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Mental Dynamics

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MENTAL DYNAMICS

by

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ABSTRACT

The non-physical life activity within an organism is described mathematically by means of a basic formulation to which numerous variations and embellishments can be appended as required. The fundamental principle of overall activity normalization is presented and discussed in terms of its practical and philosophical consequences. Discrimin is introduced as a necessary complement to intelligence and creativity in the structure of genius. Future directions for development are described in terms of both deterministic and stochastic analysis for the organism as an isolated unit, as a member of society, and as an interacting element of the natural universe.

I. INTRODUCTION

Mental dynamics refers to all non-physical life activity occurring within an organism. Not included are physiological activity or response, although there is an intimate relationship to those collateral processes.

Mental dynamics is conceived to be a highly complex sequence through time of strongly interacting activities, with much nonlinear feedback and coupling. As with the dynamics of molecules in a box or turbulent eddies in a river, the investigation of all details is considered from the outset to be impossible. Just as the principles of those complex processes nevertheless have been given precise formulations, so also the present goal is to write a precise formulation of the principles of mental dynamics. The approach is mathematical for two reasons. First, the conciseness allows for a description of ideas in a manner that is unobscured by lengthy verbal maneuvers, enabling the interaction among principles to be considered with relative ease. Second, the equations can be subjected to quantitative verification by solving them, or approximations to them, in a variety of specific circumstances.

The name, mental dynamics, is chosen in recognition that the entire scope of these complex internal life processes occurs within a generalized domain of cognisance and comprehension, of which consciousness is only a small part.

The basic entity for discussion is $N(x,y,t)$, which describes the intensity of mental-dynamic activity with pattern x, at time t, centered in the internal subdomain, y. The variables x and y range through non-ordered, discrete variations, and much attention will be required in order to define the sense and content of these variables.

Consider, first, the internal coordinate, y. To give some examples of the subdomains designated by this variable, consider several that may touch our conscious awareness:

1. Motion - the sense of changing physiological relationship to the external environment, or within the organism itself.
2. Regeneration - the sense of growth, repair, immune response, and the maintenance of health in all parts of the organism, rarely with conscious cognisance (usually only through the feeling of well-being or illness).
3. Vision - the sense of sight or mental image.
4. Hearing - the sense of sound, music.
5. Nerves - the sense of feel, bodily sensation, touch, taste, smell.
6. Conception - the sense of ideas, concepts, relationships.
7. Empathy - the sense of presence, personality, non-physical communication with another organism.

The independence of these and other subdomains from each other is an important property of the domain of internal life processes. To test for this independence it is useful to sense, for example, the completely different ways in which a person visualizes a scene on the one hand, or recalls a melody on the other, either in the absence of external stimulus. Consider also, the impossibility for delivery of a musical message by visual images, or a visual message by the images of sound. In this regard, it is necessary to distinguish direct communication to a subdomain from associative coupling between subdomains. This latter, which is an important part of mental dynamics, enables, for example, the induction of a visual image as a consequence of <u>coupling</u> from the audial subdomain, which has been delivered a musical message.

The existence of activity in a subdomain can be associated with stimulation of that subdomain by the external environment. With variable frequency,

the existence may result from the dictates of consciousness. Many forms of activity, however, are not accompanied by awareness. A primary activity may not be sensed, but the collateral activities induced by associative coupling can enter consciousness in a rich and sometimes bewildering array.

Coupling is the process whereby activity $N(x,y,t)$ is induced by activity $N(x',y',t)$. This coupling may be intrinsic (instinctive) or learned.

The pattern, x, is somewhat difficult to define with precision. It may, for example, be a concept, an image, a sound, or a feeling. In each case it may refer to a specific, individual entity or to a collection (synthesis) of entities. For example, patterns associated with "door" and "wall" can exist as concepts or images. "Door" as a concept exists in a different subdomain from "door" as an image, but activity in the vision subdomain at pattern "door," perhaps induced by external stimulus, may couple to produce activity at pattern "door" in the conception subdomain. Both "door" and "wall" are elements of the pattern "house," but the latter contains no more complexity than the element patterns.

Every pattern is exactly as simple or complex in content as every other pattern. This rule, which we shall accept by definition, serves to describe more precisely the meaning of a pattern. For example, the pattern, "clock," is no more complex than the pattern, "that clock," even though "clock" contains, in a sense, not only "that clock" but also all other specific clocks. Thus the group pattern contains only the features that characterize the group, and is as simple in content, therefore, as the content necessary to specify any particular member of the group.

Response is any process for which the existence of mental-dynamic activity couples to produce physiological action, for example

1. flow of blood
2. running
3. breathing
4. intestinal action
5. building of scar tissue
6. speaking
7. destruction of disease
8. growth of hair.

The complexity of these processes implies the simultaneous existence of activity at many closely coupled patterns. Note that the mental process centers

only on the pattern; the resulting response itself is neither a pattern nor a mental-dynamic activity.

Any residual ambiguity at this stage of description regarding the meanings of x and y may be dissipated gradually by the following development, which introduces a formulation for the variations of activity and the associated correlative processes that constitute mental dynamics.

II. VARIATIONS OF ACTIVITY

We postulate a description of activity variation by means of the following equation

$$\frac{\partial N(x,y,t)}{\partial t} = \alpha(x,y,t)\, E(x,y,t) - \gamma(x,y,t)\, N(x,y,t) + Q(x,y,t) + \sum_{x'} \sum_{y'} \beta(x,x',y,y',t)\, N(x',y',t) \quad . \tag{1}$$

The various terms on the right side can be explained as follows:

$\alpha(x,y,t)\ E(x,y,t)$ describes the creation of activity from external stimulus, of which the intensity is $E(x,y,t)$. The coefficient, $\alpha(x,y,t)$, varies as a function of its arguments in different ways for different individuals. Theological and various philosophical teachings may include in this term the stimulus from a "hidden" external environment, designating the effects as inspiration or creativity. Dependence of the intensity of external stimulus on y describes the form of the stimulus, and thus its capability to communicate to that particular subdomain.

$-\gamma(x,y,t)\ N(x,y,t)$ describes the decay of activity, with $\gamma(x,y,t)$ varying in a manner to be described below.

$Q(x,y,t)$ describes the creation and/or repression of activity by conscious will and/or the natural response to discrimin.

$\sum_{x'} \sum_{y'} \beta(x,x',y,y',t)\ N(x',y',t)$ describes two types of coupling, intrinsic and learned.

An alternative equation could be postulated in which all but the decay term are written within the time derivative, but this formulation precludes short term memory and lends difficulty to identifying the sense of time passage because it determines the instantaneous state of activity from the instantaneous state of the stimuli and couplings.

III. NORMALIZATION AND CONTINGENCY

A fundamental postulate of our theory is fixed activity normalization. In symbols,

$$\sum_x \sum_y N(x,y,t) \equiv N_0 \quad , \tag{2}$$

in which the variations of N_0 with time are very slight, except as a result of major injury. By slight variations we mean that they are appreciable only on the time scale of a major fraction of the elapsed time since biological conception of the individual. The intrinsic quantity, N_0, may differ considerably, however, from one individual to another.

The concept of normalization invokes the previously described condition for equal content of every pattern, and requires, in addition, a unique distinction among patterns at the various x coordinates.

Normalization implies a contingency status for the variable $\gamma(x,y,t)$, which can be formulated more precisely (but not uniquely) by summing Eq. (1), as follows:

$$\sum_x \sum_y \gamma N = \sum_x \sum_y \left[\alpha E + Q + \sum_{x'} \sum_{y'} \beta N\right] \equiv S(t). \tag{3}$$

To ensure uniqueness requires a further postulate. For example, we may wish to explore the consequence of

$$\frac{\partial \gamma(x,y,t)}{\partial t} = A_1(t) - b\gamma(x,y,t) \tag{4}$$

from which we can derive an integral equation for $A_1(t)$ in the form

$$\int_{-\infty}^{t} A_1(t') e^{b(t' - t)} dt' = S(t)/N_0 \quad . \tag{5}$$

The interpretation of such a postulate is that the decay rate tends to increase at all internal and external coordinates at the same rate, and to decay in proportion to itself. An alternative postulate to investigate is

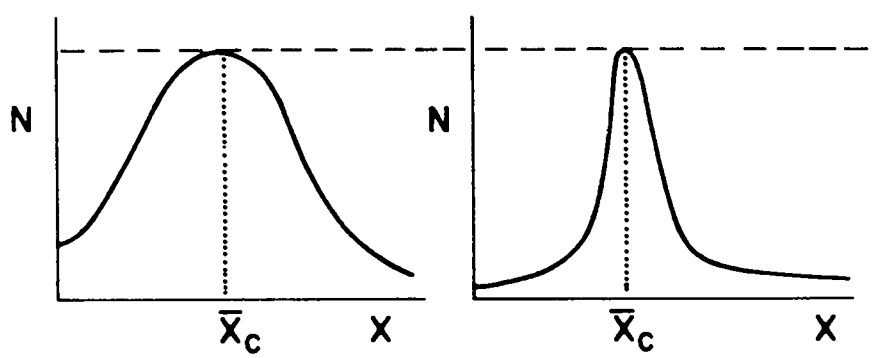
$$\frac{\partial\gamma(x,y,t)}{\partial t} = A_2(t)\ N(x,y,t) - b\gamma(x,y,t) \quad , \tag{6}$$

which shows an increase in decay rate as a result of prolonged activity, describing growing ease of distraction as a result of boredom (limited attention span). From Eq. (6) we derive a slightly different integral equation for A(t),

$$\int_{-\infty}^{t}\left[A(t')e^{b(t'-t)} \sum_x \sum_y N(x,y,t)\ N(x,y,t')\right]dt' = S(t). \tag{7}$$

An example of the idea contained in Eq. (6) is furnished by staring at a fixed object, such as a star in the sky, for which it is more and more difficult to maintain the mental image. The longer the pattern activity is retained, the more easily it decays.

Note that the postulate of normalization gives meaning to the maximization of N(x,y,t). For example, with y denoting the domain of conception, the pattern coordinate maximizing N(x,y,t), denoted by $\bar{x}_c(t)$, describes the progression of a train of conceptual thought, which, of course, is not necessarily continuous. Normalization also implies that the greater is $N(\bar{x}_c,y,t)$, the lesser will be N(x,y,t) for all other x coordinates. In words, this means that strength of activity (i.e., level of concentration) may be either lightly distributed over numerous patterns, or very intensely focused on one pattern, but cannot be intensely focused on numerous patterns. Thus, the concept of "intelligence" is closely related to the level of N_o in an individual. To see this relationship, we may compare the following idealized graphs of activity strength as a function of pattern coordinate for two different individuals. Both show the same maximum



of intensity (at the level of the dashed line), but one is much wider than the other, corresponding to a larger value of N_0. Thus both individuals may concentrate with equal intensity on the pattern at the center of focus, but one can simultaneously give relatively strong attention to numerous collateral patterns while the other cannot. Another way of characterizing the contrast can be seen by an alternative pair of plots with the same width but different heights. In this comparison both individuals are contemplating the same scope of patterns, but the one with larger N_0 is capable of much stronger attention than the other. In both of these comparisons, it is seen that the processes we use to measure intelligence (i.e., synthesis, ordering, relating, etc.) are much better accomplished by the individual with larger N_0. Although intelligence is usually measured by testing the internal subdomain of conception, the broader concept of activity normalization across all internal subdomains means that high intelligence may imply superlative capability in other aspects of mental processing, which is, indeed, an observed feature in humans.

Another aspect of normalization over all the interior subdomains is associated with the enforced persistence of strong or weak activity in any one of them. A large decrease in activity in the conscious brain during sleep, for example, may allow for a corresponding increase in activity in the regenerative subdomain. In contrast, continued excessive activity in the consciousness may preclude sufficient regenerative activity, leading to illness. It has been observed that illness often follows a major event in a person's life. Prolonged enhancement of activity in the non-regenerative subdomains may be the cause. Recuperation from an ordinary illness is generally enhanced by decreasing the activity in other than the regenerative subdomain; indeed intensive regeneration activity would automatically preclude activity in other areas. "Miraculous" cures, associated with "faith" or with the Gestaltist's "return of mental control to the natural processes" (a direct consequence of "body awareness"), may be attributable to the effects of decreasing a frenzy of partially-conscious self-controlled activity (the giving up of "free will" as a gesture of secular or theological faith), and the consequent increase in activity associated with the regenerative subdomain. A corollary of this viewpoint is that visible curing, either "spontaneous" or "miraculous," is no different from the continuous process of hidden regeneration, all being the natural activity of an organism until precluded by contingency degradation of the regenerative subdomain induced by increased activity elsewhere. Many additional conclusions that follow from

these postulates and interpretations are of consequence to both practical and philosophical questions in their relation to the full spectrum of possible coupling among subdomains, and thus in the interpretation of numerous aspects of behavior in the whole (Gestalt) organism.

It has been shown that normalization requires a contingency status for $\gamma(x,y,t)$. As a result, this function can vary with great rapidity, depending on the reception rate of external stimuli and self dictations. The magnitude of $\gamma(x,y,t)$ represents the strength of distraction, not loss of memory, this latter being related to variations in the activity function, $N(x,y,t)$ for short-term memory, and in the coupling function, $\beta(x,x',y,y',t)$ for long-term memory. Coupling strength generally varies more slowly than γ or N, representing the cumulative effects of activity, as described in the next section, although perhaps there are contributions to the variations of β that can vary with contingency-function rapidity.

Thus we see two levels of time variation, one derived from contingencies and self dictation, for which the rapidity can be as great as the rate of changes in pattern stimulus, and one derived from the integral of the contingencies and self dictations, for which the rate is much slower, with significant changes often requiring hours, weeks, or perhaps even years.

In addition, there is a third level of time variation, carried by the intrinsic parameters and functions, which normally will remain essentially constant for major fractions of a lifetime. N_o is a principal example of such an intrinsic quantity, and others will emerge as details of the theory are developed. Here we may note that irregularities, malfunctions, or departures from "normalcy" can occur at each of the three levels of variability rate.

1. Malfunctions at the intrinsic level include retarded intellect and psychosis.
2. Malfunctions at the integral level, not produced by those at the first level, include neurosis.
3. Malfunctions at the contingency level, not directly attributable to an integral-level source, include such manifestations as occasional strong frustrations.

It could be postulated that $\alpha(x,y,t)$ is also a contingency function. This coefficient describes the effectiveness of external stimuli in enhancing the intensity of activity at the coordinate of the stimulus pattern. While almost any type of stimulus, if strong enough, will induce activity, there are various fac-

tors that work to mitigate the effectiveness of this inducement. One of these is related to the strength of activity at some other coordinate; the greater this is, the less effective is the external stimulus in accomplishing a distraction, a conclusion that follows directly from the normalization principle. Another factor is the nearness to saturation of the full spectrum of external stimuli; the greater the diversity and strength of $E(x,y,t)$, the less is the influence that can be exerted by the stimulus for any particular x. To describe these effects, however, does not require contingency variation of $\alpha(x,y,t)$; they can just as well be attributed to enhancement or suppression of activity by the other terms in the equation, so that we postulate only very slow changes in the coefficient over major fractions of lifetime.

IV. COUPLING

Activity at coordinates x', y' can induce activity at coordinates x,y through the coupling term in Eq. (1). The coupling function $\beta(x,x',y,y',t)$ is composed of two parts:

1. Intrinsic coupling $\beta_0(x,x',y,y',t)$, which describes the intrinsic (instinctive) processes of association.
2. Learned coupling, which can be continually reinforced by experience or allowed to decay through neglect.

An example of intrinsic coupling is the association in a baby of sucking action with mouth touch. Learned coupling is exemplified by the ability to play a musical instrument.

To describe the variations of the coupling function, we postulate an equation of the form

$$\frac{\partial}{\partial t}\beta(x,x',y,y',t) = B(x,x',y,y',t)\, N(x,y,t)\, N(x',y',t)$$

$$- \omega(x,x',y,y',t)[\beta(x,x',y,y',t) - \beta_0(x,x',y,y',t] \quad . \tag{8}$$

The function $B(x,x',y,y',t)$ expresses both intrinsic talent and the effects of interest, desire, or pleasure, which "subjective" attributes are described in a subsequent section. The decay function, $\omega(x,x',y,y',t)$, is expected to exhibit time variations only at the slowest rate.

Coupling is the source of long-term memory, which is here recognized as the inducement of activity at a pattern for which no external stimulus is present,

as a result of coupling from a pattern currently receiving activity. Examples are the "spontaneous" conceptual or visual image that comes from hearing a particular piece of music; and the nostalgic or nervous feeling that comes from sensing a particular fragrance. In other words, long-term memory is a learned association between patterns, activity at one of which can be induced by coupling from activity at the other. Short-term memory is simply the continuity or persistence of activity, perhaps enhanced by conscious dictation or other reinforcement.

A sequence of couplings constitutes a train of thought and/or (with induced responses) action. Many couplings can be occurring simultaneously. As a by-product, the induced activities, also occurring simultaneously, reinforce the strength of the coupling function. Even if external stimuli occur in a temporal sequence of isolated patterns, the persistence of activity at a previous pattern can join with the inducement of activity at the present pattern to give the simultaneous activity required to enhance the coupling function.

Note that Eq. (8) omits reference to such possible binary terms as $E(x',y',t)N(x,y,t)$, which might have been supposed to enhance coupling; but only if $E(x',y',t)$ induces activity $N(x',y',t)$ is there then an enhancement to the coupling function, and Eq. (8) already expresses this process.

A time-averaged (saturation) level of coupling strength is described by the time averaged vanishing of the right side of Eq. (8). The larger the talent or desire as expressed by B, the greater will be the mean level of coupling.

Synthesis can be defined as the recognition of traits in common among multiple patterns. The key to the concept is recognition, not the "creation" of a traits-in-common pattern. The latter must exist even before synthesis takes place, serving as a collective pattern for correlation of multiple concepts, images, etc., in the synthesis. Accordingly the process of synthesis relies heavily on the existence of coupling strength, and is already described by the theory as stated.

An increasing level of ability for synthesis in a particular class of activities is thus dependent on the growth of coupling strength, which in turn depends on the B function, describing the level of talent and/or desire. The ability for synthesis is also enhanced by possession of a large magnitude for N_0, and small magnitude of the ω decay function.

An example of synthesis and the ability to achieve it is given by the classifying of automobiles as to make and model. The traits in common for a par-

ticular group can be recognized if coupling strength has been built between the individually observed objects and the patterns of their distinguishing characteristics. Even if coupling between "that car" and "broad front end" tends to be built by simultaneous activity (resulting from simultaneous observation), the Q function may repress the potential trait-in-common pattern as noise, not essential or valuable to the individual, and hence not persistent long enough to build up coupling. As another example, "brown clock" and "brown radio" are both "brown," but the mind may suppress the trait-in-common pattern because it is noise, not essential or even interesting unless, of course, the mind belongs to an interior decorator for whom "brown" couples in turn to the other objects in a room for which he wishes to make a pleasing arrangement. In this latter case, the synthesis coordinate becomes a highly useful pattern, to which he reacts with enhancement, thereby exhibiting talent, learned ability or desire for that type of synthesis.

Emotion is here recognized to be a special kind of coupling, namely the by-product coupling from activity at some x and y to activity specifically centered in the nervous subdomain. There need not be an actual physiological response; only the mental sensing of the bodily region associated with the response is required for emotion. Thus, for example, activity at some pattern in the conceptual subdomain is termed sad if there is coupling to a sensation of the tear ducts and of those muscles around the mouth that produce crying. It is termed fearful if a "lump in the throat" or a twinge in the stomach is sensed. It is termed angry if the eye-widening and adrenal-gland muscles are sensed. The primary activity may occur in any of several subdomains. Loving emotion, sensed in almost all parts of the body, may arise from primary activity in the subdomains of vision (seeing a beautiful person), nerves (feeling a soft touch or smelling a particular fragrance), conception (reading a sexy novel), hearing (listening to a particular song), and perhaps even motion.

A mechanistic variety of creativity exists that can be related to a strong capacity for sensing activities that have been induced through long chains of coupling circuits, bringing into simultaneous cognizance the activities at patterns that were never before closely associated, thereby creating new couplings. The results of creativity need not make "sense;" for that aspect of the process, discrimin is required.

V. DISCRIMIN AND THE Q FUNCTION

Discrimin is considered to be an intrinsic property that allows for the absolute discrimination of rightness or correctness. To the extent that the actions of discrimin are sensed by the conscious mind, the effects are manifested by what we call contentment, conscience, natural interest, feeling of intrinsic (rather than emotional) pleasure, and perhaps most especially, by the sense of beauty. The manifestations of discrimin are not emotion, although emotion may be simultaneously present. The messages from discrimin may be weak or strong in various individuals, and may be heeded or ignored in any one individual.

Discrimin is the property that enables the body to follow the proper course of regeneration. It guides the composer of music to the proper choice of melody and arrangement, among all the possibilities furnished by his creativity. It guides the scientist whose "hunches" seem usually to be correct in the course of his research. It serves as a continuous gentle hint regarding the proper decision to make at every level of mental-dynamics activity, conscious or unconscious. It is absolute in its correctness, independent of the individual, but is never absolutely followed because of the ease in overriding its influence. Indeed, for some individuals its voice may be so weak as to be imperceptible; for all individuals it may be weak in at least some subdomains of the activity and pattern coordinates. A person may develop a distrust of discrimin and ignore it even when its voice is loud, or perhaps even act in opposition to it.

In our mathematical formulation, discrimin is represented in both the B functions, which modify the development of coupling strength, and the Q functions, which influence the level of activity.

Consider, first, the effects of discrimin on $N(x,y,t)$. Let $P(x,y)$ be an absolute measure of rightness for mental dynamics activity at pattern x in subdomain y. Thus, $P(x,y)$ is not just a property of the individual, but extends in collective fashion through the domain of the sub-species, species, genus, or higher biological unit, indeed throughout nature in some cases. As a species imprint, for example, it carries all the traits that give specific identity to the individuals. To the extent that the traits are physiological, they are carried, at least in part, by the structural molecules of the genes. More generally, they are carried by an unspecified mechanism, with effects represented by $P(x,y)$, which function may be positive, producing enhancement, or negative, producing repression.

The effects of possible "hidden" external sources to activity, identified as the inspirational part of creativity, are contained in the term proportional to $E(x,y,t)$. Discrimin, in contrast, is a somewhat different entity, to which we do not ascribe the capability for reasoning (intelligence) or innovating (creativity). As an independent attribute from those, it needs a different form of representation. The basic principle here is that discrimin can only comment on activity that arises from other processes. Thus, we write for the discrimin part of the Q function,

$$Q_D(x,y,t) = P_o(t)\ P(x,y)\ N(x,y,t) \quad ,$$

in which $P_o(t)$ measures the slow (or rapid) variations of the strength by which discrimin is allowed by the individual to function. Note that the proportionality of Q_D to N works to ensure that Q_D can never produce negative values of N, despite the negative values that $P(x,y)$ can have.

Regarding the effects of discrimin on coupling, we have already indicated an intrinsic imprint through the presence of $\beta_o(x,x',y,y',t)$, part of which may be specific to the individual but part of which may be collective across some subset of natural organisms, thus absolute. This absolute part of the intrinsic imprint, however, is not to be identified with discrimin. Consistent with the idea that discrimin only moderates the effects of otherwise-existing activity, rather than dictating or creating these effects, we must restrict our identification of discrimin in the coupling equation to the B functions. Just as Q is divided into several parts, one being Q_D described above, so also can we identify the term

$$B_o(t)\ B_D(x,x',y,y')\ N(x,y,t)\ N(x',y't) \quad ,$$

which carries the discrimin effects in the equation for coupling strength.

The rest of the Q function describes consciousness modulation of activity, represented by $S(x,y)$ in the form

$$Q_E = S(x,y)\ N(x,y,t) \quad .$$

Whereas $P(x,y)$ measures absolute rightness (independent of the individual), the analogous $S(x,y)$ is an individual intrinsic function of the particular organism.

Thus S(x,y) expresses a permanent imprint on the individual, and carries no particular message of absolute rightness or wrongness. Note that while P(x,y) is modulated by $P_0(t)$, which may vary rapidly in time, there is no similar modulation to S(x,y), although the effective strength of Q_E does depend on the magnitudes of the other terms with which it competes.

With the establishment of the distinctive characteristics of discrimin, in particular its ability to function only as a modifier to otherwise-existing activity, it now becomes apparent that E(x,y,t) plays a more crucial role than may previously have been apparent. In addition to a representation of the sensible environment, and to those parts of the "hidden" environment related to creativity, inspiration and instinct, E must carry the continuous message of all relevant facets of regeneration, growth, evolution, and functioning related to the activity of the individual as part of various larger biological and natural entities.

The remaining facet to be modeled is the seemingly capricious, almost random innovations and modulations impressed by consciousness itself, representing the effects of free will as opposed to the more deterministic parts of the theory described above. For the moment we may consider this input function to be included as random-variable parts of E and P_0, thus letting the dictates of consciousness be, in part, a subset of the "environment" in which the organism is functioning.

This analytical modeling of discrimin brings up questions of the objective (analytical) verification of its presence and effects. At the same time, however, it is important to look for the possibility of internal (subjective) verification. This latter relates to the procedures a person can use within the laboratory of his own internal life processes, which is the only arena of observation accessible for first-hand study. In this regard, there are various techniques that the observer can use to sharpen his cognizance and comprehension of mental dynamic activity, and to discriminate among the various moderating influences that direct the course of that activity. For example, the influence of discrimin has been described in terms of beauty and pleasure but it should be emphasized that the pleasurable sensation of true discrimin is quite distinct from the <u>emotion</u> of pleasure, which may have little to do with the discrimination of correctness.

To enhance conscious observation of the sensation of discrimin requires only that the dictates of consciousness be curtailed. To the extent that this

curtailment can be accomplished, the resulting "spontaneous" activity will be discrimin-directed, with the associated sensations of well-being, beauty and rightness reflecting directly the awareness of discrimin in action. "Gestalt Therapy" exercises and certain types of meditation allow return to discrimin-directed activity, thereby dissipating false concepts of rightness and beauty in favor of a true and absolute sensing of correctness and well-being.

Discrimin plays a central role in the definition of art, which is any process done with feeling and a sense of rightness. In mental dynamic terms, feeling means emotion coupling and the sense of rightness means cognizance of acceptance by discrimin. Here, art is identified as the process; the products of art are often designated by that same word, which is only appropriate if those products are capable of stimulating the process of artistic observation or performance.

Active discrimin in each subdomain is manifested by various direct and coupled sensations, of which the following are a few examples:

1. Motion - the pure joy of dancing, kinesthetics, physical re-orientation, spatial change and sense of bodily position.

2. Regeneration - the beauty of pure well-being; the sense of confidence in good health and of rightness of bodily sensation, with emotion coupling to and from the sensations of delicious nervous activity, tingle, shiver, and stretch joy.

3. Vision - the sense of attractiveness in art, scenery, and the products of human manufacture; the joy of color, visual form; the pleasure of forms and colors that induce beautiful ideas and bodily sensations.

4. Hearing - the beauty of music and the sounds of nature; the joy of the associated beautiful ideas and spontaneous bodily sensations.

5. Nerves - the beauty of feeling and tasting and smelling good textures, foods, perfumes; the feelings of strength; the rightness of emotion linkage from other centers; the feelings of sexual fulfillment as an end in itself apart from the concepts of purpose or appropriateness.

6. Conception - the beauty, thrill, and joy of an idea that makes sense, of rational ordering, synthesis, and of scientific cognizance.

7. Empathy - the pure joy of human presence; the feeling of belonging to society, the fulfillment of the purposes for gregariousness, the beauty of vicarious experience.

In the "lower" animals, intrinsic coupling (instinct) and discrimin predominate, whereas in the "higher" animals, the effects of self dictation become progressively stronger, and may strongly predominate in man, in at least the conceptual subdomain.

VI. THE "HIDDEN" EXTERNAL STIMULI (A PHILOSOPHICAL QUESTION)

Creativity and imagination are described as a strong capacity for sensing activity induced through long chains of coupling circuits, bringing into simultaneous cognizance the activity at patterns that were never before closely associated. Alternatively, these attributes are sometimes conceived, at least in part, to represent communication from hidden (nonapparent) external stimuli.

The first interpretation implies that creativity and imagination do not introduce activity at any new patterns, but represent instead the ability for retaining strength in a wide variety of coupling functions. As a result, simultaneous activity occurs with patterns not previously associated, allowing for the buildup of direct coupling strength between those patterns. This interpretation therefore allows even a computer to have creativity and imagination.

With the second interpretation, activity is induced at completely new patterns by means of stimulation from a hidden external source. In that case, we often refer to the process as inspiration.

The conscious self, through the response of its dictates, possesses the ultimate capability for at least partially cutting off the ordinary environmental source of stimulus, either temporarily (e.g., by removing oneself from an undesirable location) or permanently (e.g., by suicide). Likewise the "hidden" external environment, the source of inspiration, can be eliminated either temporarily (e.g., through emphasis on self-reliance and the insistence on reality for only the ordinary environment) or permanently (e.g., through "killing the soul," "eternal damnation," etc.). Concerning the dominance of self dictation in its effect on inspiration, we may expect the existence of communication in both directions; during lifetime, reception by an individual is related in intensity to the return of experience to the source; after lifetime the previously established level of communication is all that remains after removal of the ordinary environment and the termination of self dictation. In theological terms, faith and inspiration (the receptive process) are accordingly related to salvation (the donative process), with free will (the self dictation) maintaining a capability for either the enhancement or repression of both.

Note that the concept of two-way interaction with the "hidden" external environment implies a generic or even specific identity for the reservoir of patterns, to which we have also previously ascribed a possible discrimin, linked to the proper psychic (or other) evolution of the genus or species.

The philosophical question raised by these considerations can be stated as follows: Is it possible to distinguish between the organism as an isolated entity, and the organism as an integral part of the hidden external environment? In particular, can this distinction be illuminated by a mathematical model in which the consequences of both possibilities are examined in detail?

VII. GENIUS

Genius is defined as the superlative ability that is manifested when the organism possesses three essential (and independent) attributes, all previously described: strong creativity (persistence of long β-coupling chains and/or close access to hidden external stimuli), strong discrimin (P_0 functions with large magnitudes), and strong intelligence (the value of N_0 large).

Genius can be expressed in either (or both) of two closely related ways: innovation (e.g., the composer) and interpretation (e.g., the performer). In some cases these merge, as in the creation of visual arts, when the innovator (artist) and the performer (craftsman) are the same person.

Genius in each center is exemplified as follows:

1. Motion - intense skill in spontaneity of activity; the gymnast, musician, typist, dancer.

2. Regeneration - development and growth of a superb body and mind, perfection of well-being, health, long life, absence of senility in old age.

3. Vision - magnificent capability for the expression of visual beauty, the artist, the inspired tour or nature guide (in part).

4. Hearing - the finest musician (composer or performer), poet (including only the sounds, not the ideas), the discriminating recorder of natural sounds.

5. Nerves - the magnificently excellent masseur, sex partner, chef, creator of perfumes, designer of supple leather garments or sensuously soft fabrics, the sculptor of fine rubbing stones.

6. Conception - the outstanding scientist, essayist, news analyst, philosopher, psychologist.

7. Empathy - the expert story teller of human circumstances, the central person in social activities, with charisma and personal magnetism.

Partial genius results from strength in one or two of the necessary attributes. Intelligence plus discrimin make a fine and useful combination, even when creativity is weak, especially if another person can supply the missing new ideas. Intelligence plus creativity in the absence of discrimin can lead to quackery. Inspiration plus discrimin in the absence of intelligence may lead to "sainthood." Intelligence alone can produce an interesting curiosity, for example, a mathematical wizard who ends up in a menial job because of his lack of capability for useful research, investigation or application except when completely supervised. Discrimin strength alone produces the conscious-stricken person who suffers at the wrong all about him, but is helpless to do anything about it. Creativity alone can result in a life of madness, imbedded in a morass of ideas and thoughts but unable to recognize reality or to express the pandemonium that surges within.

In summary, creativity develops the new ideas, discrimin sorts out the correct ones, intelligence allows the results to be arranged and communicated, and all three processes are required for true genius.

VIII. DREAMS

A dream is sensed mental dynamics activity during sleep, occurring at a variety of patterns, perhaps in a separate subdomain of its own, with memory of it principally associated with the visual and conceptual subdomains. Dream-like activity, precluded by normalization during wakefulness, occurs more easily and as a result of milder coupling strength during sleep. The resulting activity can accordingly be intense, and can proceed through a sequence of patterns for which the coupling would otherwise be too weak for occurrence when awake. The dream may therefore be quite unexpected and surprising in its content.

Unless associative coupling strength is built between the dream patterns and the patterns sensed during first wakefulness, there is likely to be little or no long-term memory built for the dream, which fades in the same way any activity (short-term memory) dissipates.

A dream may be coupled to the first wakeful senses, namely the environmental surroundings of the sleep area, so that later returning to that same area produces mental activity that couples to activity at the dream patterns. This, in turn, may couple to other activity that re-creates the whole dream, or at least to that part of it for which there are coupled interconnections.

Learning how to remember dreams is learning to build coupling strength between the subdomain of dream activity and the subdomains associated with conscious thought, which usually can be accomplished only during the brief period when both are simultaneously sensed. To build this coupling requires the self to perpetuate the cognizance of both types of activity, for which it is necessary to disallow (or avoid seeking) the buildup of so much wakefulness as to destroy the dream before β coupling has been sufficiently established. The value of dream memory is the usefulness of these strengthened coupling chains, which can enhance creativity and self understanding. They also can remove concern associated with the nagging presence of subliminal coupling tendencies, for which the energy required to maintain suppression can be directed to other useful purposes.

IX. DIRECTIONS FOR DEVELOPMENT

At this stage the theory is primarily deterministic, with stochastic properties arising only through a consideration of time-averaged moments or moments across patterns in one or several subdomains of activity. In addition, the interaction with a seemingly capricious sequence of self dictations may introduce the need for stochastic interpretations in the mental dynamics of an individual.

To the extent that the theory is deterministic, however, there are various simplified models for which calculations can be performed, either analytically or with computer. Preliminary results, not presented here, exhibit in believable fashion the effects of normalization and demonstrate learning as a result of exterior stimulation. Many more results are yet to be obtained.

The deterministic approach is also appropriate for the investigation of encounters between two organisms, the activity of each resulting in response that the other senses as stimulation from the environment. For more than a small number of organisms, however, the deterministic approach must be supplemented by a stochastic analysis of the group. For this purpose we require a Liouville formulation, in which the primary variable is a distribution function for the joint probability of activity among all the different organisms, each with specified patterns and subdomains. In such a Liouville equation, the required deterministic laws of behavior for the individual may be those that this paper has formulated. The stochastic properties then emerge in terms of moments across the range of all individuals. Reduction to a Boltzmann-like equation for the

one-organism distribution function will be accomplished by taking appropriate moments and utilizing auxiliary principles, empirical data, or speculative models as a means for closure. The result at that stage will be a fully stochastic description of the individual in his environment, in contrast to the deterministic description presented above. In that form, the theory should be applicable to the study of human mobs, schools of fish, packs of dogs, and other animal aggregates. It would also apply to the study of cultural units, villages, neighborhoods, industrial organizations and larger political units, and to the long-range evolution of biological populations with competition for sustenance. Problem examples for investigation include the analysis of control methods for a riot and the effects of proposed legislation on a human population.

Conversely, the investigations could begin at the other end, with postulated or empirical relationships to express the stochastic properties of a group. A rioting mob of people, for example, can be characterized by such functions of position and time as those that describe fear, density of people, velocity of propagation and the intensity of incitement. Comparisons between analysis and field observations would lead to confidence in the mathematical description, serving in turn as a useful basis for accomplishing closure for the stochastic moment equations and for the specification of unknown descriptive functions in the basic deterministic equations themselves.

The problems are complex and so are the details (but not the principles) of formulation, but our contention is that the systematic description afforded by the deterministic mental dynamics theory and its stochastic derivatives will provide a necessary and sufficient basis for considerable progress in understanding the behavior of organisms, both individually and in relation to each other and their environment.

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