Hiroshi Kawano

A NEW METHOD IN SCIENTIFIC AESTHETICS

1 Classic experimental aesthetics

Modern aesthetics gave "cognitio confusa" which is one of human intellects besides metaphysics - "cognitio distincta", a proper status as science, behind the historical background of which English Empiricism and French Enlightenment, as well as the movement of modern art beginning at the Baroque period and the birth of new aesthetic consciousness of genius or taste, played their parts. Such modern ideologies proposed another problem of the synthesis of knowledge by experience, casting doubt on the dogma of reason of traditional metaphysics and seeking a new norm of forthcoming new world. Thus, modern science was established, and so aesthetics as a science of sensitive cognition was burdened with the obligation of modern science since it was born. That is, modern aesthetics was most likely born with its proper destiny, i.e. that it should work as an empirical science.

However, this empiricism supporting sciences has become orientated toward subjectivism. That is, experience becomes a phenomenon of personal consciousness, and the empirical data providing new knowledge about the objective world becomes composed of subjective sense-data. The world images caused by such empirical data, fall into a fiction of subjective idea being exposed to a crisis of agnosticism, and at the same time, in order to escape from the secret scope of private experience, smuggles or revives such speculations of reason as Hegelean dialectics which has become newly softened through empirical criticism.

Thus, the German idealistic philosophy was born. It has made the dynamic and realistic metaphysics of enlightened reason embedded in a critical empiricism, in the underdeveloping mental climate of Germany. This general trend of German philosophy has reflected deeply on the progress of modern aesthetics. Its typical example can be found in Hegel's aesthetics. He defined the beauty as "sinnliche Erscheinung der Idee", located the arts as "absolutem Geist" in the dialectical process where the abstract idea grows concrete by importing experiences, and conceived the historical development of art as the dialectic triad (*These - Antithese - Synthese*), that is, the symbolic → the classic → the romantic. Nevertheless, Hegel's aesthetics has been systematized as the logic of idea made by reason's speculations, although it was equipped with empirical data given by the European history of art.

Aesthetics which was born as anti-metaphysics has, however, lost its revolutionary power through a subjectifying deviation of empiricism and fallen into opportunistic metaphysics which could not help casting an amorous glance at empiricism, having been on leeward of German idealism. Next, the criticism of Hegel has pro-

duced (1) existentialism which drove a subjective empiricism home on the one hand, (2) dialectical materialism which inverted rationalism on the other hand, and this philosophical movement against Hegel has endeavoured to refuse rationalism, the principle of which is based on reason. In such movement of anti-Hegel, the new movement of modern aesthetics occured, which aimed at an objectification of aesthetics as an empirical science. This is Fechner's so-called "aesthetics from below". He avoided German idealistic aesthetics the peak of which was Hegel's "aesthetics from above" because it was a speculative systematization of art by the logic of the idea of reason, and tried to build a new scientific aesthetics based on empirical fact.

Fechner endeavoured to find the law of aesthetic consciousness which works at enjoyment in art-aesthetics from the psychological analysis of aesthetic experience. An experience is usually analyzed by introspection, whereby the experience is limited to the self-experience of the analyser himself, and the inter-subjective (objective) experience of others must be denied from the viewpoint of agnosticism of subjective empiricism. Thus, the aesthetician (analyser) must build his theory only out of his private data, and so this data will not fit to any theory with linguistic expressions, because it is a pure description of only the aesthetician's personal impression of art. As shown in the case of an aphasia, a subjective impression disappears immediately after it presents itself now and here, and there is nothing which can effect a bridge between the present impression and the next one (therefore the color-perception cannot be obtained). Thus, introspective aesthetics cannot but fall down into the silent world of poetry groaning out "Uh!". Instead of such an introspective method, Fechner introduced an experimental method which can bring objective data of experience into the analysis of aesthetic experience. In the experimental method, the aesthetician's sensor is replaced by a physical observation-apparatus, which, being a mechanical sensor without personality or subjectivity, can obtain the same data ($x_1, \ldots, x_n$) whenever it observes an object X under a certain condition. Further, as this artificial sensor has a common mechanism of observation, whatever apparatus (A, B, C) may be used, the observation data of X (X (A), X (B), X (C)) can always show the same results ($x_1, \ldots, x_n$). These data are called "protocol" which shows the quantitative values of X, cutting down its quality. The protocol obtained from experimental observation can become public. Therefore, the aesthetician can treat any data brought up by the observation-apparatus, independent from his personal subject. This means that the aesthetician can observe the artistic experience of other persons, and it also becomes a necessary condition of theory-building to obtain the data (protocol) from the other person's experience. This is caused by the principal impossibility of self-observation from outside.

Now, having observed the art-experience of the other persons, then obtained the protocol output from an object (art-work) producing aesthetic pleasure, and a dynamic state of aesthetic consciousness, Fechner endeavoured to compose the scientific theory of aesthetic consciousness, in which he found the following ten

laws of aesthetic consciousness: (1) Sensuous impulse should cover a certain threshold to become a pleasure, (2) sensuous impulse which cannot procuce pleasure alone can do it by collecting other impulses and effecting mutual cooperation among them, (3) sensuous impulse should have diversity as well as coherence to produce pleasure, (4) an intuitive clearness is required by the sensuous impulse producing pleasure, (5) there should be no collision among sensuous impulses, and (6) an association must be added. Four further derivative laws follow.

Fechner, in order to obtain a general law of art-experience, endeavoured to find by induction the causal relation between an observation protocol of the impulse-source (object) and a response protocol, after having obtained both protocols, where he analyzed mathematically the qualities of impulses producing aesthetic pleasure by induction (including some qualitative interpretations). Compared with Fechner, Allen analyzed the neuron's physiological process of aesthetic pleasure by a physiological method, and concluded that it is based on the activity of the neuron of the sensor (maximum affect with minimum fatigue) and that the quantity of pleasure is in proportion to the number of activated neuron and in inverse proportion to the frequency of the neuron's excitement by activation.

This aesthetics from below is considered to build a theory of aesthetics by an induction from data as protocol, obtained from the experimental observations of art-works as aesthetic object and enjoyment experience with aesthetic pleasure (**Figure 1**). Incidentally, the induction employed in this theory-building, which derives a general law from individual specific data, is so complicated that the induced law should have a universal validity despite the data being finite. In the case of simple data (for example, number), the infinite sequences of number satisfying $n_3 \xrightarrow{f} n_4, \ldots, n_l \xrightarrow{f} n_{l+1}$ can be found by recursively generalising the relation "f", when the relation "f" of $n_1 \xrightarrow{f} n_2$ and $n_2 \xrightarrow{f} n_3$ among n_1, n_2 and n_3. However, the data of art in enjoyment experience as well as art-work has infinite varieties, and so the stable standardization of variables or parameters to be ob-

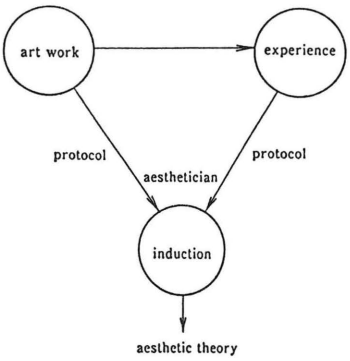

Fig. 1 aesthetics from below

served is impossible. Therefore, the theory partially induced from such data becomes only *ad hoc* an empirical law, and its truthfulness shows only a statistical probability. This means that aesthetics from below has only a status of descriptive aesthetics as a kind of empirical science. Thus, the method of experimental observation and induction lost the characteristics of a normal science which requires universal truth, even if it could retain the status of empirical science.

2 Foundation by analytic aesthetics

2.1 Emotivism-orthodox of scientific aesthetics

As mentioned above, empirical science can have nothing but an unsufficient truth due to its methodological limitation of induction despite the objectivity of the data. This means that its effectiveness is limited by itself. For example, Newton's classic mechanism, which can explain only the law of movement of a particle in ordinary time-space, has become useless to explain the new macro- or micro-world beyond the ordinary time-space. A collapse of natural science based on experimental method since Galileo produced a slump of classic experimental aesthetics and a new appearance of philosophical aesthetics; here then appeared the movement of science-criticism which inspects science itself basically and is called "logical positivism".

The logical positivists endeavoured to avoid the ambiguity and meaninglessness of scientific theories and to make them a meaningful and logically-structured expression. To do so, they introduced the following two principles, (1) empiricism and (2) logicism, from the integration of which, they thought, the theory of science can be composed. Empiricism requires an atomic proposition which is the basic unit to compose the scientific theory and should be verifiable by observation, and logicism requires that the scientific theory should be a truth function, the operand of which becomes an atomic proposition. The theory of science is a set of basic sentences as a discourse, and, in order to be a meaningful expression, each basic sentence as its component, which is an empirically verifiable observation proposition, must have a truth value, and the whole discourse must become true, being composed of atomic propositions by logical computing. They looked for the meaning of proposition in a verifying condition, and insisted that the scientific theory must be not only well-formed as logical formula but also meaningful because its being true is verifiable.

Thus, the protocol can be obtained from an atomic proposition, which is a verifiable proposition observed by objective, public experiments. The truth of the whole discourse could be deduced by logical computing from the truth values of the protocol. The logical computation, which is a deduction, can necessarily determine the truth value of the proposition, compared with induction. That is, it is determined

by only an automatic procedure of logical computing without any empirical data that various conclusions of the scientific theory which are composed logically from observation data, become true. In true propositions, there are (1) an analytic one (tautology) independent of the truth value of the protocol, and (2) an empirical, synthetic one being true, conditioned by the eventual truth value of the protocol, where it is important; even the latter empirical truth is deduced necessarily from the protocol, instead of being obtained probabilistically by induction. While an analytic proposition gives a logical coherence between propositions in the discourse and confirms the systematization of any scientific theory, a synthetic proposition gives new knowledge to it and makes it an empirically meaningful expression.

Consequently, the building of a meaningful and systematic theory of science becomes possible. But this means that a science is to be reduced to an ideally systematized physics and that this ideal physics can reach sovereignity among other sciences. When we consider the scientific theory as describing the world events exactly and clearly, only the logical positivist's so-called "ideal physics" seems to have a right to such scientific theory. If the world, based on micro-physical facts, is to be macro-structured hierarchically, the theoretical organization of the protocol and its logical composition could be considered to reflect fully the structure of the world.

By aiming at the above-mentioned theoretical system, aesthetics as science could reach the ideal which the classic experimental aesthetics had intended but not achieved. However, this new aesthetics of ideal physics could not but have the following difficulty, i.e., the absolutism of logical positivism cannot but cut off the essential parts because it reduces even the science of humanity, history or culture, which are concerned with mental values, to the physical. Accordingly, aesthetics must consist of (1) a physical science of art and (2) a theory of aesthetic consciousness, where only one physical standard criterion can be justified.

However, the history of art tells us that there were many kinds of aesthetic consciousness, and in aesthetic theories, the propositions of value-judgement reflecting such multiple aesthetic consciousness do inevitably appear. What a view does the logical positivist take on the aesthetic value-proposition "X is beautiful"? The science of art makes it possible to obtain a protocol $(x_1, x_2, \ldots, x_n)$ of a certain object X (art-work). Here, using the value-function F, we would have the proposition "X is beautiful" be true, when the protocol $(x_1, \ldots, x_n)$ can experimentally be observed from X, from which protocol the function F can get a certain value C:

$$\text{"X is beautiful"} = \text{def } F\ (x_1, \ldots, x_2) = C$$

But as there are properly various right value-judgements to the same aesthetic object (John says "yes" but Mary says "no"), it would be obviously difficult for the value to be reduced to a physical fact. Then instead, the logical positivist

argues as follows: getting protocol $(y_1, \ldots, y_m)$ obtained from a physio-psychological observation of the brain appreciating X, and computing the value-function G the variables of which are $(y_1, \ldots, y_m)$, "X is beautiful" becomes true when G gets a certain value C'.

$$\text{"X is beautiful"} = \text{def } G\ (y_1, \ldots, y_m) = C'$$

In this case, as these protocols obtained from the inner states $(y_1, \ldots, y_m)$ differ from each other according to the respective appreciators even when they appreciate the same object X, the meaningfulness of aesthetic value-judgements could be justified despite its subjective relativity. Now, may we consider the value-proposition as reducible to physio-psychological description? If so, the theory of aesthetic consciousness would become a mind-physiology or an experimental psychology.

The logical positivist continues further. When Mr. A says "X is beautiful", is it equal to Mr. A's saying "the state of my brain is so and so" $(G(y_1, \ldots, y_m) = C')$? No! While the latter psychological statement is an objective information free of value, the former value-judgement is the manifestation of Mr. A's subjective attitude or his appraisal appeal. Unlike a factual statement, the verification procedure could not properly be applied to such a value-proposition. Therefore, from the semantic viewpoint of logical positivism, a value-proposition should be expelled as nonsense from scientific aesthetics. A logical positivist's assertion like this is called "emotivism", where scientific aesthetics becomes the ideal physics (including physiology) the two branches of which are the science of art and the physio-psychological theory of aesthetic consciousness. Although scientific aesthetics, into the theoretical structure of which the logic is embedded, could successfully build a coherent theoretical system as a science, it remained narrow-minded scienticism avoiding a logical norm as axiology, on the other hand.

2.2 Contextualism

The movement of the criticism of science in the latter half period intended to find a logic of value-propositions and to build a new value science on the basis of ordinary language by abolishing the narrow inclination to scienticism of logical positivism.

Does the proposition "X is beautiful" present a subjective attitude equivalent to "I like X"? As shown in a case of saying "I dislike X although X is beautiful", it would be correctly supposed that there is a big difference between a value-judgement and an emotional expression of liking or disliking. While the feeling of liking or disliking is subjectively arbitrary and anarchic, the value-judgement is correctly considered to have a demand of objectivity or a persuasiveness by being accompanied by some reasoning.

Let us consider a court judgement as a typical model of value-judgement. The court judgement is a judge's value-judgement passed on an accused person's act, and so a judge expresses his negative attitude to X by pronouncing "X (so and so act) is not right (therefore the person committing X must be sentenced to such and such punishment)". This value-judgement could seemingly not have a verifiable truth value as it is not a factual proposition describing the judge's mental state, but it must not be only his emotional expression of liking or disliking. To justify this, the reason "because..." is surely added to the judge's sentence. Since it is accompanied by a reason, the judge's proposition becomes objectively valid with persuasive power as a value-judgement. Now, let a judgement be Q and a reason be P. If a judge intends to sentence "Q because P" which can have an objectively valid persuasiveness, all he needs is a premise of law "if P then Q ($P \rightarrow Q$)". If there is a law $P \rightarrow Q$ and protocol P as an evidence of the accused's act X, the judgement Q can be derived from the following deductive inference: $P \rightarrow Q, P \vdash Q$.

Similarly, an aesthetic value-judgement Q is never the expression of a subjective feeling of liking or disliking and can be persuasive as an objective judgement, if there is taste, habitus or an implicit norm "$P \rightarrow Q$" as Q's reasoning, and as far as the quasi-protocol or sense-data P can be perceived in the aesthetic object X. Now, let X's sense-data be P, and pleasure or satisfaction of life produced by P be P'. If there is taste or aesthetic consciousness that P' is aesthetically desirable (Q) as a life standard, the value proposition "X is beautiful (aesthetically desirable)" can be derived through the medium of P' by the following logical procedure. In the court judgement, there also is such P' as a social, psychological influence produced by the act X, and so $P \rightarrow Q$ can be decomposed into $P \rightarrow P, P' \rightarrow Q$.

$$P \rightarrow P', P' \rightarrow Q, P \vdash Q$$

Thus, the value proposition refused by emotivism becomes objective (where its logical value is not true or false but valid or invalid), and so a judgement like "X is beautiful" becomes objectively valid as long as the premises can be satisfied, otherwise it becomes invalid. On the possibility of deriving a logical value of the value proposition by deduction, the value propositions can be composed into the theory of scientific axiology including aesthetics.

As a whole set of these implicit premises, which support value-judgements logically, is considered the context of the value propositions (where the proposition itself is a text), the standpoint which approves of such a scientific theory of axiology is called "contextualism". Thus, the realistic principle of logical positivism and emotivism, claiming that there is only one orthodox science describing the world correctly and only one complete logic system composing such a theory, has been found to be contradictory, and the various non-Euclidean geometries have also been approved as having the same status and right as the traditional Euclidean geometry. As a result, a relatively logical deductive system equipped with the

formal Hilbertean finitism or the tolerant Carnapean logical syntax can be designed. This relative logicism confirms the way of composing multiple logic systems and scientific theories as well as non-Euclidean geometries by arbitrarily setting axioms or context of premises, and accelerates the general relativization of scientific theories including a value-science. Thus, the contextualism of scientific aesthetics was born in this movement of relativization.

The significant results given by contextualism are as follows: (1) a value proposition can be admitted to scientific theory as a meaningful expression, and the categorical borderline between a natural science and a value-science is removed; (2) a value-proposition as well as propositions composing scientific theory can be derived as a theorem deductively by using axioms as context and inference rules; therefore, an empirical science, the borderline of which to a formal science becomes null, is to be reorganized as an axiomatic system; (3) a scientific theory as a finite formal system can be modified into various kinds of theory by choosing itscontext optionally; thus, the various scientific theories which share the same world as their objects come into existence. Furthermore, a new subjective scientific theory appears by introducing the scientist's optional context, avoiding the dogma of a unique, absolute theory of ideal science, under Hilbert's finitism and Goedel's incompleteness theorem as well as Carnap's tolerant logical syntax.

In order to attain a scientific systematization of aesthetics, the achievements brought by the above-mentioned contextualism are as follows: (1) the relativization of aesthetics and the tolerance to do so; (2) incorporating a value-proposition, scientific aesthetics has succeeded not only in making its theory meaningful, but also in making a formal, consistent systematization of its theory by logical or natural deduction, which the classic experimental aesthetics and emotivism had not been able to attain. Now, the new experimental aesthetics is equipped with a logic of scientific theory, has obtained the qualification as a normative aesthetics transcending a descriptive aesthetics, and is able to stand on the starting-line for a new progression, overcoming the inferiority complex to traditional metaphysics.

3 Experimental aesthetics from above

3.1 Simulation of art

The new experimental aesthetics does at first logically formulate the activity process of aesthetic consciousness concerning the production and appreciation of artworks. An artist's brain has in advance the knowledge which activates and orients artistic activities. An artist is expected to produce or appreciate works of art by using this knowledge which is composed of rules or concepts of art, or a reasoning context of artistic activities. The objective results of the process, despite its subjective quality, can be justified as being valid, because there is logic in the working

process of this knowledge, which can be obtained from the deductive mechanism in the above-mentioned contextualism. The context in contextualism is, as shown above, (1) an axiom or proved theorem, (2) a protocol as data, and (3) a rule of inference or transformation. The context can become a model of artistic activity with artistic knowledge by being given a certain interpretation. And this model can be developed in the inference process as an artistic production or an appreciation by means of the deductive mechanism shown by contextualism.

Although this deductive process is rather a natural inference using various transformation rules (the example of which is, as mentioned later, the generative grammar rule) or an analogy searching a network which is associatively linked by using a similarity relation than a syllogism in a strict sense, its algorithm can be automatically computed because the procedure of symbolic manipulation (assignment or transformation etc.) is explicitly defined. This means that the representation of the artistic model can be realized by the computer. That is, if the data-structure of finite knowledge describing the artistic concepts and rules is stored into a computer's memory and the program interpreting it inferencially is embedded in a computer, this computer can be expected to produce the digital, approximate behavior of an artist's or appreciator's activity with artistic knowledge by letting the program run. This computer's behavior has been called "simulation of art" by Kawano [4], as it imitates the natural human art, where the aesthetician, setting arbitrarily the rules of artistic activity as a theoretical hypothesis, can represent any process of the production of art-works or criticism following the simulation by the described algorithm regarding artistic logic and its computing. That means, we can approximately represent any art on computer, and this representing process is implemented in a form of inference by the computer's digital logic. This mechanization of aesthetic thinking which constructs the theory of artistic activity by the logical machine experiment of computer-based inference, even if under an *a priori* setting of the art model, is affirmed to be an unparalleled contribution to modern experimental aesthetics in the history of science, which information science has brought forth following the exellent results of contextualism.

The method of art simulation has been further fruitful, which means that the empirical data is indispensable to the art simulation, although this is a function of the logical procedure. This means that the model setting has actually the arbitrarity as a hypothesis because the simulation model must have the initial setting of its context prior to inference. Choosing the context freely, we can represent logically whatever art we want, but whether the highly approximate representation of natural human art is possible or not, could not be determined merely within the logic of model representation. That is, the criteria of choosing Euclidean geometry among many geometries cannot be found in the logic of the axiomatic system itself. In order to obtain the highly approximate, effective art and its theory, we need to compare the works derived logically from inference and generated by simulation with the observed protocol in natural works of art, and must confirm

the correspondence or matching between them. This second stage of procedure (the first one is logical inference) is the so-called verification in logical positivism. When the inferred results derived from the first stage are compared with an empirical protocol of natural art, the coincidence between them, at first, cannot be found properly due to the hypothetical arbitrarity of the simulation model. Then the hypothetical model must be revised by using a feedback of the detected discordant difference. Thus, the second revised simulation improves the approximity of the former model. By repeating the simulation process with regard to a feedback of verified data and revising the model, the art model - aesthetic theory reflecting the natural human art in the real world is to be gradually formed in convergence. Here is needed not only a logic but also an experience in order to make the art simulation effective as the method of aesthetics; but that which brings an empirical protocol necessary to a verification procedure, is experimental observation. Now, our new modern experimental aesthetics, such as the simulation of art on computer, uses the experimental method in both aspects of logic and experience, but unlike the classic experimental aesthetics, its main part of the experiment is composed of the mechanization of a logical inference. Therefore, it should be called "experimental aesthetics from above" in the sense of overcoming metaphysics under a leadership of contextualism in analytic aesthetics.

3.2 The cybernetic model

From the suggestions of C. Shannon's information theory and informational aesthetics as its application to art by M. Bense, A. Moles, L. Meyer and L. Hiller, one of the models of art simulation was conceived by H. Kawano [4], and the model has the following structure and function. (1) It receives art-works in the external world as sense-data, analyzes and understands them in the destination after decoding them as a message, and stores the unified image of input art-works as experienced knowledge of art; then (2) it executes synthesis and expression of the new image of the art-work by using the knowledge acquired or learned about input art-works in its artistic experience and the generative procedure equipped in the information source, and finally produces a new work of art as the instantiation of the image by

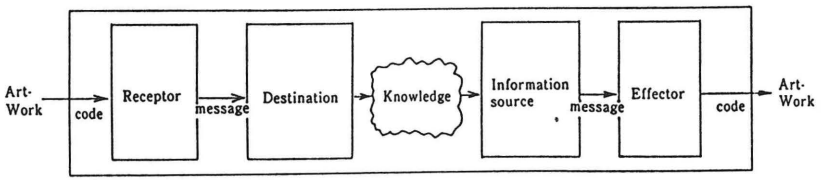

Fig. 2 Kawano's cybernetic model

a physical code into the external world again (**Figure 2**). In addition to a sensory receptor and a physical effector, the Kawano model has the understanding station called "destination" and the expression station called "information source", each of which does convert the message to the knowledge (image) or the knowledge (image) to the message by its own analysis or synthesis procedures. While the code has a physical body which is sensible and channel-depending, the message has an ideal form as image stored in the model's brain.

Art-work as the object of this model is a string of finite alphabet. That means, this model processes only the surface structure of art-work. The model stores the finite combination-set of alphabet obtained from the analysis of input art-works in its short-term memory (STM), and the obtained multi-tuple of alphabet composes the model's inner state. The model, with its experience of art-works, lets the inner state transit from the old one to the new one according to its sensed input i-tuple of alphabet, where the transition path is modified probabilistically by the frequency of the state-transition and, as a result, its own idiomatic state-transition probability matrix is formed in the long-term memory (LTM). In Figure 3 the graph of the model's state-transition matrix in LTM is shown, which has the alphabet A and B, and can store only one alphabet element in its STM (**Figure 3**). We can define the model's knowledge by the graphic pattern of such a formed state-transition as shown in Figure 3. Here, the model's knowledge is plastically acquired in dynamic accumulation of its artistic experience, and so this model's characteristic knowledge can understand and express the art-work by regulating the behavior of its destination and its information source.

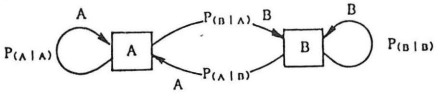

Fig. 3 state transition graph

As we have seen, the ecological behavior of the cybernetic model's knowledge can be considered to have an original power of understanding and expressing art-work. Now, let the size of the alphabet composing the state which the model can process be n: $\{a_1, \ldots, a_n\}$ and let the STM store one letter (alphabet element). Then the power of the model's understanding and expression can be stated as the following measure of entropy H.

$$H = -\sum_{i}^{n}\sum_{j}^{n} p(a_i) \times p(a_i \mid a_i) \log p(a_i \mid a_i) \text{ bit}$$

The negative logarithm of the transition probability $p(a_i \mid a_i)$ means that (1) the higher the transition probability is, the weaker the shocking power of input-output message is, and, inversely, the lower that is, the stronger this is, and (2) the model's

entropy H increases by experiencing new, innovative art-works and decreases by stereotypical, banal art-works. Naturally, the model with high entropy creates new innovative art-works while the model with low entropy can create only banal art-works.

The information source generates art-works as a message by the Monte Carlo method. (1) The information source procedure sets, at first, the initial inner state by drawing out the knowledge from LTM, (2) accumulates the probability density of the current state's transition to the next state, (3) creates the inverse function of the accumulated probability distribution function, (4) generates a series of uniform random numbers, and (5) creates a new series of the alphabet random numbers in random number conversions by using the inversed function. Then, (6) the current state is updated and transits into the next state, when the created alphabet random number is stored in STM (in Figure 3, the model repeats state A after getting a random number A in its current state A, and the current state A transits to the next state B after creating a random number B). Finally, (7) after having updated its inner state, the model's behavior repeats the above procedures (4) ~ (6). Thus, by the Monte Carlo method, the string of the alphabet random numbers (Markov-chain) is produced, which is nothing but the art-work as a message the model has created.

In order to generate English text, Shannon let the model experience or learn natural English, constructed the three kinds of English knowledges with STM capacity 0, 1, 2, in the model, applied the Monte Carlo method to each of them, and obtained the following English text as a Markov-chain:

0. ordered Markov-chain English
   OCRO HLI RGWR NMIELWIS EU LL NBNESEBYA TH EEI ALHENHTTPA OOBTTVA NAH BRL.
1. ordered Markov-chain English
   ON IE ANTSOUTINYS ARE TINCTORE ST BE S DEAMY ACHIN D ILONASIVE TUCOOWE AT TEASONARE FUSO TIZIN ANDY TOBE SEACEC CTISBE.
2. ordered Markov-chain English
   IN NO IST LAT WHEY CRATICT EROURE BIRS GROCID PONDENOME OF DEMONSTURES OF THE REPTAGIN IS REGOACTIONA OF CRE.

Further, Kawano tried the picture-generating experiments, having let the model with the same mechanism input and learn the three natural pictures shown at **Figure 4**, where the alphabet consists of two kinds of pixcel, white and black, and the state is composed of an 8-tuple of pixcels. The arrow → (up to down) shows the dependency-relation between input and output, that is, the upper pictures are input to the model, the lower pictures its output.

It is interesting that the image of art-work which the model generates is highly approximate to the experienced input natural art-works, in proportion to the capacity of its STM (number of the states). And it is more important that the balance between variety and unity is needed for a group of input art-works. From this viewpoint, we can see that this cybernetic model becomes similar to the human artistic model. That is, the human learning needs to experience as much various data as possible which, nevertheless, keep a certain unity.

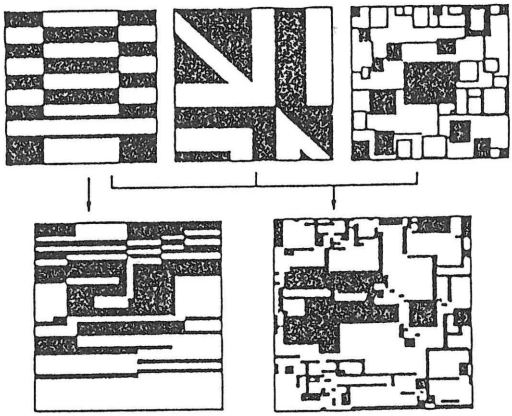

Fig. 4 Markov-chain picture

Let us consider the understanding case of the destination. The model's destination transits its state according to the i-tuple of its alphabet elements of input art-works by using its already acquired knowledge, where, like in the case of generation, it repeats the state A receiving A in the state A (AA-tuple), and the state A transits to the state B receiving B (AB-tuple). The state-transition in the current state B becomes inverse (Figure 3). In its state-transition, the destination receives the information of $-\log(p(j|i)$ bit from the input art-work according to its stored transition probability $p(j|i)$. (This is applied correspondingly to the information generated in the information source, where the former entropy H shows an average amount of information.) In such an input process of art-works, the destination's state-transition at its current state, increasing the probability parameter of the current transition path, changes the content of its knowledge to adapt to the art experience. That is, the model learns about the art world.

Now, supposing here is a model whose state-transition matrix of A-B equipped with the knowledge structure of Figure 3, is given as Table 1. When the destination inputs such a message as "ABAB...", each letter of the message has only a low information of $-\log 3/4$ bit because the state-transition occurs under the probability 3/4, and so the model feels this message banal. That is, this message is none the better for the change compared with the message already experienced. On the contrary, if it inputs the message like "AAA...BBB...", the transition probability

→	A	B
A	1/4	3/4
B	3/4	1/4

Table 1 transition probability matrix

stored in the model's matrix is low (1/4), then the destination feels this message innovative and modern (each letter's information is $-\log 1/4$ bit). In the former case, as the acceptor's knowledge has the similar structure (see Table 1) to that of a sender which sent the message "ABAB...", the acceptor model's destination can accept stablely the information of the message sent from the sender, and so can be approved to understand it well enough. However, in the latter case, as there is a big gap between the knowledge of the sender (inversion of Table 1) which creates the message "AAA...BBB..." and the knowledge of the acceptor which tries to accept it, the destination of the acceptor model is strongly shocked and surprised by the novelty of the message with too much information. It is proved as true by information theory that, generally speaking, when a message is communicated from sender to acceptor, the acceptor's destination cannot but receive more information than the one which the sender's infomation source created, because there is a principal gap between the information created by a sender and the one received by an acceptor as follows:

$$-\sum^{n} p_i \log p_i \leq -\sum^{n} p_i \log p'_i$$

where p_i means the sender's probability matrix while p'_i means the acceptor's probability matrix. Although the understanding model falls into neurosis temporally by experiencing strange input messages, it is confirmed that the model strengthens its power of understanding the messages, gradually updating its knowledge structure by learning them. Of course, this understanding power is proportional to the model's STM capacity. Thus, the effect of knowledge is the same as in the case of expression.

Now, the above-stated expression and understanding behavior of the cybernetic model can be simulated by computer following the mechanism as shown in Figure 5. The expression process is formulated by the following two functions: the expression function (IS) and the state function (g).

■ ← IS (STM, TP) ..... (1)
STM' ← g (STM, ■) ..... (2)

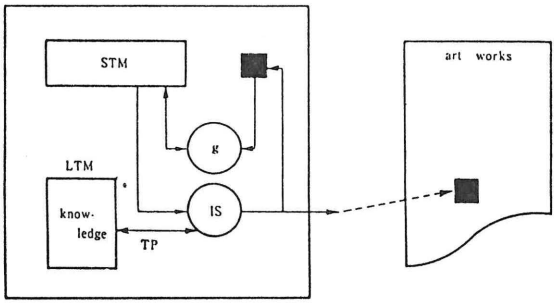

Fig. 5 art simulation mechanism

In the understanding process, formula (1) is replaced by the understanding function (DS) as follows:

$$TP' \leftarrow DS\ (STM, \blacksquare)$$

TP means the state-transition probability density table in the model's knowledge which the STM's current state needs. ■ is the pixcel composing the art-work, being the unit of input and output. The mark ('), put on the shoulder of "TP" and "STM" means that TP and STM have been updated. In the understanding process, IS is replaced by DS and the output arrow → changes to the input arrow ← with inverted direction.

The cybernetic model endeavours to represent the process of art creation and appreciation by means of information theory, and its computed result by the simulation tells that, by increasing the capacity of STM, this model can be close to natural, human art. That is, the model's entropy decreases according to the STM capacity's becoming large. But it is well known that this entropy function is not linear, but reaches to a ceiling at STM capacity = 10, and thereafter hardly decreases. (The entropy becomes Hmax / 5, when the STM = ∞, where Hmax means the maximum of entropy.) (Figure 6) This means that the art-work processed by the cybernetic model cannot but carry fatally only a local, short order with randomness, lacking a total order. That is, the work produced by this model can have only a short-ranged structure with a string-like surface texture. In addition, this model cannot process the meaning of art-work because the processing object of information theory is only a symbol of syntactics, not including semantics. Thus, in spite of A. Moles' positive estimation of the cybernetic model which aims to represent mechanically an artistic creation and an innovation in modern art, a new, more natural model, the object of which, reflecting a deeper human mind, can have a meaningful, long-ranged ordered structure with a non-string pattern, has to be further looked for.

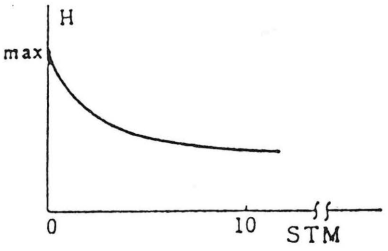

Fig. 6 memory-entropy relation

3.3 The linguistic model

The art-work is not a string structure with merely a sensuous surface, but it is a non-string type, total structure with a semantic hierarchy. And here appeared the model of generative grammar invented by N. Chomsky as a more effective mechanism of representing ▪ understanding of natural object expressions [5].

This grammar is the mechanism to generate artificially a natural English sentence with a phrase-structure, which shows that a natural sentence is never a word-string but a hierarchical structure composed of the phrase with a recursive nesting. In order to generate a sentence with such a structure, Chomsky invented the following rewriting rules.

(1) Sentence → NP + VP
(2) NP → T + N
(3) VP → Verb + NP
(4) T → the
(5) N → boy | apple
(6) Verb → eat

Here "Sentence", "NP", "T", "N" and "Verb" written with capital letters are meta-symbols describing a phrase, while small letter symbols are the terminal object codes which make the surface of a sentence. These rewriting rules of the generative grammar describe the phrase-structure hidden in a deep structural level of the sentence by the non-terminal meta-symbol representing this phrase. The model mentioned here does possess a set of conversions (the left side meta-symbol is to be converted into the right side meta- or object-symbol) called "rewriting rules" as its knowledge-base, and can generate English sentences in the following mechanical process by loading the necessary knowledge into its information source.

Sentence
$\xrightarrow{(1)}$ NP + VP
$\xrightarrow{(2)}$ T + N + Verb + NP
$\xrightarrow{(3)}$ T + N + Verb + T + N
$\xrightarrow{(4,5,6)}$ the boy eats the apple

That the sentence produced in this generative process can have a hierarchical phrase-structure, can be shown in Figure 7 where the generation tree represents this process graphically (Figure 7).

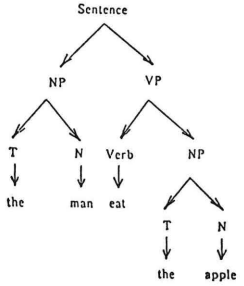

Fig. 7 generation tree

Next, by loading these production rules into the model's destination and executing the rewriting in inverse direction (for example, NP ← T + N), the model can understand similarly its input English sentence. As shown in the following process, the articulated phrase-structure of the input sentence is analysed there, and as a result, the model can recognize the input sentence as well-formed, while the non-well-formed sentence is to be rejected by the model. This linguistic model has later on proved to be applicable to the generation and understanding of the picture as well as the sentence [6].

the boy eats the apple
$\xrightarrow{(4,5,6)}$ T + N + Verb + T + N
$\xrightarrow{(2)}$ NP + Verb + NP
$\xrightarrow{(3)}$ NP + VP
$\xrightarrow{(1)}$ Sentence

The artificial English generated by the generative grammar model can increase a syntactic approximation to natural English by possessing a phrase-structure; this model, however, is not yet considered to have a semantic approximation.

To avoid this semantic defect, the case-frame of a predicate by which semantic marks are added to the rewriting rules, is applied to the model and helps the syntactic generation to work semantically. Thus, by this rewriting production

equipped with a semantic marker, the two following sentences which will be generated as well-formed sentences, can be avoided as meaningless sentences by the model.

"the apple eats the boy"
"the apple eats the apple"

In this case, the case-frame of the predicate "eat" has the following descriptions with semantic marks and is utilized to confirm the meaning of the word (noun) which is assigned to N by attaching it to the related N and constraining its case function:

eat: active case (animal)
objective case (food)
instrumental case (mouth).

Nevertheless, a sentence generated by the conversion - rewriting rule is only a skeleton called "core-sentence" and far from being an ordinary natural sentence. Therefore, the generative grammar model has (2) the transformation rule as well as (1) the rewriting rule. The transformation is to form the core-sentence according to the speakers's belief, viewpoint or focus of interest. Chomsky's transformation rules are summarized as follows [5]:

(1) insert the mark ? in front of predicate Verb
(2) ? → N (B) (M)
(3) $N \rightarrow \begin{cases} S & \text{if subject N is singular} \\ \Phi & \text{if subject N is plural} \\ P & \text{if predicate Verb is past} \end{cases}$
(4) B → may | can | will | must | shall
(5) M → have ⊔ en | be ⊔ ing | be ⊔ en | be ⊔ ed
(6) X ⊔ Y → YX if X - N | en | ed | ing and Y - Verb | B | have | be

Additionally, let the following passive voice transformation be introduced here, which is to be applied when the speaker's attention moves from subject NP to object NP':

(7) NP + Verb + NP' → NP' + Verb + by + NP

When the speaker of "the boy eats the apple" directs his attention upon "apple" looking at this event, the following transformation would be applied to the core-skeleton:

the boy eat the apple
→ the apple? eat by the boy

→ the apple N M eat by the boy
→ the apple P be ⊔ en eat by the boy
→ the apple beP eaten by the boy
→ the apple was eaten by the boy

While the former rewriting was context-free, the words are replaced contextually in the transformation. As a result, the generative process becomes more sophisticated by adding the speaker's participation in the context. By adding such transformation rules as contextual replacements, the model of the generative grammar can narrowly produce a natural sentence with meaning and style as well as well-formed legality.

Incidentally, in the former Chomskyean model, the meaningful expression of a sentence can be realized as a skeleton only by context-free rewriting prior to context-bound transformation. However, this syntactics-directed model cannot help but have the difficulty that "the boy eats the apple" and its transformation "the apple was eaten by the boy" have different deep-structures or skeletons in spite of having the same meaning. It would be desirable that deep-skeletons with the same meaning have a common semantic structure even if their surface structures are different. Thus, the advanced model of generative semantics appears which can generate (syntactically) various surface sentences with the same meaning as paraphrase of their common deep semantic structure by deep transformation.

This new model takes advantage of inter-lingual, conceptual super-predicates and their deep case-frame. For example, the super-predicates are as follow:

(1) x CAUSE y
(2) x BECOME
(3) x NOT
(4) x HAPPY

By using these four super-predicates, the conceptual image (S) of "the news causes the boy's mind not to be pleasant" can be represented in the following deep-skeleton:

S = (((the news) (CAUSE)((((the boy) HAPPY) NOT) Become)))

Now, if we apply the transformation of right-moving-up which moves up a super-predicate to the right side of a super-predicate one level higher, sequentially to this semantic skeleton, and assign a corresponding predicate to a chain of linked super-predicates, the surface sentence could be generated as follows:

S → (((the news) (CAUSE (((the boy) NOT · HAPPY) BECOME)))
→ (((the news) (CAUSE ((the boy) BECOME · NOT · HAPPY)))

→ ((the news) make ((the boy) sad)))
→ the news make the boy sad.

Further, if we additionally apply the other transformation of left-moving-up to the second-line skeleton half-way of the transformation, another paraphrase with the same meaning can be derived:

S → ((the news) (CAUSE · BECOME · NOT · HAPPY (the boy)))
→ ((the news) (disappoint (the boy)))
→ the news disappoint the boy.

It is interesting that the two sentences: (1) "the news make the boy sad" and (2) "the news disappoint the boy", which have different surface structures, are semantically identical in their deep-skeletons. This generative semantic model which generates deep-transformationally grammar-depending surface-sentences as paraphrase after having set a transcendent semantic image beforehand (that is, moving from the semantic entity to the syntactic forms), is to become equipped with the mechanism closer to a natural linguistic expression. While in the former Chomskyean model semantic processing is added to initially-set syntactics, in the new model semantics precedes syntactics. Schank's conceptual dependency theory [7], in which such a mechanism as generative semantics is embedded, is to produce a computing model for a meaningful expression of natural language. And, furthermore, this semantic model is confirmed to be effective in the understanding of meaningful sentences as well (that is, it can parse the two sentences mentioned above into the same semantic skeleton).

That which completely demonstrates the generative linguistic system equipped with the above-mentioned contextual semantic processing of expression and understanding, when extended into a story or scene composed of plural sentences of objects, is Minsky's frame [8]. It has a theme as an *a priori*-organized meaning structure of transcendental concepts which anticipates the image contents of input-output art-works; and then this frame model can express and understand the world as a story or scene by employing a sort of total intuition which the frame mechanism makes possible.

For example, if the understanding of a love-scene as a story or picture is wanted, it is desirable for the model to have in advance a frame as shown in **Figure 8**. Presetting its own proper ID attribute such as (1) frame-name and (2) characters playing here, the frame adds a certain number of slots or pointers to its sub-frame. These slots or sub-frames are mutually related and structured by the case-frame of super-predicates (for example, "appear", "propose", "OK", "love", "tempt", "defeat", and "happy" in Figure 8) and causal links in the frame. The stronger an evidence degree of the frame's instantiation becomes by the input of the object's data, the better the model with the frame is to understand the object. But all slots are not

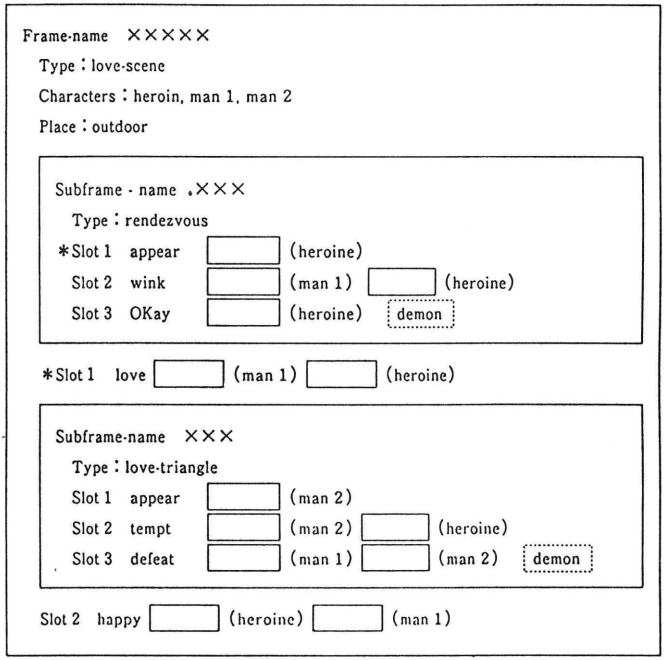

Fig. 8 frame of "love-scene"

always needed to be filled by data. If only the necessary slots with the * mark are filled, the frame is to be activated even though it is imcomplete. For example, at the beginning of the story "Hanako (heroine) is alone looking at the moon ...", the model's sub-frame "rendezvous" becomes activated as its slot is filled, and the model continues to read the story's succession expecting the appearance of man 1 who will approach Hanako. If, next, a love-scene progresses further and slot 1 of the main frame (8th line from above) is filled, the model can understand the whole story as a love scene and next expects the appearance of a love triangle.

Thus, as a knowledge of the conceptual relations which construct a given story or scene by semantic control of its theme, the frame is preset in the model before the execution of expression or understanding - constituting what Kant called "schema" as an interface of the concept of "love-scene" and a real love-scene. As this frame is the linguistic generative model anthropomorphized to be applicable to the world, it can also generate a love-scene story by receiving a certain value in its slot (for example, heroine ← Hanako, man 1 ← Taro, man 2 ← Akuta) even in an expression process. In such a process of expression and understanding, the frame is a system from above which works top-down because it processes input-output data as an *a priori* knowledge engine of a simulation model. Nevertheless, it may be revisable by feedback and verification of the results of its output. Now, the art

simulation model can have a highly natural approximation to logic and humanity by reaching the Minskyean frame model, having started from the cybernetic and generative linguistic models.

4 Pragmatic model

Although the new model has found the way of logically systematizing an artistic experience by using the frame mechanism as a scheme, it should properly be a theory which is open to the world experience in the sense that it can be revised and improved by feedback and verification. Additionally, not by the way that a scientist changes the structure of the theory directly from outside of the theory, but just by setting this open mechanism as an autonomous operator within the theory, a theory as a science can become a world-adaptive, living theory without falling into any poor, mistaken logicism.

When the frame works as a prior knowledge, its expectation may be betrayed by real experience. Such an empirical speciality is rather a normal phenomenon in the real world. Therefore, the frame seems to have *ad hoc* procedures. The so-called demon in Minsky's frame is a prescriptive call for procedure which is embedded in its declarative knowledge descriptions as a facet of its proper slot, and so it lets the demon's procedure of exceptional treatment run, awaking when a special, exceptional event, which does not fit the frame, occurs. For example, if slot 3 of the sub-frame "rendezvous" in Figure 8 cannot be filled by an expected data because of heroine Hanako's refusal, the love-scene frame must be cancelled and exchanged for another suitable one by the demon, and if man 2 (Akuta) does inversely defeat man 1 (Taro) in slot 3 of the sub-frame "love triangle", the demon must call a procedure which changes man 1 into man 2 in slot 2 (happy) of the main frame. Thus, the demon as a procedural attachment makes the structured, firm frame become sufficiently flexible to adapt to the real world.

In addition to the demon mechanism, it is desirable that a supervisor with a meta-frame is introduced into the above-stated frame [9], because the demon's scope is bound by the slot and it can make only local and temporary micro-changes of its frame. Compared with this, the frame supervisor can change the frame-structure itself to adapt to the external world by means of using its meta-frame which shows how to change the frame under certain circumstances. The supervisor's frame-control is executed by the following two ways: (1) The choice of a suitable rule among many possible rules which may be applicable toward the thematic event or object in the world is as follows:

if theme = A, then select and execute rule P
if theme = B, then select and execute rule Q
if theme = C, then select and execute rule R ...

where the frame is a set of possible rules P, Q, R ... (2) The revision of the frame's default rule, which is suitable to the normal world, to the modified one which can adapt to the world even with a specific theme, is given as follows:

if theme = normal A, then execute the default rule P
if theme = B, then change P → Q and execute Q
if theme = C, then change P → R and execute R

where the frame has only a rule P and the meta-frame has the modified rules P → Q and P → R. After having changed the default rule P, the supervisor does execute the revised rule Q or R according to the theme (B or C) of the world appearing in it. Compared with the former supervisor as a selector, this latter supervisor is rather important to the art model, in the sense that it is self-reflective and self-transfigurative by reconstructing its own frame content. That the default, standard rules of frame can be dynamically revised by the supervisor's option, is to further strengthen a flexibility and anthropomorphizablity of this model.

Now, let the frame rules P, Q, R have the following function to create y and y', y'' (as deviated y) from input data x of the world:

P (x) → y
Q (x) → y'
R (x) → y''

Then, usually when the normal theme A is given, it expresses y from sensing x by means of its default rule P. But receiving some different theme B or C, it does revise its rule P into Q or R and, as a result, it can express the transfigurative, deviated y' or y'' in spite of the same input data x. Thus, the model of art, which has a self-transfigurative "Self" behind the frame body, can perform an artistic expression which is properly deviated from a normal, logical form.

Further, the self-reflective "Self" as a user of the meta-frame is a belief-based meta-system with a feeling and a will. That means, the supervisor concerns itself with the surrounding world and so brings its own fear or pleasure into the theme of its world. In order to explain this supervisor's character, the phenomenologist introduced the term "intention", and Heidegger called it "Sorge" which "Existenz" as "In-der-Welt-Sein" cannot but possess, affected by the external world theme. Additionally, the deep intentional function of the supervisor's "Self" may be founded on Freud's "Id" with subconsciousness.

Accordingly, the meta-frame is a deep belief meta-system, and it motivates and controls an artistic expression which is a conscious frame transformation. When the proper content of expression and understanding in communication is to be considered the speaker's intention beyond a semantic meaning, this frame transforma-

tion controlled by the frame supervisor with the meta-frame is to express its supervisor's intention. The Kawano model of art becomes able to generate or understand an abnormal expression of art-work with deformation and metaphor (semantic deformation) by using the mechanism of meta-frame and the frame supervisor.

The above-stated process of this model can be shown in **Figure 9**, where (1) the theme of the experienced world is given to the frame supervisor in advance, (2) the supervisor selects the transformation rules in the meta-frame with belief marks by using its affected intention, and revises (transforms) the default normal frame to be adaptive to the world theme, and (3) the revised frame's generative rule is interpreted and executed (by the supervisor) and a new art-work is expressed or understood. Here, the supervisor's operations of the meta-frame can be called "pragmatics", in the sense that they work upon the syntactic and semantic representation of the frame and change the frame itself.

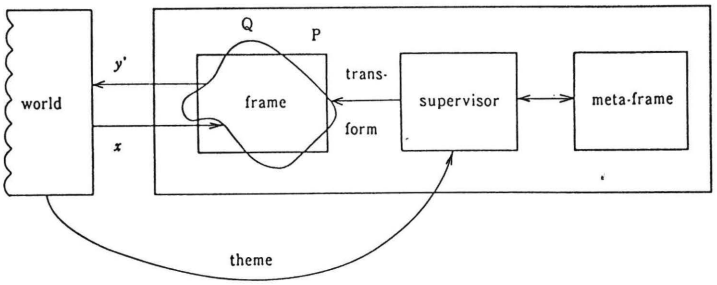

Fig. 9 pragmatic frame

Consequently, the art model equipped with the mechanism of a pragmatic framework can develop a human logic of art on the computer by an AI (artificial intelligence) algorithm and perform a natural art, while the model of artistic computation has conversations with the experienced world and updates and refreshes itself. Art simulation by this pragmatic AI model can build the aesthetic theory automatically on the computer to adapt to natural art. Here seems to be a new, vintage art model which can attain an irrational artistic activity, deviating from a normal standard.

5 New empiricism and bottom-up method

The above-stated pragmatic frame model has the following three shortcomings which should be overcome to attain a really artistic, free expression. (1) The part of the supervisor and its meta-frame must be extremely enlarged in order to contain all sorts of pragmatic rules a priori which make the semantic transformation of a normal objective frame possible. That is, a meta-frame becomes bigger than an objective frame. Additionally, (2) the enlarged supervisor controlling the frame should be fixed as an initial set-up at a final stage of its self-reference, because

endless recessions of the meta-part cannot be permitted. Finally, (3) the message which determines the supervisor's intention of transformational expression is to be given from outside. Therefore, the frame supervisor cannot but accept a previously given command of a message and depend on the theme it means. Thus, the pragmatic frame should possess a fixed authority and a heteronomy which hinder it from making a vintage mechanism of an artistic subject with a creative expressiveness.

The programming of a creative art expression needs to change its approach from the top-down method mentioned above to the bottom-up empiricism. According to D. Hume's epistemology, a world image is to be built empirically by an idea's association of sense data in a certain living habitus. Therefore, a world image should have an unfinished, imcomplete structure in proper. For example, in the tradition of Japanese art, the idea of P. Winston's so-called "learning from examples" is highly valued. Compared with western art, where a rational creation method which, after getting the rule of expression at first, realizes it in the art-work, is adopted, Japanese art adopts an inverse method, i.e. a bottom-up method. It is a manifestation of its proper empiricistic philosophy which rejects, in principle, a top-down rational method of expression. This approach makes the artist search for a new creative way, after having started from finding and learning his master's specific, characteristic way of expression which is implicitly used in the master's exemplary art-work.

In the case of natural, human art, the subject of expression is, as M. Heidegger puts it, an "Existenz" thrown into the world, which is a unique, characteristic being with a temporality and a physical body. Let us consider a child or a primitive tribe as an example of "Existenz". They are thrown into an unknown world with the mental state of tabula rasa. How do they recognize the world and get the world image? They might perhaps be able to catch nothing but a local event in their neighborhood by moving their bodies and touching it with their hands; i.e. they catch the event as a local image by using their near-sightedness and haptic sense. Accordingly, we can say that their image of the world event has a concreteness in close touch with the reality of life, but it is fragmentary.

A. Riegl classified the subjective principle of artistic expression into the following three types: (1) near-sighted - haptic, (2) normal-sighted - haptic-optic, and (3) far-sighted - optic, an let each of them correspond to (1) primitive art, (2) classic art, and (3) modern art (Baroque - romantic) respectively. [10] From the viewpoint of a near-sighted haptic art-will, we can seemingly find the way of escaping from classicism and further of overcoming modernism. Setting the Ego in the center of the world, modern art endeavoured to idealize the world as a fiction by its subjective creation. Starting from the perspective of Renaissance, modern art, moving to Baroque - romanticism, converted the world into a fantasy, and, particularly at the present day, transformed it furthermore radically into a far-sighted mental

mood in the movement of the abstract - expressionism via impressionism. Thus, the idealistic world image, represented by classicism, has been destroyed. Compared with this, the primitive art with its near-sightedness aims to catch a stable and distinct world image by using a physical sense. As for the characteristics of this new world image, (1) the stuff of expression is a figurative fragment, and (2) the form is a multi-viewpoint composition. The event or object recognized by a near-sighted and haptic sense which is a local, partial fragment, cannot have a total structure as an image, but contrarily has an evident figurality. In order to catch the total world image, this expression subject must accordingly adopt the composition of multi-viewpoints by the sight-journey where a viewpoint transfers from one point to another.

What is the world image about which an expression subject with a near-sighted-haptic sense talks on his journey? It is neither a perspective world centralized around the Ego, nor a classic drama shown in Boileau's so-called "triple unities", and neither a music with a functional harmony dominated by one key, nor a story as a progression with causal, temporal sequence. Therefore, it does not give us any pleasure by producing an empathizable mood. Contrarily, it must be a dissimilated, strange image dropped out of the normal road of rationalism and idealism which the Ego laid. During the journey of the unknown world, "Existenz" meets small, unexpected figure fragments sequentially, but the total meaning is ignored by "Existenz" which is only near-sighted and haptic. It takes the unexpected, strange stuff-fragments for the real ones which have been experienced most deeply on its journey, and forms an idea's association linked locally between them. This association is not a redundant chain of Ki (start) · Sho (succeed) → Ketsu (end) in a monotonic tendency, but a zigzag sequence where Ten (change) is laid at the mark → between Sho and Ketsu (that is, Ki · Sho · Ten · Ketsu). There is no causal rule necessary to make a total image and no central viewpoint in it. The deviated course, which rationalism regards as absurd, becomes the drama of the world journey of "Existenz", where it can experience the real world emotionally in struggles with the unknown and frustrations. As a phenomenologist, E. Husserl proposed the intuitionism by "epoché" close to "Sache" (real state of things), and his successor M. Heidegger also insisted that the world shows its real being only in the frustration of the cognitive subject under an extreme situation; the real world, which is different from the ideal world created as a fiction by the Ego, is full of endless riddles and shows its new figure partially each time "Existenz" loses its way on the journey. "Existenz" does create its epic drama of the world journey from the local, contextual assembly of its newly experienced data. Thus, the dramaturgy of this "Existenz" becomes S. Papert's so-called bricolage - a patchwork of waste pieces. Such an artistic practice has been experimented with in the movements of Dada, Neue Sachlichkeit and, currently, Pop-art, where the Ego-centric modern art (abstract - expressionism) was finally overcome. And in this avant-garde art, a challenge toward a new creation which aims to represent the real world as a bare, non-fictitious image, has been effected.

As an example of the new images formed in a bottom-up, parallel, distributed processing way, we demonstrate W. Auden's poem "Musée des Beaux Arts" which depicts P. Brueghel's painting "The Fall of Icarus". [15]

> About suffering they were never wrong.
> The old Masters: how well they understood
> Its human position: how, it takes place
> While someone else is eating or opening a window or just walking dully along;
> How, when the aged are reverently, passionately waiting
> For the miraculous birth, there always must be
> Children who did not specially want it to happen, skating
> On a pond at the edge of the wood:
> They never forgot
> That even the dreadful martyrdom must run its course
> Anyhow in a corner, some untidy spot
> Where the dogs go on with their doggy life and the torturer's horse
> Scratches its innocent behind on a tree.
> In Brueghel's *Icarus*, for instance: how everything turns away
> Quite leisurely from the disaster; the ploughman may
> Have heard the splash, the forsaken cry,
> But for him it was not an important failure; the sun shone
> As it had to on the white legs disappearing into the green
> Water; and the expensive delicate ship that must have seen
> Something amazing, a boy falling out of the sky,
> Had somewhere to go and sailed calmly on.

Here we can see such parallel images as (1) the aged passionately waiting for the miraculous birth and children skating on a pond at the edge of the wood, (2) dreadful martyrdom, the dogs and the torturer's horse (scratches its innocent behind), and (3) the ploughman, the sun, the expensive delicate ship (sailed calmly on), and Icarus' white legs (disappearing into the green water). Avoiding an Ego-centric empathy and perspective, Auden adopted this parallel imaging in order to express the tragic reality of Icarus and human life itself. Therefore, in order to recognize or express the distributed image as this poem, man as "Existenz" with only near-sightedness is naturally making a seeing journey across the world. Thus, the new post-modern art will go the way of "Sachlichkeit" which tries to express the reality of the world intuitively in conformity with an objective fact, instead of classic modernism sticking to an Ego-centric idea. It will be able to create a new world image which is self-organized paradoxically in a flexible self-transformation, apart from modern rationalism.

6 Toward a social model of art

It was stated above that the existential being, near-sighted and haptic, forms a new world image from bottom-up on its world journey. What kind of mental mechanism has man in order to make the world imaging possible in this way? Traditional

philosophy considers the human being as having an always identifiable, constant uni-character. If such a uni-characteristic person wants to form a world image on his journey, he must store the fragments of figurative data, which he experiences at every stage of his journey, in his memory and synthesize them. This image synthesis, however, which is a bottom-up bricolage, as stated above, seems to have the following difficulty: How the expression subject of unicharacter, which has only one consistent logic of expression, can organize the various contradictory data, which are seperated from each other without any causal connection and any semantic similarity in the real world, into the one world image.

To find such a mental algorithm, we would again propose the multi-characteristic model. This multi-person composed of many dwarfs as a mental agent of cognition and expression catches a fragmentary world image locally by using a body of near-sight and haptic sense. Each dwarf who has his own domain working on his body behavior and playing his own role which executes the domain-specific works, performs a bottom-up information processing depending on his experience. Therefore, the dwarfs' works are independent of each other, i.e., they are activated and work independently in the world. However, they form a group in which one dwarf with strong activity conveys his working effect to his neighboring dwarfs. Under this mutual influence, the dwarfs gradually form a society where the group's world image is created as the result of convergence of their mutual effects.

Let us consider O. Selfridge's Pandemonium [11] which represents a perceptual imaging process of the human brain, as the above dwarfs' society model suggests. The Pandemonium is summarized as follows: the Pandemonium has the following dwarfs: (1) external world-oriented dwarfs and (2) inner dwarfs. The former dwarfs are (1) dwarf1 sensing a vertical line segment, (2) dwarf2 sensing a horizontal line segment, (3) dwarf3 sensing an oblique line segment, (4) dwarf4 detecting a right angle, (5) dwarf5 detecting an acute angle, (6) dwarf6 catching a discontinuous curved line, and (7) dwarf7 catching a continuous curved line; the latter dwarfs are 26, each of which can recognize the roman 26 alphabet {A, B, C, . . . } respectively. When the Pandemonium meets, for example, a letter "M", dwarf 1 sensing two vertical line data utters in a loud voice of 2 degrees, dwarf 3 sensing two oblique line data utters in a loud voice of the same 2 degrees, and dwarf 5 detecting three acute angles utters in a louder voice of 3 degrees. Listening to these voices, one of the inner dwarfs (M) utters in the loudest voice "Yes!" with strong confidence, while the other dwarfs K and Y also utter in a rather lower voice due to half confidence and half doubt. Monitoring the voice communication among the inner dwarfs, the boss dwarf of the Pandemonium's decision-making can finally recognize the input data as the letter "M", not as "K" or "Y".

Such a cognitive mind model with the dwarfs' social cooperation was later developed by Minsky - Papert. Truly speaking, Minsky had proposed the origin of this social idea named "frame-system" of an array-structure [8], where the previously

(3.3) stated frames with similarity or neighborhood are mutually connected by up ↔ down and left ↔ right relational local links, in order to recognize the drastically changing world. Only one world event with one specific theme could be recognized by one frame, even if the frame had used the demon mechanism which could execute a structural update of the default world image as a micro-adjustment. Therefore, apart from the former idea of the uni-frame, Minsky invents the system of frame network, in which a flexible transfer from the one old frame with a poor and weak adaptability to the other newly activated neighboring frame with a stronger adaptability can be performed for a cognitive processing of a quite unpredictable change of the world event, and he has recently developed this idea to the theory of the "society of mind".

Influenced by Minsky - Papert's society theory [12], Kawano also invented the following society model named "K society of mind" model [13]. (1) This model is surrounded by the external real world and has a convention forum inside; (2) there live three kinds of dwarfs: (i) terminal, peripheral dwarfs (□) facing to the external world and sensing its data, (ii) inner, non-terminal dwarfs (●) working at the forum and exchanging their mutual voices, (iii) the supervisor dwarf (★) representing the whole society; (3) terminal dwarfs who have their own domain-depending sensing works, crying only when they catch their satisfying data according to their confidences, and transmitting their voices to the forum; (4) inner dwarfs paying attention to the forum, crying and moving to the neighboring dwarfs who are also crying with a greater loudness and an understandable, meaningful voice; (5) the dwarfs' crying voices in the forum which form the unique sound and layout, converge in the mutual-conversational convention process; (6) the supervisor dwarf watches the inner dwarfs' activities, listens to their voices in the forum und finally determines the converged voice as the representative of the society. Thus, in the "K society of mind", the data of the real world becomes structured into the characteristic image by the dwarfs' division of work and convention in the forum (**Figure 10**).

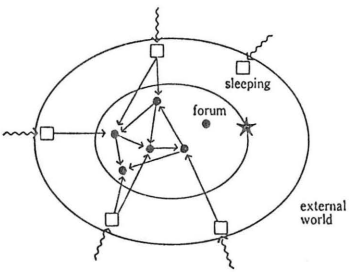

Fig. 10 K society of mind

The near-sighted and haptic man should therefore possess the multi-processing mechanism as this society of mind, in order to obtain the world image on his world journey. The new multi-person makes his dwarfs carry the processing of the local concrete data he encountered on his journey, and the dwarfs do their own specific data processing of cognition and expression when they meet their domain-specific fragment of the world event on the journey. Thus, the image is generated in parallel and distributed ways from concrete data of the fragmentary world event which the dwarfs caught in their near-sightedness. By means of mutual interactions among the dwarfs' distributed imaging effects (that is the dwarfs' convention), in the "K society of mind", the dwarfs (1) show the result of their own cognitive tasks mutually in the society's forum, (2) get close to each other, strengthening the connecting linkage between those involved in the closely related task, and, inversely, are separated repelling each other, weakening their linkage between those with no relation, (3) during which they add a micro-adjusted transformation to their working contents of half-created figurative images, and (4) gradually create the structure of the total world event image. That means, it seems that in the "K society of mind" the convention will converge toward the world image with a consensus reached by competition and coordination among the dwarfs as its members.

There is a story of some blind men passing their hands over an elephant. The blind A catching a nose says, "it is like a rope", the blind B embracing a leg says, "it is like a pillar", the blind C touching the body says, "here is a wall", and the blind D picking up an ear says, "it is like a wrapping cloth" respectively to recognize one elephant. This story sounds funny, but its picture seems clear enough to illustrate the K society's mechanism. The dwarf of the K society is compared to these blind men who are very near-sighted and haptic. Meeting an elephant, first, the dwarfs as the blind men C and B, being full of confidence, utter with loud voices and form an association between the body and the leg, making their locations above and below get close to each other, while the dwarf A cries with a rather weak voice a little apart from B and C. Then the dwarf D appears, approaching

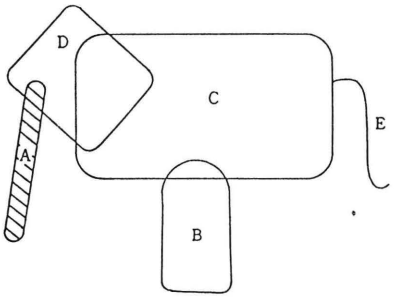

Fig. 11 imaging of an elephant by the dwarfs

the association of B and C, and forms a D-A linkage by working more upon A, because A is located nearest to D. Afterwards, the dwarf E saying "it is like a string", looking at a tail part, appears and sidles up to C who is crying with the loudest voice, being attracted to the strong association structure B-C and D-A. In these conventions of the blind dwarfs, the image of an elephant can be created gradually as its convergence like **Figure 11**.

7 Conclusion

The art which can be created by a really free, human mind, is seemingly to be the modern avant-garde art, because it is produced not by a prior top-down logic, but by a bottom-up engagement toward the irrational, real world. The lastly proposed society model aims to simulate such an alogical creation process as shown in the avant-garde art. This society model, suggested by recent, advanced researches regarding artificial intelligence, particularly from Minsky - Papert's idea of the "society of mind", could represent the mental mechanism of creative art on computer, which would have a new parallel, distributed architecture beyond the traditional Neumann computer. Now, aesthetics is being expected to design a human computer and its algorithm for a vintage creative information processing. Consequently, the proposed model of the dwarfs' journey-tale embedded within innovative aesthetics would be effective to the computation of art. Thus, our scientific aesthetics is considered to obtain an ultimate method which can perform a real art simulation. Here, we notice with interest that, having proceeded from classic aesthetics from below, we have now arrived at new scientific aesthetics from below again. This approach from below helps us to keep our scientific aesthetics effective and adaptive to the real world of art.

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SUMMARY

Proceeding from a criticism of classic aesthetics (herein called "aesthetics"), a new method or model of scientific aesthetics is proposed. The characteristics of this new aesthetics are a logical inference system as well as a traditional, inductive empiricism, being founded on analytic philosophy, where the model has been developed from the emotivism based on logical positivism to contextualism.
Thus, this new aesthetics is a simulation of art on computer. At first, the cybernetic model is introduced as a model, which, based on Shannon's information theory and Markov's process theory, can create and appreciate art-works on computer.

Then, the linguistic model is discussed in search of a more structural processing of art, where (1) syntactic generative grammar, (2) generative semantics with a deeper transformation, and (3) a frame model including the procedural demon which is required for artistic flexible transformation, are introduced. After having criticized these top-down methods, a new strong artificial intelligence model is shown. This model functions bottom-up empirically. Thus, through a trial of frame revision by pragmatics, the idea of a social frame system is finally attained and discussed in detail in relation to modern avant-garde art. It is called "the dwarfs' journey-tale model" which can be expected to represent a creative activity of art on computer.

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