ON THE FUNDAMENTAL INTER-SYSTEMIC RELATION FOR BIOSYSTEMS

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Introduction:

In a recent study[1] of the evolutionary origin of life we have delineated certain necessary and possibly sufficient conditions for divergence of matter into living and non-living branches. Briefly stated, this process depended upon the emergence of the following:

- A.) Hierarchical (Subsumptive) Relations
  - 1.) Bidirectionality
    - a.) Dynamical Control
  - 2.) Continuability
- B.) Image (Carrier) Relations
- C.) System-Image (SI) Interrelational System (Process)
  - 1.) Decision System

Bidirectionality and continuability were seen to be effected through the SI interrelational process working on persisting image relations. A specific consequence is that the living branch exhibits an increased tendency-to-order (order-disorder→order) relative to the non-living branch. This appears because the persisting images when continued hierarchically via the SI interrlational process generate a next order level.

In the present paper we intend to explicate in detail the nature of the SI system. In particular, we will show that when it is cast in dynamical form (SI interrelational dynamics) and compared to particle dynamics the intersystemic relation (ususally termed the "potential function" in the latter) is seen to depend explicitly only upon the "past" (including, and in most formalisms confined to, the present instant) whereas in the case of SI interrelational dynamics, the intersystemic relation depends both upon the past as well as upon a possible "future" via the image relations.

It is our claim that this realization represents a major conceptual breakthrough in understanding the process of formalization of experiential biosystem relations. Moreover, it implies various new areas of investigation, such as (1) An entirely new mathematics of duo(actually tri)-relational forms is suggested; (2) The relationship of physics and biology can be more clearly stated; (3) An explication of the meaning of molecular decision theory emerges as a consequence; (4) The basis required for the development of a biosystems theory (esp. the dynamics); (5) The foundation for a theory of psychosystems; (6) A take-off point in the development of a theory of sociosystems; and (7) A possible framework within which such phenomena as those of parapsychology may be understood.

Preliminaries:

Relationalism* is presumptively founded upon the experiential notion of ***Relational System***, which man is and within which he is ***Subsumed***, which he ***Images*** in another form of the same, and which he acts upon by a ***Decision Process*** which is itself relational. Within a presupposed decision system, all theories are defined and formed as specific subsumptive

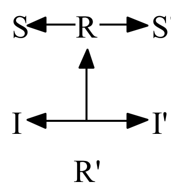
*J.R. Hamann, Relational Systems: Introduction. An evolving monograph.

decision structures. Also subsumed by these presumptions are the notions of "order" and, in inseparable relation, "disorder". It is principally in terms of order-disorder relations that experience is in fact imaged by man in formal systems.

If by prior decision we are given the system variables and relations thereon, but with no given (initial) values, the <u>minimal</u> structure of a "(specifically spatial-temporal) 'real' subsumptive decision system" includes five classes of relations in each level in the hierarchy. These five classes include order-disorder (kinematical and dynamical) and decision (initial value and actional) relations.

As a specific realization of the presumptive foundations of Relationalism, consider the following. By a SI interrelational process we formally mean a structure in which systems S and S' are interrelatable <u>only</u> via a relation R which itself depends upon(relates to) a further relation R' connecting images I and I'. This structure we symbolize as

(R1.)



or more contractedly as

(R2.)

$$\frac{S \quad R \quad S'}{I \quad R' \quad I'}$$

This is as opposed to the general system-system (SS) interrelational process in which S and S' would be connected directly by the single relation R alone.

This latter we symbolize simply as

(R3.)

SRS'

In prior work (see e.g., refs. 2 & 3) the form SRS' has generally been referred to as a "formal system" whereas

$$\frac{S \quad R \quad S'}{I \quad R' \quad I'}$$

has been termed a "formal decision system." The reason for this nomenclature is based upon the identification of existing mathematical relations (e.g., equalities, identities, inequalities, membership, inclusion, transformation, operations, mappings, etc. etc.) as having the form SRS'; hence the term "formal system". In the case of

$$\frac{S \quad R \quad S'}{I \quad R' \quad I'}$$

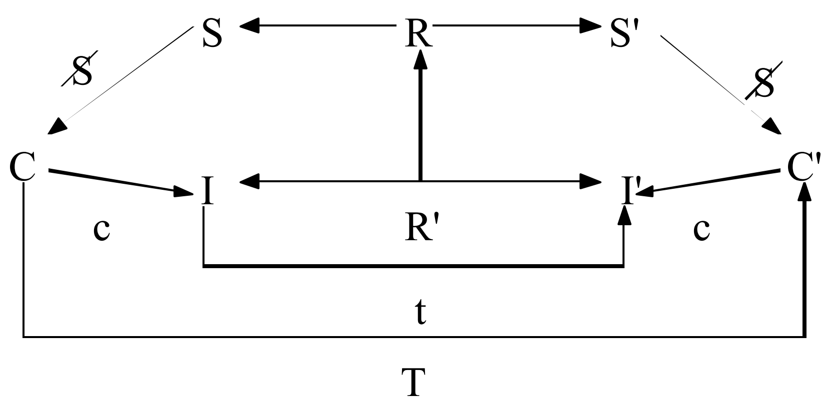
the term "formal decision system" is based upon an analogy with decision theory, especially as it is applied, for example, in economics. This analogy will be made clearer in the next section where a specific decision process is analyzed as a basis for understanding the system

$$\frac{S \quad R \quad S'}{I \quad R' \quad I'}$$

especially its dynamical significance.

As a final point in this section we note that the form of the SI system which must emerge basically for matter to diverge into living and non-living branches is as follows:

(R4.)

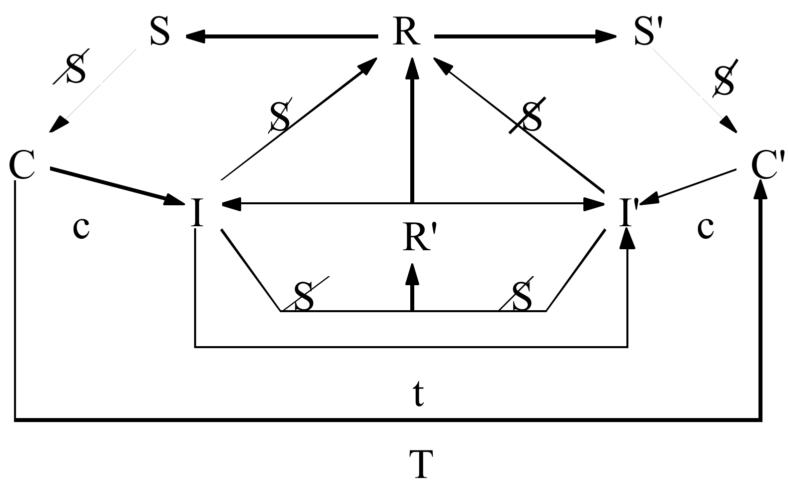


That is, there emerges a carrier C which is subsumed by the physical system S and which carries (c) the image I. In the process of carrier transformation CTC' there is a corresponding image transformation ItI'. S and S' are then interrelated via a relation R which itself depends upon(relates to) the relation R' between I and I'.

<u>Decision System (see, e.g., ref. 4)</u>

Consider the following case from economic decision theory. A small business (S) is described by all available information (I) relevant to the state of business at a given time. For example, the inventory of stock-on-hand, sales rate of all inventory items as a function of time, locality, population, etc., might represent the information-of-state. The immediate problem facing the operator as the carrier (C) of I in S is to decide on his course of action (future) for the day with respect to wholesale purchasing in order to replenish his stock. The procedure for making a choice is as follows: the set of possible (future) actions (I') is constructed on and interrelated (R') with I. R' generally takes the form of some "value" relation, e.g., a utility function, loss function, or other analagous relation. The future (S') of S is then determined as a relation (R) itself related (↑) to R' in IR'I'. This is relationally represented as:

(R5.)



It should be noted that system (R5) differs from (R4) only in the subsumption of R and R' by the image system. This point will be further elaborated upon in the section on sociosystems.

As an example, if R' is a loss function, each possible action I'_i represents a loss in the amount R' (I; I_i'). The future S' of S is determined by R'→R: choose that action I_i' which minimizes the loss R'.

The dynamical interpretation of this process will be given through a comparison with particle dynamics.

<u>Particle Dynamics</u>:

In the case of particle mechanics (see ref. 2 & 3) the dynamics take the form of an SS interrelational system. For example, in either classical or quantum particle mechanics where the initial conditions are dependent only upon one prior time point (t_o), the dynamics of a function (F) of the system variables can be written in solution operator form as

(R6.) $$F_t = K_{t;t_o} F_{t_o}$$

where $K_{t;t_o}$ is an appropriately defined solution operator which interrelates F at times t and t_o. An operator equation (R6.) as noted earlier is an SS interrelational form.

Comparison of Particle and Decisional Dynamics:

The distinctive characteristic which emerges from a comparative analysis of these two dynamical systems is best seen as follows. In the case of particle dynamics the intersystemic (interparticle) relation (the potential function in Hamiltonian mechanics) is an explicit function only of the system variables at the "present" instant of time. The dynamics can be expressed in terms of this function and the resolution of the dynamics (the determination of the system variables at a future point) depends only upon fixing the variables at the present for Newtonian-Hamiltonian mechanics (or more generally, for all or partial past time).

In direct contrast is the decisional dynamics. In this instance the resolution of the dynamics (the determination of the state of the system at a future point via the choice of one of the possible actions) depends not only upon the past but also explicitly upon the possible future through the system of alternative actions (the image system I').

Intersystemic Relation for Biosystems:

We are now prepared to offer the principle thesis of this paper. *The SI interrelational (decisional) process, which appears as one of the necessary and (possibly) sufficient conditions for the evolutionary origin of life, is seen to imply a system dynamics which, when characterized in terms of an intersystemic relation (V), depends not only on the image of the system's "past" as in psycho-chemical (non-living) systems, but also on the image of the system's "possible future".* That is, for psycho-chemical systems

(R7.) $$V = V\ (\text{Past})$$

where the "past" is to be considered as including the "present" instant. For biosystems

(R8.) $$V = V\ (\text{Past; Possible Future}).$$

In that our linguistic description of the difference between living and non-living systems is itself a symbolic image system which is related to the "real" through actional (correspondence) relations within physical theories, it behooves us to clarify how images and decision relations enter differently in the representation of these two classes of systems. Theories of both non-living and living systems are images and both include decision relations. In the former, however, the system imaged is not considered to subsume either image or decision relations. Contrasted against this is the latter in which case the system imaged is considered to subsume both an image carrier and a decision system. Hence the need for the SI interrelational form which formally implies the difference in dynamics.

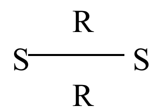
Also, it should be noted that in the symbolic image (spatial-temporal theory) of a given "physical" (real) system, the "possible" always appears in the delineation of the kinematical relations. Again, however, we are concerned with the image of a system (biosystem) which itself subsumes an image carrier whereby it may also subsume the "possible".

Possible Consequences of this Thesis:

A.) Mathematics

In addition to the necessary development of the mathematics of SI interrelational systems, a new notion is also suggested. It is the duo(actually-tri)-relational system

(R9.)



in which two interrelated relations are required in order to connect S and S'. These relations cannot simply be contracted into one in a sequential operation thus generating an ordinary formal system.

B.) Science

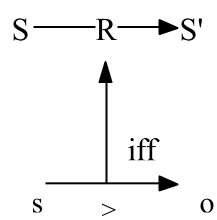
1.) Natural Systems Science

a.) Chemistry

In the treatment of molecular interactions, one would generally have a system S of molecules at a given time being transformed dynamically (R) into a system S' at a subsequent time. However, an alternative representation of this process would be the following.

The system S (reactants) is transformed (R) into a system S' (products) if the energy of S (E_S) is greater than the energy of the reaction barrier (E_O). That is,

(R10.)



Although various conditional modifications of (R10.) may appear, it is obvious that the basic interrelations are of the form (R4.). As specific instances of this process, consider the following:

i.) Molecular Decision Theory

aa.) Activated State Complex Theory (see, e.g., ref. 5)
bb.) Enzyme - Substrate Reactions
cc.) Drug - Receptor Interactions
dd.) Antigen - Antibody Interactions

b.) Biology

It is thought that recognition of the dynamical significance of the SI interrelational process represents the necessary conceptual breakthrough in biological theorization. This is not to say that there exists a satisfactory experiential basis upon which to explicitly formalize a biosystems dynamics in terms of an explicit V = V (Past; Possible Future) relation.

We propose that a particularly profitable approach to the study of the critical branching point(s) in the evolution of matter might be in terms of the transition,

(R11.) SS (physical) interrelational dynamics
↓
(molecular) decisional dynamics
↓
SI (biological) interrelational dynamics.

2.) Anthroposystems Science

a.) Psychology

With the emergence of

i.) specialized control of dynamical stability and subsequently,

ii.) specialized control of dynamical stability through continuability, reactive and active biosystems respectively, evolved. It should be noted that psychology to date has been concerned almost totally with the development of a stimulus - response theory of man, i.e., the first (2-a-i) case of specialized control. The future developments in psychology will see an increasing emphasis of the second (2-a-ii) case, especially in the formulation of a psychodynamics based upon the V (Past; Possible Future) relation.

b.) Sociology

In (R5) we noted that the fundamental additional feature characterizing sociosystems relative to biosystems is the subsumption of both of the relations R and R' by the image system. A common realization of this occurs in the case of a group in which each person knows the procedure for group decision making. It is expected that this conceptual clarification will lead to specific formalizations of the experiential data concerning group dynamics.

3.) Natural Systems - Anthroposystems Interrelations

Finally, let us note, rather more speculatively, that a new kind of "potential" relation (V=V (Past; Possible Future)) may carry with it associated new kinds of "forces". It is possible that in terms of these latter an approach to understanding various parapsychological phenomena, such as ESP, could be formulated.

Acknowledgement:

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