Chance-Imagery

by George Brecht

Art is not the most precious manifestation of life. Art
has not the celestial and universal value that people
like to attribute to it. Life is far more interesting.

TristanTzara[1]

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"Knowledge is the source of all mystery."

Shen-hui.

The purpose of this article is to encourage insight regarding chance-imagery, especially certain less intuitively obvious formal aspects. Every statement of opinion is as wrong in one sense as it is right in some other, for every distinction is an artificial one, an arbitrary subdivision of what is actually a unified whole. This is one of the reasons that words about art are so infinitely inferior to the art itself. Art unites us with the whole; words only permit us to handle a unified reality by maneuvering arbitrarily excised chunks.

With this apology for juggling words at all, let us indicate how we intend to approach an infinitely broad and complex subject, chance and its relation to the arts. ("Arts" here is taken in a broadly historical, but actually no longer appropriate, sense.)

First, a working definition (*Chance*).

Some background (*Dada and Surrealism*).

A focal point in development (*Jackson Pollock*).

Some parallel developments in our culture (*Historical Concurrences: Statistics, Science and Philosophy*).

Randomness.

Some methodology (*Ways of Invoking Chance*).

Coda.

Chance

The word "chance" (with a Latin root relating to the falling of dice) can conveniently be taken to mean that the cause, or system of causes, responsible for a given effect is unknown or unlooked-for or, at least, that we are unable to completely specify it. Of course, in the real world, causes are also effects, and effects causes. The fall of a die,

for example, is the effect of an infinite number of (largely unknown) causes (among which we can imagine resilience of the die, hardness of the table, angle of contact to be included), and this effect, in turn, may be the cause of my winning a certain amount of money.

It is sometimes possible to specify only the universe of possible characteristics which a chance event may have. For example, a toss of a normal die will be expected to give a number from one to six. Any particular face will be expected to turn up in about one-sixth of a great many throws. But the outcome of any one toss remains unknown until the throw has been made. It is often useful to keep in mind this "universe of possible results," even when that universe is hypothetical, for this clarifies for us the nature of our chance event as a selection from a limited universe. We should note here that events are defined as due to chance in a relative way. There is no absolute chance or random event, for chance and randomness are aspects of the way in which we structure our universe. These are elementary considerations with many ramifications, but I hope they will serve as a conceptual base-line for the discussion to follow, which should clarify the nature of chance. We shall later discuss the random event, as a special type of bias-free chance event.

In connection with art, and the affective image, we shall indicate two aspects of chance, one where the origin of images is unknown because it lies in deeper-than-conscious levels of the mind, and the second where images derive from mechanical processes not under the artist's control. Both of these processes have in common a lack of conscious design.

Dada and Surrealism

In the sense that there is a certain lack of conscious control in everything we do, the use of chance in art could be traced (academically) to the cave drawings of prehistoric man; but the first explicit use of chance in painting seems to have come shortly before World War I. If we admit automatism as chance, then the improvisations of Kandinsky (1911), painted "rather subconsciously in a state of strong inner tension," would take

precedence over the first *papiers colles* of Picasso (1912), in which were incorporated for-
tuitous scraps of newspaper and cardboard.

(The question of the chance nature of automatism might be endlessly debated.
It seems to me that the answer lies in the distinction between our seeking immediate
causes or ultimate causes of automatic actions. It takes little reflection to see that ulti-
mate causes might readily and reasonably be ascribed to chance, but psychoanalytic the-
ory has taught us to expect "conscious ignorance and unconscious knowledge of the
motivation of psychic accidentalness" [2], and it does not always take very deep or
lengthy probing to reveal immediate causes for the psychically accidental. At any rate, it
is practical to consider chance as being defined by *consciously* unknown causes, and by
this definition, at least, automatism is a chance process.)

Since we are restricting ourselves to the generation of chance-images, and not
to their appreciation, we shall indicate only the place of the unconscious (including the
subconscious, or fore-conscious) as a source of significant images. The importance of
chance to the unconscious has manifold facets, not only in modern psychology, but also
(and particularly) in Oriental thought (such as that manifested in the *I-Ching* or in Zen).

The Dadaists considered the unconscious to be a source of images free from
the biases engrained in us by parents, social custom and all the other artificial restric-
tions on intellectual freedom:

"We are now in a position to formulate the problem of art, more accurately the
problem of expression, as it appeared to the writers of and Litterature group [Aragon,
Breton, Soupault]: only the unconscious does not lie, it alone is worth bringing to light.
All deliberate and conscious efforts, composition, logic are futile. The celebrated French
lucidity is nothing but a cheap lantern. At best the 'poet' can prepare traps (as a physi-
cian might do in treating a patient), with which to catch the unconscious by surprise and
to prevent it from cheating . . . ." Marcel Raymond (3)

"The unconscious is inexhaustible and uncontrollable. Its force surpasses us. It
is as mysterious as the last particle of a brain cell. Even if we knew it, we could not
reconstruct it." Tristan Tzara (1)

As far as affective form is concerned, chance is an aspect of the universe made significant by unconscious interactions, but it is not the only aspect. When the largely iconoclastic displays of Dada were superseded by the more systematic researches of the Surrealists, Breton, for one, in the "First Surrealist Manifesto" (1924), made this general interest in the unconscious explicit:

"During the course of Surrealist development, outside all forms of idealism, outside the opiates of religion, the marvelous comes to light within *reality*. It comes to light in dreams, obsessions, preoccupations, in sleep, fear, love, chance; in hallucinations, pretended disorders, follies, ghostly apparitions, escape mechanisms and evasions; in fancies, idle wanderings, poetry, the supernatural and the unusual; in empiricism, in *super-reality*." (4)

(This statement, written in 1924, followed *The Interpretation of Dreams* by 24 years, and *Psychopathology of Everyday Life* by 20.)

It is useful practically to include automatism in a consideration of chance in art, and it is only our viewpoint which makes it a chance process, but there is actually no reason why the others of Breton's categories could not also be included. We exclude them arbitrarily from this discussion only to preserve a certain tightness in our consideration of the methodological resources of the contemporary research "artist," which we will take up further on. Automatism is also an aspect of chance in the sense that we accept its product as something which it really is not. In all of Breton's manifestations of the marvelous (a handy summary) we read into phenomena characteristics which they do not possess in an absolute way. Duchamp called this "irony" ("a playful way of accepting something"), and the concept is a critical one in understanding the vector through Dada, Pollock, the present-day chance-imagists, and the future. The idea will appear again in the section on Pollock, and shows up particularly as a method I've called the "irrelevant process" (also discussed later).

We are more interested, though, in the mechanically chance process, and here Duchamp did the pioneer work. In 1913 he undertook what seems to be the first explicit use of chance for the creation of an affective image, in the "3 stoppages etalon." He

made these images by holding a thread one meter long, "straight and horizontal," one meter above a blank canvas. After letting it fall onto the canvas, it was fixed with a trickle of varnish into the chance convolution in which it fell. This process was repeated to give three such canvases.

Duchamp seems to consider three phenomena basic to his exploitation of chance: wind, gravity and aim. (This discussion is based largely on an article about Duchamp by Harriet and Sidney Janis; see reference 5.) The "3 stoppages etalon" illustrate gravity; wind was used to create the cloud formations for "La Mariee mise a nu par ses celibataires, meme" (1915-1923): "Air currents blowing a piece of mesh gauze against a screen, imprinted a limpid rectangle upon it. The experiment repeated three times gave three chance images, variations on the square . . . . The third device in allowing shapes to create themselves and thus void the responsibility of the hand, is termed by Duchamp *adresse*, that is, skill in aiming. Nine marks were made upon the glass by the impact of shots of matches dipped in paint, from a toy cannon . . . . Aiming nine shots at a given point, these formed a polygram as a result of variation in the aim-control and accompanying conditions. He then converted the flat polygram or floor plan into an elevation plan. Here the nine points became the locations for the nine malic forms in perspective." (5)

Duchamp's theories on the use of chance seem highly developed, but not exhaustive. Other Dadaists, especially Arp, Ernst and Tzara, later developed other important applications of chance:

Arp composed collages by picking up chance scraps of paper, shuffling them, and gluing them down just as they fell (example: the "Squares arranged according to the laws of chance," a collage of 1916).

Ernst developed the "decalcomania of chance" (5), wherein, for example, ink was spread between two sheets of paper, which were then pulled apart (example: "Decalcomania, 1936" by Oscar Dominguez, illus. in ref. 4, p. 161).

Tzara composed poems by drawing words from a hat. ("To make a dadaist poem/ Take a newspaper./ Take a pair of scissors./ Choose an article as long as you are

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planning to make your poem./ Cut out the article./ Then cut out each of the words that make up this article and put them in a bag./ Shake it gently./ Then take out the scraps one after the other in the order in which they left the bag./ Copy conscientiously./ The poem will be like you./ And here you are a writer, infinitely original and endowed with a sensibility that is charming though beyond the understanding of the vulgar." (6)

Frottage was a "semi-automatic process for obtaining patterns or designs by rubbing canvas or paper which has been placed over a rough surface such as planking, embossing, a brick wall, etc." (7) (example: Ernst, "The Horde," ca. 1927). This is an example of a technique for which we shall later have a more general term - the "irrelevant process."

A very interesting technique of the Surrealists, which permitted the cause of an event to be lost, so to speak, in multiplicity, was that of the *cadavre exquis*, wherein several persons each made part of a picture, folding the paper to cover his addition, before passing the drawing to the next participant. (An example is the "Figure," 1926-1927, by Yves Tanguy, Joan Miro, Max Morise and Man Ray, illus. in ref. 4, p. 251.)

The ability of the unconscious to reconcile opposites is nowhere so evident as in Dada, for within a periphery of nonsense the ridiculous and the profound were made to evince each other: "Dada wished to destroy the reasonable frauds of men and recover the natural, unreasonable order. Dada wished to replace the logical nonsense of the men of today with an illogical nonsense. That is why we beat the Dadaist bass drum with all our might and trumpeted the praises of unreason. . . . Dada like nature is without meaning. Dada is for infinite meaning and finite means." (Gabrielle Buffet-Picabia, 1949, ref. 8.) Within such a (frameless) framework, chance played a major part, as testified by Arp himself (9): "Chance opened up perceptions to me, immediate spiritual insights. Intuition led me to revere the law of chance as the highest and deepest of laws, the law that rises from the fundament. An insignificant word might become a deadly thunderbolt. One little sound might destroy the earth. One little sound might create a new universe." The almost incredibly incisive mind of Tristan Tzara, as early as 1922,

even recognized the relationship of all this to Oriental philosophy (in one of the most convincing of Dada documents, the "Lecture on Dada"): "Dada is not at all modern. It is more in the nature of a return to an almost Buddhist religion of indifference." (10) Such aspects of reality as Oriental thought-scientific thought-Dada-chance become somewhat clearer in such a light. Perhaps chance is the most allusive of the phenomena studied by the Dadaists and Surrealists because it is capable of being most widely generalized. We shall see.

The Second World War helped to disperse the European Dadaists and Surrealists, and many of the most original artists - Breton, Ernst, Tanguy, Masson - regrouped in New York, particularly around two New York galleries, the Julien Levy Gallery and Peggy Guggenheim's Art of This Century.

Jackson Pollock

Jackson Pollock's first show was held at Peggy Guggenheim's gallery in 1943. Here he was able to associate with the proponents of that "sacred disorder" which was later to become the key to his own original style. "To them Pollock owed his radical new sense of freedom, and he spoke more than once of his debt to their unpremeditated and automatic methods. By elevating the appeal to chance and accident into a first principle of creation, the Surrealists had circumvented the more rigid formalisms of modern art." (11) It is not difficult to find their influence in Pollock's paintings of the war years (for example, "Guardians of the Secret," 1943). Pollock achieved a profound, sustained and irrational synthesis of all the principles which had preceded him in Dada, and in a way consistent with his contemporary world. His paintings seem much less manifestations of one of a group of techniques for releasing the unconscious (as the Dada experiments seemed), than they do of a single, integrated use of chance as a means of unlocking the deepest possible grasp of nature in its broadest sense.

Not to get lost in conjecture, let us briefly give evidence for two points, first that Pollock's calligraphy was truly automatic and second that there is a considerable element of chance in the ultimate arrangement of pigment in the chance-paintings of roughly

1947-1951.

First, part of a statement by Pollock (12), made in 1947:

"When I am *in* my painting, I'm not aware of what I'm doing. It is only after a sort of 'get acquainted' period that I see what I have been about."

Again, from an earlier statement (13):

". . . the fact that good European moderns are now here is very important, for they bring with them an understanding of the problems of modern painting. I am particularly impressed with their concept of the source of art being the unconscious. This idea interests me more than these specific painters do. . . .

Aside from the lack of conscious control of paint application in these paintings, there are technical reasons for looking at this complex of interdependent forms as predominantly chance events. For one thing, the infinite number of variables involved in determining the flow of fluid paint from a source not in contact with the canvas cannot possibly be simultaneously taken into account with sufficient omniscience that the exact configuration of the paint when it hits the canvas can be predicted. Some of these variables, for example, are the paint viscosity, density, rate of flow at any instant; and direction, speed and configuration of the applicator, to say nothing of non-uniformity in the paint. Even if we deny automatism, and claim omniscience for an unconscious molded by a long learning period, it is obvious that in some of Pollock's paintings of this period (in "One, 1950," for example) differently-colored streams of paint have flowed into each other after application, resulting in a commingling completely out of the artist's hands. Never before Pollock were chance processes used with such primacy, consistency and integrity, as valuable sources of affective imagery.

Paintings get to be what they are physically through an interaction of method and material, and they have their effect in an interaction between painting and observer. As far as the observer is concerned, Pollock has demonstrated that the ability of humans to appreciate complex chance-images is almost unlimited. Here I would like to introduce the general term "chance-imagery" to apply to our formation of images resulting from chance, wherever these occur in nature. (The word "imagery" is intentionally ambiguous enough, I think, to apply either to the physical act of creating an image out of real materials, or to the formation of

an image in the mind, say by abstraction from a more complex system.) One reason for doing this is to place the painter's, musician's, poet's, dancer's chance images in the same conceptual category as natural chance-images (the configuration of meadow grasses, the arrangement of stones on a brook bottom), and to get away from the idea that an artist makes something "special" and beyond the world of ordinary things. An Alpine peak or an iris petal can move us at times with all the subtle power of a "Night Watch" or one of the profound themes of Opus 131. There is no a priori reason why moving images should originate only with artists.

This leaves "art" to mean something *constructed*, from a starting point of pre-conceived notions, with the corollary that as art approaches chance-imagery, the artist enters a oneness with all of nature. This idea has in essence been well expressed by Suzuki:

"There is something divine in being spontaneous and not being hampered by human conventionalities and their artificial hypocrisies. There is something direct and fresh in this lack of restraint by anything human, which suggests a divine freedom and creativity. Nature never deliberates; it acts directly out of its own heart, whatever this may mean. In this respect Nature is divine. Its 'irrationality' transcends human doubts or ambiguities, and in our submitting to it, or rather accepting it, we transcend ourselves." (14)

"Our inner life is complete when it merges into Nature and becomes one with it." (15)

When an artist achieves this essential oneness with all of nature, everything he creates illuminates nature, as well as himself.

"*Reason has cut man off from nature.*"

Hans Arp (16)

Historical Concurrences: Statistics, Science and Philosophy

I think it is interesting to look at these developments in the use of chance in

painting against a background of our growing understanding of chance in other fields over the last several centuries. The conjuncture of statistical theory with mathematical physics, which occurred about 1860, resulted ultimately in a reformulation of our concept of the workings of nature; the requirements of strict causality, which classical philosophy had regarded as an a priori principle underlying the mechanics of the universe, were replaced by a measure of probability. The predominance of cause thus gave way to the predominance of chance (see ref. 17), and a climate in which chance-imagery seems an almost inevitable concomitant grew up.

The first questions regarding probability were formulated by gamblers, and perhaps this is natural, for games of chance go far back into history and prehistory (at least to the third and fourth millennia B.C.). (See, for instance, David, ref. 18). The literature of games of chance began to collect in the sixteenth century, and about 1526 Gerolamo Cardano (who, himself, was both mathematician and gambler) wrote his *Liber de Ludo Aleae*, in which a probability was calculated by theoretical argument for the first time. In the seventeenth century, Galileo, Pascal and Fermat carried further the concepts of probability applied to gaming. In 1733 De Moivre, the English mathematician, published his formulation of the so-called "normal law," describing the distribution of events subject to a great number of independent chance influences, and these results were found to describe the distribution of errors of observation in astronomy, social science and the physical sciences, largely through the work of Laplace and Gauss, about the end of the eighteenth and beginning of the nineteenth centuries.

We now wish to trace a concurrent thread of events in physics, specifically in the kinetic theory of gases. In 1661 (two years before Cardano's *Liber de Ludo Aleae* finally appeared in print) Robert Boyle had described the relationship between the volume of a gas and the pressure exerted by it on a closed vessel, and tried to account for this behavior by comparing the gas particles to little springs lying on each other, which coil and uncoil. Twenty years later Robert Hooke suggested that the pressure of a gas was due to the impingement of hard, rapidly moving particles on the walls of the containing vessel, and this work was followed, in 1738, by the explanation of Daniel Bernoulli that Boyle's

Law would be true if the particles of a gas were considered to be infinitesimal in size.

The subject of gas kinetics then lay dormant for almost a hundred years, until new progress was made in the first half of the nineteenth century, when Joule (1848) showed that the kinetic energy of gas molecules is proportional to the absolute temperature of the gas. Clausius then gave the subject both a wider and more rigorous treatment (1857), which resulted in a theoretical understanding of the simultaneous volume, pressure and temperature relationships in a gas, which had already been empirically determined. Clausius had made several simplifying assumptions, however, which turned out to be untenable, for he had held that the gas molecules were all to be considered as moving at the same speed. Since the molecules must frequently collide, changing their speeds with each collision, even if the speeds of all the molecules were initially equal, they would not be equal for long. Two years later James Clerk Maxwell set out to determine the average speed of the gas molecules (allowing for the effect of collisions), and also the distribution of speeds of individual molecules about this average.

Maxwell's conclusion* was that the distribution of speeds of the molecules was described by the normal law, brought into scientific considerations by Gauss. That is, the macroscopic behavior of a gaseous mass (as exhibited, for example, by its temperature) was to be described by the average of the speeds of the individual molecules. The phenomenon of temperature as an effect, measured, for example, by the expansion of mercury in a thermometer, was therefore attributable not to a cause, but to a very large number of independent causes, the magnitudes of which were due to chance. Thus a change in the amount of heat energy in a body means a change in an average of many independent events. This explains why heat ordinarily travels from a hotter body to a colder, and not the opposite way. We expect an ice cube placed in a glass of water at room temperature to result in a cooler mixture; the liquid becomes cooler, and the ice melts. We do not expect the heat to travel from the ice cube to the warmer liquid, leaving a yet colder ice cube and warmer

*Rigorously proved by Lorentz in 1887, following a method developed by Boltzmann in 1868.

liquid. This is the essence of the so-called Second Law of Thermodynamics, and this principle is made understandable by Maxwell's statistical interpretation of gas kinetics, because this interpretation lets us form a conceptual model of a mixture of gases with different temperatures, in which high-energy molecules of the warmer gas are colliding with low-energy molecules of the cooler, imparting some of their energy in the collision. The result is a total amount of energy which, after mixture, falls somewhere between the extremes of amounts of energy possessed by the two original volumes of gases. Since the macroscopically observable variables are averages, based on summation of individual chance events, an event such as our ice-cube-in-water becoming colder becomes, not impossible by a deterministic law of nature, but only highly improbable, based on laws of probability.

We might argue that these developments do not in themselves require us to abandon strict causality, for we might hypothesize (as Laplace actually did) a superman, to whom the exact motion and speed of each molecule were known, and who would thus be capable of calculating the motion of each molecule after any specified length of time.

The resolution of these questions of strict causality versus probabilistic prediction came with Werner Heisenberg's publication of his principle of indeterminacy in 1927. Specifically, Heisenberg showed mathematically that it was not possible to determine both the position and the momentum of an electron at the same time, that is, that as the precision with which the momentum of an electron was measured was increased, the precision with which the position of the electron was measured necessarily decreased, and conversely. This was later interpreted as reflecting our inability to measure the characteristics of the smallest particles without disturbing the particles themselves, for even when the photon itself is used as the most sensitive instrument for observation of these elementary particles, it has the same order of magnitude as the objects being observed.

The causal descriptions of classical physics (and philosophy) then, (that is, such statements as: "When A happens, then B will always happen") are idealizations, or sim-

plified models of the actual state of affairs. The best we can do is to make statements with a high degree of probability (e.g., "When A happens then B will happen in a certain proportion of cases"), for we cannot exhaustively describe the causal structure of any real system.

Thus chance became an underlying principle of our world-view.

Of course, we don't mean to imply that chance-imagery is the direct result of the artists' knowledge of these trends. We only mean that the works of great artists are products of the same complex, interacting welter of cause and effect out of which came the results of mathematical physics. If we believe history to show that art of the past has fit into the cultural matrix of the time in which it was produced, we have incentive to look for the trends in contemporary art which are consistent with analogous trends in these other fields. Unfortunately, though this must have seemed like an over-long digression, we have only been able to hint at the parallelism in these trends here.

"*. . . Reason is an indispensable instrument for the organization of knowledge, without which facts of a more abstract kind could not be known. The senses do not show me that the planets move in ellipses around the sun, or that matter consists of atoms; it is sense observation in combination with reasoning that leads to such abstract truths*." Hans Reichenbach (19)

Randomness

Chance images are characterized by a lack of conscious design. When these images are "hand-made," and conscious thought is evaded, so that the images have their source in deeper-than-conscious areas of the mind, we will prefer the Surrealists' term "automatic" to the word "random," though "random," in the way it is used in everyday speech, might seem appropriate (as meaning, for example, "without definite aim, direction, rule, or method," ref. 20). We will prefer this usage in order to restrict "random" to a technical meaning which it has more commonly in statistics, where it applies to special techniques for eliminating bias in sampling. The term "strict randomness" is useful for ensuring that the word random is understood in this technical sense, but, in general, we shall merely say random, and it should always be understood here that the technical

meaning is implied. Chance is sometimes used in painting in such a way that the images are neither clearly automatic nor random, and here we can only refer to chance-images or chance-processes.

It remains to indicate, then, what this technical meaning comprises, recognizing that, in general, the reason for the importance of randomness for purposes of scientific inference will be the same as the reason for its importance in the arts, that is, the elimination of bias. It is not intuitively obvious that strict randomness is difficult to achieve; therefore let us indicate the general presence of bias where human choice or ordinary mechanical systems are involved. This will give us an intuitive insight into approaches capable of eliminating bias, and will lead finally to a working definition of randomness itself.

Concerning a general bias in human choice, Kendall and Smith (21) have made the following interesting statement:

"It is becoming increasingly evident that sampling left to the discretion of a human individual is not random, although he may be completely unconscious of the existence of bias, or indeed actively endeavouring to avoid it. House-to-house sampling, the sampling of crop yields, even ticket-drawing have all been found to give results widely divergent from expectation."

Yule and Kendall (22) have given an example of human bias which was detected in the course of agricultural experiments carried out in England. The heights of wheat plants were to be measured at two stages in their growth. Of the sets of eight plants sampled for measurement at each of the two stages, two were selected "at random" by eye, and the other six were selected by strictly random methods. Analysis of the measurements showed clearly that, in the samples selected by eye, there was a clear bias toward selecting taller shoots in May, before the ears of wheat had formed, while in June, after further maturation, another bias toward selecting plants of more like average height, and avoiding the extremely tall or short plants, was evidenced.

I have attempted some one-hand typing of series of random digits, and found not only a bias toward a greater frequency of higher digits (regardless of the hand used

for the typing), but also peculiar patterns in the series; digits being followed unusually often by certain other digits, for example. (For an interesting discussion of chance numbers, and further references on this subject, see section 12 of Freud's *Psychopathology of Everyday Life* in *The Basic Writings of Sigmund Freud*.)

One might expect to avoid human bias by using mechanical systems, but experience has shown that it is not easy to find simple unbiased mechanical systems. Perfectly balanced coins and roulette wheels, like perfectly cubical and homogeneous dice, seem to occur rarely in nature, if at all. Weldon (23), for example, threw twelve dice 4096 times. For unbiased dice the probability of a 4, 5 or 6 is 1/2, so that he should have obtained one of these faces 24,576 times. These three faces actually occurred 25,145 times, which is a statistically significant bias. Even an electronic analog of a roulette wheel, built by the RAND Corporation for the generation of random digits, after careful engineering and re-engineering to eliminate bias, was found again to have statistically significant biases, after running continuously for a month, in spite of the fact that tests showed the electronic equipment itself to be in good order (24).

How can bias be avoided? First, it can be reduced by resorting to compound chance events, and, formally, it can be eliminated by the use of random numbers.

By making the chance-event a compound of two or more independent events, elements in the compound event can be made more nearly independent of each other, and thus biases can be avoided. For example, in the Surrealist *cadavre exquis*, it was made impossible for any one person to foresee the overall result of combining the independently contributed parts of the drawing, so that bias in the relationship of elements in the compound chance-event (drawing) was avoided. John Cage has also used this technique in his "Music for Four Pianos," wherein four pianists play independently of each other, the resulting rhythmic and melodic pattern being thus freed of personal bias. In fact, this technique has been used, in a much-refined way, to generate a table of strictly random numbers (those published by the Interstate Commerce Commission, ref. 25). Independent columns of digits from waybills received by the commission deriving from numerical data such as shipment weight, revenue, car serial number, etc., were used as a

basic set from which the final set was derived.

Tables of random numbers provide a convenient and reliable means of avoiding bias in selection; convenient because they allow random selection of anything which can be numbered, reliable because they can be verified to be statistically random. Tests for randomness in random number tables are described in references 21 and 26. The use of tables of random numbers is briefly described in the following section on methodology.

Randomness, then, implies an independence of each individual choice from every other choice, plus an aggregate impartiality toward the characteristic being sampled. In tables of random digits, for example, a state of randomness implies both that the occurrence of any particular digit at a particular point in the table is independent of the occurrence of all the other digits, and that the proportional occurrence of that digit in the long run is arbitrarily close to some pre-established value. Practically speaking, this means that in a table such as the RAND table, the digit 5 in a certain place is just as likely to be followed by a 6, 7, 8 or 9 as it is to be followed by a 0, 1, 2, 3 or 4, and also that in the table as a whole, the proportion of digits 5 should be reasonably close to one-tenth.

Ways of Invoking Chance

The technique chosen for making random or chance selections in the arts is largely determined by the number and nature of the elements from which the selection is to be made. In addition, the degree of randomness of the finished image can be made as great as the artist's desires and capabilities allow. For example, a coin can simply be tossed to determine whether a pre-selected image shall be painted in black-on-white or white-on-black, or, at the other extreme, random number tables can be used to determine the field material (canvas, paper, etc.), size and shape of the field, medium, colors, method of application of the medium (brush, drip, etc.), components of the method (brush width, applicator dimensions, etc.), and any other characteristics of interest.

It is practical to use coins, dice, or a roulette wheel where only a limited num-

ber of elements are available for selection. Where the number of elements is large, these techniques become unwieldy, and others must be found. Where the elements can be numbered, tables of random numbers are relatively easy to use, otherwise automatism, or a very flexible approach, which (for want of a better name) I have called the "irrelevant process," can be used.

For convenience, I have listed these techniques below, with some examples. Readers may be able to add to the list.

Coins

One coin can fall either heads or tails. Two coins can fall in three different ways: both heads, one head and one tail, or both tails, and in general n coins can fall in n + 1 ways, without regard to order. With more than one coin, however, the different combinations are not equally likely. We are six times as likely to get two tails and two heads in a toss of four coins, as we are to get all tails, for example. If we desire to consider HT different from TH, then two coins can fall in four different ways (NH, HT, TN, TT), three coins in eight different ways, and n coins in 2^n ways. When coins are used for making chance selections, therefore, it is necessary to know the nature of the possible outcomes (events) which can occur, in order to avoid prejudice due to the characteristics of the chance process.

Dice

The ordinary six-sided dice are somewhat limited with respect to flexibility, having only up to six spots per face. Two or more dice used at once lead to the same complications as met with in the use of coins, that is, the necessity either of knowing the probability of various outcomes, or of using sophisticated devices to obtain the situation desired with respect to probabilities. Two dice of different colors, for example, may be used, in order to make 4:3 distinguishable from 3:4, or the dice can be thrown one after the other instead of together.

Though a die is now by definition cubical, analogous devices can be (and have been) constructed with other than six faces. David (18), for example, describes a rock crystal polyhedron of twenty numbered faces which dates back to ancient Greece.

Numbered Wheels

Small roulette wheels with 36 compartments are readily available, but are not likely to be unbiased. The device is very convenient to use, however, and gives quite usable chance series. Allan Kaprow has used the roulette wheel to arrange the elements in a composition for five voices, bell, flute, match-box, and scroll.

Another form of the numbered wheel is that sometimes found in children's games, a card with a circular series of numbers, and a pointer which can be spun. Paul Taylor has used this method to determine direction of motion in the dance.

Cards

Card shuffling must be very thoroughly done in order to approach randomness. Earle Brown has used the technique analogically in his "25 Pages" (of musical notation), designed to be played in any page order.

Bowl Drawing

Metal-bordered paper tags in a bowl provide a very convenient universe of chance instructions, if the tags are carefully and thoroughly mixed after having had the original set of instructions written on them. Some elements lend themselves to being drawn directly, without coding; for example, magnetic tapes containing a population of sounds can be cut into lengths, mixed in a bowl and drawn directly. A poem of Tzara's arranged in this way is printed in the Motherwell anthology (6).

Automatism

A chance-process by definition, and probably the most commonly used among "action-painters."
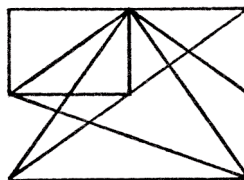
Random Numbers

Eight tables of random digits have been published, that I know of, but one or two of these are no longer in print. Two of those most readily available have been cited in references 24 and 25. After numbering the elements from which a random choice is to be made, the table is consulted, starting at any point and reading in any direction. Numbers with the requisite number of digits are taken in the same order as they occur in the table, discarding those too large for use and those previously selected (if unusable for that reason). For example, nine points are chosen on a field, and numbered 1 to 9:

```
1    2    3

.    .    .

4    5    6

.    .    .

7    8    9

.    .    .
```
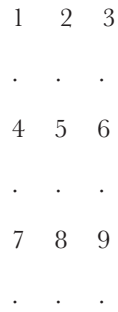
A random block of digits from the RAND table is:

25412

49703

72007

32309

02069

Reading left-to-right and top-to-bottom, and connecting the points above in order, we obtain the random pattern:

Less naive approaches suggest themselves; placing the points unevenly (at will) (Brecht: "Random Form R3") , using consecutive sets of two random numbers as sets of Cartesian coordinates (Brecht: "Random Form R4"), and so forth. Such systems for obtaining visual forms can be elaborated almost indefinitely. A special random process for the dancer exists in the 'Random Walk," a theoretical model developed in statistics to describe (among other things) the random motion (Brownian movement) of small particles suspended in a liquid, and acquiring their motion from numerous chance impacts. (See reference 27.)

The Irrelevant Process

In general, bias in the selection of elements for a chance-image can be avoided by using a method of selection of those elements which is independent of the characteristics of interest in the elements themselves. The method should preferably give an irregular and unforeseen pattern of selection.

John Cage has used this approach in a composition for orchestra, ruling a staff on a sheet of paper, and placing notes on the staff at points where certain minute imperfections in the paper occur. Inked marbles rolled over an irregular surface trace a pattern determined by unforeseen imperfections in the surface and chance rebounds of the marbles from each other (Brecht: "7-57").

More remotely, significant images occur as the result of processes over which we exercise no selection at all. The most moving collage I ever experienced was the 4 x 24 foot side of a truck carrying boilers, a piece of canvas patched irregularly with other pieces of canvas of various shades of gray. Map patterns, and the classical *objets trouves*, would also seem includible within this principle.

Coda

Chance in the arts provides a means for escaping the biases engrained in our personality by our culture and personal past history, that is, it is a means of attaining greater generality. The result is a method of approach with wide application. The meth-

ods of chance and randomness can be applied to the selection and arrangement of sounds by the composer, to movement and pace by the dancer, to three-dimensional form by the sculptor, to surface form and color by the painter, to linguistic elements by the poet. Science tells us that the universe is what we conceive it to be, and chance enables us to determine what we conceive it to be (for the conception is only partly conscious). The receptacle of forms available to the artist thus becomes open-ended, and eventually embraces all of nature, for the recognition of significant form becomes limited only by the observer's self. It must be obvious too that the infinite range of application of these methods is compounded when the matter of materials is also considered, and this is a subject we have only incidentally touched on here. One hopes that so-called avant-garde painters will some day look beyond the classical oil medium with the same open-minded receptivity that, say, Pierre Schaeffer did in his field, in 1948. ("Quand on s'entete contre toute logique, c'est qu'on attend quelque chose d'un hasard, que cette logique n'aurait pas su prevoir. Mon merite est d'avoir apercu, entre cent experiences, celle, apparemment aussi decevant que les autres, qui creait l'evasion. Encore fallait-il avoir l'audace de generaliser." (28)

I doubt that an increase in our ability to recognize significance in the chance-images which nature presents all about us will mean an end of the personal activities which we have been calling art. The artist will probably continue to make significant images, both because some such images rarely occur in nature, and because of a personal release which comes about from such activity:

"The painter makes paintings in the urgent need to discharge his own emotions and visions." Pablo Picasso (29)

"Pictures are vehicles of passion, of all kinds and orders, not pretty luxuries like sports cars. In our society, the capacity to give and to receive passion is limited. For this reason, the act of painting is a deep human necessity, not the production of a hand-made commodity. Robert Motherwell (30)

But it seems to me that we fall short of the infinite expansion of the human spirit for which we are searching, when we recognize only images which are artifacts. We

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are capable of more than that.

AN AFTER-NOTE

In 1957, when this article was written, I had only recently met John Cage and had not yet seen clearly that the most important implications of chance lay in his work rather than in Pollock's. Nor could I have foreseen the resolution of the distinction between choice and chance which was to occur in my own work.

We are eight years farther on the spiral, and I prefer work to re-work. "Chance-Imagery" is presented in the form in which it was originally written.

November, 1965

Reference

(1) Tristan Tzara. "Lecture on Dada" (1922). *The Dada Painters and Poets: An Anthology*. Edited by Robert Motherwell. The Documents of Modern Art series. Wittenborn, Schultz, Inc., 1951, p. 248. We will hereafter abbreviate this anthology to "Motherwell."

(2) Sigmund Freud. *Psychopathology of Everyday Life. The Basic Writings of Sigmund Freud*. English translation by A. A. Brill. The Modern Library, Random House, New York, 1938, p. 164.

(3) Marcel Raymond. *From Baudelaire to Surrealism*. Quoted in Motherwell, p. xxix of the Introduction.

(4) Andre Breton. "First Surrealist Manifesto." Quoted by Georges Hugnet in one of his two introductory essays for *Fantastic Art, Dada. Surrealism*. Edited by Alfred H. Barr, Jr. Third edition, The Museum of Modern Art, New York, 1947. Hereafter this book is referred to as "Barr."

(5) Harriet and Sidney Janis. "Marcel Duchamp: Anti-Artist" (1945). Motherwell, Appendix C, p. 306.

(6) Tristan Tzara. "manifesto on feeble love and bitter love." Motherwell, p. 92.

(7) A. H. Barr, Jr. "A list of devices, techniques, media." Barr, p. 65.

(8) Gabrielle Buffet-Picabia, "Some Memories of Pre-Dada: Picabia and Duchamp" (1949). Motherwell, p. 266.

(9) Jan (Hans) Arp. "Dada Was Not a Farce" (1949). Motherwell, p. 294.

(10) Tristan Tzara. "Lecture on Dada" (1922). Motherwell, p. 247.

(11) Sam Hunter. Catalog of the 1956 Pollock retrospective show. *Bulletin*, vol. xxiv, no. 2 of the Museum of Modern Art.

(12) Jackson Pollock. "My Painting." *Possibilities* (N.Y.), no. 1:79, Winter 1947-48, pp. 78-83.

(13) Jackson Pollock. "Jackson Pollock" (a questionnaire). *Arts and Architecture*, vol. 61. no. 2, February 1944, p. 14.

(14) D. T. Suzuki. "Zen Buddhism." *Selected Writings of D. T. Suzuki*. Edited by William Barrett. Doubleday & Co., Inc., New York, Anchor edition, 1956, p. 234. Used by permission of Hutchinson & Co., Ltd., London.

(15) D. T. Suzuki. Ibid., p. 256.

(16) Jean (Hans) Arp. "Notes from a Dada Diary." Motherwell, p. 222.

(17) Max Born. *Natural Philosophy of Cause and Chance*. Oxford University Press, London, 1949, p. 92.

(18) F. N. David. "Studies in the history of probability and statistics: I. Dicing and Gaming." *Biometrika*. University College London, vol. 42, parts 1 and 2, June 1955, p. 1.

(19) Hans Reichenbach. *The Rise of Scientific Philosophy*. University of California Press, Berkeley, 1951.

(20) *Webster's New International Dictionary*, Second edition, copyright 1959 by G. & C. Merriam Co., publishers of the Merriam-Webster Dictionaries. Used by permission.

(21) M. G. Kendall and B. Babington Smith. "Randomness and Random Sampling Numbers." *Journal of the Royal Statistical Society*, London, vol. CI, pt. 1, 1938, pp. 147-166.

(22) G. Udny Yule and M. G. Kendall. *An Introduction to the Theory of Statistics*. 14th edition, Hafner Publishing Co., New York, 1950.

(23) Cited in M. G. Kendall. *The Advanced Theory of Statistics*. Fifth edition, Hafner Publishing Co., New York, vol. I, p. 199.

(24) The RAND Corporation. *A Million Random Digits with 100,000 Normal Deviates.* The Free Press, Glencoe, Illinois, 1955. A description of the method used for production of the random digits is contained in the introduction.

(25) Interstate Commerce Commission, Bureau of Transport Economics and Statistics. *Table of 105,000 Random Decimal Digits*. Washington, D. C., May 1949. Copies are available free from the Commission. Refer to Statement No. 4914, File No. 261-A-1.

(26) G. Udny Yule. "A Test of Tippett's Random Sampling Numbers*." Journal of the Royal*

Statistical Society, Vol. CI, pt. 1, 1938, p. 167.

(27) W. Feller. *Probability Theory and its Applications*. John Wiley & Sons, Inc., New York, 1950, vol. 1, chapter 14.

(28) Pierre Schaeffer. *A la recherche d'une musique concrete*. Editions du Seuil, 1952, p. 16.

(29) Quoted by Frank Elgar; in Elgar and Maillard. *Picasso*. Frederick A. Praeger, Inc., New York, 1956.

(30) Statement by Robert Motherwell; in "The New Decade" exhibition catalog. Edited by John I. H. Baur. Whitney Museum of American Art, New York, 1955.

Additional Reading

The Growth of Physical Science. Sir James Jeans. Cambridge University Press, 1948.