TOWARD AN ARCHITECTURE AND URBANISM OF NATURAL PROCESSES:
Analysis of the Metabolist Group

by

Michael J. Stapenhorst

A THESISSubmitted IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARCHITECTURE

O. Jack Mitchell
Thesis Director

Houston, Texas

May, 1972
ABSTRACT

TOWARD AN ARCHITECTURE AND URBANISM OF NATURAL PROCESSES: Analysis of the Metabolist Group.

Michael J. Stapenhorst

THESIS STATEMENT:

The Metabolist Group of Japan—Noboru Kawazoe, Kiyounori Kikutake, Noriaki Kurokawa, Fumihiko Maki, and Kenzo Tange—is evolving a theory of architecture and urbanism based upon the recognition that architectural and urban form, or built form, can be understood and ordered in accordance with natural processes. This theory seeks to accommodate growth and change as determining forces of form; to provide a meaningful and relevant human environment.

METHODOLOGY:

Part One introduces the problems of growth, change, and provision of human space for the designer. The core of the problem is the disparity between architectural and urban form and the demands of contemporary physical and
cultural forces, or determinants of form. One particular aspect of the problem is stated—the necessity of looking at architectural and urban form as organic, of making the human environment responsive to the requirements of a dynamic reality. Finally, Part One suggests a possible answer: a design methodology which incorporates the use of natural processes, or systems, as an architectural technique.

Part Two demonstrates that the Metabolist Group of Japan is evolving a theory of architecture and urbanism based upon the use of natural processes. It establishes who the Metabolists are by providing biographical studies, and in a brief historical description of salient cultural and architectural features of Japan suggests reasons for the formation of the Metabolist Group, and indicates its goals.

Part Three analyzes specifically Kiyounori Kikutake's three step methodology—Ka, Kata, and Katachi. This Metabolist methodology provides the framework for the accommodation of the problems of growth and change and human space in contemporary built form.
Part Four discusses the degree to which the Metabolist Group has been successful in creating form responsive to a dynamic reality, and offers some conclusions about the significance of the Metabolists for the environmental design community at large.
Footnotes for Abstract

1. Composition of the Metabolist Group is in a constant state of flux. The first publication of the Metabolists, *Metabolism 1960—the Proposals for New Urbanism* states, "Others will come to join us. Others again will leave us, and thus the metabolic process will apply also within the membership of our group." Therefore it is impossible to precisely state the membership of the Group. Masta Otaka, a founder-member, and Arata Isozaki, who joined with Kenzor Tange in 1964, are not considered in this thesis because of the lack of information available about them. Consistency of membership and sufficient information dealing with each individual formed the basis for the selection of the Metabolist Group to be dealt with in this thesis.

2. **Natural processes, or systems:** Generally, the set of rules which nature obeys. Natural systems are the methods found in nature for the solution of functional problems of living—metabolic function, reproductive function, circulatory function, mobility function, etc. *Webster's New World Dictionary of the American Language*, 1966, pp. 977, 1161, 1480.

To Linda
# CONTENTS

<table>
<thead>
<tr>
<th>PART ONE</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Problem: Growth and Change</td>
<td>1</td>
</tr>
<tr>
<td>The Answer: Natural Processes?</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PART TWO</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>13</td>
</tr>
<tr>
<td>Who Are the Metabolists</td>
<td>16</td>
</tr>
<tr>
<td>Metabolists and Japanese Tradition</td>
<td>24</td>
</tr>
<tr>
<td>Metabolist Group: Its Formation and Goals</td>
<td>51</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PART THREE</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ka, Kata, Katachi</td>
<td>60</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PART FOUR</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>78</td>
</tr>
<tr>
<td>Conclusion</td>
<td>143</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BIBLIOGRAPHY</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>149</td>
</tr>
</tbody>
</table>
PART 1
One thing that is new is the prevalence of newness, the changing scale and scope of change itself, so that the world alters as we walk in it, so that the years of a man's life measure not some small growth or rearrangement or moderation of what he learned in childhood, but a great upheaval.\textsuperscript{1}

Robert Oppenheimer
Growth and change have become determinative forces of major significance, invading all aspects of contemporary life and influencing all other forces and force modifiers. Change, especially the increasing rate of change, is possibly the single most characteristic fact of our global society.

Within a decade or two it will be generally understood that the main challenge to U. S. society will turn not around the production of goods but around the difficulties and opportunities involved in a world of accelerating change and ever-widening devices. Change has always been a part of the human condition. What is different now is the pace of change, and the prospect that it will come faster and faster affecting every part of life, including personal values, morality, and religion, which seem most remote from technology.

Certainly, man's total milieu has been changing since time immemorial, but it was not until the mid-1940's, announced perhaps by the atomic bomb, that the rapid acceleration of the rate of change began to edge its way into the consciousness of man's collective mind. Up until this time, change occurred relatively slowly, enabling economic, social, political, and architectural and urban form to keep pace. There was some balance between force and response. Existing methods of dealing
with these problems seemed adequate and flexible, within
the limits imposed by the nature of the changes, and when
obsolete form remained, and traditional solutions failed, man adapted.

Indeed, in a time when the scale and scope of change was
not bewildering, change was regarded as progress, a step
toward some static, ultimate goal. This is not to say
that change did not have dramatic impact on man, and
subsequently on architectural and urban form. Natural
catastrophes have seriously affected life throughout time;
changes in methods of warfare, brought about by the inven-
tion of gunpowder, altered the fortress concept of cities;
the invention of the steam engine also obviously altered
the form of cities. However, the impact of certain
changes of the past, the impact of the locomotive on
urban form, for example, has a greater effect on cities
today, and their potential development, than it had
initially. 3

The rate of change in society has superimposed new cul-
tures on old, and consequently new cultural forces upon
the framework of older built form. It has modified our
institutions, shifted our values, and substituted transience for permanence.

Nowhere are the processes of growth and change more evident than in our cities, for the world is undergoing the most extensive and rapid urbanization in its history. This is urbanization in the most total sense, not just city building, and it is characterized by a complex interdependence between circulation systems (communications, transportation, energy supply); industrial, social, and economic organization; technology, art, and science. In 1850 there were four cities in the world with a population of one million; by 1900 there were nineteen; and, by 1961 there were 141. Urban population is growing at the rate of 6.5% per year.  

An equal challenge is the tremendous urban growth that lies ahead. Within fifteen years our population will rise to 235,000,000 and by the year 200 to 300,000,000 people. Most of the increase will occur in and around suburban areas. We must begin now to lay the foundations for livable, efficient and attractive communities of the future. Land adjoining urban centers has been engulfed by urban development at the astounding rate of about 1,000,000 acres a year. But the result has been haphazard and inefficient suburban expansion, and continued setbacks in the central cities' desperate
struggle against blight and decay. Their social and economic base has been eroded by the movement of middle and upper income families to the suburbs, by the attendant loss of retail sales, and by the preference of many industrial firms for outlying locations.  

Attempts to find solutions which accommodate these new conditions with traditional methods, techniques, and forms has led only to further variance between force and response; traditional methods lose validity as the forces which gave rise to their development face. It has become necessary to acknowledge that architecture can no longer be perceived "as enduring, permanent structures." What William Zuk has called "the monument syndrome" is ill-suited to our dynamic times. A new set of forms and structures must be evolved. "From the standpoint of a rapidly advancing industrial society, we have been building in too permanent a fashion."
1.2 The Answer: Natural Processes?

How deeply can man comprehend nature, with its multimillion scales and its interlocking combinations of action? As has been remarked by Eddington, there is no confusion possible between natural and man-made objects. The latter are single purposed, while nature is capable of fulfilling many requirements which are not always clear to our minds. . . .

Together with life comes the problem of growth.  

Robert le Ricolais
Man is faced with the most rapid rate of change the world has ever witnessed. In response to this new force man is changing: he is becoming more mobile; his pace of daily activity is increasing; he is relating to people, things, and ideas of art and value differently; his social and business organizations are changing; he is using energy resources more than ever before; and, he is developing new life styles in response to changes in technology.

While man rushes to keep pace with the acceleration in change, his architectural and urban form plod slowly along, the result of a massive time lag. This time lag is caused by the failure of man himself to evolve new architectural and urban form in response to new conditions and forces. This lack of fit between force, physical and cultural, and form is leading to something akin to a massive adaptational breakdown, a psychological disease resulting from an inability to accommodate a great deal of change in a relatively small span of time. 

The shocking fact is that very little is known about adaptivity to change, either by those who call for or
create forces for change, or by those who attempt to accommodate these changes. Man needs insight into the problems of adaptability. He must learn to accommodate the forms he creates to changes in determinative force.9

Form is the ordered expression of a need; the end product of a process of response to pressures. Sometimes the interaction between need, or pressures, and the end product, or form, is direct, immediately clear, and involves relatively simple technology. Under such conditions every form reflects the pressures that are responsible for its existence, and the appropriateness of the form, in terms of its structure and function, may be apprehended accordingly. . . . Forces have a characteristic pattern and the good form is in equilibrium with the pattern, almost as though it were lying at the neutral point of a vector field of forces. In contemporary, industrial society simple things exist side by side with those of the greatest complexity. The pattern of pressures changes faster and faster with the drift of culture and the shifts in knowledge and technology. As a result forms easily slip out of equilibrium and become obsolete. If the form making process is obsolete, the design itself will be stillborn.10

Despite every effort to conceive of them in static terms, however, architectural and urban form do exhibit characteristics of organic forms. The most simple one room house is an expression of a relatively complex interrelationship of parts: structure, membrane, light, air, sound, and circulation systems; functional areas: public,
semi-public, semi-private, and private. On an urban scale, form exhibits even greater complexity. Yet architectural and urban form have consistently shown a response to changing conditions: the conversion of a basement into a workshop; the addition of an extra bedroom; the replacement of a roofing surface; the demolition of an old landmark to make room for a new parking lot; the construction of a new freeway. These changes may not be adequate solutions, but what is important is man's tendency to display characteristics of adaptability, despite his need to produce order in his life, to invest a sense of permanence in his institutional and architectural and urban form.

We know that all living systems exhibit adaptive behavior. That is, they possess an ability to react to their environments (broadly defined as the set of all objects and events containing a system that change or are changed by the system's behavior) in such a way that is favorable, in some sense, to the continued operation of the system. A self-organizing system maintains its existence through a continual interaction with its environment. Changes within the system or in the larger world invoke an automatic response aimed at restoring a favorable balance, or homeostasis, between internal and external conditions. In a living system, this point of equilibrium will change as the organization of the system evolves. The very act of
evolving entails irreversible changes in the system and its environment. The process is cyclic; the living system progresses ever further from an original condition.

It seems reasonable to try to understand the process of adaptability where adaptation to change is unceasing—in nature. Natural organic forms offer a living expression of the process of growth and change. Any theory that seeks to order a responsive built form will profit from an understanding of this process, for these theories must direct themselves to the effective and rapid implementation of adaptive forms. What they require is the understanding that architectural and urban form be organic and dynamic. Another, more subtle, reason for examining architectural form in relation to organic form, is man himself, the most highly evolved organic form. In every built form there is a response to some want or need of man. Man is an organic being; therefore, architectural and urban form are expressions of man's organic nature.

It should be noted that the purpose of studying natural processes is not to copy these systems, but to grasp the characteristics and principles of organic form and to apply that knowledge to man-made form.
Surely our present task is to unfreeze architecture—to make it a fluid, vibrating, changeable backdrop for the varied and constantly changing modes of life. An expanding, contracting, pulsating, changing architecture would reflect life as it is today and therefore be part of it. If it is not, rigor mortis is bound to set in.\textsuperscript{12}
Footnotes for Part I


9. Ibid., p. 5.


PART 2
2.1 Introduction
In the early 1960's, small groups of architects recognized the emergence of growth and change, and the related problem of providing human space, as fundamental determining forces of form. The Metabolists number among these groups, and seek to create a total environment that accommodates and expresses these forces, and rightly so, since an unrecognized change in force will result in a disparity between the expression of force, or form, and the force itself.

A new physical urban order is needed to give expression and meaning to the life of "urbanizing" man, to clarify, to define, to give integrity to human purposes and organization, and finally, to give these form. Today modern cities and other man-made elements in the physical environment are becoming shapeless for lack of an informing principle. But no such principle will be forthcoming, and no action will be taken, until the processes of design are themselves informed and controlled by the recognition of new realities.  

The Metabolist Group approaches these problems in a unique manner in contrast to Western architectural and urban theory. A fundamental part of their methodology is the use of natural processes to understand and order built form. This method does not copy the theory of organic architecture advocated by Frank Lloyd Wright,
though it does contain elements of that theory. Rather Metabolists seek to integrate principles of natural order into architectural order; to create a total "environment which corresponds to the vital processes of life itself." ³

The close association of the Japanese with nature, their language, religion, and even topography has somehow enabled them to gain a unique insight into the dynamic problems of contemporary architecture and urbanism. The Metabolist Group has developed this capability most fully, and while in practice their success in ordering a total environment has been only partial, further development is promising. The following is an attempt to analyze Group Metabolism, and to judge its effectiveness in ordering an architectural and urban form responsive to contemporary pressures. "The essential characteristic of our society [is] change. It is clear that the principles which contributed to past successes in architecture are inadequate for the speed, scale, and nature of change today. A new adaptable architecture must be developed." ⁴
2.2 Who Are the Metabolists
The Metabolist Group

The International Design Congress in Tokyo in 1960 set the stage for the emergence of the Metabolist Group on the contemporary scene. A great deal of interest was engendered by their manifesto, *Metabolism 1960—the Proposals for New Urbanism*. It was their first published work, and it dealt with reorganization of the total environment. At that time, the group consisted of Masato Otaka, Kiyounori Kikutake, Fumihiko Make, Noriaki Kurokawa, and Noboru Kawazoe. Four years later, Kenzo Tange and Arata Isozaki joined them. This mixing of Metabolist and Semi-metabolist produced Team Tokyo.5

Prior to the International Design Congress of 1960, individual members of the Metabolist Group has been working independently on designs formulated in the spirit of the manifesto, and today each member maintains his own practice, distinct from group involvement. However, members meet frequently to discuss and refine their theory, and use their collaborative efforts as a vehicle for presenting their ideas. While operating from the same conceptual framework, each member tends to emphasize
a particular aspect of metabolist theory, both in writings and formal expression.

The group's unity lies in its common methodology, and common use of natural systems to understand and order form.

Noboru Kawazoe

Kawazoe received a Bachelor of Architecture and Psychology at Waseda University in Tokyo. An independent architectural critic since 1957, he is a member of the original Metabolist Group founded in 1960. He is considered the voice of the Metabolists, and is an effective communicator of the essence of Group Metabolism. A critic and correspondent for Zodiac, he has recently authored: Creative Foundations of Modern Architecture, The Dwellings of People and Gods, What is Design?, City and Civilization, Japanese Culture and Architecture, Modern Urban Architecture, Movable Space, Modern Design, and The City and Architecture. Kawazoe is unique in the group for his knowledge of psychology and sociology.
Kenzo Tange

Tange received a Bachelor of Architecture degree from the University of Tokyo in 1938 and his Masters in 1945. After completing his studies he worked in the office of Kunio Mayekawa, and since then has worked throughout the world. From 1959-60, he served as visiting Professor of Architecture at Massachusetts Institute of Technology. Presently, he is Professor of Urban Design at the University of Tokyo, and maintains his own architectural and urban design practice. He was active in C.I.A.M. until its dissolution, and is a conferee of the current Team 10. Tange established his influence on Japanese architecture early with his competition winning design for the Hiroshima Memorial project. He is considered by many to be Japan's most prominent architect. Although considerably older, he has been the "catalytic" leader of the Metabolist Group, and his Tokyo Bay Scheme is a summation of initial Metabolist thinking.

A prolific writer, Tange's concern is the humanistic aspect of architectural and urban form. He reflects on the "realities of human space and the structure of
buildings," which he sees as expressions of the "incompatibles," the dualities of life.

There have been several stages in the evolution of Tange's thinking. Projects vary from small scale early work (his own residence, children's library, etc.) to medium scale public buildings (city halls, community centers, industrial facilities, sports complexes) to large scale urban design. At present, Tange designs entire cities, sections of cities, or individual structures considered as vital parts of the whole urban structure.

Fumihiko Maki

Maki received his Bachelor of Architecture degree from the University of Tokyo, and a Master of Architecture degree from Cranbrook Academy and Harvard Graduate School of Design. He worked for the U. S. firms of S.O.M. and Jose' Louis Sert, and in Japan for Kenzo Tange. He has been a professor of Architecture at Washington University (St. Louis) and at Harvard Graduate School of Design. Presently, in addition to his own practice, he is a professor at the University of Tokyo, and a visiting
professor at the University of California. Maki is probably the most successful of the Metabolist Group in establishing links around the world. Current and historical trends in Europe and the United States are as familiar to him as those of Japan.

His article (in collaboration with Masato Otaka), "Group Form," initially published in *Metabolism—1960* and later further developed and reprinted, states some fundamental architectural theories and principles shared by Metabolists. Maki sees architectural and urban form as a single entity which must maintain an equilibrium with its individual parts, adapting easily to changes in form determinants. He thinks in terms of building groups, and has a definite humanistic bias expressed in architectural space. His major works are campus design and urban planning.

**Noriaki Kurokawa**

Kurokawa is the youngest founder of the Metabolist Group. He received his Bachelor and Master Degrees of Architecture from the University of Tokyo, and worked for
several years in Tange's office, where he collaborated with Tange on the Tokyo Bay scheme, which was presented at the International Design Conference of 1960. An outspoken critic of the functionalist tenets of C.I.A.M., Kurokawa is a participant in Team 10.

Kurokawa's urban proposals and analyses are based upon the use of the organic principles of natural systems. His Wall City proposal concluded the Metabolist manifesto of 1960. He relates all design work to urban structures as a whole, and envisions the city as a single entity, not merely a collection of individual elements. In his thinking, all forms are related in a unity of experience. His major works cover a wide range: individual and mass housing; industrial, hotel, and recreational facilities; work for individuals, institutions, and governmental agencies. His designs show his ability to translate Metabolic theory into practice. Kurokawa, like Tange, is a prolific writer. In his proposal, Helix City, he seeks to achieve a "dynamic city creating three dimensional, organic, vertical land—an artificial landscape where the dynamic process of nature is stimulated by modern technology."
Kiyounari Kikutake

One of the original members of the Metabolist Group, Kikutake is one of the most influential and progressive architects in Japan. He received his Bachelor of Architecture degree from Waseda University in Tokyo. After graduation, he worked in several offices, most notably for Togo Marano and Moto Tawe. At present he has his own architectural firm, is a professor at Waseda University, a director of the Japan Institute of Architects, and a participant in Team 10.

A panelist in the World Design Conference, Kikutake's architectural and urban proposals are directed toward achieving human living space distinct from areas of variable service function. He makes no distinction between individual and urban concerns, and seeks to reflect the dynamic reality of today through responsive form.

Kikutake's works include the application of industrialized building processes to: single and multi-family housing, cultural centers, hotel facilities, and, what some
consider his most significant work, the administration center at the Izumo Shrine where he incorporated Metabolist theory into traditional shrine architecture. In addition, it is Kikutake's writings which provide the framework for the basic methodology of the Metabolists.
2.3 Metabolists and Japanese Tradition

The Japanese do not seem to have any philosophy like "eternity" or "perfection," but believe that nature and society are flowing on all the time. For them change or flux is the sole reality.  

Noboru Kawazoe
All philosophies seek to distinguish what is real—the nature of reality, what we think and feel about reality, and how we behave in and alter reality are all interrelated concerns. We subordinate reality to the world we perceive, experience, and act in. We respond to and effect this reality in a highly personal way, which varies with emotions, purpose, and intelligent perception. What we see, how we act, and the way we structure forms is also influenced by cultural forces: language, religion, and physical forces.9

Language

Actually, thinking is most mysterious, and by far the greatest light upon it that we have is thrown by the study of language. This study shows that the form of a person's thoughts are controlled by inexorable laws of pattern of which he is unconscious. These patterns are the unperceived intricate systematizations of his own language—shown readily enough by a candid comparison and contrast with other languages, especially those of a different linguistic family. His thinking itself is in a language—in English, in Sanskrit, in Chinese. And every language is a vast pattern system, different from others in which are culturally ordained the forms and categories by which the personality not only communicates, but also analyzes nature, notices or neglects types of relationship and phenomena, channels his reasoning, and builds the house of his consciousness.10
It has been established that the relationship between language and thought patterns is highly complex and interdependent, and that concepts tend to evolve from language structure. What is important to note here is that the Japanese do not conceive or represent things in terms of static phenomenon, but in terms of action. There are no nouns in the Japanese language. Both the Japanese language, and the Chinese from which it derived, find their basis for expression in natural processes, or systems.

In Kanji, Japan's adopted Chinese script, the ideographic roots...are not pictures of abstract things, i.e. nouns, but of actions. The majority of the original Chinese ideograms are shorthand images of natural processes and operations (natural systems). There is no such thing in Nature as an isolated, abstract thing, corresponding to a noun. Things are always only the end points, or rather, the intersecting points of events, the intermediate stages of processes, comparable to a snapshot. An abstract movement, corresponding to a verb in grammar, is impossible in Nature. For the Chinese, the substantive and the verb are the same: things in movement, movement in things. As things are in Nature so are words in the Chinese language. They remain living and flexible, since thing and function are not formally divided... The Oriental mind saw things not only in their aspect of things as they are, as was primarily the case in the West, but also as the movement of things in their continuous mutation. Change, growth, interaction and the simultaneity of functions are integrated components of their thinking and writing.
As nothing in nature is static, so nothing in language is static. This sensitivity to environment, to the endless process of growth and change, which informs even Japanese language structure, accounts for the emphasis on the idea of organic form in Metabolist thought.

Religion

Religion, like language, is fundamental to the development of a culture. Japanese thought and Buddhism are as inseparable as Western thought and Christianity. When the Chinese introduced Buddhism into Japan, in 522 A.D., a deeper, broader culture, more complex in thought and style evolved. Temples became centers for academic and cultural activity, in addition to their religious function, and involvement with government followed. Around the eighth century, coinciding with political centralization, Buddhism gained national acceptance. It was not until the ninth century, however, when contact with China was curtailed, that Buddhism began to exhibit native Japanese characteristics and to mold Japanese character. "The idealism of early Esoteric Buddhist art had combined with
the deep mysticism of Esoteric Buddhism and had intensified the love of nature, a distinguishing feature of the Japanese people.\textsuperscript{12}

The result was a distinct form of Buddhism. Originally, Buddhist temples, because of Chinese influence, were erected in the center of cities; now they were erected deep in the mountains away from city life. Increasingly, the effects of native Shintoism came to reflect and encourage harmony with nature.

A feeling of religious respect toward nature is clearly sensed. . .this manner of treating nature as something noble and holy remained for a long time and became a part of the traditional sensitivity of the people. To feel the presence of a god in a single branch or in the petal of a flower is a way of appreciating nature which had developed in Japan over the centuries. This way of approaching nature with veneration developed in Japan quite organically by a people who love nature and who immerse themselves in it.\textsuperscript{13}

Shintoism shared with Zen Buddhism a sense of unity within complexity, a sense "of the relativity of all existential phenomena, both physical and spiritual. . .its conditionality. . .its interrelation and interdependence."\textsuperscript{14}

This Shintoist concept emerges in the Metabolists' commitment to making form a graphic expression of change.
Nature

Language and religion are obvious components and determinants of a particular culture and that culture's resultant physical expression. Generally, a more subtle force is climate and topography. These natural determinants produce a unique regional form. In Japan, however, nature, as a total process, has the most significant effect upon the development not only of cultural forms, but also upon the development of built form. Awareness that nature is the dominant form-determining force is of vital importance in understanding Japanese tradition and the Metabolist Group.

Out of the deep relationship between the Japanese and nature, a particular cultural form and built form evolved. Accordingly, the language, religion, and architectural form evolved from this unique relationship tends to reinforce the dominance of nature in an indeterminant and interrelated cycle.¹⁵ "A long history of primitive contact with nature developed in the Japanese a profound respect for natural form; in it they found evidence of a larger order to which they felt inexorably linked. And
the natural, organic way became to them the religious and right way."^{16}

Within Japanese architectural tradition nature played a dominant role in determining: construction technique, structural detailing, building materials, form, organizing concepts of space, planning, aesthetics, and general architectural appreciation.

The abundance of primeval forests gave the Japanese an almost unlimited supply of building material. Natural forces dictated the requirements of an earthquake resistant construction, free ventilation, protection from sun and rain, etc. From the processes of nature the Japanese were able to perceive the essential order of nature and from this a most reasonable building system resulted.

A simple direct structure was the basis for the evolving forms. Such structure was understandable and related to a common experience with the fundamental forces involved. As skill increased these multiple forces eventually were resolved into their vertical and horizontal components thereby creating the basic rectangular geometrical order of post and beam structure. The underlying order was thus not an arbitrarily imposed geometry but structurally derived and contributing to the functioning unity of the whole.^{17}
The column became the main supporting member, and the walls, unlike early Western architecture, became subordinate to the structural members. Walls were used mainly to define space and, therefore, could be of the lightest construction. This provided the freedom for achieving flexible space—allowing openings to be of variable size or to be completely removable. The interior was then easily related to the exterior for functional as well as psychological purposes. Japanese traditional architecture is well known for its communion with nature—the free flow of interior and exterior space. Built form became symbolic of the order and beauty inherent in natural form, and expressed the close ties of the Japanese with nature.

The unadorned use of natural materials reflected again the deep link the Japanese felt with nature. "Materials were revered for their natural shapes, patterns, and textures; effects were achieved by simple contrasts and relationships of these inherent qualities." Materials are not colored or painted, and usually the structural elements are left exposed in order that the natural color of the juxtaposed materials create their own harmony.
Because of this special appreciation for the natural appearance of wood—grain, texture, and color—the carpentry and joining techniques became an almost emotional experience of unity with nature. The total effect of all materials was to relate man-made form to nature from whence it came, and to reflect man's dual nature as a human being apart and a part of nature.¹⁹ "The expressive power of unadorned form...[produced] an innate sense of interdependence of man and nature and the forms of each...[and] the essential contrast wrought by the mind and hand of man."¹⁰ The use of natural materials expressed the understanding of the indeterminant order of nature—it is a ceaseless process having no final, or ultimate, form. "Man's oneness with nature is expressed by the use of materials left in their natural colors and by the love of deliberately unfinished detail, corresponding to the irregularities in nature. For only the incomplete was considered to be still part of the fluid process of life...."²¹

The dominant element in traditional Japanese architectural form is the roof. The roof is a direct response to the forces and order inherent in nature. The roof
serves to provide protection from heavy rains, and the prominently projecting eaves allow for optimum ventilation during these rains and prevent direct sunlight from entering the interior spaces during the hot summer months. The large roof also serves to provide structural stability during the high winds which regularly sweep across Japan during the typhoon season. Despite its dominant position, the Japanese relate the roof to the earth— to nature. The gentle curve of the roof harmonizes the form of the building with the surrounding land in a way that makes the form appear to grow from the earth.

It is within these limits, of earth and roof, that the Japanese define their living area—a shelter both to house man from nature and to relate him back to that nature.

The intricate patterns [of defined space] are contained between the powerful horizontals of roof and earth. The roof in Japanese architecture is the most difficult element to relate in the composition. It, of course, provides that dominance of one element which helps to unify the total form, but more important it acts in the visual sense as a separate element serving in an abstract way to divide the small scale events beneath from the background; its hovering dominance implies a felt limit to the architecture as shelter, at the same time permitting freedom of movement beneath.
The concepts of spatial planning, aesthetics, and the living patterns of the Japanese expressed in their built form are organic. This organic quality of traditional architectural form is the reflection of the response of the Japanese people to the impact of nature—to be one with the totality of nature.

The overall location and planning with respect to nature was quite significant in the major elements of Japanese architectural tradition—temples, shrines, palaces, and dwelling houses. Placement and orientation were emphasized to take advantage of the positive forces of nature and to minimize the disadvantages of the negative forces of nature relative to climate, topography, and religious practice. "The principle involved is the same as that which governs the growth of all living things in the universe. It is the principle of positive and negative, of male and female, of sunshine and shadow, in which one mingles harmoniously with the other." 23

Kiwari, the modular system of construction, evolved by the Japanese, is based upon the human scale and, therefore, relates all built form to man and thereby to nature. This
standardized system allowed for a great deal of variation within a system of pervasive order. "In the growing complexity of building requirements and with the refinement of techniques the clarity of the structural fabric maintained the scale of the wider relationships in space."\(^{24}\) This structure was exposed and made visible not for its own sake but to express the organic relation of structure and form found in nature. "The mere statement of structural fact was not the final intent...and the structural necessities of spatial form were gradually transformed into a series of patterns and radiating rhythms that created a dynamic order of the whole."\(^{25}\)

Visually, each element of the total form gave expression to its purpose through a frankness of simple expression found in natural colors, surfaces, textures, etc. It reinforced the total order and was sensed as beauty by the Japanese people. "The conjunction of contrasting materials, elements, or forces was a valid source of expression. Here in these seemingly mundane events of architecture the overall order was given the added depth of expressive relationship... Each element, each material has its own existence stated clearly yet always
with a sense of value beyond itself—of the spiritual emanating from the material and the universal reflected in the particular."

Just as in nature, the Japanese established a basic system and created an infinite variation from it. "A common denominator of means, attitude, and spirit meant an organic unity defining the broad direction of architecture while incorporating the natural energy of diversity; continuity of growth and change stimulated by individual experimentation within the framework of a unified structural module." This diversity within order resulted in asymmetrical composition in plan and in space. It is through this intended asymmetry that architectural form reflects the processes of nature in its dynamic, organic reality. "In Japanese architecture the extension of...three dimensional relationships was by an asymmetrical order which gave the feeling of infinite extendability. Based on this order the architecture developed within and beyond the structural cage as a series of patterns and planes of reference precisely defining certain portions of continuous space."
Nowhere in Japanese traditional expression is the realization of the order inherent in nature developed more fully than in the garden. It is the physical statement of the link between man and nature, nature and architecture. In it is the union of man, nature, and architecture bound forever. The garden was an expression of physical linkage:

The meeting of architecture and nature was the key to spatial expression. The building had a definite even precise relationship to the ground. No exuberant interpenetration of the forms of nature and man. The integral use of natural finishes and textures within the architecture made this gesture towards humanism. . . redundant. The expression of space as one and continuous was the indication of ordered movement from interior to exterior. The outward flow of asymmetrical rhythms from architecture--progressing from the stark geometry of the rectangle to the tree and infinite rhythms of the rocks, trees, and mountains. 30

and of psychological linkage:

The garden expresses perfectly the relation of man to his universe. . .the dichotomy of man's existence. . .man alone and man in the world. This contrast in scope is expressed by a seemingly inconsistency of scale--for the garden contains elements of human scale: bridges and walks that invite participation and wandering yet at the same time by the absence of any time-bound object it conveys a feeling of vast timeless vistas of mountains, islands and sea--the universal space. . ."our
mortal desire for the near, the precise, the closely seen, can be assuaged only by a reminder of the greater reality of the far, the vague, the dimly seen, the transient. . . ."
Nature and the Metabolists

The natural predisposition of the Japanese people toward nature was fostered by close primeval contact and dependence, encouraged by a diverse and subtle natural climate and topography, and reinforced by a particular linguistic and religious system. Their built form expressed the indirect influences of nature, cultural form determinants, and the direct influences of nature, natural forces and processes.

Japanese architectural tradition, based upon the understanding of the order inherent in natural processes, is relevant in the contemporary world. The attitudes created and the forms produced in traditional Japanese built form show a remarkable similarity to contemporary counterparts.

The introduction of new construction techniques in the West, brought about by the materials and methods resulting from the industrial-technical developments of the 1900's--namely steel and reinforced concrete, demanded new formal expression. Various architects attempted to
come to grips with the architectural problems created by the technology of posts and beams, standardized parts, and modular construction. In Japan, the architecture that evolved was for centuries concerned with these very same problems. In modern architecture, trends in aesthetics emphasizing a minimum of ornamentation and a simplicity of material and expression, find precise parallels in traditional Japanese architecture.

"Japanese architecture has been able to absorb vital changes in form, materials, and philosophy and yet maintain its essential integrity. Such a continuity of growth and change, free from stifling arbitrary doctrine, is a basic aim of modern architecture." \(^{32}\) The ability of Japanese architecture to transcend change lies in its fundamental principles—perceived order, the essence of reality found in nature. Within this environment the Japanese developed an attitude toward and an understanding of change pertinent to the contemporary world. Change for them was something that could not be stopped, only guided. Physically, it was expressed as a movement through space that could be directed but not confined. This realization of the essence of change brought about
an intimate scale and the further realization of the need to integrate the part to the whole, to create organic unity. Meaningful experience was the result of subtle dualities, or contrasts. Organic unity takes on added significance in a world of constant change where dynamic order is a necessity.

The richness of experience with nature, in Japanese tradition, had profound influence on their architecture. Today this is reflected in the Metabolist Group's concern with natural processes and cycles. The Metabolist Group seeks to reinterpret this tradition—to apply the understanding of nature and the techniques of traditional built form to contemporary realities. The Metabolist Group is building upon man's collective achievements by taking an architecture and urbanism based upon the use of natural systems one step further into the future.
The close association of the Japanese with nature influenced the development of their language, religion, and built form.
Nature endowed Japan with an almost unlimited supply of wood; and from the processes of nature the Japanese were able to perceive the essential order of nature and thereby develop a most reasonable building system which was responsive to changes in cultural or physical forces.
The column is the main supporting member and walls serve, mainly, to define space.
The use of natural materials expresses the fundamental duality--man a part of nature and man apart from nature; and the understanding that nature is a ceaseless process.
The roof is the dominant element in tradition Japanese architecture.
The Japanese established a basic system for building and then created infinite variation within it.
Nowhere in Japanese tradition is the realization of order inherent in nature more fully expressed than in the garden.
The richness of experience with nature, in Japanese tradition had profound influence on their architecture.
The attitudes and forms of traditional Japanese architecture show a remarkable similarity to contemporary counterparts.
2.4 Metabolist Group: Its Formation and Goals

[The Metabolist's] premise is that the human community is a living perpetuum, a continuous biological process, which does not allow for the application of rigid, schematic principles.  

Udo Kultermann
Reaction to Functionalism

From the beginning of the twentieth century, until the 1960's, the functionalist approach to architecture and urbanism dominated. The underlying concepts and basic methodology of functionalism, which resulted from technological developments, are machine oriented. Le Corbusier referred to the house as the "machine for living," and cities as tools. Functionalism demanded that a clear separation of function exist in buildings and cities, similar to the separate functions of parts in a machine. Several difficulties inherent in functionalism are readily apparent, however. People and machines are not analogous: they differ in structure; they differ in function. Machines are single purposed; man is multi-purpose.

When children played in the streets, the neighborhood houses, fences, and the street itself were all a sort of play equipment where the young ones felt some contact with the city and learned something from the human life and seal of history carved out in those streets. With functional separation and concrete gradation of playing spaces into neighborhood parks, children's parks, and kiddy parks, these areas become purely independent hotbeds.
"Form follows function," another tenet of functionalist theory, illustrates a second difficulty: when function determines form there is no form capable of responding to changing function. 36

The Metabolists, aware that a changing technology constantly produces new construction materials and techniques, attempt to combine and "systematize" those developments in order to create new forms which better serve contemporary demands: the demands of growing urban populations on space, for example, and particularly in Japan, the demands of a changing social structure. The Metabolists recognize that "growing cities are organisms which cannot be held to any sort of fixed planning concept." 38

Toward Open Form

Although Metabolist theory can be read as a reaction against functionalism, or any other static architectural theory, the group directs its energy not toward argument, but toward a positive re-evaluation of Japanese tradition in order to create "a re-organization of the total
environment." Major emphasis is on creating a vital form which accommodates growth and change, and satisfies the basic need for human space. This form, which should reflect the essential organic characteristics of living things—"the ability to grow from oneself" and the existence of "mutually reinforcing functions"—the Metabolists call "open form."

Open form is achieved through the establishment of a spatial "archetype" and "prototype" which has as a characteristic the ability to accommodate the changing needs of a dynamic society without disrupting the entire system. Open form realizes the "process of movement, change, and development." The specific objective of the Metabolist is, of course, to find techniques for achieving open form, form capable of making "metabolic changes," and this means thinking in terms of creating "space and changeable function." Additionally, the Metabolist Group seeks to structure the urban environment as an organic whole; any individual form must relate to the total environment.
The Metabolist Group is committed to the future, but their desire to accommodate the mass-society of the future does not mean a break with tradition. The Metabolist always seeks to integrate tradition into his design. "Only when the future is squarely faced can the past be fully understood: only men living on the heritage of their cultural traditions are in a position to work for the future." The Metabolist Group, recognizing the necessity of creating flexible form capable of "changeable function," looks to nature and natural processes, so much a part of their cultural tradition, for insight into the laws of growth and change and for the "prototypes" with which to realize open form. "The basis of Metabolist Group thinking is that they see architecture and city as a response of movement, change, and development. In other words they conceive architecture and city as 'open form,' not as 'closed form.'" They seek an indeterminant system to express and fulfill an indeterminant process.
Footnotes for Part II

1. Christopher Alexander, *op. cit.*, p. 34.


15. Herbert J. Gans, People and Plans (New York, 1968), p. 13. Herbert Gans has suggested that there are two forms of mass media effects—hypodermic and phenomenistic. In the hypodermic theory "the media and their content were thought to have direct effects on their audience, changing behavior and attitudes in line with directives explicit or hidden in the content." Gans points out that recent mass media research has shown convincingly that this model is not satisfactory. The phenomenistic model states that "alleged effects of the media stem from predispositions, and that the media tend to reinforce beliefs and patterns already existing in the audience."

In applying these models to the limited set of forces interacting in the Japanese situation, considered in this thesis, language, religion and nature; it should be clear that the hypodermic model finds that the elements of language and religion have direct effects in determining the Japanese's sympathetic attitude toward nature. Thereby establishing cultural forces as dominant in the determination of form. In contrast, the phenomenistic model proposes that the Japanese attitude toward nature is in fact responsible for the formation of a particular language and religion, whereby both of these cultural forms reinforce the Japanese predisposition in favor of close participation with nature. Thereby establishing nature as the dominant force in the determination of culture and the physical expression of culture—built form.


17. Ibid., p. 28.

18. Ibid., p. 20.


22. Norman F. Carver, Jr., op. cit., p. 91.


25. Norman F. Carver, Jr., ibid., p. 32.

26. Ibid., p. 45.

27. D'aroy Thompson, On Growth and Form (Cambridge, 1942).

28. Norman F. Carver, Jr., op. cit., p. 120.

29. Ibid., p. 130.

30. Ibid., p. 150.

31. Ibid., p. 193.

32. Ibid., p. 8.


35. Ibid., p. 80.


42. Ibid., p. 12.

43. Ibid., p. 11.


45. Udo Kultermann, op. cit., p. 27.

46. Ibid., p. 27.

PART 3
3.1 Ka, Kata, Katachi
Three Step Methodology

Although the architects considered here belong to a common school of thought, individual identity is not stifled. As a result, terminology, conceptual emphases, and formal expression vary considerably. The writings of Kiyounori Kikutake, however, provide a workable framework for analyzing some individual approaches to design essence, design implementation, and final expression, or built form.

Kikutake's methodology originates with the concept of Ka. Ka is the essential in design; the essence and source of form. It is the "process by which new functions are discovered from the contradictions of real life, and these new functions are projected into the unknown world of the future." In Western terminology, Ka is the perception of order. Ka brings to mind Louis Kahn's theory of architecture based upon the "realization of order." For Kikutake, "the essence of architecture is spatial order," or the spatial expression of the function or a function of life. It was man's image of this spatial
order that first enabled him to conceive of a sheltering form distinct from that provided by nature. As time passes, and conditions change, however, new images or orders are required.

"Kata come into being when the Ka are realized in concrete form through the medium of techniques." The Kata, or system, is the organizing principle of form. There are many different Kata, and the Kata of any given design may be evaluated on the basis of its "degree of universality and social validity." The compatibility of the Kata with different aspects of everyday life determines the compatibility of the realized built form with different patterns of association and identity, or living patterns. "When this Kata is applied to various real situations and different functions are fulfilled, different concrete Katachi are obtained." The Kata have validity far beyond the particular, concrete form, Katachi, if the Ka, or image, which was the source of the Kata, was correct as well. Without Ka and Kata, final built form will lack the potential for infinite variation and, therefore, social validity. Mere form produces only a "lifeless formalism." "It was only because the
Japanese dwelling has been handed down as a Kata, not as a mere Katachi, that it was able to survive to the present day, adjusting to the successive modifications in living patterns which have been occasioned by the vast historical changes which occurred from period to period."9

Kata, however, involves more than planning and organizational principles. Accurate perception of order will also yield a vital technology. In architecture, the development of construction techniques and the development of building materials, movement systems, and mechanical systems result.

When the Kata satisfy different programmatic requirements, different Katachi are obtained. Katachi is form in the sense of type, rather than form in the limited sense of style or shape. The Katachi must be an accurate reflection of the Ka and Kata, and must have the ability of undergoing "metabolic changes."10

This three step methodology is the design process or theory that is "cultivated and developed by...a constant process of evaluation."11 According to Kikutake, "when a theory of practice has been faithfully carried
out, one must evaluate whether the theory was correct or incorrect by the Katachi obtained as a result."^{12}

Ka

For the Metabolist, there are three routes to Ka: by reflecting on the condition of human life; by perceiving the inherent order in traditional forms, systems, and images; and by comprehending nature and its processes, for it is here we find the common denominator, the unifying factor which embraces all.

Where Kikutake best expresses the Metabolist three step methodology, Kenzo Tange clarifies their view of tradition. "I believe we Japanese architects have considered Japanese tradition from almost every possible angle. The conclusion I have reached is that tradition is like a catalyst—it can stimulate or hasten creative activity, but not a trace of it should remain in the finished product."^{13} Here Tange states that it is the Ka and Kata of tradition that is important, not the final form.

The old and the new are thus interdependent in Metabolist thinking. If the Ka and the Kata of a traditional
Katachi are valid, they will lead to the creation of new form that accommodates new conditions. Ka, in this sense, goes beyond any artificial division such as time. Past, present, and future are a continuum. Ka also makes no distinction between the abstract and the concrete. In Tange's words:

This understanding of reality which takes place through architectural creation requires that the anatomy of reality, its substantial and spiritual structure, be grasped as a whole. The realities of present day Japan, while part of a historically conditioned world-wide reality, are at the same time given their unique shape by the traditions of Japan. Living within this reality, yet also trying to comprehend it afresh in a forward-looking spirit, these traditions force themselves insistently upon our attention. Only those who adapt a forward looking attitude realize that tradition exists and is alive.

Kurokawa also comments on tradition as a catalyst, and finds in traditional designs organizational concepts and systems for construction which are valid today. "Kyoto is a skillfull composition of interlacing 'streets' and 'passages,' and it is in this old concept that we found the answer to our problem in designing the Nishijin Labor Center." In addition, his ideas on
prefabrication, structuring, and exchangeability reflect the Ka and Kata of traditional Japanese timber buildings.

Finally, Kawazoe partially attributes the formation of the Metabolist Group itself to its members' common high regard for tradition. "Convinced of the validity of this idea [the value of tradition] we formed our Metabolism Group. . . . I am convinced that our. . . . theory is applicable to architectural history everywhere. . . . Group Metabolism is convinced that if a thing has universality it is pertinent to all history." 17

The Metabolists are committed to the idea that the "human community is a living perpetuum," and as their name itself indicates, that man-made form be organic, reflecting the "process of continuous or cyclic transformations." 18

In nature, a complex system of interdependencies and delicate balances exists and nothing can be considered in isolation. Accordingly, the Metabolist Group "as architects, never tackle buildings or evolve principles in isolation, but always in connection with the city structure as a whole. All separate activities evolve
from this basis. They avoid the static master plans characteristic of Western planning methods; there is no attempt at pre-planned phasing found in self-conscious planning techniques. The Metabolist's open form is open to change. "Flexibility must plan a central part and . . . the laws of change have to be taken into account."  

Noboru Kawazoe seeks the harmony between man and his surroundings, both natural and man-made, through the use of highly developed structural and technical means. The whole process is dependent upon "the communication between human activities and organic natural processes."  

Kenzo Tange, looking upon society from a different scalar bias, sees the development of a nervous system organizing itself, and "creating its own brain" in the communication networks found in contemporary metropolises. The whole system is characterized by mobility--mobility of information, energy, and man. If present architectural and urban form is ordered in terms of natural processes, "the physical structure of the city will grow to have a more completely organic nature in keeping with the progress of man's social organization."
Noriaki Kurokawa has been outspoken in his criticism of the functionalist tenets of C.I.A.M. He believes the machine analogy is largely responsible for the inability of architects to conceive of form responsive to contemporary forces, and to create a meaningful environment for human life. In contrast to functionalism, Metabolism "springs from an analogy with living things." In Kurokawa's words, "a city should be nearer a living thing than a machine, and streets should fulfill more than just traffic functions." The city cannot be seen in static terms, and man's relation to his environment cannot remain the same. His need to realize his place in that environment, however, remains constant. It is the fulfillment of this need that challenges the Metabolists. For Maki, the designer must "stand between technology and man"; he must provide the link between the two conflicting elements. In order to achieve this goal, architectural and urban form must be "physically and visually clear," providing a clear sense of the relationship of part to whole. The designer must take into consideration the problems of dissimilar and often conflicting needs of individuals and
institutions; rapid and extensive transformation in the physical structure of society; rapid communication methods; and the impact of technology upon regional cultures. In a rapidly changing world, it is necessary "to move into changing states of equilibrium and maintain visual consistency and a sense of continuing order...to discover a clear and organic relationship that will link together people, automobiles, goods, and urban facilities." Kenzo Tange also sees the resolution of the conflict between technology and humanity as the designer's task. He believes that architectural and urban form can exert a subconscious influence on man and society, and works to create a dynamic balance, to close the gap between technology and man. This task is immense. "We live in a world where great incompatibles coexist: the human scale and the superhuman scale, stability and mobility, permanence and change, identity and anonymity, comprehensibility and universality." It is the forces of growth and change that have created this super-scale contemporary scene now threatening individual identity. "People are becoming more alike throughout the
They are being organized into huge groups in which they become anonymous. The individual man's needs and wants are becoming subservient to those of mass man." 30

For the Metabolists the solution to this contemporary dilemma lies in the perception and realization of an order based on natural processes. In Tange's words: "I like to think that there is something deep in our own world of reality that will create a dynamic balance between technology and human existence, the relationship between which has a decisive effect on contemporary cultural forms and social structure." As "organic life. . . includes order and freedom, mobility and stability," so must an organic architecture. 31

Kata

Much of Kiyounori Kikutake's writings and works have dealt significantly with the development of a Kata capable of undergoing metabolic changes. This Kata is based upon the traditional concept of space, Ma, 32 and the contemporary need for highly adaptive form. "We
must stop thinking in terms of function and form and think instead in terms of space and changeable function." 33

The basic organizational principle, then, derives from the concepts of "human space," space for human activity, and of "service function," functions which assist and serve free human space. According to Kikutake, "if we think of space and function as two opposing elements it will be possible for the human environment to attain a metabolic order instead of a static beauty. This will make it possible for the human environment to respond truly to the requirements of a dynamic reality." 34

Although these two concepts oppose one another, to neglect either one is to forfeit unity.

Another component of this organizational principle is the further division of space into "destination spaces and connecting spaces." 35 Destination spaces are recognized as being human spaces, while connecting spaces are generally considered as service spaces. They can be seen as the basic system for development of growth in architectural and urban form. Emphasis can be placed on dominant service spaces--where destination spaces are
added to connective spaces—or on dominant human space—where destination spaces are linked by connective spaces.

Generally, the Metabolists see the forces of growth and change as related phenomena, but as Kurokawa points out, there is a distinction. "Growth...refers to the quantitative increase of volume of the living system, particularly an increase in the volumes of its elemental forms." Metabolic change involves a change, in one way or the other, of the structure of an organic system. Systems for growth are more difficult to order than systems for change in that "growth manifests itself as change in the total form."

Kurokawa distinguishes between two patterns of growth: "infrastructure and master space." The first, infrastructure, corresponds to the growth pattern of plants, where growth is "external, autonomous, circumstantial." Infrastructure places emphasis on connective spaces. Growth in this system will "eventually arrive at the stage where the main infrastructure...cannot grow to a succeeding stage."
Infrastructure channels human activity patterns, in terms of energy and information flows, in order to give meaning to the concept of flow. The infrastructure system "attempts to attach to the flow patterns of life...the concept of unitized living." The methodology of infrastructure is outlined by Kurokawa:

1. Conceive of people, things, and energy as information and clarify their flow patterns.

2. Combine these flow patterns in flexible ways.

3. Give order to the relationships between the information patterns and spatial units.

Steps 1 and 2 interpret and organize architectural and urban form in terms of information patterns which exhibit a hierarchy. Step 3 establishes the human space, or destination space, relates to the infrastructure, and that the scale of the spatial units has a determinative effect upon the flow of information and therefore the infrastructure. "The infrastructures of buildings, metropolises, and megalopolises differ each from the other."
The second growth pattern, master spacing, corresponds to the growth of animals, where growth is "internal, active, spatial." Master spacing establishes a spatial hierarchy by distinguishing between human spaces and equipment spaces, thereby determining structure by placement of spatial units or districts in buildings or cities. This spatial hierarchy has a "temporal metabolic... rhythm," which reflects the various rates of change within individual elements. Kurokawa outlines the methodology of master space systems as follows:

1. Divide spaces into basic units.

2. Divide the units into equipment and living units.

3. Clarify the differences in metabolic rhythms among the unit spaces.

4. Clarify the connectors and joints among spaces with differing metabolic rates.

Steps 1 and 2 establish significant spaces within an architectural or urban form and organize these spaces into human space elements and service function elements,
distinguishing living spaces from equipment core. Step 3 identifies the various rates of change within the living spaces and equipment core. Step 4 attempts to relate living spaces and equipment core by emphasizing, or clarifying, connective spaces. Master spacing can achieve a higher level of development than infrastructuring.

Kurokawa describes infrastructure as: "Fiber form—homogeneous, plant-like, information-like, linear"; and master spacing as: "Porous space—heterogeneous, animal-like, metamorphic, spatial, membranous." 46

Both systems derive from the same organizational principle of space and changeable function, but infrastructure systems will eventually reach a stage where further development is impossible unless what Kurokawa calls "metamorphosis" 47 takes place. This process, mirroring nature, involves "change in the entire form of the system." 48 Metamorphosis takes place by means of "interiorization," 49 which occurs when exterior spaces, or connective spaces, are made part of the interior elements of spatial units or districts within towns or cities. An internalized infrastructure system thus
combines the characteristics of both infrastructure and master spacing.

Change presents to the designer of architectural and urban form problems distinct from the problems of growth. For the Metabolist Group, change requires the establishment of a Kata, system, which is itself metabolic; a system which can facilitate change without constant rebuilding and system disruption.

In order to make architectural and urban form "changeable, moveable, and comprehensible," and to create "a human environment that will correspond to the vital process of human life...the metabolic process," the Metabolist must identify cycles of change, of "temporal metabolic rhythms," and must relate each cycle to the entire system. According to Kenzo Tange, the architect must organize the various cycles of change in the various elements. "The coordination of interrelated and interdependent cycles of duration, calls for constructive exchanges in space. In other words the longer life cycle of the infrastructure is organically connected to the shorter life cycle of the element structures, so that this spatial organization is living and moving itself."
Kiyounori Kikutake relates the concept of metabolic form to nature's cyclic changes: "Like the leaves on a tree change from year to year so the individual units will change from year to year with the taste and requirements of each succeeding generation." 

The concept of a legible order becomes increasingly important as architectural and urban form become increasingly complex because of the myriad cycles of change in operation throughout the system. Fumihiko Maki expresses this notion well: "For the human, who tends to lose sight of himself in the vastness of large cities, the existence of visual spatial understanding provides a sense of psychological liberation and an increased feeling of participation in the organization of the city." As in nature, the aesthetics of change lie in the perception and legibility of order, rather than in fixed rules of composition and proportion. Metabolic order and metabolic beauty, in contrast to static beauty, offer the sense of completeness in incompleteness, the graphic expression of change.
Footnotes for Part III


2. Although there is a striking similarity between the methodologies of Kikutake and Kahn there is no indication of mutual contact or mutual influence. All indications lead to the conclusion that these similar expressions were developed quite independently. Although the Metabolists certainly recognize the clarity of Kahn's expression, given Japanese architectural traditions it is improbable that the methodology and theory of the Metabolist Group developed under his influence or was in any sense mere translation of his theory into Japanese.


4. Ibid., p. 13.

5. Ibid., p. 13.


9. Ibid., p. 12.

10. Ibid., p. 13.

11. Ibid., p. 13.

12. Ibid., p. 13.


42. *Ibid.*, p. 82.


51. Nitschke, Gunter, "The Approach of the Kenzo Tange team in their plan for Tokyo 1960," *Architectural Design*


PART 4
4.1 Examples
Katachi

Katachi is the physical expression of the Kata, system, and reflects the Ka, order, which is the basis of Kata. The following analysis attempts to determine whether the Katachi truly expresses the Ka and Kata; and how successfully the Katachi accommodates growth and change, and provides for human space.

Although the Metabolists have received world-wide attention for their proposals which deal with the design of the whole urban fabric, in practice, they have been confined to the design of individual buildings. While their urban proposals make most effective use of their theories, they have not been physically implemented. The application of Metabolist theory to smaller scale work is equally valid and it is the purpose of this section to show the existence of the elements of the KATA characteristic of Metabolist theory in representative examples of their completed work. Kikutake has stated that the KATA of contemporary architecture must be metabolic—"changeable, movable, comprehensible...capable of meeting the requirements of the contemporary age."
Noriaki Kurokawa: Project for an Agricultural City (1959)


Yamagata Hawaii Dreamland

A master space system, this recreational facility features an "interiorized" artificial environment; equipment shafts and service elements are interiorized and separated from structure. Cycles of change in service function, human space, and structure are recognized. Space is treated in a "topological" manner, open to change and capable of infinite variety without ever losing its basic properties. The topological spaces are used to create an environment in keeping with natural, especially human, processes. Its asymmetrical form is a reaction to the built environment of perfect geometrical forms. The use of topological space creates a world of fantasy, in keeping with the purpose of the building. Whenever man is exposed to topological space, as when he takes a trip to the country, he forms an immediate affinity for it. He reflects a desire to be part of the world of organic life, of a space full of vitality. Topological spaces and forms are characteristic of natural forms and processes. Hawaii Dreamland represents the world of organic life. The indeterminant nature of
its form implies growth, change, life, and metabolism. Equal emphasis is placed upon destination and connecting, or street, spaces. The street makes an organic whole of the external natural environment, the internal man-made environment, and the building itself. Planned to grow in the manner of individual cells, new elements will be added springing from the courtyard, the nucleus, and linked by means of the street. The street swirls in, around, and out of the building providing the user changing vistas, color schemes, moods, and activities.

The Hawaii Dreamland clearly expresses its organizational principles in the distinction between service and human spaces. Service spaces, staircases, toilets, etc., are located in the towers and separated from the main structural body. These towers serve to link the various levels. The individual, human, or activity, spaces are emphasized by their link with the street. The form of the building seems to express change, and the linkage for incorporating change is provided. The materials used in the construction of the major structural body of Hawaii Dreamland negate any reasonable effort to change the
exterior form of the building itself, however, interior partitions can be removed as desired. The Hawaii Dreamland can be judged as an extremely successful built form which accommodates the changing activities found in recreational functions.
Yamagat Hawaii Dreamland--a spatialized fantacyland.
Topological form.

Growth Pattern.
Floor Plans.

Plans of ground floor (left) and upper floor. Key: 1 entrance zone, 2 administration, 3 technical plant, 4 aquarium, 5 tea pavilion, 6 bar, 7 restaurant, 8 kitchen, 9 tea room, 10 public lounge, 11 changing room, 12 shower bath, 13 cloak room, 14 toilets, 15 staircase tower, 16 rock garden, 17 swimming pool, 18 paddling pool, 19 fishpond, 20 giant wheel, 21 boating moat, 22 games room, 23 bowling alley, 24 sauna bath, 25 rest room, 26 bath house, 27 public lounge, 28 conference and banqueting rooms, 29 hall, 30 chair store, 31 pantry, 32 large banqueting hall.
Pool and courtyard seen from in front of the kitchen. The area combines “interiorized nature” and “street architecture” in its theme. The towers contain the staircases and the toilets.

6. Courtyard, seen from the access gallery on the first floor. The gallery and the traffic zones on the ground floor are painted with striped bands in different colours, suggesting movements.

Interiorized external environment.
Connection of service tower with connective space and activity space.
Nitto Foods Plant  

A master space system, this manufacturing plant was conceived as an expandable system that permits future growth and change. Functional support spaces are attached to the main activity space. The space frame offers open space adaptable to changing function, and the column form facilitates easy change in the number of units. The columns visually express the potential for change, and are excellent examples of Kurokawa's concern for the aesthetics of change. The materials and joining techniques used reinforce the ability to respond to growth. The use of standardized components contributes to the sense of total order regardless of formal configuration, as well as the ability to grow, positively or negatively. Erection time for the first eight units was three months. The Nitto Foods Plant is definitely responsive to the demands of growth and change.
The column not only facilitates easy growth but also expresses the intention to grow.
Prefabricated tubular space frame.

Separation of activity space and service space.

Plan
Plan and growth pattern.
A master space system combining elements of both master space and infrastructure systems, this world's fair pavilion is an expression of how Metabolists view buildings of the future. Here, versatility within a basic framework achieves a high level of expression. It is a built response to the demands for changing spatial requirements and an expression of form in change. Prefabrication of the individual elements of the total form bring it close to the ultimate in accommodation of change. Each cycle of change is visually identified—structure, space, and service element. A three dimensional space network, the Takara Beautilion expresses an organic relationship of part to whole, and equivalent emphasis is placed upon destination and connective spaces. The body, a steel pipe rack, provides a three dimensional framework in which to place human space capsules. The capsules, independent units can be inserted where, and as, required. The nature and appearance of the Beautilion change as capsules are added and taken away. The Takara Beautilion can best be described as a physical expression of Metabolist theory expertly suited to its functional requirements and contemporary requirements.
A uniform prefabricated structural framework provides the basis for a rich variety of form. Its very incompleteness has a vitality expressing the ability to accommodate change.
First-floor plan. Scale: 1/400.

Third-floor plan.

Section.

Plans and Section
Distinction between structure, service elements, and activity space.

Spatial units can be "plugged in" or removed as required.
Franges are welded at the edges of steel-pipe, and by eight high-tension bolts.
Odakyu Drive-In  KUROKAWA

This roadside restaurant, is a practical application, of the Kata, of the Takara Beautilion. Major programmatic requirements called for a neutral structure that would stimulate further construction and provide the necessary space for the single facility. The space frame is adaptable to any direction that the future program follows. The prefabrication and bolted connections mean low initial and future cost with respect to growth and change. Certainly, this facility shows the validity of Metabolist theory at the small scale.
The tubular steel space frame provides a three dimensional framework for the accommodation of a variety of activities.
First-floor plan. Scale: 1/400.

Rooftop plan.

Second-floor plan.

Section.

Plans and section.
Connection detail expresses the ability to grow.
An infrastructure system, the most notable design features of this university are: a two level design strategy taking into account the temporal metabolic rhythms of various components; and an emphasis on the physical expression of information flow—linkage. The Master Design strategy was developed at two levels: the "macro scale," overall design, and the "micro scale," details. The "macro scale" develops a formal, functional framework; limits the use of materials to assure a unified character for the entire campus. The "micro scale" uses a narrow range of construction details; exposes all mechanical systems; uses color for accent and identification; and, carries a coordinated modular system through the entire campus, thereby providing a uniform variety. Also at the "macro scale," spaces with indefinite functions were primarily considered; and at the "micro scale" general campus buildings and facilities were of primary importance. The plaza creates a group feeling while giving independence to individual elements. Consistent use of materials provides visible spatial flow.
The campus was divided into fixed destination spaces—classrooms—and public connecting spaces—corridors, walkways, and plazas. While the fixed spaces are conventional, the public spaces are not. The connective spaces dominate and provide linkage as well as a place for spontaneous human interaction. The differentiation of Axis and Plaza, station, corridor and walls, give spatial expression to the hierarchy of flow, communication between people. Along the major axis the various elements work together to form a plaza which unites the facilities built along it, and defines, or separates these same facilities thus encouraging informal spontaneous action. Stations connect space and building, and are focal points in the general campus organization. Corridors and walls handle the flow of pedestrian traffic, and serve as areas of informal communications. The fixed spaces, stage and focal function are the basic elements in the composition. The stage is a special function station, and the gymnasium, library, administration center, etc., are placed along the axis according to convenience and symbolic considerations. While the materials used in the construction of the campus do not lend themselves
to change in built form, growth is provided for in a flexible framework of spaces. Individual building forms, though dissimilar, are related by the organization of space between them. This spatial flow visually unites the parts to the whole and the result is a high degree of legibility. The space and texture of the connective spaces give the campus its identity, or character. The Rissho University is most successful in its organic unity and its provision for spontaneous, vital human activity in addition to the programmatic activity of destination spaces.
1. Site plan. Key: A administration wing, B lecture room wing, C annexe with the large lecture rooms, D community centre I, E sports hall, F exhibition building (planned), G auditorium (planned), H community centre II (planned), J athletics sports ground, K baseball pitch, L tennis courts, M heating plant, 1 entrance hall, 2 information desk, 3 interview room, 4 office, 5 control room, 6 connecting corridor, 7 cafeteria, 8 medium-sized lecture rooms, 9 office, 10 large lecture rooms, 11 hall, 12 refectory, 13 kitchen.
Master Design: The organizational system which establishes the content and primary form. The spatialization of flow.
Plaza: An architecturalized plaza surrounded by the campus buildings, the open square is one of the main elements in the plan. The triangular space suggests an axis for extracurricular as well as scholastic activities.
41. Rissho University, the central plaza.
Stations: As a traffic junction point this will become a place of calm in the flow and of relaxation. The number of stations dotted inside and outside of the building add charm as well as stimulus to the students' daily life.
The staircase that links the welfare wing and the square is made to serve as a station.

The west end of the corridor joins the station.
Corridor: Though a traffic space, the corridor is also designed to serve a number of other functions including information. It is similar in character to the station spaces.
Mall through the spectators' seats in the gymnasium.

Mall: The corridor is a street with an interior nature; the mall is a corridor with an exterior nature.
Specific spaces: Buildings and rooms whose functions are definitely fixed. Contrasting to the more flexible corridor and station spaces.
Micro Design Elements.

- Handrails
- Sashes
- Lighting
- Openings
- Equipment
- Handrails
Sky House KIKUTAKE

A master space system, this residential prototype relates the elements of change, human space, and service function. Human living space is surrounded by moveable service functions. The moveable service functions are constantly being modified by changes in living patterns and technology. The change and adaptability of these elements gives the form a constantly changing appearance which occurs in various cycles. The Sky House is responsive to the contemporary need for the creation of flexible space within the framework of modern technology. Additional service units, i.e. children's rooms, can be hung from beneath the house. This is a successful application of Metabolist methodology in a single family detached house.
Movable equipment units define the interior space
A moveable system of wooden screens control the amount of light that can penetrate into the house, the degree of visual privacy, and the amount of storm protection.
Apartments at Asakawa KIKUTAKE

At a slightly larger scale, the Kata applied to the Sky House have validity for a master space system applied to a multifamily residential prototype. Like the Sky House, elements of change, human space, and service function are related. Service functions are separated to create free human living space and to respond to the temporal metabolic rhythms brought about by changes in living pattern and technology. This is a successful application of Metabolist methodology to a conventional multi-family development.
2. Plan. Key: 1 entrance, 2 installation unit with kitchenette, 3 bathroom and W. C., 4 wardrobe closet, 5 Tami room, 6 loggia.
Vertical circulation is separated from the main structure.

Interior Space is defined by moveable wall sections.

Service elements are suspended from the rear facade and are prefabricated units which can be replaced as desired.
Yamanashi Communication Center  

A master system which places equivalent emphasis on porous space and fiber form, the center is a concrete vision of the direction Metabolist design will take in the future. Although its scale is near the lower limits of effectiveness, as an urban design project, the building serves to express the possibilities for future order in urban form. Tange has created a three dimensional open spatial structure through the use of a dispersed service core. Activity space is distinct from service function and service function is tied to the vertical structure. Destination and connective space receive equivalent emphasis. Although there was an attempt made to express information flow in the vertical tubes it was not too successful. Movement within the tubes was not visible because of sectional requirements demanded structurally. Potential for expansion is implied in the projection of the tubes above the building and the opening left within the structure. Both techniques give a sense of vitality and life because of the incompleteness perceived. The structural system implies linkage with a
total urban form. Generally speaking, the Yamanashi Communications is an excellent example of a built form which reflects the organic relationship among elements, forces, and processes in nature, and which accommodates contemporary realities. The implied response to change cannot achieve its fullest development because the service functions are bound within a closed structural tube. That is to say that the facility was divided into changable and permanent elements. While service functions may remain constant in location they need to vary in make-up, which is difficult in the present plan. It exists in isolation—a part without a whole. Its suggestion of, however, the individual structure as part of an organic whole, the urban environment, is a most powerful concept.
The facility is intended to be a part in a larger urban system not presently developed.
3. North-south section (top, right) and plans of basement (bottom, left), ground floor (bottom, right), second floor (centre, left), third floor (centre, right) and sixth floor (top, left). Keys: 1 lettable space, 2 air-conditioning plant, 3 paper stores, 4 machinery, 5 electrical plant, 6 entrance hall, 7 air-conditioning shafts, 8 goods elevators, 9 store room, 10 W.C., 11 oil stores, 12 lift and stairwell shaft, 13 dining room, 14 kitchen, 15 drug store, 16 newspaper printing works, 17 machinery, salon, 18 packing room, 19 television camera van, 20 selling and printing plant, 21 editorial offices, 22 reproduction, 23 book binding, 24 photographic section, 25 production planning, 26 roof garden, 27 management, 28 electronic data processing, 29 cashier, 30 office, 31 conference room, 32 library, 33 small TV studio, 34 preparation for TV transmissions, 35 large TV studio (extending through two storeys), 36 store room, 37 radio editing, 38 film editing.
Connection points are expressed in the structure to give the indication that expansion is not only possible but expected.
A three dimensional open spatial structure created by the use of a dispersed vertical circulation core. Extension of the core vertically expresses the potential for growth.
Equal emphasis is placed on destination and connection spaces.
Open spaces are deliberately left in the structure to provide the vitality expressed in an incomplete structure.
Shinzuoka Newspaper Company TANGE

Like the Yamanashi Communications Center, this office is a master system with equivalent emphasis on porous space and fiber form. It eliminates the problems of the closed structural core by excluding service functions from the structural body. The asymmetrical composition indicates the potential for future growth. The structural system, by freeing the periphery of the building, encourages linkage with surrounding built form. Potentially, its greatest significance lies in the fact that it is an expression of frustration with the slowness with which proposals seeking the integration of the urban environment into a dynamic whole are being implemented. While others smirk at this effort, Tange continues in his commitment to design as total environment, to the inclusion of individual parts in the overall urban fabric.

Second-floor plan.

First-floor plan.
The structural system frees the periphery of any load bearing duties and thereby allows linkage with other structures to occur.
The incomplete form strives to achieve a linkage with other elements in the urban structure.
Japan Olivetti Company TANGE

A master system, this industrial warehouse is a direct response to the pressures of growth. Its visual expression is one of unlimited extension. Equipment element, structural system, and activity space are all distinct in contrast to the previous examples where the single core bore the responsibility for multiple function and an inability to accommodate the various temporal metabolic rhythms of the various components resulted. Expansion and contraction of this single function structure has no limits other than the amount of surrounding land available. Inherent in the form is the capability for growth. The Japan Olivetti Company is a successful Metabolist venture.
Separation of structure, service elements, and activity space
Long cylindrical beams contain ducts and axial flow fans that introduce fresh air to the interior. These elements indicate the direction of future change and their form gives the implication of unlimited growth potential.
A total order was established through the overlapping of ventilation and lighting patterns and patterns of human movement and units for future growth of the building.
Footnotes for Part IV

1. Noboru Kawazoe, "Topological Spaces," Japan Architect (December, 1967), p. 77. Topological, in Metabolists' terminology: "Maintaining essential characteristics when changed. A topological shape, or form, a square is not topological for when the basic form is changed it is no longer a square, but a ring shape is topological for it will always be a ring no matter how its shape is altered. A topological space has the ability to change its basic form without altering its essential characteristics. Artificial space, space created by man, is generally Euclidian, or geometrical, and decidedly non-topological. Topological spaces and forms imply the ability to change and are characteristically asymmetrical.

2. Ibid., p. 77.


6. Fumihiko Maki, ibid., p. 41.
4.2 Conclusion
Because the Metabolist theory is formulated upon the basic methodology of Ka, realization of order, Kata, organizational principles and systems techniques, and Katachi, type (form, free from style or shape), it has universal applicability. If the theory was based on mere formal expression it would produce an authoritative style, incapable of much variation and inappropriate for other cultures. Because it is a design methodology, however, it has the virtue of adaptability, of lending itself to modifications of history, tradition, time, and religion. In this sense, it is timeless and truly international. It makes possible free expression of unique situations and conditions, and allows the highest possible level of development.

Similar methodologies, which look beyond the programmatic requirements of a particular facility and into the deeper issues of architectural and urban form, exist. What makes the theory of Group Metabolism unique and significant is its reliance on natural processes or systems in understanding and ordering architectural and urban form.
Natural systems pervade the Metabolist methodology. From the realization that these systems can indeed provide a basis for ordering built form, came new techniques and the creation of a type-form which not only solved the problems created by contemporary form determinants, but also expressed the essential realities upon which architectural form is based.

In an editorial for *Progressive Architecture*, Forest Wilson states that although most of our institutions today have come under "critical examination or outright attack...we have never seen them so clearly." In an age where technology is an all pervasive force, it is not surprising to see the Metabolist Group ordering architectural and urban form (and consequently technology) in terms of natural processes. An off-shoot of the most dramatic technological achievement in the contemporary world, manned space travel, has increased awareness and interest in natural processes; the ecological movements would have little impetus without it. Yet the popular notion is that technology is inherently anti-nature. It is the Metabolists who see clearly the interdependence and interrelationship of technology and nature; technology
and man; nature and man. The increasing scope, scale, and rate of change in the world today continues without pause, and with this fact comes the necessity for man to order his entire environment—to create architectural and urban form which answers not only to the cultural problems associated with growth and change, and provides meaningfully for human space, but also relates form to the natural environment. This is possible only if open form is made truly open, and the relationship of all elements can be seen in the light of their commonality. Only then can architectural and urban form, which now must consciously include the natural environment, be ordered in the total sense; only then can true dynamic equilibrium exist.

At present the theory of Group Metabolism is new, and although it provides for the accommodation of contemporary forces in built form, it has relatively little large scale application and is not highly developed. A dreadful time lag exists before a theory can be developed, expressed, distributed, accepted, and finally applied. Possibly not until the environmental crisis reaches suicidal proportions will attempts be made to integrate
and order the total environment, allowing for the achievement of pure open form—a form in which all elements can reach their highest possible expression.

The significance of the Metabolist Group is that the application of their theory has no boundaries. Although variations are bound to exist, and would be expected, Metabolist methodology is universally valid. Finally, the Group Metabolists have taken the initial step in the development of a total architecture and urbanism of natural processes relevant to present and future time.
Footnotes for Conclusion

BIBLIOGRAPHY (BOOKS)


BIBLIOGRAPHY (PERIODICALS)


Kojiro, Yuichiro. "Fumihiko Maki: The Man and His Works." *Japan Architect*


Maki, Fumihiko. "The Theory of Group Form." *Japan Architect*


Nitschke, Gunter. "'Ma' the Japanese Sense of 'Place.'" *Architectural Design* (March, 1966), p. 117.


"Big Steel Tinker Toy." Architectural Forum (April, 1968).


