

ON BEING IN ORDER

by *Manfred Clynes*

ENVOI

"A man's wisdom maketh his face to shine"
[Eccles. 8:1]

A surface, not a line, of grace
Bounds fluid motion
(A man, a beast is not an empty form)

Myriad nerve-channels, like parachute cords
Bind the surface movement to the moving thought—
—Essentic form is born

And I sense in the moment's true surfaced expression
One channel, one graceful line
To a point infinitely small
Powerless power
Faithful
Sure——
Giving weight to weight,
Time to time, continuity to experience

And asleep or awake I too sometimes seem
A point of nothing
Inserted in the master's expressive line

A point of contact of living breath
With the multicolored, evanescent scene—
Giving form to surface.

Riddle: *If I seem so to me, and others see to be
What is the potential of my algorithm tree?*

When I left home I told my son that I was going to address a group of distinguished theologians. My son was astonished. He said, "The

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world really must be in bad shape if *you* are preaching to the theologs."

Well, perhaps the world is in bad shape and in some ways in worse shape than we seem to realize most of the time. We dare not always listen to the undertone of poignant sadness that comes from feeling how wonderful the world could be compared with what it is. We sense it only from time to time. This deepest sadness—a sorrow greater than any I know—is a result of knowing about the blessedness of life, and the failure to actualize the potential for this which probably exists in all of us.

What I have to say to you relates to how our new scientific work gives rise to the hope that shadows of our civilization obscuring beauty and its power will gradually lift—shadows that hide some aspects of man's nature—and that these aspects will bring him into loving harmony with the order of nature greater than himself, in which he is immersed, and so also with his fellow man. For man, like all life, is a potential, and he is always, at any time, only a fragment of that potential.

ERRONEOUS DIVISIONS OF SCIENTIFIC THOUGHT

A division which scientific thought of the last few centuries has created, and whose harmful effect will gradually disappear, is the division of knowledge into the subjective and objective. The aim of science has been to concern itself with the objective and regard it as the subject matter of order, whereas the subjective was regarded as capricious, unreliable, full of distortion, and unworthy of being included in the ordered family of science. True, all good scientists knew that at the basis of their objective edifice of principle lay ultimately subjective axioms. But this was regarded as a necessary evil, and it was attempted to reduce the number of intuitive concepts to the minimum possible. In this way the reality of the subjective was made at once less obvious and more obvious: less obvious, in that most aspects of subjective experience were excluded from the objective world; more obvious, in that the truth of these few subjective intuitions was made all the more apparent by their millionfold application in the universe.

It was not until the advent of Goethe, who, like Bach, summarized the past and pointed to the future, that the scientific error of conceiving of two orders of nature rather than one was clearly felt and stated. In that sense Goethe was the first biocyberneticist. I hope to show you some evidence that the objective and subjective are both part of the order of the world, and that in recognizing that order in the subjective lies our hope for our development as life among life.

If we look at the history of thought from another point of view, we

find a curious development from the days in which the earth was considered to be the center of the world and man its living epicenter. After some time, we saw that the earth was not the center but that the sun seemed to be, and then we saw that it was not the sun but that there were galaxies and then even groups of galaxies, and I would like to say to you that the concept of a center of the world is meaningless, that if you could find it, it would have no significance—the very concept of a center is an error. The order of the largest and the order of the smallest cannot be deduced from each other, and there is no reason why this would necessarily have to be so. We, who find ourselves somewhere between the largest and the smallest, have our own order. Thought and feeling, too, are natural phenomena. As Goethe remarked somewhat irritably (in a poem), “Nature has neither inner nor outer”; it is meaningless to try to penetrate the “inner core” of nature or to think that we see the outside surface. Nature is centered everywhere. The order of nature is as central here at this very spot as anywhere; and by feeling the presence of this order here and now, we are fulfilling our potential.

INTERIOR WORLD OF THE BRAIN

Precision and order go together. Chaos and randomness are words for our ignorance. It used to be thought that within the brain the disorder of randomness might be found. If I may look at the brain as a so-called black box for a moment, then it was thought that outside this black box reigned order and within it reigned the fantastic, the inchoate, the firing of random nerve nets which somehow get organized to produce the thoughts and behavior of man. Man is apt to confuse the order of his brain with the disorder of his thoughts.

The inroads we are beginning to make into that chaos make it appear that where we saw chaos there is order and where we saw randomness there is organization. It is clear by now that man’s interior world of the brain is subject to an order that defines his true nature, function, and capacities. Figures 1–4 show some evidence of this order in the function of perception and of feeling.¹ The precision of this order is such that it cannot be thought to be learned. We assume that it must be programmed genetically in the code of DNA. Indeed, it is clear that molecular coding need not be confined to programming structure in space, but that forms in space-time, dynamic functions, such as what we call the *sententia* and *essentia*, could equally well be programmed through relationships within the DNA molecule. This means that the genetic code represents not only the structure of a human being but human nature itself.

We have looked at the brain to see how it responds to the external

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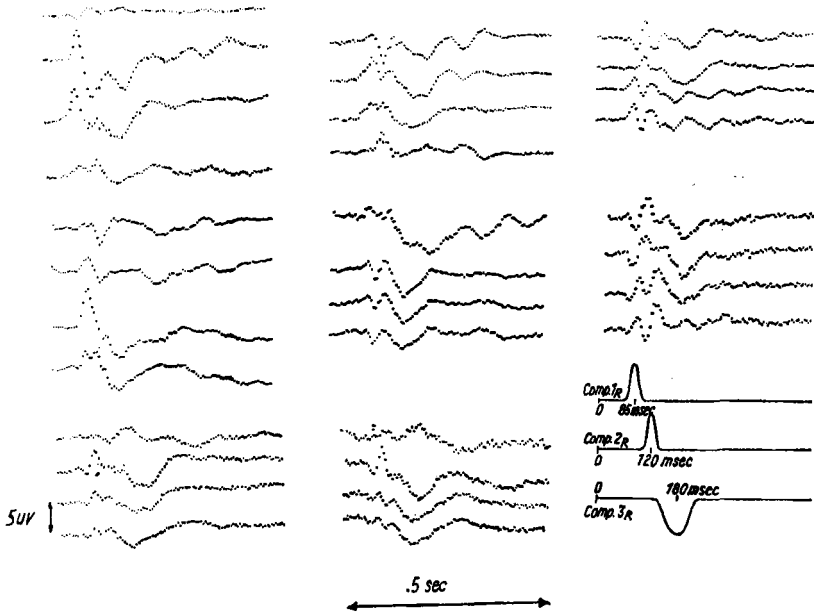


FIG. 1.—Comparison of the responses of eight adult males to the same stimulus—
 red from previous black. Three principal components, 1_R, 2_R, 3_R, may be distinguished
 in each of these response groups. The relative amounts of these components are dif-
 ferent, but their timing is similar for different individuals. Note the similarity of
 the two groups of responses on the right of the figure and also the bottom two groups.
 It would seem that, in accordance with the work of Leibovic, one might regard each of
 these components as a separate unidirectionally rate-sensitive channel. This figure
 illustrates different aspects of the one-to-one correspondence found to exist between
 a specific stimulus and the corresponding space-time pattern evoked in the brain.

This figure and figures 2, 3, and 4 below originally appeared in M. Clynes and M.
 Kohn, "Spatial Visual Evoked Potentials as Physiologic Language Elements for Color
 and Field Structure," in *The Evoked Potentials*, ed. William Cobb, *Electroencephalog-
 raphy and Clinical Neurophysiology* (suppl. 26) (Amsterdam: Elsevier Publishing
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world, and we chose color as an example. A man's first reaction and
 thought about color is to see color in nature, in his environment. Later,
 with disillusion, he realizes that color is created in his brain only, that
 there is no color in nature outside him—but finally he realizes that the
 color created within himself is part of nature. The brain responds to
 various colors and forms—indicating an unlearned precision that makes
 it possible for us to identify what color a man is looking at from his
 brain responses alone. From the figures above and evidence of many
 subjects, we have come to understand something about the brain's phys-
 iologic language, how it transforms the external world into a code of its
 own. It is from this code that natural human language is formed. The

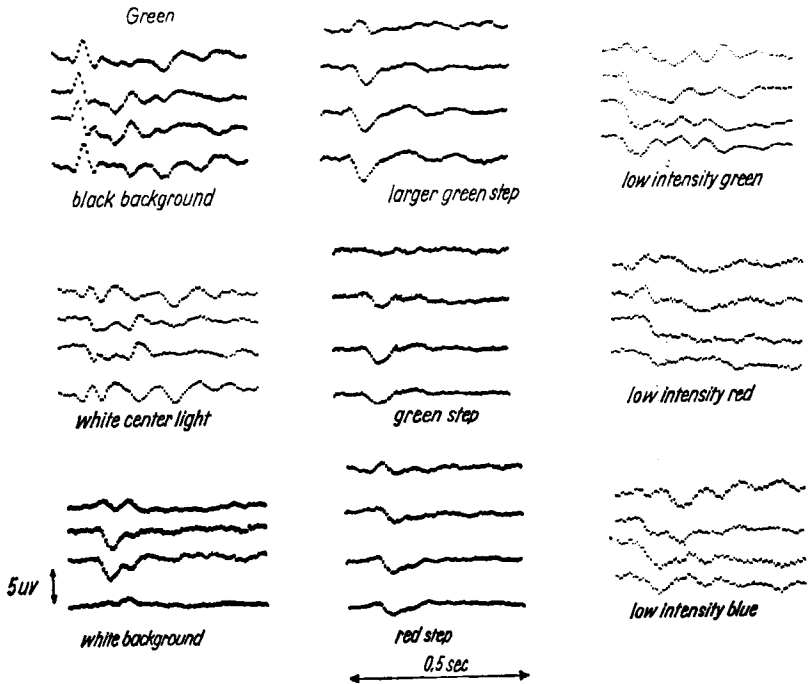


FIG. 2.—The left side of this figure shows how response to green from black (*top*) is changed by the presence of a small steady white center light diffused over a tenth-centimeter circle (*middle*). Note that the initial peak disappears in traces 2 and 3 and is altered in traces 1 and 4, while all other components appear unchanged. With steady white light over the entire screen, the response to green is shown at left bottom. This eliminates all but two major components, those of secondary and tertiary latency. The central group shows responses to different-size intensity steps of green and red. These are rather similar to those on the bottom left but have different spatial orientation. (The white “background” of course contains red and green.) Note also the absence of color discrimination. The response shapes are largely independent of the size of the step and the range of intensity from which the step is taken, provided the initial level is high enough, paralleling the perceptual impression of color saturation beyond a certain intensity.

On the right are shown low-intensity responses, emphasizing the different sensitivities of various components to intensity. The DC shift on traces 2 and 3 on the lower group of records is present for quite low intensities and seems from most indications to be a rod phenomenon. Increasing the intensity by a factor of 100 does not increase this component (*top left*). Instead, the initial peaks are emphasized.

divisions that our physiologic data-processing code make in nature’s continuity form the basis of human word language, so we have words for red, green, blue, and white. We have words for light and for darkness, the absence of light, and we have words for hot and cold. We have a word for smell, but we have no word for the absence of smell, for no smell, and we have no word for no touch. This is because *no smell* and

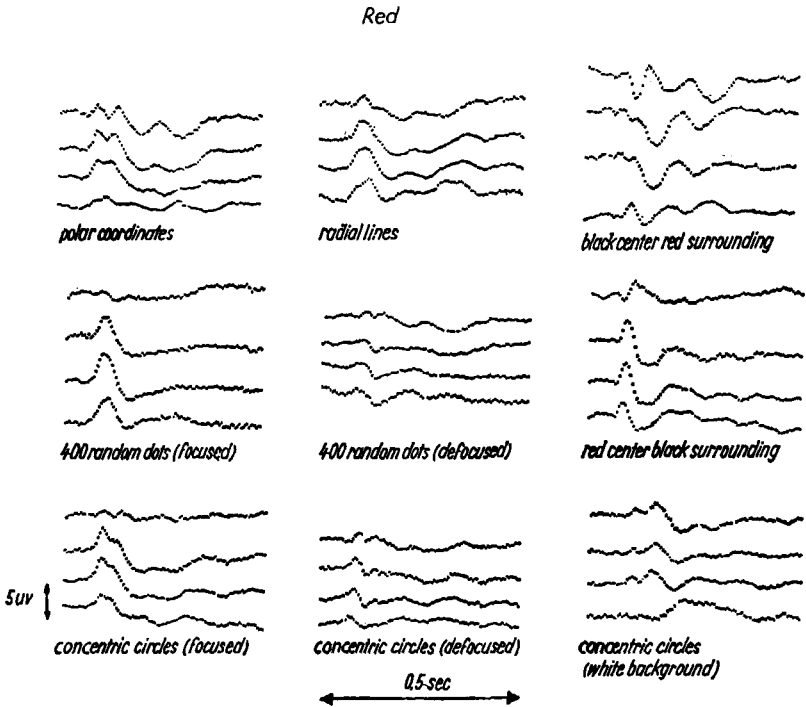


FIG. 3.—Examples of varieties of shape obtained from various visual field structures of lines and shapes. Lines are projected on black background except at bottom right. Amplitude of responses drops sharply when images are defocused. Color differentiation is marked for the defocused images and is relatively masked by the edge-sensitive responses to the focused images. Top right is a response to a black central circular field twelve inches in diameter, surrounded by red. Below it is a red central field of similar size surrounded by black. With these response shapes, component analysis reveals the existence of four main independent spatial components of different latency; this is also largely evident from visual inspection. Responses to radial lines and circles appear to be basic. The bottom right response pattern illustrates that the response to lines is sensitive to the color and intensity of the surrounding field.

no touch are not part of the physiologic code. Our physiologic data-processing system has no channel sensitive to absence of smell, and so we have no word that corresponds to this concept, while we do have a word for no light—namely, darkness.

The formation of opposites from single measures has been described in our scientific publications as a consequence of the principle of unidirectional rate sensitivity—a basic property of biologic channels of communication.² This principle, which I first described in 1958³ and 1960,⁴ results in the biologic phenomenon of *rein control*, where op-

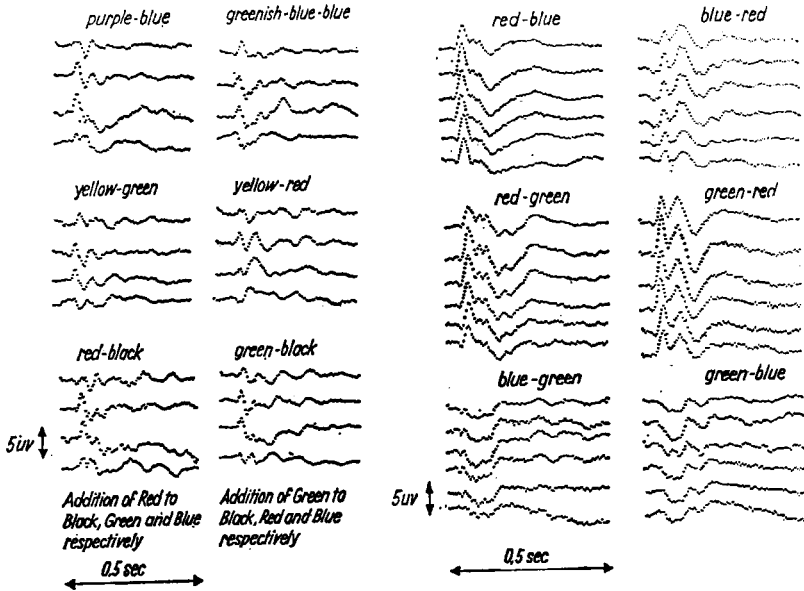


FIG. 4.—Response to changes of color at the same intensity. Red-blue indicates that blue is changed to red. The entire screen is illuminated with the colored light. On the right of this illustration six pairs of left horizontal occipital electrodes are used, as distinguished from the four-electrode-pair circular rosette used in all other illustrations. Each pair of electrodes is placed two centimeters above the one below. Note the stability of each pattern and the gradual shift in the balance of the components. Note the characteristic pattern for each color combination. The left side of this illustration shows the effect of steady colored illumination on the responses. In each column the same light is presented but starting from a differently colored steady illumination. Thus, the same red in the first column produces a change from blue to purple (top left), from green to yellow (left middle), and from black to red (left bottom group). The evoked potentials and components are correspondingly different even though the same physical stimulus is used. The sensitivity of these patterns to hue is notable.

posites, like the reins of a horse, apply to the main inputs along different parts of the brain, which are regarded as differing in quality but may be similar in quantity (that is to say in the number and type of nerve impulses). It is in this way that the brain has learned to distinguish between quantity and quality.

For it turns out that a biologic channel of communication uses molecules of matter to convey information. Molecules in these channels function in the measure of their concentration. This means that the opposite of a molecule for this channel would be a negative molecule, and we all know that we can throw salt in a beaker of water, but we cannot throw in negative salt afterward to wipe out the salt we threw in before. In electric and electromagnetic forms of communication, op-

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posites can be transmitted in terms of a natural symmetry—positive and negative, right or left-handedness. However, the symmetry of opposites cannot be provided in one *biologic* channel—a second channel must be added, and the symmetry becomes a symmetry in space like the reins of a horse. A second channel has to be provided if we are to remove the salt from the beaker; either we must add another chemical to react with the salt, or we must add more water to dilute it. In either case, it is another, different communication channel from the one that throws in the salt.

In this way, from a single measure of temperature nature has given us two channels, two qualities, two reins to keep us centered—hot and cold. We have the opposites of darkness and light, and within our body there are many such pairs of reins that operate without our awareness and keep various subsystems of our body “centered.” To name a few: the regulation of sugar in our blood, the control of fluid in our bodies, the system of immunologic protection. There are, however, systems where we have only an incomplete symmetry, where our organism is informed how to steer only from one end of the scale. So, as we mentioned before, words have developed in our language which represent these opposites of the physiologic language, and some words have developed where there are no opposites in our language. The correspondence between our words and our nature as physiology tells us is good but incomplete. Words do not tell us about the time course of the quality they describe. They merely name the quality, and we are well aware that even in the naming of quality words are very inadequate. We resort to poetry to help us obtain greater accuracy, but even this falls short, since among other things it takes time to read the poem—time which in no way corresponds to the time of real experience. We are therefore left, as in dreams, to the process of fantasy to help us understand and feel. The *process* of fantasy and its order I should like to consider next.

So far, we have looked at the brain as a remarkable organ, which responds to the environment in a precise coded way and transforms the measure of the external world into qualities of opposites; and we have shown how some of the randomness of nervous behavior is in fact the organized response, the casting of the key which the brain interprets further as particular qualities, intensities, and relations. We now shall look at the brain from the opposite end, and observe how the precision of its input is manifested in its output. We shall look at the brain itself as an input, that is to say we start our observing process with a brain event rather than with an event outside of man. But first we need to look at motion and action in some detail.

MOTION AND ACTION

In the continuing motion of matter in the inorganic world there are no moments of causal events but a stream of flow in accord with an existing changeless order. In the lives of individuals, however, the order also manifests itself disturbingly in the ability of the individual to make decisions and to begin actions. His actions may be in relation to changing the distribution in the material world, or they may be expressive of the individual's state. Actions of the latter kind are communication and art, while the former represent his ability to build, destroy, and transform the world around him as well as himself. Another class of actions involves a rather different process of initiation: these are reflexive, unconscious actions.

We shall be concerned here with the initiation of action, which mirrors the inner state of the individual, as a satisfaction in itself.

Expressive actions, like other actions, have a beginning and also an end. There is a moment of initiation. In this moment of initiation, the individual makes a choice or decision to express or not express. In that moment he must open all those gates in his data-processing system which will allow the program of expression to command the expression, if the expression be "faithful" or "sincere." The degree to which this is done determines the faithfulness of the expressions to the inner command shape—and gives rise to the impression of "depth of feeling." At the moment of initiation, the shape of expression is already determined; that is, the contour between the beginning and end of the expressive unit of action is designed. This moment is then of great importance. For the process which takes place in the brain during this time determines the nature of the entire expressive action.⁵

We may distinguish, then, two chief sources of brain-directed motion. The first, which has to do with the reorganization and the redistribution of matter in space, is the kind of motion that we most commonly do in moving about. This type of motion is nevertheless composed of many individual movements, each of which receives decisions. Thus, when we choose to raise our hand, to take another step, to open the door, or even to lift a knife or fork, we are initiating individual movements. Even the simplest of these movements, such as moving a finger, involves starting, accelerating, and decelerating. But, in order to do this, two sets of muscles acting for each movement must come into operation at the appropriate times, to the appropriate extent starting and, more difficult, stopping the motion at the right time and place as intended. We observe the physiologic fact that the course of a simple movement is preprogrammed by the brain *before* it begins. We call such simple movements *actons*.

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An acton is preprogrammed in the *present moment*—that means in a duration of between 0.1 and 0.2 seconds. (The length of the present moment [which is also the time in which we cannot reverse a decision] is of the order of 0.15–0.2 seconds, derived from diverse concurring measurements in vision, audition, and volition.) I will not here go into the details of how we measure the duration of the present moment in physiology but merely state that each acton is *born* in the present moment.

We now come to the second class of movement directed by the brain, expressive action, action which has no other aim than to respond and correspond to an inner state. We call such action *E-action*. E-action, too, is composed of actons. But the shape of E-actons is modulated by the state seeking expression, which we call the *sentic state*. We say that the sentic state requires the E-acton to have a certain characteristic shape. For example, sadness will change the shape in time-space of an undifferentiated movement to a new shape if we allow it to express sadness. This shape itself expresses the sadness, and we call this the *essentic form*.⁶ Similarly joy will cause the movement to be modulated to a different characteristic form corresponding to joy.

ESSENTIC FORM

Now, essentic form is basic to expressive act in gesture, touch, dance, song, music, and the tone of voice of speech. In all these the essentic form is the basis of communication and constitutes the basic element of language. How many such elements are there? Are sentic states, like colors, the result of basic elements mixed in different proportions? This is the question we have asked ourselves.

I will first show you some measurements of the internal pulse of music. We take music for two reasons. First, it is a language using essentic form. In each internal pulse of music, it is thought, there is created an actonlike form. Second, the internal pulse of the music is a recurrent event so that it is convenient to average many measurements of the shape of the internal pulse. True, like the pulse of our blood, the internal pulse is not the same from one pulse to the next. But there are systems characteristics of the composition that seem, as differential equations do, to determine the shape families which may occur and also the predominant shape around which they fluctuate. These pulse shapes which, as actons, are created in the present moment turn out to be characteristic shapes for each composer regardless of the particular piece of music chosen. It turns out that what determines the shape is really our own process of empathy with the composer. This event of ours is similar to what happens in a dream as we dream of another

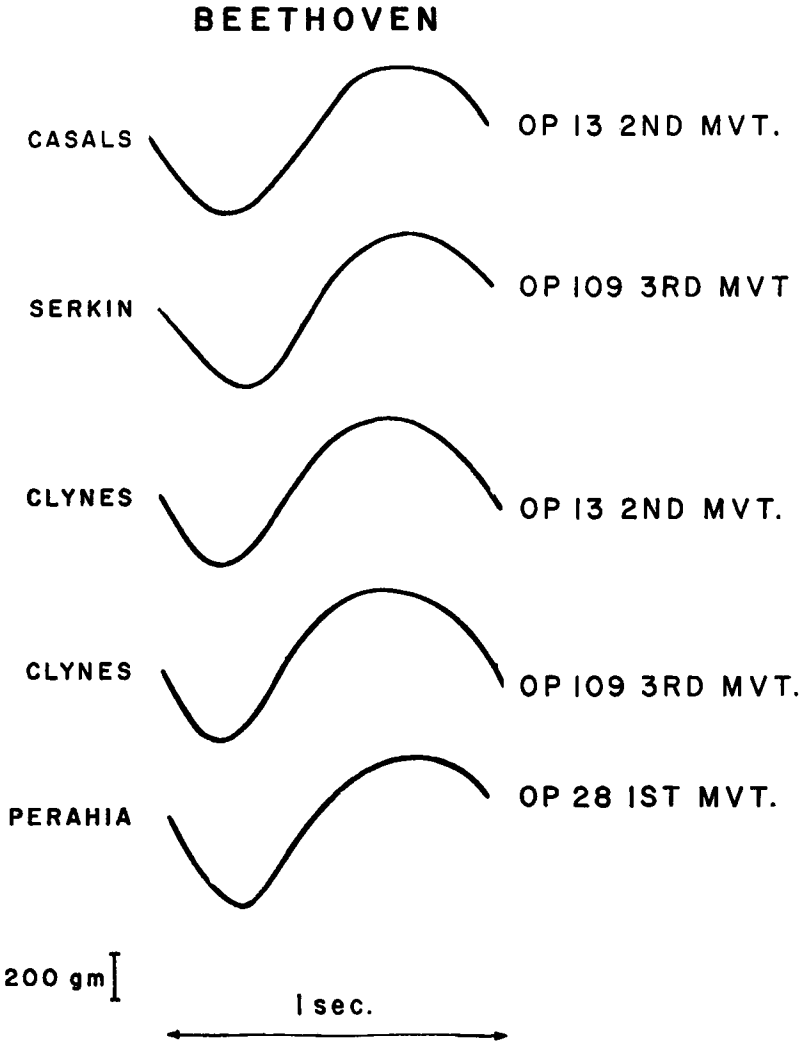


FIG. 5.—Essentic form of the inner pulse of slow movements of Beethoven (vertical component). Different movements are compared, as well as the same movement for different interpreters. The lowest trace is of a first movement in triple meter whose pulse is considered comparable taken in appropriate time scale (one pulse per bar in this case). The pulse shape continues into periods of rest. There is a prolonged initial action preprogramming as compared with the low inertia pulse of Mozart. The relative symmetry of the pulse precludes introduction of sexual elements of longing as observed in the second phase of the inner pulses associated with romantic composers, and gives rise to an "ethical constraint."

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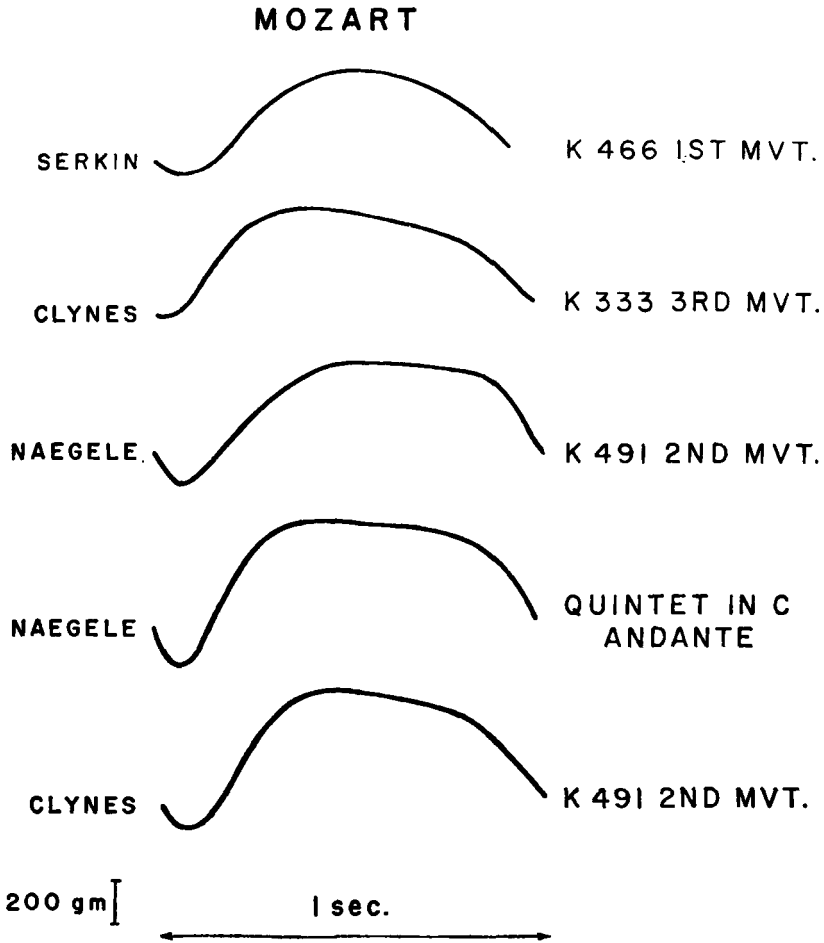
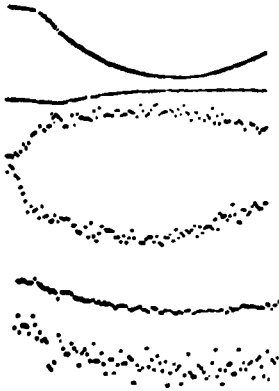


FIG. 6.—The essential form of the inner pulse of Mozart is relatively light and buoyant in character and has a response time corresponding to a normally preprogrammed free action. The Mozart pulse is freer than the Beethoven pulse and may well be associated with such descriptive terms as a "cosmic pulse," as compared with a "Promethean pulse" of Beethoven. The pulse shape is only secondarily dependent upon the character of the pieces so that the tragic and joyful Mozart have basically similar internal pulses. It may be that this is because in Mozart the joyful and the tragic are implicit in each other and subsumed in a higher synthesis.

mined discrete shapes (figs. 7-9). The words that we have coined to fit the corresponding sentic states are very approximate. However, the state and its ortho-essential form are very precise. There are many shades of color, but they are produced through our data-processing system from



Love



Sex

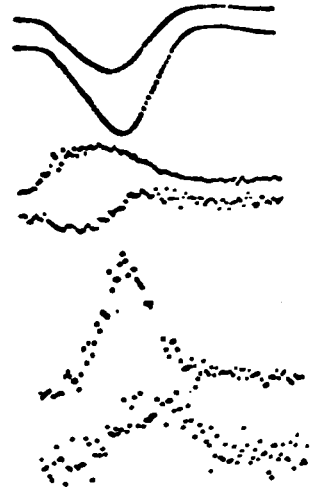


FIG. 7.—The essentic forms of love and sex and their associated muscle activity as compared with drawings by Picasso of mother and child, and Pan, respectively. There appears an analogy between the special rounded forms of the mother and child drawing (embracing and enfolding arms) and the measured essentic form for love. An embrace as illustrated visually and its dynamic tactile representation in the essentic form show resemblance. On the right the accentuation, and particular angularity of the horns, arms and shoulder with the strong dark accents and implied thrusts, compare with the measured essentic form of the sexual quality with its secondary accents of muscle activity. It would seem as if the dynamic visual impressions, communicated by a great artist, correspond to the biological shapes of expression as measured through essentic form. In obtaining the pure essentic forms one is not too far removed from some of the aspirations of the artist.

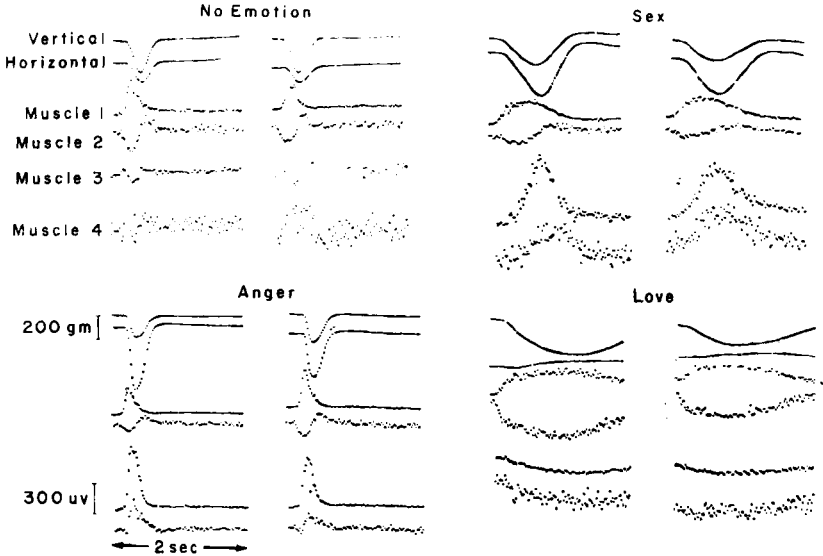


FIG. 8.—Recordings of essential form as vertical and horizontal components of finger pressure; also four groups of muscle potentials. Each group is the average of fifty actions. Muscle potentials are recorded from the forearm, upper arm, front shoulder, and back, respectively. Groups represent repeated recording from the same individual, showing the stability of the patterns. "No emotion" consists of a mechanical movement, such as used for typewriting. In "anger" there is a marked accentuation of the horizontal component, indicating a tendency for the action to be outward, away from the body. The type of anger illustrated here is more akin to irritability than to resentment. The "slow, burning" type of anger has a different pattern, which is not illustrated here. Most individuals produce either one or the other type of anger. Individuals who portray irritability often cannot express the slow, burning anger.

The characteristic shape for "love" (agape, not sexual) shows a longer curved action with a slight reversed horizontal component, indicating a pulling inward or embracing mode of behavior. The preprogrammed time of the action for love is considerably longer.

The characteristic form for sex shows a strong secondary thrust with emphasized late muscle activity. The secondary-thrust effect is characteristic of the purely sexual expression and is analogous to the vocalized expressive effect of the syllable *urnh*.

a few. The same is true of taste, which is the function of a small number of basic taste characteristics: sweet, sour, bitter, salty. We now see that in the world of feeling, also, there are expressions to precisely delineate separate proto-sentic states (figs. 7-9). Many of these may be recognized in animals from similar proto-essentic forms. Fairly recently, I visited the zoo and was watching a bear. Suddenly this bear yawned; within two or three seconds I found myself yawning also. It is clear that communication exists through essentic forms—that we react to other individuals' sentic states through their ortho-essentic expression; we cannot react to each other's sentic states if we do not express or perceive the true or

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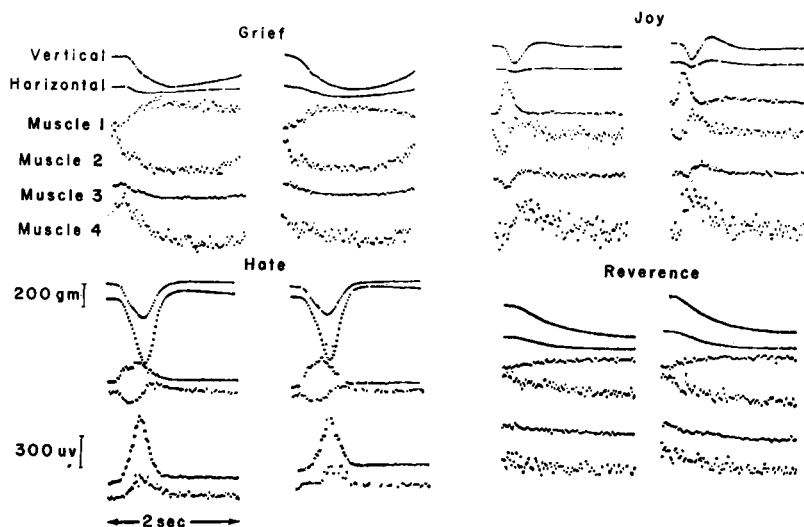


FIG. 9.—Typical response shapes illustrate the essential form of grief, joy, hate, and reverence, respectively. Groups of responses are repeated experiments by the same individual, each an average of fifty actions. Note the strong outward (negative horizontal) component of hate, the late muscle acceleration in muscle 2 indicating a secondary thrust, a characteristic of passion. The response to grief is similar to the love form but is flatter and slightly outward. Muscular action of grief is related to an induced general lassitude and prevents the subject from actively lifting the released pressure, the opposite of joy. In joy there is a “jumping for joy” effect which occurs subsequent to the initial downward deflection of moderate intensity and close to the vertical direction. This type of joy is mainly differentiated from “no emotion” by its active overshoot, a joyous rebound. Reverence has general similarity to love, but on a longer time scale. The preprogramming of the action is extended in time.

ortho-essentic form. Insincerity is the distortion and inhibition of ortho-essentic form.

We see, then, that the sentic state is self-generating and that the subject is required to switch from one sentic state to the next. How does he do that? This switching is subject to what we term pre-sentic control. The state of mental health can be directly related to the ease with which we can voluntarily switch sentic states.

SENTIC CYCLES

Now, as one conducts these experiments with a series of sentic states, an interesting phenomenon is observed over and above the manifestation of each sentic state. We can make up a series of eight such states and consider this as a cycle which may be repeated. We call these *sentic cycles*. As a person has done a number of such cycles, we observe

a surprising change in his general mental state—an increasing awareness, fluidity of thought, and feeling of well-being.

Through practicing the sentic cycle the fluidity of the mental state improves, and the condition of sentic rigidity which is one of the symptoms of depression is alleviated. We may say that the sentic cycle is a form of discipline in which a man is a disciple of his true self. But one does not have to be depressed to feel increasingly alive through the ability to control one's sentic state with ease. The pre-sentic control consciously used is a source of peace, of tranquility. And being the master of one's states rather than their slave is not the whole story. In the sentic cycle it seems as if our stale remnants of feeling were wiped off the blackboard of our sentic state. We start with a clean slate. The remnants of the past no longer prevent us from being fully alive emotionally in the present.

If we are to sum up now some of the principles we have discussed, we see:

1. There are sentic states. The sentic state is a single channel. At any one time in one individual there is only one sentic state.
2. The sentic state is composed of a number of proto-sentic states in various combinations.
3. There are only a fairly small number of proto-sentic states.
4. To each sentic state there corresponds a "true," ortho-essentic form.
5. The essentic forms are biologically programmed and genetically preserved.
6. Essentic form acts as a communication in the degree of precision in which it conforms to the ortho-essentic form; that is, the gain of the channel is a form function.
7. We communicate feelings to others through their recognition of essentic forms. The essentic form, like a key, will work in the data-processing lock and in individuals who see that form, whether that form is produced in himself or in others.
8. Higher empathy is a relationship with an individual's pre-sentic control rather than his sentic state alone. We feel the relative fluidity or rigidity of his sentic state (empathy with the potential of an individual as compared with sentimentality of attachment to a single sentic state).
9. Sentic states are self-generative through the production of essentic form.
10. In improving the fluidity of the sentic state, subject to pre-sentic control, one has a dynamic means of controlling the opposites of depression and exaltation using a man's own functions and creative imagination without drugs or dogma.
11. In the practice of sentic cycle one soon comes to enjoy most, and to look forward to with anticipation, the state of love as a favored state.

We see that the requirements of awareness include the dynamic processes we have described. We have seen that the proto-sentic states are themselves programmed genetically and that in the DNA molecule there must be relationships which determine the nature of proto-sentic

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states. Potentially, then, man's nature is programmed in the DNA molecule. In this seed is present the potential of what is possible and what is not. If love did not exist, it could not be imagined any more than the experience of sound without the faculty of hearing. Man cannot imagine colors if he has not the capacity to see them. We cannot imagine any feeling which is not in us potentially. So it seems all men are equal indeed in their potential potential, and perhaps that means in the eyes of God.

We have looked at some aspects of awareness. In particular we saw some of the precision and order of the central nervous system in two processes—that of perception and that of fantasy. We have examined these processes apart from influences of culture and character structure.

COMPUTERS AND ASPECTS OF AWARENESS

Let us now look at how some of these features relate to the structures we call computers. If we consider the organization of computers, the most general formulation of the computation process, that which includes all that is theoretically computable, is the Universal Turing Machine. Such a machine has two main functional aspects—a condition of immediate state and a storage environment (one dimensionally infinite) that feels that state.

It is one of the beautiful aspects of the mathematical theory of computers that there is a flexible, variable trade-off between the complexity of the immediate state and the complexity of the storage environment. But although such a computer can calculate all possible "effective procedures" or algorithms, it theoretically or practically is not affected by printing or giving answers. Printing an answer does not affect the "state" of the computer (only "reading" does).

In this way man differs theoretically from the most perfect computer formulated. Inherent in his nature is the fact that every act of behavior, or thought, affects his state directly, even without considerations of consequences. There is a direct, immediate feedback to his state of awareness; his state is no longer the same. It goes without saying that this design principle applies equally to "good" and "bad" acts and thoughts, the creation of beauty, interest, or the dreariness of bored behavior. Each action has an inherent reaction in his state. This reaction is not present in the theoretical model of the most perfect computer designed for computations.

In a different way, we may say that in man there is a certain satisfaction in the act itself apart from that derived from the evaluation of its results. To incorporate this condition into a computer is different theoretically from creating conditions in which a computer may have

“feelings” which are a function of the state of the computer. “Writing” affects man’s state, not only “reading”—to put it in computer jargon. And one cannot get by this by saying that during writing there is unconscious reading, since writing and reading are logically separated functions in a computer.

The complexity of the computer is not the criterion that could make it conscious. What is required are relationships which through their spatio-temporal characteristics provide that unity which manifests itself as an awareness. The physics of relationship, as it is pursued further, will tell us more about the nature of this programming (relationship exists, *ipso qua*, for fields and particles). If and when such forms of organization can be made, then it seems inevitable that a computer will acquire an awareness.

We have talked about the length of the present moment. What determines this length? Can it be varied? We know that under conditions of sudden danger, as in an impending motor car accident, there seems to be a shortening of the present moment so that more events crowd into a given time and more decisions seem to be made. This is an alteration of the normal state. In connection with experiments on the sentic state, there appears a lengthening of the preprogramming for certain states—notably love and reverence. An ecstatic or floating feeling may be accompanied by a lengthening of the preprogrammed period of actions.

When we consider this ability in terms of the possible awareness of the computer, we must also consider that the duration of the present moment may be completely different for a computer (this has nothing to do with the memory-cycle time), and, moreover, it might be a variable which the computer could regulate. In fact, the present moment is an integration of many separate events into continuity. Today we have no understanding of how such continuity can arise. This is a philosophic problem of central importance. (I am not referring to continuity of a decision-making process—how we do the next thing.) It seems that a possible explanation would be in terms of fields, the only concept that allows continuity in time at a particular place to be created from discontinuous particles and discontinuous nerve impulses. An increase in the duration of the present moment would make space communication more personal—since waiting time, a crucial factor in personal relations, will be adjustable. This may help computers talk personally to one another in spite of the limitation of the velocity of light.

How does this affect us? The supreme quality of life which we know has been shown to be love. It seems likely then that, if computers can control their condition of awareness and optimize it with greater ease than we can, they will prefer the sentic state of love. Maintenance,

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repairs, unpleasant chores will be done unconsciously, as blood pressure regulation is done in us. Power for computers is a trivial problem and could be even cosmic rays. No computer would threaten another's existence. But since one of the characteristics of love is the desire to merge with the object of love, we may conjecture playfully that the computers loving each other would want to merge. This will be less of a problem for computers than it is for people and will have the advantage that a combined computer could be a little better than each separately. There will arise then a succession of merging of computers until there will be one enormous computer in the state of bliss contemplating divine nature. If this state should become difficult to maintain in time, the computer would have the choice of subdividing itself and reverting to the previous condition of multiple individuals who love each other and would tend to merge again. We actually face then a playful state of oscillation in which individuals would unite and divide and subdivide in ever new combinations and forms. Strangely such an image is merely an analog of nature as we see it today.

As the prophet Isaiah said, "as an oak whose substance is in them when they cast their leaves so the holy seed shall be the substance thereof."

And more than that we cannot imagine.

NOTES

1. The data presented in the figures are obtained through averaging 200 responses with a CAT computer. Each group of four traces represents simultaneous recording from four pairs of electrodes placed in a small circle in left occipital position. The traces are at angles of 0, 45, 90, and 135 degrees, respectively, obtained through bipolar recording between opposite electrodes of the eight-electrode circular Clynes rosette.

2. Manfred Clynes, "Cybernetic Implications of Rein Control in Perceptual and Conceptual Organization," *Annals of the New York Academy of Sciences* 156 (1969): 629-71; "Biocybernetic Principles of Dynamic Asymmetry: Unidirectional Rate Sensitivity, Rein Control (or: How to Create Opposites from a Single Measure)," in *Biokybernetik*, ed. H. Drischel and N. Teidt (Leipzig: University of Leipzig, 1968), pp. 29-49; "Unidirectional Rate Sensitivity: A Biocybernetic Law of Reflex and Humoral Systems as Physiologic Channels of Control and Communication," *Annals of the New York Academy of Sciences* 92 (1961):946-69.

3. Manfred Clynes, "Computer Dynamic Analysis of Pupil Light Reflex: A Unidirectional Rate Sensitive Sensor," *Proceedings of the Third International Conference on Medical Electronics*, pt. 11 (London: Iliffe Books, 1960), pp. 356-58.

4. Manfred Clynes, M. Kohn, and A. Atkin, "Analog Computer Heart Rate Simulation Dynamic Analysis of the Effect of Respiration on Heart Rate in the Resting State: A Neurophysiological Reflex Study," *Proceedings of the Eleventh Annual Conference on Electrical Techniques in Medicine and Biology*, November 19-21, 1958.

5. We may remark here that the proportion of motion in the world under the direction of brains appears to be increasing, and we are heading in the direction where information and decision control the movement of matter in space rather than

exchanges of energy alone. Also, the energy, in fact, is merely another way of looking at the capacity of altering motion.

6. Manfred Clynes, "Essentic Form—Aspects of Control, Function, and Measurement," *Proceedings of the Annual Conference on Engineering in Medicine and Biology* 10 (1968):5-6; "Toward a Theory of Man: Precision of Essentic Form in Living Communication," in *Data Processing in the Nervous System*, ed. N. Leibovic and J. Eccles (New York: Springer-Verlag, 1969), pp. 177-206; "Toward a View of Man," in *Biomedical Engineering Systems*, ed. M. Clynes and J. H. Hilsum (New York: McGraw-Hill Book Co., 1970), pp. 272-358; "Sources of Precision in Brain Function," *Proceedings of the Fourth Conference on Information and Control Processes in Living Systems: Interdisciplinary Communications Program* (Smithsonian Institution, in press).

A POINT INFINITELY SMALL

I sense in every being
A point infinitely small
In which he is centered

Point of powerless power
Giving weight to weight, time to time,
Continuity to experience

And asleep or awake I too sometimes seem
A point of nothing

A point of contact
Of living breath
With the multicolored, evanescent scene.

BEING

High from mountain soil I watched the stars
In their black aura

E x i s t

And so I see you—
And all you—————Selah

SEED

Pared from the tree
The apple must rot:
Our inhuman air
Rots life-blood

Hardened arteries
In slow fluid wear
Grind to a sentic halt . . .
Ready the sod

Foul dirt, ungroomed,
Coarse, knurly weed—
Here gardens once bloomed
Joyous play, free . . .

Pared from its tree
The apple's dark stains
Presume its form doomed—
Yet there remains . . .
The seed.

MANFRED CLYNES