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Full Length Research Paper

The (+)-adrenaline and skydiving as a solution to psychogenic symptoms and a possible prevention of psychosomatic diseases

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Abstract

In this article, we analyze the emotional shock that a person, in a state of depressive anxiety, suffers while performing a parachute jump. We present the testimonials from ten psychotherapy patients that had depression. They reported that after skydiving they were cured from depression or had the depression symptoms drastically reduced. We propose that in the case of parachute jumping, the positive enantiomer of Adrenaline is the substance that mediates the cause and effect relationship between skydiving emotions and the cure of depression. We suggest that during skydiving the person experiences a shock that results from the racemization of the adrenaline molecule (C9H13NO3) and its enantiomers [L (-) and D (+)]. We also suggest some clinical tests that should be performed before and after the jump and finally, we conjecture a possible way of producing or manipulating the D (+) - adrenaline.

Keywords: Depressive anxiety; skydiving; enantiomers of adrenaline

INTRODUCTION

Emotions might cure, cause or prevent psychosomatic illnesses. This cause and effect relationship, although very well documented in scientific literature[1-3], yet remains to be explained. What is the "mechanism" that enables an emotion to prevent or produce a psychosomatic illness?

In an article recently published[4] we proposed for such "mechanism" the following conjecture:

*When a person experiences an emotional shock, **L(–)-**Adrenaline is released into the bloodstream. And, in its flow, the molecules start to interact, with some of them changing into D(+) – adrenaline. Depending on the person's emotional conditions, this adrenaline might be rapidly dissipated, for being less potent as it happens zwhen obtained in a laboratory. However, depending on the emotional control of the person, there might happen an increase on its power and, with it, the desired racemization occurs and thereby the prevention of a psychosomatic illness* (Oliveira Filho et al., 2012).

In this article, we examine one aspect of this conjecture concerning the emotional shock that a person in a depressive anxiety state, suffers while performing a parachute jump. According to one of the authors (JPOF) Oliveira Filho, 2011, when a person jumps from an airplane at a speed of 220 km/h and a height of 4,000 m, during the first 55 seconds of free fall (before opening the parachute), the person experiences a rite of *Buddhist* passage of "death and rebirth of the ego", because his unconscious is not aware of the conditions of flight safety. So, in that moment, one performs unconsciously, the myth of Icarus (Guirand, 1971), which reflects the ancient desire of humans to fly, and to experience the feeling of finally reborn from the ashes like in the myth of *Fenix* (Guirand, 1971).

During the jump, we conjecture in this article that the L

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(-)-adrenaline initially discharged, undergoes racemization, being transformed into D (+)-adrenaline and, therefore, at the end of the jump, due to this racemization, the skydiver feels that there was a "revival in his life", allowing him later to reflect on the problems that were afflicting him, as shown in some testimonials we collected for this article, which will only be numbered in ascending order, to preserve the patients' identity.

Before presenting these testimonies, we will make a historical review of the two types of adrenaline, called enantiomers; we will also see, the dynamics between them – the racemization. Considering that there already exists the possibility of measuring the D (+)-adrenaline (Sänger-van de Griend et al., 2006), we suggest it to be measured before and right after the parachute jumps in therapeutic treatments. At the end of the article, and based on the Cognitive Neuroscience (Cunha, 2011), we conjecture the possibility of a relationship between the "rites of passage" of shamanic cults and parachute jumps.

Enantiomers and racemization

Initially, we will present a brief history about enantiomers. The *tartaric* acid (TA) [H2C4H4O6 (CHOH.COOH) 2], acid obtained from the *tartars*, which are deposits that form in the fermenting grapes, was known by the ancient Greeks and Romans in the form of salt of potassium acid – the *tartar*: KHC4H4O6. However, only in the 18th Century, the TA was isolated as a free acid by Swedish chemist and pharmacist Carl Wilhelm Scheele (1742-1786). A second form of this acid, the *paratartaric* (APT), was mistakenly taken as oxalic acid [H2C2O4 (HOOC.COOH)], around 1819, by the wine maker, frenchman Paul Kestner. Later, in 1828, the french chemist Joseph Louis Gay-Lussac (1778-1850) showed that APT had the same chemical composition of the AT, and then gave him the name of racemic acid (RA), which derives from the Latin word *racemus*, which means grape. In 1831, the Swedish chemist Jöns Jacob Berzelius (1779-1848) showed that grape acids (TA and RA), as he denominated them, in 1830, had the same chemical composition, but with different properties, a phenomenon denominated by him isomerism (which derives from the Greek word isomeric, which means two parts). In 1835, the French physicist Jean Baptiste Biot (1774-1862) noted that the APT (AR), in solution, showed optical activity since turned the plane of polarization of light to the right. In 1838, Biot realized that free AT and AR were optically inactive. The detailed study of these acids and their salts were performed by chemists, Frenchman Hervé Ferdinand Frédéric de la Provostaye (1812-1863) in 1841, and the German Carl Remigius Fresenius (1818-1897) and Eilhardt Mitscherlich (1794-1863) in 1842. In 1844, after sending a letter to Biot, Mitscherlich presented to the French Academy of Sciences the result of his experiments in which he observed that while the commercial AT salt crystals had optical activity, i.e., they rotated the plane of polarization of the light that passed through, the same did not happen with crystals AR. Such results were an enigma, since these acids besides having identical chemical compositions had the same structure, i.e. were stereoisomers (nowadays enantiomers) Kauffman and Myers, 1998.

The above riddle was solved by the French chemist Louis Pasteur (1822-1895), in 1848 and 1850, while studying these acid crystals, mainly AR (*paratartaric*, as he denominated it) with the aid of a microscope. Indeed, by observing the crystals AR, Pasteur found that there are two kinds of them, one being the mirror image of the other. He obtained these crystals from a solution which did not rotated the plane of polarization of the incident light on them and, immediately he guessed that a 50% x 50% mixture (racemization) of two types of crystals was the explanation for the observed optical inactivity. Thus, with the aid of clamps, he carefully separated the crystals in two mounds and, by passing again polarized light through it, he realized that one of the mounds rotated the plane of polarization of the light clockwise and the other counterclockwise. [Note that this rotation was measured with a polarimeter, the *Nicol prism*, invented by the scottish physicist William Nicol (1768-1851), in 1828.] Pasteur also observed that one of the two forms of AR was identical to AT. In view of this, he described the crystals studied in two types: *levorotatory* [L (-)] (left-hand) and *dextral* [D (+)] (right-hand). Today, these molecules known as chirals (from the Greek word keir, meaning hand) are called enantiomers and are of two types: L (-) - enantiomer and D (+) - enantiomer. These molecules have a property; there cannot be an overlap between its structural representation and its mirror image. It is also important to register that the name, *chirality*, was given by Scottish physicist William Thomson, Lord Kelvin Lars (1824-1907) in 1884 (Geison, 2007).

In his research with the AR, Pasteur noted in December 1857 that in the fermentation of ammonium paratartrate [(NH4) 2 C4H6O6], the polarimeter used indicated an increase in the optical activity of the left-hand crystals [D (+)], and that the right-hand [L (-)] were attacked during fermentation. In view of this, Pasteur linked this discriminatory action with the nutritional needs of microorganisms and thus discovered a new method (biological or physiological) to separate the crystals of AR. Later, in 1860, Pasteur showed that a specific micro-organism, the fungus penicillium glaucum, selectively metabolized L crystals in a solution of ammonia paratartrate.

Based on these experiences, Pasteur reinforced his theory of molecular asymmetry, whereby the biological properties of chemical substances depend not only on the nature of the atoms constituting the molecules, but also in the way the atoms are arranged in space. On the

other hand, the relationships observed by Pasteur between microorganisms and molecular asymmetry convinced him that the Chemistry of Life showed a preference for the *chirality* of certain molecules, and therefore, there was a clear distinction between living matter and dead matter. This conviction led him to appear before the French Academy of Sciences his famous conjecture: - The universe is dissymmetric (Hegstrom and Kondepudi, 1990).

As time went on, Pasteur's conjecture proved to be true, and in the 20th Century, the development of Science revealed that this asymmetry of the Universe occurs in all levels, from the microscopic to the macroscopic, especially as for the chemistry of life. As a matter of fact, enantiomeric forms of molecules are found in many organic and inorganic substances, and especially in all molecules crucial to the development of life, such as molecules of DNA (deoxyribonucleic acid) and RNA (ribonucleic acid) which carry the genetic information as well as the proteins which are responsible for the chemical structure and regulation of living cells. With respect to these enantiomeric forms, there are interesting things to observe. For example, only the D (+)-enantiomers of sugar are present in DNA and RNA. Furthermore, although there are hundreds of amino acids in nature, only 20 comprise the proteins: aspartic acid, glutamic acid, alanine, arginine, asparagine, cysteine, phenylalanine, glycine, glutamine, histidine, isoleucine, leucine, lysine, methionine, proline, serine, tyrosine, threonine, tryptophan and valine. However, although these amino acids exist in the forms of L (-) - enantiomer and D (+) - enantiomer (except glycine), only the L (-) are found in proteins (Monod, 1976; Gribbin, 1989).

To conclude this history of the enantiomers, we believe it is appropriate to report certain facts related to the *chirality* of some enantiomers. Thanks to that *chirality* it was possible to explain the famous case of thalidomide ($C_{13}H_{10}N_2O_4$). Let's see how. In Europe, particularly in England and Germany, between 1956 and 1963, it was observed that pregnant women who used a certain syrup (containing thalidomide), indicated for coughs and also prescribed to reduce nausea, its use was causing the birth of thousands of deformed children. Withdrawn from the market, the syrup began to be studied. Then it was discovered that the D (-)-enantiomer of thalidomide cured nausea, while the L (-) - enantiomer caused defects in the embryo. Thus, the sensitivity of enantiomeric thalidomide allowed it to be successfully used in curing leprosy. This same sensitivity also explains other interesting cases. For example, the compound limonema ($C_{10}H_{16}$) in its two forms: L (-) and D (+) are responsible for flavor (acid, and sugary) of citrus fruit (lemon, and orange, respectively) and is widely used in the perfume industry. Moreover, the efficacy of penicillin-G ($C_{16}H_{18}N_2O_4S$) [the first penicillin was discovered in 1928 by Sir Scottish bacteriologist Alexander Fleming (1881 - 1955)] against bacteria resulted from the fact that bacteria , exceptionally, use D (+)-amino acids in the construction of their cell walls, and penicillin also contains a group of L (-)-amino acid which interferes with the synthesis of bacterial cell walls.[15]

Having concluded a brief historical summary on enantiomers we will now show how racemization occurs between them, especially with the enatiomers of adrenaline ($C_9H_{13}NO_3$) (also known as epinephrine), which is the subject of this article. First, we will do a quick historical overview of this molecule. Adrenaline is a hormone secreted by the suprarenal glands (located above the kidneys) and, each cell that make up the gland medulla has about 30,000 packets containing this hormone[4]. The adrenaline was discovered independently by four researchers: the American physiologist William Horatio Bates (1860-1931), in 1886; Polish physiologist Napoleon Cybulski (1854-1919), in 1895; biochemist and pharmacologist American John Jacob Abel (1857-1938), in 1897, and the Japanese biochemist Jokichi Takamine (1854-1922) in 1901, who, incidentally, coined its name: ad (Latin prefix meaning proximity), renal (kidney related, renalis in Latin) and ine (suffix applied to some chemicals). Adrenaline was artificially synthesized in 1904 by the German chemist Friedrich Stolz (1860-1936).

As we mentioned in the introduction the adrenaline molecule has two enantiomers: L (-) - adrenaline and D (+) – adrenaline. The former is ten (10) times more powerful than the latter[1]. It has been well known since a long time, the effects of the L (-) - adrenaline on human beings as, for example, when used as a local anesthetic and in medical emergencies.[3] On the other hand, when a change in the conditions threats the physical and emotional integrity of a person, adrenaline is released into the bloodstream, causing rapid heartbeat, elevated level of blood sugar, minimization of blood flow in the vessels and in the intestinal system, while maximizes the flow to voluntary muscles in the legs and arms and "burns" fat in adipose cells. In turn, since the 1950s, researchers began to study, in mice, the effects of the two enantiomers of adrenaline.[7,8] However, the major role of L (-)-adrenaline in allopathic medicine resulted from research conducted by the English (Scottish) doctor and pharmacologist Sir James Whyte-Black (1924-2010, Nobel Prize in Medicine, 1988) when he organized, in 1950, the Department of Physiology of the Veterinary School of University of Glasgow, in Scotland. So in that Department, Black began studying the effect of L (-)-adrenaline in the human heart, especially in patients with angina pectoris. Later, in 1957, was created the Imperial Chemical Industries Pharmaceuticals (ICIP) and, in 1958, Black went to work there in order to nullify the effects of that enantiomer of adrenaline. Thus, researchers and Black A. F. Crowther, R. G. Shanks, L. H. Smith and A. C. Dornhorst in 1964[16] developed propranolol (pronethalol), a beta-adrenergic blocker used (so far) in the treatment of heart diseases, especially for those who suffer heart attacks. It is worth noting that these

researchers speak of side effects (dizziness and nausea) due to non-specific actions of the isomers, (+) – active and (-) - inactive, of this molecule on the central nervous system of man. Note that the researcher Dan Handley, in 1999 (Geison, 2007), referred to the enantiomers of adrenaline in his study of the beta-blockers and bronchodilation.

Although, there is not yet a test of the presence of D (+) - adrenaline in humans or that it is produced directly in the human body, it is known, however, that L (-) - epinephrine solution is inactivated by racemization, i.e., half of it is converted into D (+) - adrenaline. It should be noted that the racemization of enantiomers is generated by the interaction of enantiomeric molecules with molecules of the medium (dense gases or liquids) in which they are immerse (Cattani, 1996).

Let us now present a brief theoretical summary about racemization. The optical activity of an optically active material changes with time, according to L. showed D. Baron and S. F. Mason, in independent books published in 1982. Therefore, a sample containing predominantly one *stereoisomer* (*enantiomer*) can become a mixture of equal amounts of each isomer. This relaxation process, which is called racemization, occurs spontaneously or it is due to the interaction of an active molecule with the environment.

According to what A. Vardi wrote in 2000, many theories have been proposed to describe this process. Let's see how to calculate this temporal optical activity, using one of these theories, which takes into account the quantic tunneling (Cattani, 1996). Imagine an active molecule soaked in a gas, liquid or solid, subject to a generic external field U (t) resulting, for example, from a collision. The calculation of the racemic function r (t) (to be defined later) is performed through the Non-Relativistic Quantum Mechanics (NRQM) described by the famous Schrödinger equation, given by the following expression (Bassalo et al., 2007): $i\hbar\partial\left|\Psi(t)\right\rangle/\partial t = H\left|\Psi(t)\right\rangle$ where $\left|\Psi(t)\right\rangle$ is called Schrödinger function state, $\hbar$ = h/2π, where h is Planck's constant, and H is the Hamiltonian which is the sum of kinetic energy (T) with the potential energy (V). Thus, we consider that the racemization is produced mainly by two vibrational states of the enantiomers, $\left|L(-)\right\rangle$ and $\left|D(+)\right\rangle$ which are self-states of the initial Hamiltonian (Ho) at a time considered to be zero (to), that is, let us consider $\left\langle L(-)\left|H_0\right|L(-)\right\rangle = \left\langle D(+)\left|H_0\right|D(+)\right\rangle = E_0$, as being the total system energy, and that there is little penetration (tunneling) (δ) of these states separated by a potential barrier Vo (x) so that: $\left\langle L(-)\left|V_0\right|D(+)\right\rangle = \left\langle D(+)\left|V_0\right|L(-)\right\rangle = \delta$.

According to NRQM, the state function $\left|\Psi(t)\right\rangle$ of the active molecule is given by: $\left|\Psi(t)\right\rangle = a_{L(-)}\left|L(-)\right\rangle + a_{D(+)}\left|D(+)\right\rangle$ which satisfies the following Schrödinger equation - $i\hbar\partial\left|\Psi(t)\right\rangle/\partial t = [H_0 + V_0(x) + U(t)]\left|\Psi(t)\right\rangle$, where $a_{L(-)}$ and $a_{D(+)}$ represent, respectively, the probabilities of the active molecule be found in one of the self-states $\left|L(-)\right\rangle$ and $\left|D(+)\right\rangle$, and are determined by differential equations (Bassalo et al., 2007). With this data, one can calculate the racemic function r (t) $= \left|\left\langle D(+)\left|\Psi(t)\right\rangle\right|^2$, which describes the optical activity during the passage, from $\left|L(-)\right\rangle$ to $\left|D(+)\right\rangle$. Details of the calculation of r (t) for some physical situations (Bassalo et al., 2007)

Testimonials of skydivers-patients

We will present in this section, some testimonials of depressed patients who, on the recommendation of one of the authors (JPOF) of this article, performed parachute jumps as a way of helping on their recovery. The author (JPOF) monitored their jumps.

The preparations for the jump are described by JPOF as follows: - In the preparation for the first jump, filled with expectations during the waiting period, the parachutist-patient prepares himself for the decision making moment. The jump manifest determines the time of boarding. While putting on each item of the equipment, the parachutist-patient level of cortisone further increases his heart rate (HR) which then is around 140 beats /minute (140 b/m) and his whole being gets prepared to cope with the stress of jumping. The exit of the airplane is the scariest part. Just before jumping his heart rate (HR) is around 160 beats /m and his fear is transformed into dread. When he stands at the door of the plane ready to jump, he sees the height and his eyes get bulging. Then, the incomprehensible happens. When jumping, the change is immediate, because when he start to free fall, the dread disappears and he finds himself overcome by a feeling of tense euphoria due to a biochemical response in his body, changing immediately his mood from dread to pleasure, but keeping the physiological fear.

D1. (T.A., 52 years old) After retirement I felt a sense of grief and depression that worried my family; I sought help and it was proposed to me to experiment a parachute jump. I did just a double jump that changed my life's focus. It was extraordinary.

D2. (A.O., 25 years old) I graduated in dentistry in *Espírito Santo* and went to work in *Paragominas*. With six months of work, I was dissatisfied with the life I was leading, which made me think of doing therapy. I got to know about the skydiving work developed by JPOF, through information from friends. I did a double jump and became a parachutist. This attitude has changed my life.

D3. (P.P., 26 years old)

I went to see JPOF two months after suffering a robbery at the Bank branch in which I work. As a consequence, I began to have fears, with intense sweating and panic episodes. I was treated with anxiolytics, which improved my state. However, the nightmares and constant flashbacks of the horror I have been through, continued. After 30 days of therapeutic treatment with JOPF, he recommended me to skydive, which I practice to this day. This activity made me completely overcome my trauma.

D4. (J.R., 38 years old) As a lawyer, I was extremely shy and was terrified of exposing myself in public. So I had many frustrations and disappointments in life. After convinced and prepared by JPOF, I did a double jump. The feeling is indescribable and the joy in landing is of ecstasy. So I decided to do a course in skydiving and I made nine jumps. It surprises me to this day, my changing as a person, especially my confidence. This allowed me to be approved in a public tender. Also, my relationship with people and the world has changed.

D5. (B.P., 30 years old). I had a sudden breakup of my marriage due to infidelity. So, deeply depressed, I sought help from JPOF who, realizing my taste for sport, suggested that I should practice a sport which would end my mourning and grief: parachuting. I accepted promptly and after the first jumps I completely overcame the grief, which astonished me.

D6. (L.S., 32 years old). For almost one year I suffered from depression which left me discouraged and that interfered with my professional performance as a doctor. After going through a traditional psychiatric treatment, JPOF indicated for me a parachute jump. After the first jump, there was a real turning point in my life, because when we are up there, we see the size of the world, feel the nature, and perceive a mixture of ecstasy with freedom. It made me reflect for one week and, months later, I felt alive, happy and confident, and I was able to make important decisions in my life. It was fantastic.

D7. (Camir, 58 years old) I am a heavy auto mechanic businessman. I read an article of yours (JPOF) in a magazine. What caught my attention was your idea of death and rebirth. I had been separated for 6 months and felt an inner emptiness. It was unbearable and I actually felt dead and my soul ached. I was convinced by the article and then decided by myself to do the course in parachuting. My life has regained sense and it transformed me immediately. Today I am happy in a new relationship and I am a skydiver with 200 jumps. I do not live stressed anymore.

D8. (M.M.; 34 years old) I found myself with low self-esteem, very insecure and lacking the courage to do anything. I began a therapeutic treatment with JPOF and, within three months, I made my first parachute jump. Because I felt good, I decided to do the parachuting course and now I am skydiver. I mean that, after this experience, my life took on a new meaning, because I overcame my low self-esteem and I began to see myself with my own eyes since before I saw myself through the eyes of others. So, I went to live with ease; finally there was a complete change in my life, including in my legal profession.

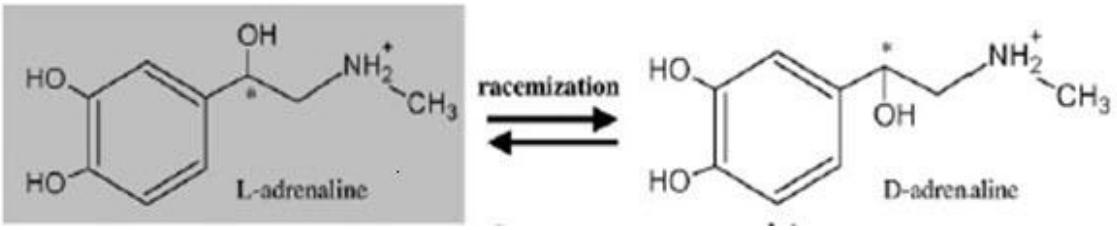
D9. (R.S., 59 years old) After 30 years of marriage, I lost my husband in a traffic accident. As a result, I became prostrated and lost the will to live. Six months later, at the insistence of a friend, I sought Dr. JPOF to make a therapeutic treatment. Knowing that I already had practiced canoeing and sailing sport, JPOF proposed me to make a parachute jump. I agreed, but my intention was different: was to die. Fortunately, after this extraordinary experience, I came to discover life and today I have a lot of pleasure in dealing with my branch of business: I am a farmer.

D10. (S.A., 50 years old) I've always had a phobia of height and had ended abruptly a conjugal relationship of seven years which left me in a state of deep depression, almost a pathological mourning. Life for me did not make much sense, I felt guilty for the failure of this relationship and the suffering it caused in my son. Then in an act of almost desperation, I decided to accept the unusual invitation from my therapist (JPOF) to try something, which he said could change my life: parachute jumping and to experience free fall! An absurd to whom, as I said, had height phobia. But as life did not mean much to me at the time, I could do anything, any risk would be negligible before my mood at that moment. To my surprise, during my first experience in free fall, I felt the fullness of my freedom, and after the parachute opened, I had the distinct feeling that I was not alone. It was the greatest sensory experience of my life, and led me to a holistic conception of the universe: I met with god. Nowadays I exercise my role as a university teacher and university.

FINAL CONSIDERATIONS

In the introduction of this article, we conjectured that the initial discharge of **L (-)**-adrenaline (in a parachute jump performed by a person in depression) undergoes a process of racemization turning itself into D **(+)**-adrenaline (Stepensky et al., 2004):fig.

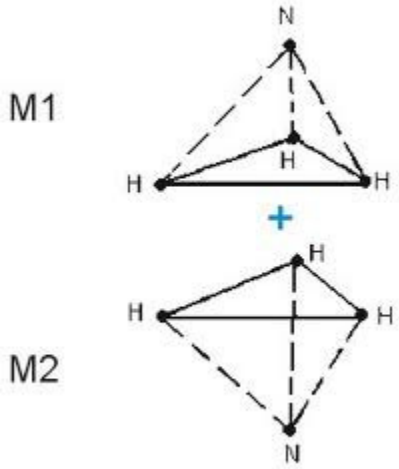
Upon completing the jump, the parachutist-patient feels that there has been a paradigm shift in his life, as indicated by some testimonials transcribed in the previous section. However, for confirmation (or not) of this conjecture, it is necessary to carry out some steps. A first step is to measure the variation of some biochemical parameters [bp: dosage of L (-)-adrenaline, heart rate (Holter-EEG) and cortisol], before and after the jump. A second step would be to measure the actual racemization of adrenaline. If the occurrence of racemization can be proved, then two other important research work should be done. First, to see if there is an involvement of the brain in this racemic process based on Cognitive Neuroscience (Cunha, 2011). Now, as there already



Racemization of Adrenaline - $C_9H_{13}NO_3$

exists neurological studies on the "rites of passage" of shamanic cults (Winkelman, 2010) a type of search to be performed would be to check if there is a kind of shamanic racemization of adrenaline. In subsequent work, we will discuss whether there is an racemic isomorphism between parachuting and the shamanism. Finally, the physical explanation of the process via the racemic NRQM (seen in item 2). As shown in the figure above, this process is nothing more than the oscillation of oxidrila (OH), being this oscillation due to an external field U (t) whose origin can be, for example, dynamic (collision).

At the end of this article, it is worth doing a practical conjecture. For this, we will recall how the invention of the first *MASER* (Microwave Amplification by Stimulated Emission of Radiation) happened. Since 1951, American and Russian physicists, in independent studies, began studying the amplification of radiation using quantum molecular transitions. In 1954, American physicists Charles Hard Townes (n.1915; Pop, 1964), Gordon James Power (n.1928) and Herbert J. Zeiger (1925-2011) announced that they had invented the first *MASER* using an ammonia gas (NH3), being the frequency (v) of nitrogen (N) oscillation, between the M1 and M2 states, located in the microwave region (~ 23 kmc/s), Townes, 1964. (Google Images)



In analogy with the case of *MASER*, knowledge of the oscillation frequency (if any!) of the OH molecule of adrenaline is of fundamental importance, because it would be a possible mechanism used to generate or manipulate the D (+) - adrenaline.

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