

On the Origin of Space

Part 7:

Dialogues Concerning a Third New Science

- Day 2 -

©2004 Roger Y. Gouin

Independent Scholar

[to be published- revised 4/25/04]

rgouin@mindspring.com <http://rgouin.home.mindspring.com/>

Abstract

Supporting material for articles on space and the basis of life is presented through a stage adding to Galileo's 17th century Dialogues. In this second day, the participants explore key biological processes based on the state of space being affected by the dynamical needs of matter.

THE STAGE: *After being forgiven at last by the Pope, Galileo asked his friends Sagredo, Salviati and Simplicio to go back to Earth to find out what made the Pope change his mind 400 years after their dialogues on the two sciences that Galileo instigated back then.[1] Quite quickly to their dismay, they saw how distorted these sciences became at the hand of Scholars, with so much mathematics and so little physical feelings. They concentrated first on finding the facts and theories of the 20th century since they appeared to be behind the pardon by the Pope, and subsequently went to see whether any new science was hopefully in the works in order to redeem the situation. After 10 years of search and new learning, they finally fell upon a series of articles that reminded them a lot about the old ways of their dear Academician. Following the line of his work, these articles were running square against what they saw at the house of Scholars. A lot of hope was coming from them for the future of Science, as the science of Life they addressed could not be envisioned at all the first time they were on Earth. The decision was made to hold new dialogues, which were to last 3 days. This is the second day.*

1. **Simpl.:** *When it comes to features of Life in general, why does embryo development need more than the classical morphogens envisioned by the Scholars?*

Sagr.: The immediate answer is: “**Diffusion is not a precise enough phenomenon to account for embryo development.**” Under the leadership of Wolpert [2], the embryology of the Scholars is seeing the development of living organisms as a chemical clockwork process classically programmed through the genes (using a conveniently unidentified physical process) to direct the cells differentiation implemented through series of macromolecular reactions (“**pathways**”), in effect a **classical computational process** as understood by the Scholars’ computer science. A key problem in such a subject is how the **unfolding** in real time of a body 3-D shape is **directed** through the organism development; this is certainly at first sight a **non-local** process since it has a definite sequence; and many parallel subprocesses operating, no doubt under an overall control.

The key hypothesis in this field is the existence of **morphogens** doing the directing from data in the genes (**homeobox** genes – [3]) providing a **positioning system** [2, 4] for defining the kinds of cells in the embryo that are differentiated, at least in the early stages when differentiation and oocyte partitioning has not yet occurred.

However, (1) what is seen in the initial division of a tiny vinegar-loving fly, the **Drosophila Melanogaster**, into segments [5, 6] may not come from a diffusion process (i.e. **statistical mechanics**). It appears more like a **quantum wave function collapse** across the oocyte. (2) Experiments have yet to show how the genes of a cell modify their **program** according to the concentration of so-called morphogens at their location! What is known is that certain molecules **present** around a cell can trigger or inhibit the production of other gene products. What is not known is how such external molecules could affect, **via their presence**, the internals of the cell nucleus through two isolation membranes.

There is no indication on how the cells that are part of the choreography described in the Scholars’ literature can change or trigger an **ongoing program** among many different programs available through the DNA, and somehow run by it (or by an associated system in the cell nucleus), and this **in synchronism with other cells**. For such a program to run in parallel across cells, some kind of **physical support for a synchronization** must at least be present between these cells, at least all the cells involved in one function, and maybe one organ. What is this non-local clocking mechanism in real time – not in number of cell divisions time since synchronism would then be quite imprecise and variable?

Also, molecules such as “**Sonic HedgeHog**” (a gene product with a weird name) have been found as the closest thing to morphogens (see for example [7]). But they appear in the development process more like **initiating a cascade**

of **local cell-signaling responses**, or as inhibitors of other programs to implement a small part of the 3D blueprint that would be in the genes. They would also appear at specific stages in which **their presence** (not their concentration) is in effect **directed** by other molecules via **signal pathways** for their **activation** as the chemists describe, with no attempt of course at getting into the physics part of the things (i.e. their physical movements).

Recent observations [8] have shown that Hedgehog and other such products, that supposedly **regulate** growth and **decide** on cell fate, are in fact being transported in the embryo via **cytonemes**, very thin threads of cytoplasm thrown by individual cells from one side of the embryo to the other by using transport vesicles going along MTs to send **chemical messages** from the source cells. The formation of such cytonemes is a big mystery, but they were produced in vitro by the mere **presence** of target cells nearby. So there must definitely be a **quantum entanglement** here that needs study.

In another example in the same referenced article, egg rotations have been observed as being directed by **MTs transporting a protein in vesicles from one side of the egg to the other**, and this protein “turns on a host of genes.” In the article it is advanced that “*developing embryos may actively ship key signaling molecules from place to place, instead of relying on diffusion to carry the messages,*” and the processes observed “*may show the way to solve the long standing mystery of how signaling molecules orchestrate development so precisely.*”

Simpl.: Apparently **it has then been known for quite some time** in Scholars’ biology that diffusion is not a precise enough phenomenon to account for embryo development. Theoretical Scholars there seem to have missed (or chose to miss) that fact. So the **regulation and decisions on embryo development are not based on chemical processes after all, but on unknown physical processes directing chemical processes.**

2. **Salv.:** *We need now to go over the features of mitosis that are explained through “leptonic” space as you so brilliantly introduced yesterday.*

Sagr.: The observed starting point of mitosis [9] is when the pair of centrioles in the cell breaks up. Each centriole subsequently replicates itself into another centriole perpendicular to the axis of the original one.

The separation between the parent and the child centrioles at the start of mitosis (Fig. 1 - step 2) occurs as a result of the evolution of the structures in leptonic space. Their photon exchanges are stopped through an **external agent** coming into their common leptonic dimension. This common dimension lays in ordinary space as we have seen earlier (dimension 2 in Fig. 1).

Salv.: This stop in exchanges appears to be the key to the relation between the DNA replication and the MT replication process timings, something that must have come from the original symbiosis between the systems. The messaging between the two systems appears to be obtained through the production of the **cyclin-dependent kinase 2-cyclin E (Cdk2-E)**

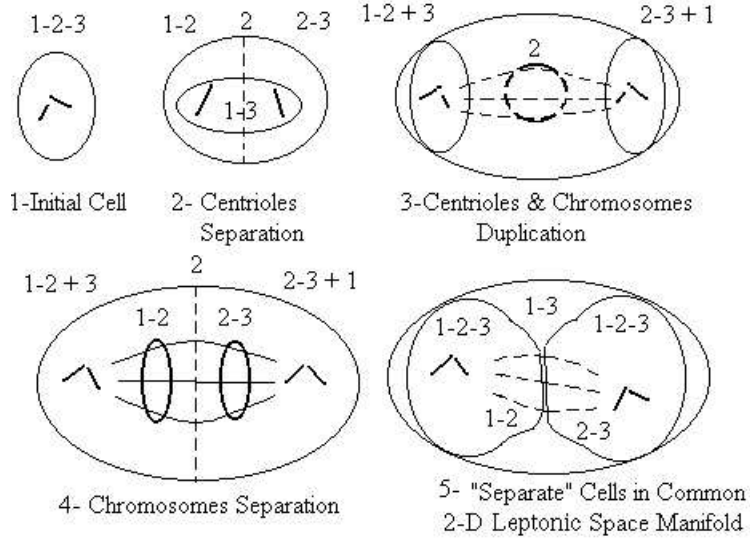


Fig. 1 - Cell leptonic space manifold connections

complex by the nucleus [10], a large molecule that would be **attracted by the quanta exchanged between the two centrioles** in the leptonic space common dimension (in ordinary space) and would block it. Cdk2-E is shown in the referenced article as being localized in **very specific areas of the cell**. This can happen only by this molecule following **unobservable leptonic space tracks** laid out between the nucleus and the centrioles through the MT system evolution and the centriolar program.

Sagr.: With one of its quanta exchange dimensions eliminated, the 3-D leptonic space manifold (identified with the centriole pair) **splits into two 2-D manifolds**, thereby **disconnecting** the two structures within ordinary space (their dimension 2). Then they merely drift apart, but are still connected through their leptonic space dimensions 1-3, which remain intact.

Subsequently, new child centrioles are built out of the "separated" centrioles, and the resulting new pairs have each a **rebuilt 3-D leptonic space manifold**.

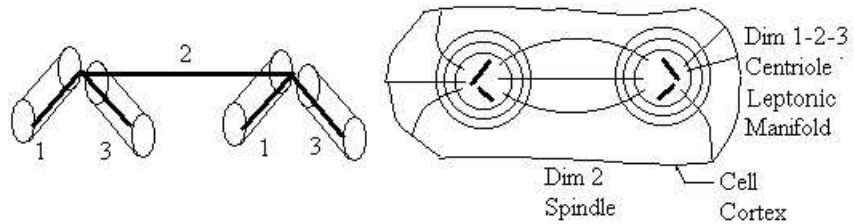


Fig. 2 - Mitotic spindle construction pulses in dim 2

Since being kept connected via leptonic space 1-3, **the two pairs are still quantum coherent with each other in their evolution**. They are then able to exchange photons through leptonic dimension 2 as they have it again in

common with ordinary space when their common program reaches the stage of producing these photons –via patterns in their automata. (Fig. 2)

Such 1-D (curved) quantum coherent photon exchanges **inflate** their individual 3-D leptonic space manifold. This inflation in turn sends the two pairs of centrioles at opposite locations in the cell.

Simpl.: Such an obvious motion of “asters” (centrosomes) in cells has never been explained before, even though it is prominently displayed in the Scholars’ basic teaching!

Sagr.: Then polymerization of MT’s occurs **between the centriole pairs**, induced by quanta exchanges between the pairs. They form the well-known mitotic **spindle** (Fig. 1 - step 3 and Fig. 10). These MTs support different sets of leptonic dimensions (1-2 or 2-3) according to which centriole pair emits the photons.

Salv.: The separation of the cell into two cells after the completion of chromosomes duplication is described in the Scholars’ literature (see for example [11]) as being effected through MTs polymerizing in-between the centrioles, and between them and the cell cortex. This is conceived as a **Newtonian pulling force** generated by a **treadmill effect** of the MTs, helped with dynein **motors** attached to them (quite mechanistic, indeed in the way we thought 400 years ago!). But the evolution of the MTs is observed to occur **in concert** with all the components of the cell, including the nucleus components, which replicate in their own way, helped by the MTs segregating somehow the replicated chromosomes. This is quite a miracle for so many separated entities!

Simpl.: I shall note here that the **coordinating agent** for this **non-local** so-called **pulling apart process** (which can only be seen indeed as miraculous when considering all the other coordinated events happening in the nuclear material) cannot be found described in the Scholars’ literature, and **is not even pointed out to students like me as a theoretical void!** Such a non-scientific attitude appears very common in Scholars’ biology these days. That’s probably why the present Pope forgave our Academician, thinking he must have been acting that way too deep down...

Sagr.: Let’s then now turn to our earlier **multi-dimensional picture** of the system. MTs are mostly produced in the period starting before the pulling apart process begins, and ending with the start of the cell splitting into two cells. [8] This indicates to me that the dual layer of ordinary space, with its associated leptonic space manifold, **connects the entire cell** up to and including the mole-

cules of the cell cortex (outer membrane), and this through MTs that go from the centrosome to that cortex (Fig. 1 - steps 3 and 4, and Fig. 10).

The chromosomes in the nucleus of the cell include molecular complexes called **kinetochores**. Their replication must end up with 2-D leptonic space manifolds in separate dimensions 1-2 and 2-3, **probably through principles similar to the ones of centrioles replication**.

Such kinetochore manifolds would be included in the corresponding MT system manifolds through the photon exchanges between centriole pairs (according to the extent of their leptonic dimensions), and thus attach the chromosomes they hold to the corresponding threads of the spindle (Fig. 1 - step 4).

Then, as it happened for the separation of centrioles, the photon exchange between centriole pairs ends, forcing dimension 2 of the centriole pairs leptonic space **to recede** between them.

What makes the photon exchange end here? From many reports this looks to be effected by the kinetochores, as **they must all attach in order to stop all the photon exchanges in leptonic space dimension 2**, thereby breaking at last the 3-D leptonic space manifold of the cell into two 2-D manifolds.

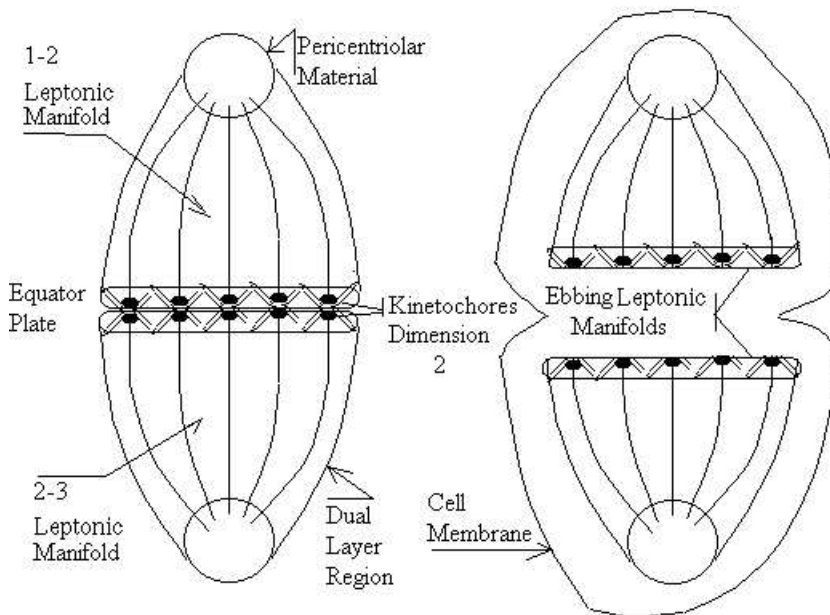


Fig. 3 - Mitosis with kinetochores control

Simpl.: Note that such a spatial process would be much simpler than any based on chemistry, and thus much more likely when taking the standpoint of Evolution. This goes on top of the precision required of the process, a precision that cannot be attained via the stochastic phenomena of chemistry.

Sagr.: The subsequent **receding leptonic space** then segregates and pulls apart the two sets of chromosomes, as well as the other parts of the cell that were duplicated in parallel with the nuclear material. Since the cell membrane itself is connected to leptonic space via its receptors, the **ebbing process of this space** ultimately results with a separation into two cells (Fig. 1 - step 5 and Fig. 3).

The final separation of the daughter cells involves the transient formation of an *actin* “**cleavage furrow**” ring seen in the literature as “squeezing apart” the cytoplasm.[12] The localization of actin may be an indication this component of the cytoplasm senses leptonic space manifold connections. It then locates itself at the connection of the two cell submanifolds where they form a 3D border due to their different MT dimensions, thus forming a ring in the spindle equatorial plate plane. *This submanifold operation has been recently verified through cutting a cell while it was in the middle of its mitosis, as this lead to a very odd budding of each cell containing a single spindle pole, with actin still forming a furrow.*[13]

Actin coating of the nuclear membrane in a “geodesic dome,” [12] would be another instance of this phenomenon. This dome would identify the nuclear envelope as sustaining a set of leptonic space manifolds with their connections located at the vertices of the dome, being common to six manifolds alternating in their dimension 1-2 or 2-3. Margulis [14] did identify the nuclear envelope as a filiation of the MT/nuclear material symbiosis that resulted in the eukaryotes, so the material making this envelope has to reflect the properties of its parents.

Such an arrangement would also induce the cell cytoplasm layout into an *actin microtrabecular matrix* of domains as [12] mentions. The cell membrane provides anchor points through its receptors (integrin) for MTs in-between the actin filaments.

Simpl.: But the above **matching process** between kinetochores and quanta exchange paths would require the number of these quanta paths connecting the two centrioles (not the number of spindle threads) to equal the number of kinetochores. What physical process could result in such a quantified and precise function? My thought there is that the required number of photon pulses generated across two pairs of centrioles forming the spindle must come from the characteristics of the computational program occurring through the electronic shuttling inside the centriole pair leptonic space.

Sagr.: Let me restate the problem. Through the split of the leptonic space manifold into two 2-D manifolds in different dimensions at step 2 of mitosis, the computation on the centrioles is stopped (from the DNA signal molecule, as we have seen); and this with the electronic states frozen at the instant of separation since only one leptonic dimension is available for the electron shuttling. In order for the computation to restart, the centrioles must drift apart far enough such that the dual layer of ordinary space is limited to the neighborhood of each centriole, thereby allowing a sufficient localization of photons in dimension 2 to start a new child construction.

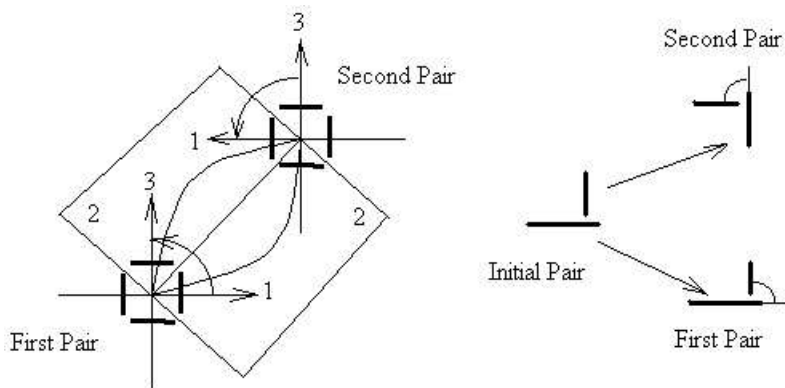
The computations on the two centrioles then become separate in their evolution, even though they are coherent evolutions by themselves. They just have

now to exchange quanta through conduits provided by MTs (the observed spindle) in order to have a common computation. They are realizing then a **composite quantum system** between themselves.

Salv.: Ok, now I get it. A computational output occurs when electrons simultaneously shuttle in dimension 1 and dimension 3 at the same corresponding location along a slat on both centrioles, thereby emitting photon pulses in dimension 2 common with ordinary space. Such pulses have a circular polarization in leptonic space dimensions 1-3 and thus do not interact with ordinary space contents (water, etc.). They are thus unobservable. They attract biomolecules because they **connect** with them through their leptonic space in the process of extending a space manifold.

They contain a **set of photon realities** by being simultaneously emitted from a set of **computation realities** from the **entire length of the slats**, forming a parallel train of photons along dimension 2 superposed with each other. (Fig. 4)

The other pair of centrioles being coherent with the first one will emit at the same instant a corresponding pulse. But the centrioles in that second pair result from the initial pair that split up. A 90 degree rotation was made to create a complement pattern in dimension 3 during the original pair build-up. An-



other rotation was made for the construction of the present pairs so the initial pattern is again in dimension 1 but rotated 180 degrees (Fig. 4).

Then the present second pair has its automata computation running in the opposite direction in dimension

Fig. 4 - Quanta exchanges forming spindle

1 from the first pair, thereby emitting the photon pulse in the opposite direction from the pulse emitted by that pair, and thus towards it.

Dimension 2 of the leptonic space between the two pairs is a **curve in 3-D through ordinary space**. The pulses generate two **complementary spindle threads** between the pairs of centrioles, one thread having its leptonic space in dimensions 1-2 and the other in 2-3 according to the dimensions of the source that emitted the photons. The attracted biomolecules sense (“observe”) the photon pulses polarization in leptonic space through their own electron shuttling orientation, and thus “get into it,” as any **quantum observer** (per Everett’s analysis).

The **spatial separation between threads at the equator of the spindle** is created by the presence of the nucleus kinetochores creating a dual layer in the ordinary space manifold as described earlier (Fig. 3), and the process has no other outcome but having the kinetochores matching the quanta paths. The set of duplicated kinetochores have their leptonic manifolds in dimension 3 if the originals have theirs in dimension 1, thus, together, they form a 3D leptonic manifold in two submanifolds connected in dimension 2 at the kinetochores themselves. The kinetochores are then **selectively** attracted by the photons on their way to the other centriole pair according to their leptonic space manifold orientation.

When the photon pulses meet the corresponding slats in the other centrioles pair, they do it in the same way they were emitted (thinking in more than 3D is here important!): At that point, each pair of centrioles in effect receives back (“observes”) its own photon pulse (**undistinguishable** set of monadic spaces) as if it was reflected in a mirror. The computation then runs as if a time reversal occurred until a new set of photon pulses is generated by the computation. **Therefore the computation must generate a fixed, even number of quanta paths (threads) through processing its automata pattern program generating the same pulses again and again until this cycle is stopped by the kinetochores as we have seen earlier**, allowing the computational process at that time to go further in its evolution. Other programs with a different number of quantum paths would have been discarded by Evolution. And conversely, a defect in the program defining this number will lead to very serious development or maintenance problems.

Simpl.: Experiments with mitosis without chromosomal material showed the spindle then reduced to straight parallel lines between centrioles. ([14], p. 229), with no cell separation ever happening.

Salv.: As a result of the above analysis, I can infer that, when alone in a cell, a pair of centrioles generates MTs either all with leptonic dimensions 1-2 or all with dimensions 2-3, depending on whether the pair was the **first** or the **second** one in the mitosis they come from. In other words, the 3-D leptonic space manifold of the cell is basically a 2-D layer **lining up** the ordinary 3-D space of the cell, except for the centrioles area which has a stub in a third dimension (here again thinking in more than 3D is important).

The leptonic space of the cell will be fully 3-D only during mitosis when the spindle threads intermix to pick up the chromosomes as seen earlier.

Sagr.: In the picture you drew above, the MTs generated by the centrioles cannot perform a computation since only two complementary conformational configurations through either leptonic dimension 1 or 3 is available (see the left

side of Fig. 2 seen yesterday). The electrons have then a fixed dual state to shuttle between in leptonic space. These states correspond to molecular conformations forming a fixed 3-D pattern in ordinary space. This pattern is dynamic as it propagates through the **phonons waves**, except that no computation is performed here. This non-local dynamic pattern of conformations propagating in waves can be seen as at the physical origin of the synchronized motions observed for dynein and kinesin **motors** used in intra-cellular transports along MTs.

These **dynamic patterns** have other functions: They can be modified either by **multiple reality photon pulses from the centriole pair** or from **(classical) ion translation in the cytoplasm**. They are therefore the **memory** of the cell quantum system as well as its input/output versus the outside classical reality, something that Descartes would have been very interested in indeed!

Simpl.: Let me add one aspect I get from all this: In step 5 of mitosis, once the cells are separated in ordinary space, quanta exchanges can exist through the cells MTs, membrane and extracellular matrix, allowing their centrioles to continue evolving with some input from their neighbors, but **provided they remain in sufficient contact** so that a leptonic space manifold is maintained. However, a common computation can no longer be sustained as it happened in mitosis. Input from neighbors may allow **synchronizing their replications**, among other things, through quanta exchanges with the kinetochores of their own nucleus so that their DNA programs can remain synchronized. If they don't we are bound to see some cancer developing, marking the onset of a **separated entity** within the organism...

3. **Salv.:** *Now that we have the geometrical principles of cell division, let's describe more precisely the geometry leading to synapses as they appear to be connections between cells.*

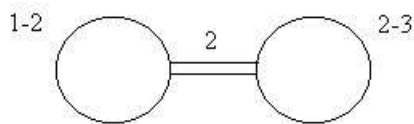


Fig. 5 - Neurons leptonic space connections

Sagr.: In order for two **spatially separate** centriole pairs in glial cells to have a common quantum computation, a 3-D leptonic space manifold common to the neurons and glial cells is needed in order to allow exchanges of their quanta. However, in the physical picture of mitosis outlined earlier, neurons, **as any cell in the organism**, have their MTs leptonic space in either dimensions 1-2 or 2-3, per our earlier discussion. Therefore a connection with ordinary space in dimension 2 must complement the neurons leptonic manifold dimensions 1-2 and 2-3. The need for such a 3-D manifold connection then gives a physical reason for neural synapses (Fig. 5), as **the MTs within the neurons would be then able**

to provide the quanta exchanges paths between glial cells centrioles pairs as they were providing in mitosis within a single cell.

Simpl.: Indeed, this is the confirmation of the lengthy geometrical analysis Salviati went through earlier!

Sagr.: In that picture, each pair of centrioles in a glial cell emits a photon pulse in dimensions 1-2 or 2-3 through the synapse of the nearest neuron (Fig. 6b), maybe using neurons cytoplasm elements such as vesicles coated with the supramolecular structure **clathrin**, which is known to enclose **cell membrane receptors**.

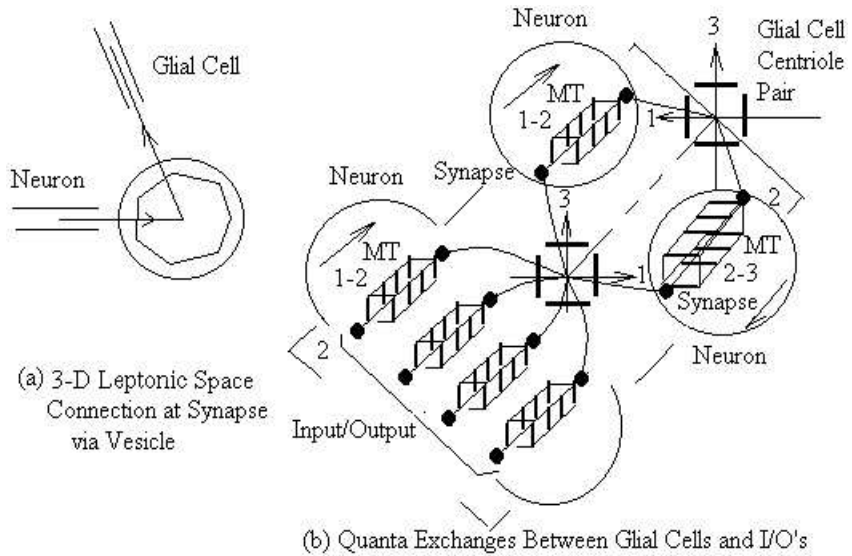


Fig. 6 – Relationships between neurons and glial cells

Such vesicles would then be involved not only in releasing neurotransmitters in the synapse cleft for subsequent classical ion pulses, as the Scholars look at, but more importantly act as a **photon pulses redirector between leptonic space submanifolds**.

They would, by themselves, effect a 3-D connection with leptonic space as **centriole pairs do**. This function there would come from the **cell membrane receptors** put in a quasi-spherical arrangement inside the clathrin “triskelion” structures forming the

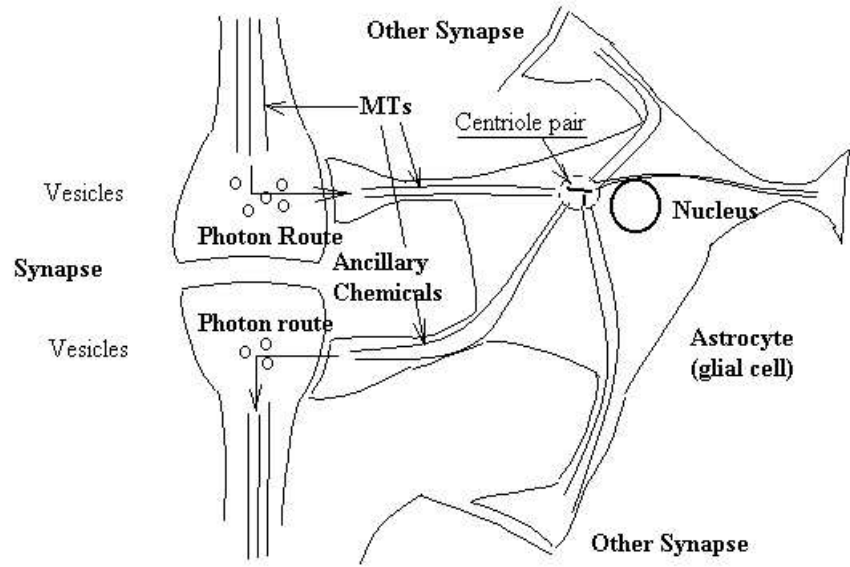


Fig. 7 – Physical relationship neuron-glia cell

vesicle clathrin coat. Their sharp geometrical features hints at their function: Such receptors would sustain a quasi-spherical dual layer of ordinary space through polyhedral “crimps” in ordinary space centered at the vesicles, thereby creating an orthogonal 3-D leptonic space connection (Fig. 6a).

The glial cells then modify the synaptic connections (which would occur initially at random via DNA) as their computation calls for, and this through developing the required MTs in the neurons via their clathrin-coated vesicles (Fig. 7). (The MT patterns in turn **direct actin for the needed growth cones.**) These vesicles would in a sense provide the pulling strings of the puppet master, as the article from our Academician’s disciple identifies.[15]

To-morrow we will review what we learned and conclude!

References

- [1] Galilei (1638), *Discorsi E Dimonstrazioni Matematiche intorno à Due Nuoue Scienze (Dialogues Concerning Two New Sciences)*, Elzevir, Leyden, transl. de Salvio, Dover 1954 reprint
- [2] Wolpert (1991), *The Triumph of the Embryo*, Oxford
- [3] Goodwin (1994), *How the Leopard Changed its Spots*, Scribner
- [4] Wolpert (1969), *Positional Information and the Spatial Pattern of Cellular Differentiation*, J. Theor. Biol. **25**, 1-47
- [5] Nuesslein-Volhard and Wieschaus (1980), *Mutations Affecting Segment Number and Polarity in Drosophila*, Nature **287**, 795-801
- [6] Ingham (1993), *Localized Hedgehog Activity Controls Spatial Limits of Wingless transcription in the Drosophila Embryo*, Nature **366**, 560-562 (9 dec)
- [7] Lee et al. (1992), *Secretion and Localized Transcription Suggest a Role in Positional Signaling for Products of the Segmentation Gene Hedgehog*, Cell **71**, 33-50 (2 oct)
- [8] Vogel (1999), *Many Modes of Transport For an Embryo’s Signals*, Science **285**, 1003
- [9] Vandré and Borisy (1989), *The Centrosome Cycle in Animal Cells*, in Hyams and Brinkley, *Mitosis: Molecules and Mechanisms*, pp. 39-75, Academic
- [10] Hinchcliffe et al. (1999), *Requirement of Cdk2-Cyclin E Activity for Repeated Centrosome Reproduction in Xenopus Egg Extracts*, Science **283**, 851 (5 feb)
- [11] Kuchel and Ralston (1998), *Biochemistry*, 2nd ed., McGraw-Hill
- [12] Hameroff (1987), *Ultimate Computing*, Elsevier
- [13] Alsop and Zhang (2004), *Microtubules Continuously Dictate Distribution of Actin Filaments and Positioning of Cell Cleavage in Grasshopper Spermatocytes*, J. Cell Science **117**, 1591-1602
- [14] Margulis (1993), *Symbiosis in Cell Evolution, 2nd Ed.* Freeman
- [15] Gouin (2004), *On the Origin of Space – Part 6: The Power of Quantum Dynamical Life*, to be published