Molecular semantics and the origin of life

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Abstract

The physical origin of life addresses itself to a semantic process on material grounds, in which causation toward contextualization is at work. Physically semantic process of whatever kind is specific in that every material participant is searching and modifying the material context to be fitted in. Fundamental to the physical semantics is the process of measurement proceeding internally among the constituent material participants, whereas the molecular syntax alone as embodied in the form of the quantum-mechanical equation of motion supplemented independently by exogenous boundary conditions cannot cope with the material process underlying the origin. A basic physical attribute of the phenomenon called life is variable duration, in contrast to invariant duration of Galilean inertia. In fact, molecular replication thought as a harbinger of the phenomenon of life is a concrete form of variable duration and could be established unless internal measurement being instrumental to physically semantic process is forcibly eliminated by some external means. Physical experiments on the onset of molecular replication could become feasible only when external controllability over the intended experiments even at nano-meter scales is abandoned so as to save the room of internal measurement on the part of participating molecules. © 1997 Elsevier Science Ireland Ltd.

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1. Introduction

Evolutionary onset of molecular replication on the primitive earth would have been factual and unquestionable (Schidlowski, 1988; Kandler, 1993; Schopf, 1993; Moorbath, 1994). But, describing how it could have got started remains problematic. The difficulty in describing the onset is within how to figure out the separation between the explanans and explanandum as facing the phenomenon. For instance, in view of the fact that major atomic elements involved in replicating DNA molecules are hydrogen, carbon, nitrogen and oxygen, one might ask how DNA replication could get started out of the primitive material resources including those atomic elements of the four different kinds (Eigen, 1992). However, choosing atomic hydrogen, carbon, nitrogen and oxygen as the explanans in order to cope with the beginning of DNA or even RNA replication as the explanandum would make the description of the evolutionary onset of molecular replication formidable because of the seemingly almost unbridgeable gap between the explanans and the...
explanandum (Joyce and Orgel, 1993; Lorsch and Szostak, 1994).

Cosmic abundance of hydrogen, carbon, nitrogen and oxygen alone could not answer the question of how replicating molecules could have got started. Some manipulative procedure would have to be implemented in the molecular resources that would have been available on the primitive earth (Rosen, 1991). Describing the evolutionary onset of replicating molecules now reduces to identifying the manipulative procedure for how to get replicating molecules from their component elements.

When viewed from the perspective of manipulative procedure acting on component elements, there are at least two distinct possibilities for generating replicating molecules from their components. One possibility is to apply the manipulative procedure externally as most experiments on molecular replication would admit (Cech, 1986, 1987; Doudna and Szostak, 1989; Wang et al., 1993). If the laboratory synthesis of replicating molecules from their components is made feasible, the origin of the manipulative procedure even at nano-meter scales would have to finally be sought in the setup the experimenter would contrive. In contrast, one more possibility is to let the component elements take care of themselves as the evolutionary onset of replicating molecules on the primitive earth would have been so (Morowitz et al., 1991; Morowitz, 1992). Natural onset of replicating molecules assumes that the manipulative procedure would be endogenous to the component elements, whereas the experimental onset would have to be exogenous in asking the experimenter to furnish the manipulative procedure for engineering replicating molecules.

Both natural occurrence of and possible experimental fabrication of replicating molecules suggest that molecular manipulative procedure instrumental to the replication can be both endogenous and exogenous to the molecules. Estimation of how molecular manipulative procedure could be endogenous or exogenous can be attempted by referring to various constraints molecules have to be subject to. One of such constraints is that if a molecule is symbolized as a wavefunction, it has to obey the quantum mechanical equation of motion. Separation between symbols and their manipulation comes to mean that the syntax acting on symbols can be fixed and identified independently of those symbols to be acted upon (Pattee, 1977). The present estimation now raises the question of how molecular syntax could contribute to the occurrence of molecular replication.

2. Molecular syntax

Molecular manipulative procedure completely separated from the symbol or the total wavefunction of a molecular system is exogenous in its origin, because the externally imposed boundary conditions specifies how the wavefunction develops in time in its every detail. In addition, externally manipulative procedure is global in letting the molecular system be an object to be controlled from its outside (Matsuno and Salthe, 1995).

A possible onset of molecular replication through externally manipulative procedure alone may be seen in such a rare occasion that there could happen to arise an externally manipulative procedure that can afterward reproduce part of the procedure indefinitely internally. Emergence of a replicative manipulative procedure through the haphazard updating of externally manipulative ones on the part of external agents can be equated to a physical onset of molecular replication if the replicative procedure can allow both molecular association and dissociation.

However, seeking a possible onset of replicating molecules exclusively within externally manipulative procedure is in itself contradictory in asking the external agents both spontaneous appearance of a replicating molecule and the subsequent holding of replication. This is because if spontaneous appearance of a replicating molecule is feasible through a quantum mechanical process, the counteracting process of its spontaneous disappearance would also have to be taken into account (Wigner, 1961). Molecular syntax assuming the symbol manipulation external to the symbols themselves is thus methodologically incompetent in raising replicating molecules. At issue is how those spontaneously appeared could hold themselves indefinitely since then.
Molecular replication requires at least an ongoing production process localized spatially. Some of the products have to be reintroduced into the process in order to facilitate a form of replicative manipulative procedure (Matsuno, 1984). This facilitation can be materialized by installing looped production processes internally (Matsuno, 1989). In fact, if a molecular system of interest is not in thermodynamic equilibrium, the most likely structure to be realized in the system would be the one that could be most durable, that is to say, the one that could minimize its rate of structural dissociation (Matsuno, 1978; Schneider, 1988). Although it may sound tautological, the least dissociable structure could be most durable in which the rate of dissociation can be estimated by counting the number of uncorrelated molecules coming out of the structure to be realized, per unit time. Accordingly, spontaneous appearance of a looped process could be less dissociative and more durable by retaining part of the products that would otherwise be thrown away into the environment.

What is lacking in molecular syntax of externally manipulative procedure is the capacity of raising an ongoing production that can incorporate a looped process. The emergence of such a looped process would imply a de novo appearance of manipulative procedure especially in making the loop. In order to cope with the emergence of de novo manipulative procedures, it would be required to go beyond the molecular syntax supplemented exclusively by externally manipulative procedure.

3. Molecular semantics

Once the methodological separation between the symbols and their manipulative procedures is lifted as being a mere artifact, the matter of concern would now become how they would develop mutually in time (Pattee, 1982). The symbols cannot be defined separately from their manipulative procedures as much as the latter cannot from the former. This is equivalent to saying that the symbols manipulated by pre-existing procedures can point to something else other than those manipulative procedures that have already been identified. Semantic implication would become inevitable to those symbols at least in the sense that they may modify the manipulative procedures while being acted upon by the latter. The semantic implication will become more vivid and visible if interacting molecules are the case.

Let us imagine, for instance, a pair of molecules of whatever kind interact with each other. Description of the two molecule system requires two different dynamic attributes. One is dynamic identification or detection of these two molecules as they are, and the other is dynamic realization of their movement in time (Matsuno, 1985, 1989).

The most frequently quoted dynamic scheme coping with detection and realization is the quantum mechanical equation of motion supplemented by its boundary conditions, in which the equation of motion refers to the dynamic realization while the boundary conditions refer to the dynamic detection of the system. In particular, the significance of dynamic detection as an inevitable dynamic attribute is epitomized in the observation that the equation of motion itself cannot say anything specific about the dynamics unless supplemented by its boundary conditions. Boundary conditions have to be guaranteed and implemented independently of the equation of motion.

The present separation between dynamic detection and realization now would come to imply that identification of boundary conditions may be accomplished globally in an instantaneous manner without being aided by the dynamic realization due to the equation of motion. However, global detection underlying such an instantaneous identification would simply be impossible physically because nothing can propagate faster than light does. The complete separation between the equation of motion and its boundary conditions could be feasible only when detection could be taken to proceed at an unphysical infinite velocity. Otherwise, it has to be admitted that dynamic detection of whatever character proceeds no faster than light.

Dynamic detection as an indispensable attribute of any dynamics is local in the sense that the process of detection proceeds at a finite velocity, in contrast to global detection assuming its com-
plete separation from the process of dynamic realization. Local detection internal to interacting molecules lets each molecule be an agent of doing measurement internally (Matsuno, 1985) and accordingly acts as an agent of realizing the process of internal measurement endophysiologically (Rössler, 1987). Since dynamic detection and realization are inseparable, measurement internal to interacting molecules is responsible for actualizing what these molecules have realized subsequently (Matsuno, 1989; Kampis and Rössler, 1990).

One of the well established characteristics of any physical realization is the observation of the empirical principle of the conservation of energy. It is measurement internal to interacting molecules that detects and realizes the conservation of energy, since the global characteristic is not something to be imposed externally, but the one to be constructed internally (Matsuno and Salthe, 1995). Internal construction of the conservation of energy is actualized through asynchronous updating locally, instead of global synchronization, because of the absence of any global means for the actualization.

The empirical certitude of the conservation of energy is only within the global characteristic of the finished detection and realization, each locally, that is to say, the conservation of energy emerges through asynchronous local processes of internal measurement. The inevitable posterior reference to the global conservation of energy lets internal measurement be semantic in relating itself to the much larger context within which it is embedded.

Semantic nature of internal measurement is most visible in fulfilling the conservation of energy in the posterior record. Fulfilling the conservation of energy internally comes to imply that each agent of internal measurement acts toward the outside from its inside for the sake of the conservation. Internal measurement is the agency having the capacity of either wanting or yawning for energy from its inside or being exploited energetically from the outside by others having the similar capacity of wanting. Physical implementation of the semantic nature of internal measurement is thus visualized in the material embodiment of the agent wanting or yawning for energy, or simply in the form energy consumers (Matsuno, 1992, 1995).

Molecules or molecular aggregates acting as energy consumers are most fundamental to material interaction, but actualizes only in the mode of molecular semantics.

4. Cohesive interaction

One of the distinct characteristics latent in molecular aggregates as energy consumers is their capacity of cohesiveness extended toward their energy resources. The present form of cohesiveness rests exclusively upon internal measurement letting any material process of detection be local and the global configuration of material interactions emerge only afterward (Sattler, 1990; Paton, 1992). The local nature of cohesive interaction due to internal measurement exhibits a sharp contrast to another type of cohesive interaction specific to external measurement, in the latter of which only the external observer such as an experimental physicist assumes the capacity of doing measurement.

Electrostatic interaction as exhibited in the Coulomb interaction, for instance, is undoubtedly the case of external measurement, because the interaction presumes the global configuration of interacting molecules that can be made available only through global detection proceeding in an instantaneous manner at every moment. External measurement that is commensurable with the notion of the state of a global configuration is, however, methodologically incompetent in coping with cohesive interaction intrinsic to local character of the dynamic detection of material origin.

Cohesive interaction due to energy consumption is specific to internal measurement (Matsuno, 1992), but its consequence can be described in terms of a pair of mechanistic terms, that is, a flux and its generalized force (Prigogine, 1969). The present mechanistic description, though of imposed character externally, does not assume that the underlying dynamics would also have to be mechanistic. To the contrary, the mechanistic and external description is an artifact derived from the consequence of internal measurement. External
description of the consequence of internal measurement can follow a syntax of symbols to be acted upon by externally manipulative procedures as in the form of a set of the equations of motion supplemented by the exogenous boundary conditions. This is simply a descriptive artifact. Description can be more than just being external. Description referring to the capacity of wanting energy from the inside is internal in the sense that the manipulation of the descriptive symbols is internally driven and endogenous.

Internal description of the on-going internal measurement is, however, peculiar in contrasting the object to be described to its internal author, whoever or whatever it may be. The present constant reference to the internal author renders the resulting internal description to lose its objectivity. Nevertheless, the reality of internal measurement makes its local description inevitable by letting the measurement itself be a descriptive object. The lack of impartial objectivity in internal description is found in the fact that although it is tried, the internal authorship could survive in the effect only if the wanted energy has become available as a consequence. Otherwise, internal description would fail in the resulting external description, the latter of which in turn remains objective in the posterior record without any direct reference to its author.

Cohesive interaction due to the capacity of wanting energy through internal measurement could be legitimate only to its internal description. Objective description of the interaction can be accomplished by referring to the consequent external description in terms of the flux and its generalized force. But, this by no means implies that the activity based upon the capacity of wanting energy from the inside would follow a mechanistic development stipulated by externally manipulative procedures. External description in mechanistic terms, though certainly objective and legitimate, cannot and does not prescribe the underlying process of measurement or detection to be external. External description of internal measurement does necessarily invokes the involvement of internal description at its intermediary stages, since internal measurement is already a descriptive term pointing to a certain process proceeding internally. Once it is duly recognized that external description, though legitimate in its own light, does not enforce measurement of whatever sort to be external, cohesive interaction grounded upon internal measurement can certainly survive.

External description of internal measurement is an emergent property arising from the intervening internal description. This makes a mechanistic description be an emergent consequence of the non-mechanistic internal measurement (Gunji, 1995). Cohesive interaction due to internal measurement that can be associated with the posterior mechanistic interaction is, however, more than what only the resulting external description could tell us about. Vicissitudes of the participating internal descriptive agents are inevitable. Those that could fail in obtaining energy resources wanted would eventually fail in surviving. Even those surviving are constantly involved in conflicts with each other for obtaining further energy resources because of the absence of the prior global coordination. The survivors are those that could have succeeded in passing those internal conflicts over to the others on and on, while those failed in passing the internal conflicts forward are destined to fail in surviving.

The present form of dynamics coping with internal conflicts, that is unique to internal measurement, is more than what mechanics would give us. Although the consequence of coping with those internal conflicts would follow a mechanistic description, the on-going process of generating internal conflicts and constantly passing them forward refers to those variations caused internally. Internally caused variations are foreign to mechanics, because in the latter of which variations are defined to be those manipulated only externally.

Dynamics of internal conflicts intrinsic to internal measurement requires a unique internal description of its own. A best candidate for this will be information.

5. Information dynamics

In contrast to external description of internal measurement, its internal description lets each
internal descriptive agent be informed of the similar internal descriptions by others through their inter-connectedness with the elapse of time. Information is thus seen to be a basic attribute of internal description of internal measurement (Küppers, 1992). Information dynamics, when properly understood, refers to internal description of internal measurement, while there is no room of information for external description because of the externally imposed character in the latter. External description is incommensurable with information, since the descriptive agent there is to claim that the descriptive object, once fixed, remains as it is while admitting in itself no capacity of being further informed. Precisely for this reason, internal description is informational in maintaining the capacity of being constantly informed on the part of each internal descriptive agent (Ulanowicz, 1986; Wicken, 1987; Brooks and Wiley, 1988).

What is basic to information dynamics, intrinsic to internal description is the notion of events, that remain descriptively local, in contrast to that of states carrying a global connotation unique to external description (Matsuno, 1993). Events by themselves already necessitate the duration of time for their own identification. The time dimension required for the identification of events is, however, local in dismissing the likelihood of global synchronization. Information dynamics in terms of events thus operates in the mode of asynchronous updating (Salthe, 1993).

There is no prior mechanism for coordinating all the simultaneous events of local character in an instantaneous manner. The intrinsic absence of a means for coordinating simultaneous events in the making globally now induces a queer contrast between external description of the completed events and internal description of events per se. The completed events in external description have to be consistent among themselves, otherwise the descriptive integrity would be lost. In contrast, internal description of events is both prescriptive and generative. It is prescriptive because it leaves completed events behind, while generative in passing internal conflicts existed among those events constantly forward onto the succeeding stage under new guises on and on. Internal description associated with internal measurement producing an event constantly anticipates further internal description because any newly produced event of a local character renders itself to be a new object to be further measured internally (Matsuno, 1989). Internal description is persistently more than what external description of the completed events would give in that the current activity of internal description cannot make itself the object of internal description at the same time. Describing the current activity of internal description cannot bc simultaneous, but always sequential in time. Internal description constantly carries with itself the leftover of those events that have yet to be described internally. What drives internal description is the leftover of internal description that has not yet been contextualized and that defies to become an object of external description (Matsuno, 1996). Internal description of internal measurement is a description of the causation ascribed to the context in the sense that the leftover of internal measurement to be contextualized constantly drives further internal measurement (Conrad, 1996). Contextual causation toward and for the sake of contextualization is intrinsic to internal description, while external description exclusively addresses mechanistic causation toward individuals and individualization since the context is externally fixed in the latter.

Internal description of internal measurement looks like ordinary conversations in everyday life in which everybody as an agent of measuring and describing is constantly measured and described by others. It is of course legitimate to observe that rigorous sciences cannot derive from ordinary conversations that constantly have recourse to the speakers. That rigorous sciences based upon external description of external measurement cannot be brought about from mere ordinary conversations rests upon the indefiniteness of the viewpoint of each internal description attempted there. What is unique to internal description is the recursiveness of letting itself be an object to be further measured by others internally within the framework of on-going ordinary conversations. Henceforth, indefinite continuation of ordinary conversations is found within indefinite succession
of internal description of internal measurement. The on-going nature of information dynamics is thus found within internal description of internal measurement. Information dynamics is causative toward contextualization, while mechanistic causation is unique in relating each preceding event to the subsequent one on the individual basis under a given context. Of course, contextual and mechanistic causation are not antagonistic with each other.

If one intends an external description of information, on the other hand, the capacity of contextualization would have to be left behind. Describing information as something to be out there externally remains causally mechanistic in relating a precedent event to the subsequent one uniquely. Although internal measurement is information-generative in itself because of the contrast between the a priori and a posteriori indefiniteness, its external description presumes the externality of finished consequences. If an invariant ensemble of finished consequences is available and if it can serve as an informative means for predicting what will come next, the underlying external description could be inclusive of information.

As a matter of fact, Shannon’s information just happens to be this case. Availability of an invariant source matrix of information, that specifies the probability of occurrence of each mutually exclusive event, can now determine the conditional probability of events and the resulting entropy to an intended information receiver. However, Shannon’s information is peculiar in admitting that the joint probability of event A and event B, that are mutually exclusive with each other, is identical to the similar joint probability of event B and event A. Shannon’s conditional entropy turns out to be indifferent to the ordering of events to occur in time. Commutability of events that is fundamental to Shannon’s information deprives the latter of historicity latent in information. Shannon’s information appreciates the significance of internal measurement by taking events, instead of states, as most basic ingredients. Nevertheless, external description formalizing information is already severely restricted in that only those events satisfying their commutability are allowed.

One more candidate for describing information externally is a Bayesian approach enabling us to relax the strict condition already latent in external description of external measurement (Dougherty, 1994). Once it is admitted that the capability of the agent doing external measurement is not unlimited as is most often the case, the external observer involved would perceive the historicity of events because of the technical incompetence of prediction on the part of the observer. Bayesian probabilistic perspective is, however, quite subjective, being unique to the presence of those incompetent external observers. Once it is duly recognized that information dynamics of material origin is of our prime concern, the Bayesian perspective of subjective nature could not apply even if it is legitimate in its own light.

Unless specially stipulated, information is diachronic in referring to the one met in a historical context relating to phenomenon or events as they occur or change over a period of time (Marijuan, 1991; Küppers, 1992; Salthe, 1993; Depew and Weber, 1995). This characteristic exhibits a sharp contrast to synchronic information such as Shannon’s that is concerned with those events existing only in a limited time period and ignoring historical antecedents.

Both Shannon’s and Bayesian perspective cannot cope with diachronic information of material origin. In view of the fact that diachronic information as a material attribute originates in internal measurement, one thus comes to note that internal measurement should properly be described either internally or externally in order to explicate its diachronic character. Shannon’s has been incompetent for the explication because of its arbitrary articulation applied to internal measurement by discarding its historicity, while Bayesian has been irrelevant due to concentrating only on external measurement.

Describing diachronic information is accordingly double featured if properly framed. One is internal, and the other is external. Internal description of internal measurement refers to diachronic information in the making, whereas its external description does to that in the product. What is unique to internal description of internal measurement is its insistence on the local activity
of searching the semantic context to be accommodated linguistically. This does not necessarily imply that every activity of searching the semantic context could be fulfilled. Some activities may fail in the end. Internal description of internal measurement cannot claim objective unchangeability on its own. Diachronic information conceived as a descriptive representation of what internal measurement is all about is signified by its variable durability, instead. A more concrete problem we shall face is how variable duration envisaged from internal description of internal measurement could relate to the subject matter of the origin of life (Matsuno, 1984, 1993).

6. Variable duration underlying the origin of life

Fundamental to the origin or emergence of life on the primitive earth about 3.80 billion years ago would be an indefinite continuation of replicating molecules of whatever kind (Moorbath, 1994). Duration underlying the indefinite continuation is variable because of incorporating into itself production processes that are variable. Variable duration upholding molecular replication is, however, totally different from invariant duration unique to Galilean inertia. Whereas Galilean inertia refers exclusively to external description of external measurement, especially at the limit that a moving body would externally be prepared as being almost frictionless, variable duration underlying molecular replication is specific to internal description of internal measurement. This is because internal measurement constantly provides further causes of internal measurement so as to fulfill the conservation of energy to be found in the record.

Linguistically, this reduces to an indefinite sequence of internal description so as to fulfill the principle of the excluded middle in the resulting external description (Matsuno and Salthe, 1995). The present contrast between external description of external measurement and internal description of internal measurement may shed some light on our problem of how the phenomenon called life could have got started.

First of all, it should be noted that difficulties in tracing the physical origin of life on the primitive earth are both empirical and theoretical. Isotope dating of carbon and other atoms has pinned down the beginning of life on the earth into the narrow window region of far less than 10 million years centered around 3.80 billion years ago (Moorbath, 1994). However, empirical details on how life would have got started on the earth have been extremely scanty and have hardly been preserved. The oldest fossil record of micro-organisms available has been at most 3.45 billion years old (Schopf, 1993). Tracing the course of evolution further back toward its origin could not be facilitated by empirical observations alone. The endeavor would have to be supplemented by experimental efforts.

Nevertheless, experimental investigation of the origin of life has its own limitation ascribed to the underlying queer methodology of external description of external measurement, because any experimental setup is destined to be described externally (Rosen, 1991). External description of external measurement is peculiar in that the author of external description who can also serve as an experimenter monopolizes the agential capacity while rejecting any other material participants from assuming the similar capacity.

It is of course one thing to insist on the capacity of controlling whatever situations of experiments contrived externally, but quite another to estimate its real significance. In fact, controllability and reproducibility required of any experiments simply contradict the uncontrollability and historical uniqueness of the phenomenon called life on the earth. Historical uniqueness and coherent integrativity of the continued sequence of events over the past 3.80 billion years since the beginning of life set forth a formidable problem to any experimental studies. It is simply inconceivable to contrive an experiment on the origin of life that could guarantee the succeeding evolution since then for another 3.80 billion years. What could be possible instead while employing the methodology of external description of external measurement is to design likely experiments at most piecemeal.

One principal objective of such piecemeal experiments for the origin of life is to design the onset of replicating molecules without assuming
any biological organisms. In particular, RNA molecules having catalytic capabilities of their own have been demonstrated to be able to exhibit their replication if the constituent monomers and appropriate energy sources are available (Joyce and Orgel, 1993; Lorsch and Szostak, 1994). The present likelihood of a RNA replication, though impressive, does not, however, answer the question of how the molecular replication as a harbinger of the phenomenon called life could have been settled in the first place. The original RNA templates prepared in the experiments are as controlled and imposed externally.

The issue is how to get molecular replication started out of the material and energy resources that could presumably have populated the primitive earth about 3.80 billion years ago and how to sustain the evolvable capability indefinitely since then. An essence of the problem resides in how to figure out variable duration unique to internal description of internal measurement that would seem almost incommensurable with practising experiments that would be externally controlled.

One of the driving forces toward the possibility of more primitive replicating molecules could be found in the theoretical idea asserting that molecular replication, if any, could exhibit their evolvability if supplemented by making errors in the process as epitomized in the phrase of molecular Darwinian evolution (Eigen, 1992). If natural selection understood as differential retention of slightly modified heritable traits is applied to molecular replication, Darwinian evolution originally conceived in the biological realm (Depew and Weber, 1995) may look to readily be extended over to the prebiotic regime so long as the presence of molecular replication could be guaranteed. The present perspective, however, does not answer the original question, but rather comes to beg further questions. Molecular replication is of itself in the mode of variable duration while making the strict separation between replicating molecules and making errors unavailable. The question again reduces to empirical feasibility of variable duration unique to internal description of internal measurement.

A clue for variable duration originating in internal measurement can be found in the physical ubiquity of internal measuring agents. In fact, atoms and molecules are undoubtedly legitimate candidates of the agents because they interact or communicate among themselves at a finite velocity no faster than light does. Variable duration is synonymous with the presence of atoms and molecules. The only problem with the origin of life is how the quality of variable duration would be transformed. Those internal measuring agents supposedly appeared at the onset of life and since then would assume a unique quality of continuity as in the form of organisms even if they are alternated frequently.

While internal measuring agents of whatever kind are intrinsically coherent in inducing internal measurement among themselves so as to fulfill the conservation of energy, its effect can be classified into three major classes. The first one is that if a coherent alternation of internal measuring agents is frozen as with atoms in a solid crystal, it would not be necessary to pay attention to actual alterations explicitly. On the other hand, if gas molecules are the case, each gas molecule surviving as an internal measuring agent would be alternated in the role of fulfilling the conservation energy by too many of other molecules too frequently, with the result that the consequence of internal measurement would approximately reduce to an aggregation of incoherent molecular motions. Except these two extreme cases, though quite ubiquitous in the realm of physics, coherent alternation of internal measuring agents remains as the rule.

What signifies coherent alternation of internal measuring agents is in generating and passing internal conflicts forward without leaving any of them behind among the predecessors. In particular, in view of the fact that internal measurement acts at least so as to fulfill the empirical principle of the conservation of energy retrospectively, each internal measuring agent comes to exercise the capacity of wanting or yawning for energy from the inside (Matsuno, 1992, 1995). This agent is no more than a form of energy consumer.

The onset of coherent alternation of internal measuring agents can thus be equated with the appearance of consumers to be alternated successively. If one associates behaviors exhibited by
consumers grounded upon the capacity of wanting energy from the inside with a major characteristic of the phenomenon called life, the evolutionarily significant events occurred on the primitive earth at about 3.80 billion years ago would certainly have included the emergence of those consumers wanting carbon dioxide, water and light energy from the sun (Fox, 1988). Of course, a fine tuning of the coding mechanism between protein and nucleic acid molecules would have had to be installed almost at the same time, otherwise those primitive consumers, even if once got started, could not have sustained themselves through their alternation.

7. Concluding remarks

The physical origin of life perceived as an instance of internal description of internal measurement can also suggest a new directive to how one could design a successful experiment on the origin. The emphasis should be on the significance of internal measurement and on the emergence of sustainable consumers grounded upon the capacity of wanting energy from the inside. The present perspective urges us to recognize a possibility of doing experiments not strictly constrained by the tradition observing external description of external measurement. That means an incomplete experiment that would not claim its complete controllability from the outside. If such an incomplete experiment is intended, one could save the possibility that a consequence of internal measurement may survive in the products that may definitely be identified once followed by the traditional methodology of external measurement. If one can set up an experiment that could come to enhance energy concentration locally in microscopic regions of protocellular size in the environment prepared homogeneously initially without being accompanied by, say, any control at nanometer scales, it may be seen as a consequence of energy intake on the part of those microscopic bodies behaving as consumers.

The possibility of approaching the physical origin of life on an experimental basis shed a new light on the relationship between experimental research as a methodology and a scientific language as a means of description. Needless to say, description of an invariant configuration of experimental or empirical findings requires a formal language as a means of external description that preserves the observed invariant. As far as external description of external measurement is concerned, a formal language that preserves context-independent and irreducible basics would remain invincible. However, the present forcible stipulation of a context-independent formal language does not apply to internal description of internal measurement. What is unique to internal description is its constant capacity for searching and modifying the context to be fitted in. Semantic activity latent in internal measurement can be retrieved only through internal description that is context-dependent. Internal description of internal measurement thus requires a natural language, instead of a formal one, as its descriptive means.

Appreciating the role of natural languages in experimental and empirical studies on the physical origin of life is at least two-fold. One is to open the perspective that enables one to see the origin to be internally caused. The other, that is far more significant, is to make a room of exercising a natural language in the realm of experimental sciences that have formerly been practised exclusively by employing a formal language. The physical origin of life to be investigated experimentally urges us to fathom a potential latent in a natural language in designing and interpreting experiments of whatever sort related to the origin.

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