best that is in contemporary man comes through, even if the message is sometimes blurred. His command of historical experience and scientific knowledge comes through, even if the particulars can't be itemized. In all these respects, he epitomizes youth, genuineness, sincerity, knowledge, feeling, passion and, more than anything else, *love*.

Bucky makes love to his audience, and they love him back. The words he uses are much less important than the transmission of feeling. And any time a person can have a loving experience today, he knows what life is about.

Norman Cousins was, until recently, the Editor of the Saturday Review.

INDIRA GANDHI:

A vision of unity amidst specialization

सत्यमेव जयते

PRIME MINISTER

With Buckminster Fuller, architecture has gained new meaning. Like others of his profession he deals with living and working spaces, but he is a path-finder in his obsession with the architecture of the universe. His innovations in the use of materials and shapes follow from his endeavour to understand what science and man can do to each other.

Every conversation with Buckminster Fuller is an exhilarating experience. He so clearly sees unity amidst specialisation that he can dismiss the pervasive feeling that technology is a tool-room of destruction; he reassures us that man can triumph over shortcomings for his mind and spirit are man's greatest resources.

I deem it a privilege to be associated with the plans of the Architectural Forum to honour Buckminster Fuller.

Indira Gandhi

(Indira Gandhi)

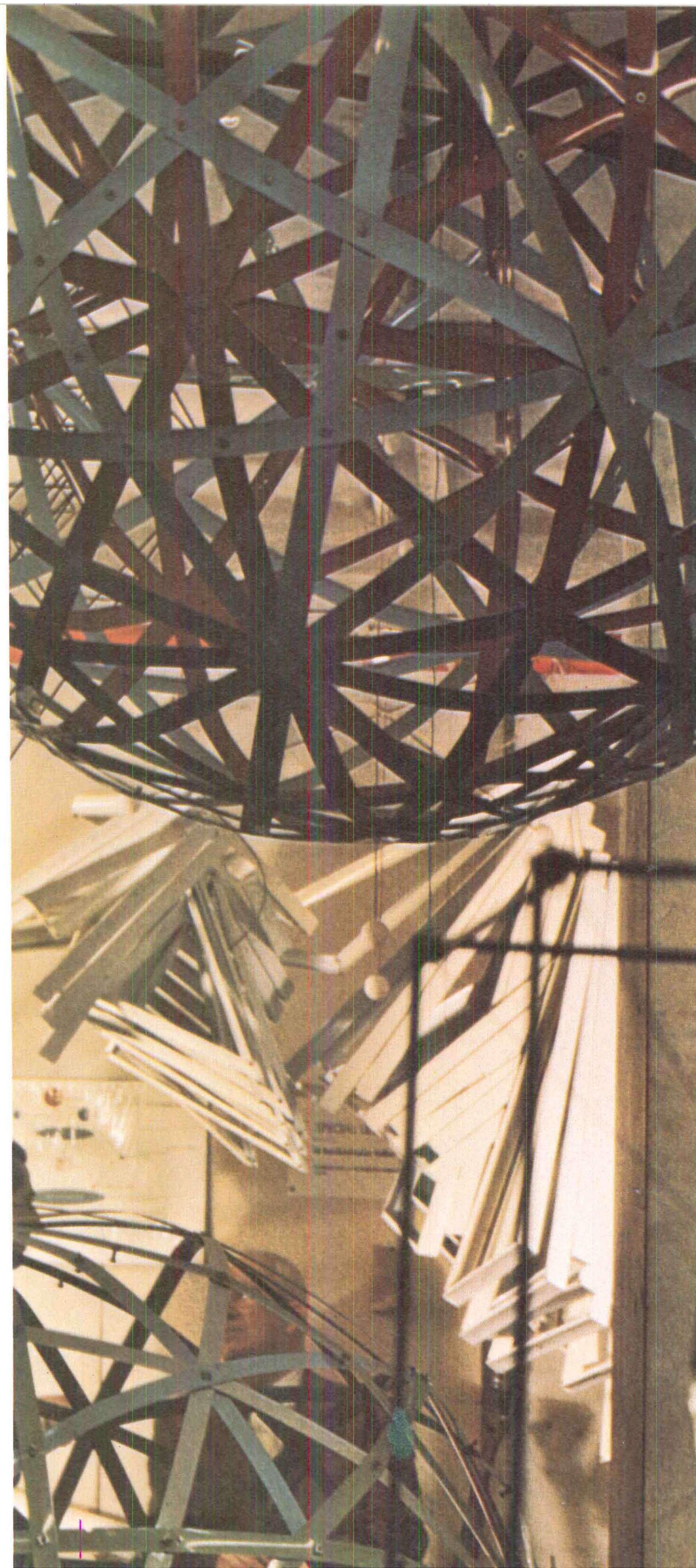
Calcutta,
September 1, 1971.

Prime Minister Indira Gandhi has been a close friend of Buckminster Fuller for many years.

“Buckminster Fuller—
friend of the universe,
bringer of happiness,
liberator.”

Ezra Pound, Spoleto, June 29, 1971

Right: Fuller's workshop at the Institute of Design in Chicago, 1947. PHOTOGRAPH: Charles Eames.



WILLIAM MARLIN:

The evolution and impact of a teacher

One evening last summer, Buckminster Fuller walked into a Chicago restaurant with some cardboards under his arm.

He asked the waiter for a good-size dinner plate and sat down with two associates who had flown in to work a few days on *Synergetics*, Fuller's long awaited treatise on geometry.

Reaching into his coat, he pulled out a rather dull-edged pocketknife and a handful of hair pins. The perplexed waiter finally managed to produce the plate Fuller wanted. About nine inches diameter. And he used it to trace circles on the cardboards. After cutting these out with great care, he folded the circles in half, the halves in thirds. He pushed, pulled and squeezed the folded forms and began putting them together with the hair pins.

Following this solemn, almost childlike ritual, Fuller happily held up an intriguing polyhedron of 14 faces. Six squares. Eight triangles. He passed it around. There was something strange about this structure he had made. It didn't appear to be a "thing" at all. It had no outer surface. It wasn't solid. The squares and triangles were modules of space bound by the configuration of folded cardboards. It was as if invisible forces coming from its center were being restrained by forces moving toward it. It was dynamic. And it was balanced. Not unlike the awfully fit 76-year-old scientist who had constructed it. With the patience of St. Francis preaching to the birds, Fuller explained that nature never works in ways you can't model. And he had modeled the coordinate system of *all* nature. The *vector equilibrium*. It was rational. And about as abstract as the cardboard, pocketknife and hair pins he had used.

Fuller is *the* empirical pioneer of our century. He has never accepted anything secondhand. All his discoveries, his many prophecies over the years, his practical, patented inventions are based on his sustained study of human trends and an earnest effort to set in order the facts of human experience. The Universe—an aggregate of all experience in all time—is his *minimum* consideration. Sharing the generalized principles operating in the Universe is his minimum objective.

He says, "You aren't going to follow me unless you realize I talk *comprehensive*.

"I'm very used to something in science which says that if you get all your special cases listed, and you have them there all together, some patterns begin to show up. Then you do something else with them. Then something else. You're liable to find, all of a sudden, something very fundamental running through it all. Something we call a generalized principle, holding true in *every* case. Now this is where I really begin. You're going to go as large as the Universe and really get at the absolute fundamentals of what it is you are permitted to do by its laws. If you find out some of those things, you might really *know* something."

Fuller does. And his life's passion has been to "pass a line," as the sailors say, so men can more readily tie into those fundamentals. That is why he has traveled two million miles, teaching, lecturing, consulting, always learning. That is why he has embraced and influenced so many areas of human activity. That is why he is described as a mathematician, philosopher, scientist, architect, engineer, cartographer, poet. He has discerned in universal process an integrity, economy, and ethic which know no boundaries, biases or prejudice, no specialized fields, no academic departments. They are *all* one. And because Fuller has succeeded in projecting much of the world into a new relationship with the Universe, students as well as heads of state now look to him for the larger perspective—the cosmic perspective—in which to see their problems and seek solutions. In the same way that he has discerned a structure, a basic grid, guiding all the interactions in the sub-atomic world, so has he disclosed an ethic to guide the world's peoples in seeking shared solutions to the common problems facing them. More than any man alive, he represents both the mystery and the sublime certainty of universal order and teaches that ultimately what man does on Earth will be governed by the same ethic of the sub-atomic world and the cosmos. In this concerted effort to harness principle and apply it in human affairs, Fuller sees man's mind having perhaps the highest function yet observed. He sees its drive to sort, select, integrate and give order. He sees life and consciousness closing in on the inanimate world and senses there is a complex but constant process structuring both mind and matter. In the Fuller Universe, the physical and the metaphysical converge in a common coordinate system. That system is the major revelation of Synergetics. It is not a system which dehumanizes man, but one which liberates him. It is not a system which divides, but one which unites. It is a system of values to benefit a world which has too long behaved and built as if no values are possible.

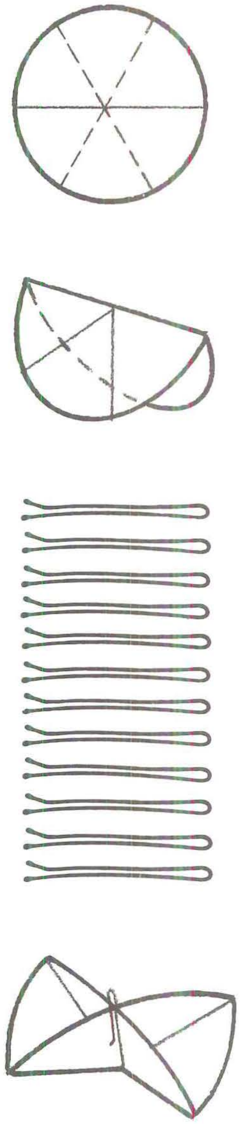
When Fuller put together the *vector equilibrium* model that evening in Chicago, letting others touch it, showing them how it was made, he was demonstrating that Nature's clues are not abstract. They are modelable, comprehensible, and usable. He was demonstrating with utter simplicity something which is only now dawning on world society. That is, man is not only part of evolution. For the first time, he can structure, control, even improve upon its processes. For the first time—and, possibly, the *last* time—man can attain comprehensive success.

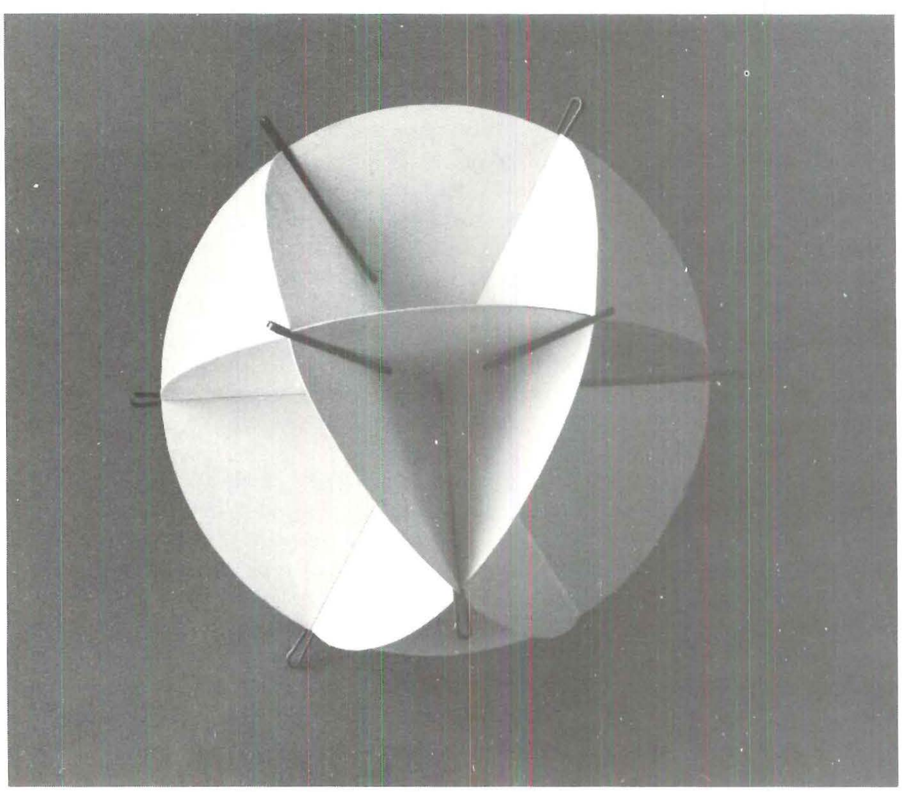
Fuller has a compelling innocence about such current crises as pollution, population growth and the so-called "urban problem." But it is well-informed innocence.

As a student of trends, Fuller has observed that with respect to both natural and human resources pollution is only a resource out of place, doing damage precisely because its potential usefulness has not been harnessed. "We must redesign the use of the world's total re-

William Marlin is a Senior Editor of the Forum.

The Vector Equilibrium.





sources in such a manner as to make those now engaged exclusively in the service of only 44 percent of humanity adequate to the effective service of 100 percent of humanity at higher standards of living despite a continually decreasing inventory," Fuller asserts. "For instance, all our metals are constantly being melted up and recirculated. Out of all the copper mined in all history, only 14 percent is not at present in an averagely recirculating 22-year cycle of use; and the 14 percent which is not in present recycling use is now in munitions ships at the bottom of the ocean. Sixty-five percent of all our steel is now made out of scrap. That is roughly the ratio of recirculating metal to new mine production in all of the metals categories. It is perfectly practical to think about taking the metals out of obsolete automobiles, taking all the two-ton automobiles off the road, melting them up and making twice as many higher performance one-ton automobiles from the same metal. You may say that you don't want more automobiles—that the parking problems are too great. In speaking of automobiles, I am speaking of a familiar industrial tool. I am not advocating more autos. I am simply considering the feasibility of the principles involved through which we can take care of twice as many people in a given function with a given obsolete scrap resource."

With a similar, refreshing insight, Fuller dismisses all the doomsaying about population, "I find that as industrialization increases, the population decreases. With industrialization, life expectancy increases. When that happens, families don't have to be large. In the last five years, the absolute number of babies has been less each year. The big bulge everyone's worried about occurred because all the people that used to die have not been dying, particularly at birth. This bulge is working up to a time when there will be a great, great many people who are very old. But the number coming in at the bottom is lessening very rapidly."

The big message here is that Malthus was wrong. If man's resources are properly managed, if his technology is applied in the direction of conscience, there *can* be enough for everybody. "Bare maximums," as Fuller puts it, of energy, food, shelter, medical care, education. In a world where scarcity has been sanctioned and abundance abused, a new day is dawning. There is no longer any excuse for scarcity. No longer any excuse for the fear, want and ignorance which have persisted in man's competition for what there was not enough of. The new day, in Fuller's vision of the global village, is one of *cooperative* enterprise by which mankind will break down the barriers dividing them in order to build the Earth.

Central to this is Fuller's long-evolved concept of design science, a fundamental alternative to *political* initiative. No referendum was held to permit Edison to invent the light bulb or the Wright brothers to fly. Einstein didn't have to campaign for the right to work out his relativity theory. Nobody elected Henry Ford to mass-produce automobiles. And, of course, no one asked Fuller to remake the world.

In 1927, this is quite literally what he set out to do. He made a bargain with himself that he would look for the generalized principles operating in the Universe and turn those over to his fellow man.

In fulsome Fullerese he wrote, "Acutely aware of our being's limitations and acknowledging the infinite mystery of the *a priori* universe into which we are born but nevertheless searching for a conscious means of hopefully competent participation by humanity in its own evolutionary trending while employing only the unique advantages inhering exclusively to the individual who takes and maintains the economic initiative in the face of formidable physical capital and credit advantages of the massive corporations and political states and politically avoiding political ties and tactics while endeavoring by experiments and explorations to excite individuals' awareness and realization of humanity's higher potentials I seek through comprehensive anticipatory design science and its reductions to physical practices to reform the environment instead of trying to reform men being intent thereby to accomplish prototyped capabilities of doing more with less whereby in turn the wealth augmenting prospects of such design science regenerations will induce their spontaneous and economically successful industrial proliferation by world around services' managements all of which chain reaction provoking events will both permit and induce all humanity to realize full lasting economic and physical success plus enjoyment of all earth without one individual interfering with or being advantaged at the expense of another."

This 200-word, unpunctuated sentence really says it all. Comprehensive anticipatory design science. Reforming the environment instead of men. Doing more with less.

The validity of design science comes through when we realize that 44 percent of mankind is now benefiting from technological advance compared to less than 1 percent in 1900. This incredible increment in advantage stems from the accelerating effects of technology coming out of the last half of the 19th century, converging during World War I when, in Fuller's words, industry moved "from the track to the trackless, from the wire to the wireless, from visible structuring to invisible structuring in alloys."

He points out, "The integration of the new 20th century science and technology during World War I resulted in entirely unprecedented magnitudes of technical advantage gains accomplished in all the fundamental capabilities of the world's industrial networks. As a consequence of this major mobilization of industry, brought about through realizations of the long-suppressed scientific backlog, the industrial advantage subsequently accruing in the domestic economy, as by-products of the munitions industry, had so increased that by 1919 6 percent of humanity were enjoying the prevalently 'high' standard and ever-advancing physical advantages of the industrial network. By 1940, the percentage of the ever-increasing world population that had now come to enjoy high standard industrial advantage increased to 20 percent. As a consequence of the again extraordinary advances of technology during World War II, and in the post-World War II cold wars, we have now increased the numbers of those humans who are participating in the industrial network to 44 percent of the world's total population. The continually accelerating rates of increase in the number being served with ever-higher standards of industrialization has occurred despite the ever-more rapid *increase* in world population, concurrent with a continual *decrease* in the world metals per capita. The surprise rise in the number of people enjoying higher standards may only be accounted for by the fact that the increased ability of man and the increase in the number being served is an *indirect consequence of our constantly doing more with less per given unit of resources, per given function.*

"Doing constantly more with less came from the world of seaborne or airborne weapons. To persist as a 'winner' in the game of world armaments a constantly accelerating evolution must be regeneratively initiated in specific improvements in performances per pounds of physical resources and per hours of scientific and technical expertise invested in a given task in order to be supreme in carrying the greatest hitting power the greatest distance in the shortest time, with ever-increasing accuracy of aim and at ever-higher degrees of energy efficiency."

Fuller's sustained, impassioned plea for systems of "livingry" instead of weaponry are rooted in his rich Navy experience. In recent years, anything military or mechanistic has become practically immoral. But Fuller has never hesitated to look for the benign, beneficial fall-out in Pentagon and NASA programs. As long as the resources, skill and insight of science and technology are preoccupied with preparing for war, *that* is where Fuller will seek it. He often reminds people that battleships had refrigerators 30 years before they were generally available. And the same can be said for almost any other basic improvement which we now take for granted.

Like most of Fuller's insights, the strategy of reforming the environment instead of reforming men had its origin on board ship. As a boy, he spent summers at the family home, Bear Island, in Penobscot Bay off Maine. There, working the cold currents every summer since, he has built up a fluid, nautical view of man.

Among the many things Fuller thought about was the wisdom of those who take to the sea. Sailors learn to negotiate distances in the path of least resistance. They build their ships to accommodate change and maintain course despite any contingency. The ship does not change course by its bow, but by its rudder after most of the ship has gone by. The sailor can work his rudder in such a way to create a low pressure opposite the direction in which he swings it. The low pulls the stern over, and he's got the ship moving in the preferred direction. The bow may help keep the ship on course. But the rudder puts it there.

In a similar way, aircraft pilots mediate the motion of their planes by tiny trim tabs trailing out from the "stern" edges. Most of the plane has gone by. But what has remained constant is the pilot's critical points of maneuver. These trim tabs are his option.

By working the rudder or trim tab, the sailor or pilot, with skill and timing, can obtain a forward edge on the fate of those on board.

In 1927, when Fuller was 32, he came into critical proximity with his fate.

Like four generations of male Fullers before him, he had gone to Harvard from his birthplace and boyhood home in Milton, Massachusetts. To the chagrin of his tradition-conscious family, he was expelled for general irresponsibility because kidding around seemed to make more sense than the curriculum.

He was exiled to a cotton mill in Quebec and did so well there, helping assemble new machinery, ever keeping notes, that his family decided he should re-enter Harvard. Again he was expelled. And although he held the Charles Eliot Norton Chair of Poetry there many years later, Fuller never took a degree. (He now has 26 honorary ones.)

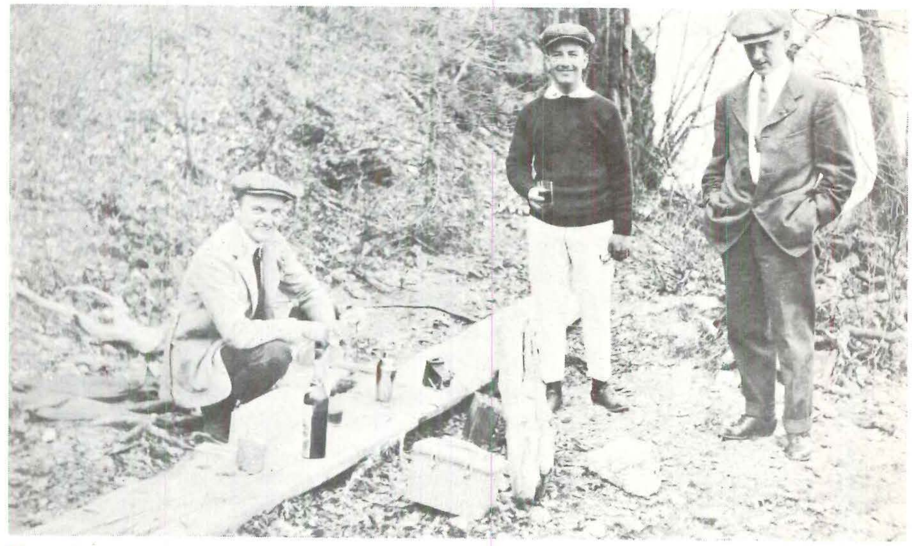
In 1916, Fuller joined the Navy by offering his mother's boat, the *Wego*, for sub-patrol duty off Maine. He became a boatswain, and was later recommended for special course work at Annapolis.

In 1917, Fuller married Anne Hewlett, daughter of a prominent New York architect, at Rock Hall, her family's Long Island estate. It was the beginning of a beautiful relationship which has survived all the hard punches and empty pockets of leaner years when he was ignored.

When he came out of the Navy in 1919, Fuller went to work for Armour & Co. in New York. For a year, he worked in sales for a leading trucking firm. Their daughter Alexandra, born in 1918, was afflicted with polio and spinal meningitis and suffered tremendously until her death in 1922. During these years, Fuller was making about $50 a week, and most of that went to pay two nurses.

Alexandra's death sent Fuller into something of an emotional tailspin. His father-in-law had developed a fibrous building block, and Fuller went to work setting up the Stockade Company to manufacture the new product. Between 1922 and 1927, when he was forced out by new ownership, Fuller built 240 buildings, set up five factories, and even invented the machinery that went into them. He also found himself playing

A boyhood summer, Bear Island, Penobscot Bay, Maine



Time-off from meat packing at Armour

The greatest poem ever known
Is one all poets have outgrown
The poetry, innate, untold,
Of being only four years old.
Still young enough to be a part
Of nature's great impulsive heart,
Born comrade of bird, beast and tree
And unconscious as the bee,
And yet with lovely reason skilled
Each day new paradise to build.
Elate explorer of each sense,
Without dismay, without pretense,
In your unstained, transparent eyes
Life's queer conundrums you accept
Your strange divinity still kept.
Being that now enthralls you,
All harmonious, unit, integral,
Will shed into perplexing bits—
Oh contradiction of the wits—
And life that puts all things in rhyme
May make you poet too, in time,
But there were days, oh tender elf,
When you were poetry itself.

—*Christopher Morley*, 1922

On board "my Navy," World War One

poker, going to all the right parties, and pandering to and parroting everyone's view but his own. Between bad luck and the bottle, not to mention his continued anguish over the lost child, Fuller seemed to be getting nowhere. He found himself in Chicago, where he had moved to supervise a factory in Joliet, and he became the father of a new daughter, Allegra.

As he recalls, "This precipitated my absolute determination to peel off. I had really been through a great deal. But I had gone into Harvard with high honors in physics. I had very rich boyhood experience with boats. In my Navy, I had looked into electronics, the chemistries and navigation. I had papers to command unlimited tonnage on the ocean. I could fly. But I had kept pushing things, trying them out. And it always seemed to come to a dead end. I decided I'd better call myself to account, with this new child to care for. Or get myself out of the way, because I was a mess."

Standing on Daniel Burnham's Chicago lakefront, Fuller decided he had no right to do away with himself. Instead, he contemplated his own "no little plans" and entered his "trim tab lab." Fuller moved his family into a tenement on Belmont Street and, quite literally, stopped talking until he felt he knew what he could say for himself.

The neighborhood was not exactly Rock Hall or the Beaux Arts balls of New York. Capone gangsters lived nearby, and they cheerfully helped Anne with the garbage and grocery sacks while Fuller worked things out in silence, occasionally walking Allegra over to Lincoln Park. It's really presumptuous to try to figure out exactly what happened in Fuller's mind during this moratorium. But there is no doubt that with his resolve, considering subsequent evidence, he must have experienced an almost Augustinian reversal in outlook. He has said that he went back to thinking about all the things he had thought about and learned before he'd decided to "earn a living." He went back to being a child, with eyes open to see, to understand why.

"This is really where I started. I was not called an architect; I was not called anything. I was simply faced with the problem of organizing myself and really starting to use *me.* I had to educate myself in a great many ways to pursue such a course. But I found it's actually possible for an individual to make first moves, and that these will incite various others.

"So I said to myself, 'If this gets anywhere, it's going to take 50 years and unless you're willing to spend 50 years, don't touch it. Because it's too important. It's too big and right. Don't flub this one, or you'll discourage a lot of others coming along.'

"I said to myself, 'What can I do to help my fellow man without trespassing on him?'

"Let's say you're looking at me. But I can see behind you. And a rock is tumbling downhill and it's going to hit you in the head. Let's say I divert it. You'd have been killed if I hadn't. You didn't even know you were going to be killed. You might say, 'Why did you do that? I wanted to die.' Well, I would say, 'Then jump out that window over there. There are many ways for you to die if that's what you really want.' But I want you to have the option of saying whether or not you want to die."

Out of Fuller's isolation came his first book, a privately published work called "4D"—after the 4th dimension in Einstein's theory. He also developed the first schematics for the Dymaxion House. By April of 1928, its design was complete and Fuller filed for a patent.

Rather extraordinary, this house. Fabricated industrially, deliverable anywhere in 24 hours, installed and serviced as a telephone would be, generating its own light, heat and power without outside utilities. A house eliminating drudgery, safe against all forms of weather, liberating time for education, amusement. A house as easily within reach of an average worker as the Model A, which had just come out.

A series of exhibits followed; the first, a private show at Chicago's *Le Petit Gourmet* restaurant; in April 1929, a two-week show at Marshall Field's; in May, a show at Harvard, where he exhibited at the Society for Contemporary Art.

There weren't many architects willing to listen to Fuller. One who did was Pierre Blouke, who had finished his studies in architecture at MIT after World War I and became very active in the Chicago Chapter of the American Institute of Architects. The Chapter was asked to appoint a special committee to review home exhibitions, including one on the "House of the Future." Blouke wrote something about this show in a local paper and two days later, Fuller appeared at his office, "This chunky little fat boy, looked like a Buddha, walked in and asked if I'd seen what he'd been working on. I hadn't. He opened up his case and showed me the Dymaxion House. That's how our friendship started.

"He didn't have any money, and I had a car. So for two years we traveled around quite a bit with his house. In June of 1929, we drove down to St. Louis for the AIA Convention. I managed to get the house model on the convention floor, but only 30 or so of the architects stayed on to listen. One Harvard dean, must have been about 80, denounced Bucky's work in every possible way."

Fuller, in going to St. Louis, had intended to offer the house patent to the Institute. In reply, its Board passed a resolution, "Be it established that the American Institute of Architects establish itself on record as inherently opposed to any peas-in-a-pod-like reproducible designs." This is, of course, the same Institute which gave Fuller its Gold Medal in 1970, probably wishing it had accepted his patent.

In November 1929, Fuller moved his family back east, and he found himself spending most of his time in New York's Greenwich Village, while Anne and Allegra stayed out on Long

Island. He had met Isamu Noguchi, then a little-known genius who, having first studied medicine, was getting into sculpture. He'd been two years in Paris under Brancusi and had returned to New York and a studio at Carnegie Hall. Fuller became a fixture there, as he did most other places Noguchi moved to.

Day-long coffee breaks and interminable walks were the routine. The favorite watering hole was Romany Marie's Tavern, where the two first met. Romany Marie was a Rumanian gypsy who took to Fuller right away. She would give him free food just for being around. In return, he gave his first "public" lectures, talking to anyone who would listen. After nearly two years of silence, Fuller definitely had some ideas about the great things to be done in the world.

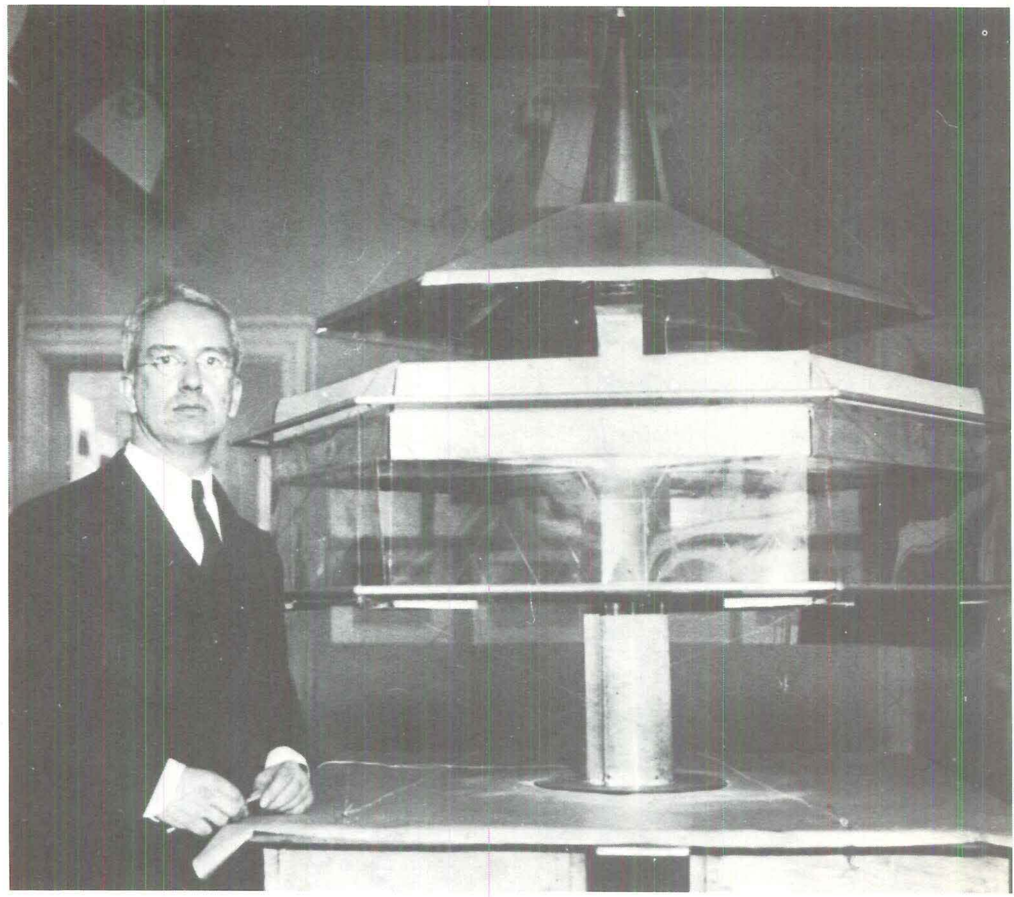
Noguchi has called those early Village days the time of Romany Marie and prophecy. Certainly, Fuller went on to be one of the more incorrigible gypsies of our day. And, as many people in many parts of the world know, he has never stopped talking.

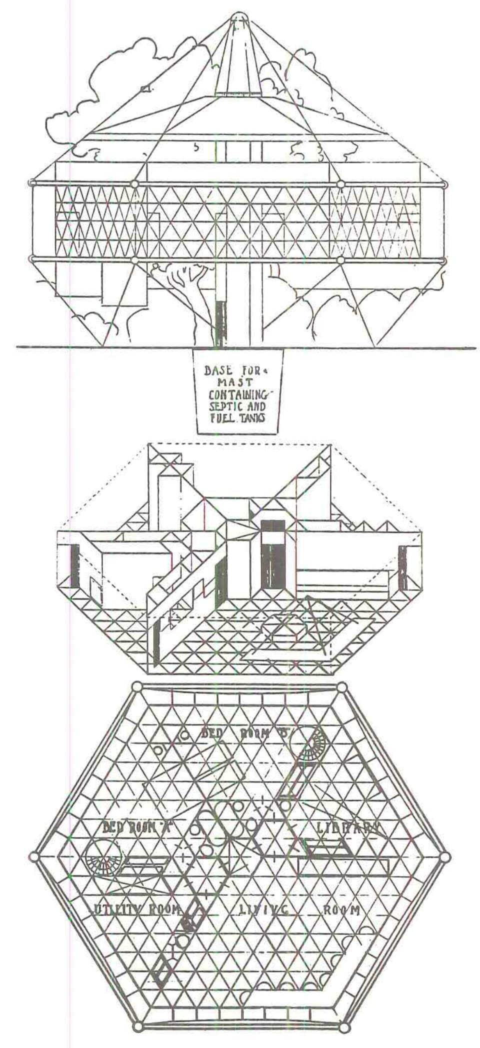
In 1930, Fuller and Noguchi set out on a road tour. Fuller had a Dodge station wagon and his model of the Dymaxion House. Noguchi had done some superb heads, including one of Fuller and two of dancer Martha Graham. First, there was a show at the Yale architecture school; another show at Harvard; then they left for Chicago and an Arts Club exhibit.

Inez Cunningham, describing this show in the Chicago Evening Post, wrote perceptively of Fuller's house and the motivation behind it, "Mr. Fuller had a dream of freeing women and children from the housing problem, but on account of his particular quality of intellect, the dream had to filter through the mind and so became a philosophy. There was the heart and the mind—in other words, love and thought, but they had to be related to sense—to the outside world. Mr. Fuller, instead of looking to past experience, felt he had come to that state in our progress where mind must use matter, instead of matter using mind. This problem was not a problem for Boston or Detroit. It was cosmic. It was not a problem for 1930. It was for humanity in time."

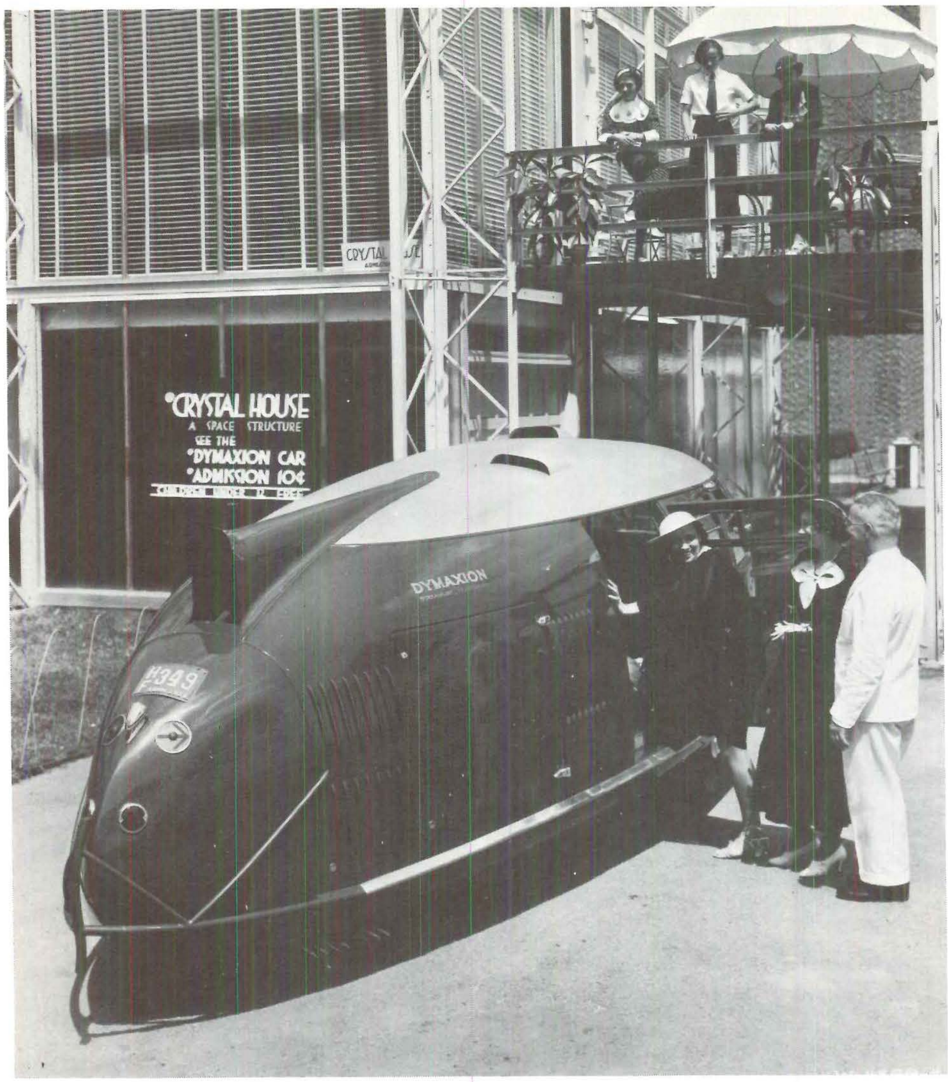
Apparently quite a few people sensed the long-range significance of Fuller's concept. Forget the "architecture," or the look of it.

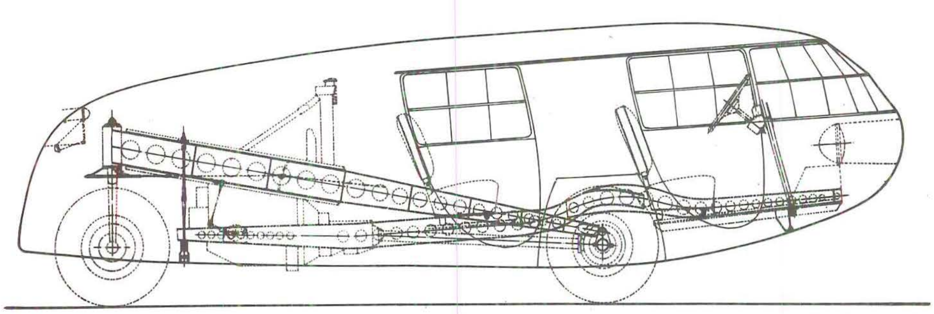
Writing in *Fortune*, Archibald MacLeish was especially prescient, "The construction problem is not a problem of more house for the money but of more housing for the money. The problem of design, in the modern low-cost house, is not an esthetic problem but an industrial problem. It is now past argument that the low-cost house of the future will be manufactured in whole, or in its parts, in central factories, and assembled at the site. It will be produced in something the same way as the automobile. And design will occupy the same relative position it occupies in the automobile industry. Design will dictate the form of the thousands of units





The hexagonal, mast-hung, cable-supported Dymaxion House, 1927, was a "metallurgical pound cake" of only three tons and would have sold for 25¢ per pound. Designed for mass production and air delivery, its theoretical application of high-strength alloys and recycling of wastes for heat and light are far in advance of even our building technology.





The Dymaxion Car, 1933, was conceived as a prototype of a combined land **and** air transport, first envisioned by Fuller in 1927.

instead of the form of one. And the designer will necessarily consider not only the appearance and convenience and efficiency of the completed product but the feasibility of its production in mechanized plants and its distribution by modern transportation." *That* was 40 years ago.

During the depth of the Depression, Fuller and Noguchi often found themselves at New York hotels, like the Carlyle and Winthrop, which put them up for nothing. Fuller had sold a Navy life insurance policy to start up his *Shelter* magazine, which had been written and published all over New York, copy scattered about with air mattresses and sandwiches. The last issue came out as Roosevelt was elected, featuring a "conning tower" conference room for industrial executives which had instant call-up of data for high-level decision-making.

Though the magazine folded, the Depression gave Fuller a chance to buy a factory at Bridgeport, Connecticut in partnership with Starling Burgess, designer of The America Cup defender "Enterprise." Like Fuller's close friends Amelia Earhart (who flew the Atlantic in 1928) and Sir Charles Kingford-Smith (who flew the Pacific the same year), Burgess was also an aviator. He and Fuller went to work building a 36-foot boat *and* the first Dymaxion car. As you might expect from Fuller, being a good sailor and pilot, the technology and engineering of the car had far more to do with Lockheed than with River Rouge. It even looked like an airplane. Three wheels, including a rear one for steering. Front traction. It could turn in its own length and reach 120 miles per hour. Its one concession to Detroit was the stock V-8 Ford engine.

The first car was purchased by aviator Captain Alford Williams who had it driven, at Fuller's request, to the 1933 Chicago World's Fair where it was quite a hit until it was involved in a collision with a conventional auto. Not even the pictures of Amelia Earhart and Eleanor Roosevelt riding around in it rivaled the scare headlines in the Chicago press. Undaunted, Fuller spent an inheritance from his mother's estate to manufacture two more cars. One sold to a racing driver; the other to conductor Leopold Stokowski. Unfortunately, early European interest in the car was dampened by news of the collision, and Fuller went broke. He had, however, acquired quite a reputation in engineering circles, and he began work for Phelps Dodge Research, looking into the history of industrial and economic trends.

Building on some research he had done in 1931 in connection with the Pierce Foundation of the American Radiator Company, Fuller tooled up for production of a five-foot-square Dymaxion bathroom, formed of four die-stamped sections bolted together for assembly and then requiring only installation at the site. Phelps-Dodge turned out 12 of the prototypes before yielding to pressure from manufacturers of more conventional plumbing. Two of these were installed in the Long Island home of Fuller's close friend Christopher Morley, who was then writing

Kitty Foyle; two more in a Neutra-designed house in Rhode Island for John Nicholas Brown, former Secretary of the Navy.

To many people, including several in his own family, Fuller had always been something of an amusement. And the so-called "failure" of the Dymaxion House, car and bathroom did little to change this attitude. Coming from and marrying into a family where life was one constant house party, Fuller—ever preoccupied with his ideas—was not exactly comfortable. A typical, witty appraisal of Fuller in the late 30's was given by his second cousin, author John Marquand, who was, of course, very good at describing the kind of house parties Fuller didn't like.

Replying to an inquiry from the *Saturday Evening Post,* Marquand wrote, "On the rare times I have met him, there has been the same glitter in his eye which must have appeared in the eye of John the Baptist before he lost his head. He once told me that in his dream house, which stands on a pillar like a toadstool, it will be unnecessary to worry about trivial duties. If your shirt is dirty, you simply open a slot in the side of the wall, throw it in, and out it comes three minutes later washed and dried. I asked him if it would come out ironed. He said no, but that it was silly to have an ironed shirt. To my way of thinking, this single anecdote is illustrative of my cousin's entire mental process. He has a great many bright ideas, any one of which if patented and marketed should make him a fortune, but the trouble is the shirts never come out pressed."

The point is that Fuller never intended they should. What is a pressed shirt, anyway, but preoccupation with profit, which is one thing Fuller vowed he would never become involved in. For fundamental to his strategy of design science initiative is that it must operate independently of politics and the big corporations. He had faith that integrity and competence in design would eventually invite support.

In 1940, Christopher Morley invited himself to support Fuller and volunteered the proceeds from *Kitty Foyle* to any project Fuller might want to initiate.

Since 1938, when he left Phelps-Dodge, Fuller had been technical editor at *Fortune* and, in a special issue on American industrialization, his command of social and economic trends came through loud and clear: "The historical fact referred to under the word industralization is a great change—a revolution—in the life of the individual. The process has not been merely mechanical, but organic and evolutionary. It has created a new kind of life, augmented and hitherto unimagined."

Fuller knew better than anyone else, of course, that the one industry which had seemingly escaped evolution was housing. With Morley's backing, he designed the Dymaxion Deployment Unit, a corrugated steel grain bin of a house, in cooperation with Butler Manufacturing Company in Kansas City.

These were conceived as emergency shelters for remote wartime use and cost $1,500 complete and ready for occupancy. The peak output of grain bins at Butler was 1,000 a day, and it was planned to maintain a similar production schedule for the Deployment Units.

When the War broke out, these were already being shipped to many parts of the world by the Army Signal Corps which found them especially useful in Persia and Alaska—two of the more important jumping off points for Allied airmen. Production continued until 1942, when Roosevelt diverted all steel to weapons production.

Attention, however, could no longer be diverted from Buckminster Fuller. For it was becoming apparent that he was, more than a brilliant technician, a brilliant tactician as well. Not only had he designed a valuable end-product. He had designed it with the logistic of distribution in mind.

In 1942, Fuller became chief mechanical engineer of the Board of Economic Warfare. Throughout 1943, he gave two weekly three-hour lectures on geopolitics to indoctrination classes. During these years, he was also hard at work refining the principles of Synergetics and in March 1943 *Life* published the first of his Dymaxion maps—the Airocean World. It was the first of Fuller's inventions to receive serious attention from other scientists and was the first cartographic projection ever accorded a U. S. patent.

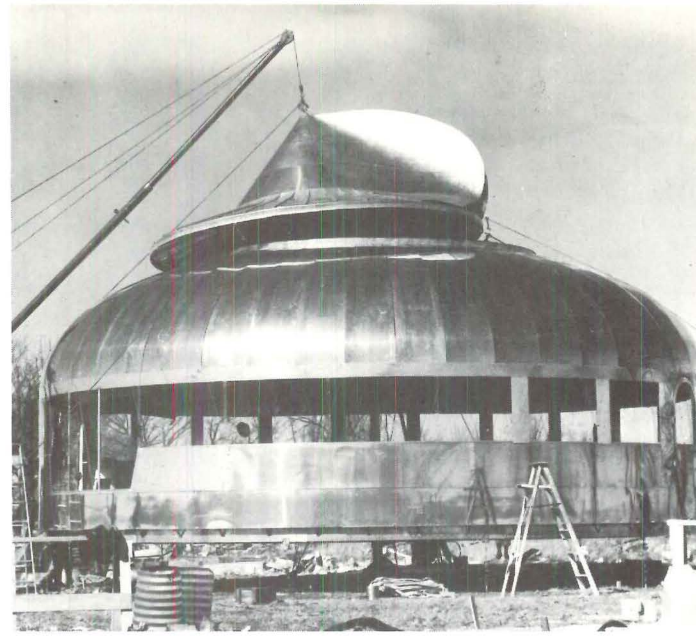
The map was particularly important in that it was the first practical application of Synergetics. It represents a topological transformation between a sphere and the planes of a 20-face icosahedron. The map eliminates all visible distortion of the relative shapes and sizes of the geographical features. All the familiar maps, like the Mercator, have considerable distortion and breaks in the continental contours. In contrast, Fuller's map shows one world-island in one world-ocean.

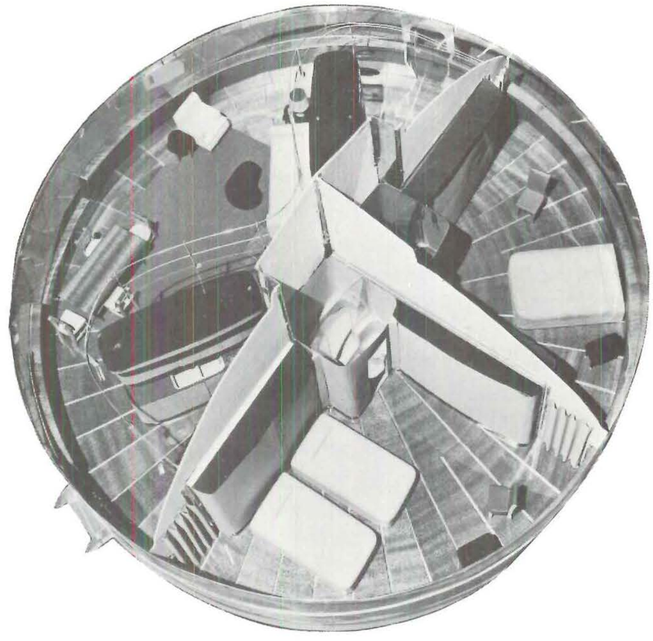
He notes, "When you transfer the projected data from the surface of a sphere to a plane, you have to break open the spherical skin in order to 'peel' it. There will be various angular cuts in the periphery of the skin when it is layed out flat, just as you take the skin off an animal. The openings along the edge are called sinuses. The sinuses on my map occur in the water. None of the cuts go into the land. Therefore, I am able to take all of the data off the earth globe and make it accurately available in the flat." The Fuller map is a powerful conceptual tool for seeing the world whole but, to date, it isn't hanging in any public schoolroom except, perhaps, as a curiosity item. As with so many other Fuller inventions, the map is being discovered by today's university students who are strongly committed to the elimination of distortion, whether it is of the Mercator kind or that of political maneuvering.

In 1944—not unlike the present—Washington found itself assessing the problems of converting to a peacetime economy. Management and

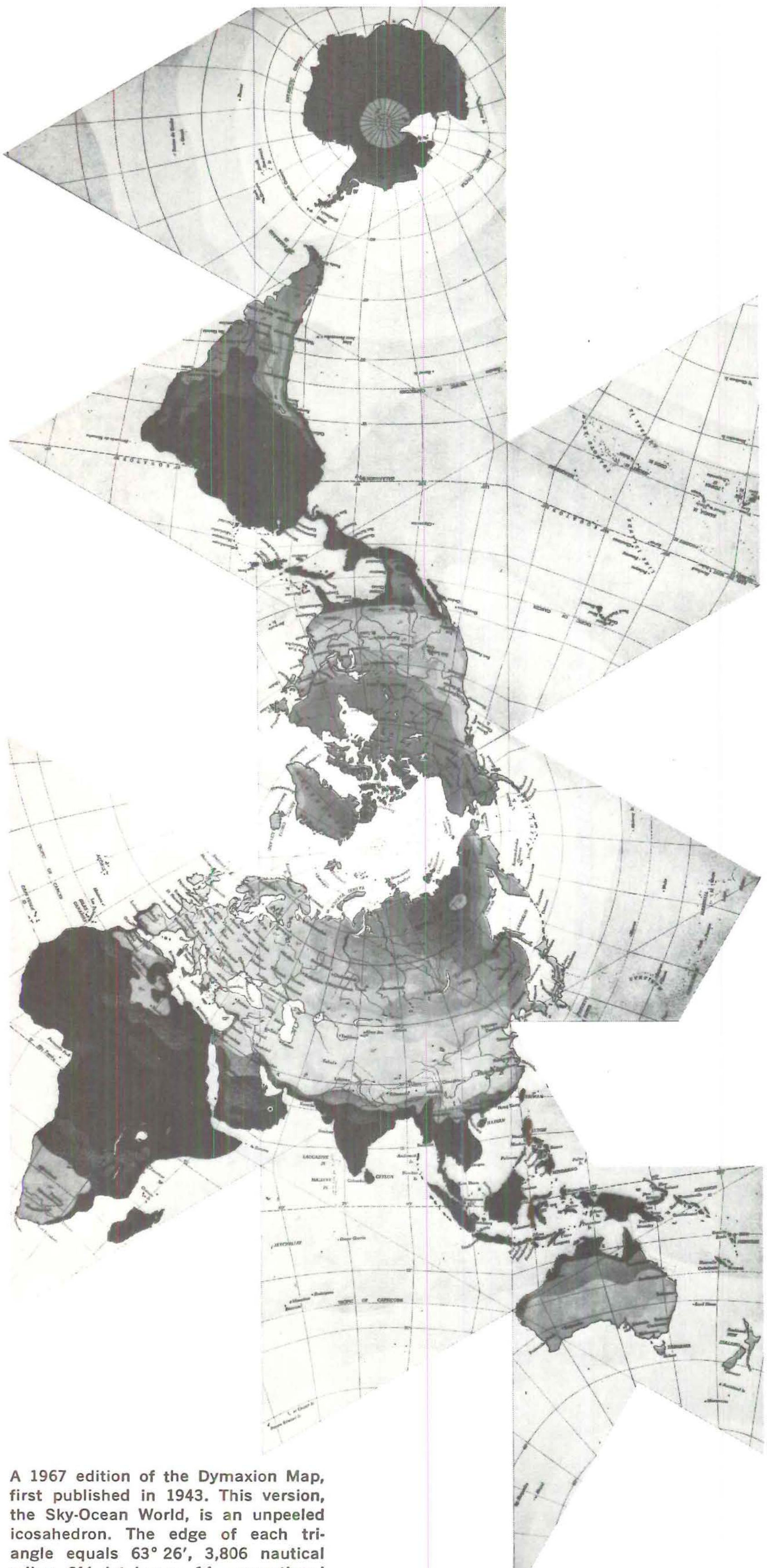
The Dymaxion Bathroom, 1931-36, was the first fully equipped unitized toilet facility. Weighing only 420 pounds, it was first built in copper but was conceived for eventual production in aluminum and plastic. Like the refrigerator or stove, it was a mass-produced, plug-in item which owners could move from house to house.

The Dymaxion Deployment Unit, 1940, a 4,000 pound grain bin of a house, was tooled for a production rate of 1,000 per day.





The Wichita House, 1944, was a 6,000 pound, $6,400 dwelling machine designed for production on Beech Aircraft assembly lines. Eventual production volume was set at 500,000 houses per year, a figure which might interest both HUD and our unemployed aerospace engineers of today's "generation of peace."



A 1967 edition of the Dymaxion Map, first published in 1943. This version, the Sky-Ocean World, is an unpeeled icosahedron. The edge of each triangle equals 63° 26′, 3,806 nautical miles, 6½ jet hours, 14 conventional aircraft hours, or seven ship days.

labor were also concerned. The International Association of Machinists was worried that most of its members involved in plane production would lose their jobs. With the War ending, a serious housing shortage was foreseen.

This emergency forced cooperation between government, management and the unions, leading to support for Fuller's Wichita House—a circular, $6,400 dwelling machine of aluminum alloy, stainless steel, and plastic with air conditioning, indirect lighting and such Thomas Jefferson-style gadgets as mechanical bureaus consisting of nine trays on a chain conveyor.

The Beech Aircraft Company, having a good record in labor relations, was chosen to manufacture the house in their Wichita plant. One of the more interesting and, certainly, relevant aspects was that the Wichita House was designed for mass production on airplane assembly lines. Fabricating its 200 parts was as efficient as turning out the 25,000 parts of a typical aircraft. The cost for shipping a crated house from Wichita to the farthest point in the nation was to have been only $100. So-called variations in "style" would have been, as *Fortune* described it, "as natural as those between a Piper Cub and a B-29."

Unfortunately, the Wichita House fell to the same negative forces which had torpedoed Fuller's earlier houses. He had learned from brutal experience with the Stockade Company and, later, from the architects' general reaction to his first Dymaxion concepts, that the building industry was preoccupied with doing everything on a more-with-more basis, not with achieving a more nautical more-with-less efficiency. Yet, for society in general, having never experienced a totally new alternative in housing, heavier walls, like higher grocery stacks, like bigger cars, were symbols of status and security. Therefore, technology had never really made any fundamental improvement in housing since the development of the simple two-by-four and mass-produced nail. The Wichita House was a high benchmark in housing technology.

In 1947, working with the unfolding premises of Synergetics, Fuller made the breakthrough to his most famous discovery, the geodesic dome. Veritably, a countenance of principle.

He had been working quietly with Synergetics for years. Alone as a comprehensive thinker. Alone as a rationalist. Here was this intuition, this sense of nature's own larger purpose and design. The big question was how to share this insight in a way that would benefit mankind.

The first industrial acceptance of the dome occurred in 1952 when the Ford Motor Company commissioned Fuller to design a 93-foot cover for its Dearborn, Michigan Rotunda.

This marked the first time anyone had ever come to Fuller with a job. It was a great Christmas present for a man who, in 1927, had suggested using the Graf Zeppelin to plant prefab towers like trees around the world.

Fuller remembers, "I found I could make a ten-deck building so light that it could be carried by zeppelin, suspended under its belly."

The game plan was for the zeppelin to drop a bomb at the buidling site, lower the structure into the crater, then fly back home leaving the installation ready for occupancy.

Fuller had suggested that the first such "tree" be planted on the North Pole, trying to illustrate the increased mobility and worldwide migration of technologically emancipated peoples. It is not surprising that Fuller has since proposed immense tetrahedronal cities to navigate oceans or spherical colonies floating high in the atmosphere. In Fuller's view, such environmental controls—lightweight, mobile, efficient—are essential for the evolving race of world men. The thing is, of course, that most of us are quite unaccustomed to thinking in these terms, even though we may watch a satellite broadcast or fly regularly. This is why Fuller, for a long time, was considered a kind of H. G. Well of housing. You either read him for amusement or just didn't pay attention.

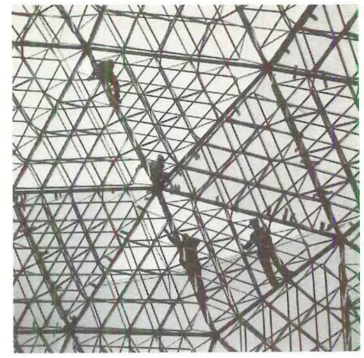
The acceptance of Fuller's concepts was partially troubled in that they far preceded the technology needed for realization. He realized in 1927 that there is a more or less predictable rate at which alloys and plastics are developed and then worked into industrial practice. By 1952, however, the technological advantage of high-strength alloys existed—fallout from war-based research. The geodesic dome became technically feasible as well as conceptually valid.

The 1952 "payoff" was really no surprise to Fuller. "I made up my mind," he recalls, "that if you really develop the tools and abilities and don't waste any time or effort trying to persuade people to look at what you're doing, and you find out whether your designs will work or not, that when and if they do work, someone will say, 'What is that?' And you will tell them. And the news of your invention will get around and in due course if what you have developed is needed in an emergency, the world will come to you for it."

Ford Motor had the emergency. And Fuller was ready.

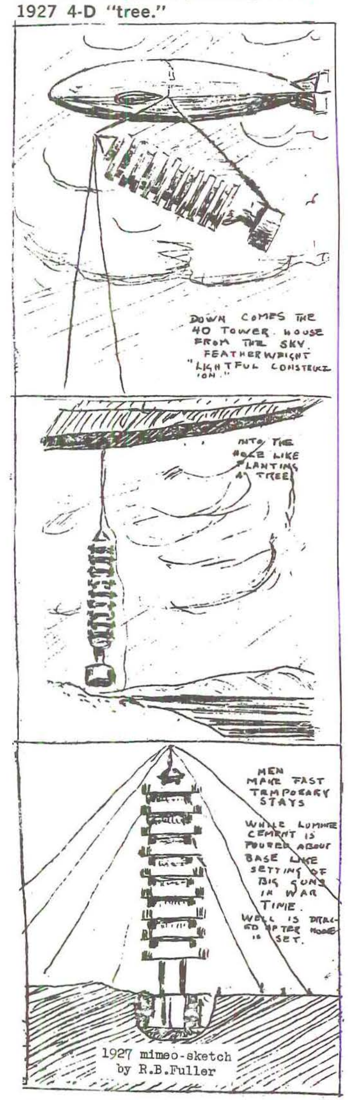
In 1953, the Marine Corps sent its representatives to North Carolina State College in Raleigh, where Fuller had been teaching off and on since the late Forties. The Marines, with an emergency of their own, needed lightweight, advance-base helicopter hangars, and the geodesic dome seemed just right.

James Fitzgibbon, now professor of architecture at Washington University in St. Louis, was one of the cadre of strong faculty support for Fuller at Raleigh and soon found himself vice president of a company Fuller set up to administer dome activity. Fuller himself was DC-6ing it around the country, teaching and lecturing at many colleges and universities and would keep in touch with dome work in some now-infamous two-, three- and even four-hour phone calls. One Marine general had to issue an order to his officers not to phone Fuller, but to fly wherever



The Ford Rotunda Dome, Dearborn, Michigan, 1952, was the first industrial recognition of Fuller's long-evolved, light weight structures. With his fierce sense of loyalty, Fuller soon took to driving a Continental.

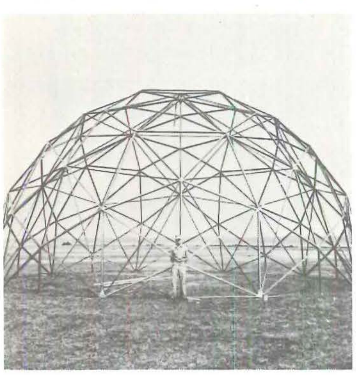
The Graf Zeppelin planting Fuller's 1927 4-D "tree."



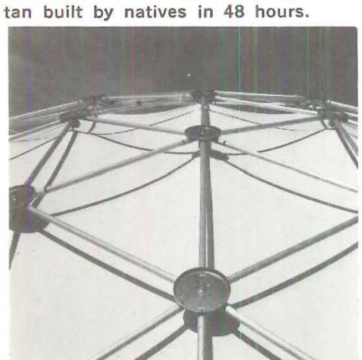
1954, a Marine helicopter flys off with its own hangar, signaling "the first basic improvement in mobile environment controls in 2,600 years."

PHOTOGRAPH: Sam Rosenberg

At ease, an airman with his hangar



1956 U.S. Pavilion in Kabul, Afghanistan built by natives in 48 hours.



he might be. It seems the Marines had a very strict budget on almost everything but fuel. In 1954, all the conferences culminated in the first helicopter airlift of a geodesic hangar at Orphan's Hill near Raleigh. Fuller's prophecy of an air-deliverable architecture 27 years before came crashing in at 50 knots.

Meanwhile, the Cambridge, Massachusetts office, set up by Fuller under William Wainwright, had been working on geodesic enclosures for Air Force radar installations on the DEW line.

After two years of severe testing at Lincoln Laboratories at MIT and atop Mt. Washington in New Hampshire, the first fiberglass and plastic radomes were installed in 1955. These were pieced together in the Arctic cold by Eskimos using numbered components. The average construction time per dome, just 14 hours. Ironically, when the Museum of Modern Art in New York exhibited one of the radomes later on, it took laborers one *month* to do the same job.

In 1956, the Commerce Department advised Fitzgibbon that it wanted a 100-foot dome for an international trade fair in Kabul. The company had 32 days to design, fabricate, deliver and install the structure. The parts, like so many CARE packages, were flown to Kabul in one DC-4 and erected in 48 hours by local, unskilled laborers who were absolutely mesmerized by what they had wrought. This same dome was later demounted and flown to New Dehli, Bangkok, Burma, Tokyo, the Philippines, to South America and Africa. The Marine Corps was not far off when it pronounced Fuller's invention as "the first basic improvement in mobile environment control in 2,600 years."

It is interesting to note that during these years comparatively few young people, out of all the university audiences Fuller spoke to, got involved in the work-a-day mechanics of dome construction. There were several stunning student projects done at Chicago's Institute of Design, where Fuller first taught on a full-time basis in 1947. And others at Black Mountain College in North Carolina, Minnesota, Cornell, and Princeton. Yet, the "young world" in which Fuller so steadfastly placed his faith just didn't seem all that interested in striking out on their own. For one thing, the dome was a patented invention. Fuller was adamant that the integrity of the concept be upheld, and he used to worry out loud that someone would use the dome to make Orange Crush stands. For another thing, of those young men who did work closely with Fuller on geodesic projects at the various schools, many developed an almost Oedipal relationship with him. To this day, there are those spreading the Fuller "word"—quite often without his knowledge—whose utterances have degenerated to philosophical parody to such an extent that you have to wonder whether being "with it" means forgetting anything you might ever have said for yourself. The biggest difference between Fuller and those who follow him is that too few have subjected themselves to the same self-examination and loneliness. Too few have made the big "peel off." And I mean this in terms of thought, not superficial changes in life-style.

Last Christmas, sitting in his little apartment outside Los Angeles, where he regularly spends the holidays, Fuller spoke very emphatically to a young man, "I realize you have this very big love and you want to do some very fine things with it. But I'm afraid you won't be able to do anything beneficial until you really start to think and get inside what's *causing* this love. You are going to have to think very clearly about basics and about what moves *you* can make to bring about changes in the things you see wrong. It doesn't do any good to get angry. And it doesn't do any good for you to sit here with me unless you can find in all this something of your *own* to say."

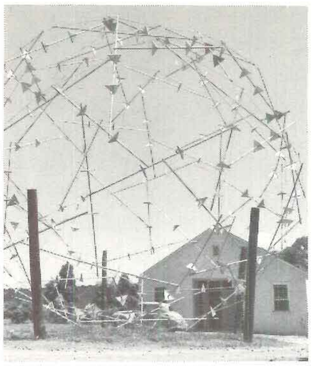
Fuller has been saying the same thing ever since he began his career as an itinerant teacher, leaving little bits of insight here and there, knowing full well it might take decades for them to develop in the minds of others.

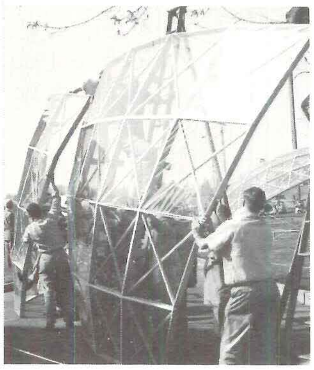
His old friend, the photographer and author Sam Rosenberg, believes that Fuller pursued students because they offered a path of least resistance. "Bucky's trouble has come from the fact that he has a special vocabulary and a special vision. When he went to the industrialists of this country and to people who make things, they rejected him and his great design concepts for one simple reason: he was premature. The technology of the country had not yet arrived at the point where it could utilize Bucky's vision. So Bucky had to stand still and dance from side to side in that peculiar shuffle of his for 25 years. But then, of course, he has always been a strategist, and he realized that while he was waiting he would have to bypass the industrial establishment. With his characteristic brilliance, he went to the universities. He found students who were not yet committed to an industrial process that Bucky knew was obsolete, and they were in a position to listen.

"The effect of Bucky on students is electrifying. He is sort of a Pied Piper of the intellect. He brings to the world of scientific ideas an order and cosmological view which previously has only been found in the supernatural religions. The reason that many students responded to it is that Bucky gave them a religion and an order they did not get from the barren, materialistic science they were studying."

Professor Fitzgibbon notes, "I had always been deeply impressed with the depth and profundity of Fuller's own religious commitment, and there is a liturgy and rubric to his message—this geometry. People could hear him and go home to prepare toothpick and dried pea models of his structures—these beautiful little integrities. And then hang them up."

In other words, part of his power is that his message, whatever one might interpret it to be, can be touched, held, contemplated. Not as an abstraction, but in a tactile sense.


Princeton, 1953


University of Oregon, 1953

You cannot understand Fuller's significance today without recognizing this aspect of his appeal. The youth of the late Forties were not so unlike the youth of today in that they too sensed this spiritual undercurrent.

Like many great scientists, Fuller arrived at his results, not only by calculation and demonstration, but by intuition and inspiration as well. It is this quality in his work, more than any one thing he has said, more than any one thing he has built, which commends the affection, even the homage, of a generation not normally given to praising, let alone following, men in their seventies.

To follow Fuller is both an inspiring and exacting process. On one hand, you are projected into an entirely new relationship with the universe; on the other, you are projected into an entirely new relationship with yourself. This can be as unnerving as it is enlightening. Although Fuller touches many people deeply and has a habit of making people be at their best, he also tends to open up reservoirs of self-doubt which can only be overcome by serious, sustained self-examination and personal renewal. He has been called a "creator of creators" just because of this effect he has on people. If he had only one legacy to leave, this kind of thought process is perhaps the most durable. You cannot follow in the footsteps of a man like this. You can, with great dedication, only seek what he has sought. He is not an anchor, but a mast.

Niels Bohr, the great Danish physicist, once observed, "When it comes to atoms, language can be used only as in poetry. The poet too is not so concerned with describing facts as with creating images and mental connections."

This is what Fuller has been doing with his domes, and his *vector equilibrium* models. He has been trying to create the very same images and mental connections Bohr talks about. The dome is empirical evidence of a universal structure; indeed, an ethic. Today, more and more young people are building domes. But for them it has become, more than something to live in, a kind of icon for a new philosophical age.


31-foot, 3,000 pound geodesic me atop Mt. Washington, N.H., stood 200 mph winds during a year test for use on the DEW Line.

For the nearly half century that Fuller has been evolving the principles of Synergetics—his "omnirational comprehensive coordinate system of Universe"—we have been living in a quiet scientific revolution.

Man's view of the Universe and his place in it has altered in a fundamental way. Interest has shifted from the study of parts to a study of organizational patterns by which parts assume order. Organization has become a third force, interweaving matter and energy, expressing itself in various levels of order. Steadily science has disclosed, from the illusive "quark" particles of the sub-atomic world to the mysterious quasars of the far cosmos, some as yet undefined coordinate system.

Synergetics reveals some powerful *clues* to the character of this coordinate system. If any of you say this is not the place to discuss mathematics and science, think of Synergetics as poetry or art. For one of Fuller's more interesting contentions is his belief that Nature makes no distinction between what men call science and what they think of as art. His coordinate system offers a common language for them. And, if we look over many of the major art exhibitions of recent years, we will find—true to Fuller's early thinking—engineers, biologists and physicists moving into new realms of subjective expression. We find greater numbers of artists, architects and poets becoming interested in the discoveries of modern science. This convergence is one of the happiest, if generally unrecognized, developments of recent years.

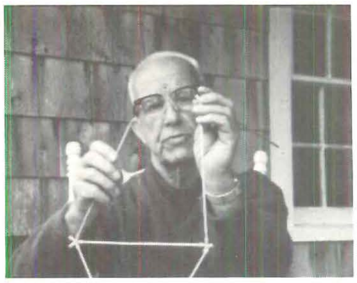
In this context of seeing the world whole, Synergetics becomes particularly compelling, for it is a studying of interrelationships and hidden strengths. The most fundamental concept in the Fuller Universe is synergy. A phenomenon first observed by chemists. *Synergy means the behavior of whole systems unpredicted by any of their parts or sub-systems.*

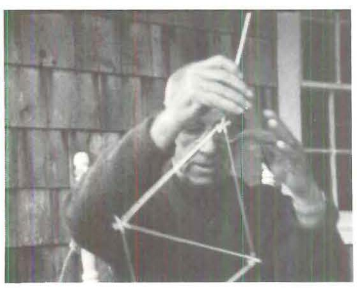
Synergy is an explanation of the mass attraction between bodies. It is an explanation of the increased strength of alloys. Fuller's most-often-used example of this is chrome-nickel steel, "Its unprecedented structural stability at super high temperatures has made possible the jet engine—one of the reasons why the earth has swiftly shrunken. The primary constituents are chromium, nickel and iron. The subsidiary or minor constituents are carbon, manganese, etc. Iron at its highest commercially available tensile strength is 60,000 pounds per square inch; the chromium, 70,000 psi; the nickel, 80,000 psi. The sum of the strength of the carbon and manganese, etc., about 40,000 psi. I am going to say hypothetically that 'a chain is as strong as the sum strength of all its links.' That seems preposterous. To test it, I add 60,000 to 70,000, making 130,000 plus 80,000, making 210,000, and I add 40,000 more giving a total of 250,000 psi. But chrome-nickel steel has a strength of 350,-000, very much higher, 40 percent higher. *That* is synergy."

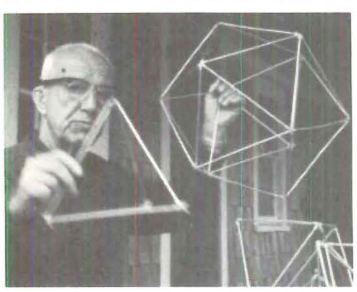
With synergy, there is energy. Like tension and compression, they coexist. Synergy refers to the integrative behavior of parts—the trend toward order. Energy refers to the differentiated behavior of parts—the trend toward disorder.

In the second law of thermodynamics, there is a quality called entropy, which is a measure of disorder. In this scale, the highest form of energy is considered to have the least disorder—the least entropy. Gravity is the highest form of energy because it has zero entropy. Fuller's word for the trend toward order is *syntropy*.

In recent years, Fuller has applied the concept of synergy and that of syntropy to solving one of the most crucial problems facing mankind: the production and distribution of electrical energy. He has proposed a worldwide energy grid, spanning continents, hopping oceans, the whole thing tied into the power of tides.







On Bear Island, "Grandpa" gets back to basics which means back to Universe. Here he models the constituents of the Fuller cosmos, showing that the tetrahedron, octahedron and icosahedron are different phases of the same configuration of forces.

PHOTOGRAPHS: From "Primer of the Universe," produced for University-at-Large by Robert Snyder.

Because tidal power is gravitational power, it would be the highest order of energy. And it would be virtually pollution-free.

The world's total water power capacity has been estimated at three trillion watts. Only 8 percent of this potential has been harnessed. Africa, South America, Southeast Asia have the greatest potential but are also the most underdeveloped industrially. Because it is now technically feasible to transmit power over vast distances, it would be in the economic interest of all nations for the advanced states to cooperatively invest their skills and resources in harnessing this untapped reservoir of energy.

Fuller points out that tidal power offers the most exciting potentials. Such power is obtained by the filling and emptying of a bay or estuary which is dammed. The enclosed basin is allowed to fill and empty only during those brief but powerful low and high tide periods. Fuller and his associates have pinpointed many possible sites which would form the strategic energy-producing points in this lattice. By harnessing the tides, mankind could harness a perpetual source of sustenance, for energy is the basis of all wealth, and the basis of industrialization.

Scientific American has estimated the total tidal power at 64 billion watts—which is a mere 2 percent of the world's total water power. Fuller has written, "This now feasible intercontinental network would integrate America, Asia and Europe and integrate the night and day, spherically cycling, shadow-and-light zones of Planet Earth and would occasion the 24-hour use of the now only 50 percent of the time used world around standby generator capacity whose 50 percent unused capacities heretofore were mandatorily required only for peakload servicing of local interconnected energy users. Such intercontinental network integration would overnight double the already-installed and in-use electric power generating capacity of our Planet."

This is a good example of what Fuller calls "planetary planning." But it is also a beautiful example of how the principles of synergy and syntropy can be put to work for man. The technology which would make such an energy grid possible would be positively benign. It would be practically invisible, generating abundant increments of increased economic success for all men and, inadvertently, generating the kind of international cooperation so basic to peace.

In this example, we can see how Fuller has made the connection between what he perceives to be the structural ethic of the Universe and the structure of mankind's strategies for survival. This example also explains why Fuller's significance comes through in an even more powerful way when we understand the evolution and unique discoveries of Synergetics, the structure of those universal energy processes which will ultimately determine what mankind can do.

The physicist Eddington observed, "From the point of view of the philosophy of science, the conception of entropy must be ranked as the great contribution of the 19th century. It marked a reaction from the view that everything to which science need pay attention is discovered by microscopic dissection. It provided an alternative standpoint in which the center of interest is shifted from the entities reached by analysis to the qualities possessed by the system as a whole. We often think that when we have completed our study of one, we know all about two, because one and one is two. We forget that we still have to make a study of 'and'. That is to say, of organization."

Eddington's comment helps relate Fuller's strategies to the context of scientific progress. In his thinking, synergy is the study of "and" in that "and" may behave in ways "one" and "one" did not. Just as entropy comes out of the 19th century as a powerful concept, so does synergy, in Fuller's teachings become important for a world which must see its problems and plan its solutions in a wide perspective.

Mankind is imperiled as never before, not by inadequate resources but by inadequate attitudes. Common world problems have generated the need for a world language which will transcend the biases and fears of yesterday. A language, not of words, but of approach. In the exploration of space, in the stewardship of the oceans, in the distribution of food, in the exchange of information, nations must converge in a common effort. There can be no other way in a world where technology has stretched the spectrum of human experience, where technology has taken the telephone poles and village back fences into the sky and launched mankind into a new era of mobility and freedom.

The increased awareness of these social synergies is one of the most exciting and reassuring aspects of life in our times. Despite political inertia, despite still-prevalent ignorance, want and fear, there is a healthy option for man in the coordinated management of his resources.

Fuller's Navy experience gave him the first insights into universal structure. "One day in 1917, I was standing on the deck of my ship looking back at the wake. It was all white with all the bubbles. I began wondering how many bubbles were back there. A bubble is a sphere, and my mathematics teacher had taught us that to make a sphere you have to use *pi*. Then she taught us that *pi* is an irrational number. I began wondering how nature makes a sphere. I said to myself, 'To how many places does nature carry *pi* out before she gets frustrated and decides to fudge a bubble?' I concluded that nature would never work in such a way and that she has a different system for coordinating her various undertakings. I didn't see any circumstance in which nature was working without models. In all chemistry, there are only beautiful whole numbers. Nothing irrational. So I said, 'Nature is working in a very simple way, but man's been messing things up by not working in a very simple way'. "

In 1905, when Fuller was ten, Einstein had written his epochal equation E equals Mc^2, making the speed of light man's universal benchmark. The long-venerated Newtonian cosmos was shattered. "At rest" was no longer the reality of natural process. What this implied was that everything, which is to say every *process*—physics has found no "things"—is an eternal state of becoming. Kepler's cosmic harmonies were not the repose of inertia but the repose of *action*. This high-power view of matter and energy supplanted the static geometry of Copernicus, Kepler and Newton with a dynamic concept. Points and particles no longer existed—only processes. Lines were replaced by vectors, which are descriptive of energy events. What Fuller calls the "ghostly Greek geometry" could not describe the realities of an energetic, Einsteinian Universe. Vectors could.

Fuller began looking for the patterns in which these energy events interact. He knew that such interactions occur because of the phenomenon of mass attraction. Due to the phenomenon of precession, however, these interactions occur at other than 180 degrees. As energy events move into closer physical proximity, the angular effect becomes stronger. Fuller thought of the triangle as *three energy events* moving into critical proximity. Because of precession, they would be deflected towards or away from each other in other than 180-degree directions. No straight lines and no parallels. Such *angular* deflections suggested a triangular patterning in nature. A lattice composed of vectors.

In looking for nature's basic geometry, Fuller remembered that scientific experiment had proven that no two lines can go through the same point at once. Neither, he supposed, could two vectors. These would tend to overlap.

In the triangular patterning of energy interactions, the angularly deflected vectors would tend to describe, not a triangular plane, but a very *flat* spiral—an open but unstable triangle.

To create stability, which means creating structure, Fuller found he could stabilize a vector interaction by combining two of these open triangles and make, synergetically, a *stable* vector-edge tetrahedron with four triangular faces.

Therefore, one and one is four. And the meaning of Eddington's study of "and" becomes more pertinent.

"Mathematically, there are some very important concepts about the tetrahedron," Fuller notes. "It is made up of four triangles. The angles of each are interstabilized. Each of the separate angles, originally amorphous, becomes stable. The triangle is the fundamental structure, but it takes *two* functions—the positive and the negative—to make a structure. The tetrahedron is the simplest known structure."

Further, Fuller saw that when you take equal diameter spheres, six of these pack most compactly around one on a flat surface. He also saw that twelve spheres pack most compactly around one in space.

In 1944, Fuller wrote, "It will be found that the number of spheres in any complete layer around any nuclear group of layers always terminates with the digit two, which is always preceded by a number which corresponds to the square of the number of layers surrounding the nucleus.

"The third layer's number of 92 is comprised of the number three multiplied by itself with the digit two as suffix. This third layer is the outmost of the symmetrically unique nuclear system patterns and may be identified with the 92 unique atomic patterns, and with the 92nd element, uranium.

"Because of its three inner layers of 12 plus 42 plus 92, which equals 146, the number of neutrons in uranium, plus the twoness value characterizing the outer layer of 92, we get 146 plus 92 equals uranium 238. The geometrical form thus 'most compactly' developed is not that of a composite sphere, but is always a polyhedron of 14 faces, comprised of six squares and eight triangles and twelve points, extending in tangential radius from the original 12 spheres surrounding the nucleus."

This polyhedron is the *vector equilibrium,* so called because the radial vectors are restrained and balanced by the circumferential vectors. "The concentric push-pull interchange between outwardly pushing wave propagation and inwardly pulling gravitational coherence."

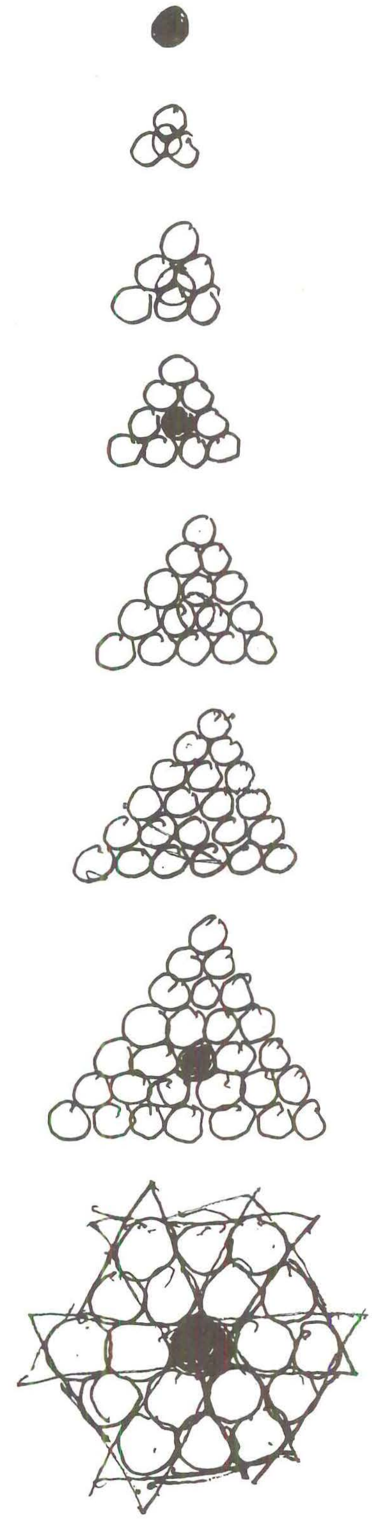
Fuller identified the number of layers around a central sphere with waves of energy—"waviform vectors"—some of these radiational (entropic), some gravitational (syntropic).

He wrote, "The volumetric measurement of any one wave is determined by the square of the radius multiplied by the nuclear ten plus two." Neatly packaged, this reads $10f^2$ plus 2.

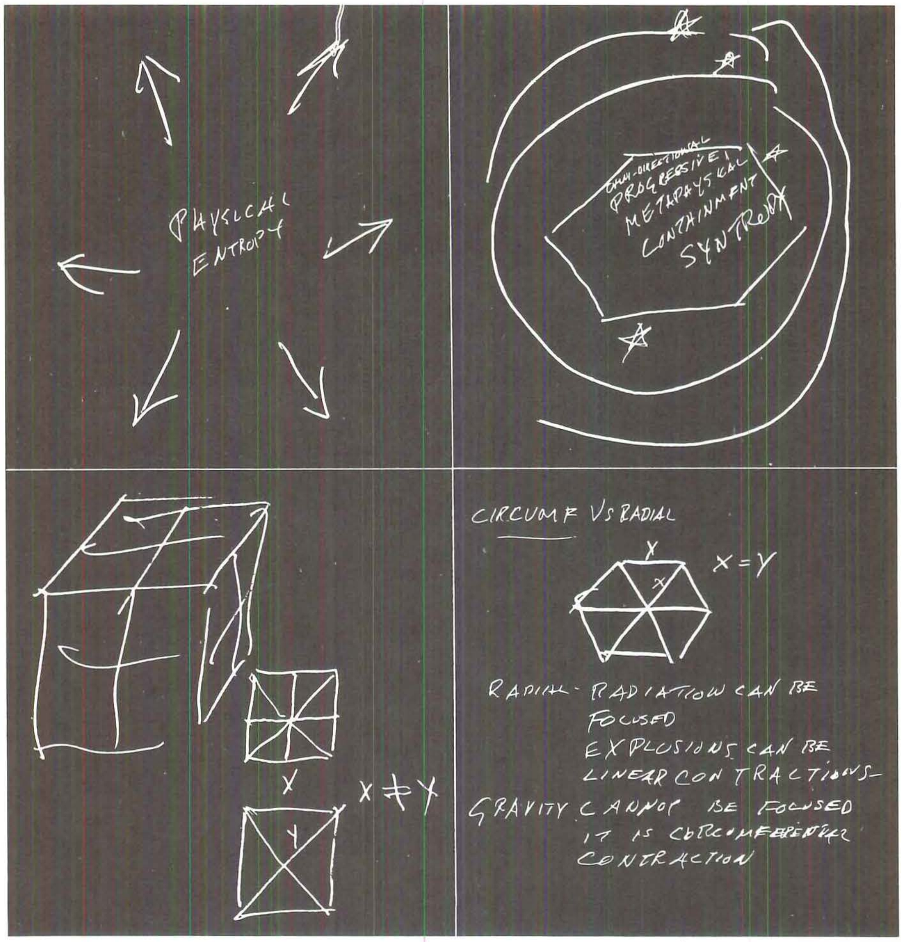
It seems to relate to Einstein's E equals Mc^2, where c is the speed of radiation multiplied by itself. And to the gravity formula of Newton which expresses the second power of radial proximity between entities in mass attraction.

Bear in mind that these insights came crashing in usually in the dead of night during the very late Thirties and early Forties. All the while Fuller was involved in Kansas City, in Washington and in Wichita, the pursuit of Synergetic principles—on the backs of envelopes, menus, hotel paper—was one constant in all his toings and froings. He learned to travel very light, perhaps to approach more easily the speed of it. It is highly doubtful that a stationary Bucky Fuller—content with making some respectable mark in his native Massachusetts—could ever have come up with so all-motion a system.

Fuller further revealed that by removing the center sphere from the *vector equilibrium's* compact cluster, the other spheres closed in to form an icosahedron—12 vertexes, 20 faces, 30 edges. Removing the center sphere from the icosahedron, the others closed in to form an octahedron—6 vertexes, 8 faces, 12 edges. Removing another, the remaining spheres closed in to form Fuller's "good friend tetrahedron"—4 faces, 6 edges, 4 vertexes. He saw there could be nothing more compact or more stable. It became the



Fuller diagrams the closest packing of spheres



minimum structure of the Fuller Universe.

What this says is that all energy transformations appear to be different phases of the same configuration of forces, not unlike the recycled themes in a Mozart symphony. These transformations—from the tetrahedron, to the octahedron, to the icosahedron—were, for Fuller, "the least-effort structural systems in nature." Increasingly, he saw that nature's coordinate systems was sublimely rational, always economical, and never arbitrary.

Using the tetrahedron as his minimum module, Fuller took its volume as one; the octahedron's as four; and the icosahedron's as 20. He equated this minimum unit volume with the four identical triangular surfaces. Four became his common denominator. This way, the ratio of faces to volume for the tetrahedron was one; for the octahedron, two; for the icosahedron, five.

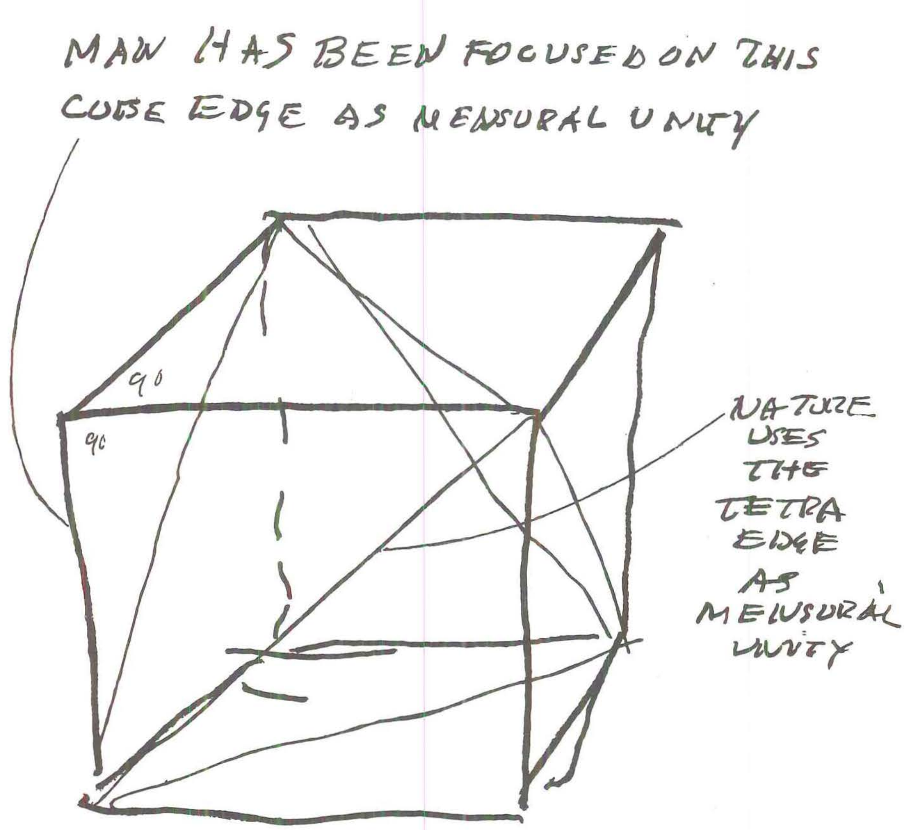
Fuller wrote, "Of the three fundamental structures, the tetrahedron contains the least volume with the most surface and is therefore the strongest structure per unit of volume. Whereas the icosahedron gives the most volume with the least surface and, though least strong, is stable and gives the most efficient volume per units of invested structure."

The observation was really the genesis of the geodesic dome. Fuller concluded, with a somewhat unsettling certainty "to develop the triangular icosahedron as the fundamental volume controlling device of man."

This 60-degree coordinate system shatters the cube as the basic building block of nature. Synergetics assigns a unit volume of one to the tetrahedron. And a unit volume of *three* to the cube. In an interesting maneuver, Fuller divided the unit volume of the *vector equilibrium*, which is 20, by the cube's unit volume of 3, yielding 6.665 . . . . , Planck's Constant. He has concluded that this irrational number must have been the needed fudge factor to correct the fallacy that the cube is minimum structure. If Fuller is correct, the right angle is through. So are many courses and concepts in architectural history, chemistry and physics.

You may not happen to believe a word of this. The important thing, however, is that Fuller has evolved a thoroughly rational way to understand and, yes, *model* universal process. As science and society have moved from studying parts to studying wholes, both have needed a tool to conceptualize reality in all its dimensions. Mere calculation, like mere analysis, is not ultimately beneficial unless it can lead to synthesis. Synergetics supplies a tool to conceptualize such a synthesis.

Two years ago, in his celebrated Nehru Memorial Lecture in New Delhi, Fuller explained, "When a century ago electro-magnetics introduced completely invisible energy behaviors, scientists were unable to explain their discoveries conceptually. When experiments disclosed energy behaviors of n^4 and n^5, the scientists concluded that the XYZ geometrical coordinate system's inability to provide a conceptual model



of more than n^3 suggested that nature's fourth and fifth dimensions needed no models because they said nature is coordinating only mathematically abstract formulations. Synergetics discloses that nature is coordinating with the tetrahedron as volumetric unity, which uses only one-third the volume of space employed by the cube. It becomes possible to make fourth and fifth dimensional models. Thus, conceptuality returns to reunite the sciences and humanities."

The social implications of Fuller's discoveries take on tremendous importance, for the gap between science and society has been one of the most grievous aspects of 20th century life. Science is held responsible for wars, pollution—even our crisis of the spirit. Cities are said to be dying because billions are spent on killing people instead of improving their environment.

Technicians are condemned for moral neutrality as they piece together the engines of war and pollution, rarely measuring the social impact of the projects they are part of.

Reading all the articles announcing Armageddon, you would think we are approaching Samuel Butler's *Erewhon,* that "idyllic" society which, hating machines, put them all in museums and went back to farming. But technology is not the outlaw. Mankind must assess and act on the trends which lead to crisis—preventing, not just managing, the results of what Fuller calls our "cosmic nearsightedness." He insists that Universe is the ultimate technology, that man must discern and employ its principles, that our acquisitive society, confusing expediency with progress, is the *real* outlaw.

Certainly, technology has been much abused. And much maligned. But it has also been the basis of man's increased economic success. A century ago, over one quarter of all farm land was given over to raising feed for plow horses. Technology replaced the plow horse and, since then, more and more people are eating. The so-called Green Revolution did not sprout from somebody's thumb. It too is a product of technology. As a result, even such underdeveloped countries as India are becoming self-sufficient in the staple grains.

Such "bumper crops" are dividends of doing more with less. When copper is scrapped, it is recycled at a higher level of efficiency. The first telephone wires carried one message; later on, thousands. Now microwave relays arc information from point to point in seconds. Computers and satellites are becoming more compact even as work loads increase. Technology is trending toward the miniature, and Fuller is quite convinced that as it reaches its true fulfillment, it will completely disappear. Automation would free us to think, trout fish, or travel. Spare time would be productively used. Abundance would assure altruism. The meek wouldn't have to worry about inheriting the earth. Everyone would be eating. Or maybe rereading "Myth of the Machine."

One example of doing more with less is the harnessing of tides, the basis of Fuller's proposed energy grid. Another is atomic fusion which will, when researched and perfected, harness deuterium from the one and a half billion cubic kilometers of ocean water around the world. If only one percent of that were used, atomic fusion would release 500,000 times the energy of the Earth's initial supply of fossil fuels. Fusion research promises to be formidably expensive but, here again, its long-range preferability calls for international cooperation. No one nation or ideology has a premium on the world's fast-depleting supply of fossil fuels. The universe doesn't recognize our biases or boundaries, our fiscal years or five-year plans. There is only one accounting system—nature's.

Fuller reminds us that saying technology is bad is like saying the hydrogen atom is bad. "Like the hydrogen atom, man is born to be a success," he commonly says.

There is plenty of evidence that Fuller may indeed have correctly perceived the nature of universal structure.

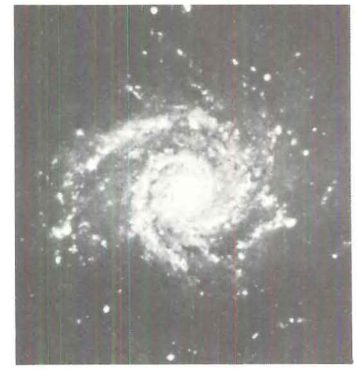
Chemists were the first to see tetrahedronal structuring in molecules. Van't Hoff first discovered it in carbon—a basic constituent of life. This occurred in 1885.

In the 1930s, Linus Pauling found that metals are also tetrahedronally structured. During the Fifties, physicists disclosed a staggering array of sub-atomic particles. Fuller's early efforts to achieve maximum strength with minimum material were acknowledged as somehow relating to the sub-atomic interrelationships being disclosed. In 1963, virologists announced that the mathematical principles mediating the structure of the viral protein shells were also explained by Synergetics; in particular, Fuller's formula $10f^2$ plus 2. Moreover, when nuclear physicists began investigating viral structure with X-rays, patterns very much like Fuller's geodesic domes emerged.

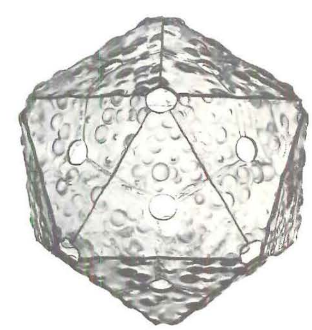
One of the world's leading geometers, H.S.M. Coxeter of the University of Toronto, has confirmed Fuller's insights. He has written a paper called "Virus Macromolecules and Geodesic Domes," which is part of a book entitled the "Spectrum of Mathematics" to be published by the University of Auckland, New Zealand.

In this Coxeter writes, "In 1955, Fuller built a dome as bachelor officers quarters for the U.S. Air Force in Korea. This seems to be the shape of the Reovirus. His 31-foot geodesic sphere at the top of Mt. Washington in New Hampshire is like the herpes virus and the varicella (chicken pox). His U.S. pavilion in Kabul is like Adenovirus. His radome on the arctic DEW line is like infectious canine hepatitis virus."

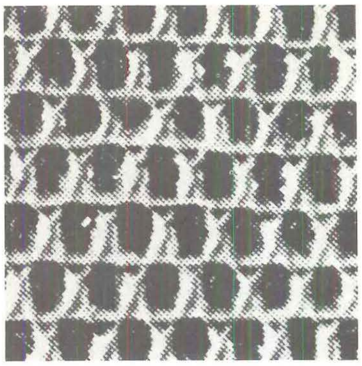
So far, there are no records of domes being contagious. However, Coxeter has also studied the formula $10f^2$ plus 2 and comments, "If this remains valid for greater values of f, I regard



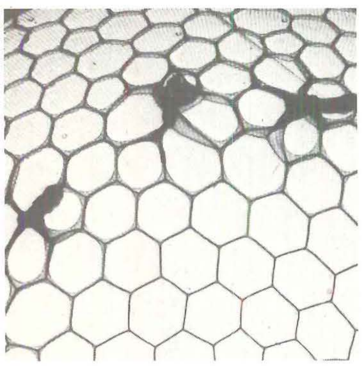
The spiral Galaxy M 74



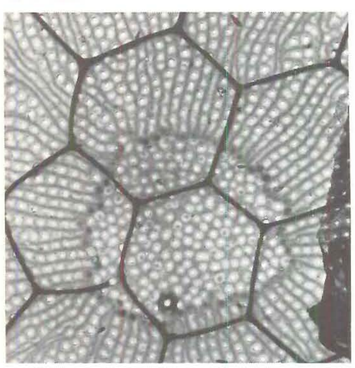
Plastic model of the polio-virus showing the icosahedal configuration



Watersnake skin

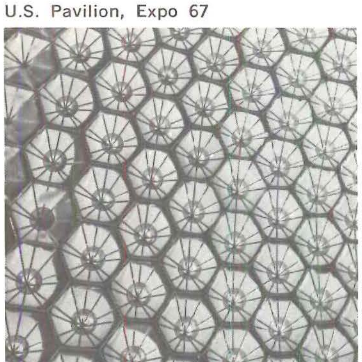


Fly's eye



Fly's eye

U.S. Pavilion, Expo 67



it as a remarkable discovery. The whole infinite lattice of points is of such complexity, one would not expect its ramifications to satisfy such an elegantly simple rule." Late in 1970, Professor Coxeter acknowledged it *is* true, and his proof will appear in a paper called "Polyhedral Numbers" in the Festschrift Edition of Boston University's Philosophy of Science series. Whether or not Fuller is right is quite beside the point. There are many unique discoveries of Synergetics which will long bear the burden of proof.

What should be remembered is that science learned long ago that whenever an unexpected simplification appears, it may well define a point from which to glimpse the wider connections, thus opening up, as Fuller has put it, "new ranges of cosmic comprehension."

Cosmic comprehension does not imply certainty of the truth. In 1927—the year of Fuller's "peel off"—Werner Heisenberg, the German physicist, stated that man alters truth in the very process of measuring it. This Indeterminancy Principle, while recognizing an ultimate truth in the Universe, also recognized that man, despite improved technology and instrumentation, could only narrow the gap between the known and the unknown.

Newton's cosmos once was held to be absolute. Now, Newton is only a special case of Einstein. And Einstein, a special case of quantum theory. What is next? It doesn't really matter. What matters is that, increasingly, an ordered structure in the Universe is being revealed. In the process of measuring the Universe, science—perhaps due to that increment of uncertainty Heisenberg spoke of—has discerned not a cosmos of chaos but a cosmos which prefers order.

Research in the Fifties and up to the present time has substantiated this view. Particle physics demonstrated that nature is not symmetrical. The concept of parity had held that any physical reaction, yielding certain results, could be reversed to yield the original configuration of particles. In 1956, it was discovered that this did not hold. Physical reactions, when reversed, yielded entirely different particles. The mirror image of a symmetrical Universe was shattered. It was seen that nature *did* have a preferred direction. Not a direction toward annihilation and chaos, but one toward evolution and order. As George Steiner, science writer for *New Yorker*, put it recently, the grid of the world has altered. And so has man's sense of himself.

In this schematic, there is no disorder *or* order. No symmetry *or* asymmetry. No black *or* white. No past *or* present. No all *or* nothing. Like the tetrahedron, octahedron and icosahedron, these "opposites" are manifestations of the same force. What has seemed chaotic to man —whether he looks into the electron microscope or into city slums—may be the external evidence of a more subtle ordering at work. There is no longer another side of the tracks.

What physicists have described as Time's Arrow can be thought of as Fuller's Vector—that velocity times mass description of events. In the rhythmic cycling of the Universe, there is no past, no now, no future. For Fuller, they are all one.

"It is one of those strange facts of experience," he ponders, "that when we try to think into the future, our thoughts jump backwards. It may well be that nature has some fundamental law by which opening up what we call 'future' also automatically opens up the 'past' in equal degree. Time is not linear, but probably consists of omni-directional wave propagations. Because every action has both a reaction and a resultant, every 'now' must have a 'past' and a dawning 'future.' "

Mankind does not think into the past. We spiral into it on ever higher levels of order. T. S. Eliot, even before Heisenberg, had noted that man alters the past in the process of studying it. Which is also what Fuller seems to be saying. As man views the past, he must—*because* of evolution—think of the past in a way that the past never thought of itself. As Fuller has said, "The very consequence of awareness is to impose the phenomenon time upon an eternal Universe."

I believe that Fuller's long-range significance, beyond his many prophecies and practical inventions, rests with this grand synthesis he has communicated.

Fifty years ago, he foresaw that the gold standard would ultimately be abandoned in deference to energy and intellect as the real constituents of wealth.

In the Thirties, he foresaw the advent of new energy sources from within the atom and delineated its potential for world society.

He foresaw in 1927 the revolution in communications and transportation which would transcend geography and release man into a new sense of place—the whole Earth catalog of options for social advancement.

In all this, he foresaw the common world consciousness which, despite national and political bias, has emerged as a natural fallout from the many crises all men face.

Fuller's vision, his lasting faith in the human community, does more than inspire. It informs. And it is, itself, a vital resource which must be carefully studied and applied in seeking innovative, integral solutions to the problems of both scarcity *and* abundance.

It is not surprising that Fuller has become strongly identified with the revival of spiritualism—especially among the young. For him, the concept of God is implicit in the order and integrity of the Universe and, by seeking a modelable structure, he has sought to share its rationality, as well as its mystery, with man.

"I think you are going to have coming out of science some statements as to the integrity of the Universe discovered directly by a great many individuals. There are so many of high capability and integrity making such discoveries that they themselves wouldn't even think of trying to persuade you. These people will avoid proseletyzing, but more gradually their ranks will be joined by more and more scientists, and we are going to get to the point where a very large number of individuals will begin to recognize an integrity of Universe and an integrity of the total experience of life that will be of the order apparently experienced by the first great men, such as Christ.

"No one will be asked to believe anything. Everybody will make firsthand discoveries. What has been thought of as atheism is really just an evasion. It wasn't a declaration of againstness, not something against religion, but there seemed to be nothing else to take its place."

Perhaps Fuller's greatest appeal stems from his having shown that there *is* something to take its place. Having overcome the Cartesian preconceptions of the past, he has projected mankind into a more intimate and affirmative relationship with the forces of nature.

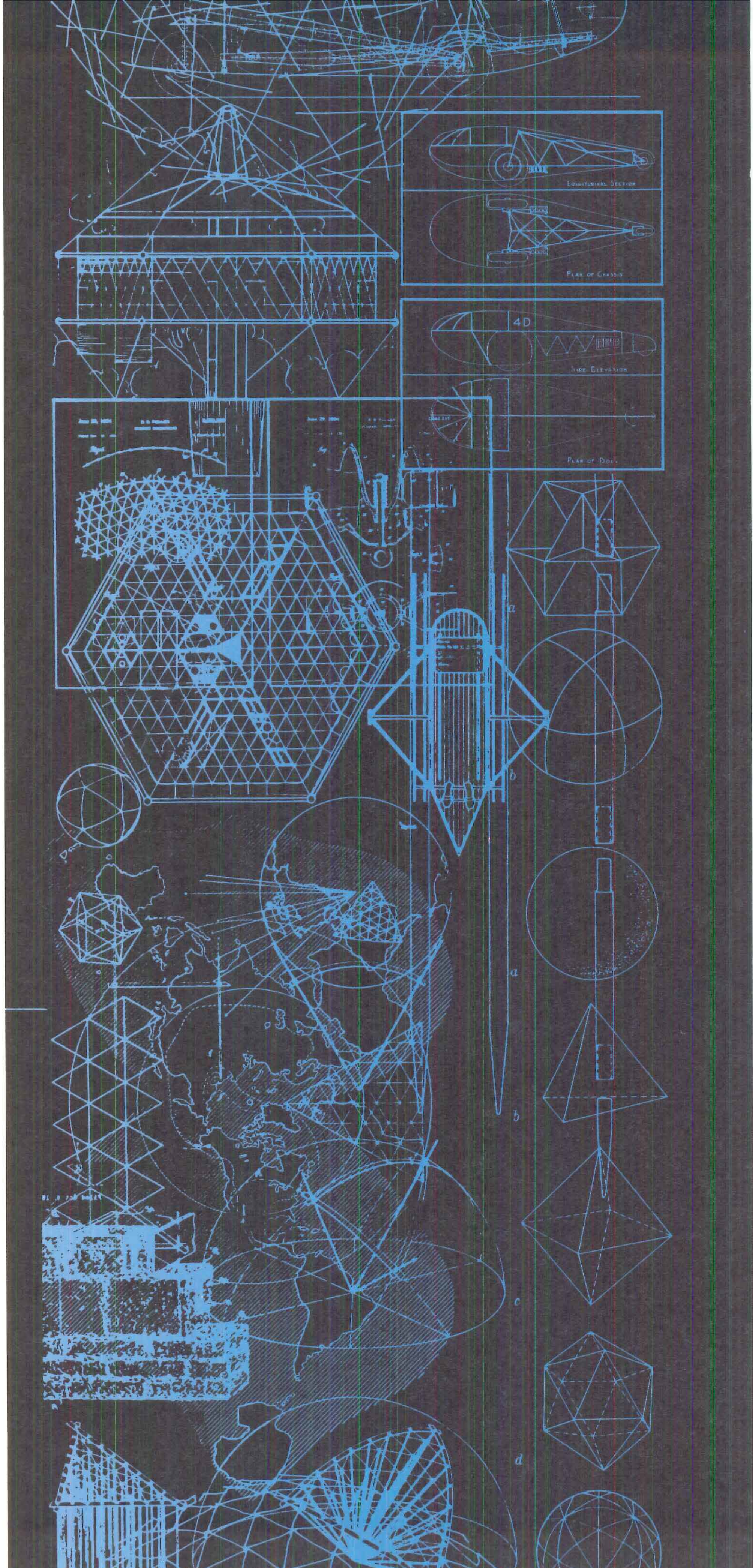
It is really only natural that Fuller considers *intuition, competence* and *integrity* the three most important words in his vocabulary. If you look into the eyes of the people who hear him, you can sense their understanding of his hopeful message. In a period of nihilism, his kind of good news may seem somewhat naive. Yet, despite what he calls the "negative inertias" of our time, he has managed to arouse and sustain a moral energy among men which is basic to realizing human possibilities.

Two years ago, Fuller returned to the same Chicago slum where he had cloistered himself in 1927. The "Young Lords," a militant gang of Puerto Ricans, had invited him to speak about the problems of renewing their deteriorated neighborhood. Typically, however, he soon had them thinking about renewing themselves. Something he had gone through a good deal of pain to do years before.

"Society is full of this horrible thing, fear," he told them. "And when society is fearful, it gets panicky and does stupid things. So don't do things just to defy or make people fearful. Do things to give them confidence. Don't do things which invite opposition. Do things which invite support. Try to think clearly, and you will find answers for your problems. Very shortly, society will be in enough trouble to want them."

Perhaps Fuller was thinking of that time when he was himself afraid, that time when he set out on his search for truth against a world given to teaching lies and preaching deceit. He has come to personify that vital search and he has given it a structure as logical as the molecular language physics and biology are revealing. Perhaps, as the biophysicist Lancelot Law Whyte said several years ago, this new structure awaits a Newton to display its empirical power. And a Lucretius to sing the philosophical emancipation it promises. Fuller, at least, will not have to wait. He has already seen the new age.

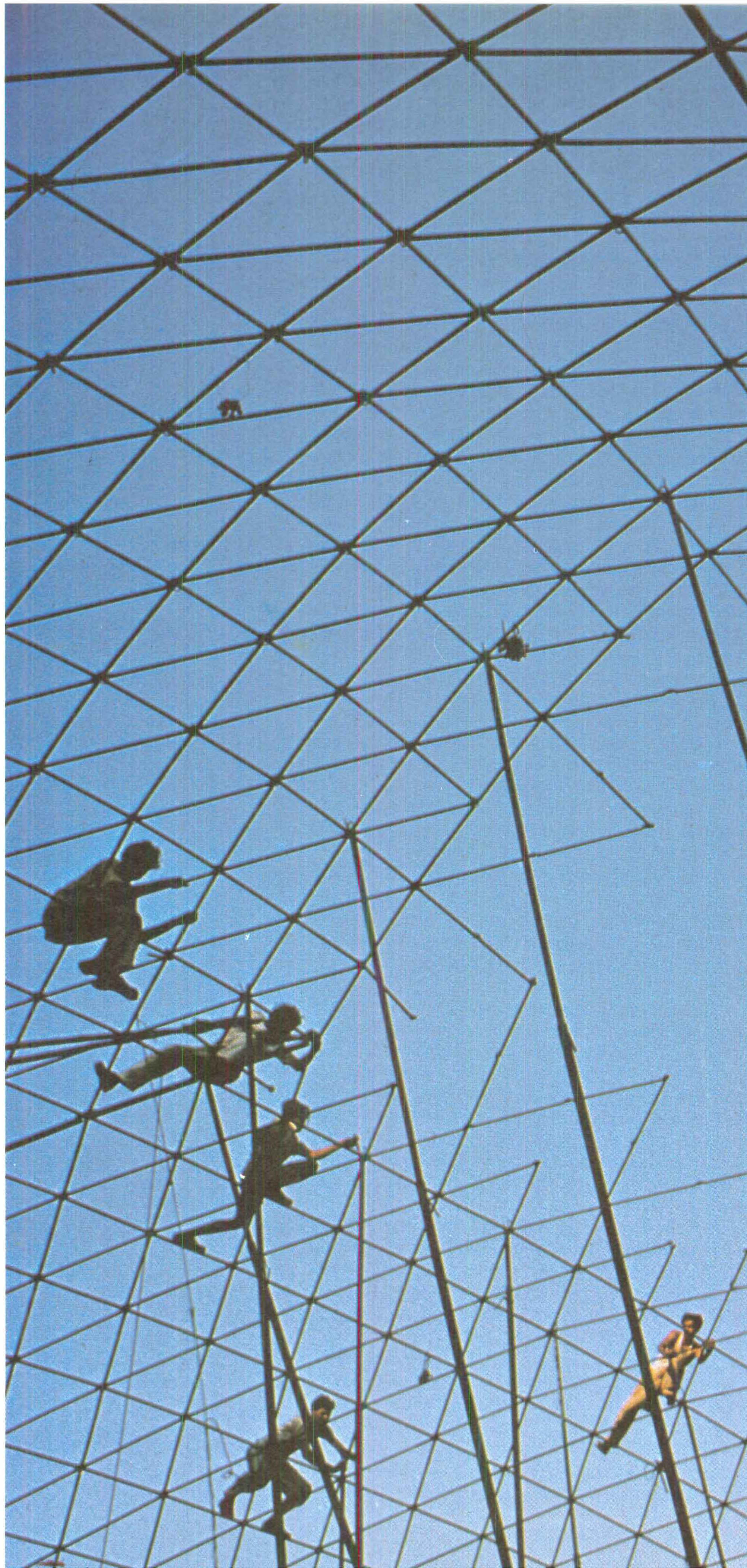
K. Sotiriov

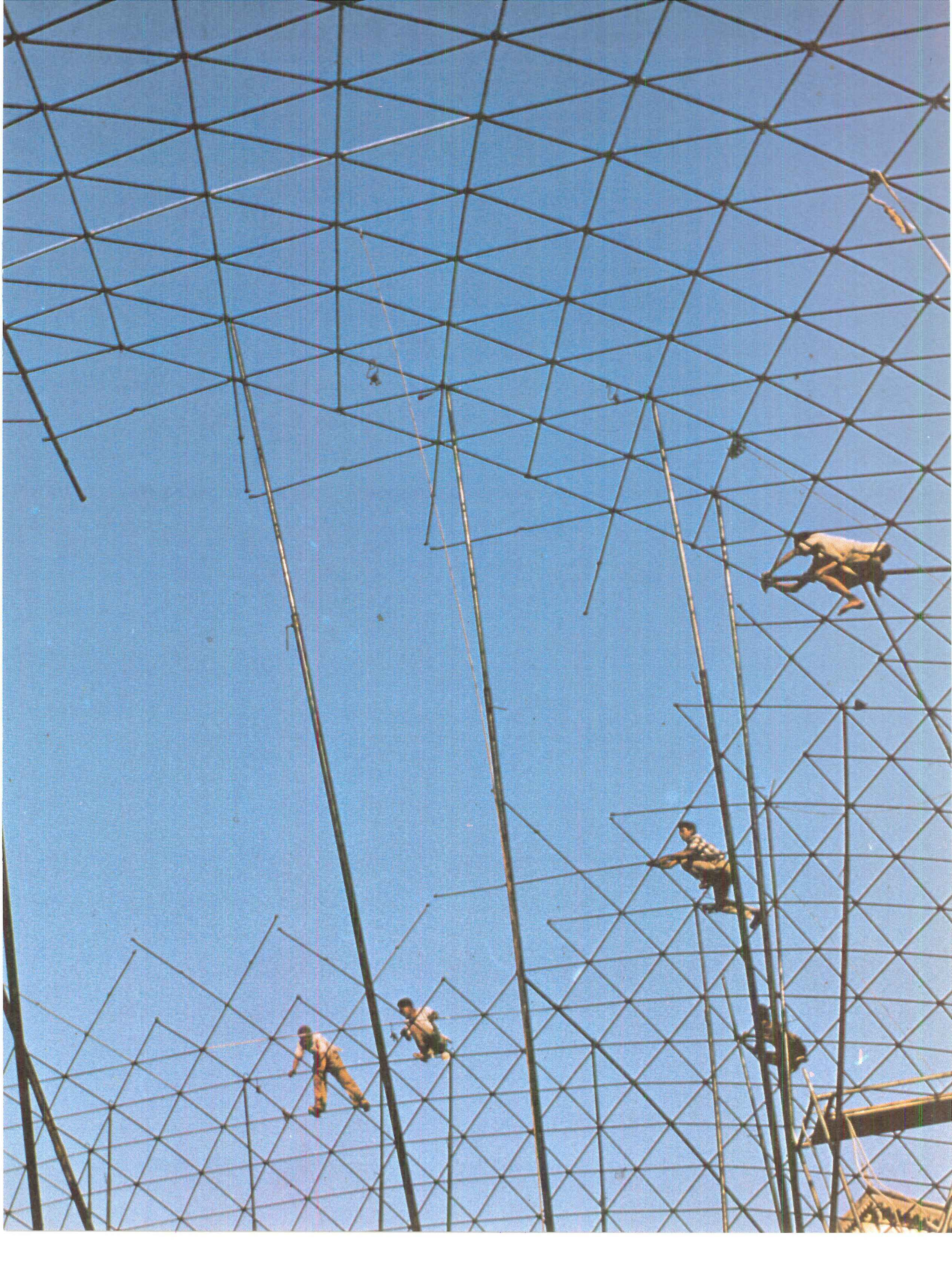


"Humanity owes a great deal to Professor Buckminster Fuller, the distinguished architect, inventor and philosopher, who dedicated himself to the improvement of the living conditions of his fellow men. He has covered thousands of miles traveling all over the world, giving lectures before scientists and scholars, and explaining his visions for a new era in which technology will defeat scarcity, and will create a race of world men whose allegiance will be universal."

His Beatitude The President of the Republic of Cyprus, Archbishop Makarios, in a statement prepared for this issue of The Architectural Forum.

Right: Geodesic theater-in-the-round, Bombay, 1958.
PHOTOGRAPH: Charles Eames.





GEODESIC DOMES

The rationale and the reality

BY DON L. RICHTER

Back in August 1951, when the ARCHITECTURAL FORUM described Bucky Fuller's geodesic concept in detail, I was privileged to be working with him as director of prototyping for the Fuller Research Foundation. Since then, my independent researches in geodesic systems for Kaiser Aluminum, the R. C. Mahon Company and Temcor have convinced me that geodesic has far more going for it than is generally recognized. In fact, I believe that it will be one of the principal architectural forms of the future.

Many architects and designers, of course, already recognize the basic beauty and efficiency of the geodesic dome. Now, however, as conservation of materials and energy resources grows in importance, a better understanding of geodesic geometry will help in the wise and purposeful use of geodesic building systems.

The use of geodesic geometry for spherical dome structures was originated by Bucky Fuller, but geodesic geometry has also been used in the design of transmission towers and aircraft fuselages—a fact that is not so widely known. You see, the basic definition of a "geodesic line" is "the shortest line that can be drawn between two points on a surface"—any surface. The geodesic line on a flat plane is a straight line. On a cylindrical surface, the geodesic line can be a straight line along its length, or it can be a circle or a spiral around the cylinder. The geodesic, or shortest, line between any two points on a sphere is a great circle—that is, a circle of maximum radius. The equator, for instance, is a great circle, while all other latitude lines are lesser circles—i.e., of smaller radius. This concept has been made familiar by ships and airplanes that follow "great circle routes," since they are the shortest distances between embarkation and destination.

Similarly, if all other factors are equal, a structural framing geometry that follows geodesic lines would automatically have the shortest possible lengths of members. It would also be the most efficient generalized structural system.

To illustrate this point, four commonly used basic framing systems for dome structures have been designed and computer-analyzed. In order to compare these systems fairly, all four domes were made as nearly equal as their individual geometries would permit. All four sample domes have the same base diameter, the same spherical radius, and the same number of gusset, or nodal, points interconnected by struts following their four different geometries: Schwedler, Lattice, Lamella, and Geodesic. (Figures 1-4)

Figure 1 is the plan view geometry for the Schwedler (or "radial rib") dome. You will notice that the Schwedler dome has a group of frame members extending from the base tension ring to the apex in great circle arcs. The base ring and the three concentric inner rings are lesser circles. Virtually all of the commonly used nongeodesic dome frame systems have a number of lesser circles in concentric rings, as shown in Figures 1, 2 and 3. In Figure 1, diagonal framing members that are required to stabilize the dome have been shown as dashed lines. These diagonals make this dome geometry a completely triangulated three-dimensional space truss.

The plan view of the Lattice geometry dome is illustrated in Figure 2. In this configuration, framing struts that follow intersecting, spiral-like patterns connect the base ring to the concentric inner rings and the apex of the dome. None of the framing lines in the Lattice dome follows a great circle arc.

A typical Lamella geometry is shown in Figure 3. Notice that this geometry also has horizontal lesser circles concentric with the base ring. The Lamella dome has an advantage over the previous two systems, in that the clutter of members intersecting at the apex has been reduced. The triangles formed between rings and struts are also more nearly equal in size.

The final geometry illustrated is the Geodesic dome shown in Figure 4. Notice that Geodesic geometry does not employ concentric lesser circles. This is the key feature to look for in determining whether the dome geometry is truly geodesic. The great circle arcs in the Geodesic dome extend from the base ring on one side of the dome to a corresponding point on the other side. The space truss formed by the three sets of intersecting great circles yields surprisingly uniform, almost equilateral, triangles.

Although other geometric configurations and variations have been studied, these four basic types are the most representative. For our computer analysis of the four types, the following equalizing criteria were used:

1. All domes are the same overall size; that is, 100 feet in diameter and in spherical radius, and all are 14 ft. high.

2. All domes have 61 nods (strut-connections).

3. All four are completely triangulated space-truss configurations.

4. All domes have their own tension ring and are supported vertically at each of the base-ring nodal points.

5. All strut connections are pin-connected.

6. All domes are assumed to be fabricated of six-in. outside-diameter aluminum tubing.

7. All dome frames have the same total weight: 10,000 pounds of aluminum. Since each dome requires a different amount of tubing, the tube wall thickness was adjusted to hold the 10,000-pound weight limit.

8. All loads are assumed to be vertical and are distributed over the nodal points.

9. Two loading conditions were assumed: symmetrical and unbalanced. The first is a uniform vertical load over the total surface. The second (unbalanced) is a full load on one side and a half load on the other side of the dome.

10. All structures were designed in accordance with the allowable stress established by the Aluminum Association for alloy 6061-T6.

Figure 1.

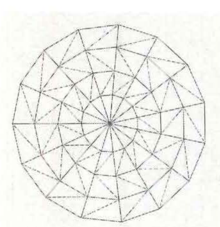


Figure 2.

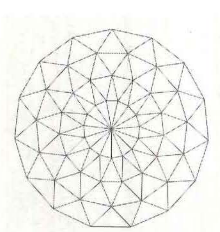


Figure 3.

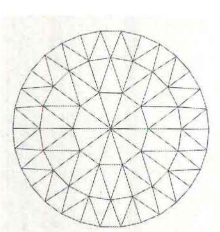
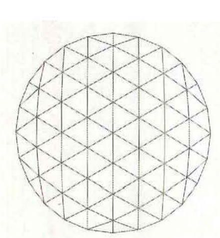


Figure 4.



Don L. Richter, whose 25-year association with Fuller began at the Institute of Design, is Vice President for Geodesic Dome Development and Marketing at Temcor.

11. To illustrate the importance of a completely triangulated space truss configuration, the radial rib dome shown in Figure 1 was also analyzed without the dashed diagonals. For this dome to support any loads at all, it was necessary to assume that all joints were rigidly connected.

The results of our computer analysis are shown on Table I. Although the Schwedler dome without diagonals looks rather good under uniform symmetrical load, the unbalanced loading condition is far more important in simulating actual field conditions. Under such conditions, the Schwedler dome without diagonals would only support 12 psf on one-half the dome, with 6 pounds distributed over the other one-half. By adding the diagonals to the Schwedler dome, its strength is more than doubled to 28 psf on the high load side. This increase in strength was accomplished without increasing the weight over the 10,000-pound limit.

DOME TYPES	SCHWEDLER radial rib figure 1		LATTICE figure 2	LAMELLA figure 3	GEODESIC figure 4
	w/o diagonals	with diagonals			
weight in pounds	10,000	10,000	10,000	10,000	10,000
number of nodal points	61	61	61	61	61
max. uniform load psf evenly distributed	45	29	25	32	45
max. unbalanced load psf right side psf left side	12 6	28 14	20 10	28 14	40 20
relative strength with unbalanced load	30%	70%	50%	70%	100%
inches deflection with unbalanced load of 12 psf and 6 psf	17½	1½	1⅝	⅞	⅞

The Lattice dome will support 20 psf under the unbalanced condition; and the Lamella, 28 psf. The Geodesic configuration will support a full 45 psf, either as a symmetrical load over the total surface or as a non-symmetrical loading of 40 psf on one side and 20 psf on the other.

We are now manufacturing three types of domes employing Geodesic great-circle geometry at Temcor: Crystogon structures, Polyframe Domes and the Geodesic Dome proper, each of which has its own unique applications.

Crystogon Domes employ triangular panels of clear acrylic secured to a framework of extruded aluminum alloy. The transparent or translucent panels are non-structural and in fact must not receive stresses from the aluminum frame. The low deflection of the geodesic configuration, as noted in Table I, is particularly important in this regard.

The Polyframe Dome is widely used for storage tank covers and special structures like the "big igloo" described below. This dome employs wide-flange beams of extruded aluminum covered with flat, triangular aluminum panels. As with the Crystogon, the non-structural panels are designed to provide protective covering only and do not contribute to the strength of the dome frame.

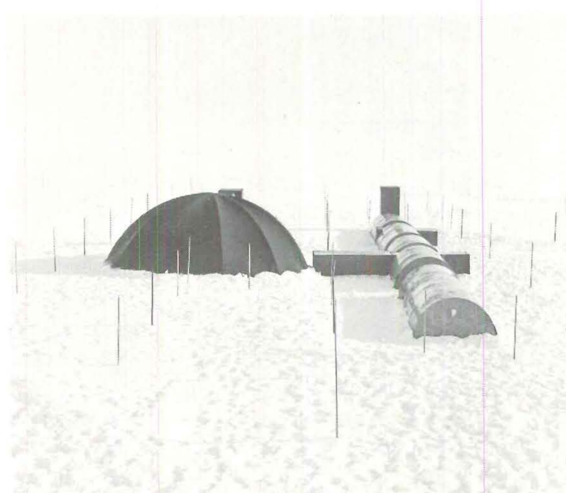
The advantages of the Polyframe for tank covering are obvious when one considers that a concrete cover for a typical 135-ft-diameter tank weighs about 460 tons. A steel cover for the same size tank weighs about 150 tons. But a Polyframe Dome weighs only 17 tons—just 3.7 percent of the concrete and 11 percent of the steel one.

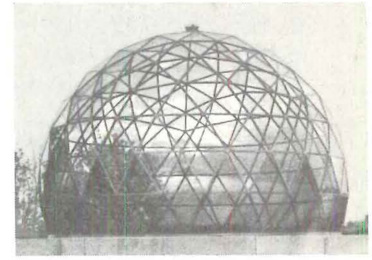
A highly unusual application of the Polyframe Dome is the U. S. Navy's new South Pole station, now under construction by Navy Seabees during the brief Antarctic summer. Scheduled for completion by February 1, the dome will be 50 ft. high and 164 ft. in diameter. This "big igloo" will serve as a giant weather break to keep snow away from three buildings inside, which will serve as crew's quarters, science headquarters and communications center for Operation Deep Freeze.

Designed to overcome the twin problems of wind-exposure and heavy snow loads that have nearly destroyed the present station (now buried under 50 feet of snow), the Polyframe Dome will be unheated. Heat escaping from the three interior buildings will be vented through an opening at the top of the dome; and a large blower will pump in cold outside air to keep the average temperature at 0°F. Maintaining a sub-freezing temperature will prevent the three buildings inside from sinking into melting snow.

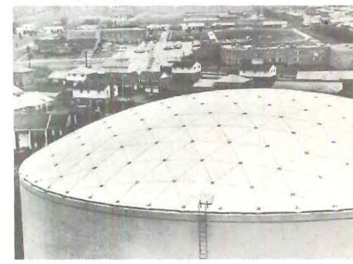
This Polyframe Dome was designed to withstand 125-mph winds and snow loads of 120 psf. A structure of such shape and strength is expected to postpone the eventual crushing and disappearance of the station under heavy snow drift for at least 10 to 15 years.

Since transportation is one of the most critical

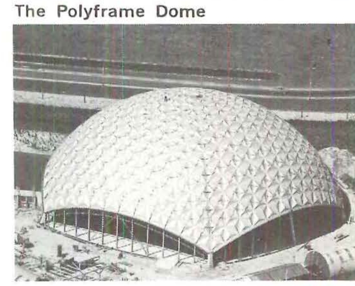




The Crystogon Dome



The Polyframe Dome



The Geodesic Dome

factors in implementing Operation Deep Freeze, the Polyframe design offers the additional advantages of light weight and prefabricated, modular construction. Components had to be sized to fit the 8½ by 8½ by 36-foot cargo holds of the Hercules LC-130 aircraft that transported the "big igloo" the last 900 miles from McMurdo Station, on the edge of the Antarctica, to the South Pole.

An interesting sidelight is that the new station is being built a quarter of a mile "upstream" of the pole to allow for the inexorable drift of the polar ice cap toward South America. The station will be exactly atop the South Pole in an estimated five years; and will have moved a quarter of a mile "downstream" in another five.

The Temcor Geodesic Dome, unlike the Crystogon and Polyframe Domes, is used in most architectural applications and employs my patented concept using structural panels with the space truss. The three-dimensional framing efficiency of the space truss has been utilized by bracing diamond-shaped aluminum panels with tubular struts of extruded aluminum. Each panel with its strut forms a tetrahedron. The several hundred tetrahedrons that comprise the typical dome are joined together at the four corners with forged aluminum gusset-and-hub fittings to form a space truss that follows Fuller's geodesic geometry.

Combining geodesic geometry with the structural panel and the space truss results in a building that is exceptionally lightweight and extraordinarily strong. Although the weight of the dome is only 2½ psf, it is designed for 40 psf (four feet of snow) and 125-mph winds. Temcor Geodesic Domes have easily withstood the hurricanes of Florida and Guam Island, the snows of Alaska and the earthquakes of California.

Because of the construction efficiencies made possible by geodesic principles, Temcor can fabricate the aluminum panels and other dome components at its Torrance manufacturing plant and—as in the case of the "big igloo"—transport a 150- or 200-foot clear-span dome by rail, ship or air to job sites anywhere in the world. Once on location, Temcor domes are erected at safe ground level by successively bolting rings of diamond-shaped panels and struts together around the base of a lifting tower. The dome is hoisted up the tower as the assembly of each ring is completed. After the dome is totally assembled, hoisted and secured to previously prepared supports, the lifting tower is removed and the top opening closed with additional panels, a cupola ventilator or a skylight. The dome is then sealed and made ready for closure walls and interior treatment. Judging by the rapidly growing numbers of Geodesic Dome installations—installations that now span the hemispheres from North America, Europe and the Orient to South America and the South Pole—it would seem that the reality of geodesics is at last beginning to approach the dreams of Bucky Fuller.

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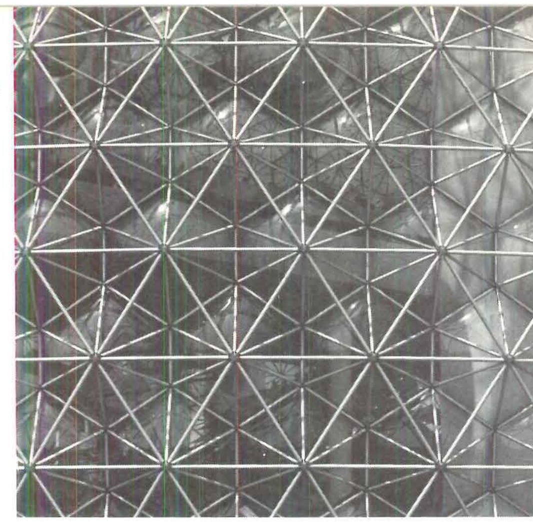

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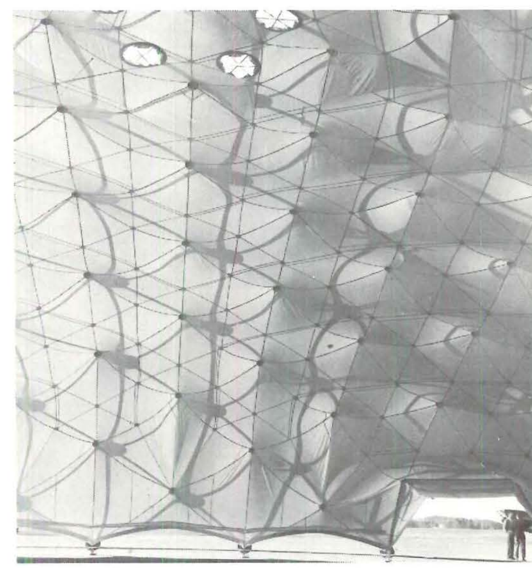

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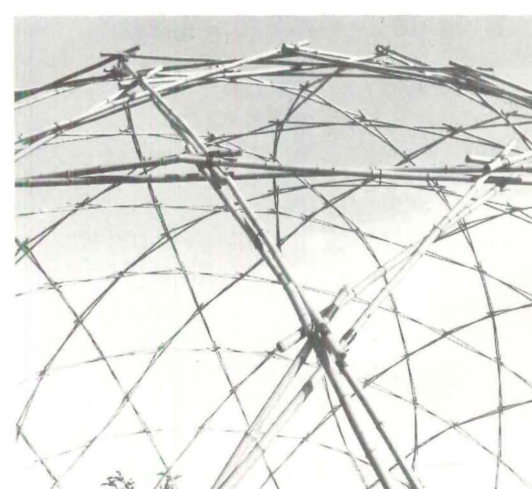

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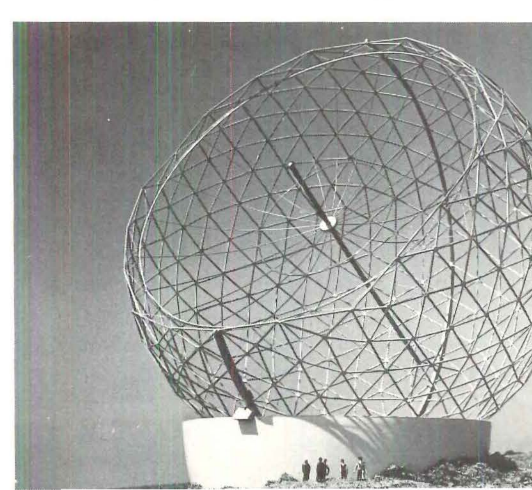


(1) Close-up of the steel and plexiglass geodesic skybreak bubble at Expo 67, Montreal. (2) U.S. trade fair dome, Kabul, Afghanistan, 1957. (3) Bamboo dome assembled by students of the Bengal College of Engineering in Calcutta. (4) Sky-eye, a 300-ft. spherical diameter radio telescope. (5) Religious center at the new Edwardsville Campus of Southern Illinois Univ. 1971. (6) Airplane Museum, Skipoel Airport, Amsterdam.

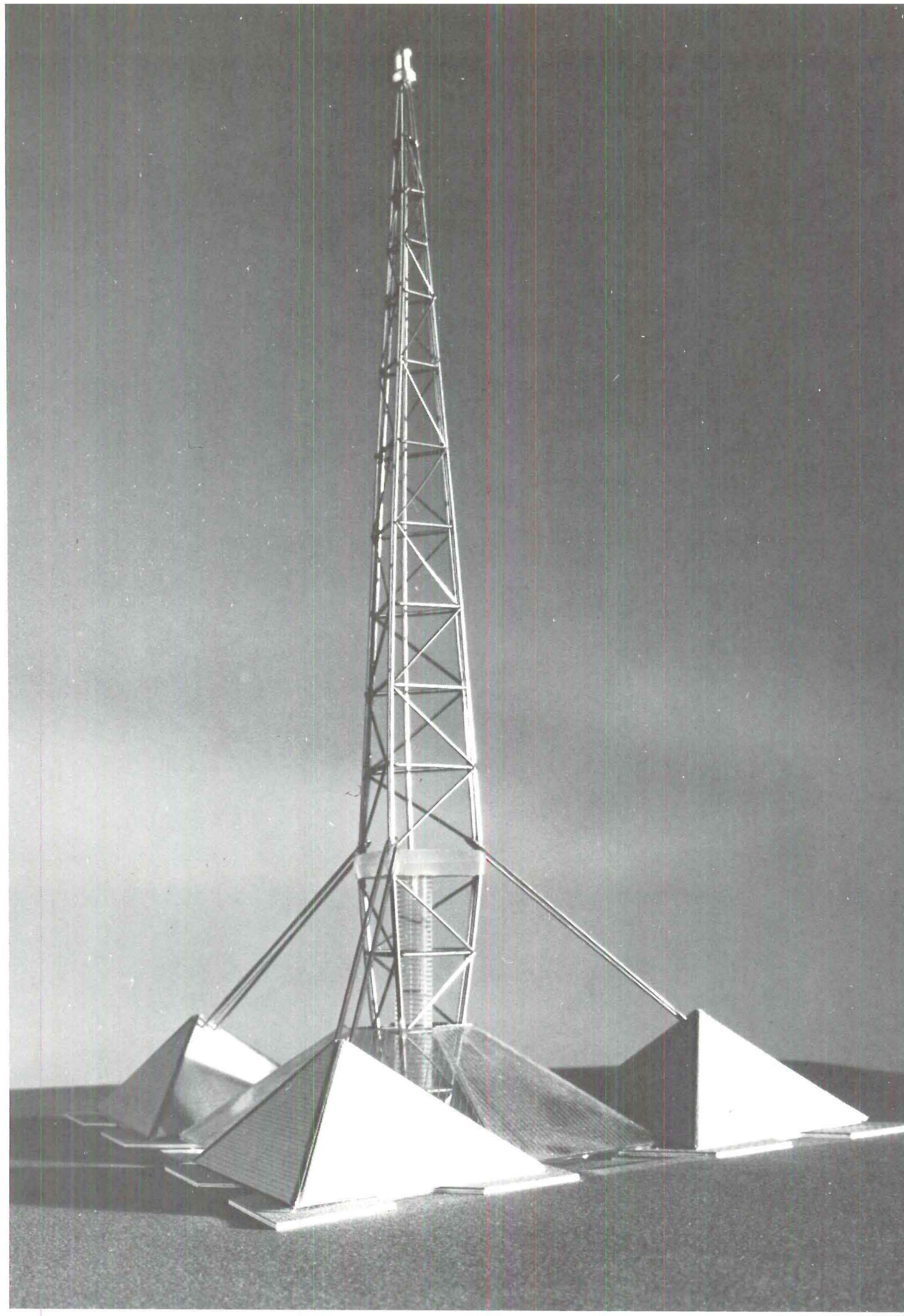
5

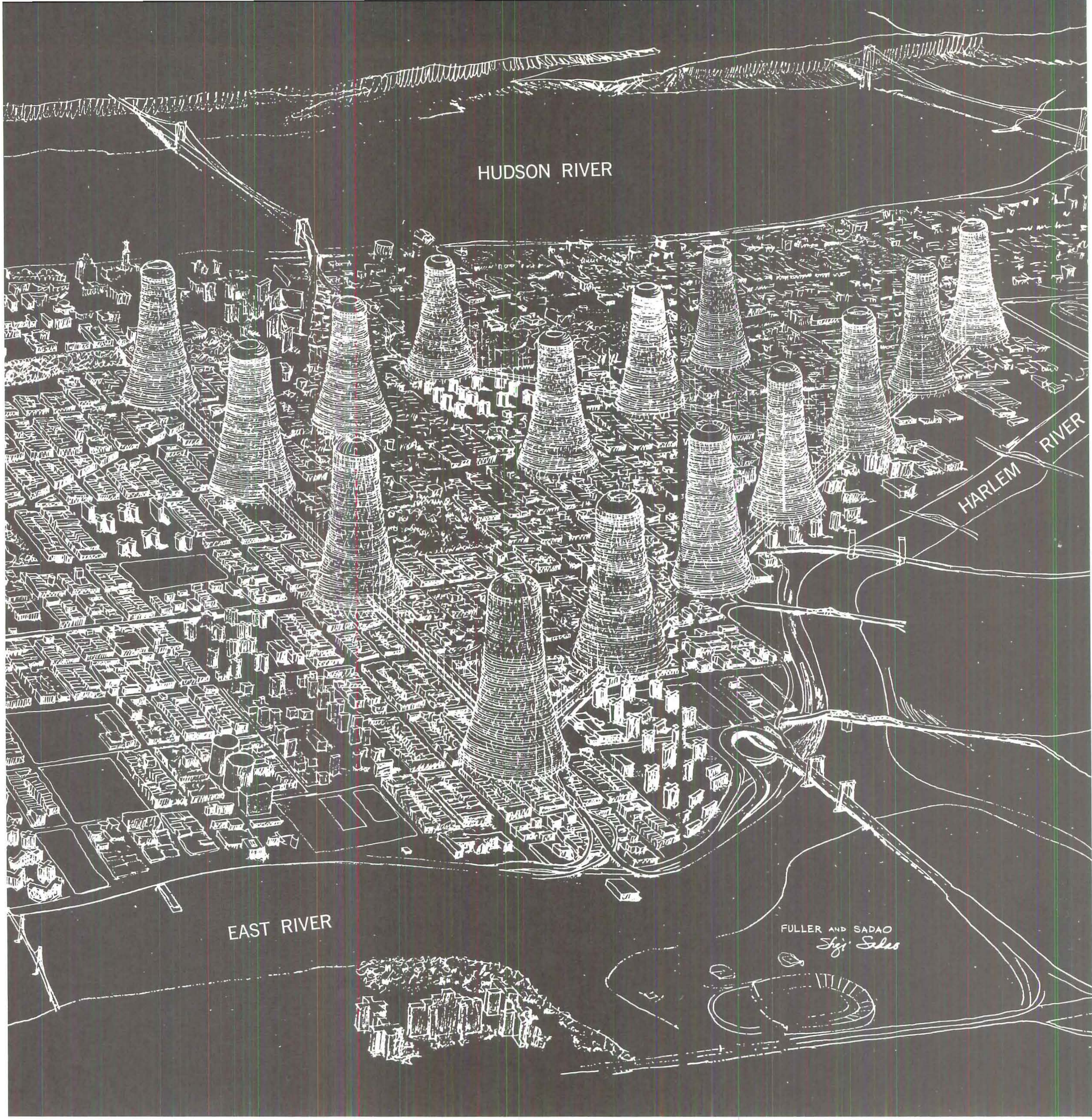
6

JAPANESE TOWER

Originally envisioned as a two-mile-high observation point, this 8,000 ft., semi-guyed alternative was proposed when real estate and money problems blocked the more ambitious scheme. Three tetrahedral structures at the base of the tripod-shaped mast were designed as anchorages for the guys stabilizing the lower tower sections and were to contain revenue-producing facilities, including housing, offices, shopping and a stadium. Unfortunately, the project was dropped because its backers decided it wasn't worth building something shorter than Mt. Fuji.

Participating in the study were Shoji Sadao, who has run Fuller's architectural office in Cambridge, Massachusetts since 1964; Geometrics, Inc., also in Cambridge; and Simpson, Gumbertz & Heger, Inc., consulting engineers.





HARLEM

Here is Fuller's Instant Slum Clearance Project conceived for *Esquire* in the mid-60s. His solution was to clear as little as possible. Instead, he proposed 15 widely spaced "Skyrise" towers, each consisting of 100 circular living decks, cable-suspended from a central mast. Fuller suggested planting the tree-like towers in the back alleys of Harlem. Planned to house 110,000 families, these were intended to help relieve congestion on the ground, thus enabling the community to recycle itself as parks and rehabilitated neighborhoods. The towers featured spiral vehicular ramps and highway connectors 10 stories up, all on the apparent assumption Skyrise congestion would never occur.

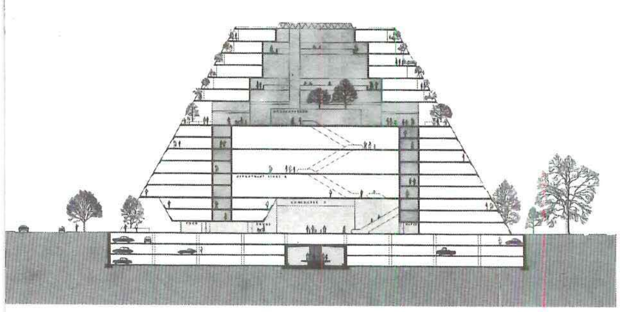
EAST ST. LOUIS

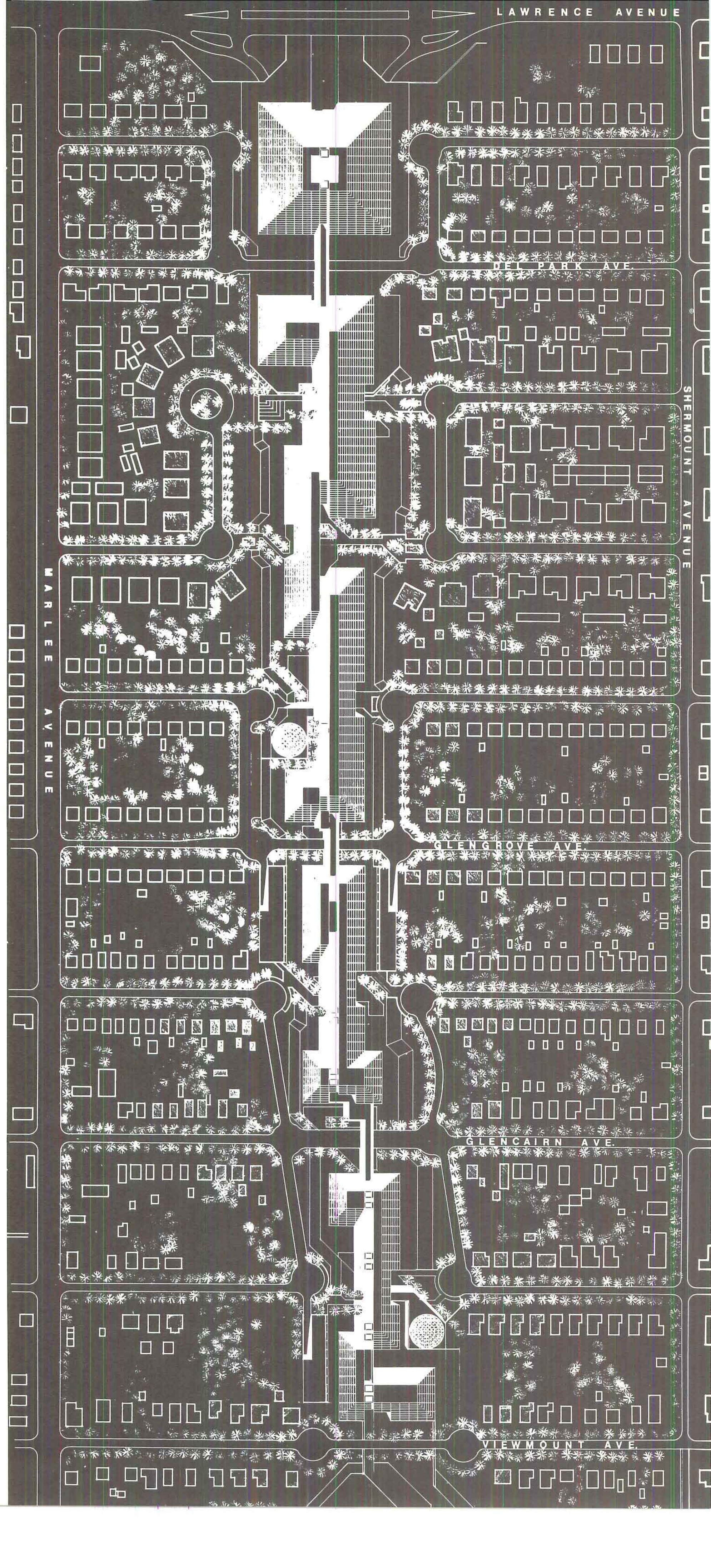
"Old Man River," a dome-covered moon crater of a city for 9,000 families, was conceived by Fuller late in 1970 for the East St. Louis Riverfront Development Commission. Beneath the 1,000-ft. high half-mile diameter dome, garden apartments for a broad housing mix will be deployed over the sloping outer surfaces of the crater. A close-grained complex of civic, cultural, educational, commercial and light industrial facilities is to be contained inside. The transparent dome will hover 30 feet above ground, allowing access from all directions while opening the city to the vast parklands to be developed along the Mississippi. All work on the project has been personally funded by Fuller, who has met frequently with various community representatives ranging from planners and highway engineers to monsignors and militant blacks. Despite the decay and despair of this nonstop ghetto, East St. Louis has enthusiastically endorsed "Old Man River." Research on its technological and social aspects is underway with a team of experts from Washington University in St. Louis and Howard University in Washington.

TORONTO

In a refreshing (not to mention realistic) move, the Government of Ontario decided to halt construction of the Spadina Expressway. Fuller's proposal is to recycle the cleared 46-acre site as a linear urban development astride a rapid transit extension to downtown Toronto. Its principal features are a climate-controlled environment, the integration of housing with parking and rapid transit, and a broad range of options for personal and community activity. The 4,000 apartment and maisonette units, together with 250,000 square feet of commercial, office and institutional space, will take the form of a series of low hills and broad valleys which will provide an inviting physical and visual access between those neighborhoods partially bisected by the site. The Spadina project embodies a low-profile, compact and intensely human answer to the scourge of urban crowding and *ad hoc* development.

The proposal has been developed by Fuller & Sadao, Inc.

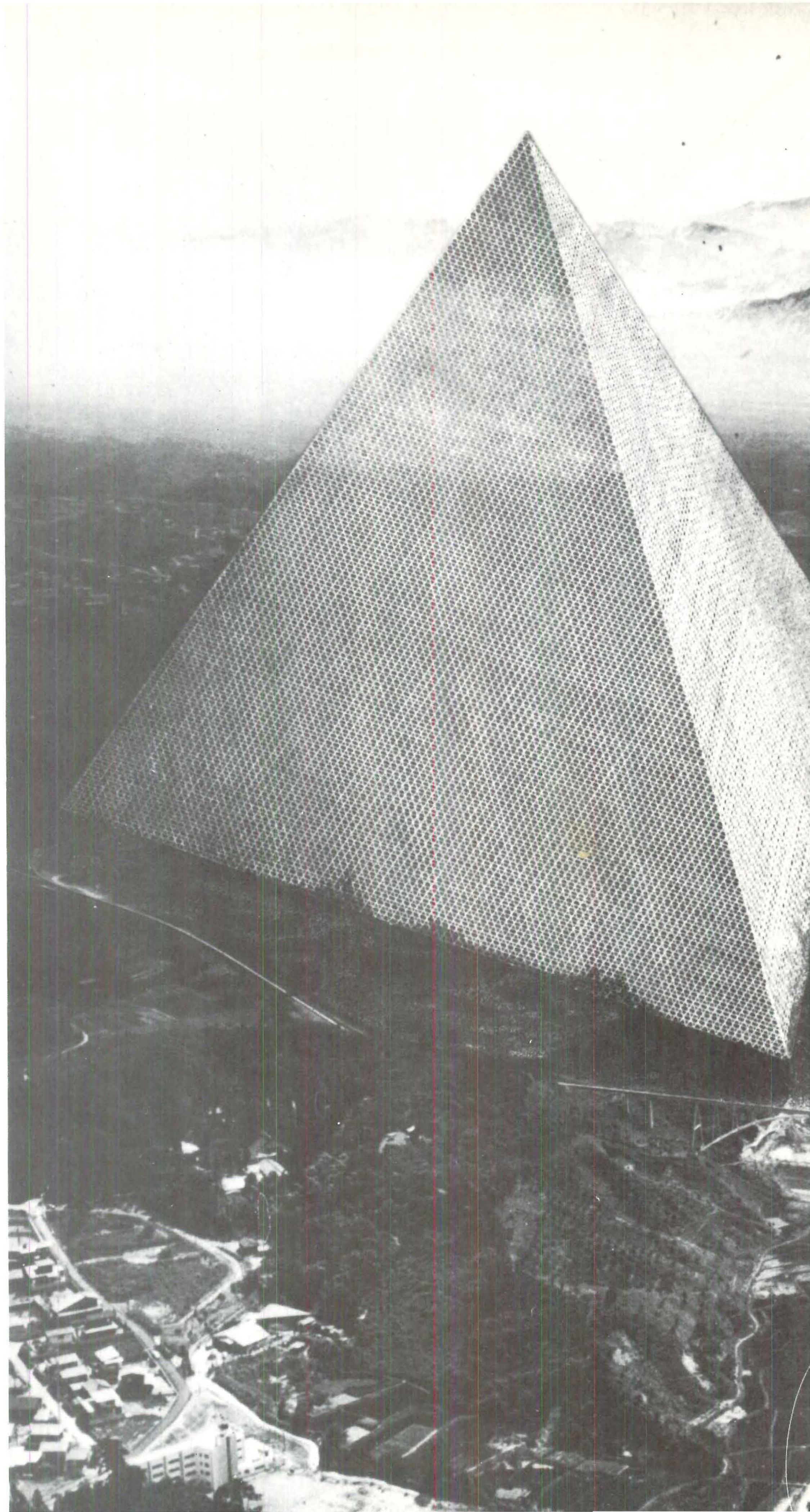


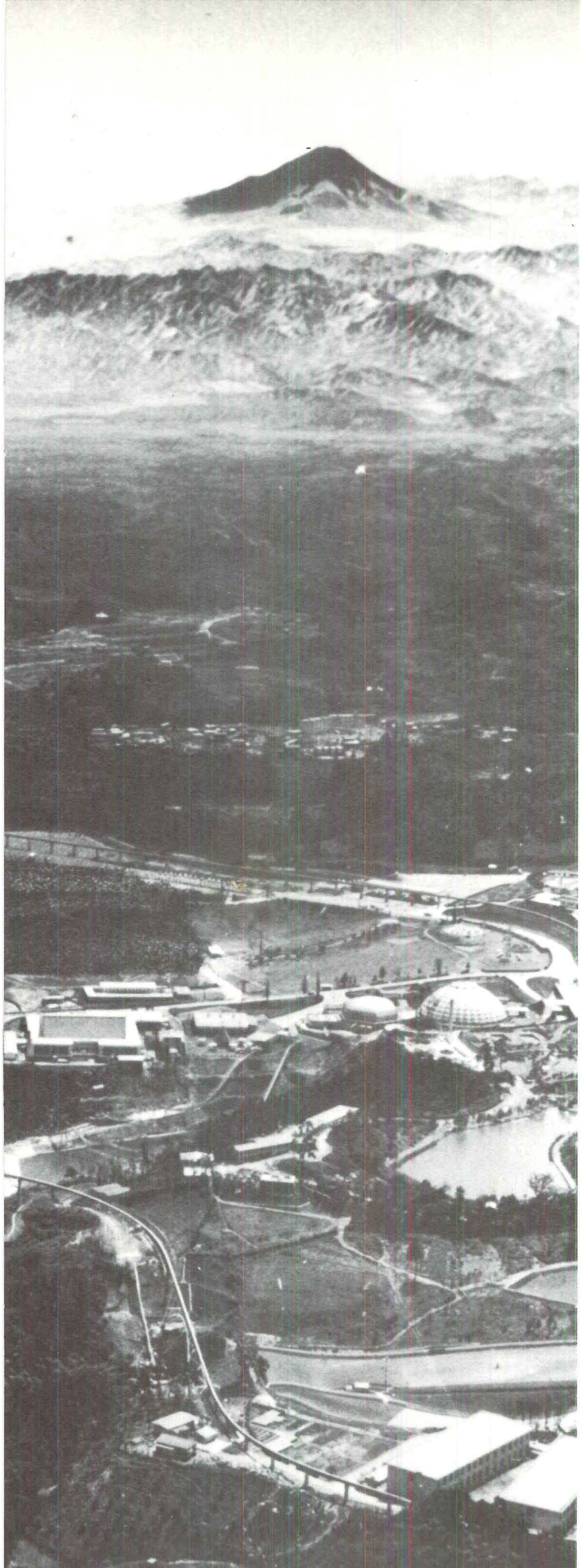


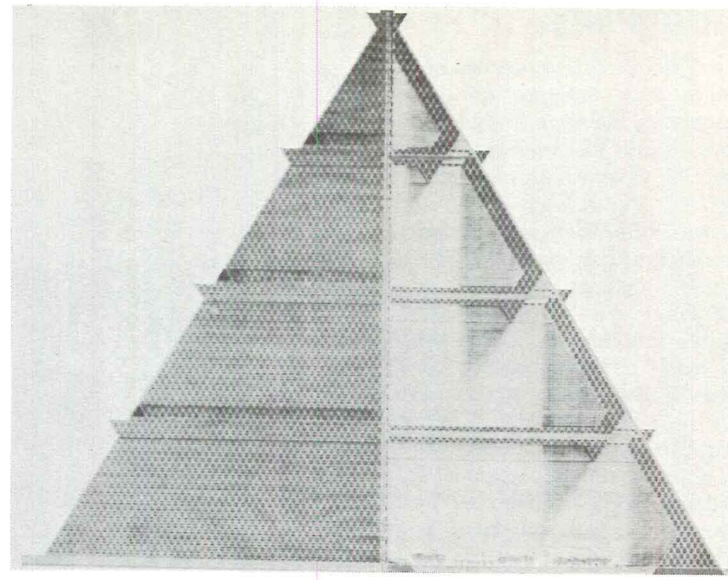
TETRAHEDRAL CITY

A "floating triangular atoll," Fuller's tetrahedral city was commissioned by Japanese financier Matsutaro Shoriki. In this picture, the city has been "beached" inland, with Mt. Fuji competing in the background. Its 200-story open-truss structure would house a million people or roughly 300,000 families in 2,000-sq.-ft. terrace apartments. These were conceived as tray-like receptacles where owners could "plug in" their trailers, houseboats or other "mobile environment controls." About half the apartment space could be used for gardening or recreation. Moreover, families could "peel off" with ease, taking their house along but leaving the terrace behind. All the high-technology machinery would have been integral with the structure, as would the transit system interconnecting commercial, cultural and community centers, each with its hanging gardens and cool lagoons. On land, the interior of the city would contain a vast park, sunlit through broad openings every 50th floor. At sea, the interior would shelter a great harbor for the largest vessels. Its foundations—hollow sections of reinforced concrete, 200 feet deep—would go below the level of ocean turbulence, providing stability during earthquakes and storms, and enabling it to navigate the seas or rest at anchor. Wherever the city might be at any given time, it would have been accessible by jet because the outer edges of its triangular base—two miles to a side—would have provided aircraft carrier style landing strips. Fuller envisions that flotillas of such cities will enable man to deploy and converge in large numbers over the Earth's surface without further ruination of our land resources. The heat of the city's atomic reactors would desalinate ocean water, wastes would be recycled, whole communities as well as individuals could circumnavigate the planet as casually as making a phone call. This habitat for the Ancient Mariner offers everything but an albatross.

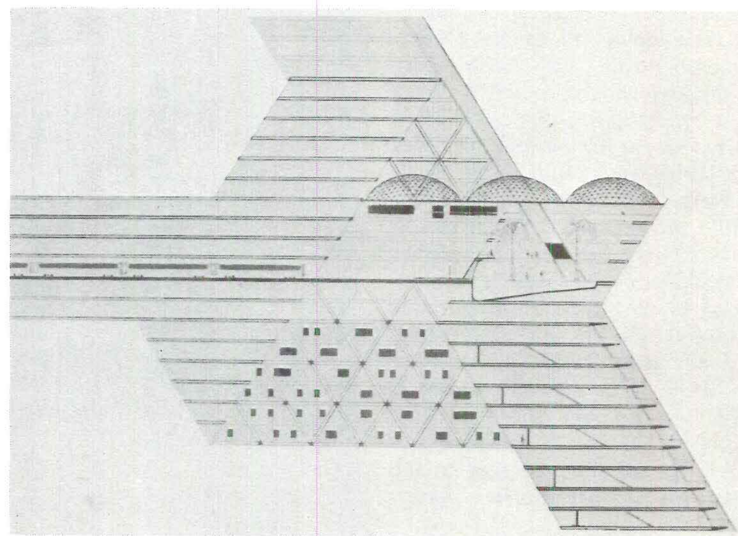
Fuller & Sadao, Inc. were project architects.







Elevation and section

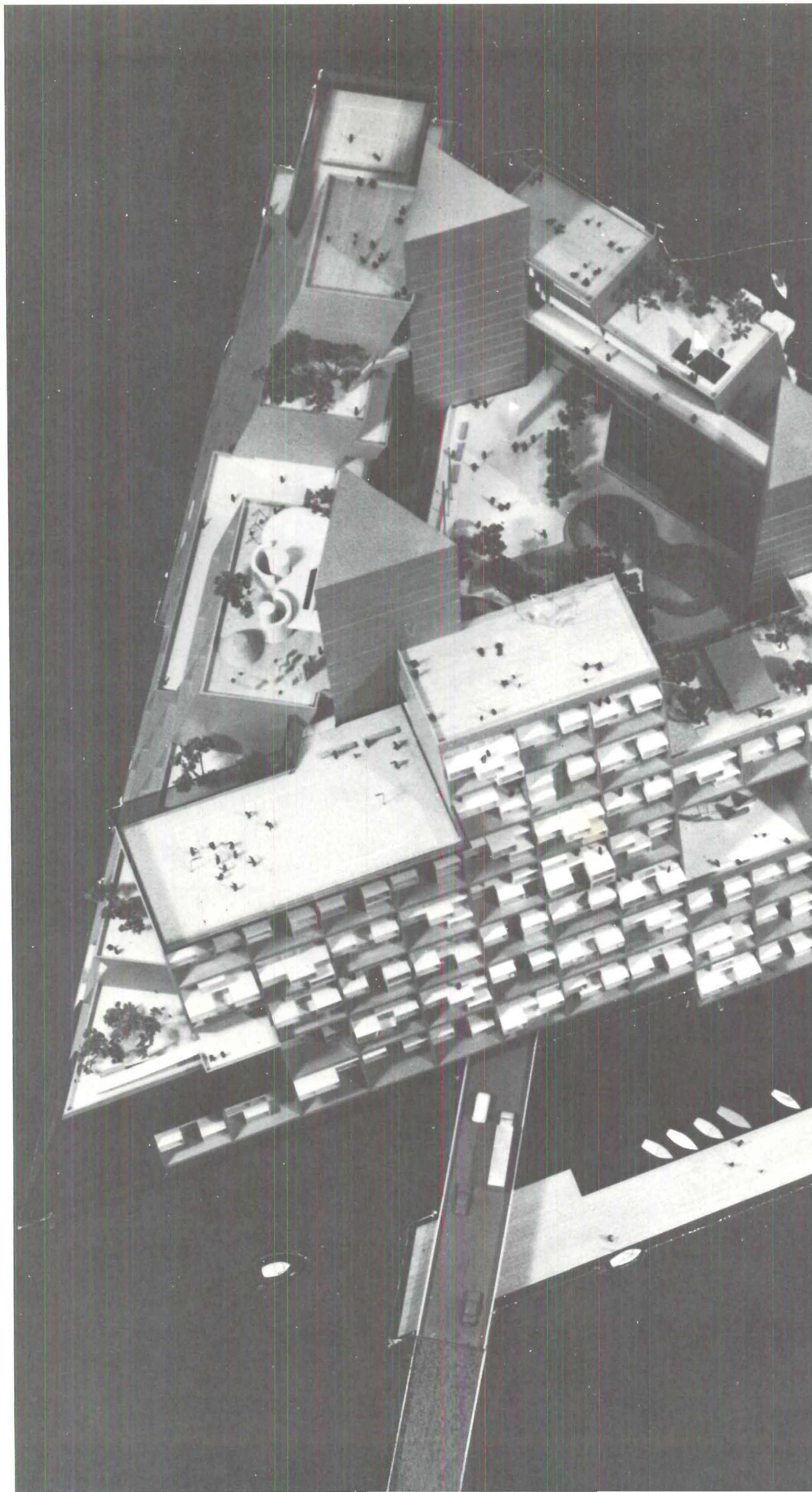


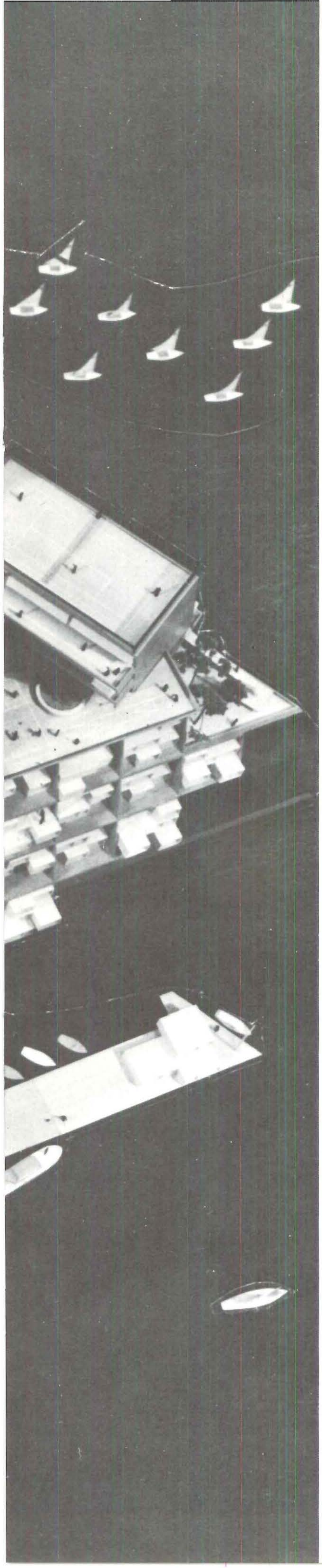
Detail of community park

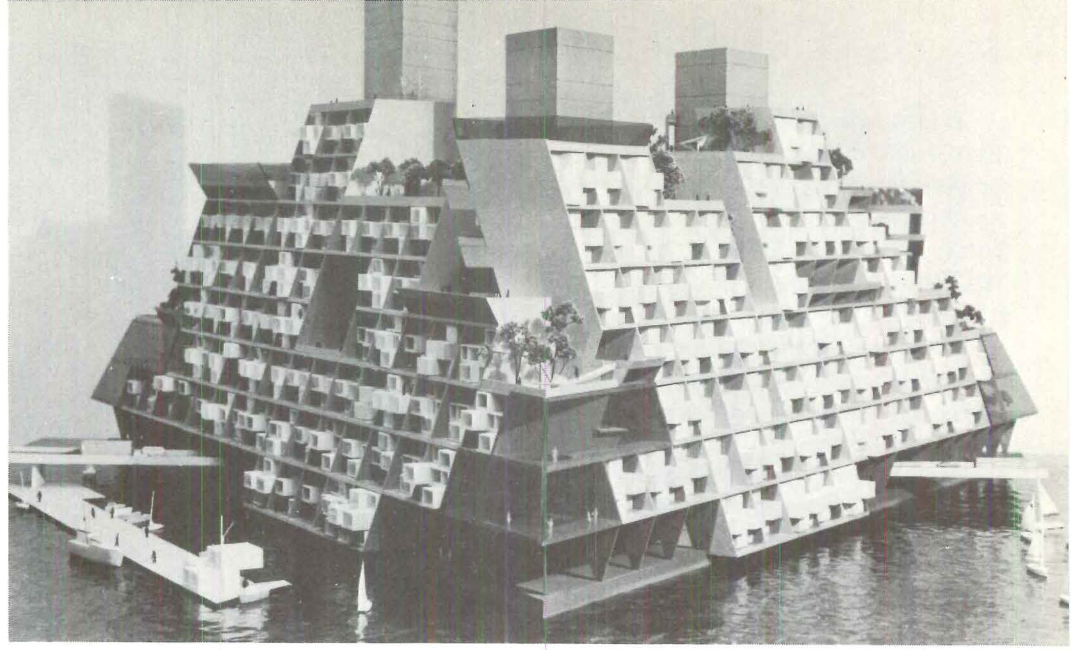
TRITON CITY

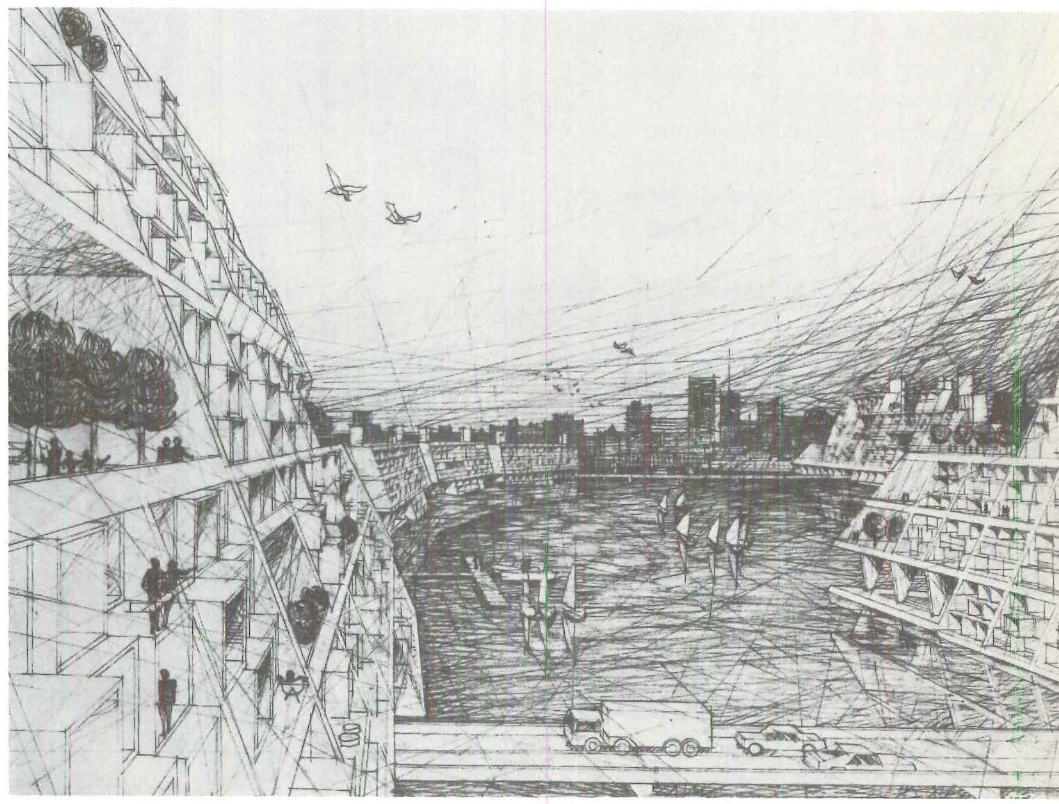
Two kinds of floating neighborhoods were designed to lay at anchor in the waters off America's larger metropolitan areas. One is a series of four to six "rafts," each holding 1,000 people; the other, a crystal-like, tetrahedral platform for 3,500 to 6,500, enough to support an elementary school, supermarket, stores and services. Three to six of these "neighborhoods" would make a new town in town, rather *off* town, and another platform would be added to accommodate a high school, and commercial, recreational and civic functions. Three to seven of these new towns would make a new city of 90,000 to 125,000 people who would then presumably endorse still other platforms containing a community college or a government center. The Triton City components, engineered for steel or concrete, are megastructures. The single framework of each neighborhood would make it, in effect, a complete building. Infill modules for apartments, classrooms, stores and offices would be prefabricated and plugged in or replaced without disturbing the overall city framework. It is feasible to engineer floating structures of 20 stories for waters only 25 to 30 feet deep. And the Triton study offers an option by *design* to the high-density decay of our waterfront cities.

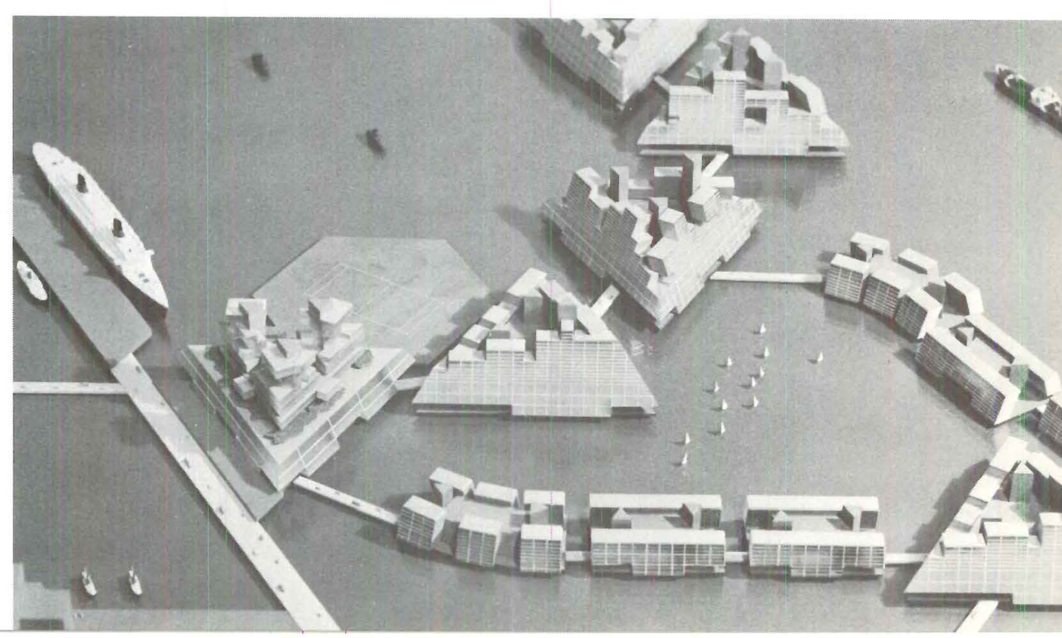
The project was conducted by the Triton Foundation; Dr. R. Buckminster Fuller, President; and directed by Peter Floyd of Geometrics, Inc. and Shoji Sadao of Fuller & Sadao, Inc.











. . . It also seems clear
That an increasing number of young,
Or young-minded people
Are beginning
To share my awareness
That total holocaust
Is now being ignorantly induced
By the world's preoccupation with
Exclusively political palliatives
Which are inherently shortsighted
And applicable only
To the emergency-dramatized local aspects
Of the greater and unrecognized
Evolutionary problems
With which human life
Aboard our planet is beset.
For evolution is apparently intent
That life in Universe
Must survive.
Biological life
Is syntropic
Because it sorts and selects
Unique chemical elements
From out of their randomly received
Time and locality of reception
As celestial imports;
Or from out of their random occurrence
As terrestrial resources—fresh or waste—
Anywhere around our Earth's biosphere,
And reassociates those elements
In orderly molecular structures
Or as orderly organs
Of ever-increasing magnitude.
Thus effectively reversing
The entropic behaviors
Of purely physical phenomena
Which give off energy
In ever more random,
Expansive and disorderly ways.
For human life contains the weightless
Omnipowerful, omniknowing
Metaphysical intellect
Which alone can comprehend,
Sort out, select,
Integrate, co-ordinate and cohere.

From Intuition *by R. Buckminster Fuller*
to be released in May by Doubleday & Company