Historical and cultural aspects of the pineal gland: comparison between the theories provided by Spiritism in the 1940s and the current scientific evidence

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Abstract

Significance has been attached to the pineal gland in numerous different cultures and beliefs. One religion that has advanced the role of the pineal gland is Spiritism. The objective of the present study was to compile information on the pineal gland drawing on the books of Francisco Cândido Xavier written through psychography and to carry out a critical analysis of their scientific bases by comparing against evidence in the current scientific literature. A systematic search using the terms “pineal gland” and “epiphysis” was conducted of 12 works allegedly dictated by the spirit “André Luiz”. All information on the pineal having potential correlation with the field of medicine and current studies was included. Specialists in the area were recruited to compile the information and draw parallels with the scientific literature. The themes related to the pineal gland were: mental health, reproductive function, endocrinology, relationship with physical activity, spiritual connection, criticism of the theory that the organ exerts no function, and description of a hormone secreted by the gland (reference alluding to melatonin, isolated 13 years later). The historical background for each theme was outlined, together with the theories present in the Spiritist books and in the relevant scientific literature. The present article provides an analysis of the knowledge the scientific community can acquire from the history of humanity and from science itself. The process of formulating hypotheses and scientific theories can benefit by drawing on the cultural aspects of civilization, taking into account so-called non-traditional reports and theories.
INTRODUCTION

The pineal, formerly called the epiphysis, is a structure with a mass of around 0.5 g which protrudes from the posterior aspect of the diencephalon. This definition, taken from one of most respected books on medical physiology available today (Guyton & Hall 2006), seriously underestimates the importance of the pineal, providing scant information on this gland and its known physiological effects as well as those under study.

In the space of little over a decade (1954–1965), the pineal gland was revealed as an active neuroendocrine transducer, particularly following the isolation of melatonin by Aaron Lerner at Yale University in 1958 (Lerner et al. 1958). Currently, this tiny structure is one of the most studied by modern science and knowledge regarding its structure and functions is growing at an impressive pace. Up to our last review (performed on 7th of June, 2013 using the uniterms “pineal OR melatonin”), there were a total of 27173 indexed articles available on the Pubmed/MEDLINE database, 8957 of which were published within the last 10 years, while the SCOPUS database yielded 36488 articles, 14475 of which were published within the last decade.

Considered the most controversial organ of the body, it has been conceived as anything from a rudimentary vestigial remnant to the “principal seat of the soul” (López-Muñoz et al. 2010b). Today, in light of new knowledge, the pineal gland is recognized for chronobiology (Webb & Puig-Domingo 1995b), but even more so as a source of melatonin, which is a potent anti-oxidant (Galano et al. 2011; Galano et al. 2013) and anti-inflammatory agent (Mauriz et al. 2013).

Thus, significance has been attached to the pineal gland in numerous different cultures and beliefs and its role has been described by thinkers, mystics, philosophers and religious figures alike. One religion that has advanced the role of the pineal gland is Spiritism.

Spiritism consists of a collection of philosophical and scientific ideas and religious doctrines founded in France by Allan Kardec in 1857, author of the book entitled “The Book of the Spirits” (Lucchetti et al. 2011). Briefly, Spiritism adopts a dualistic concept of human beings: it postulates that we are essentially immortal beings; that we are essentially immortal spirits that temporarily inhabit physical bodies for several necessary incarnations to attain moral and intellectual improvement. It also implies a possible beneficial or maleficent influence of the spirits over incarnate humans (Moreira-Almeida et al. 2005; Lucchetti et al. 2011).

Although of European origin, Spiritism spread widely in Brazil, where it is currently the third most popular religion in number of followers (Lucchetti et al. 2012), owing to several factors, especially the work of a medium called Francisco Cândido Xavier who, despite limited schooling, penned over 460 books attributed to various spirits.

This study focuses attention on this work, particularly the books attributed to the “spirit” called André Luiz, allegedly a physician in a past life in Brazil, who authored books containing information of a scientific nature in the field of medicine through the hands of the medium. The most notable of these books is “Missionaries of the Light”, published in Brazil in 1945 (Xavier 1945) and translated into English (Xavier 2009/1945), whose second chapter is entitled “The Pineal Gland”.

According to “André Luiz”, the pineal gland “secretes the psychic hormones or ‘power units’, which act positively on the generative energies”, suggesting the role of a hormone produced by the pineal gland, some 13 years prior to the isolation of melatonin by Lerner et al. in 1958 (Lerner et al. 1958). Throughout the works of Francisco Cândido Xavier, the “spirit” dictates further statements pointing to the role of the pineal gland in the human body.

The objective of the present study was to compile information on the pineal gland drawing on the psychographed books by Francisco Cândido Xavier and to carry out a critical analysis of their scientific bases by comparing against evidence in the relevant scientific literature.

METHODS

A review of the works allegedly authored by the spirit “André Luiz” written through psychography by Francisco Cândido Xavier was carried out. This “spirit” was chosen for having produced several publications on the mechanisms and functions of the pineal gland.

Books were selected based on a search of the spiritist literature and subsequently leaders of the spiritist community were consulted on those books containing information about the gland.

It was decided to include all the titles included in the “Life in the Spirit World” collection, comprising a total of 13 volumes, all allegedly dictated by the spirit “André Luiz”, namely: Nosso Lar (Our Home), Os Mensageiros (The Messengers), Missionários da Luz (Missionaries Of The Light), Obreiros da vida eterna (Workers Of The Life Eternal), No Mundo Maior (In the Greater World), Libertaçao (Freedom), Entre a Terra e o Céu (Between Heaven and Earth), Nos Domínios da Mediunidade (In the Realms of Mediumship), Ação e Reação (Action and Reaction), Evolução em Dois Mundos (Evolution On Two Worlds), Mecanismos da Mediunidade (Mechanisms of Mediumship), Sexo e Destino (Sex and Destiny), and E a Vida Continua (And Life Goes On). Although originally written in Portuguese, all these titles have since been translated into English (Xavier 2009/1945).

Analysis of the book passages containing information referring to the pineal gland was carried out by scanning collection contents using the search function provided by Adobe Acrobat Reader with the uniterms “pineal” or “epiphysis”.

After selection and counting uniterm matches, the authors opted to read all chapters in which the terms
appeared, for subsequent analysis of the information. All information potentially related with the field of medicine and current studies was included.

Finally, endocrinologists, neurologists, neuroscientists, general clinicians and scholars of the spiritist theme were recruited to compile the information and draw parallels with evidence in the scientific literature.

RESULTS

Table 1 shows results of the systematic search for the uniterms in the different books from the “A Vida no Mundo Espiritual” (Life in the Spirit World) collection.

The book containing the greatest number of uniterms related to the theme of the pineal gland was the book “Missionários da Luz” (Missionaries of the Light) (1945) with 20 uniterms matches, followed by the book “No Mundo Maior” (In the Greater World) (1947), and “Evolution On Two Worlds” (1958). Six out of the 13 books (46.1%) in the collection yielded some information related to the pineal gland.

The themes addressed by the “spirit” author were: information on the spiritual connection of the pineal gland (7 passages), mental health (6 passages), reproductive function (4 passages), endocrine function (4 passages), criticism of the theory that the organ exerts no function (2 passages), physical activity (1 passage), and description of a hormone secreted by the gland (1 passage). A total of 6 passages reporting visualizations of light emitted from the pineal gland by the spirits were rejected because they lacked correlations with current evidence. Tables 2–4 contain passages related to each theme.

DISCUSSION

Based on these findings, the books by Francisco Cândido Xavier written through psychography, yield numerous statements pointing to the roles of the pineal gland in the human body. The results in the ensuing section are stratified by subtheme, allowing parallels to be drawn with current scientific evidence.

A: Mental Health

Historical background: The role of melatonin in mental health was first seen in early reports from the XVII and XVIII centuries linking this gland to “madness” (Miles & Philbrick 1988). In 1920, the first extracts from the pineal gland for treating schizophrenia were assessed with controversial results (Kitay & Altschule 1954). Only after isolation of melatonin in 1958 (Lerner et al. 1958) did experimental studies start to confirm this link between melatonin and mental health (Cardinali et al. 2012; Sanchez-Barcelo et al. 2010).

Vision held by Spiritism in the 1940s: The passages analysed point to a strong relationship between the pineal gland and an individual’s mental health. The “spirit” André Luiz makes clear that the pineal gland “is the gland of mental life”, that “it presides over the neural phenomena of the emotions”, acting as “the controller of the world of the emotions” and “the most advanced laboratory of a human being’s psychic elements (Xavier 1945).

Current scientific evidence: This relationship, a remote and futuristic notion for the 1940s, has been increas-
ingly proposed recently based on a number of studies investigating melatonin. In fact, psychiatric diseases (bipolar disorder, depression, schizophrenia) are related to sleep disorders; and insomnia is a symptom commonly associated with decompensation and recurrence of these diseases (Maldonado et al. 2009b).

It has been shown that melatonin exerts an antidepressant-like action when assessed in animal models predictive of antidepressant action of drugs in humans (Raghavendra et al. 2000). Similarly, recent studies have shown that melatonin receptors are elevated in the suprachiasmatic nucleus of depressed patients and may rise during the disease course (Wu et al. 2013). Some authors (Maldonado et al. 2009b; Maldonado et al. 2009a) have also proposed that melatonin might play an important role as an adjuvant therapy for depression, due to other properties including its anti-inflammatory, anticonvulsant, sedative, anxiolytic and, protective actions against osteoporosis, among others.

In schizophrenia, biological rhythms, including that of melatonin, are altered and treatments based on exogenous melatonin used in association with antipsychotics can reduce the collateral effects (Webb & Puig-Domingo 1995a).

Eating disorders are also associated with changes in melatonin level: in bulimia levels are high during the day; in anorexia high during the day/night; in panic syndrome high at night, whereas in obsessive compulsive disorder (OCD) concentrations are low at night (López-Muñoz et al. 2011).

Recently, studies have also shown effects of melatonin in improving dementia-related changes in behavior (such as depression, anxiety, apathy, as well as lower prevalence of hallucinations, delirium, agitation, irritability and appetite disorders), according to evidence compiled in a recent Cochrane systematic review (Jansen 2011).

According to Verster (2009), developments have proven the efficacy of melatonin receptor agonism in synergy with serotonin antagonism. Possible applications in the treatment of other neuropsychiatric conditions have been suggested, and further investigation

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<th>Tab. 2. Passages from books psychographed by Francisco Cândido Xavier mirroring current scientific findings.</th>
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<td><strong>Theme</strong></td>
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<td>Mental Health</td>
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<td>Mental Health</td>
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<td>Pineal gland and physical activity</td>
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<tr>
<td>Criticism of the theory that the organ exerts no function</td>
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<td>Criticism of the theory that the organ exerts no function</td>
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Bargmann studied the pineal gland of mammals, and Engel soon followed. However, it was in 1943 that reports by other scientists such as Marburg, Berblinger, and early puberty (addressed in more depth in the section: "reproductive function") (Kappers et al. 1979). Reports by other scientists such as Marburg, Berblinger and Engel soon followed. However, it was in 1943 that Bargmann studied the pineal gland of mammals and suggested the possible role of the organ in regulating hypothalamus function. According to historians, in the first half of the XX century, notions already existed of an antigonadotropic influence and cooperation among the pineal, hypothalamus and pituitary gland (Reiter & Fraschini 1969).

**Conclusion of the section:** The works analyzed suggest the pineal gland has great importance in the mental health of individuals, while also positing that this organ is “the gland of mental life”. Current evidence reveals a relationship between the pineal gland and mental health, including the role of melatonin receptor agonists for the treatment of depression. The role of the pineal gland in individuals’ mental health however is not yet fully elucidated.

**B: Endocrine function**

**Historical background:** The relationship between the pineal gland and endocrinology dates back more than a century. In 1898, Huebner was the first to describe this relationship, reporting a case of a boy with pinealoma and early puberty (addressed in more depth in the section: "reproductive function") (Kappers et al. 1979). Reports by other scientists such as Marburg, Berblinger and Engel soon followed. However, it was in 1943 that Bargmann studied the pineal gland of mammals and suggested the possible role of the organ in regulating hypothalamus function. According to historians, in the first half of the XX century, notions already existed of an antigonadotropic influence and cooperation among the pineal, hypothalamus and pituitary gland (Reiter & Fraschini 1969).

**Current scientific evidence:** The pineal gland is currently believed to play an active role in the integrative process of the neuroendocrine system (Cardinali et al. 1979). As demonstrated by Cardinali et al. (Cardinali

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**Tab. 3. Passages from books psychographed by Francisco Cândido Xavier mirroring current scientific findings.**

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<thead>
<tr>
<th>Theme</th>
<th>Book title</th>
<th>Passage</th>
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<tr>
<td>Reproductive functions</td>
<td>Missionários da Luz</td>
<td>&quot;[the pineal gland] The individual yields to the recapitulation of his or her sexuality and examines the inventory of passions experienced in the past, which reappear under strong impulses.&quot;</td>
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<td>(Missionaries Of The Light)</td>
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<td>&quot;the pineal gland – if I may put it this way – secretes the ‘psychic hormones’ or ‘power units’, which act positively on the generative energies. The chromosomes in the seminal sac cannot escape the pineal gland’s absolute and determining influence.&quot;</td>
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<tr>
<td>Reproductive functions</td>
<td>Missionários da Luz</td>
<td>In its capacity as controller of the world of the emotions, its position in sexual experiences is basic and absolute</td>
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<td>&quot;During the period of childhood development – the readjustment phase for this important center of the preexistent perispiritual body– the epiphysis seems to restrain the manifestations of sex&quot;</td>
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<tr>
<td>Endocrine function</td>
<td>Missionários da Luz</td>
<td>&quot;the coloration of the epiphysis, resembling a small bluish sun, keeps within its magnetic field all the other bodies, from the hypophysis out to the region of the ovaries, like our life star&quot;</td>
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<td>(Missionaries Of The Light)</td>
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<td>&quot;the pineal gland maintains control over the entire endocrine system (...) under its direction psychic energies are supplied to all the autonomous storage areas of the organs&quot;</td>
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<td>Endocrine function</td>
<td>No Mundo Maior (In the</td>
<td>&quot;I noted that the habitual light from the endocrine centers dimmed, where only the epiphysis continued to emit abnormal rays.&quot;</td>
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<td>Greater World) – page 108</td>
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<tr>
<td>Endocrine function</td>
<td>Ação e Reação (Action and</td>
<td>&quot;The epiphysis, hypophysis, thyroid, parathyroids, thymus, supra-renals, pancreas and the genesic sacs were perfectly characterized against a living backdrop of perispiritual centers, which interact in harmony with one another&quot;, in highly subtle nerve branches, singularly adjusted, through the plexus, with each center emitting its own irradiations, together comprising one harmonic, which impels use to ecstatic contemplation.&quot;</td>
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<td></td>
<td>Reaction) – pages 241 and</td>
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<td></td>
<td>242</td>
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<tr>
<td>Description of hormone</td>
<td>Missionários da Luz</td>
<td>&quot;The genital glands secrete the sex hormones, but the pineal gland – if I may put it this way, secretes the “psychic hormones” or “power units”, which act positively on the generative energies.&quot;</td>
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<td>secreted by the gland</td>
<td>(Missionaries Of The Light)</td>
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<td>(melatonin?)</td>
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et al. 1979), the pineal gland exhibits characteristics of neuroendocrine transduction and integration, for example: (a) the existence of putative receptors for various hormones (estradiol, testosterone, 5 alpha-dihydrotestosterone, progesterone, prolactin); (b) the steroid metabolic pattern resembling other brain areas involved in gonadotrophic regulation, correlation of pineal responsiveness to hormones with activity of sympathetic nerves; (c) the modification by hormones of pineal beta-adrenergic mechanisms and; (d) the dissociation of hormone effects on the pineal gland in those mediated or modulated by changes in afferent neuronal activity and those relatively unaffected by denervation.

Similarly, the passage "The epiphysis, hypophysis, thyroid, parathyroids, thymus, supra-renals, pancreas and the genetic sacs were perfectly characterized against a living backdrop of perispiritual centers, which interact in harmony with one another", resembles the intimate relationship of the pineal gland to organs associated with the endocrine system. In fact, by regulating circadian rhythms, melatonin is directly involved in the photo-neuroendocrine system (Korf et al. 1998).

Melatonin interacts with other circadian periodic variables and thus indirectly controls or exerts influence on a wide variety of physiologic functions, such as the sleep/wake cycle, thermal regulation, feeding, and sexual behavior and certain cardiovascular functions, and through its interaction with serotonin participates in the regulation of the secretion of ACTH, corticosteroids, β-endorphin, prolactin, renin, vasopressin, oxytocin, growth hormone, and luteinizing hormone (LH). (Touitou & Haus 2000).

There is evidence that Melatonin inhibits ACTH-induced production of cortisol in the adrenals (Campino et al. 2008), inhibiting the expression of the clock genes PER1 mRNA, BMAL1, StAR, the protein 3β-HSD and ACTH-induced production of cortisol and progesterone in the adrenals (Campino et al. 2011). Melatonin also participates in the fine regulation of ACTH in corticotrophins, a mechanism related to the chronobiological action of the hormone from the pineal (Tsukamoto et al. 2013).

Melatonin is secreted at a rate ten times higher nocturnally than during the day and acts directly on the Pars Tuberalis of the adenohypophysis, inhibiting cAMP production through a Gi type g-protein signalling pathway coupled to the Melatonin Receptor (MT1). Thyroid stimulating hormone (TSH) is produced in the Pars Tuberalis and has the opposite action to melatonin, stimulating cAMP production through a Gs protein signalling pathway coupled to the TSH receptor (Duprē et al. 2011). Melatonin acting on the Pars Tuberalis medi-

Tab. 4. Passages from books psychographed by Francisco Cândido Xavier mirroring current scientific findings.

<table>
<thead>
<tr>
<th>Theme</th>
<th>Book title</th>
<th>Passage</th>
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| Connection with the spiritual world| Missionários da Luz (Missionaries Of The Light) | "In any type of mediumistic practice, the pineal gland plays the most important role. By means of its well-balanced energies, the human mind intensifies the power of the sending and receiving of rays peculiar to our realm."
|                                    | page 13                                        |                                                                         |
| Connection with the spiritual world| Missionários da Luz (Missionaries Of The Light) | "However, we are not examining problems of embryology. Let's stick to the initial subject and analyze the epiphysis as the gland of a person's spiritual life."
|                                    | page 18                                        |                                                                         |
| Connection with the spiritual world| Missionários da Luz (Missionaries Of The Light) | "It is in the epiphysis that human beings' new sense lies; however, in most people the divine potential still sleeps in an embryonic state."
|                                    | page 13                                        |                                                                         |
| Connection with the spiritual world| Missionários da Luz (Missionaries Of The Light) | From the epiphysis, situated between the cerebral hemispheres, to the procreating nuclei, the glands appear to form a beautiful luminous system, similar to tiny stars of life, congregating in a vertical direction, whose gleaming antenna attracts light coming from the Higher realms."
|                                    | page 163                                       |                                                                         |
| Connection with the spiritual world| Evolução em Dois Mundos (Evolution On Two Worlds) | "In spiritual form, the coronal center of the future perispirit, reflects in the pineal gland."
|                                    | page 58                                        |                                                                         |
| Connection with the spiritual world| Evolução em Dois Mundos (Evolution On Two Worlds) | The epiphysis starts to consolidate, by energetic support of subtle sensations for the translation and selection of the various mental states, in mechanisms of reflection and thought, of meditation and discernment, presage the operations of mediumship, conscious or unconscious, by which incarnate and discarnate Spirits consort with one another, in the same band of vibrations, for the great creations of Science and Religion."
|                                    | page 58 and page 59                            |                                                                         |
| Connection with the spiritual world| Mecanismos da Mediunidade (Mechanisms of Mediumship) | the epiphysis of the hypnotized, a gland of utmost importance in all mediumistic processes, given that it favors the passivity of the receptive nuclei of the brain, provoking at the same time, the attention or closed circuit in the magnetic field of the patient. |
ates TSH gene expression and exerts a direct action on seasonal physiology (Barrett & Bolborea 2012). Both melatonin and cortisol have been identified as regulators of the hypothalamic-pituitary-thyroid axis (Mazzoccoli et al. 2011).

Melatonin participates in immunoregulation by increasing production of the thymic peptides (Thymosin and Thymulin) (Bateman 2007). The fall in melatonin levels with ageing accompanies the age-related decline in the immune system, evidencing the immunomodulatory effect of melatonin (Espino et al. 2012).

Melatonin also promotes ultrastructural changes in parathyroid cells (Chen et al. 1991) and appears to influence bone metabolism (Ostrowska et al. 2003), representing a candidate modulator of osteoblasts with a possible therapeutic role (Cardinali et al. 2003).

Similarly, melatonin has been reported as a potential treatment for Metabolic Syndrome (Kozirog et al. 2011) given its action reducing insulin release directly within pancreatic B cells, increasing sensitivity to the action of insulin, and reducing intolerance to glucose and fructose (Korkmaz et al. 2009). Obesity, a component of Metabolic Syndrome, has been associated with the suppression of the endogenous production of melatonin and chrono-disruption (Reiter et al. 2012).

In the case of Polycystic Ovary Syndrome (PCOS) (March et al. 2010), melatonin participates in the regulation of the hypothalamic-pituitary-gonadal axis (Shi et al. 2013). Melatonin receptor 1A gene polymorphism is also associated with the etiopathology of the disease (Li et al. 2011), perhaps explaining the elevated melatonin levels found in some studies (Luboshitzky et al. 2001; Luboshitzky et al. 2004). Melatonin has also been used in the treatment of PCOS (Saha et al. 2012) with controversial results.

Endocrinology is the study of hormones and hormonal signalling. Melatonin is considered a pleiotropic hormone given its versatility as a hormonal signal (Reiter 1995; Hardeland et al. 2011) and new assaying techniques are set to open up a vast new avenue of knowledge on the physiology of the pineal (Klein et al. 2010).

Conclusion of the section: The books analyzed, although not employing scientific language, appear to yield endocrinologic information about the pineal gland and its main hormone (melatonin) that closely mirrors the findings in the current scientific literature.

C: Pineal gland and the reproductive system

Historical background: The relationship of the pineal gland with human reproduction dates back to the mid-1900s when Huebner reported that a tumor of the human pineal gland altered pubertal development (Reiter et al. 2009). This led many scientists in the first half of the 20th century to experimentally examine the association of the pineal with the reproductive status in a variety of species but with limited success in terms of demonstrating a functional relationship. The findings were not sufficiently compelling to convince most, if any, reproductive biologists that the pineal gland and the reproductive system were functionally linked (Reiter et al. 2009). Finally, the discovery of melatonin by Lerner in 1958 (Lerner et al. 1958) heralded a new field of research in reproductive physiology.

Vision held by Spiritism in the 1940s: With respect to reproductive function, the passages from the books yielded the following information:

“In its capacity as controller of the world of the emotions, its position in sexual experiences is basic and absolute”; “During the period of childhood development – the readjustment phase for this important center of the preexistent perispiritual body – the epiphysis seems to restrain the manifestations of sex” and, “The chromosomes in the seminal sac cannot escape the pineal gland’s absolute and determining influence”.

Current scientific evidence: In the 1940s, when the book under analysis was written, the information available on this correlation was extremely scant and highly conflicting. Nowadays, various different studies have linked melatonin production with fertility (Nir & Hirschmann 1979; Reiter et al. 2009). Pinealocytes also express receptors both for luteinizing hormone (LH) and for GHRH, hypophysiotropic regulator of LH (Itoh et al. 2006).

The role of melatonin also seems to be related to the male selection due to its ability to enhance sexual and ornamental pigmentation (Bertrand et al. 2006), the reduction of morphophysiologically flawed traits being passed to the next generation, as studies have preliminarily shown its ability to protect the gametes from oxidative and nitrosative damage (Sarabia et al. 2009), and to an additional protection to the placenta, fetus, and mother from oxidative damage due to a variety of toxic oxidizing events associated with pregnancy (Nagai et al. 2008).

The passage “The chromosomes in the seminal sac cannot escape the pineal gland’s absolute and determining influence”, mirrors the current evidence showing that the seminal fluid contains melatonin (Bornman et al. 1989), and also how melatonin appears to be a protective factor in decreasing the radiation-induced chromosome damage as dimethyl sulfoxide at 1.0 M (Bornman et al. 1989).

Likewise, drawing parallels between the passage “During the period of childhood development (…), the epiphysis seems to restrain the manifestations of sex” and current knowledge reveals that deficiencies in melatonin may be related to sexual functioning in human males (Grugni et al. 1994) and there is evidence for a facilitatory role of melatonin in sexual behavior, through its mechanism involving the 5-HT2A receptor (Grugni et al. 1994).
Conclusion of the section: The relationship between the pineal gland and human reproductive system is strong, being backed by solid contemporary evidence. As mentioned earlier in this section, this relationship was first suspected in the beginning of the XX century but rejected by scientists of the time due to studies with inconsistent results.

D: Pineal gland and physical activity:

Historical background: It is unclear exactly when the link between the pineal gland and physical exercise was first reported. However, the first studies showing that the exposure of rats to various types of stress (increasing catecholamines in the bloodstream) led to increased melatonin levels in plasma and in the pineal, date back to the late 1970s and early 1980s (Monteleone et al. 1990; Lynch et al. 1977). The first studies along these lines in humans were conducted in the 1980s (Monteleone et al. 1990).

Vision held by Spiritism in the 1940s: The books analyzed also contain a passage in which the “spirit” tells of a possible role of the pineal in physical activity: “As a means of combating the potential dangers of the excessive accumulation of neural energies – as the electrical secretions of the epiphysis are called – they have advised the youths of all countries to practice rowing, ball games, jumping, pole vaulting, and running”.

Current scientific evidence: According to a recent review, physical exercise acts as a zeitgeber. The impact of exercise on the rhythm of melatonin secretion was found to vary depending on the time of day, intensity of light and how closely the exercise coincided with the circadian production of melatonin (Escames et al. 2012).

However, the role of physical exercise in melatonin secretion remains controversial, with different studies showing increased (Skrinar et al. 1989), decreased (Monteleone et al. 1990) and unchanged production of the hormone (Elias et al. 1993). Notwithstanding the inconsistencies in the scientific evidence, there is a general consensus that nocturnal exercise, of moderate and high intensities, if performed routinely, can result in phase delays in melatonin onset (Escames et al. 2012; Van Reeth et al. 1994). Accumulating evidence also suggests that, in addition to its phase-shifting effects, exercise can also acutely alter melatonin levels (Buxton et al. 1997; Escames et al. 2012).

Moreover, studies investigating the role of melatonin in physical performance (Atkinson et al. 2005) have shown promising results and beneficial effects on the cardiovascular system, skeletal muscle, exercise-related metabolism and on muscle oxidative stress (Escames et al. 2012).

Conclusion of the section: Despite only one rather generic sentence from the book on the possible relationship between the pineal gland and physical exercise, it is noteworthy that this relationship was not embraced by the scientific literature in the 1940s. Current evidence holds that the exercise and melatonin effect appears to exert a favorable influence on several systems of the human body. Nevertheless, further studies are needed to clarify contradictory findings in this area.

E: Description of a hormone secreted by the gland

Historical background: As outlined previously, in the first half of the XX century, the notion that the pineal gland might be responsible for an endocrine function and for producing hormones had already been established (Kappers et al. 1979). It was only in 1958 however, that Lerner et al. (Lerner et al. 1958) isolated melatonin.

Vision held by Spiritism in the 1940s: According to the book “Missionaries of the Light”, the pineal gland “secretes the psychic hormones or power units, which act positively on the generative energies”. This passage suggests a role of a hormone produced by the pineal gland which may be alluding to the role of melatonin in the regulation of energy.

Current scientific evidence: Melatonin was isolated by Lerner in 1958 (Lerner et al. 1958) (13 years after the passage was written), and in recent years evidence has emerged confirming the role of the hormone in mitochondrial oxidative stress (Martinis et al. 2012), as a coadjuvant in hypothermic neuroprotection in neonates (Robertson et al. 2013). as well as in the physiology of brown adipose tissue (BAT) promoting hypertrophy and increasing its activation, having therapeutic potential for combating obesity (Tan et al. 2011).

Results of studies in rats (Hatzis et al. 2013) suggest the antioxidative role of melatonin appears to attenuate non-alcoholic fatty liver disease (NAFLD).

Melatonin may also play an epigenetic role in the prevention of perinatal oxidative stress, acting in fetal gene programming in high-risk pregnancies (Chen et al. 2013).

Conclusion of the section: The passage given above clearly describes the role of the pineal gland in the secretion of physical hormones, emphasizing the endocrine function of the gland. Speculation that the hormone alluded to was what later became known as melatonin, isolated 13 years after the book “Missionaries of the Light”, although plausible, should be viewed tentatively.

F: Pineal gland and the “connection with the spiritual world”

Historical background: Hindu philosophy and Vedic medicine, written some 5000 ago, describe the pineal – “the sixth chakra”, according to these traditions – as a window to the spiritual world, where mental power
resides, associating this gland with clairvoyance and meditation, professing that its activity is nocturnal (López-Muñoz et al. 2010b). However, the first detailed descriptions of the pineal are found in the works of Galen (131-200 AD), expounding on a theory that proposed the gland was an organ exercising valvular control. His underlying theoretical bases were founded on pneumatics of the school of the Alexandria school (López-Muñoz et al. 2010a). Acting like a pump, the pineal gland was thought to distribute “spiritus animalis” around the body, Galen's whole structure was called the “pneumatic-ventricular model” and was purely hydraulic in nature (López-Muñoz et al. 2010c).

The “pneumatic-ventricular model” provided the theoretical basis of René Descartes (1596–1650), a great philosopher renowned for pronouncing the pineal “the principal seat of the soul”. According to Descartes, the “spiritus animalis” were subtle fluids, like tiny, fast-moving particles which circulated through the interior of the cerebral ventricles and nerves – a kind of “quintessence” originated from blood fluid by rarefaction (Fishman 2008). Harmony between the mind and movements of the body, required perfect communication between the physical seat and the human soul, a role attributed to the gland (López-Muñoz et al. 2010b).

The theory of Descartes began its demise with the principles of Claude-Nicolas Le Cat (1700–1768) who claimed the cerebral cortex, and not the pineal, was the seat of the soul (López-Muñoz et al. 2010c).

Vision held by Spiritism in the 1940s: André Luiz also defined the role of the pineal gland as the connector of the “spirit world”: “The tiny gland had become a radiating nucleus and its rays formed a lotus flower of sublime petals around it”.

This description by André Luiz was based on an observation he made of the pineal of a medium psychographing a message during a mediumistic session, showing the great flow of energies travelling along this path and identifying the structure as very important in communications from the spirit plane.

“You can see that every glandular center is an electrical power source. In any type of mediumistic practice, the pineal gland plays the most important role (...) “It is in the epiphysis that human beings' new sense lies; however, in most people the divine potential still sleeps in an embryonic state”.

Current scientific evidence: In fact, the association between spirituality and the pineal gland has been consistently reported throughout the history of civilization. However, only in recent years has research confirmed an association between these variables.

Recently, five studies supported the long-standing speculation that the pineal plays an important role in the intrinsic awareness which might concern the spirit or soul. The first of these studies (6) found that the pineal gland was activated during religious medita-

Conclusion of the section: The Spiritist works analysed point to a relationship between the pineal gland and spiritual connection. Current studies have shown some promising results in support of this hypothesis but remain preliminary, precluding the drawing of robust conclusions.

CONCLUSIONS

Analysis of the content of the information revealed the author has summarized the importance of the pineal gland under six main items, noting that it: (a) is responsible for governing the world of emotions; (b) maintains control over the entire endocrine-gonadal system; (c) commands subconscious powers under the direct determination of the will; (d) supplies all the autonomous storage areas of the organs with “psychic energy”; (e) is the gland of mental life; and (f) has primordial function in the mediumship phenomenon and spiritual connection.

However, it was noted that some key issues in the current scientific literature on the pineal gland are not reported in the books, such as the role of the gland in sleep and chronobiology.

The fact that a text written by an unlearned individual without academic training or involvement in the field of health, who resided in the hinterlands of Brazil during a time when access to articles was limited (the case of Mr. Francisco Cândido Xavier), furnishes highly complex concepts and information on the physiology of the pineal gland 60 years before any scientific confirmation, raises deeper questions as to the true source of this information.

The first hypothesis is that the author, drawing on books and articles available in the 1940s detailing the physiopathology of the pineal gland and published before the isolation of melatonin, created these theories himself, wording them in non-specific language thus allowing them to appear to be supported by subsequent advancements in science. A second hypothesis posits a mere coincidence of findings, whereby the author ran-
domly created several theories surrounding the pineal gland, many of which happened to be confirmed by scientific evidence. The third hypothesis centers on alleged communication with “spirits”, that have “brought forward” future findings related to the pineal gland.

The aim of investigation however, was not to draw hasty conclusions based on unsubstantiated evidence. The present article provides an analysis of the knowledge that, the scientific community can acquire from the history of humanity and from science itself. The process of formulating hypotheses and scientific theories can benefit by drawing on the cultural aspects of civilization, taking into account so-called non-traditional reports and theories.

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