

The Pineal Gland, LSD and Serotonin

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Dedicated to John Blofeld

*Om Mani Padme
Hum!*

Overview:

To present correlations between the Pineal Gland, the psychopharmacological molecule LSD and, it's antagonistic neurotransmitter Serotonin.

Outline of the Paper

I. Brief Description of the Discovery - Historical Findings

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*Om Hail! the Light of the Ages
Coming in From above like the
Righteous Thunderbolt!!!*

The Pineal Gland, LSD and Serotonin

The following is an attempt to correlate seeming unrelated material into a meaningful whole. The goal is to synthesize information gathered about the pineal gland, the psychopharmacological molecule LSD, and the neurotransmitter serotonin. There have been detailed studies done on each one of these subjects. For instance, there are volumes of work and research done on the molecule LSD; the pineal gland has been studied extensively; and even the hormone serotonin has had its day in the lab. But there are few studies which have brought together this three-fold relationship.

This paper involved a great amount of research. It is the result of manipulating many manuals, texts, and magazines published by the lay and the respectable. Almost all the literature available on LSD, serotonin and the pineal gland is written in their native scientific nomenclatures. In spite of the amount of study, very little is really known about these three subjects which is what makes this report valuable as an initial exploration. The informational pool this paper provides will be valuable to those true seekers of inner transactions, that is, subtle metabolic processes which are influenced consciously.

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Brief History of the Discovery of the Pineal Gland (Epiphysis)

The pineal gland is about the size of a grain of rice. Therefore its initial discovery was difficult and late in coming. Galen (2nd century) was probably the first to describe it in the West. He thought it might be a valve to regulate the flow of thought from the lateral ventricles--cavities on each side--of the brain. [1] Rene Descartes, the French philosopher, who made a number of rather remarkable scientific discoveries wrote about the gland 1500 years after Galen. In Descartes opinion the pineal was the "seat of the soul". He also postulated a direct connection between the eyes and the pineal by means of "strings" in the brain. Also that the gland acted as an interpreter, indeed the chief interpreter of vision. Not only did the gland operate as an interpreter but it also directed the muscles to respond to objects in the visual field. This was done, Descartes believed, through the flow of humours passing through hollow tubes between the gland and the muscles. [2]

The first person to give the pineal gland an endocrine status was Otto Heubner, a famous German pediatrician. In 1898 he described precocious puberty in a boy who had a pineal tumor. To confuse the situation, there were reports of patients with delayed sexual maturity who also had pineal tumors. As the result of these reports, conflicting though they were, it was believed for the next fifty years that the pineal had something to do with the control of puberty.

A slight diversion from the puberty theory came in 1918 when Nils Holmgren, a Swedish anatomist, made detailed microscopic examinations of the pineal glands from frogs and dogfish sharks. In these glands he found cells that looked very

much like cone cells (color sensitive photoreceptor cells) of a retinal nature in the tip of the pineal. Because of the resemblance Holmgren suggested that the pineal was not a gland at all, but that it functioned as a 'third eye' in frogs and dogfish sharks. Holmgren made no study of mammalian pineal glands. [3]

A new round of investigation began in 1958 when Lerner and his team at the Yale University of Medicine extracted a substance they called melatonin from the pineals of cattle. Giving more evidential information towards the validation of the hypothesis that the pineal gland is an endocrine gland.

Further microscopic probing, this time with mammalian pineals, indicated an intimate association between the epiphysis (the pineal) and the sympathetic nervous system. It also revealed no cone cells of the type found in the retina, so the mammalian pineal did not seem to have the resembling third eye structure that had been reported for frogs and dogfish sharks. [4]

Obviously the discovery of the pineal is a recent one. Research is fragmented because of the variety of professionals interested (e.g. theologians, biologists, endocrinologists, and zoologists). At this point it can be conjectured there is still much history to be written about this curious pineal gland. Hopefully the next entry in the historical text will be the discovery of the "spiritual" connections of the pineal gland to the brain.

The star of this essay is the pineal gland. LSD and serotonin are taken in consideration because of their mysterious relationship to the pineal. Most of the findings regarding LSD and serotonin will be better understood after being first familiar with the epiphysis (the pineal gland).



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General Location of the Pineal Organ in Various Animals

Indian yogis who use third eye meditations and exercises refer their students to the center of the forehead between the lateral eyes. This is the aft/stern relation of the pineal gland. If anything could be called the "center" of the physical brain it would be the epiphysis. In higher vertebrates it rests between the two large cerebrums at the anterior end of the cerebellum. It appears to be a vestige of some one-time larger feature. Strangely enough it persists in most animals. If you were to draw an imaginary line from the center of your forehead crossed by a line through your head at the ears you would have the general location of the pineal body. It is definitely buried deep in the great mass of neurons known as the brain. One fact immediately raises interest: the pineal, in higher animals, is connected to the cerebellum.

The cerebellum is one of the oldest features of the brain. It consists of two deeply convoluted hemispheres. Its most important function seems to be coordinating muscular activity in the body. [5] Such activity is initiated by impulses arising in the motor area of the forebrain. These impulses not only travel down the spinal cord to the motor neurons but also pass into the cerebellum. As the body action is carried out, sensory impulses from the proprioceptors, the eyes, the semi-circular canals, etc., are also sent to the cerebellum. The cerebellum then compares the information on what the body is actually doing to what the forebrain had instructed it to do. [6] If a discrepancy exists, the cerebellum sends modifying signals to the forebrain so that appropriate corrective signals can be sent out to the muscles. It is not surprising that birds have relatively large cerebella when we consider that they must be capable of moving swiftly and accurately in three dimensions of space, while we and other earth-bound animals spend most of our lives moving about on fairly flat surfaces. [7] When thinking of the location of the pineal gland think of it as being near the upper end of the spinal cord. It ends or terminates in the oldest anatomical region in the brain.

It might be useful here to note the various locations of other animal's pineal glands. The most popular creature in third eye studies is the Western Fence Lizard-*Sceloporus occidentalis*. This little gentleman not only has a fine and

functional pineal gland but also a photoreceptive element plainly called a 'third eye'. The pineal of the Western Fence Lizard is located directly on top of the head. A small opening (foramen) can be seen in the skull where the 'third eye' actually protrudes.

Similar to this tiny reptile is a very distant relative, the Pacific Tree Frog-*Hyla regilla*, which also has the pineal topside. *H. regilla* does not share the Fence lizard's foramen or optic lens. The pineal of the Treefrog is barely visible because of the many similar "bumps" on the skin. Nonetheless it is functional.

Another classic example is the Pacific Sea Lamprey-*Petromyzon marinus*. This lamprey represents the lowest forms of living vertebrates, the cyclostomes, where are jawless, limbless creatures of great evolutionary significance. [8] The lamprey, too, has a conspicuous pineal gland. In fact it has two, both located together. The pineal gland of the lamprey is usually studied when the lamprey is in the larval stage. It is then when the gland is most visible.

And like the Treefrog and Fence Lizard, the Lamprey has its pineal organ located above the brain. We will look closer at these three dealing with the optic quality of their receptors.

It should become apparent after looking at the embryological evidence that the epiphysis and its possible pathways have semi-receded in the higher vertebrates. It has migrated from the position of above to the position of below and center.

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The Optic Third Eye Compared to the Endocrinial Pineal Gland

The three animals previously mentioned (Western Fence Lizard, Pacific Tree Frog, and Sea Lamprey) are to be considered now for their contribution to the research being done on the optic importance of the pineal body.

Since the first discovery, right on down to present findings, there has been the question of the pineal's relation to light. How romantic to think of a functional third eye pointed skyward for the ultimate in ground protection! Other obvious benefits are associated with the having of such a receptor.

In the Western Fence Lizard (*S. occidentalis*) the pineal and the parietal third eye are connected by means of the parietal nerve. The epiphysis is located above the cortex and under the bone of the skull. Under high magnification one sees the ultrastructures of the cornea, lens, and retina. The cornea is composed of an inner, highly fibrous layer and an epidermal layer. The cornea is fused with the lens, a palisade of elongate, cylindrical cells whose nuclei lie at their basal ends. A fibrous capsule encloses the eye and attaches it to the skin. The parietal nerve leaves the retina, passes through the capsule, and courses posteriorly under the roof of the cranium and then ventrally to the epiphysis and brain. [9]

We know that the parietal eye is functional because there are changes in electrical activity, which can be recorded from the retina (ERG) or parietal eye nerve when light to the eye is turned off or on. It is also interesting that a deficiency of vitamin A causes a breakdown in the outer segments of third eye receptors in *S. occidentalis*. Let it be said now that the third eye contains a light sensitive substance (or perhaps two substances) since it reacts differently to short and long wave lengths of light. [10]

The Pacific Treefrog has a similar structure for the third eye and epiphysis. Even though close observation does not reveal this. Detailed examination illustrates that it too has a pineal third eye which protrudes above the surface of the cranial wall. It is responsive to light stimulation. [11] The Pacific Treefrog is the amphibian example of animals with third eye function.

The Sea Lamprey-*P. marinus* is the aquatic example of third eye animals. It has, in the larval form, two parietal eyes and nerve which runs through the epiphysis.

And as mentioned, the Sea Lamprey is a representative of an ancient group of animals. The fact that it has a third eye is relevant to this story. To know that nature has been working with the third eye through many cycles of evolution gives just more inspiration for further studies concerning our pineal organ.

While looking over the many diagrams and sketches of the brain region of various creatures, one can not help noticing the proximity of the third eye to the pineal. In fact in some animals there is no dividing line distinguishing the two. Furthermore there is a relatively major nerve which comes from the parietal eye to the epiphysis. Certainly this anatomical connection suggests that light received by the third eye is sent to the epiphysis for translation and storage. The literature in the spiritual community may not be so far off when they postulate that the pineal is the 'Oracle of Light'.

*The light of the body is the eye:
therefore when thine eye is single,
thy whole body also is filled with light;
but when thine eye is 'evil',
thy body also is full of darkness.[12]*

But we know from anatomy that *Homo sapiens* and all higher vertebrates have no protruding third eye. They do have a pineal which is sensitive to light. [13] But it is buried quite deep in the bed of cortical tissue.



The Recent Findings of Pineal Function and Physiology

Since light on this planet is regulated alternatively day and night (circadian), it would be easy to discern the relation of such cycles to the pineal and other glands. Indeed, this has been proven. [14] There are 24 hour cycles in the concentrations of serotonin (N-acetylserotonin - NAS) and melatonin in the pineal of the rat. There is also a 24 hour cycle in the conversion of the norepinephrine (one of the neurotransmitters needed for the functioning of the synaptic sites in the nervous system's soma) in the sympathetic nerves innervating in the pineal gland. "This rhythm persists in blinded rats and animals but is suppressed in normal rats by light. The same rhythm in norepinephrine turnover generates the rhythms in pineal indole-amines and N-acetyltransferase." [15]

There is a relationship between sex hormones and the light receptive quality of the epiphysis. It has been proposed that one function of the pineal in the rat is to serve as a neuroendocrine transducer, mediating the effects of environmental lighting on the gonads. [16] Accordingly information about lighting is perceived by the retina and nervous impulses are conveyed to the pineal gland by way of the sympathetic nerve. The pineal responds by altering its production of methoxyindoles, these enter the bloodstream and influence endocrine economy of the body. The methoxyindoles are synthesized by the pineal in the absence of light and presumably exert inhibitory effects on the gonads. [17]

Another curious feature of the pineal organ is the production of melatonin and serotonin. Serotonin is produced in the gut of the intestinal tract as well as the Pineal organ. Serotonin is another transmitter. It is one of the major four, this is, one of the commonest neurohumors.

The interesting thing about serotonin is its change over to melatonin which occurs chemically in the pineal gland. The pineal gland is the only area where this is done. This has direct significance to what happens to the larval stages of most amphibians. It is known as blanching. Larval forms of amphibians undergo a marked blanching when maintained for a time in darkness. A similar response is displayed by many fishes. [18] It is likely that blanching is due, in some measure, to a degree of decrease in MHS (a hormone) release in darkness, but for the most

part it is believed that the principle effect results from the release of melatonin (N-acetyl-5-methoxytryptamine) from the pineal. [19]

This hypothetic scheme, advanced by Bagnara and supported by others [20] suggests that under conditions of darkness, the pineal is stimulated to release melatonin, presumably a pineal hormone, in the general circulation. [21] Melatonin exerts a profound contracting effect on dermal melanophores (pigment pores) leading to rapid blanching. [21] The involvement of the pineal in this response relates to two aspects of its physiology, light reception and endocrine function. [22] Morphologic and electrophysiologic studies have clearly established that the pineal can function as a photoreceptor, but its role as an endocrine organ is more obscure, despite the fact that circumstantial evidence strongly indicates that this is the case. [23]

The first evidence indicating that the pineal organ contains humoral agents comes from the experiments of McCord and Allen, who made the important discovery that tadpoles underwent profound blanching when they were fed mammalian pineals. [24] But they discarded this as an unusual pharmacological phenomena. Later Lerner and his colleagues isolated a potent "melaosome-aggregating agent" (hormone) from beef pineal glands, which they identified as melatonin. Since then this indole has been found in the pineal of other animals (e.g. monkeys, cows, rats, birds, and amphibians). Of great interest is the remarkable fact that relatively large amounts are found in the lateral eyes. [25] The lateral eyes as well as the pineals contain all the substrates and enzymes essential for the synthesis of melatonin. [26]

Melatonin is synthesized from serotonin (5-hydroxytryptamine) in the following manner: (1) An N-acetylating enzyme converts serotonin to N-acetylserotonin; (2) the latter compound is O-methylated through the action of hydroxyindole-O-methyltransferase (HIOMT). Serotonin is metabolized to 5-hydroxyindole acetaldehyde by the enzyme monoamine oxidase (MAO). The activity of this enzyme in the destruction of serotonin and that of HIOMT in the O-methylation of N-acetylserotonin provide convenient vehicles for controlling the amount of melatonin present in an organism at any one time. [27]

In view of all available data, the hypothesis that the body-blanching reaction of amphibian larvae is mediated by the pineal seems rather convincing. However, it must be mentioned that this mechanism is restricted to the larval form. The adults do not have such a function. The melanophores of adult fishes and amphibians are generally unresponsive to melatonin. The body-blanching aspect of the pineal is the most convincing and clear cut evidence for endocrinial activity. So far this can not be said of any of the other implication, aroused in this exploration, or pineal function. [28]



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Serotonin, LSD, and the Epiphysis (Third Eye)

In the last section we described some of the physiology of serotonin, the pineal gland and its synthesis of the hormones serotonin and melatonin. Serotonin is a normal, necessary chemical transmitter of electrical impulses across the synapses (the gaps between nerve cell bodies). It is intriguing to find that certain hallucinogens have the same chemical skeletons as serotonin. [29] This really doesn't surprise neurologicians, for the fact of psychedelically induced psychosis has been known.

As mentioned, serotonin is one of the four main neurohumors or neurotransmitters in higher vertebrate nervous systems. I have mentioned the location of serotonin production and note here that the serotonin is transported via the bloodstream to the nerve cells throughout the body, but most especially in the neurons of the brain. Here they accumulate in their minutest molecular form. The molecule serotonin is utilized by the nerve cells for the complete execution of electrical impulses across the synaptic gap (which is the micro-gap between every connection of every nerve cell in the entire nervous system). The impulses come along the nerve cell going through the electro-chemical processes with the ionic

forms of calcium and potassium (the two vitals of the nervous system) until they reach the terminal end of the cell's dendrites. Upon reaching the end of the electrical impulse is translated into the neurochemical serotonin. This is then "squeezed" out into intercellular space only to connect and meet the other side which is the beginning of the next nerve soma (lining of the nerve cell). [30]

Few molecules can penetrate what is known in biology as the "blood brain barrier". Those that do go directly to the neuron. After that it becomes a matter of their ability to imitate one of the neurotransmitters. Our neurons have a safety device for this type of situation. The neurotransmitters have a unique molecular shape and can only fit in a specific slot on the synaptic surface. Mind-altering drugs all operate on mimicking one of the neurotransmitters. (Most all drugs work internally, one exception is alcohol. Alcohol's effect is caused by altering the sensitivity of the some or cell wall.)

LSD happens to be one of the more famous antagonists. It not only penetrates the blood brain barrier but slips slyly into the transmission site inside the nerve cells themselves. It can mimic serotonin to the point where the body thinks its serotonin and consequently shoots it across the synaptic gap. When LSD reaches the other side it is accepted but the LSD doesn't carry the message any further. The impulse of electricity is redirected down less familiar pathways, pathways which have not been highly conditioned. Specifically LSD affects the oldest parts of the brain first (e.g. upper end of the spinal cord, medulla oblongata, cerebrum, pineal gland and hypothalamus region) then the bloodstream takes it forward into the immediate back brain (location of sight interpretation) up through the area of hearing, the cerebellum, other sense interpretive centers, and the motor areas.

Using radioactive molecules traced with LSD, science has been able to follow the course of LSD through the various channels and avenues of the body. It has been found found that after selecting certain areas of the various parts of the brain it then migrates to sections with fewer imprints, for instance the right of the hemisphere, the so-called creative center. By redirecting consciousness, as it were, into the unimprinted areas of the cortex, one hypothetically experiences the world anew, hence the variety of interpretations which arise upon questioning psychedelic voyagers about their "trip". Because of LSD's antagonistic effect on serotonin and the pineal gland itself, it would seem quite likely there is a chemical relationship between mental illness and deficiencies of serotonin. [31] But intravenous doses have been administered to humans with no psychedelic effects noted. [32] Melatonin itself has the same indole structure as LSD. Interesting indeed!



Speculations

I have a few speculative concepts on meditation's effectiveness on the practitioner. I hypothesize that performing various breathing techniques, while concentrating on the third eye (pineal pseudo-location), will inevitably and imperceptibly stimulate the pineal to produce less melatonin and serotonin which in turn brings about a change in consciousness, creating naturally the dynamic somatics of a truly religio-spiritual experience. Indeed we know now how light plays an important role in the pineal's production of various hormones and neurotransmitter-related molecules and we can rather loosely associate this with the "Light" that often accompanies one during solitudinous "third eye" meditations". Many have witnesses the light in the past and many more will witness. [33]

The following is a question and answer dialogue between Lu K'uan Yu (student) and Liao Jan (teacher) concerning taoist meditation techniques:

Question: I have read Taoist books which all urge the development of the light in the original cavity or center of spirit (tsu ch'iao, in the center of the brain between the eyes) at the start of practice but I do not see why. All Taoist schools regard this as the aim of the cultivation of (essential) nature without giving details. Will you please tell me where true nature actually

manifests?

Answer: (The tsu ch'iao cavity in) the center of the brain branches out into two minor channels on its left and right; the left one stands for t'ai chi (supreme ultimate) and the right one for ch'ung ling (immaterial spirit); they are linked with the t'ien (heavenly valley) center above them and yung chuan (bubbling spring) centers in the soles of the feet after running through the heart in the chest.

The Tao Ching says: "Nature is (in) the heart and manifests through the eyes; life is (in) the lower abdomen and manifests through the genital organ."

(Essential) nature is spiritual vitality in the heart that manifests through two channels from the center of the brain. So when seeing is concentrated on the spot between the eyes, the light of (essential) nature manifests and will, after long training, unite with (eternal) life to become one whole. This union is called seeing the void that is not empty and he who is not awakened to this union will achieve nothing in practice.

Question: When I was taught meditation I was urged to empty my heart (house of fire) of all thoughts, set my mind on cultivating (essential) nature and open my eyes to contemplate the void to accord with the correct Way; will you please explain all this to me?

Answer: Seeing the void as not empty is right and seeing the void as empty is wrong, for failure to return to the (tsu ch'iao) center (which is not empty) prevents the light of vitality from manifesting. Under the heart and above the genital organ is an empty space where spiritual vitality manifests to form a cavity. When spirit and vitality return to this cavity, spiritual vitality will soar up to form a circle (of light) which is not void. Voidness which does not radiate is relative but voidness which radiates is absolute. Absolute voidness is not empty like relative voidness. Voidness that is not empty is spiritual light which is spirit-vitality that springs from the yellow hall center (huang ting or middle tan t'ien, in the solar plexus).

My master Liao K'ung said: "When the golden mechanism (of alchemy) begins to move and gives out flashes of light, that hall of voidness (hsu shih, i.e. the heart devoid of feelings and passions) will be illuminated by a white light which reveals the mysterious gate (hsuan kuan), the presence of which does not mean emptiness."

Man lives and dies because of this immaterial spirit-vitality; he lives when it is present and dies when it scatters. Hence it is said: 'Spirit without vitality; does not make a man live; and vitality without spirit does not cause him to die.' Prenatal spirit in the heart is nature and prenatal vitality in the lower abdomen is life; only when spirit and vitality unite can real achievement be made.

Question: Will you please explain the saying: 'If one reaches the original cavity of spirit (tsu ch'iao, in the center of the brain between the eyes) one will find the source of immortal breath.'?

Answer: Worldly men who discover the original cavity of spirit are very rare indeed. It is under heaven (the top of the head), above the earth (the lower abdomen), west of the sun (the left eye) and east of the moon (the right eye). Behind the mysterious gate (hsuan kuan) and before the spirit of the valley (ku shen) is true nature (chen hsin) which is the source of true breath (chen hsi). Although this true breath is linked with postnatal (ordinary) breathing--the latter coming in-an-out through the mouth and nostrils, cannot reach the original cavity of spirit to return to the source. The immortal breath that comes from inner (vital) fourfold breathing (a four-fold breath consists of in-and-out breaths with corresponding ascent and descent of vitality in the microcosmic orbit) and not through the nose and mouth, can then return to the source.

In your quest for immortal breath, you should regulate post-natal (ordinary) breathing in order to find its source. This immortal breath is hidden in the original cavity of spirit and is genial and will not scatter away when post-natal (ordinary) breathing is well regulated. Hence my master Liao Jen said: "When vitality returns to the original ocean (its source) life becomes boundless."

(Note: the part that follows is very important.)

Question: Will you please give me the exact position of the original cavity of the spirit?

Answer: It is (in the center of the brain behind) the spot between the eyes. Lao Tzu called it 'the gateway to heaven and earth'; hence he urged people to concentrate on the center in order to realize the oneness (of all things). In this center is a pearl of the size of a grain of rice, which is the center between heaven and earth in the human body (i.e., the microcosm); it is the cavity of prenatal vitality. To know where it lies is not enough, for it does not include the wondrous light of (essential) nature which is symbolized by a circle which fatherly Confucius called virtuous perfection (jen); the Book of Change (I Ching) calls it the ultimateless (wu chi), the Buddha perfect knowledge (yuan ming) and the Taoists, the elixir of immortality or spiritual light; which all point to the prenatal One True Vitality. He who knows this cavity can prepare the elixir of immortality. Hence it is said: 'When the One is attained, all problems are solved.'

Therefore, during the training both eyes should turn inward to the center (between and behind them) in order to hold on to this One which be held in the original cavity of spirit (tsu ch'iao) with neither strain nor relaxation; this is called fixing spirit in the original cavity which should be where (essential) nature is cultivated and the root from which (eternal) life emerges. [34]

The above is a translation from a very ancient Chinese dialog between master and student, a conversation which illustrates there were and are some who have put the knowledge of the pineal gland to beneficial use by concentrating upon its general location which we have described in quite some detail. Those who also use this information will be directly altering their biochemical balance for the better.

I will go one further step in speculative ideology. It is my assumption there is a LIGHT which penetrates even the deepest of neural tissue. I believe this has a direct effect on the physiology of the pineal gland which in turn affects the organism as a whole.

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Research Presently Needed For Further Understanding

At present we need further research in specific fields. First there should be extensive research done on the effects of light on the ultrastructure of the epiphysis. These experiments should not be limited to selected species but carried out in relation to all species which have a pineal organ. Along with this should be the research on the whys and wherefores of Lysergic Acid Diethylamide. Serotonin/LSD antagonism and neurological disease and health should be openly researched. Evidence found along the way should be related to the findings of pineal studies. There should be further endeavors regarding melatonin and its relationship to neurological functioning; further exploration on meditation's effect on the chemical balance of the body and effect of meditation the production and synthesis of serotonin and melatonin.

All in All there is Much to be Done!

This information can be useful to your life now. To know that there are physical effects of "mind-drugs" that mimic natural body effects and that physical phenomena is altered through external methods (drugless), is to bring more light to all these new and dynamic ways to truly "change" one's "consciousness".



**Om Hail! the Light of the Ages!
Shining within your own mind!
Coming in from above
like the Righteous Thunderbolt of the Source!!!
O Holy, yet Mysterious Pineal!**

**Your secrets are Unfolding
like the Thousand Petaled Lotus
that you are!!!**

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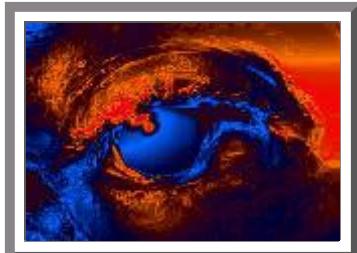
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