Practicing Quantum Mechanics in the Present Progressive Mode: A Clock-Time Complex

Koichiro Matsuno
Department of BioEngineering
Nagaoka University of Technology
Nagaoka 940-2188, Japan
fax: +81 258 47 9420 - e-mail: kmatsuno@vos.nagaokaut.ac.jp

Abstract
Time is relational to the act of reading a clock in one way or another. Any relative motion can serve as a clock to the third party who reads it, and time is associated with an attribute of the act of the reading. Interacting material bodies can be seen as a set of interacting local clocks, in which the act of reading one clock constantly serves as an impetus for moving others. This observation dispenses with Newtonian absolute time that has no relation to anything external. Materialistic underpinning of the clock-time complex can be attempted within the framework of quantum mechanics, in which a distinction between quantum entanglement and measurement internal to quantum mechanics is noted. Quantum entanglement as a form of phase dynamics is responsible for moving a clock, while internal measurement implemented as amplitude dynamics dealing with exchange of a quantum particle between interacting bodies induces the act of reading the clock. Interacting material bodies constitute a sticky nebula of nested local clocks. If the most encompassing clock is conceivable that can be read by the other outside but does not react upon others, time read out of the clock can be referred to by all of the other nested local clocks as being objective. The feasibility of such an encompassing clock is upon the likelihood of a heat sink conceivable within quantum mechanics *cum* thermodynamics.
Keywords: Clock, Internal measurement, Phase, Quantum entanglement, Time

1 Introduction

Despite the fact that time has been taken to be a fundamental factor presiding over how material dynamics develops, the issue of how time itself would develop has been put aside for long because of the methodological stipulation of letting time be an irreducible fundamental of whatever dynamics (Matsuno, 1997, 1998a). Newtonian absolute time is certainly the case as rendering time to flow equably everywhere with no relation to anything external. Even the relativistic extension of time leaves the nature of the mover of time intact as in the classical counterpart. The Lorentz transformation in special relativity is not the mover of the relativistic time. It only specifies the nature of time in a moving framework in relation to another time in another moving framework.

In contrast, our experiences rooted in this empirical world take time to be related to the act of reading a clock in one way or another (Baker, 1993; Riva, 1994). The clock has historically been associated with any material constellation exhibiting a relative movement within itself, and time has been related to the act of the third party who reads it (Matsuno, 1998c). This association of time with the act of reading the clock has definitely preceded both the advent of Newtonian absolute time and the fabrication of a Galilean pendulum clock grounded upon the latter, as demonstrated in the pre-Newtonian activities of seeking clocks in, for instance, regular flooding of the river Nile in the ancient Egypt, four seasons, tidal waves, shape of the moon and sundial among others. The present perspective comes to pave the road towards addressing the issue of the clock-time complex without being entrapped by the stipulation of Newtonian absolute time (Matsuno, 1998b). Dynamic nature unique to time can be more clarified once we refer to the clock-time complex directly. Underlying the clock-time complex is the activity in the present progressive mode (Matsuno & Paton, 1998).

2 Three-Body Interaction as a Prototype of the Clock-Time Complex

In order to see an essence of the dynamics underlying the clock-time complex, let us suppose that there are three material bodies A, B and C interacting with each other. Any relative movement between arbitrary two bodies can serve as a clock towards the remaining third party because the interaction between the relative movement and the third party is nothing other than the act of reading the clock, at the least (Hoffmeyer, 1996) . In fact, the relative movement between A and B serves as a clock towards material body C which functions as the internal observer reading the movement. C's interaction with the two bodies A and B is taken to be the act of C's reading of the clock A-B.

At the same time, all of the three are interacting with each other. When A acts upon B, A is going to be acted upon not only by B, but also by C, because of the intrinsic interconnectedness among the three. The action and the reaction are however not concurrent but rather sequential, contrary to the traditional view that both should be taken concurrent and simultaneous, unless Newtonian stipulation of absolute time is forcibly imposed. There is no global synchronizer over the three on the spot (Salthe, 1993; Matsuno & Salthe, 1995). When B reacts upon A as a consequence of A's preceding action, it also acts upon C because of the interconnectedness of A, B and C. A's action towards B can now be going to partly be reflected upon A through C. Since C's reflection upon A is a new action towards A because of the lack of concurrence, a similar sequence of action-reaction comes to follow *ad infinitum* (Matsuno, 1989; Gunji, 1995). Consequently, C's reading of the clock A-B subsequently causes some inevitable changes in the clock C-A, and B's subsequent reading of the clock C-A does the similar to the clock B-C and so on. The act of reading a clock constantly comes to move another clock.

Once it is taken for granted that an attribute of time can be associated with the act of interacting with or reading a constellation of material bodies in movement (Plautz et al, 1997), both reading and moving clocks are found to be inseparable activities of material origin more than anything else. This perspective exhibits a distinct contrast to Newtonian absolute time in which time is taken to be prior to any activity of reading clocks. At the least, time in the clock-time complex serves as both a cause and an effect of moving material clocks of whatever kind. The present association of time with the activity of moving material clocks now raises a serious question of how this could be actualized in the framework of quantum mechanics because quantum mechanics has been considered to provide an infra-structure of any material dynamics. At issue is quantum mechanics in the present progressive mode.

3 Quantum Mechanics of the Clock-Time Complex

Quantum mechanics as a common ground for addressing any dynamics of material origin is characterized by at least two distinctive aspects. One is that interactions between any material bodies take place by exchanging quantum particles of material origin, and one more is the possibility of superposition of those material configurations in the absence of interaction. Of course, if one formalizes the quantum mechanical scheme as employing Newtonian absolute time as exemplified in the form of Schrödinger's equation of motion in non-relativistic regime, both the linear superposition of the wavefunctions and the complete incorporation of material interactions into each wavefunction can be fulfilled in the global synchronous time. There could thus be no room of an interaction for reading and moving a material clock. What should be addressed at this point must be to figure out a quantum mechanical framework appreciating both superposition of material configurations and exchange of quantum particles without employing Newtonian absolute time (Matsuno, 1996b, 1997).

The absence of Newtonian absolute time, once legitimately observed, does not enforce both of a linear superposition of different material configurations and an exchange of quantum particles to proceed totally in a globally synchronous manner. Accordingly, there could arise two processes upholding quantum mechanical phenomena. One is the process for entangling different material configurations with a consequence of giving rise to their linear superposition (Schulman, 1997; Bouwmeesta et al, 1997; Dürr et al, 1998), and the other is for implementing interactions through exchanging quantum particles between participating material bodies (Matsuno & Paton, 1998). The lack of a synchronization between the quantum mechanical entanglement and the implementation of exchange interaction now sheds a new light upon the quantum mechanics of the foregoing three-body system of A, B and C as the clock-time complexes.

Each of A, B and C maintains its own quantum mechanical configuration. The act of C's reading of the clock A-B is due to the clock's action towards C while proceeding through exchanging a quantum particle between the clock A-B and the internal observer C. That is nothing other than an instance of exchange interaction in quantum mechanics (Matsuno, 1989). The effect of the exchange interaction at the end of C is an inevitable change of a quantum mechanical nature due to either adding or subtracting a quantum particle. The addition or subtraction of a quantum particle at C as a form of the quantum mechanical entanglement now induces a change in the clock C-A. The resulting change in the clock C-A due to the quantum entanglement imputed intrinsically to the end C subsequently comes to influence the internal observer B as exchanging another quantum particle between the two just for the sake of fulfilling the counterbalancing between the action and reaction in the effect. However, there is constant leftover for further fulfilling the counterbalancing between the action and reaction because of the absence of a complete synchronization between the quantum entanglement and the implementation of exchange interaction on the spot. Quantum mechanics of the clock-time complexes is thus found to rest upon the constant interplay between the quantum mechanical entanglement and the implementation of exchange interaction. Either one of the two constantly anticipates the other and serves as a factor driving it in an alternating manner.

In fact, the process of measurement internal to quantum mechanics in the form of exchanging a quantum particle between interacting material bodies induces further internal measurement through changes in the resulting quantum entanglement. Phase adjustment underlying a quantum entanglement can be both a cause and an effect of amplitude adjustment imputed to an internal measurement. Since it can propagate at an arbitrary velocity without being limited by light velocity, phase adjustment could be non-local compared to amplitude adjustment whose propagation is intrinsically limited by light velocity. Internal measurement as a form of implementing an interaction of a local character thus comes to induce changes in quantum entanglement to a non-local extent, the latter of which again serves as an impetus for generating subsequent internal measurement for the sake of fulfilling the counterbalancing between the action and reaction. The clock as a manifestation of phase dynamics is constantly driven by the act of reading it by others, the latter of which is associated with amplitude dynamics in quantum mechanics. The issue of the clock-time complexes reduces to an interplay between phase and amplitude dynamics in quantum mechanics. Although it can equip itself with the capacity of exhibiting a non-local correlation as in the form of sharing the same phase front non-locally, phase dynamics cannot be substituted by a form of boundary conditions imposing a simultaneous phase correlation to a non-local extent externally. There is an internal correlation between phase and amplitude dynamics in quantum mechanics that cannot be controlled externally (Matsuno, 1985, 1996a; Rössler, 1987).

What is unique to the clock-time complexes in the framework of quantum mechanics is that all of the clocks available are convoluted and nested among themselves. Every clock as constituent elements of the other clocks also is moved by reading the others constituting the nebula of the nested clocks. In this respect, if one can conceive of a most encompassing clock that can include all of the other clocks in it but cannot be part of any other clock, the encompassing clock can only be read by the other residing in its outside but does not move anything else beside itself. Once it becomes available, the encompassing clock can render the time to be read by the outsider to be a referential one to be consulted and shared by each of the local clocks constituting the nebula. The presence of such an encompassing clock is conditional upon the likelihood of a material circumstance that may be acted upon but does not act upon others as a consequence. As a matter of fact, there is indeed such a circumstance in the realm of material dynamics. That is the occurrence of a heat sink in the framework of thermodynamics. Heat sinks as a theoretical artifact are unique in absorbing anything without inducing any reactions towards their outside (Swenson, 1998). The encompassing clock in quantum mechanics can thus be grounded upon the availability of a heat sink in thermodynamics.

An intrinsic affinity of thermodynamics to quantum mechanics come to arise when one addresses the issue of the clock-time complexes. Of course, if one employs Newtonian absolute time as facing quantum mechanics, there could be no need to invoke thermodynamics to decipher the nature of time. Precisely for this reason, time practiced in quantum mechanics has been taken to carry no arrow. However, once the stipulation of Newtonian absolute time is lifted, a totally different perspective could emerge. If there exists the time that could be referred to objectively even in the absence of Newtonian absolute time, the likelihood of such a clock that remains unaffected even though read by others should be sought. In fact, the most encompassing clock conceived within the framework of quantum mechanics just fulfills the requirement that it may remain unaffected even if read by others. What is more, the existence of such an encompassing clock could be guaranteed only when it is associated with a heat sink in one way or another. The issue of the clock-time complexes without the stipulation of Newtonian absolute time makes thermodynamic implications inevitable in the practice of quantum mechanics if time is still taken to be referred to objectively there.

Whether or not time has its arrow is rather an ill-stated question. If one starts from Newtonian absolute time, it has no arrow by definition. Unless the definition is revised, there should be no room for the arrow of time to emerge. Irreversibility or historicity conceived within the framework of time that sustains itself without referring to any sort of material clocks must be sought in other than time itself, such as in peculiar initial conditions. On the other hand, once time is taken in conjunction with the associated clocks of material origin, it comes to proceed as carrying the irreversible and historical arrow from the very start.

4 Concluding Remarks

We have observed that there is a deep connection between quantum mechanics and thermodynamics if Newtonian absolute time is not taken for granted. This issue of the clock-time complexes in the framework of quantum mechanics *cum* thermodynamics has also its linguistic dimension because the grammatical tense is inevitably involved there. More specifically, in view of the fact that any dynamic movement on the spot is in the present progressive mode more than anything else (Gendlin, 1995; Rosen, 1997), the descriptive transference from the present progressive to the present perfect mode has to be employed when it is intended to describe the dynamic movement. Any description in the present perfect tense presumes that the author of the description monopolizes the descriptive agency while the very dynamic situation in the present progressive mode is unquestionably multi-agential. There are many actors on the scene in progress. Nonetheless, once the record in the present perfect tense has been registered, it remains unaffected since then. Time read into the record is objective in the sense that the distinction between concurrent and sequential events remains immune to the act of reading the record. A materialistic counterpart of such an act of reading an invariable record is found in reading a most encompassing clock whose reading by the others residing in its outside does not affect the movement of the clock. The existence of the record in the present perfect tense can thus find its materialistic underpinning in the most encompassing clock envisioned in the clock-time complexes conceived in the practice of quantum mechanics.

At the same time, grammatical temporality is of course not limited to the present perfect tense. There is always some leftover in the present progressive mode that cannot be transferred into the perfect mode. For instance, if there are many agents participating in an ongoing negotiation among themselves, unsettled negotiations cannot be frozen into the perfected record in any sense of the word. They constantly serve as an impetus moving the act in the present progressive mode forward. Each agent involved in the negotiations in progress not only acts upon but also is acted upon by others. A materialistic embodiment of such a constant exchange between action and reaction is seen in the interplay between those local clocks as members constituting the most encompassing clock through their mutual action and reaction as letting the local act of reading one clock be an impetus for moving another locally. Reading and moving local clocks are thus a fundamental attribute of material dynamics in the present progressive mode.

The issue of time and temporality is most fundamental in our linguistic practice, and our descriptive endeavor for material dynamics is just a concrete instance of such a practice. If both the linguistic practice and the descriptive endeavor for material dynamics are mutually consistent with each other, it would be required to come up with the linguistic temporality from the dynamics. The issue of the clock-time complexes practiced in quantum mechanics without recourse to Newtonian absolute time is certainly a candidate for the purpose of integrating both linguistics and material dynamics.

References

Baker, P. L., 1993. Space, time, space-time and society. *Sociol. Inq.* **63**, 406-426.

Bouwmeesta, D., Pan, J.-W., Mattle, K., Eibl, M., Winfurter, H. & Zeillinger, A., 1997. Experimental quantum teleportation. *Nature* **390**, 575-579.

Dürr, T., Nonn, T. & Rempe, G., 1998. Origin of quantum-mechanical complementarity probed by a "which-way" experiment in an atom interferometer. *Nature* **395**, 33-37.

Gendlin, E. T., 1995. Crossing and dipping: some terms for approaching the interface between natural understanding and logical formulation. *Minds and Machines* **5**, 547-560.

Gunji. Y.-P., 1995. Global logic resulting from disequilibration process. *BioSystems* **35**, 33-62.

Hoffmeyer, J., 1996. *Signs of Meaning in the Universe*. Indiana University Press, Bloomington Indiana.

Matsuno, K., 1985. How can quantum mechanics of material evolution be possible?: symmetry and symmetry-breaking in protobiological evolution. *BioSystems* **17**, 179-192.

Matsuno, K., 1989. *Protobiology: Physical Basis of Biology*, CRC Press, Boca Raton Florida.

Matsuno, K., 1996a. Internalist stance and the physics of information. *BioSystems* **38**, 111-118.

Matsuno, K., 1996b. Symmetry in synchronous time and information in asynchronous time. *Symmetry: Culture and Science* 7, 295-305.

Matsuno, K.,1997. Information: Resurrection of the Cartesian physics. *World Futures* **49**, 235-249.

Matsuno, K., 1998a. Dynamics of time and information in dynamic time. *BioSytems* **46**, 57-71.

Matsuno, K., 1998b. Emergent phenomena of time in quantum mechanics. *Acta Polytechnica Scandinavica* **91**, 61-70.

Matsuno, K., 1998c. The clock and its triadic relationship. *Semiotica*, in press.

Matsuno, K., and Paton, R. C., 1998. Quantum mechanics in the present progressive mode and its significance on biological information processing. *BioSystems*, in press.

Matsuno, K., and Salthe, S. N., 1995. Global idealism/local materialism, *Biol. Philos.* **10**, 309-337.

Plautz, J. D., Kaneko, M., Hall, J. C., and Kay, S. A., 1997. Independent photoreceptive circadian clocks throughout Drosophila. Science 278, 1632-1635.

Riva, M., 1994. Local/global: literary postmodernism and the scientific rediscovery of time. *Soc. Sci. Info.* **4**, 649-661.

Rosen, S. M., 1997. Wholeness as the body of paradox. *J. Mind Behav.* **18**, 391-424.

Rössler, O. E., 1987. Endophysics, In: Casti, J. L., and Karlqvist, A. (eds.) *Real Brains, Artificial Minds,* New York: North Holland, pp. 25-46.

Salthe, S. N., 1993. Development and Evolution: Complexity and Changes in Biology. Bradford/The MIT Press, Cambridge Massachusetts.

Schulman, L. S., 1997. *Time's Arrow and Quantum Measurement.* Cambridge University Press, Cambridge UK.

Swenson, R., 1998. Spontaneous order, evolution, and autocatakinetics: the nomological basis for the emergence of meaning. In: Van de Vijver, G., Salthe, S. N., and Delpos, M. (Eds.) *Evolutionary* Systems. Kluwer, Dordrecht, pp. 155-180