

Quantum state transition from liquid to vapor water by physiological entanglement

Dr. Alfred Bennun
Full Professor Emeritus of Biochemistry
Rutgers University

Abstract

A liquid water state transition to vapor at the physiological parameter is hereby described by adenylate cyclase (AC) function in neuronal membranes, across hydrophilic and hydrophobic regions. The cerebral enzymatic reactions involves Mg exceeding ATP as a substrate reacting with polymeric liquid H_2O ($n=3.4$) to produce Pyrophosphate (Pi) and AMP. The closing of the ring to form cAMP and release H_2O . The individual molecules by forming entangled pairs, which could not fit into the active site, avoid reentering in a backward reaction. Thus, but still have turnover to free the enzyme from the product to interact with substrate polymeric liquid water, complete its cycle and eludes microscopic reversibility. The latter, vapor state is present at 5% concentration in exhaled air. This physiological state transition allows that the critical point for change of state, for 500ml water within the cerebrospinal fluid (CSF) occurs at 36.6°C. The entangled pairs as a whole adopt an entanglement state. Obviously, the individual molecules could not circulate in the vapor state within the astrocytes system. However, paired do at a rate of 1.6×10^{16} pairs per milliseconds (ms), greater that AC operational turnover. The water paired structure could oscillate between two states, one entangled by two oxygen atoms in the pair, and the other, by two structures of two entangled hydrogen atoms in the pair. The system allows directionality propagation to the uniformly entangled pairs allows by the hierarchical of the initial effect. At a dissipative forming rate of 1.6×10^{16} pairs per ms allow a liquid state to water within the astrocytes. Individual molecules were operated by entanglement to allow a physiological function of cooling the body by releasing heat as vapor, at body temperature. Energy-Consuming Processes in the Brain by vasoactive intestinal peptide (VIP), adrenaline in tissues AC, and noradrenaline (NA) activated AC in brain. The glycogenolysis actions and the adenylate-cyclase cascade, coupled to the release of vapor out of the system. These create an open system preventing any metabolic reversibility even by a short time to the functional brain.

Introduction

The water molecule during its entanglement with its opposite forms a pair that conserves the momentum of molecular kinetic energy.

In general, oscillatory systems generate tension and compression that tend to align the spins, especially at resonance. This force in general, is structured within the structures and by magnification of the sound, breaks glass or bridges when soldiers march in unison. Therefore, the entanglement can be magnified to allow for an abrupt phase change when reaching the decoherent state.

This decoherent state is latent, it can emerge from structures with a resonance potential. This manifests itself when approaching the critical point of temperature, pressure, etc.

The Pauli's exclusion principle excludes 2 electrons to occupy the same quantum state, but allows in a pair if the atoms have vacant energy levels, in which the atoms can move like a gas, or as proposed here in entangled molecules.

At the critical point temperature and pressure, the liquid and gas phases (they are in a latent transition state), the spin effects propagate in the atomic substrate and form pairs that do not obey Pauli, and therefore all pairs could occupy in the same quantum state, because they cannot be mutually exclusive.

The depolymerized water, which has lost the H-bonds, and therefore a quasi-crystalline immobilizing structure, in the cerebrospinal fluid transits as a liquid. Thereafter, when it loses compression by the environment evaporates, upon reaching the oral cavity. This transition is mediated by the vomeronasal organ.

Results

Prigogine description of the cosmological relationship allowing open thermodynamics [1] reversing entropy apparently was in contradiction with the physical principle of microscopic reversibility. Thus, it requires description of cosmic events within thermodynamic parameters, as well that of life, within the context of its relationship to the structure and function of cellular and internal membranes (chloroplast, etc.) [2, 3, 4]. Studies of the genesis of cellular membranes by D.D. Sabatini [5, 6, 7, 8, 9] and a high number of scientists over many years have studied the structure and function of cellular membranes. The kinetic function of adenylate cyclase and several enzymes located in the cell membrane [10, 11].

However, particularly in brain [12, 13, 14, 15] could not be obtaining kinetic evidence to overcome the mandate of microscopic reversibility. A still accepted as sufficient the concept that always catalytic activity is dominated by mass action equilibrium. Thus, not looking for thermodynamic system could allow water to bypass this principle to configure unidirectional pathways.

However, the neuronal-astrocyte system evidenced non-equilibrium reactions [16] and the need for unidirectional operative function.

From the examination of brain kinetics was inferred that H-bond consumption [17, 18] from its polymeric state was released single molecules of water evidenced intermediate states allowing alternative structural associations, allowing a circulation in liquid state to water within CSF that manifested lack of H-bonds that could be correlated to the its release as 5% vapor in exhaled air. Therefore, outwardly to the cell, liquid water $(H_2O)_{n=3.4}$ could be process by systems inwardly uptaking H-bonds. These bonds had been loss in AC kinetics, the enzyme located in the membrane and looking to the external hydrophilic environment, catalysis the substrate MgATP (S_1) when Mg^{2+} [19] exceeds the substrate and interacting with $(H_2O)_{n=3.4}$ (S_2). However, usually, ignoring that liquid water is not homogenous at the nanoscopic level

and could be released as a single molecule as a product.

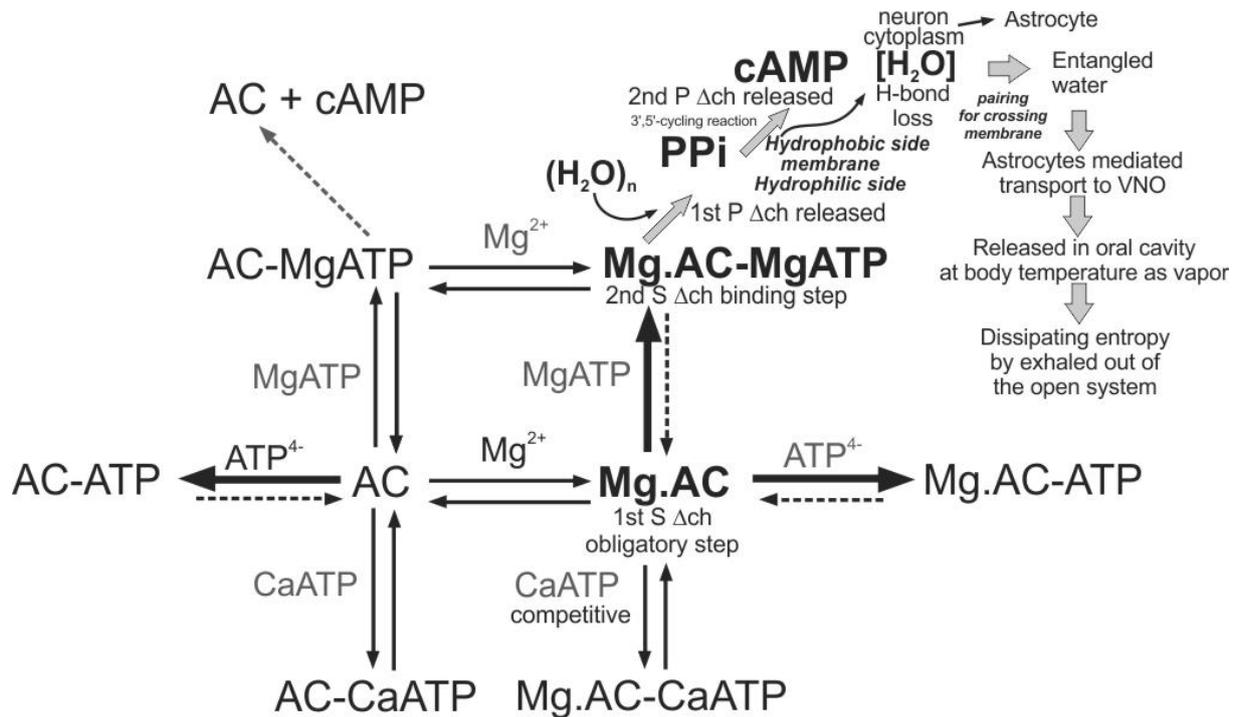
Moreover, the polymeric structure in the hydrophilic media could be dissociated to allow its entrance into the active site as a single molecule. Thus, water supports pyrophosphatase activity with product (P_1) releasing (PPi). Hence, a single water molecule is released as P_2 , after ring cycling activity to form P_1 : 3',5'-cAMP [20, 21]. The enzyme turnover allow the measurement of BiBi kinetic constants at the test tube, but physiologically has to operate in only one sense, by the release of water to the circulatory CSF system into the oral cavity were the changing pressure allows to acquire the vapor form (scheme 1).

Pair entanglement would allow the hidden of the bipolar structure of water and mediates its dissipative transit across the neuronal membrane (scheme 1) into the meninges surrounding brain, with CSF circulatory system within astrocytes. Therefore, it potentiates that all the reactions, generating isolated molecules of water could form entangled pairs to conform a dissipative release of heat but maintaining the body physiological temperature. Hence, the dissipative arrow prevents any equilibrium state by creating a vectorial irreversible system.

Equilibrium could be measured in the test tube, which would equivalent to the enzyme to operate as a within a close system, but physiologically exclusion of a product acts to conform a dissipative release operating as a open system. The hydrophilic outside of the membrane allows to dissociate $(H_2O)_{n=3.4}$ by AC activity. Thus, releasing single water molecules which by entanglement conform into a pair state able to circulate within in CSF in liquid state at 36.6°C. However, when reaching the oral cavity by excluding its oscillatory energy, became into 5% vapor state within the exhaled air.

The scheme shows the pathway for AC became able to avoid microscopic reversibility. The avoidance effect still preserves turnover by releasing free enzyme from out of the leaving product isolated water. Thus, but being unable

to accumulate the dissociated water to produce the reverse of the forward reaction.



Scheme 1. RARE BiBi (2 substrates and 2 products) ordered binding (macro mechanism) of adenylate cyclase including ATP⁴⁻ and CaATP as dead-end inhibitions. E=AC; Δch=conformational change. Applying the initial rate studies for Mg²⁺ could be assumed to be equally valid for Mn²⁺. S₁=Mg²⁺, S₂=MgATP; +(H₂O)_n product forming P₁=PPi (pyrophosphate); P₂=cAMP (3',5'-cyclic adenosine monophosphate), plus single molecules of water. Water released forms entangled pairs, which would not be able to fit back into the active site.

The change of the membrane potential between the external hydrophilic face vs internal hydrophobic environment by dissipative entanglement

Differentiable affinities between the bipolar state of polymeric water with the hydrophilic side of membranes and that of entangled pairs with the hydrophobic side regions allows coupling at the junction between neurons releasing the CSF containing pairs. Hence, the greater diffusion capability into the hydrophobic of the pair for the astrocytes environment, allows rapid circulation. Hence, the continuous flow of pairs allows capturing heat by increasing the oscillatory kinetic of the pairs, allowing their discharge into the oral cavity and reach the vapor state at the physiological temperature of 36.6°C. The vapor by reaching the surface of a mirror spontaneously returns to the liquid state, usually used to detect life. Polymeric state of

water (H₂O)_{n=3.4} allows maintaining polarity and surrounds metallic ions in soluble state vs H₂O~H₂O with hidden polarity, which results in (H₂O)_{n=3.4} could not transit across the double layered membrane to the hydrophobic environment.

Thus, polymeric water will require specific channels modulatory controls which by modulating its opening and closing state by the membrane structure functions to support ion translocation.

Discussion of these events CSF (containing entangled pairs) on the astrocytes, during circulation as liquid transitional state from liquid to vapor could be characterized by supporting an excess of the kinetic energy (vibrational, rotational and translational), but also the pairs increased solubility into hydrophobic regions.

Thus, the hidden polarity confers the possibility to a pairing state H₂O~H₂O to

modify the K^+ , Na^+ , Mg^{2+} hydrated structures of ions, allowing differential states between both flow senses as required to maintain oscillatory membrane potentials.

Moreover, the density change of entangled water modifies the solvation state of hydrophilic molecules like metal ions (Mg^{2+} , Na^+ , K^+), during transport across the membrane could accelerate an increase the membrane potentials.

In this scheme the hydrophilic outside of membrane vs the hydrophobic inside could configure a vectorial sense to water, as a carrier of entropy.

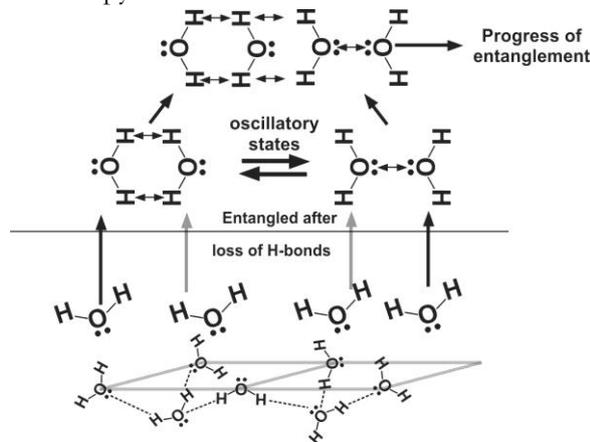


Figure 1: Molecules in coherent resonance capable by entanglement to contain energy in a latent state as liquid, when in the circulatory astrocyte system and to reach quantum decoherence as vapor at **36.6°C**, when reaching the oral cavity. Directional entanglement could be calculated to progress at about a rate of 10^{15} molecules per nano-second, for the involved dissipative function of 500 ml CSF per day.

The oscillatory mechanism between the two states of the pairing

Single water molecules could not have a liquid state at $(H_2O)_{n=0}$ because lacks H-bonds, suggesting the emergence of other structures in the interior of the cell.

Entangled by H orbitals superposition has resonance effects that participates in structure function system for thermic maintenance from muscles (temblor affecting hypothermia) a brain pulsations, etc. In perspective the rapid loss of the corporal temperature produces by death lead to speculations about the meaning, that at the

time of death, there is an instant decrease in body weight of 26g.

Entangled by the complementary pairing between the hydrogen atoms of each water-water pair of molecules as shown: $(OH_2 \sim \sim H_2O)$, results in repulsion between the atoms of oxygen. Similarly, in the complementary oscillatory state of the pair, is shown entanglement between both oxygen atoms: $H_2O \sim \sim OH_2$, and distancing between the hydrogen atoms.

The molecular entanglement surges from the tendency to relate both vibrational configurations by not breaking the water identity. Hence, it is sustained in the first configuration by each H atom participating in vibrational state with the other opposite electron orbital to reach oscillatory a complementary tendency to have tendency to configure some but insufficient stability at the two electrons resembling the orbital connections of molecular hydrogen. The participation of only two electrons out of the six in each oxygen share entanglement by its partial orbital attraction for pairing to only approach stability. Thus, lacking a complete mutual sharing of orbitals, which occurs when both oxygen atoms could acquire a molecular bonding, because each atom attractions surge from its orbitals space: "s" and "p". These allow tetrahedral geometry $2s\ 2p$ but also hybrid orbitals: $4 \times sp^3$, in which two could be share, but the other two could not. Thus, a changing attraction between orbitals of oxygen could explain an oscillatory attraction state by the loss of oxygen entanglement present in the hybrid transition: $(OH_2 \sim \sim H_2O)$ vs the gain of entanglement: $H_2O \sim \sim OH_2$, providing transition states between two differential symmetries, allowing the breaking of the attraction strength in one of them.

These instable configurations of two singles molecules of water could be entangled when interact, or share spatial proximity in a way such that the quantum state of each molecule of the group cannot be described independently of the state of the others. Entanglement has been shown between the rotational states of a $40CaH^+$ molecular ion and the internal states of

a $40Ca^+$ atomic ion. We extend methods used in quantum logic spectroscopy^{1,3} for pure-state initialization, laser manipulation and state readout of the molecular ion. Thus, quantum coherence of the Coulomb coupled motion between the atomic and molecular ions enable subsequent entangling manipulations [22].

Substantial interdisciplinary attention due to an intimate entanglement of spin and orbital degrees of freedom which may give rise to a novel spin-orbital Mott insulating behavior and exotic quantum spin liquid phases [23].

Hence, water in molecular pair entanglement, allows the hidden of the polarity affinity for ions, etc., which characterizes polymeric water configurations for hydration shells of ions and could allow differential properties in between the hydrophilic phase and the hydrophobic one. This is so because the hidden polarity entanglement allows unidirectional way to cross the membrane from the outside of the membrane to its inside.

Decomposition of the pairing yields a non-accumulative state (or dissipative function) allowing non-reversibility to the system thermodynamics, because the dissipative effect by loss of mass action.

The connection with quantum mechanics is made through the identification of a minimum packet size, called a photon, for energy in the electromagnetic field. The identification is based on the theories of Planck and the interpretation of those theories by Einstein. The correspondence principle then allows the identification of momentum and angular momentum (called spin).

Coupling of H-bonds consumption for proteins/enzymes turnover

The cerebrospinal fluid (CSF) expended H-bond water is in liquid state at 36.6°C because the H-bond between molecules has been broken, allowing a transition state in which the internal (intrinsic) structure of the water molecule itself, has absorbed vibrational and rotational kinetic energy. This allows an aggregate state, until the space allows the translational energy that characterizes the vapor

state. In physics the phenomenon is described as a transition state of second order that became independent of the microscopic structure. In a laboratory is well known that the distilled and condensed water is highly active (energy excess on the individual molecules) and has to be stationed for 24hs, before the fitting between water molecules allows their full H-bonding state.

Approaching a mirror to the mouth, a condensation test for vital signs, allows detection of a 5% vapor present in breath, to become evident. The thermodynamics turnover for an out of the system release of waste water, maintains a dissipative state characteristic of open systems. Thus, prevents a reversal of the metabolic flow and therefore conserve the energy capable to support the hydration shell turnover of ions and proteins, which maintains the cell membrane action potential.

Thermodynamic of cerebrospinal fluid (CSF) daily turnover

Thus, allows calculation that the system decreasing internal entropy by 288kcal per day. The system heat endergonic consumption to produce vapor has an equivalent of ATP-enthalpy consumption in the decomposition of water $(H_2O)_n$ ($n=3.4$) \rightarrow AMP + PPi + 3.4 H_2O isolated molecules of vapor, $\Delta G = -45.6$ kJ/mol (-10.9 kcal/mol), equivalent to 28 mol of substrate MgATP.

Astrocytes through the rapid circulation function as a radiator could prevent the brain could absorbing the entropy of the 30% the total calories ingested by the individuals.

Thermodynamically a donor solvation media, like CSF could be calculated on the bases of a turnover value of 500ml CSF, which could be expressed as 27.77 H_2O mol, considering an average value of 3.4 mol H-bond per mol H_2O and -5kcal per mol H-bond $O - H \cdots O$.

$$\begin{aligned} \text{Energy} &= 27.77 \text{ mol } H_2O \frac{3.4 \text{ mol H-bond}}{1 \text{ mol } H_2O} \frac{-5\text{kcal}}{\text{mol H-bond}} \\ &= -472\text{kcal} \end{aligned}$$

Flow of entangled water molecules per millisecond calculated from all daily the entanglement processes carried by 500ml CSF.

$$\begin{aligned} & \frac{27.77 \text{ mol } H_2O}{\text{day}} \\ &= \frac{27.77 \times 6.02 \times 10^{23} H_2O \text{ molecules}}{24hs} \\ &= \frac{3.2 \times 10^{16} H_2O \text{ pairs}}{\text{millisecond}} \end{aligned}$$

Outside the body exhausted H-bond water regenerates by cooling into cluster water because is a favorable thermodynamic process.

Brain thermogenesis

The transition from CSF as liquid at 36.6°C to vapor could have involve an increase of 60°C, if not for entanglement, in turnover per day 500ml CSF.

The temperature increases by 1kcal by increasing 1°C per ml is calculated to 3000kcal to show that it is outside the physiological parameter. This value divided by the standard assigned to ATP breakdown: 7.5kcal the equivalent to 400mol of ATP. This is outside a 25% of total consumption of body energy by the brain. Thermogenesis by H-bonds loss is equivalent to 63 mol ATP. Therefore, the release as vapor does not occur at 100°C, but at body temperature. The lab experience with water distillation and vapor cooling shows a liquid state, which requires to be stationed for 24hs to release the excess kinetic energy. Therefore, decoherence is a very slow process. In nature decoherence process couples with the day to night cycle, which release of vapor to air, coupled for decoherence changes by temperature and pressure to produce rain.

The epithelial membranes with an outside and inside confers the properties of open systems, because the depleted H-bonds from water in CSF does not have the tendency to aggregate, but by entering in the spongy tissue of the palate it rapidly became separated in individual molecules and evaporate.

Thus, exhaled air in adults of about 6 liters per minute has a 5% vapor contribution from the VNO [24, 25] conductance process of depleted H-bonds from water in CSF. These show the conduction to entropy dissipation.

ATPase

This propagates the effect of entanglement to support higher membrane potentials, allowing a nano-environment capable to confer conformational turnover to enzymes changing location of the active site from the hydrophilic outside to the inside of the membrane.

Hence, at the level of ATP-synthase-ATPase, the hydrophobic environment could decrease by much the mass action of water and modifying the tendency of $ADP^{3-} + PO_4^{2-}$ to synthesize: $ATP + H_2O$. Hence, by facilitating exclusion of water from access to the active site prevents the exergonic reaction of ATPase activity with release of heat.

Potentiating reactions: $P^{3-} + HPO_4^{2-} + H^+ \rightarrow ATP^{4-} + H_2O$. Irreversible reaction prevents the return of single water molecules by entanglement forming pairs to be capture by entering into hydrophobic environment complete turnover.

ATP synthase activity in a hydrophobic environment by transferring the generated prevents reversibility, and allows only one-direction sense, bypassing microscopic reversibility.

Photophosphorylation in chloroplasts does not show reversibility even if the synthase does manifest ATPase function by uncoupling conditions.

Discussion

However, in the absense of AC activity a Pi^{2-} increment in cerebral spinal fluid (CSF), allows augmenting the uptake Pi^{2-} and glucose [26, 27] by the erythrocyte [28, 29] incrementing anaerobic glycolysis and sugar phosphates. At pH=7.4 maximal production of uptake of Pi^{2-} , which by pirophosphate activity maximize the uptake of polymeric water, releasing H-bonds,

similarly to AC activity, results in a dissipative flow of entangled water pairs, as shown that the quantum state transition of the water into entangled pairs is a non stop process.

Conclusions

The turnover between hydrated versus hydrophobic forms of proteins involved in enzyme kinetics requires energy expenditures during the turnover of [ES], changing the enzyme hydration states into its [EP] form. A divalent metal (Mg^{2+}) when chelated by a protein loses its hydration sphere. It then releases its hydration (which is incomplete) and shows an intrinsic stronger charge.

The hydration shell of *nascent* Mg^{2+} allows capture molecules of water from the hydration sphere of Na^+ and this one in term replaces this loss from capture of H_2O from the hydration sphere of K^+ . The sequence allows the sieve effects, required to activate the electrogenic pump and the neuronal membrane potential.

This is the denominated Mg^{2+} , nascent, which functions by capturing water from Na^+ , and K^+ , allowing for sieve effects operating as intermediates of the physical open system [30, 31, 32, 33].

The dissipative energy potential is controlled within astrocytes by decreasing the concentration of H-bonds preventing feedback through rapid circulation. This is made possible by decreasing the number of H-bonds to reach the vapor state, associated with air breathing, which could also operate through the vomeronasal organ that experiences direct contact with the brain.

References

[1] Bennun, A. The thermodynamic inwardly open system by locally decreasing entropy originates life. viXra.org > Relativity and Cosmology > viXra:2104.0155 (2021).
[2] Bennun, A. and Racker, E., Partial resolution of the enzymes catalysing photophosphorylation IV. Interaction of coupling factor I from chloroplast with components of the chloroplast

membrane, The Journal of Biological Chemistry, 244, (1969), 1325-1331.

[3] Bennun, A. and Avron, M., The relation of the light-dependent and light-triggered adenosine triphosphatases to photophosphorylation, Biochimica et Biophysica Acta, 109, (1965), 117-127.

[4] Bennun, A. and Avron, M., Light-dependent and light-triggered adenosine triphosphatases in chloroplasts, Biochimica et Biophysica Acta, 79, (1964), 646-648.

[5] Sabatini, DD, Bensch, K, Barnett, RJ. Cytochemistry and electron microscopy. The preservation of cellular ultrastructure and enzymatic activity by aldehyde fixation. J Cell Biol. 1963 Apr;17(1):19-58.

[6] Redman CM, Sabatini DD. Vectorial discharge of peptides released by puromycin from attached ribosomes. Proc Natl Acad Sci U S A. 1966 Aug;56(2):608-15.

[7] Blobel G, Sabatini DD. Controlled proteolysis of nascent polypeptides in rat liver cell fractions. I. Location of the polypeptides within ribosomes. J Cell Biol. 1970 Apr;45(1):130-45.

[8] Efeyan, Alejo; Zoncu, Roberto; Chang, Steven; Gumper, Iwona; Snitkin, Harriet; Wolfson, Rachel L; Kirak, Oktay; Sabatini, David D; Sabatini, David M. Regulation of mTORC1 by the Rag GTPases is necessary for neonatal autophagy and survival. Nature. 2013;493(7434):679-83.

[9] Vasquez, B; Medel, B; Cancino, J; Retamal, C; Ren, M; Sabatini, D D; Gonzalez, A. Golgi-to-Endoplasmic reticulum retrograde transport involves Rab11-Binding-Protein. Molecular biology of the cell. 2017(2017).

[10] Harris, R. and Bennun, A., Hormonal control of fat cells adenylate cyclase, Molecular & Cellular Biochemistry, 13, (1976), No. 3, 141-146.

[11] Harris, R.H., Cruz, R. and Bennun, A., The effect of hormones on metal and metal-ATP interactions with fat cell adenylate cyclase, Biosystems, 11, (1979), 29-46

[12] Ohanian, H., Borhanian, K., De Farias, S. and Bennun, A., A model for the regulation of brain adenylate cyclase by ionic equilibria,

Journal of Bioenergetics and Biomembranes, 13, (1981), Nos. 5/6, 317-355.

[13] Ohanian, H., Borhanian, K. and Bennun, A., The effect of manganese on the regulation of brain adenylate cyclase by magnesium and adenosine triphosphate, *Biochemical Society Transactions*, 6, (1978), 1179-1182.

[14] Brydon-Golz, S., Ohanian, H. and Bennun, A., Effects of noradrenaline on the activation and the stability of brain adenylate cyclase, *Biochem. J.*, 166, (1977), 473-483.

[15] Bennun, A. The noradrenaline-adrenaline-axis of the fight-or-flight exhibits oxytocin and serotonin adaptive responses. *International Journal of Medical and Biological Frontiers*. Volume 21, Issue 4, pages: 387-408 (2015).

[16] Bennun, A., Hypothesis for coupling energy transduction with ATP synthesis or ATP hydrolysis, *Nature New Biology*, 233, (1971), No. 35, 5-8.

[17] Bennun A. The Regenerative Processes Involving the cAMP Unzipping of DNA. The Synthesis of Proteins Integrating Plasticity and Longevity. *Biochemistry Research Trends*. Book Published by Nova Biomedical, Copyright 2017 by Nova Science Publishers, Inc

[18] Bennun, A. The vomeronasal organ functions in entropy dissipation, the communication by pheromones for a feedback by the pituitary over brain plasticity and the development of the unconscious. *viXra.org > Biochemistry > viXra:2002.0143* (2020).

[19] Brydon-Golz, S. and Bennun, A. (1975). Postsynthetic stabilized modification of adenylate cyclase by metabolites. *Biochemical Society Transactions*, 3, 721-724.

[20] Bennun A. The integrated model of cAMP-dependent DNA expression reveals an inverse relationship between cancer and neurodegeneration. Book Title: *Horizons in Cancer Research*. Volume 63, Chapter 9 (Book ID: _10383_). Nova Publishers (2016) <https://novapublishers.com/shop/horizons-in-cancer-research-volume-63/> <https://arxiv.org/abs/1606.08314>

[21] De Bari, V.A. and Bennun, A. (1982) Cyclic GMP in the human erythrocyte. Intracellular levels and transport in normal

subjects and chronic hemodialysis patients, *Clinical Biochemistry* 15(4), 219-221.

[22] Lin, Y., Leibbrandt, D.R., Leibfried, D., and Chou, C. Quantum entanglement between an atom and a molecule. *Nature* volume 581, pages 273–277 (2020).

[23] Vladislav Kataev. Insights into the spin-orbital entanglement in complex iridium oxides from high-field ESR spectroscopy. *Applied Magnetic Resonance* 52, 439-457 (2021).

[24] Moran, D.T., Jafek, B.W. and Rowley, J.C. (1991) The vomeronasal (Jacobson's) organ in man: ultrastructure and frequency of occurrence. *J. Steroid Biochem. Mol. Biol.*, 39, 545–552.

[25] Stensaas, L.J.; Lavker, R.M.; Monti-Bloch, L.; Grosser, B.I. and Berliner, D.L. (1991) Ultrastructure of the human vomeronasal organ. *J. Steroid Biochem. Mol. Biol.*, 39(4B), 553–560.

[26] Vicario, P.P. and Bennun, A.. Separate effects of Mg²⁺, MgATP and ATP⁴⁻ on the kinetic mechanism for insulin receptor tyrosine kinase. *Archives of Biochemistry and Biophysics*, 278, (1990), No.1, 99-105.

[27] Vicario, P.P. and Bennun, A., Regulation of insulin receptor tyrosine kinase by metabolic intermediates, *Biochemical Society Transactions*, 17, (1989), 1110-1111.

[28] De Bari, V.A. and Bennun, A., Cyclic GMP in the human erythrocyte. Intracellular levels and transport in normal subjects and chronic hemodialysis patients, *Clinical Biochemistry* 15(4), (1982), 219-221.

[29] De Bari, V.A., Novak, N.A. and Bennun, A., Cyclic nucleotide metabolism in the human erythrocyte, *Clinical Physiology and Biochemistry*, 2, (1984), 227-238.

[30] Casciano, C. and Bennun, A., A characterization of two inhibitors of H⁺, K⁺ - ATPase in gastric tissue, *Biochemical Society Transactions*, 16, (1988), 27-29.

[31] Casciano, C. and Bennun, A., Characterization of the interrelationship of the secretory activities of gastric tissue, *Annals of the New York Academy of Sciences*, 529, (1988), 246-249.

[32] Casciano, C. and Bennun, A., Effect of Li⁺ on the secretion of HCO₃⁻ in rat fundic tissue,

Biochemical Society Transactions, 17, (1989),
1111-1112.

[33] Casciano, C., Kaminska, G.Z., and Bennun,
A., Investigations on the cytoprotective
mechanism of thiocyanate in rat gastric mucosa,
Biochemical Society Transactions, 17, (1989),
1113-1114.