The Codes of Japanese Landscapes
—An Attempt to Topological Geography—

Ichiro Suizu*

In the articulations forming a landscape on various levels, we can recognize the relationships of “material morphème constituent,” and “constituent part of a landscape.” A “region” can be regarded as a unity of places where the articulations of landscapes serve as a ground and figure for actions to be physically performed, and where the loci of these performances are stratified to reform and reorganize the given articulations. Thus, we first notice that the existence of relations which are latent in a “region” corresponds to the structure of a language.

Since ancient days, the Japanese have had the concept of “ma,” a concept related to a space-time continuum. A versatile concept, it further connotes even relative relationships among objects in the space-time realm. In other words, various performances have been considered to manifest themselves in concrete forms in the realm of “ma.” Accordingly, it is presumed that among the traditional codes (langue) which have determined performances (parole) based on the background of various articulations of landscapes consisting of morphèmes peculiar to Japan, there are some codes which contribute to providing a unique structure for “ma.”

This paper aims at verifying the existence of these codes on the basis of the results of studies on the historical geography in Japan and at clarifying their characteristics from the viewpoint of comparative geography. Furthermore, this paper aims to elucidate the codes that have some aspects corresponding to the topological space beyond Euclidean space and to give a concrete explanation to the morphogenesis of landscapes in conformity with the theory of bifurcation in topology. In addition, the author intends to clarify part of the topological underlying structure of “regions” in general.
tural units composed of morphèmes are combined into a small or large landscape or a part of it with articulations at different levels in accordance with specific codes, does a world meaningful to communal life manifest itself.

As long as landscapes or their constituents are constructed by individuals, they differ with individuals. However, as long as human beings are social beings, the functions and structures of landscapes, or their constituents belonging to each human group, must have a system common to them. These landscapes and their constituents can be compared to parole in linguistics, while the system corresponds to langue (Saussure, 1916).

But, the establishment of a structure comparable to a phonological structure is far from easy in geography. A language itself has no form and is composed of a one-dimensional chain parlée. Therefore, it may seem extremely different in nature from “regions” underlain by landscapes which are composed of concrete shapes on a land surface. Nevertheless, in order for a parole organized on a chain parlée to actually fulfill the function of communication, there arises the necessity of a “place for communication” between the speaker and the listener, a place beyond a one-dimensional realm. When various actions are performed in one place, the place also serves as a “place for communication” which assists in performing the actions more smoothly by the use of parole as a systematic whole of symbols. Therefore, “places for communication” may well be regarded as a “space for performances” in a common phase between geography and language.

We can see the following corresponding relationships among the units of a landscape, psychology and language (See Table 1).

Thus, preparations have been completed for systematically analysing the structure of a “region” as a unity of places for functions (space for performances), that is, a set of landscapes with a group of functions integrated in it (region X), with an analogy to language (Suizu, 1982a). A landscape is a corporal extension (Merleau-Ponty, 1945).

I. The codes of historical landscapes in Japan

The codes of landscapes are corresponding to the grammar of langue, while each landscape is comparable to parole (Suizu, 1980). In this thesis, I would first like to examine the geographical langue by focusing on some examples of (1) landscape construction patterns recognized in sacred or non-daily structures such as Buddhist temples, Shinto shrines, and historic gardens and architecture, and of (2) landscape representation patterns seen in paintings and drawings. Then, I would like to proceed to prove the existence of codes of historical landscapes in Japan by verifying that these patterns have been also applied to individual daily landscapes. This will be then followed by the clarification of corresponding relationships between these codes and “mathematical reality.”

1. Landscape construction patterns

(i) The pattern of marking off (kugiru) (f(0)₀) and linking (tsunagu) (f(1)₁)

A sacred realm and a secular realm: These

<table>
<thead>
<tr>
<th>Place for functions</th>
<th>material</th>
<th>material ∈ Physiotop or Ökotop</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>living space</td>
<td>morphème ∈ constituent ∈ fundamental region ∈ region at a higher level</td>
</tr>
<tr>
<td>Perceptual space</td>
<td>physiological stimulus</td>
<td>stimulus to the peripheral nervous system ∈ group of stimuli</td>
</tr>
<tr>
<td></td>
<td>perceptual space</td>
<td>group of stimuli controlled by the central nervous system ∈ Gestalt space ∈ social psychological space</td>
</tr>
<tr>
<td>Place for communication</td>
<td>phonetic signal</td>
<td>phonème ∈ group of phonèmes</td>
</tr>
<tr>
<td></td>
<td>place for communication</td>
<td>monème ∈ word or phrase ∈ sentence</td>
</tr>
</tbody>
</table>
two realms are symbolically marked off by such *morphèmes* as a torii (Shinto shrine archway), gate, moat and bridge, shimenawa (sacred Shinto straw festoon stuck with white paper which has been cut into pieces) and kekkai (wooden fence erected in the main building of a temple to show a boundary between the clergy and laymen), which are too permeable to be definite boundaries. There are transitional spaces.

(ii) The patterns of dominating (*shita-gaeru*) (*v*$_{21}$), setting off (*hikitateru*) and complementing (*tsumaninaru*) (*v*$_{23}$) (rock garden arrangement or *huseki* pattern)

The arrangement of rocks in Japanese-style gardens: With the layout of the Japanese garden grasped in its totality, principal stones (trump stones) are placed and then supplementary stones are arranged among them. The "space" between the stones is not mere empty space but it conveys a tense atmosphere characterized by the patterns of "dominating," "setting off" and "complementing." Here is a way of placement due to circumstances.

(iii) The patterns of likening (*mitateru*) (*v*$_{31}$), fusing (*tokeau*) (*v*$_{32}$) and incorporating (*ikedoru*) (*v*$_{33}$)

Gardens of the four seasons: The gardens of the four seasons are those adapted to each season and laid out in miniature in scenic spots (*shukkei*) to induce man's immersion into and harmony with the landscape. The gardens were used to be likened to the Pure Land (*Sukhavati*) in Buddhism and so on.

(iv) The patterns of moving (*ugoku*) (*v*$_{41}$), changing (*utsurou*) (*v*$_{43}$) and curving (*mageru*) (*v*$_{43}$)

Landscape gardens in the go-round style: As is indicated by the expression "the visualization of movement," which is used to describe these gardens, they are characterized by the change in the viewpoint and successive changes of scenes.

(v) The patterns of irregularizing (*kuzusu*) (*v*$_{51}$) and abbreviating (*habuku*) (*v*$_{52}$)

Tea ceremony houses and karesansui (dry Japanese gardens): These tea ceremony houses and gardens are marked by simplification, symbolization and irregularization.

2. Landscape representation patterns

Black-and-white landscape paintings called *sansuiga*, bird's-eye-view paintings, pictures of scenic spots on trips (*dōchu zu*), and paintings of the inside and outside of Kyoto—all these traditional Japanese paintings share some landscape representation patterns such as the incorporation of scenic spots, the movement of the focus and successive changes of scenes (*Yamori*, 1982). These representation patterns are often in reverse perspective and bear resemblance to the above-mentioned landscape construction patterns. Especially, the patterns of "moving," "fusing," "abbreviating" and "linking" are dominant.

All these construction and representation patterns were completed under the influence of the natural and cultural climate of Japan in and after the medieval ages in close relation with such factors as the qualities of construction materials typified by timber and bamboo, and the distinct changes of the seasons as well as Buddhism and the principle of *ten-chi-jin* (a concept of aesthetic equilibrium marked by dissymmetry and dynamic equilibrium) which is incorporated not only into the arrangement of rock gardens but also into the sectors of flower arrangement and tea ceremony. And among these patterns, mutual infiltration is recognized.

However, the discussion of aesthetics of these non-daily patterns is not the purpose of this paper. Aesthetics should be studied in the fields of architectural history or art history. What is required in geography is to verify that even in urban areas and rural villages daily functions are apt to be combined exclusively with specific groups of *morphèmes* instead of others in conformity with the above-mentioned patterns, and thereby to prove that these patterns have served as the codes of historical landscapes in Japan.

As space is limited in this paper, I would like to present only an outline of this verification by giving some examples, but the pattern of abbreviating, which has been repeatedly noted by many scholars, will not be included.
3. The pattern of marking off and linking

Open verandas (nure-en), gardens and gates: The inside and outside of a house or a room are not only marked off but also linked by these morphemes. Curtain screens (kicho), rattan or bamboo blinds (sudare), folding screens (byobu) and paper-sliding doors (shoji) also serve in the same way, though they are all used indoors (Suizu, 1982b). Space under the eaves (nokishita) also functions as a joint space where the inside and outside of the house interact with each other.

Streets: Kyoto, where a grid pattern was introduced from China in ancient days and its blocks were marked off by the streets, began to show changes in communal formation in and around the 15th century: townsmen's houses standing on both sides of a street began to form a new communal unit called "machi," or "town." Thus, so-called "ryō-gawa-machi," or "two-sided towns" of townspeople came into existence (Ashikaga, 1971). Mostly formed in the shape of a hexagon with a north-south street as the axis, these units, which were almost the same in size, made up reticular networks. In castle towns in the Edo Period (1603-1867), too, streets fulfilled the unique function of "marking off and linking" the inside and outside of the mercantile houses along them, with the houses having a lattice door, komayose (a low fence to prevent horses and pedestrians from coming near the house), noren (sign curtain), doma or tōriniwa (earth-floored corridor), and tsubo-niwa (courtyard). It cannot be denied that these helped to delay the development of streets as a public zone. In contrast to the situation in Japan, plans to make the streets wider and straight began to be carried out in Europe in and around the 15th century. And this later led to baroque urban planning. With each street and the facades of the buildings along it integrated into one, a harmonious exterior space was completed as a public zone.

Ridges along irrigation grooves: Ridges between arable land usually serve as a boundary in terms of possession or management. But in Japan, it is often the case that the owners of adjacent rice fields jointly form a small group (mizu gumi) to share an irrigation groove along them. In fields in Europe, where irrigation grooves are not so much required, phenomena like this are seldom seen. Instead in Europe, fields (Zelgen) are often surrounded by pasture fences in order to prevent livestock from going into the fields where crops are being raised. Thus, fence landscapes (Heckenlandschaften) are prevalent. It is suggestive that the word "Zelgen" in "Dreizelgenwirtschaft" in the medieval ages is derived from the word "Zaun" meaning "fence." Such a confrontational concept in Europe as is indicated by the fact that the words "Umfriedung" (enclosure) and "Frieden" (peace) have the same etymology is not applicable to Japan (Bollnow, 1963).

As was shown above, "marking off" and "linking" in Japan are closely related with each other. In this sense, the situation is quite different from that in Europe, where a sharp distinction is recognized between these codes. This characteristic in Japan has much to do with the existence of kaiwai (activity space which has no distinct boundary between a central part and its vicinities), mutual integration between urban and rural areas (urban-rural continuum), and transfer of a central area and its environs. In Japan, neither capital cities in ancient times nor castle towns in the Edo Period had a solid city wall as cities on the continent did (Suizu, 1976b; Takahashi, 1982). In addition, as is shown by the common expression "a rural area in the capital of Kyoto (Kyō ni inaka arī)" or "a mountain cottage near the city (zahen no yamazato)," few cities were endowed with absolute social and cultural values. Furthermore, it was not rare that the central government office was transferred from the inside of the capital to an outside rural area.

It should be noted that Japan was considered in ancient times to be "the Central Country (Nakatsunokuni) of Abundant Reed Plains and Rice Fields," as is mentioned in the Kojiki (The Record of Ancient Matters, a chronicle compiled in 712); but it came to be regarded in the medieval ages as "a small country in the peripheries of the world (zokusan-hendo)," which later led to attempts to give a positive significance to the Buddhist idea of "onri-edo" (regarding this world as an impure one and avoiding it) in relation to the pious faith in...
the realization of the Pure Land in this insular country (UCHIDA, 1971).

4. The pattern of fusing, likening and incorporating

The patterns of fusing, likening and incorporating may well be called an extension of the above-mentioned pattern of “marking off and linking.” They serve to re-link what have been partitioned off. In other words, they have a unique function of connecting a place which is close to one, with the external world.

The pattern of fusing: Among the examples of the fusion of nature with human beings are a solitary pine tree on the outskirts of a village which meets or sees off travelers (demukae or miokuri no matsu), a pair of sloping roads leading to a temple or shrine, one with a rougher slope (manly slope= otokozaka) and the other with a softer slope (womanly slope=onna zaka), and a spot appropriate to enjoy a beautiful view of Mt. Fuji (Fujimi-cho), where many accounts of the intimacy between man and nature have been given.

The pattern of likening: Remote areas beyond the sea and the boundaries of villages or towns were often likened to the Pure Land believed in Buddhism to exist far to the west, and to the Children’s Limbo (sainokawara) respectively. And a group of places within a small area were compared to fudasho (Buddhist temples where amulets are issued to pilgrims) on a noted pilgrimage route as a smaller version of its original counterpart. The idea of reducing a landscape to a smaller scale (shukkai) is also found in a miniature landscape stone and a dwarf tree on an alcove.

The pattern of incorporating: An external distant landscape is “incorporated” into a view of a dwelling as the background (shakkei, or borrowing space).

These patterns can be considered to be related to our ancestors’ traditional custom of worshipping remote mountains from their villages where a secular life was led, regarding them as sacred. Especially the idea of shakkei is suggestive of a primitive form of map which probably played a symbolic part in representing a sacred realm on ancient festive days.

5. The patterns of curving and irregularizing

These patterns plays an active role in the avoidance of straight lines, which are seldom found in nature, and in the adoption of indented streets (sumichigai), dead-end paths (hukuro-komichi), partial curvature of the axial lines of roads, recessed space (kubomi), non-parallel system (sunikake), and obstruction of distant views (i mishadan). These morphèmes or groups of them served as a factor to “curve” or “irregularize” the continental gridion street pattern which had been introduced from China, and thereby contributed to adding variety to urban and rural life in and after the medieval ages. No geometrical uniformity could be seen in the layout in the regrouping of former hamlets (Verdorfung) in the medieval ages, either. Instead, the formation of those settlements was characterized by a deviation from the ancient rectangular-pattern allotment of land, frequent curvature of the axial lines of streets, and the irregularity of the location of the centers of the communities (SUZU, 1965; KINDA, 1971). Even the temple or shrine which functioned as a symbol of spiritual unity of each community was usually located at one side of a settlement. Layout patterns like this were inherited and applied to the planning of castle towns later in the Edo Period, too (FUJIOKA, 1962; YAMORI, 1970). These patterns have been heretofore treated lightly in morphological analyses because they seemingly look “irregular.”

Now, it is necessary to prepare for new analytic methods which make it possible to study these irregular patterns in comparison with the “mathematical reality” and thereby to surpass conventional morphological theories. For, as will be mentioned in detail later in this paper, some of these patterns are presumed to be corresponding to mathematical bifurcation sets. For instance, some winding roads are corresponding to the “butterfly set” in catastrophe theory and some irimoya style roofs (roofs with two slanting surfaces on the upper part and four on the lower part) to the “cusp catastrophe.”

When combined with other patterns, these patterns of curving and irregularizing serve as codes peculiar to Japan.
6. The patterns of dominating, setting off and complementing

These patterns are recognized in layouts in which the principal elements such as the residential quarter and streets in a settlement, and the castle, its main gate and the temples or shrines in a castle town were first laid out and then the other elements were arranged in accordance with the situation. Similar to patterns employed in process planning, these patterns are different from static ones which can be analyzed by the use of random distribution, regular distribution or agglomerative distribution. In layouts like this, in which principal elements are first arranged with the whole geographical situation taken into account, it is natural that less importance should be attached to the gridiron street pattern, and thus the patterns of curving and irregularizing come to the fore. And as a natural consequence of the initial arrangement of the principal (dominating) elements, the elements which “set off” or “complement” them are then arranged. Arrangements of this kind were closely related with and influenced by “the idea of fusui (the wind and water).”

Originally introduced from China, this topographical idea served as more than a mere folk belief (UNNO, 1982). This idea, which explains that a community with mountains behind it to the north, hills to the east and west, and water before it to the south is geographically ideal, was suitable almost to the natural environment of Japan including its topographical features. The idea of locating a community in the bosom of hills was a reflex of experimental wisdom. The pattern of “marking off linking” is also recognized in this idea. A fundamental composition often seen in the formation of villages in accordance with this notion is as follows. First, the residential quarter is laid out at the pivot of an alluvial fan and then the kadota (the fertile rice paddies in front of the settlement) are arranged. Plots of land in the village, marked out with ridges and footpaths in conformity with the contour lines, and with the fields expanding in a fan-shaped alluvial plain, are gently slanting and tapering off toward the imposing mountains (Oku-yama) behind the village where the deities were believed to reside (Hori, 1982). With this as a fundamental structure, the codes of “dominating,” “setting off” and “complementing” are employed in various forms in accordance with the principle of “the rock garden pattern” which allows variations suitable to the situation. Thus, landscapes with both variety and flexibility were formed.

II. The geography of ma

Interacting with one another, all the codes mentioned above have served as “conventions” conductive to the formation of historical landscapes peculiar to Japan. Judging from the fact that these “conventions” are recognized in the field of literature including haiku (seventeen-syllabled poems) and renga (linked verse) and in the realm of theatrical performances including No plays, they may well be referred to as the patterns of Japanese culture itself. One could safely say that these codes are equivalent to the structure of the Japanese langue (frequent dropping of the subject, special function of particles, order of words and so on).

Naturally there must be a divergence of opinions on the interpretation of these codes as being peculiar to Japanese landscapes because Europe does have some irregular parcels of land, and some plans using the linear allotment of land were carried out in Japan, as is typified by the linear ridges between rice paddies opened up in the Edo Period (shinden). But, the use of these codes in Japan implies not a mere orientation toward disorder but the creation of a world with positive meanings through irregularity. Landscape patterns in Japan marked by the integration of such factors as the changeability of marking off, an active deviation from the gridiron street pattern, and a propensity for curved lines can be considered to be the underlaying and unique attitude toward landscape formation and its harmony with nature which is hardly found in Europe. In contrast, landscape formation against nature in Europe is characterized first of all by geometrical patterns. For instance, geometrical patterns were adopted by the Roman Empire. They were inherited by the
Frankish Empire in the form of orthogonal land allotment plans including the national colonization plan (fränkische Staatskolonisation). Furthermore, in and after the 12th century, settlements with an open space in the shape of a square or a circle became prevalent both in urban and rural areas. Especially villages in accordance with a plan of uniform allotment of land (Plangewannendorf, green village) were conspicuous (Hövermann, 1957). After this, the spirit of Euclidean geometry continued to be strengthened in the Renaissance and Baroque ages, too (Suizu, 1976a).

The Japanese have had the traditional concept of “ma,” a concept related to a space-time continuum. Various patterns are considered to manifest themselves concretely in a variety of “ma” through “en” (relation, destiny, karma) in accordance with the codes already mentioned. It is significant that the word en means originally a margin and an open veranda.

In order to have a better understanding of the word “ma,” I would like to give some examples of the meanings it signifies.

Among the meanings it has in terms of space are:

1. (a) space between objects as in “arima” (interval) and “iwa no ma” (space between rocks)
   (b) limited space as in “taema” (gap), “kyoma” (intercolumnar space) and “tsuginoma” (next room)
2. (What is made up of similar objects as in “nakama” (company or group)
3. discontinuous space as in “kakima” (empty space in a hedge) and “mabiku” (to thin out)
4. adjusted space as in “ma o kubaru” (to arrange objects with space between them)
5. important point as in “ma ga nukeru” (to lack a point or to be out of place) and “ma o miru” (to judge the situation)
6. function or ability as in “noroma” (slow in function, that is, dull-witted) and “ma-nuke” (lack of ability, that is, stupidity)

The meanings of the word “ma” in terms of time include:

1. (a) time between events as in “aima” (interval)
   (b) limited time as in “hiruma” (daytime), “tsukanoma” (a short period of time)
2. intermitted time as in “taema” (intermission)
3. required time as in “ma ga nai” (to have no time)
4. discontinuous time as in “harema” (a lull in the rain)
5. important time as in “ma ni au” (to be in time)
6. adjusted time as in “ma ga au” (to be in rhythm)
7. chance or opportunity as in “ma ga ii” (to be high time)

Thus, the word ma has a wide range of meanings and the concept of ma has taken root even in the realm of the aesthetic sense of the traditional arts of Japan (Shiraishi, 1973).

As is shown above, the concept of “ma” is related to both space and time. It can be referred to as a primitive concept of the space-time continuum. This notion of “ma” held in Japan, where this world was considered, as is above-mentioned, “to be onri-edo” or “shogyo mujo” (space where all earthly things come and go), led even to the development of an artistic concept of “utsuroi,” or “mutability and transitoriness” as typified by flowing clouds and water (“gyoun-ryusui”). In contrast, the English word “space” or its German equivalent “Raum” does not connote the concept of time. In this respect, the geography of “ma,” where and when the codes of Japanese landscapes function, is too high in dimension to be analyzed by the use of Euclidean space, which adheres to a system of orthogonal coordinates.

III. The No stage

In order to clarify the geography of “ma,” I would like to examine the system of creative actions which are determined by various codes. As the initial step of the examination, I would like to focus on the No stage, where the scenery (a group of morphèmes) is eliminated to a great extent. No is a traditional art for public entertainment which originated from a primitive festive event in rural villages.
Though the No stage is simple, it still has some setting so as to create an almost excessive sense of unity between the stage and the audience. Among the sets are four pillars erected at the four corners of the square stage, a bridge-form passageway, No masks and a mirror room (kagami no “ma,” a room furnished with a mirror where the actors put on their No masks). The unique significance of these morphèmes will be mentioned later. What is to be examined now is the mechanism of “the tense relationship between the performances by the actors on the stage as a sacred realm and the audience who has participated in the sacred realm from the secular everyday life by passing through the entrance into the theatre” (TOITA, 1982). This mechanism is suggestive of the structure of space produced by performances in general which are meaningful in terms of creative values.

Therefore, I would like to examine in detail the transformation of a system consisting only of relationships between performances and places. Let it be supposed that the body passes through places $x_1, x_2, x_3, \ldots$ toward some place infinitely far away, living each moment with the indifferent attitude of an onlooker. The space $(x_1+x_2+x_3+\cdots)$ which can be likened to shadows projected by these actions is nothing but a mere extension of the place $x_i$ and is not related to a projective transformation in mathematical terms. Creation cannot be possibly expected from actions like these. Then, what kind of space do creative actions in the definite world produce? When a creative action is performed in the bounded world, the places $x_1, x_2, \cdots, x_n$ should be united into a whole with “duration (durée)” in which $x_1, x_2, \cdots, x_n$ seem to the performer to interact with one another in the same way as “all the sounds of a musical composition seem to us to be integrated into one, each interacting with another.” Only performances that produce a mechanism like this can take part in “the creative evolution (l’évolution créatrice)” mentioned by H. BERGSON (BERGSON, 1889). On an Euclidean plane, it is difficult to find a model which can meet this qualification. At least there arises the necessity of considering sphere $S_t$ (Riemann surface) as a model.

On a spherical surface, a great circle which is drawn when the shortest course is taken between two points is equivalent to a straight line. An infinite number of straight lines can intersect at each of the two points $(x_n, y_n)$ but none of them run parallel to each other. Let us examine this model with a movement (performance) from $x_n$ to $y_n$ given the name $\text{“} f \text{“}$ and one from $y_n$ to $x_n$ named $\text{“} g \text{”}$. In the case where a projective transformation maintaining the relationship $g=f^{-1}$ exists and the identification of $x_n$ with $y_n$ is established?, the movement $f^{-1}f$ is a creative performance. Space where the relationship $x_n=y_n$ exists is a projective plane $p^2$.

When a number of performances in conformity with this projective transformation $(G=F^{-1})$ are possible, the mechanism of $X=Y$, which can be referred to as a “latent dimension,” will be established in three-dimensional landscapes with different morphologies, and space for creation will be produced.

The No theater mentioned at the beginning of this chapter can be regarded as space for a “duel” between the actors and the audience which meets the above-mentioned qualification for creation. Through the medium of the stage setting, this space manifests itself as admirable $p^2$ and assumes an unorientable mechanism. Thus, the creation of an art is recognized.

It should be realized once again that not only the code of “marking off linking” but also the codes of “fusing” and “likening” have an unorientable mechanism characteristic of projective planes like $p^2$. This is why these codes have been able to serve as codes contributive to space for unique cultural creation. In the case of No plays, these codes must be hidden on the stage with four pillars erected at its four corners with no walls between them.

IV. In pursuit of symmetry

A projective plane produces symmetrical (bisymmetrical) patterns in principle. If all creative performances are essentially supposed to produce projective planes, symmetrical morphogenesis can be expected of landscapes
or their constituents and *morphèmes* which contain these performances. The word “symmetry” originates from a Greek word meaning “equilibrium” or “harmony.” It seems that it is the word “symmetry” as a mathematical term that is connected in some respects with the “balance” or “equilibrium” which has been vaguely expected of a “region” in geography.

Not a few individual objects with a symmetrical form are found in nature. Not only animals and plants but also human beings are almost perfectly symmetrical. This phenomenon may be related to the dispute on the preservation or non-preservation of parity hidden deep in nature (GARDNER, 1964). Apart from this subject, it is presumed that the mechanism of projective planes underlies the system in which one organism sustains itself by digesting another organism or inanimate objects as food, that is, a system in which one organism can be part of the environment of another (UEXKÜLL, 1940).

Ever since early times, mankind has not merely depicted individual objects with a symmetrical form but also concretely represented symmetrical space consisting of a group of individual objects in the form of painting or sculpture. According to H. WEL, the ancient Sumerians already had a strong taste for strict bisymmetry (WEL, 1952). Symmetrical patterns were not unusual in ancient Japan and China, either.

A symmetrical pattern can be obtained when a figure is reflected in a mirror. When a figure is turned 180 degrees on an axis on the plane, a “symmetrical” pattern is obtained but this pattern is not symmetrical in a strict sense, for the figure obtained after turning is placed downward. A bisymmetrical pattern in a real sense can be obtained only when you get a reflected view of the other surface of the figure obtained by turning. This is the same as a pattern produced by a projective plane. Mankind depicted symmetrical patterns for sacred places, in spite of the difficulty of getting the reflected view. This must have been underlain by a strong desire to incorporate into communal life the mechanism of projective planes which mankind had perceived latent in “the structure of nature” (UEXKÜLL, 1940) in early times. The same desire must have been behind the totemic communal system. Images reflected on the surface of water probably helped to provide concrete ideas for the materialization of this desire. Not only the water surface of springs or ponds but mirrors also made a direct contribution to enhancing the concept of bisymmetry and were regarded as mysterious as early as the prehistoric age. In No plays, too, which tacitly reflect and convey the feelings and sentiments of the ancient Japanese, there are not a few scenes where an actor gazes at himself with the surface of water as the mirror. The mirror room is not a mere dressing room but is a place where actors experience transformation and rebirth (TOITA, 1982).

In various parts of the world, we can find many varied animal masks including those of strange imaginary animals. Similar to totemism, this must be a concrete representation of the concept of regarding oneself in the same light with the animal, the fowl or the arbor, a concept which was held by mankind who sharply discerned his proper position in “the structure of nature.” In the Japanese language, the word meaning “mask” also signifies “face.” The masks used in No plays emit even a mysterious feeling. Thus, such codes as “fusing” and “likening” come to the fore in the projective plane system. Behind this there lies a sharp discernment which is aptly described by the excellent proposition that “one is one of the others” (SAKABE, 1976).

Then, the idea of symmetry in one’s life sphere developed into the formation of images of the world. For instance, maps depicted on sand on festive days by tribes indigenous to America reflect their strong desire to comprehend the world as symmetrical about an axis (HISATAKE, 1979). Among the other examples are Buddhistic world maps in ancient India and Christian world maps in the medieval ages, both of which are of bisymmetrical arrangement. Furthermore, the symmetrical juxtaposition of the celestial world and the nether world or paradise and hell with this secular world between them is surprisingly omnipresent. According to M. ELIADÉ, it was not unusual in early days that life on the surface of the earth was regarded as a reflex
of that in the celestial world (ELIADE, 1952).

Later people sought for perfection in place of the celestial world: the ancient Chinese recognized perfection in a square shape and the ancient Greeks in a globular shape (SUIZU, 1969). This is probably because these shapes most clearly represent symmetry. In Europe, even the idea of "antipodes" was advanced under the influence of the theory that the earth was round. But there remains the question of to what extent the European people held a symmetrical image of antipodal persons or antipodal points. A Christian theologian in the medieval ages named Augustinus denied this idea saying, "I can not possibly believe that there are inhabitants called 'antipodes' on the earth and that they dwell in an area where the sun rises when it sets in the area we live in and walk with their legs upside down to our legs" (ODA, 1959). Since the days of ancient China and Rome, the creation of symmetry has been witnessed concretely in civil engineering plans (landscape plans) carried out on the surface of the earth such as national land planning and rural and urban planning. We can clearly recognize the concept of an axis of symmetry or a rotary center behind efforts to locate constituents including temples and a ruler's palace in a square street network as a way to construct as symmetrical a whole as possible. Not only the urban planning of a gridiron street pattern but also the jori system (asquare partition of arable land) in ancient Japan and the centuria system in the Roman Empire show the consistent application of a syntax with symmetry as its principle to an ancient grid pattern as a langue (SUIZU, 1969).

V. The appearance of dissymmetry

As is mentioned by R. CAILLOIS, only reflections in mirrors are in conformity with the mechanism of projective planes. He also points out, however, that real symmetry obtained like this sometimes serves as an obstacle preventing the unrestricted development of nature and communities. The unrestricted development of nature and communities is found when this rigid symmetry has been broken. He discusses dissymmetry thus brought into existence by giving a wealth of examples (CAILLOIS, 1973).

As long as life space contains many varied solid objects with different functions, they were soon to face the matter of dissymmetry in landscape planning including urban and rural planning. Especially in the case where a view of directions is closely related to an idea of deities (for instance, in Japan four deities were believed to be corresponding to the four cardinal directions), dissymmetry appears as a natural consequence. In the Buddhistic view of the world, too, the adoption of the belief that the Pure Land lies in the west immediately distorted the previous symmetrical map of the world. It should be noted, however, that dissymmetry differs from chaotic asymmetry in that the former indicates a high level of development following the partial destruction of symmetry. Dissymmetry can display its value simply because it is comprehended in relation to symmetry.

Even in the case of the belief of the four deities corresponding to the four cardinal directions, it can not be denied that behind the belief there must lie the concept of symmetry. The four pillars of the No stage are also said to have been originally corresponding to the four deities the communities believed in. This belief was underlain by the theory of "inyo gogyo," a Chinese view of the world which consists of two principal ideas. One is the idea of inyo (yin and yang), which maintains that all things in the universe come into existence and change through the interaction of pairs of conflicting factors such as right and left, up and down, man and woman, birth and death, and right and wrong. The other is the idea of gogyo, according to which all things in the universe are composed of five elements (wood, fire, earth, metal and water).

In the course of history, the formation of landscapes as a communal environment branched into two directions, one guided by the symmetry of the constituents and parts of a landscape and one with dissymmetry as its guidepost. The former served as a syntax of a landscape in Europe and the latter in China and Japan. For example, the symmetrical arrangement of sacred objects was adopted in the construction of temples in ancient Greece.
and cathedrals in medieval Europe. A persistent trait toward symmetrical spatial arrangement has been also witnessed in Europe in geometrical construction including that of urban areas since the days of ancient Rome. In contrast, a tendency to recognize the value of a slight impairment of symmetry became stronger in China and Japan. R. Caillois points out that in comparison with classical European culture, Japanese culture seems to have averted the harm caused by the fascination of symmetry, which often produces sterility. To substantiate this statement, he showed some examples. Among them is the Zen master Ikkyu (1394-1481) having had a few fallen leaves intentionally scattered on a garden that had been cleaned. Another example is the importance being attached to motion centering on one point which breaks the stillness.

The patterns of "curving" and "irregularizing" which can be considered characteristic of the historical landscapes of Japan are representative codes with which to embody dissymmetry. The arrangement of rock gardens in the medieval ages is a faithful reflex of the above-mentioned concept of ten-chi-jin (aesthetic equilibrium), which may well be referred to as a typical Japanese concept of dissymmetry. This concept was to be adopted as a principle in flower arrangement in the Edo Period, which followed the medieval ages. Another example of dissymmetry was found in the construction of "islands" in garden ponds in the medieval ages: in addition to an island likened to the Taoistic land of deities called Shinsen-to, another island representing the Pure Land was constructed in some garden ponds with lotus flowers in bloom. With the passage of time, dissymmetry became more conspicuous in the layout of ponds like these.

VI. The cloud-mist painting method

No attempt to examine the lower strata of "regions" can be possibly made without facing the problems of projective planes and bisymmetry. But a projective plane is no more than an Euclidean plane with the point at infinity added to it. This plane, composed of straight lines and curves of second order, has too many restrictions. As might be indicated by the concept of "ma" in and after the medieval ages, the geographical "region" X seems to belong to topological space with a plasticity which at least contains and exceeds both the Euclidean plane and the projective plane.

Paintings of the inside and outside of Kyoto in the 16th and 17th centuries admirably depict scenes and events in and around the capital with changes in the four seasons and annual events interwoven into them. These paintings, which are generically called rakuchu-rakugai-zu, are marked especially by the pur-

Figure 1. A rough sketch of a painting of the inside and outside of Kyoto, and the critical points in the clouds.
poseful abbreviation and separation of scenes by the depiction of clouds and mist on the canvas. Each of the divided scenes is independent of the others in terms of both time and viewpoint. For instance, one of these paintings concurrently depicts a New Year Feast being held in a garden of the Imperial Palace, floats of the Gion Festival in procession in summer along a street lined by two rows of townsmen’s shingled-roofed two-storied houses, and farmers busy gathering the harvest in autumn on farmland on the east bank of the Kamo River. Both the street running through the “two-sided town” and the river are curved. Pictures like this convey a comprehensive atmosphere of Kyoto to those who appreciate them, through the views changing one after another. This method of depiction is completely different from the European methods in which the viewpoint is always fixed at one point.

Bird’s-eye views painted in Europe which are similar to photographs must be more accurate in terms of the representation of a scene at a specific moment. But the method taken in the paintings of the inside and outside of Kyoto is superior in terms of the delineation of life space as a whole which constantly changes in different places with the lapse of time.

Known as “the cloud-mist painting method,” this technique is not limited to the paintings of the inside and outside of Kyoto but is often seen in old picture scrolls. Peculiar to Japan, this technique is characterized by the description of space with “blanks” or negative space (yohaku), which are closely connected with the concept of “ma.” Perhaps only deformation might be perceptible to those who are accustomed to European paintings characterized by a fixed viewpoint and three-dimensional representation with clear contours or to modern maps marked by the abstract symbolization of concrete objects. These European paintings and modern maps differ from the pictures painted by using the cloud-mist technique in that the former stand face to face with one who appreciates them while the latter allow him to be successively involved in the different scenes, as it were, because of “ma” or space-time continuum produced through the medium of the viewpoint floating among the clouds and mist serving as “blanks.” The pictures of Kyoto and its vicinities give an impression that the environment of the area is “in an actual existence as though it were refusing to be given a fixed shape (SHIGA, 1979). Therefore, the environment represented by these pictures is closer to “actual space” (espace vecu) (MERLEAU-PONTY, 1945). In order to reason that these pictures are truer to life, it would be necessary to clarify various matters, transcending the image of space produced by modern paintings and maps and the established concept of “regions.” The above-mentioned environment which can be called “changing space” is removed from the principle of isotropy and homogeneity, a principle of Euclidean space as artificial space. Here as a temporary measure, I would like to briefly analyze it by comparing topological manifold (which will be mentioned later in detail) to “ma” recognized in the paintings of Kyoto and its vicinities.

“It is possible to give a ‘shape’ to X by assuming topological manifold in Euclidean space. But the shape is no more than a ‘provisional shape.’ The abstract quality which the original X has as topological space is in actual existence behind the provisional shape as though it were refusing to be given a shape.” (SHIGA, 1979). Let us first suppose that the singular point and the critical point of topological space are hidden in the “blanks,” which are represented by clouds and mist, and that with the transition of the viewpoint, the topological mapping of different scenes change one after another. If X is represented on torus as $X_a$, the critical points shown in the right part of Figure 1 can be presumed.

VII. The codes of “changing” and “irregularizing”

For the purpose of deeply penetrating the “region” $X$, I would like to discuss it by showing an example in Europe, where topological mathematics was born.

Kaliningrad, located at the northeastern extremity of the Gulf of Gdansk facing the Baltic Sea, is a city which once had a shelter castle of ancient Prussia. The construction of
the city along the banks of the Pregolya River was commenced with a fortress built by a German equestrian corps in 1255 as the center. Until 1945, when it was annexed to the Soviet Union, it had been called Königsberg and had developed as the principal city of East Prussia in Germany. The Pregolya, running through the central part of the city, is joined by a tributary. An island called Kneipfhol was formed in the river in 1327, and had, among others, the city hall and a cathedral. In the 18th century, this island (A) in the river and the three quarters (B, C and D) surrounding the river were linked with one another by seven bridges, fewer than today (See Figure 2). It is said that until the early 18th century, when the urban area had not extended beyond the city walls yet and citizens could fully enjoy the atmosphere of a Hansa commercial city still ruling the whole city, they found pleasure in discussing the possibility of going through the four quarters A, B, C and D by crossing each of the seven bridges only once before coming back to the starting point.

It was L. Euler (1701-1783), a mathematician born in Switzerland, who clearly proved the impossibility of doing so. This is quite well-known in the history of graph theories. At the young age of 28, Euler, who had inherited G. Leibnitz's geometry of site, presented his admirable solution to the Russian Academy in Petersburg. In solving the problem, he made a point stand for each of the four quarters A, B, C and D and a line linking two points represent each bridge (See Figure 3). By examining the figure consisting of only vertices and edges (1), he found that only when a figure has even-points and no odd-points, is it possible to cross all the bridges (lines) without crossing any bridge twice. It is also possible when a figure has two odd-points but you cannot return to the starting point. In the geography of today, the index $\mu$ to show the connectivity between two places is often employed. Though this index has some problems to be solved, I would like to apply it to the figure under discussion now.
The index \( \mu \) = the number of edges - the number of vertexes + the number of subgraphs = \( 7 - 4 + 1 = 4 \).

When citizens strolled through all of the quarters A, B, C and D, some bridges were not crossed while others were crossed twice. Among the routes used to stroll through the four quarters were the routes (2), (3) and (4) shown in Figure 3. Whatever route the citizens took, their itineraries left figures with even-points and no odd-points when they visited all the quarters. In the case of route (2), no bridge is crossed twice but a bridge between A and B, one between A and C, and the one connecting A and D are not crossed. Route (3) shows that the bridge between A and D is crossed twice while one between A and B and one between A and C are not crossed. On route (4), a bridge between A and B, one between A and C, and the one between A and D are each crossed twice. Accordingly we can obtain the following results:

- the index \( \mu \) of route (2) = \( 4 - 4 + 1 = 1 \)
- the index \( \mu \) of route (3) = \( 6 - 4 + 1 = 3 \)
- the index \( \mu \) of route (4) = \( 10 - 4 + 1 = 7 \)

This means that the connectivity among the four quarters of the old urban area of Königsberg changed according to the way the bridges were crossed: the urban area was a pedestrian space with the index \( \mu \) changing from 4 to 1, 3 or 7. This indicates that it would be too hasty to judge the actual connectivity between places on the basis of the index \( \mu \) unconditionally.

L. Euler continued to study the mathematical characteristics of surfaces. And in 1752, he discovered a rule determining relationships among the number of vertexes \( (V) \), that of edges \( (E) \) and that of surfaces \( (F) \) of a polyhedron: \( V - E + F = 2 \).

This index of L. Euler’s was then expanded by J. B. Listing and H. Poincaré and it was proved that the index changes, depending on the surface (L. Euler and H. Poincaré’s formula, shown below).

The characteristics of space clarified by topological mathematics which has shown a conspicuous development since the 19th century have proved to be comparable not to those of a stable mass like the marbles in Greece but rather to those of something changeable like the Japanese gardens and picture scrolls. In other words, they are marked by the codes of “changing,” “moving” and “irregularizing.”

When substituting \((F - \text{Euler’s index})\) for \((E - V)\) in the formula showing the index \( \mu \) after obtaining \((F - \text{Euler’s index} = E - V)\) from Euler and Poincaré’s formula, you can obtain the following formula.

\[
\text{the index } \mu = (F - \text{Euler’s index}) + \text{the number of subgraphs}
\]

Since \((F - \text{Euler’s index})\) is affected by the characteristics of surfaces, the index \( \mu \) also changes, depending on the surface. Therefore, it would be almost meaningless to simply examine the index \( \mu \) alone in disregard of these changes when clarifying a “region” consisting of multilayered performance spaces.

The codes of “changing” and “irregularizing,” which are characteristic of the historical landscapes of Japan, are far beyond the restrictions of dissymmetry mentioned previously and have served in close conformity to the changeable mechanism of actual performance spaces: they have been conducive to the formation of unique landscapes through the combination of morphèmes suitable to the mechanism. These codes must have had difficulty in developing in landscapes in Europe which were mostly composed of solid stone buildings with almost permanent durability. But even in these landscapes, too, the above-mentioned mechanism must have operated in the lower strata of performance spaces.

Then, what kind of space structure was
latent in the central part of Königsberg, where pedestrian space could be transformed, depending on the route taken? The space structure was anything but that of the transcendental “world of form” advocated on the basis of theories of Euclid and Newton by E. Kant, who led a life of meditation in the university in this city. Instead, it is presumed that a plastic manifold \(X_b\) similar to \(X_a\) mentioned in relation to “ma” was latent in the central part of the city: the space structure of the city center can be projected onto two-dimensional open disks by using the mappings \(\varphi_1, \varphi_2, \varphi_3\) and \(\varphi_4\) in the respective shapes of the figures (1), (2), (3) and (4), with the latent coordinate systems represented by \((x_1, y_1), (x_2, y_2), (x_3, y_3)\) and \((x_4, y_4)\) respectively. In other words, in its lower strata, the city center also had different coordinate systems veiled in invisible “clouds and mist.”

The artists who painted the pictures of the inside and outside of Kyoto depicted a whole set of different localities each corresponding to different coordinate systems not by solving the differential equation but through a sharp intuition resident in artists: they symbolically integrated different coordinate systems into their paintings by the adoption of the cloud-mist painting method. Topological “mathematical reality” latent in the actual world is ingeniously incorporated into Japanese methods of constructing or representing landscapes.

VIII. The code of fear

According to K. Shiga, a mathematician, \(k\)-dimensional space “does not spread quietly” in “a mathematical background,” or in “the world of form” (Shiga, 1979). In the same way, space dealt with in geography “does not spread quietly” behind relationships among various objects.

“Mathematical space” like this is completely different from invariable space which has been regarded as a geographical model space ever since the days of J.H. von Thünen. Here is where I would begin to examine the code of “marking off \(\cap\) linking” recognized on the earth’s surface on the premise that geographical space has a variable structure, that is, a structure which changes in accordance with given conditions.

Let us analyze a central place and its sphere of influence as an example. It may be assumed that the daily shopping areas for instance, are in the shape of an almost regular hexagon when drawn on the basis of distances covered on foot. But it would be meaningless to discuss the commuting radius, a radius on a higher level, on the same basis. For the commuting radius is determined by many varied factors including the means of commuting and the conditions of location of a place of work. A number of daily shopping areas which are “marked off” from one another are “linked” together when viewed from the standpoint of commuting radiuses or areas for purchasing quality goods. In the “region” \(X\), where radiuses of different levels are concurrently existing and stratified, the center and peripheries are variable. Each place within \(X\) can be the center or a periphery, depending on the conditions of the radius. As is revealed by Figure 4, behind the existence of these relationships there lies a fact that space produced by the central places and their spheres of influence is at least a kind of dual space which is beyond Euclidean space. The code of “marking off \(\cap\) linking” in Japan is considered to be a symbolic example of the early comprehension of the duality of space.

Accordingly, in order to clarify space produced by the central places and their spheres of influence, it is necessary to sweep away “the world of form,” which can be likened to an empty bowl. For space produced by the central places and their spheres of influence is in possession of “the same multiformity as mathematical space itself has.” In other words, actions performed in the space are incorporated into a strange manifold in which porous toruses may be piled up one on top of another. It is true that the central places of a specific level and their spheres of influence can be described on a plane graph. But the plane as space for performances is transformed into a projective plane realizable in four-dimensional Euclidean space. Furthermore, if consideration is given to all levels of the central places and their spheres of influence, the description of them becomes extremely complicated. Here I want to apply the name \(X_c\) to \(t\)-dimensional manifold cor-
As was previously explained, the superiority of a central area to its peripheries was not necessarily established in Japan, where the idea of urban-rural continuity was prevalent. The prevalence of the traditional topographical notion of regarding the recesses or depths (oku) as superior to the centrality seems to have been related with this. Therefore, when discussing “the theory of central place” by W. Christaller, it is necessary to regard Xc as the same topological space as Xa and Xb (mentioned before) beyond a two-dimensional Euclidean image (Christaller, 1933).

In Japan, which had its own geographical codes, every phenomenon was considered to take place, and assume a “provisional shape” through the medium of en in accordance with the codes. The comprehension of the plastic nature of X, which never stops changing, can be aptly exemplified by the common expression “all things transmigrate” or “Matter is void.” The idea that all things are reflected in various shapes and values in ma through mapping “en” bears resemblance to the ideas of topological space.

By the way, Yi-fu Tuan, a scholar of phenomenological geography, shows us a wealth of examples of “landscapes of fear” (Tuan, 1980). They range from ghosts drawn by children to crimes in large cities. The Japanese, too, have aimed at comprehending the “space of fear,” that is, space where “all things change and nothing is permanent (shogyō mujo),” as one of the inevitable aspects of “changeable space” like Xa, Xb and Xc. If Xa, Xb and Xc contain a part corresponding to a differentiable manifold, it would be possible to apply the “theory of bifurcation” in a local dynamic system to it. The phenomenon of bifurcation of manifold is really suitable to the “space of fear,” especially to the climate of Japan, which can be colored by constant mutation and perpetual motion. The above-mentioned ideas of “onri edo” as well as “shogyō mujo,” which regard this world as impure and mutable and thus avoiding it must have been a reflex of the Japanese people’s intuitive insight into the mechanism of bifurcation of differentiable manifold latent in the actual X through their experiences in the medieval ages preceding the days.

Figure 4. The spatial duality of central places and their spheres of influence.
of topological mathematics. This idea can be further considered to have served the “codes” peculiar to Japan which were systematized on the basis of this perception.

In Japan, topological recognition has existed since the very remote ages. But it was not until the 13th century that the recognition freed itself of the ancient grid pattern introduced from China and was developed and refined in the form of the codes of landscapes mentioned before. It is suggestive that it was the 14th to the 15th centuries that the No play, derived from the Sarugaku farce in rural villages, was completed by Kan‘ami and his son Zeami. Furthermore, in the 16th century, the genre, generically called “the pictures of the inside and outside of Kyoto” characterized by the cloud-mist painting method, reached completion. In addition, both what is called the Verdorfung in the medieval ages and the construction of castle towns in the Edo Period with variegated plans woven into it were also closely connected with the completion of the topological codes of landscapes.

IX. “Likening” to “mathematical reality”

Since olden days, the practice of “likening” has been recognized in Japan: rocks arranged in gardens have been likened to the Taoistic land of deities called Shinsen-to, spots in the precincts of a temple to the thirty-three temples on the noted pilgrimage route in the western part of Japan, and the depths of mountains to the other world. Thus, “likening” is marked by reproducing objects with a distinctive feature such as Shumisen (the lofty mountain believed in Buddhism to soar in the center of the world), temples on a pilgrimage route, and the other world, and by regarding them as identical with the originals. In this sense, the idea of likening is more similar to topological transformation than to the congruity or similarity in Euclidean geometry. Not only the idea of abbreviating a landscape in essence on a smaller scale but also that of incorporating an external distant landscape into a view of a dwelling as the background can be thought of as a kind of local coordinate transformation of part of a landscape.

If this is the case, it means that the Japanese have continued to make efforts to “liken” a “region” to topological manifold by making use of such codes as “likening” and “incorporating.” Supposing that this manifold is an n-dimensional differentiable manifold as a “mathematical reality,” it is possible to describe the state in the “region” by the use of differential equations. Here, we see a new integration of qualitative geography and qualitative mathematics.

The “region” $X$ as part of land surface can be considered to contain $X$ which is corresponding to a multidimensional differentiable manifold. $S_x$, a vector field which can be referred to as a mapping of $X$, is the whole of the loci drawn by actions (the flow of human beings and objects and their functions) performed with the perceptible landscapes of the region as the ground and figure. The vector field composed of the flows of individual performances contains “bifurcation sets $(\Sigma)$” as a system of instability which causes various catastrophes and forces $X$ to undergo sudden local changes (Thom, 1977; Wilson, 1981). Naturally, these changes must lead to changes in $X$. This process seems to have corresponding relationships with the codes of “changing” and “irregularizing.” Please see “Suzu, 1982a” for details about the mathematical analysis of these relationships.

The other codes of historical Japanese landscapes listed early in this paper also help to provide unique patterns for everyday life, with a set of catastrophes sticking to each of the morphèmes such as open verandas, paper-sliding doors, ridges, indented streets and trump stones, and also to each combination of morphèmes. Here, we recognize the “space of situation” with a stable periodic orbit (Yamaguchi, 1975) and we are even reminded of the “daily prism” mentioned by T. Hägerstrand (Hägerstrand, 1977). When viewed from R. Thom’s theory, a landscape structure corresponds to a combination of sets of catastrophes, which determine the multidimensional grammar of the constant successive occurrences of the performances in a “region.” This multidimensional grammar has even an aspect comparable to the “creode” mentioned by the biologist C.H. Waddington (Waddington, 1961). This is an inevitable
Figure 5. Bifurcation sets.
A: Cusp  B: Profile of a cusp  C: Swallow-tail  D: Profile of a swallow tail  E: Consecutive profiles of a wave crest (Hyperbolic umbilic bifurcation set)

Figure 6. The creode of capturing.
A: Regime 7 with 3 points of elliptic umbilic.
B: When food is coming near, hyperbolic umbilic appears with a wave crest.
C: Regime 3 is captured by regime 7. (p=food)
D: Food is digested and elliptic umbilic appears again.

path followed by two or more sets of catastrophes, as is recognized in the morphogenesis of organisms.

Needless to say, some of the factors controlling cultural landscapes which have been produced by mankind must be different in nature from those of the morphogenesis of organisms. But as long as both landscapes and organisms have morphologies created in space of less than four dimensions, it can be safely said that there must be some points common to them. In this sense, D.W. THOMPSON's remarks to the effect that each organism has functions suitable to its own morphology abound with suggestions (THOMPSON, 1945).

It is not through the understanding of “mathematical reality” that ancient people became aware of the types and functions of catastrophes. They may have grasped some of them in a metaphorical manner through the medium of, for instance, curvature seen at a profile of strata, a crevice in a cave far away from human habitations, a tree or bamboo bent by a gale, and waves broken on the beach. Or they may have understood them through a series of events from the birth of an organism to its growth and eventual death (the creode of capturing). It should not be overlooked either that a sharp-edged profile of the “cusp” catastrophe was concretized as a stone axe to cut things with as early as the prehistoric age. The morphology of a cusp was also applied to the gable roofs of Shinto shrines and Buddhist temples. In spite of his unawareness of the mathematical theory of the “cusp” or “hyperbolic umbilic” catastrophe, the painter HOKUSAI in the Edo Period admirably depicted the beauty of the lively
motions of wave crests enclosing ("incorporating") Mt. Fuji in the shape of a cusp in one of a series of his paintings entitled "the Thirty-Six Views of Mt. Fuji." The codes of "marking off \ linking," "incorporating" and "likening" are closely related with the "hyperbolic umbilic" catastrophe or the creode of capturing.

Thus, the mechanism of 7 elementary catastrophes including "cusp" and "hyperbolic umbilic" catastrophes was perceived and systematized in the form of geographical codes with profundity in the framework of the climate and history of Japan. I can not help but admire this wisdom of our ancestors before the age of science.

In the morphology of landscape, it has been usually the case that the so-called "regular patterns" have been tacitly regarded as "general" in the analyses of morphological patterns. But I think "regular patterns" are actually special. Therefore, I consider it important to start with the so-called "irregular patterns" and examine corresponding relationships between them and "mathematical reality." Only with this reorientation of the way of thinking, would it become possible to take initial steps toward the attainment of a fine command of decipherment of variegated picturesque patterns of cultural landscapes which were referred to by A. v. Humboldt in the 19th century as "Naturgemälde (natural paintings)" (Suizu, 1982a).

X. Concluding remarks

It is found that the geography of "ma," which has traditional profundity based on the recognition that "all things change and nothing is permanent (shogyo mujo)" and that "this world is impure and therefore should be avoided (onri edo)," is a far better approach to the clarification of the real state of topological X than the geography of Euclidean "space," which is in pursuit of the illusive inflexible image of X. What I realize in the analysis of dynamics in the vector field attached to X is the necessity of clarifying the mechanism of great shocks and commotions the codes of historical landscapes in Japan have undergone because of their encounter with European codes in and after the Meiji Period (1868–1912), especially because of the rapid changes in the 1960s and afterward. At the same time, I realize the importance of the irreplaceable historical codes which are becoming extinct and their immense significance to our contemporaries.

Needless to say, it is far from appropriate to deny the merits of the traditional system established by European geography in the modern age, because objective local space produced by one’s performances, especially space in terms of directions and distances, always has a mechanism similar to that of three-dimensional Euclidean space, just as the external surface of a landscape does. We are only ready to investigate the codes of landscapes as space for varied creative performances and to roughly judge their merits and demerits now that we have reached the stage of topological geography which contains the framework of Euclidean space as its special case.

Much is left to be studied in the future: it is necessary to substantiate corresponding relationships between the codes of historical landscapes in Japan and X as topological space in a more concrete manner, to reflect these codes in the mirror of "mathematical reality" more precisely, and to analyze corresponding relationships between these codes and the structure of the Japanese language in detail. It goes without saying that the field of codes other than the Japanese ones which will be objects of comparative study is practically an unexplored land.

(Received October 1, 1983)
(accepted December 17, 1983)

Notes

1) X=LV/L=a set of landscapes, V=a unity of their functions, V=\{f\}
2) f: x_n \rightarrow y_n| x_n \in X
   g: y_n \rightarrow x_n| y_n \in Y
   g=f^{-1}
   : x_n=y_n
3) X \supseteq X
4) X \rightarrow S[x \in X, h \in S
   U\ K \rightarrow \Sigma(K=\text{catastrophe sets}
   \downarrow h^{-1}(\Sigma)}
References


HORI, N. (1982): Kukan-oshiki no gensho-kei tei ni kunsuru ichikosatsu (A proto-type of spatial organization in Japan; man, nature and deity). In: The association for projects in commemoration of the retirement of Professor Hiroshi ISHIDA (ed.), Chiiki; sono bunka to shizen (The region; its cultural and physical aspects). Okayama.


SUZU, I. (1982b): NIHON ni okeru chiri no shiso (Geographical thought in Japan). In: Geographical Institute, Kyoto University (ed.), Chiri no shiso (Geographical thought). Kyoto, 3–11.


日本の景観のコード
——位相地理学への試み——
水津一朗*

景観の各レベルの分節には、＜素材＞＞形態素＞構成要素＞＜構成要素＞＞景観の部分＞の関係がみられる。「地域」とは、かつる関係をもつ景観の各分節を地と図するとともに、各分節を変化し、再構成する身体的行動の軌跡が、重層する場所のまとまりと考えられる。そこでまず、景観を生地とする「地域」にひそむ言語との構造的対応が明らかにされる。

さて日本には古来、一種の時空統体としての「間」の考え方があった。「間」は、空間と時間とともに、さらにそこにあたたかった事物相互の関係をも含む流動的な概念である。さまざまな行動が、具象的な形を通じて「間」の中に現実化されると考えられた。したがって、日本に特有の形態素群で構成された景観の各分節を地と図するとする行動(parole)を規定してきた伝統的なコード(lanque)の中には、「間」に独特の構造を付与するものがあると推定される。

本稿の目的は、日本における歴史地理学研究の成果を踏まえ、そのコードの存在を検証し、かつその特性を比較地理学的解明するとともに、それがユーティック空間を包む位相空間と対応する側面のあることを探り、さらに具体的に、景観の形態発生を位相数学の分岐理論に即して説明することである。あわせて、「地域」一般のトポロジカルな深層構造の一端をも明らかにしたい。

*〒606 京都市左京区吉田本町 京都大学文学部地理学教室