TGD based model for anesthetic action

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Contents

Abstract

The mechanism of anesthetic action has remained mystery although a lot of data exist. The Meyer-Overton correlation suggests that the changes occurring at lipid layers of are responsible for anesthesia but this model fails. Another model assumes that the binding of anesthetes to membrane proteins is responsible for anesthetic effects but also this model has problems. The hypothesis that the anesthetes bind to the hydrophobic pockets of microtubules looks more promising.

The model should also explain hyperpolarization of neuronal membranes taking also place when consciousness is lost. The old finding of Becker is that the reduction or reversal of voltage between frontal brain and occipital regions correlates with the loss of consciousness. Microtubules and DNA are negatively charged and the discovery of Pollack that so called fourth phase of water involves generation of negatively charged regions could play a role in the model. Combining these inputs with TGD inspired theory of consciousness and quantum biology one ends up to a microtubule based model explaining the basic aspects of anaestesia.

1 Introduction

The mechanism of anesthetic action [J10] (http://en.wikipedia.org/wiki/Theories_of_general_anesthetic_action) has remained mystery although a lot of data exist.

Typically anesthetes induce analgesia, amnesia, and immobility. Some anesthetes cause amnesia (brain) but no immobility (spinal cord). I have heard also about anecdotal evidence that anesthetes do not always cause amnesia nor even analgesia.

The first question what comes in mind is whether anesthetes indeed cause a loss of consciousness? In TGD framework self dies when the first state function reduction to the opposite boundary of CD occurs and time reversed self is generated [K12, K1]. Could also anesthetes have the same effect? If so, anesthesia would be like sleep, which need not be unconscious state but could represent time reversed self at "our" level of self hierarchy. This would explain also why we do not have memories about the period during sleep.

The Meyer-Overton correlation suggests that the changes occurring at lipid layers of are responsible for anesthesia but this model fails. Another model assumes that the binding of anesthetes

to membrane proteins is responsible for anesthetic effects but also this model has problems. The hypothesis that the anesthetes bind to the hydrophobic pockets of microtubules looks more promising.

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2 Background

2.1 Some facts about anesthesia

To begin with, it is could to list some facts about anesthetes.

1. Very different substances act as anesthetes. No clear correlation with the chemical properties of substance. Even noble gases can act as anesthetes. Short range van der Waals interaction involving induction of electric dipoles are the most natural candidates for the interaction. The increase of atmospheric pressure is known to reduce anesthetic action.

2. The anesthetic potency correlation or Meyer-Overton correlation [J2] (`https://paulingblog.wordpress.com/2009/06/04/the-meyer-overton-theory-of-anaestesia/`) serves as an important guideline when one tries to imagine mechanisms of anesthetic action. The potency of anesthete is proportional to the solubility to lipids. This led to the proposal that anesthetes are solved into lipids and induce perturbation of lipid layer. anesthetes causes a fluidization of membrane. So does also a slight temperature increase but is not followed by anesthesia. Several mechanisms along these lines have been proposed [J10] (`http://en.wikipedia.org/wiki/Theories_of_general_anesthetic_action`). Further objection is that stereoisomers of anesthetes have very different anesthetic effects. Some drugs highly soluble to lipids have a convulsive effect instead (they are called non-immobilizers). A small increase in body temperature affects membrane density and fluidity as much as anesthetics but does not cause anesthesia. The reason why polar anesthetes are less effective is that they have to cross blood-brain barrier. The effect of anesthete also vanishes above certain chain length in the case of homologous series of any general anesthetic. For instance, for n-alcoholes carbon chain length of 13 units serves as a cutoff raising the question whether the anesthetic effect occurs at microtubular surface having this kind of periodicity. The solubility to lipids does not display this kind of effect.

   The conclusion is that lipid solubility is only a necessary condition (allowing the anesthete to get through the membrane) and the lipids in question need not be associated with cell membrane but be hydrophobic pockets of proteins.

3. Second proposal is that anesthetes could bind to membrane proteins. Some anesthetes are indeed stereospecific. This hypothesis led to the observation that general anesthetics can also interact with the hydrophobic proteins sites of certain proteins. It is known that lock-key mechanism is not the general mechanism. Rather, it seems that anesthetes affect protein dynamics in microsecond-millisecond time scale.

What one can conclude?

1. Effects on lipid layers do not explain the findings. anesthete must be able to traverse neuronal membrane. High solubility to lipids certainly helps here. Different anesthetic effect of stereoisomers suggests that the process involves further step(s).

2. Chemical bind and lock-key mechanism does not explain all findings: noble gases serve as a good example and suggests that also van der Waals interactions are important in some cases at least. The ability of anesthetes prefer to bind to hydrophobic pi rings might be

important. This kind of rings are associated with tubulin dimers, which suggests that the action of anesthete takes place at the level of microtubules.

2.2 Some basic facts about microtubules

1. Microtubules have been proposed to be central for consciousness. In [J1] `http://phys.org/news/2015-04-quantum-criticality-life-proteins.html` Stuart Hameroff discusses this hypothesis in light of the recent findings of Stuart Kauffmann, Gabor Vattay et al [J5] supporting the view that quantum criticality is a general property of biomolecules. Quantum criticality is the key notion of not only TGD inspired view about life [K17] but of entire TGD and realized in terms of hierarchy of sub-algebras of super-symplectic algebra represented as conformal gauge transformations [K2].

   Hameroff argues that the the hydrophobic regions are seats of consciousness and the interaction of anesthetes with them leads to a non-conscious state. The view discussed below is not so simple but assumes that this interaction is central in the process leading to a loss of consciousness.

2. A related proposal [J12, J11] is that in the case of microtubules ferro-electric phase explaining the polarization of microtubules makes possible signalling along microtubule highly relevant to consciousness. Also this view is in accord with TGD based vision where resonant communications using dark photons with large Planck constant and having universal energy spectrum in the range of visible and UV energies is central. This gives connection also with quantum gravitation but in a manner very different from that in the model of Penrose and Hameroff [J8]. Quantum coherence in even astrophysical scales is essential.

The stabilization of microtubules is due to the negative charge density along them.

1. Microtubular carry negative charge density due to the binding of 2 GTP molecules to each tubulin dimer (`http://arxiv.org/pdf/1206.4400.pdf`. The article estimates the potential experience by given tubulin dimer and coming from the other dimers. It is assumed that microtubular alpha and beta proteins have positive charge, which cannot be true. The charge density is negative.

   The article of Jack Tuszynski [J12, J11] provides a good view about non-linear liquid crystal model for ferro-electric phase of microtubules and also contains illustration about the average negative charge density of tubulin dimer.

2. Where does the positive charge reside? TGD interpretation for the fourth phase of water suggests that it resides outside microtubules at magnetic flux tubes as dark protons with large value of h_{eff} [K15, K14]. Huping and Wu [J9] have observed that proton pairs with members at opposite sides of cell membrane have spin-spin interaction frequencies in ELF scale, I have proposed that these protons are dark: TGD inspired model of super-conductivity suggests that they form a super-conducting phase. Also electrons and fermionic ions could be super-conducting with same binding energies for Cooper pairs [K10]. On basis of a model for dark protons I have proposed that they give rise to a representations of DNA, RNA, amino-acids and perhaps even tRNA and that also genetic is naturally realized [K6] and that dark proton sequences accompany DNA: this might make sense since also DNA is negatively charged with 2 negative charges per nucleotide.

3. The empirical rule for the direction of electric polarization is that the neuronal ends of axonal microtubules correspond to minus ends of the microtubule. Remarkably, in the case of dendrites there is fifty-fifty distribution in polarity in the case of vertebrates but for invertebrates the the dendrites have positive neuronal end [J6] (`http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2555934/`). This could tells something very deep about consciousness.

In TGD selves has time reversed variants born when self dies as the first state function reduction to the opposite boundary of CD takes place. Since electric potential changes sign in time reversal, the presence of two kinds of dendrites could relate to memory. Electric voltage changes its sign in time reversal and indeed leads to a loss of consciousness in the scales studied by Becker [J4]. Could

the dendrites correspond to sensory dendrites and memory dendrites? Memories would involve signalling in reversed time direction and memory dendrites. The important conclusion would be that invertebrates would not have memory at this level of self hierarchy.

3 TGD based model for anesthesia

In TGD based model for anesthesia magnetic body, supra currents [K9, **?**], and dark matter [K4, K17] should be involved. Besides this the findings of Pollack [I1], Becker's discoveries [J4], and microtubules, in particular the latest findings [J3, J7] are expected to be in a central role in the model.

1. The fourth phase of water discovered by Pollack [I1] involving charge separation creating negatively charged regions with sizes up to 100 μm and $H_{1.5}O$ stoichiometry inside negatively charged regions might be involved. Negatively charged linear structures populate living matter: for instance, DNA has 2 negative charges per nucleotide, tubulin dimers have 2 negative charge per nucleotide. Cell interior is also negatively charged. TGD based model [K15, K14] assumes that part of protons go to the magnetic flux tubes and become dark having large non-standard value of effective Planck constant $h_{eff} = n \times h$.

2. Becker's DC currents consist of electrons and are generated in wounds and lead to healing of the wound. What happens that wound gets in negative potential with respect to environment. For instance, frontal lobes are in negative potential with respect to the occipital regions and brain injury generates positive polarization. This means the presence of longitudinal electric fields and ferro-electric phase is a good guess. Becker's discoveries are discussed in TGD framework in [K10, K16]. It is proposed that elecronic Becker currents are supra currents: this assumption is not necessary but possible. It is also proposed that the currents flow along microtubules.

3. Microtubular ferro-electric property could be the mechanism generating the electric potentials and the action of anesthetes could weaken or destroy these potentials. There is an old discussion of ideas related to microtubules in [K8] and the latest findings are Bandyopadhyay et al are modelled in in [K16].

3.1 Mostly questions

It is good to start with a list of questions.

1. Could the mechanisms inducing anesthesia and sleep have something in common? Could also anesthetes induce hyperpolarization so that nerve pulses are not generated so much? How the hyperpolarization would be induced?

2. Could there be a connection with DC currents of Becker [J4]? Could anesthesia reduce the strengths of the electric fields of Becker or maybe even reverse their direction. For instance, the electric field between frontal lobes and occipital lobes could change its direction or get weaker.

3. Healing by DC currents means that the damaged body part generates negative potential. DC currents of Becker consisting of electrons make this possible. Could one say that the damaged body part becomes conscious? Could also cell interior, DNA, microtubules negatively charged be conscious. In TGD framework it is difficult to think how they could avoid of being conscious.

4. Could there be a connection with microtubules and their ferroelectric phase transition? Could the microtubular longitudinal electric fields be responsible for these electric fields and could DC currents of Becker accompany microtubules? Is the phase transition destroying microtubular ferro-electricity responsible for the loss of consciousness induced by anesthetes? Could the phase transition change the direction of electric field? Could this mean change of the arrow of time generating time reversed mental images? Could these two kinds of mental images be assigned with the dendrites with opposite directions of electric field?

If the answer to these questions is positive, one might be able to perform reduction of the control of neural activity to microtubular level. Nerve pulses might be induced by a primary wave propagating along microtubules changing locally the direction of the microtubular electric field during the nerve pulse. Temporary time reversal of a microtubular sub-self (mental image) is highly suggestive.

5. Could anesthetes act on microtubules and induce a phase transition destroying their ferroelectric character? Could Becker's DC currents [J4] flow along microtubules as proposed [K10, K16]? Consciousness would be lost, when ferroelectricity of microtubules is reduced or disappears. Longitudinal electric field of microtubule associated with its negative charge density would become radial and would induce hyperpolarization.

6. Is there a connection with TGD view about self? Could the change of the sign of voltage be a space-time correlate for time reversal for self [K7] - in the usual interpretation loss of consciousness? Could amnesia about period of "non-consciousness" be due to time reversal changing the sign of the potential.

3.2 What could happen in the ferro-electric phase transition?

What could happen in the phase transition making microtubule ferro-electric and in the reverse phase transition leading to a loss of consciousness?

1. Coherent orientation of the microtubular dipoles in longitudinal direction can generate a longitudinal electric field which for long enough microtubules is proportional to the electric charge at the second end. If the orientations of tubulin dipoles are random, the net electric field is also random. The effect of anesthete would be to randomize the directions of dipoles so that the potential between the ends of microtubule would be random. One can wonder whether this field is really strong enough to explain the experimental findings [**?**].

2. Microtubule carries non-vanishing constant negative charge density due to the presence of two GTPs differing from ATPs only in that A is replaced with G attached to the tubulin dimer and stabilizing it.

   The non-topological half of Maxwell's equations also in TGD framework at the level of space-time surfaces. One can however assume it at QFT limit. Consider first the solutions to the Maxwell equation $\nabla^2\Phi = -\rho_q$ for constant charge density ρ_q concentrated on long linear structure, say microtubule. The standard ansatz is that outside of a very long microtubule the potential depends on the radial coordinate ρ only. Φ satisfies Laplace equation $\partial_\rho^2\Phi+\partial_\rho\Phi/\rho = 0$ giving a potential of form $\Phi = klog(\rho/rho_0)$ creating a slowly varying radial electric field. For this option microtubule would be analogous to a conductor for which the tangential electric field at microtubular surface vanishes. The value of k is proportional to the surface charge density.

3. In the article of Tuzcinsky et al [**?**] it is assumed that inside microtubular surface the potential restricted to the microtubular surface satisfies the equation $\partial_z^2\Phi = \rho_q$). A more general ansatz reads as $\Phi = az + bz^2 + c\rho^2$ with $2b + 3c = \rho_q$. The electric field increases along the microtubule and voltage between the ends can be higher than the voltage solely due to a coherent polarization. One can indeed pose this kind of condition as a boundary condition in Maxwell's theory although it makes solution numerically complex.

   The physical picture would be that the electric decomposes to two parts. The first part flows along the microtubule and second part flows in good approximation in the radial direction. The electric field generated by microtubule would be at large distances that of a point like charge but nearby radial field would be weaker than for the solution carrying maximal radial flux and there would be longitudinal electric field carrying part of flux.

   If a phase transition to a situation in which the electric field is radial occurs, the value of the radial flux becomes maximal and could lead to a hyperpolarization of the cell membrane and reduce neural activity. Also the longitudinal electric field would be reduced and would accompany the loss of consciousness in accordance with the findings of Becker. Becker's

findings and a basic fact from neuroscience would be understood as aspects of one and same phenomenon.

4. Can one imagine a phase transition changing the sign of the longitudinal electric field of the microtubule. Could this occur for the dendritic microtubules of vertebrates for which both directions of electric field are present? The direction of electric field correlates with the structure of the microtubule so that the reversal very probably cannot occur for an existing microtubule.

5. How the anesthete bound to hydrophobic pi resonance rings generates the phase transition from ferro-electret to non-ferro-electric phase or to a phase with weaker longitudinal electric field? anesthete should induce a phase transition in which the electric field transforms from longitudinal to radial. The interaction with the pi rings defining hydrophobic pockets should somehow redirect the electric flux to radial direction. The simplest possibility is that the anesthete increases the resistance in the longitudinal direction and reduces the current and therefor also the voltage. Also super-conductivity might be destroyed locally.

6. Situation would be also quantum critical. Quantum criticality of TGD Universe is basically due to the huge vacuum degeneracy of Kähler action inducing 4-dimensional spin glass degeneracy, which predicts that a given induced Kähler field allows all symplectic transforms of the space-time surface as its representations. Only classical gravitational fields differ for these representations. Hierarchy Planck constants is one manifestation of the hierarchy of quantum criticalities.

   Also classical gravitation would be relevant and assuming the condition $\hbar_{eff} = \hbar_{gr} = GMm/V_0$, where v_0 is some characteristic velocity in 2-body system involving large mass M and mass m of electron, proton, or heavier particle. TGD predicts macroscopic quantum gravitational coherence [K17] and universal energy spectrum for cyclotron photons (no dependence on the mass m of charged particle mass) highly relevant for the model of bio-photons as decay products of dark photons serving as key tool of quantum control also at the microtubular level. By universality also bio-super-conductivity is universal- that is possible for all charged fermions involved being characterized by same binding energies of Cooper pairs associated with pairs of flux tubes. Also bosonic analogs of supra-currents acting also as spin currents and associated with single flux tube are predicted [K10].

One can relate this model to the TGD based model for the findings of the group led by Anirban Bandyonophyay [J3, J7].

1. Microtubules allow two kinds of conformations. For type B microtubules helical symmetry is broken and their is kind of a gap along microtubule. In this phase classical signalling is expected to be possible but macroscopic quantum coherence is restricted to single portion of microtubule helix consisting of 13 tubulins. Also super-conductivity is expected to fail and the conductivity of microtubule is expected to be low. Type A microtubules have helical symmetry since gap is absent. They might be ideal for quantum computation and consciousness since quantum coherence scale would increase from a length of single helical twist to the length scale of entire tubule.

2. There is however a problem: microtubules of type A appear in neither vivo or vitro! This problem can be solved in TGD inspired model [K16].

   The group of Anirban Bandyonophyay [J3, J7] have found highly interesting effects of AC electric fields on microtubules at frequency ranges about kHz, MHz, and GHz. The TGD inspired proposal is that the external AC signal can induce a phase transition transforming microtubules of type B to microtubules of type A, and in this manner can make possible quantum computation and consciousness. Dark photons at these frequencies but with energies above thermal threshold - perhaps in the energy range of bio-photons in visible and UV range - would serve as a control tool inducing this phase transition increasing the value of h_{eff}. The generation of the gap would also break the long superconducting wire to pieces and super-conductivity inside microtubule would become super-conductivity in much shorter

scale and therefore reduces microtubular conductivity. This implies the reduction of longitudinal electric field and explains the other signatures for the loss of consciousness (reduction of Becker's DC voltage and hyperpolarization).

3. This transition has analog also in TGD based description of both bio-super-conductivity and ordinary high T_c super-conductivity [K10]. There are 2 critical temperatures. At higher critical temperature Cooper pairs are formed at flux tubes carrying antiparallel magnetic field but supra-currents flow in rather short length scale (the analog of B phase for microtubules). At lower critical temperature the flux tube pairs reconnect to from much longer flux tube pairs (microtubules of type A) and give rise to macroscopic super-conductivity. The process is percolation type process. In the recent case the external AC frequency has the same effect as lowering of temperature.

The model could generalize to other important biopolymers.

1. The presence of negative charge density due to GTP and ATP could provide biopolymers with negative charged density generating the stabilizing electric fields. The negative charge could be due to the generation of fourth phase of water discovered by Pollack [I1] transforming part of protons to dark protons and providing the ionizing electron for GTP or ATP. This suggests a very close connection with metabolism.

2. Also the denaturation of basic biopolymers such as DNA and proteins could rely on a phase transition reducing the longitudinal electric fields made possible by GTP or ATP generated in Pollack's phase transition. In TGD framework one could say that biopolymer loses consciousness.

3. The two strands of DNA could represent sub-selves with opposite time directions. Also brain hemispheres could have opposite arrow of time at some level of self-hierarchy. The other hemisphere would remember and the other hemisphere would pre-cognize (remember in reverse time direction).

3.3 Aromatic rings as the lowest level in the molecular self hierarchy?

Of special interest from TGD point of view were the talks of Hameroff and Bandyopadphyay, who talked about aromatic rings (ARs, `https://en.wikipedia.org/wiki/Simple_aromatic_ring`) (`http://schd.ws/hosted%20files/tsc2015/9b/Abstracts%20Brain%20networks%20anesthesia%20and%20quantum%20evolution.pdf`).

I have also wondered whether ARs might play key role with motivations coming from several observations.

1. In photosynthesis ARs are a central element in the energy harvesting system , and it is now known that quantum effects in longer length and time scales than expected are involved. This suggests that the ARs involved fuse to form a larger quantum system connected by flux tubes, and that electron pair currents follow along the flux tubes as supra currents.

   DNA codons involve ARs with delocalized pi electrons (`https://en.wikipedia.org/wiki/Pi_bond`), neurotransmitters and psychoactive drugs involve them, 4 amino-acids Phe, trp, tyr and his involve them and they are all hydrophobic and tend to be associated with hydrophobic pockets. Phe and trp appear in hydrophobic pockets of microtubules.

2. The notion of self hierarchy suggests that at molecular level ARs represent the basic selves. ARs would integrate to larger conscious entities by a reconnection of the flux tubes of their magnetic bodies (directing attention to each other!). One would obtain also linear structures such as DNA sequence in this manner. In proteins the four aromatic amino-acids would represent subselves possibly connected by flux tubes. In this manner one would obtain a concrete molecular realization of self hierarchy allowing precise identification of the basic conscious entities as aromatic rings lurking in hydrophobic pockets.

3. Given AR would be accompanied by a magnetic flux tube and the current around it would generate magnetic field. The direction of the current would represent a bit (or perhaps even

qbit). In the case of microtubules the phe-trp dichotomy and direction of current would give rise to 4 states identifiable as a representation for four genetic letters A,T,C,G. The current pathways proposed by Hameroff et al consisting of sequences of current rings (`http://anesth.medicine.arizona.edu/system/files/pdfs/Why%20anesthetic%20mechanism%20research%20has%20failed.pdf`) could define the counterparts of DNA sequences at microtubule level.

For B type microtubules 13 tubulins, which correspond to single 2π rotation, would represent basic unit followed by a gap. This unit could represent a pair of helical strands formed by flux tubes and ARs along them completely analogous to DNA double strand. This longitudinal strand would be formed by a reconnection of magnetic flux tubes of the magnetic fields of ARs and reconnection occurring in two different manners at each step could give rise to braiding.

4. The magnetic flux tubes associated with the magnetic fields of nearby aromatic rings could suffer reconnection and in this manner a longitudinal flux tubes pair carrying supra current could be generated by the mechanism of bio-superconductivity discussed in [K10] and working also for the ordinary high T_c super conductivity. The interaction of microtubule with frequencies in the scales kHz, GHz, and THz scales would induce longitudinal superconductivity as a transition to phase A from phase B meaning generation of long super-conducting wires.

   This view suggests that also DNA is superconductor in longitudinal direction and that oscillating AC voltage induces the superconductivity also now. Bandyopadphyay indeed observed the 8 AC resonance frequencies first for DNA with frequency scales of GHz, THz, PHz, which suggests that dark photon signals or AC voltages at these frequencies induce DNA superconductivity. According to the model of DNA as topological quantum computer DNA is superconductor also in the transversal degrees of freedom meaning that there are flux tubes connecting DNA to a lipid layer of the nuclear or cell membrane [K3, K11].

5. Interestingly, the model of Hameroff et al for the helical pathway (`http://anesth.medicine.arizona.edu/system/files/pdfs/Why%20anesthetic%20mechanism%20research%20has%20failed.pdf`) assumes that there are three aromatic rings per $d = 1$ nm length along microtubule. This number is same as the number of DNA codons per unit length. It is however mentioned that the distance between aromatic rings trp and phe in MT is about $d = 2$ nm. Does this refer to average distance or is $d = 1$ nm just an assumption. In TGD framework the distance would scale as h_{eff} so that also scaling of DNA pathway by a factor 6 could be considered. In this case single tubulin could correspond to genetic codon.

   If $d = 1$ nm is correct, these helical pathways might give rise to a representation of memetic codons representable as sequences of 21 genetic codons meaning that there are 2^{126} different memetic codons [K5]. DNA would represent the lowest level of hierarchy of consciousness and microtubules the next level. Note that each analog of DNA sequences corresponds to different current pathway.

6. What is especially interesting, that codon and its conjugate have always altogether 3 aromatic cycles. Also phe and trp appearing in MTs have this property as also tyr and his. Could these 3 cycles give rise to 3-braid? The braid group B_3 which is covering of permutation group of 3 objects (`https://en.wikipedia.org/wiki/Braid_group`). Since B_2 is Abelian group of integers, 3-braid is the smallest braid, which can give rise to interesting topological quantum computation.

   B_3 is also the knot group of trefoil knot (`https://en.wikipedia.org/wiki/Trefoil_knot`), and the universal central extension of the modular group PSL(2,Z) (a discrete subgroup of Lorentz group playing a key role in TGD since it defines part of the discrete moduli space for the CDs with other boundary fixed [K13]). Quite generally, $B(n)$ is the mapping class group of a disk with n punctures fundamental both in string model: in TGD where disk is replaced with partonic 2-surface.

3.4 Why some anesthetes do not prevent motor actions?

Some anesthetes do not prevent motor actions. This piece of data could provide a test for the model. The two kinds of dendrites are expected to be similar. The interaction of anesthetes with the microtubules of dendrites could prevent memories as negative energy signals to past. The assumption that the two kinds of dendrites correspond to sensory experience and memories and have opposite arrows of time would explain that sensory experiences - including pain- and memories are prevented. Interaction with axonal microtubules would prevent motor actions. If given anesthete can bind only to dendrites or to microtubules inside them, one could explain the finding.

What could distinguish between inside dendrites and motor axons? Size scale is different and could prevent the interaction of some anesthetes with the microtubules of motor axons. Also the microtubules could be somehow different inside dendrites and axons.

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