Changes in Cortical Hemishperic Dominance with Kundalini Yogic Breathing Techniques

Manjit Kaur Khalsa
(Marcia E. Buebel)

Catholic University
Washington, D.C.

Kundalini Research
Institute
Boston, Mass

March 23,1977

Evidence from neurological and psychological studies indicates that the two cerebral hemispheres of the human brain serve two different and asymmetric functions (Sperry, 1964; Ornstein, 1972). The left cerebral hemisphere appears to be linked to the verbal, analytical modes of operation (Filbey and Gazzaniga,19). The right cortical hemisphere appears to be connected with spatial co-ordinations (Bogen, 1969) and with musical abilities (Bever and Chiarello, 1974).

It is claimed in Kundalini Yogic Theory that breathing through different nostrils activates different parts of the brain and therefore stimulates different subjective experiences (The Siri Singh Sahib,1976b). The left nostril, as it is located on the left side of the body, would be linked with the right side of the brain, and would therefore be associated with the receptive intuitive and spatial realms. The right nostril, on the other hand, would be linked with the left hemisphere, and would therefore be associated with the projective, analytical and verbal cognitive modes (Khalsa and Khalsa, 1976).

Experimental work utilizing such techniques as eye lateralization (Gur, 1975; Day, 1964) indicate support for a general asymmetric, contralateral body/brain co-ordination. The direction of looking is associated with innervation of the contralateral hemisphere (Bakan,1969). Investigations of ear lateralization have also been supportive of an asymmetric and contralateral relationship between the brain and parts of the body (Corso, 1964). Similarly Sperry (1964) has demonstrated this relationship to hold true for the arms and legs as well.

The review of the literature which follows will cover these and other areas in detail.

As this type of co-ordination has been demonstrated for several parts of the body, it is possible that it will also hold true for the nostrils: breathing through one nostril or the other should be related to the contralateral cortical hemisphere and should therefore elicit orientations associated with that specific side of the brain. A few pilot studies support this hypothesis (Khalsa and Khalsa, 1976). For example, Khalsa and Raymore (1975) had 6 subjects breathe through one nostril or the other for specified periods of time. An analysis of variance performed on a spatial vs verbal preference test, yielded a probability of .10 in the hypothesized direction. It is possible that a larger sample would have yielded significant data. The graphs of the EEG scores also suggested a relationship between the nostrils and the hemispheres.

In the paper which follows, Section I will discuss the contralateral and asymmetric functioning of the cortical hemispheres. A short history will be presented and a review of the major and salient literature will attempt to verify these concepts over a range of psychological and physiological investigative techniques and variables. In section II, the concept of Kundalini Yogic Theory as related to the breath will be explored. A review of the scientific literature available in this area will also be presented. Section III will combine the cortical hemispheric functioning theories with the yogic postulates on breathing and several testable hypotheses will be given. In section IV an experiment performed to test these hypotheses is presented and the results discussed.

Section I: The Cerebral Hemispheres

A. Historical Background

Several centuries before Christ, the Hippocratic School reported correlates between unilateral head wounds and contralateral convulsions... "if the head be primarily effected on the right side, the left side of the body will be paralysed. If on the left side, the right..." (Giannitrapani,1967). In the fifth century the Greek, Cassius, postulated that something like nerves crossed each other at the base of the brain. From about the 10th century up until about the 13th century (when physicians were ordered by the court to perform autopsies) religious laws forbade the touching of human cadavers, and experimental brain research came to a standstill.

Throughout the following centuries, various explanations developed; for example, in the 1500s DuLaurens explained contralateralization as follows: since the patient lay on his healthy side, the diseased fluids would seep into that side from the unhealthy side. In the 1700s Wafner concluded that brain injury interfered "with the internal flow of animal spirits." But by the end of that century,actual experiments were performed and accurate descriptions of the cortex became available. As early as 1704, Valsalva described language difficulties in relation to left hemiphlegia (a condition of paralysis of one side of the body Stedman,1976). This in turn was related to the left side of the brain.

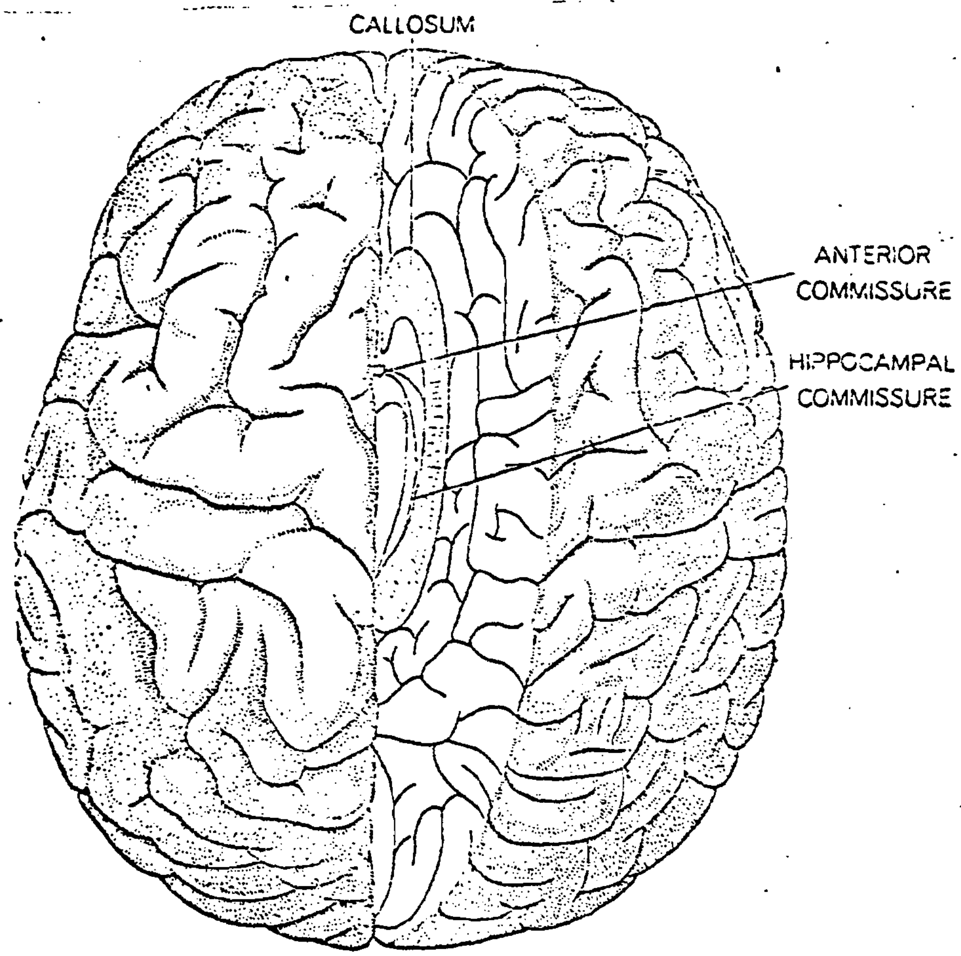
The corpus callosum is a network, or bundle of nerves which cross and connect the hemispheres (Ornstein 1979). Santori was the first to gently pull apart the coverings and show the crossing nerves (See Figure 1).

A big breakthrough came when Broca, in the 1800s, discovered a section in the left hemisphere, now known as Broca's Area, which appeared to govern speech (Jasper and Ramy, 1937). Prior to that time, researchers had found speech to be related to the frontal lobes, but had not differentiated between hemispheres (Kimura, 1973). Within about 10 years from Broca's discovery, the left hemisphere became known as the leading or dominant hemisphere. Two very influential reviews were published in 1926, one claiming that the right hemisphere was inferior to the left, perhaps playing an automatic role only (Head, 1926), while the other concluded that perhaps the right hemisphere was a "reserve organ" (Henschen, 1926).

Even into the 1950s and 1960s this was the promimant view. In the 1950s, Sperry (1964) received a personal communication from the famous experimentalist, Karl Lashley, who indicated that the corpus callosum seemed to have no function, except perhaps a mechanical one, "to keep the hemispheres from sagging".

However, as early as 1745, Dalin reported a case which directly contradicted this hypothesis. A man whose severe illness resulted in the paralysis of his entire right side, lost all

Figure I: The Corpus Callosum In Relation to the Two Hemispheres



TWO HEMISPHERES of the human brain are divided by neurosurgeons to control epileptic seizures. In this top view of the brain the right hemisphere is retracted and the corpus callosum and other commissures, or connectors, that are generally cut are shown in color.

speech, with the exception that he could still say the word "yes", sing songs clearly and recite certain prayers which he had learned as a child. Wigan (1844) stated: " a separate and distinct process of thinking....may be carried on in each cerebrum simultaneously." Wigan derived this hypothesis based upon his observations of individuals who had been completely coherent until their deaths, and yet, upon autopsy, it was discovered that one cerebrum was reduced to a "yawning chasm--an empty membrane." In 1888, Goltz performed the first hemispherectomy. He removed the left hemisphere of a dog and found that the dog could move, voluntarily, all parts of his body and his actions indicated his consciousness of sensations over all body parts. Dandy, in 1928, carried out the same operation on a human being. In Basser's 1961 review of 135 cases of left and right hemispherectomies, he concluded that "some person" remained, no matter which hemisphere was removed. It is likely that different parts of a person remained, depending upon which hemisphere was operative after hemispherectomy.

It has been difficult to determine the functions of the hemispheres for several reasons: (1) there is an overlap between the two hemispheres; e.g.deprived of a left hemisphere, a person can still sing.(2) a person with a certain deficiency can usually compensate through the use of a different organ or cognitive mode (e.g. logic can substitute for spatial organization) (3) The definition of a function has led to difficulties; e.g. is "Love" a left or right hemisphere affair? and (4) research available in the area was for the most part clinical observation of patients who had some form of brain damage. As will be seen in the review of the literature which follows, this method had several drawbacks.

By the late 1950s, the now famous split-brain studies (Sperry, Stamm, and Miner, 1956; Sperry 1964; Gazzaniga, 1967) helped to resolve these issues and to establish the hemispheres in their proper perspective: as two "brains", contralateral and asymmetric in function, each dominant for particular cognitive modes, each capable of independent action (Ornstein, 1972; Shaffer, 1974).

B. Review of the Literature

Several techniques have been developed to study the cogntive functioning of the cerebral hemispheres (Kimura, 1973). These include: post-hoc study of brain-damaged patients (Schuloff and Goodglass, 1969), the split-brain studies (Sperry et al, 1956), ear and eye lateralization investigations (Bakan, 1969; Kimura, 1961a), and EEG recordings have all provided useful data in this area (Dumas, et al 1974). Spatial and verbal tests have also served as both a technique for study and as variables in their own right (Galin and Ornstein, 1972).

The post-hoc study of brain-damaged patients was at first critical in nature (Gianotti, 1967); over the last 20 years, however, it has become more experimentally oriented (Parsons, Vega, and Burn, 1969).

Patients with left hemispheroctomies display great difficulty with language (Ornstein, 1973). It was therefore hypothesized that other analytical, verbal functions which are located on the same side of the brain would also be adversely affected (Kimura, 1961b). As the ears should bear a contralateral connection with the brain, Kimura postulated that damage to the left cerebral hemisphere would impair the hearing of digits given in dichotomous (simultaneous) timing to both ears. Although normal language appears not to show any differences (Palmer, 1964)when distorted sound is presented dictomously, significant impairment was reported from the ear contralateral to the damaged hemisphere (Kimura,1961b). Kimura cites Sinha (1959) who distorted sound with white light and obtained similar results.

In Kimura's experiments (1961a; 1961b; 1964) she employed various systems of dichtomous presentation. One example is as follows: first one ear recieves a digit through matched head phones, then both ears recieve a second digit, and then the other ear recieves a third digit. As expected, a significant superior recognition effect was demonstrated through the right ear. Using Wada and Rasmussen's (1960) intra-carotid injection of sodium amytal, the hemisphere dominant for language was determined. Contrary to expectations, the ear opposite the dominant hemisphere had the advantage, whether or not it had been damaged or not. In another experiment, Sparks and Schulhoff (as cited in Schulhoff and Goodglass,1969) tested recently injured aphasics (patients with a loss of ability to speak associated with left hemisphere damage). They found the right ear superior for retention of digits.

Perhaps the resons for the discrepancy lies in the subject pools or methodologies, or perhaps the answer lies in the materials tests. Digits have both a spatial and verbal quality. It is possible that scores obtained for a strictly verbal task, as compared with scores obtained for a strictly spatial task, would yield less equivocal results.

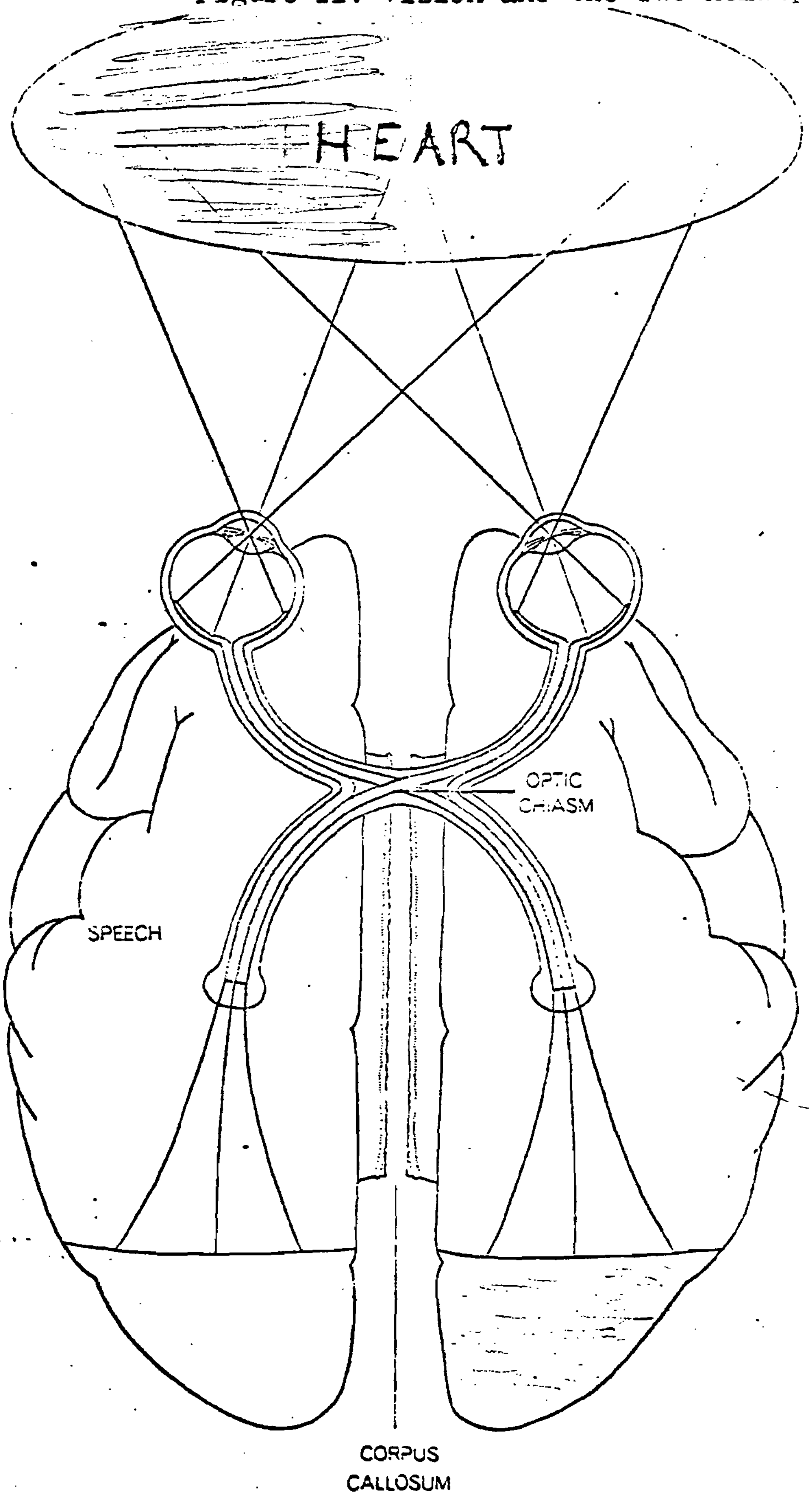
Milner (1965) noticed that left lobotomies did not depress the scores on the Timbre and Tonal memory subsets of the Seashore Music Test, while right lobotomies did depress these scores. Schullhoff and Goodglass (1969) and Shankweiler (1966) corrobate these findings. Similarly, when the dimension of spatial orientation is taken into account, Parsons, Vega, and Burns (1969) using Block Designs, DeRenzi et al (1969) using tactual shape recognition, and Milner (1965) using Maze Tracings, all report right hemisphere damage to significantly impair spatial performance, and left hemisphere damage to significantly impair verbal abilities.

Attempts to associate personality traits with hemispheric damage have not been successful. Patients all seem to be neurotic to some extent (Dikman, Surreya, and Reitan, 1974). MMPI scores and subtests do not seem to correlate with location of damage (Dikman et al, 1974). These authors review the literature and conclude that the available data are "incomplete (and) contradictory."

Much of the research from brain-damaged persons may be equivocal: the type, severity and duration of injury are difficult variables to assess and take into account; the role of compensation may interfere with otherwise observable data. Futhermore, as most of these studies are of a post-hoc nature, causation is difficult to determine and the trauma of the experience for these people may mask the effects of other variables.

Another type of physiological investigation, the split-brain experiments (Sperry et al, 1960) have substantiated and scientifically validated the concepts of (1) contralateral body/brain co-ordination and (2) asymmetric functioning of the two hemispheres. In the initial experiment, Myers (1951) cut through both the corpus callosum and the optic chiasma (see figure 2) in several animals. These are the connecting tissues between the two hemispheres and the eyes. One eye was covered and the animal was taught to perform simple learning tasks, such as discriminating between a square and a cirlce. Once learned, the problem was presented to the opposite eye. The second eye acted as though it had never seen the problem, and it took as many trials as the first to learn the solution. Sperry, Stamm and Miner (156) trained six kittens using this same proceedure. There were five daily sessions--generally 50-60 trials each.

Figure II: Vision and the Two Hemispheres



VISUAL INPUT to bisected brain was limited to one hemisphere by presenting information only in one visual field. The right and left fields of view are projected, via the optic chiasm, to the left and right hemispheres of the brain respectively. If a person fixes his gaze on a point, therefore, information to the left of the point goes only to the right hemisphere and information to the right of the point goes to the left hemisphere. Stimuli in the left visual field cannot be described by a split-brain patient because of the disconnection between the right hemisphere and the speech center, which is in the [illegible]

They concluded that each eye learned the problem as though there were two separate animals involved. There was no transfer of learning.

In 1961, Vogel and Bogen (Ornstein, 1973) found an epileptic of 10 years standing whose seizures were worsening. They surgically separated the hemispheres to control the epilepsy. The operation was remarkably successful in ending the attacks-- the patient appeared normal and said that he felt better than he had in years. But when Gazzaniga (1967) applied the same sort of tests to this man, as he had to the animals, differences in performance became quite clear. The patient could easily read, write, perform mechanical tasks with the right side of his body; however, "he cannot carry out verbal commands with his left hand or leg..." On the other hand, when non-verbal tasks were presented solely to the right side, they could not be remembered and went largely unnoticed.

As of 1967, there have been 10 such operations, and four people have been extensively studied (Gazzaniga,1967). The results are clear: the left cerebral cortex is responsible for storage and sorting of verbal, propositional material, and in the case of a severed corpus callosum, only the contralateral side of the body has access to this information. The same holds true for the right cerebral cortex (responsible for spatial, musical and other appropositional processing). In the case of a severed corpus callosum, only the parts of the body on the left side (contralateral to the right hemisphere) have access to this type of information.

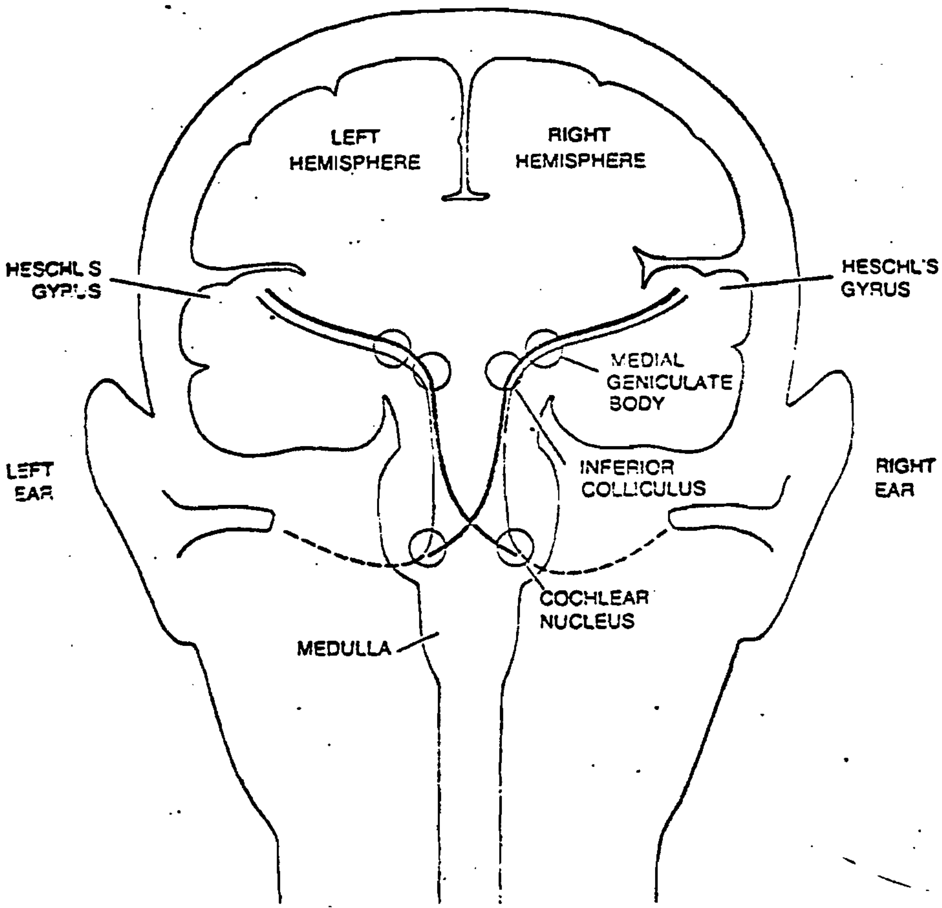
In one outstanding experiment (Gazzaniga,1967) the subject looked at center field at the word"HEART"(see Figure II). In the normal case, the person would see the word"HEART", no matter which cognitive mode he was using to respond with. But in the case of the severed corpus callosum, if a subject is responding verbally(through his left hemisphere), then it is only the right visual field which is available to him, despite the fact that both of his eyes are open. The subject doesnot respond with the word"HEART" but rather with the word"HE" The same holds true for the subject who is pointing--he has access only to the right hemisphere, and therefore only processes the information available in the left visual field. He points and responds with the word "ART". In some cases incorrect responses by the left hand may "so exasperate the more sophisticated dominant hemisphere that it reaches across with the right hand" to correct it. (Sperry, 1964). Similarly when the right hand fails in a block design problem, "impatient twitches and starts occur on the left arm" and sometimes has to be "restrained in order to keep it from intercepting the right." (Sperry, 1964). The right hemisphere may give an emotional response to a situation (e.g. a laugh), but if the right side of the body is not involved, the person may be unable to say why he is laughing.(Ornstein, 1972).

From these experiments, it can be seen that the hemisphere's main connection to the body is contralateral and asymmetric in functioning: in a patient with a severed corpus callosum, it is the left side of the body which has access to the spatially oriented knowledge stored in the right hemisphere, and it is the right side of the body which has access to the verbal information stored in the left hemisphere.

The split-brain experiments demonstrate this phenomenon in the extreme, abnormal condition. Many investigators have sought to discover the workings of the brain under normal conditions. If the contralateral side of the body to a specific hemisphere is better adapted to certain cognitive modes than is the ipsilateral (or same) side, then the organs on the contralateral side should manifest an asymmetric task superiority. Several hundred studies have been performed to test ear and eye lateralization of task functioning (Carr, 1969; Sherrod, 1972; Ellis and Shepard, 1974).

As previously stated, normal speech does not differentiate one ear from the other (Kimura, 1961a). For example, Palmer (1964) administered a list of words spoken in order of decreasing loudness. The subject was encouraged to guess if he could not clearly hear the word. He found only a slightly significant right ear superiority. Brunt and Goetzinger (1968) administered three tests of verbal aptitude and suggest that their results indicate the right ear effect is test dependent. Both hemispheres have a capacity for language (e.g. the right hemisphere is useful for musical wordage), and so in everyday speech, a superiority effect might be masked. However, under unclear or competitive conditions, the ear with the natural dominance should take over to most competantly handle the task (Kimura, 1973). (See figure IV)

Figure III: The Ear



AUDITORY PATHWAYS from the ears to the cerebral auditory receiving areas in the right and left hemispheres are partially crossed. Although each hemisphere can receive input from both ears, the neural connections from one ear to the hemisphere on the opposite side are stronger than the connections to the hemisphere on the same side. When ipsilateral (same side) and contralateral (opposite side) inputs compete in the auditory neural system, it is thought that the stronger contralateral input inhibits or occludes the ipsilateral signals.

Kimura (1961a) using Broadbent's dictomous presentation technique (1954), clearly demonstrated a right ear superiority effect. Subjects were more efficient at recalling earlier digits presented to the right ear than they were at recalling those presented to the left ear.(Carr,1969). Shankwieler and Studdert-Kennedy reported the right ear displaying significant advantage for certain syllables (1967).

The left ear has shown a superiority effect for non-verbal sounds such as crying and laughing (Kimura, 1973); it has a significant advantage over the right ear in competing dichotic musical identification tasks (Kimura,1964). Broadbent and Gregory (1964) also support this hypothesis using a different identification technique.

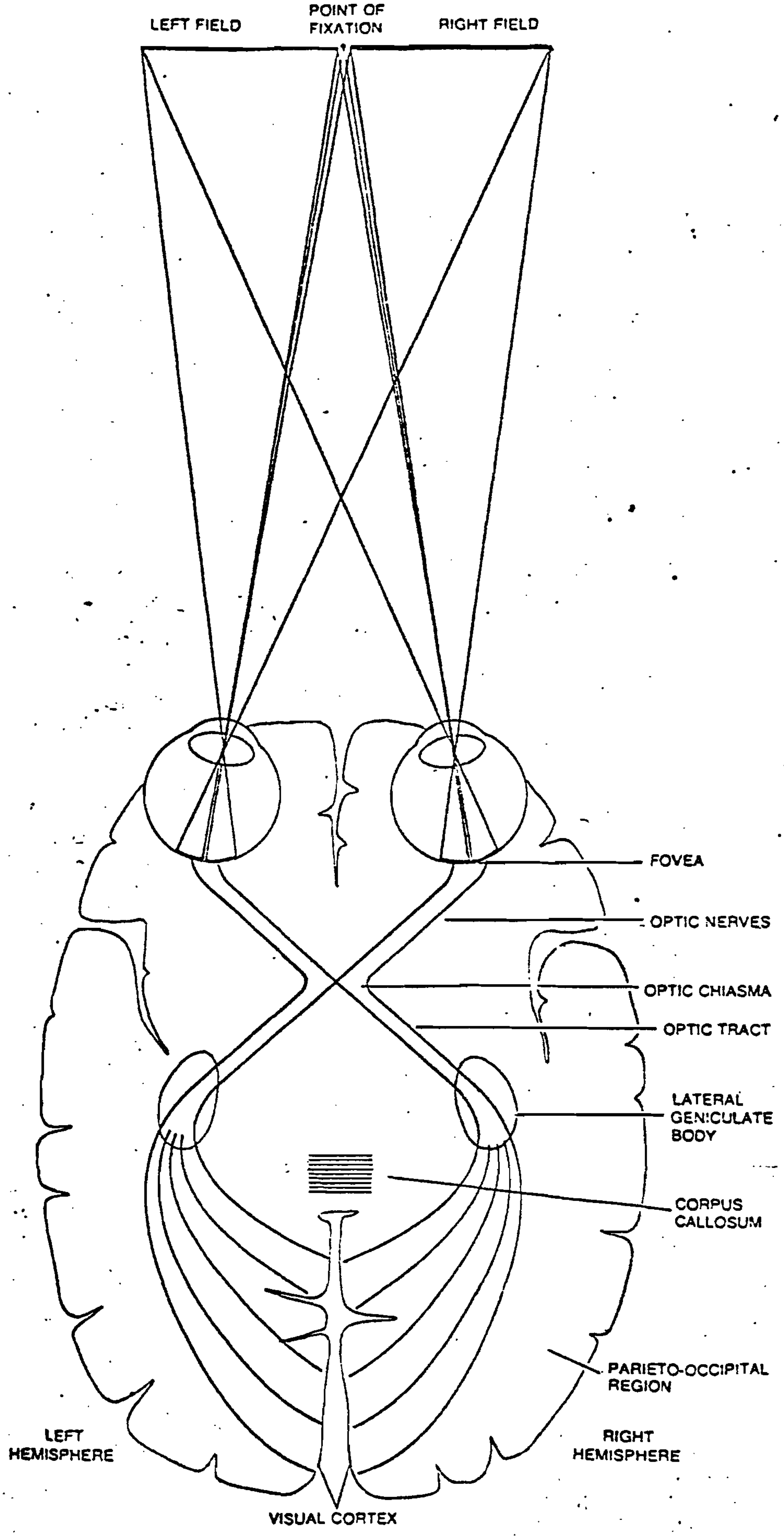
When disruptive auditory feedback was played into the left ear during the playing of the piano, there was a significant increase in length of time required to complete a piece (Bradshaw, Nettleton, and Geffen, 1971). The same holds true for a reading passage when disruptive auditory feedback was given to the right ear. In an attemt to ascertain the types of strategies employed by the two hemispheres in the area of music, Bever and Chiarello (1974) separated musically experienced subjects from naive ones. They found that experienced subjects were able to analyze the piece internally, and therefore used their right ear more effectively while the naive subjects experience a left ear superiority as they are examining the music as a whole, which is a right hemisphere affair.

In studying eye lateralization several techniques have been developed. Two of the most widely used methods include: (1) tachistoscopic presentation (while the subject fixates on a point in front of him, an image or word is flashed to the left and/or right visual field (Rosen, Curio, Mac Kavey and Herbert, 1975) and (2) studies of "direction of looking" (Bakan and Shortland, 1971).

The tachistoscopic method has shown its applicability to hemispheric issues in the split-brain experiments (Sperry et al, 1960), and it has also been quite successful with normal individuals (Ellis and Shepard,1974). Ellis and Shepard presented 12 right handed men one concrete and one abstract word equidistant from the ends of a red fixation point (the words were matched for length and difficulty). They conclude that abstract and concrete words are both more easily recognized in the right visual field. Concrete words are better recognized in the right visual field than are abstract words. The right visual field shows a superiority effect for letter recogntion (Rosen et al,1975) while the left visual field is superior for recognition of non-verbal materials (such as facial recognition (Geffen, Bradshaw and Wallace, 1971). Thus the data from eye lateralization also supports the asymmetric functioning hypotheses.(See figure IV)

In 1964, Day published a short note on his clinical observations of the shift in direction of looking among his patients as they talked. He observed that those individuals who looked left appeared to be more anxious with an internal focus, while right lookers manifested anxiety related to an external source (1964;1967).

-- Figure 4 The Eye



VISUAL PATHWAYS are completely crossed, so that when the eyes are fixated on a point, all of the field to the left of the fixation point excites the visual cortex in the right hemisphere and stimuli from the right visual field excite the left visual cortex. The visual cortexes can communicate via the corpus callosum, which connects the two hemispheres.

"The movement is characteristic in direction, for an individual, on repeated observations" (Day, 1964). Bakan (1969) explains this phenomenon in terms of an "ease of triggering of activities in the hemisphere contralateral to the direction of eye movement." The differences in ease of triggering may be due to any number of physiological and psychological variables.

Much research has been inspired by Day's original observations: Duke (1968) compared 31 females with 22 males and found that reflective questions generated more eye movement than factual questions and that 86% of all eye movements were in the same direction. Hines (1974) reported direction of gaze as correlated with heigthened awareness of that same side of the body (Fischer body awareness test). Left lookers have been found to be more extreme in their reaction to persuasive messages (Sherrod,1972); they favor defense mechanisms of an internal nature--depression, and psychosomatic illnesses (Gur and Gur, 1975). Left lookers show greater alpha production and more control over their alpha production than do right movers (Bakan, 1971). They are also more easily hypotized (Bakan, 1969), more likely to chose soft college majors (such as Art) as opposed to hard colloege majors (such as science) (Gur, 1975). Left movers are more spontaneous, emotional, and localize anxiety internally. Right movers, on the other hand, are more intellectual and see the causes of their anxiety as external to themselves (Gur, 1975; Bakan and Shortland, 196 they favor projective defenses (Gur and Gur, 1975), are less musically inclined and have fewer visual images than do left lookers (Bakan, 1969).

Etaugh (1972) administered the Catell and Eber 16 factor personality test to 45 right movers, 15 non-movers and 29 left movers. The left lookers saw themselves as more assertive, shrewd and suspicious than did right lookers. This is in direct contradiction to Day's observation (1964). The most likely reason for this discrepancy is perhaps that subjects do not report themselves to be as their lateral eye movements reveal them to be. Day himself also failed to obtain any significant correlations using another self-report questionnaire, the MMPI (Etaugh, 1972).

Ehrlichman, Weiner and Bakan,(1974) tested subjects or eye movement by having them fixate on a camera which was placed directly in front of them. They answered the questions into a microphone which was hung around their necks. The authors reported no significant differences in eye movements.

The resolution of this discrepancy may lie in another independent line of research. Kinsbourne (1972) proposed that the type of question asked (propositional or appropositional) would be likely to trigger one hemisphere or the other, correlated with a contralateral orientation response of the head and eyes. This orientation is an involuntary accompaniment of the cognitive process: activation of one hemisphere will "overflow to the orientation center of that hemisphere and cause contralateral movement."

Gur (1975) points out that in Kinsbourne's data, the subject could not see the experimenter. In Ehlrichman et al, the subject sat facing the camera and was asked to fixate upon it. The microphone was hung around his neck and this may have led to many reported downward responses, substantially weakening the data. Gur (1975) manipulated the experimenter-faces-the-subject-variable, within one sample. She hypothesized that the situation in which the subject faces the experimenter is more anxiety proking than is the situation in which the subject does not see the experimenter. The more anxious the subject is, the more likely he is to fall back on his characteristic modes of response, his eye movements therefore indicating one hemisphere or the other. When the experimenter is seated behind the subject, out of view, the appropriate hemisphere would be triggered in response to the type of question asked. These hypotheses were confirmed and she therefore supports both Bakan and Kinsbourne's data. Gur, Gur and Harris (1975) tested 32 right handed and 17 left handed males and found the same relations holding true, especially for right handed men.

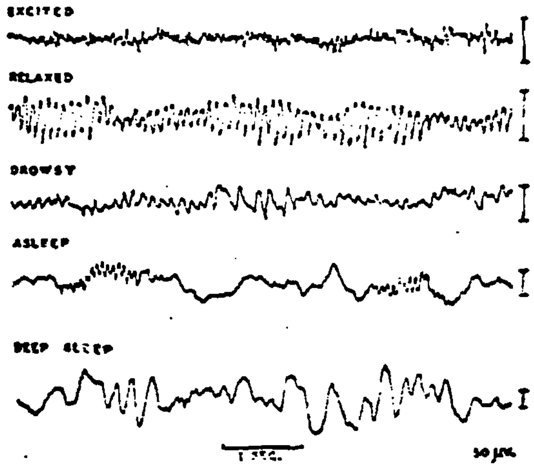
Gur and Gur (1974) and Weiten and Etaugh (1974) using spatial and verbal questions, Kocel et al (1972) and Galin and Ornstein (1974) using spatial and verbal tasks reported a relationship between spatial situations and looking left, as well as a relationship between verbal situations and looking right. Schwartz et al (1975) found a left shift tendency in response to emotional questions. In all of these cases, the experimenter sat behind the subject, out of view.

When the subject sits facing the experimenter, the results obtained follow along the lines of Day's original predictions. The direction of looking in response to reflective questions appears to indicate a characteristic mode of operation within an individual (Bakan, 1971).Gur, Gur and Harris, 1975). When the experimenter sits behind the subject, the direction of looking can serve as an index of cerebral lateralization in response to a given type of question or situation (Kinsbourne,1972). Both types of data are highly supportive of the asymmetric and contralateral hypotheses of cortical hemispheric functioning.

A very direct test of these hemispheric functioning hypotheses is available through the use of the electroencephalograph, commonly known as the EEG machine (Dumas and Morgan, 1975; Doyle and Ornstein, 1974). This machine registers different electrical currents developed in the brain (Droland, 1965). Figure V depicts the different graphic recordings which the EEG measures. The regular waves of a relaxed state are called alpha waves. Excitement causes waves of short and rapid amphiltude. Measurements are taken by means of electrodes applied to various areas in or near the brain.

Figure V: The Electroencephalograph

electroencephalogram (e-lek″tro-en-sef′ah-lo-gram). The graphic record obtained by electroencephalography.



Electroencephalogram.

Recordings made while [illegible] subject was [illegible]ited, rela[illegible]ed, and in vari[illegible] stages of sleep. During [illegible] the brain waves are rapid and [illegible] small amplitude [illegible] in sleep they are much slower and [illegible] greater amplitude. The regular [illegible] characteristic of the [illegible] state are called alpha [illegible]. (From Jasper, in Epilepsy and Cerebral Localizat[illegible] by Penfield and Erickson.)

electroencephalograph (e-lek″tro-en-sef′[illegible]-lo-graf). An instrument for performing electroencephalography.

electroencephalography (e-lek″tro-en-sef″ah-log′rah-fe). The recording of the electric currents developed in the brain, by means of electrodes applied to the scalp, to the surface of the brain (*intracranial* [illegible]), or placed within the substance of the brain ([illegible]).

Very simply, if the theory of hemispheric functioning is correct, the hemisphere appropriate for a given function should indicate a significantly lower alpha rate, as it is no longer at rest . In spatial tasks (right hemisphere) the alpha level should be lower for the left hemisphere which is not engaged in the task at hand.(Morgan, MacDonald & Hilgard, 1974). Similiarly for the right hemisphere which would be at rest during verbal tasks-which engage the left hemisphere (Morgan, McDonald & MacDonald,1971).

The most common proce dure is to place electrodes over various regions distributed over the two hemispheres (Cohen, Noblin & Silverman, 1968) . Readings are taken while S performs verbal and spatial tasks. Galin & Ellis (1975) had remarkable confirmation of their major hypotheses using this method. They tested 6 20-40 year old right handed subjects with the Kohs Modified Block Design (Kent,1934) to assess alpha level on spatial tasks. A two dimensional geometric pattern is presented for memorization for 1 minute and then taken away. S reconstructs the pattern from memory with a set of 16 multicolored blocks. (see method section,this paper). To assess alpha levels during verbal tasks, S was given 1 minute to read a passage, which contained minimal imagery and was then asked to write from memory as many facts and concepts as he could remember(see method section,this paper).

The authors unequivically conclude:"For all leads in all subjects, the alpha power ratio Right/Left was higher in the written memory task than in the block design task". There was a stable variability in ratio values between the two tasks (about .15). Within subject reliablity was very high-- across all subjects for all leads (27 out of 28), the writing ratio was higher than the block design ratios.

Several other investigators have employed this technique and have lent further support to the theory of asymmetric hemispheric dominance (Galin & Ornstein,1972; Doyle and Ornstein,1974). Dumas & Morgan(1975) tested 18 men--9 engineers and 9 artists-- and assessed alpha levels for laterality of task (facial memory vs linquistic and math problems), difficulty of task and occupation. There was no difference in alpha production for task difficulty or occupation. The data on laterality of task function did produce a significant difference in alpha production in the expected directions. Personality correlate studie such as hypnotizablity (Bakan,1971; Morgan, McDonald & MacDonald,1971), Morgan, MacDonald & Hilgard,1974) show that more alpha was produced in the right hemisphere for highly hypnotizable Ss, but that there was still significantly less alpha from the right hemisphere when it was engaged in a task. The authors conclude that alpha level of production is a product of task aysmmetry, rather than a product of personal cognitive style. (Morgan, MacDonald & Hilgard,1974).

The data from EEG studies have been fairly consistent: alpha levels are larger for the right hemisphere during verbal tasks, and larger for the left hemisphere during spatial tasks, indicating their lack of involvement in the task at hand(Morrel & Salamy,1971). Galin & Ornstein suggest that this concept may "enable the training of ordinary individuals to achieve more precise control over their brain's activities. Instead of training alpha control or theta control, it may be possible to train functionally relevant patterns of activity."

C. Summary

The spatial/ verbal orientation of the subject has been utilized both as a technique for study and as a variable in its own right (Neville, 1974). This dimension has been shown to correlate with every other investigative technique used to assess hemispheric dominance, and it will be used here to summarize this review of the literature. These effects have been most clearly demonstrated for right handed men (Bakan, 1971). Left-handed men and women in general, appear to be less clearly lateralized (Gur, 1975).

Investigations of brain damaged patients have yielded high correlations between incidents of right hemispheric damage and lack of spatial abilities (i.e. Maze tracings, Milner,1965); left hemispheric lesions are known to play an instrumental role in aphasia and other linguistic disorders (Henschen, 1926). These results,however, must be regarded with caution as they have variable factors, such as severity and duration of injury, which are difficult to take into account. As these studies are post-hoc in nature, the causal analysis must be kept minimal.

In the split-brain studies, spatial and verbal abilities were found to differentially reveal hemispheric activities, depending upon the side of the body to which the tasks were exposed (Sperry, 1961; 1964; Gazzaniga, 1967). The types of tasks varied from tactual and visual recognition to verbal recall and numerical figuring (Gazzaniga and Young, 1967).

Clear support for the contralateral and asymmetric theories of hemispheric functioning are demonstrated by these investigations (Sperry,1964).

In normal subjects, the organs on the left side of the body(ears & ey have demonstrated an acuity for certain types of spatial and musical tasks(Day,1964; Kimura,1973; Palmer,1964)In the direction of looking studies, the eyes appear to shift their gaze in the direction contralater to the hemisphere engaged in the situation (Gur & Gur,1975) When information is presented tachistoscopically to one visual field or the other, the results are in the predicted directions(Filbey & Gazzaniga, 1969). The same holds true for dichotic competitive presentation of information to the ears(King &,Kimura,1972)--the right ear is superior for digit recall,the left for musical information.(Geffen et al,1971; Dixon & Henley,1974).

In EEG investiagations, the evidence also appears supportive (Doyle & Ornstein,1974). Spatial and verbal tasks discriminate the alpha levels in the direction of less alpha exhibited for the engaged hemisphere (Dumas & Morgan,1975; Morel & Salamy,1974; Galin & Ellis,1975).

The overwhelming direction of the research is in support of these three basic hypotheses: (1) That contralateral body/brain coordination exists (Kinsbourne,1972), (2) That the hemispheres are asymmetric in function, the left hemisphere co-ordinating activities which are "propostional" (Bogen,1969) and"sequential, analytical" (Price,1975) in nature; while the right co-ordinates those activities which are "appropositional" (Bogen,1969) "wholistic" (Price,1975) --spatial and certain musical and visual organizations fall in this category (Bogen,1969). and (3) That these first two hypotheses hold true together: the body organs contralateral to the right hemisphere are more apt to be adept "appropositionally" (Gordon,1970) while the body organs advantage in propositional activities (Kinsbourne,1974; Kimura, 1961a). This should hold true over all the organs which are located on one side of the body or the other.

II. Kundalini Yogic Theory As Related to Left vs Right Nostril Breathing

"Yoga is the union of the individual's unit consciousness with the infinite consciousness...classically, your potential self is infinite, whether you know it or you dont know it...so a technical know-how is required through which a man can expand his mental faculties in order to bring about the equilibrium to control his physical structure and experience his infinite self...Remember, wisdom does not hold you. Wisdom becomes knowledge when it becomes your personal experience." (The Siri Singh Sahib,1975a).

There is a mystique about yoga, as something etheric, untestable, unapproachable by science. How can one scientifically validate such a concept of higher awareness when the methods of introspection available are poor comparisons to the accomplished work in other areas, such as physiological psychology? What operational definition should be given to such terms as "infinite truth" "God consciousness" or "State of Bliss?"

Several investigators have found various methods useful in the study of meditation. For example, EEG studies have reported supportive data in changes in brain wave activities during mediations (Goodman, 1975; Wallace and Renson, 1972). Other studies, using self-report measures, have indicated that meditators report themselves to be happier individuals; they feel a greater ability to resolve conflicts and control their behavior under stress (The Tennessee Self-Concept Test, Johnson,1975).

There are several forms of yoga and meditation, but all ultimately attempt to deal with the same theme-- the raising of the energy stored at the base of the spine, which is termed the Kundalini (Khalsa and Khalsa, 1976). "Actually Kundalini Yoga means Awareness.. this dormant energy is in you, this awareness is sleeping in you and you only experience your capacity to a limit. But...it can be extended... (and)...in that state there is nothing lacking." (The Siri Singh Sahib, 1976a p. 4).

As the Kundalini energy rises up the spine, so does the consciousness of the individual become more inclusive, more vital, and clear (Wood, 1973). There are many different methods which can be employed to raise this energy. One such method is a combination of concentrations on physical movement, in co-ordination with the breath and the mind, through the use of a mantra. This combination is known as a kriya (Khalsa and Khalsa, 1976) when the body, mind and soul are all effected. Fortunately, operational definitions of such words as soul or bliss; can be bypassed at the present time, as each of these kriyas is stated as being capable of producing specific psychological and/or physiological effects. For example, a meditation may claim to influence glandular balance. Certain breathing techniques may be said to influence the rate of pulse. Meditations or exercises may serve as the independent, manipulated variable, while the physiological, or psychological tests and tasks can serve as dependent variables.

The breath and breath control are key concpets in Yogic Theory. "Without the breath, the body has no value. However good you may be, however beautiful you may be, however rich you may be... whatever, breath is the principle of life...it is the link." (The Siri Singh Sahib, 1976c p.21). "Breathing through the left nostril stimulates the right side of the brain, the side associated with receptivity, creativity and coziness. Its compliment is stimulated when the nostrils are reversed. The left side of the brain activates projection, expansion and warmth, The two hemispheres alternate their dominance." (The Siri Singh Sahib, 1976b p.7).

There have been several investigations examining the breath patterns of the nostrils (Khalsa and Raynor,1975). It has been termed the congestion-decongestion cycle (Connell, 1968) as well as the the nasal cycle (Heetricks, 1927). It has been shown that a cycle of alternation between the nostrils lasts anywhere from 50 minutes to 8 hours depending upon the individual (Stocksted, 1953; Heetrick, 1927). The cycle appears to be self-regulatory, and it appears to occur spontaneously, without any clearly recognized outside stimuli (Connell, 1968).

When one nostril is internally blocked, the other becomes correspondingly clear. A plug in one nostril, however, is not sufficient to induce a switch in dominance (Salman, 1971), thus indicating that the reflex does not have its origin in the superficial areas of the nose, but rather, a controlling mechanism is indicated which lies elsewhere within the nervous system.

As the Siri Singh Sahib has specifically mentioned the hemispheres in connection with left vs right nostril breathing, it would appear that a scientific testing of these hypotheses, grounded in the methodology derived from hemispheric dominance research would provide a concise, scientifically valid test of the Siri Singh Sahib's statement.

III. Kundalini Yogic Theory And Hemispheric Dominance Methodology

Central control of the respiratory system is inseparably bound up with the functioning of the nervous system as a whole (Karczewski, 1970). Its firing is interconnected (Gessel, Hausan and Siskel, 1947) and its firings effect other cells (Magee, Bricker and Gessel, 1937); its rythem parellels and accompanies the various rhythmic reflexes such as walking (Nicholson, 1936). Gesell and his associates also suggest that the cerebrum plays a regulatory role in the intergration of the respiratory act... it is the organizor of theconcerted and "orderly recruitment of the respiratory muscles." (1936).

Several investigators have studied the interplay between breathing patterns and the asymmetric functioning of the cerebral hemispheres (Price, 1975). The literature provides some support for the following: breathing patterns which are long and calm (termed as regular breathing patterns), appear to be associated with different tasks than do breathing patterns which are short and somewhat jagged in nature (termed irregular breathing patterns) (Short, 1953; Gola and Antonovitch, 1929; Chowdhury and Vernon, 1964; Gola and Grey, 1934). Visual imagery appears to be related to a regular calm, breathing pattern, while verbal sequential information processing appears to be related to irregular breathing patternes (Short, 1953). Price (1975) suggests that the differences betwean the two patterns may be due to different hemispheric respiratory correlates. Thus the right hemisphere might be associated with a regular breath pattern (spatial tasks) and the left hemisphere might be associated with an irregular breath pattern (verbal tasks).

Another type of relationship between the breath and the cerebral hemispheres is suggested by Kundalini Yogic Theory. It is postulated that there is a systematic alternation of nostril dominance which operates in co-ordination with a similar alternation of the two cerebral hemispheres. This would follow along the same theoretical lines as the contralateral/asymmetric body/brain co-ordination which has been discussed earlier in this paper. It will be recalled that contraleralàty of function has been demonstrated for other paired organs such as the hands and legs (Sperry, 1964), the ears (Kimura, 1973) and the eyes (Bakan,1969). This same reasoning should also hold true for the nostrils. The nostril which is on the left side of the body should be associated withthe right hemisphere; the nostril on the fight side should be associated with the left hemisphere. Despite the fact that both nostrils join just above the nose, breathing through one nosrtil or the other would be expected to innervate the contralateral hemisphere. The same correlations of spatial and verbal performance and orientation which hold true for the eyes, ears and limbs, would be expected to hold true for the nostrils as well.

In a pilot study investigating this phenomenon, Khalsa and Raynor point out that the subjects entered the experiment with one nostril predominantly employed for breathing while the other was predominantly blocked. Six subjects were asked to breath through therocuples while EEG readings were recorded. Although no statistical analysis was performed,the graphs did suggest a contralateral relationship between the hemispheres and the nostrils. Furthermore, the nostril which was initially dominant appeared to exert a consistent influence upon the results(1975).

Based upon these findings and the above mentioned theoretical and experimental considerations, the following hypotheses were drawn:

(1) If a breathing condition (left nostril) engages the right hemisphere, then it should evoke

responses which are more oriented towards the spatial, non-verbal cognitive modes. (2) If a breathing condition (right nostril) engages the left hemisphere, then it should evoke responses which are more oriented towards the verbal, analytical modes. (3) A control condition of relaxation should evoke reponses which fall in between the other two conditions.

METHOD

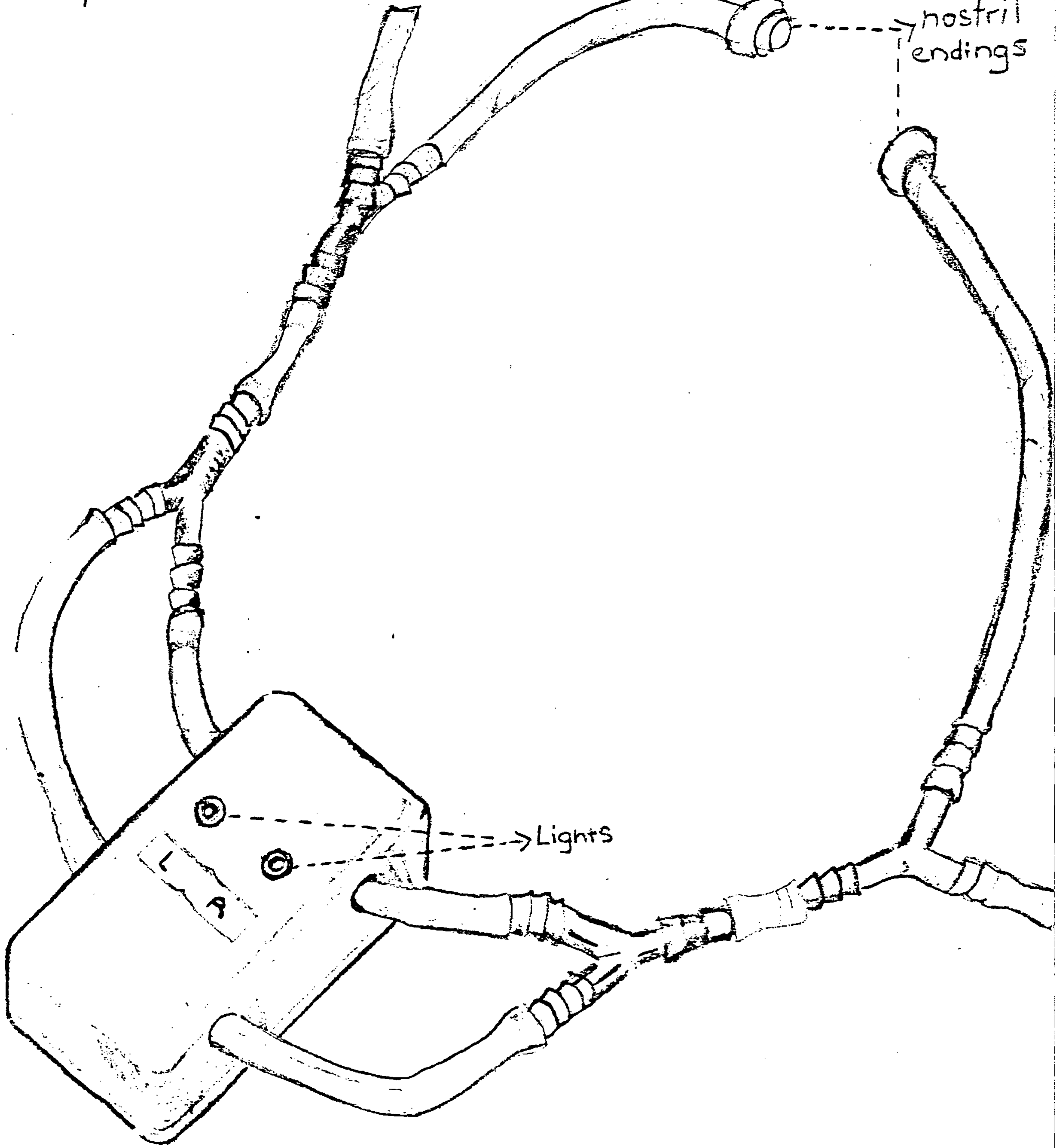
Subjects: Thirty right-handed men between the ages of 19 and 31 were tested. All Ss had been practioners of Kundalini Yoga; the range of their experiance varied from between six months to seven years.

Materials:

The Test of Nostril Dominance:

Two differential pressure switches were placed back to back and attached to lighting mechanisms (figure 1). The nostril which on the exhale,exerted the greater pressure was defined as dominant. The validity of this machine was tested as follows: Three Ss who were highly experienced in yogic breathing techniques were asked to close one nostril and then inhale and exhale. He then closed the other nostril, inhaled and exhaled. This proceedure was repeated 3 times, or until S could confidently name the dominant, least clogged nostril. He then attached the machine and inhaled and exhaled. The light on the exhale was recorded. He detached the machine and repeated the above proceedures, a total of 10 times. The

Figure 11 Nostril Dominance ...



light on the exhale indicated the same nostril as reported dominant by the expereinced S in 29 of the 30 trials.

Reliability was assessed in the following manner: S was asked as above to determine nostril dominance. He then attached the machine and inhaled and exhaled 10 consequtive times, record was kept of the switch which lit on the exhale. In all cases, the reported dominant nostril triggered the appropriate light for all 10 consecutive trials. This held true for both left and right dominant nostrils, indicating a consistency across conditions.[2]

Measures of Hemispheric Dominance:

The Verbal Test: Writing From Memory. Three different reading passages were presented separately to each subject. All were modelled after the practice exams for the SAT tests (Brownstein & Weiner, 1975). The first passage was short and served to familiarize the subject with the task. Scoring manuals were prepared for the other two passages: a total of three propositions worth 5 points apiece and 28 supporting facts worth one point apiece were contained within each passage. (see Appendix A)

Galin & Ellis (1975) tested this proceedure as an index of hemispheric dominance in correlation with EEG readings. A high level of Alpha production is indicative of a state of rest (Droland, 1965). Galin and Ellis demonstrated that the above type of task is significantly associated with a lower level of alpha production in the left hemisphere, while the right hemisphere registers a high level of alpha waves indicative of a state of rest, or lack of involvement with the task at hand.

Spatial Test: Kohs Modified Block Design (Kent, 1934). Three two dimensional geometric patterns, chosen from Kohs original work (1920) were presented separately to each subject. The first was a learning trial, while the other two were timed and used as the post and pre-tests decribed below. There were 16 colored blocks, 1" by 1" presented on the table in front of the subject. A design picture which was the same size as the blocks was displayed to the subject for 1 minute. S then completed the design from memory and his score was based on the number of seconds he took to complete the pattern.

Galin and Ellis (1975) reported this technique to correlate with a higher level of alpha production from the left hemisphere and a corresponding lower level of alpha production in the right hemisphere, for 27 of the 28 leads employed. This is clear support for an association between the spatial Kohs tasks and right hemispheric functioning. (See Appendix B)

Proceedure: The subject entered the experimental room and was asked to be seated. He was told that he would be briefed at the end of the experiment.

Pre-Tests: Measures of Hemispheric Dominance:

Verbal Test: The subject was told that he would be given a passage to read for 30 seconds, and would then have two minutes to write what he could recall. S was then given the introductory passage. Next, the subject was randomly presented with one of the two experimental passages. He was told he could read for one minute and would then have three minutes to write what he could recall.

Spatial Test:

The subject was given the introductory spatial task, and told that he had 30 seconds to memorize the pattern presented to him. He would then have up to 5 minutes to reconstruct the design from memory, using the blocks on the table in front of him. S was then randomly presented with with one of the two experimental patterns and told that he would have one minute to memorize the design, and five minutes to reconstruct it from memory.

Nostril Dominance Measure:

The subject was given the two ends of the machine and asked to place them in his nostrils. when he indicated that they were securely air-tight, he was asked to inhale and then to exhale, and then to inhale and to exhale. The light which was triggered on the exhale was recorded as the dominant nostril.

Assignment to Conditions:

There were three experimental conditions: I. The right nostril was free, while the left was plugged with a thick paper until S reported that the seal was air tight and he could feel no air escaping. S was asked to sit with a straight spine, with his legs crossed in an easy pose. He was told to concentrate on the sound of Sat as he inhaled and Nam as he exhaled. He was asked to imagine the sound and the breath rising up from the base of his spine as he inhaled and going out through the point between his eyebrows as he exhaled. "Breathe deeply and forcefully--you should hear the sound of your own breath."

The excercise lasted thirty-one minutes, and S was encouraged to try to sit still and keep up.

Condition II. The left nostril was free. The right nostril was plugged. The remainder of the proceedure was the same as for condition I.

Condition III. Relax: S was told that he could relax as he wished-- he could lie down and sleep, but he could not engage in any special breathing or mediations.

After nostril dominance was determined, each subject was randomly assigned to each of the three conditions, keeping the number of subjects in each category of dominance approximatley equal in each condition.

Post-Tests: S was administered the second half of the verbal and spatial tests and then, if he had been in conditon I or II, the nose plug was removed. He was then briefed about the experiment, and told that in order to balance out his nasal cycle, should place the plug in the opposite nostril for about 10 minutes.

Footnote 1: Two subjects were eliminated from the data pool as they were not entirely and simply right-handed: e.i.: one was ambidextrose.

Footnote 2: When the pressure was equally exerted through both nostrils, the machine was calibrated so that neither light would be activated. As this condition did not occur (except under forced air through the mouth test conditions), an equal initial dominance category was dropped from the proceedures.

Following the conventions of Galin and Ornstein (45), the following were utilized: (1) a verbal/spatial ratio was computed as an index of performance on right and left hemispheric tasks, (2) all the scores were converted to standardized T scores, with a mean of 50 and a standard deviation of 10, and (3) non-parametric statistics were then employed to evaluate the results.

RESULTS

The differences between the post and pre-test scores on the verbal (writing-from-memory)/spatial (Block Design) tests are presented in Table 1. (see appendix C for scores by subject number)

Table 1. Median Scores:* Breathing Condition, Nostril Dominance

	Left	Right	Right	Relax	Left	Relax
Breathing Condition	-.09	+.06	+.06	+.12	-.09	+.12
P ≤	.05**		N.S.		N.S.	
Nostril Dominance	-.10	+.05				
P ≤	.05***					

*All scores represent the difference between the post and pre-test verbal/spatial scores.
** One tail Mann Whitney U (MWU) Crit U=17, Obs U=17
*** Two Tail MWU Crit U=33; Obs U=33

This verbal/spatial ratio was employed because we were interested in the relative ability in these dimensions, rather than in the absolute performance levels. Absolute performance levels might be effected by such variables as general intelligence which would not actually be relevant here (45). In this ratio, the higher the score, the more verbally oriented was the overall response; the lower the score, the more spatially oriented was the overall response.

As can be seen in Table 1, the left breathing condition yielded scores which were significantly different from those in the right breathing condition ($P \leq .05$). These differences are in the predicted directions(left nostril breathing evoked more spatially oriented scores, while right breathing evoked more verbally oriented scores). As predicted in the third hypothesis, the left and right breathing conditions did not significantly differ from from the relax condition, although the median score of the relax condition did not fall mid-way between the other two as predicted.

Referring to Table 1, initial nostril dominance can also be seen to influence the verbal/spatial ratios in the predicted directions: The left dominant group scored significantly lower indicating a shift towards a more spatial orientation, while the right dominant group scored significantly higher, indicating a more verbal orientation ($P \leq .05$).

The strongest differences between initial dominance groups occurs when one examines the effects of initial left dominance

It appears then that exercising the nostril which is dominant has a greater effect than does exercising the non-dominant nostril.

DISCUSSION

The data presented in this paper indicate that the postulates of contralateral/asymmetric body/brain co-ordination which apply to the ears (24) and to the eyes (21) and to the limbs (3) appear to apply to the nasal breathing mechanism as well. As compared with the right nostril, the left nostril when examined by breathing condition, by nostril dominance, or by both is significantly more likely to elicit responses which are spatially oriented (indicating a right hemispheric engagement).

These data would appear to support a postulate from Kundalini Yogic Theory as well: that the cerebral hemispheres and the nostrils operate in a contralateral fashion (38). The influence of the initially dominant nostril, as suggested by previous research (40), also appears to play an influential role in determining the magnitude of the orientation.

Connell (46) has suggested that the nose is one of several paired organs in the body (such as the kidney) which operates in an established work-rest pattern. Cyclic oscillations have been defined as "statistically valid physiological changes recurring at regular periods which are displayed as a function of time." (47).

Yogic Theory and requires further research.

In the past many scientific investigators drew their hypotheses from the writings of the great psychological and physiological theorists such as Freud and Adler. Many of these theories have long since exhausted their heuristic functions. In the present, some of the new theories used in physics and personality investigations come from the writings of the East, hitherto seen as untestable, non-scientific works. The postulates of Kundalini Yogic Theory have been specifically stated so that they may be scientifically tested. Different breathing techniques, for example, are said to produce different and specific psychological and physiological results(39). The heuristic function of this theoretical framework may prove highly valuable, and further research is indicated.

Append A.

The president met with employes of the Labor and Commerce departments about his plans to streamline and cut back the bureaucracy, telling the federal regulators to use a minimum of rules and a maximum of common sense. He said he hopes to eliminate duplicate forms and give local governments more of a voice in running local programs. Carter told labor Department employees that he will name a woman to head one of its most critized departments--the Occupational Safety and Health Administration. The nomination was expected to go Eula Bingham, an environmental-health specialist at the University Of Cincinnati's medical school. Many other positions are still available and being named.

(TRIAL PASSAGE)

Comets are the most oddly behaved objects in the sky. No two of them act exactly alike. Most appear without warning seemingly out of nowhere, too faint at first to be detected except as fuzzy dots of lights on the photographic plates of automatic cameras attached to telescopic lenses; most of the members of the comet family move in ecliptic paths, remain visible to earthly observers for a few weeks or months, then disappear into the depths of space. There are a few comets that return periodically on predictable timetables following almost the same track they were originally on. Decades pass between some comets, while others return within a few years.

But even these few have little in common. Comets do have some characteristics in common, however. For example, it should be noted that one of the few characteristics shared is the common focal point of their orbits: the sun. Though some are so small that they are difficult to measure accurately , and many are never seen at all, some are enormous. Planet earth passed through the tail of a huge comet while the comet was only 15,000,000 miles away. Despite its giant size, the comet did not exert enough of a gravitational pull on the earth to cause a noticeable difference. Another comet passed between the planet Jupiter and one of its satelites--it did not cause the slightest perterbation in the orbits of either the satellites or the planet, although the life of the orbit of the comet was shortened from 27 to 7 years. By contrasting these experiences, it can easily be ssen that comets are, by earthly measure, insubstantial stuff.

App A iii

I wish that everyone worried about foriegn imports could visit Japan. They would quickly realize that imports so not on the balance "cost" American workmen their jobs. Quite the contrary, the very prosperity of Japanese industry-a prosperity which depends entirely on the US- is in fact creating jobs for Americans. Coal, mined by West Virginia miners fuels a large proportion of Japanese industry. Its busses, cars and machinery, to a large extent, run on oil produced in American refineries. US planes fly for the Japanese airlines, and Us parts keep the planes in the air. US office equipment and machinery is common place. The whole of Japan's great cotton textile industry virtuely runs on US raw materials.

The balance of trade figures tell the story. Last year we sold Japan $1,325 million worth of products. Total Japanese sales to the US came to $1,126 million. Japan, then actually bought $200 million worth more of goods from the US than we bought from them. It is certainly clear, from this, that US workers actually benefit as a result of the proportionally increasing quantities of food, textiles, toys and cameras that Japan ships to the US.

This being the case, Americans can actually rejoice, in sheer self interest in the fast growing prosperity of Japan. For with every upward thrust of the Japanese Gross National Product, the docks of Kika and Yohohana become busier and busier unloading goods produced by american workers. The money we send to Japan for Japanese goods has a way of making a fast return trip to the American shores. Japan has also become one of our closest partners-economically. It is our third largest customer. Its economy is more closely tied to ours than is that of all of Western Europe. And The Japanese governments hope to double the GNP within the next 10 years.

Scoring Manual

Passage One: Comets

# Points	Statement
5	A. Most Oddly behaved objects in the sky.
	1. no two exactly alike
	2. appear without warning
	3. too faint to be detected
	4. except as fuzzy dots
	5. photographic plates
	6. attached to telescopic lenses
	7. eleptical paths
	8. visible for a few weeks or months
	9. then disappear
	10. a few comets return periodically
	11. predictable timetable
12	12. same track as they have always been on
5	B. Comets have little in Common
	1. some too small
	2. to measure accurately
	3. some never seen at all
	4. some enormous
5	5. some return decades later
5	C. Common Characteristics
	1. one common focal point -
	2. the sun
	3. Earth passed through the tail of a comet(huge)
	4. 15,000,000 miles away
	5. no gravitational pull
	6. no difference on earth
	7. another comet passed through the orbit of Jupiter & Jupiter's satelite
	8. no perturbation of orbit of planet or satelite
	9. life of orbit of comet however, shortened
	10. from 27 years to
11	11. 7 years

43 total points

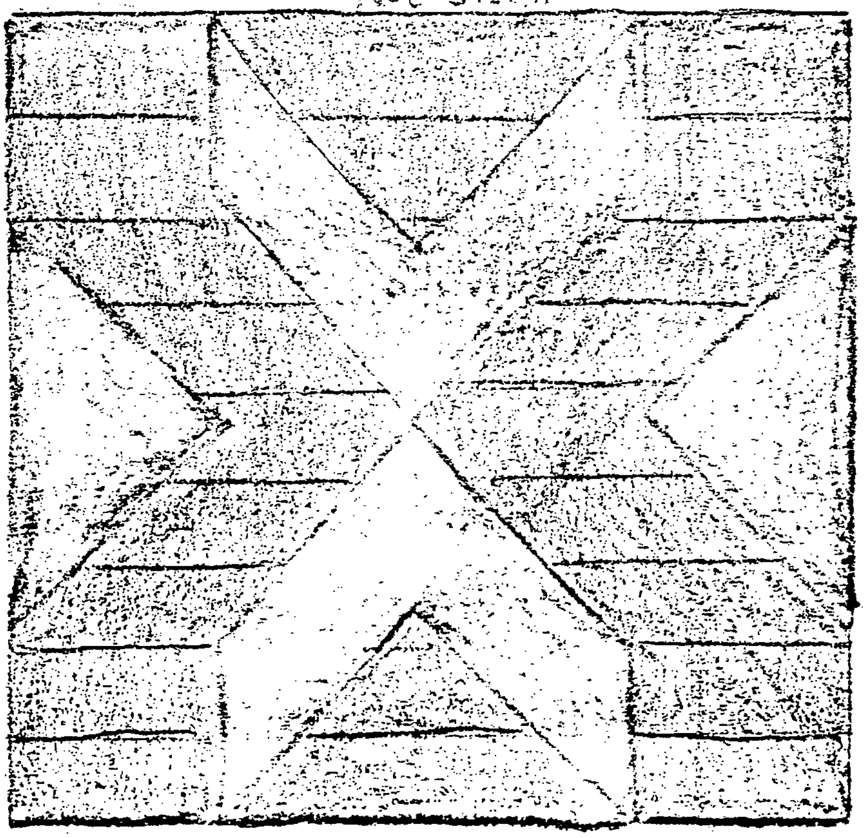
Scoring Manual

Passage Two: Japan

# Points	Statement
5	A. Imports do not cost Americans money(2 1/2), rather, just the opposite, they help (2 1/2).
	1. Coal - WV
	2. creates jobs
	3. cars (Japan)
	4. busses(Japan)
	5. machines "
	6. American Oil
	7. US Planes
	8. US parts
	9. US material
	10. US office equipment
12	11. cotton 12. If worried about imports, visit Japan
5	B. Balance of trade in our favor
	1.sold Jap $1,320 million
	2. bought from Jap $1,126 million
	3. Jap bought $200 million more from US
	4. sell food
	5. " textiles
	6. " toys
8	7. " cameras 8. US workers not lose
5	C. The prosperity of Japan depends on US (2 1/2) helps Am (2 1/2) or(as prosperity of Jap goes up, so does US)
	1.self interest
	2. Yohona or Kika
	3. dollars fast return
	4. close partner
	5. third best customer
	6. more close than W.E.
	7. Jap hopes to double economy
8	8. in the next decade
43 total points	

Appendix B

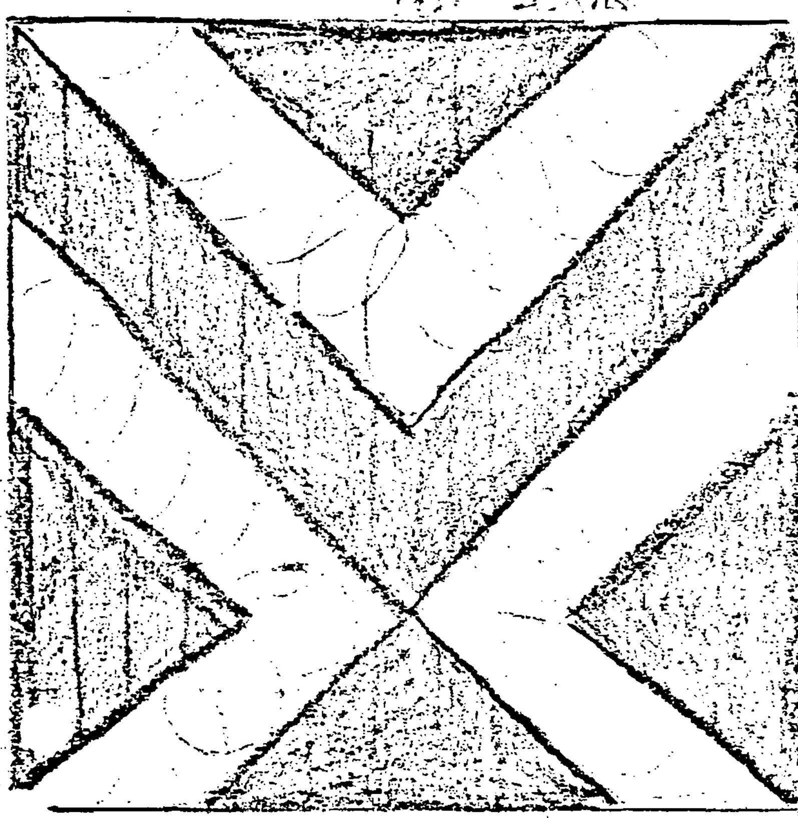
Test Design



ii

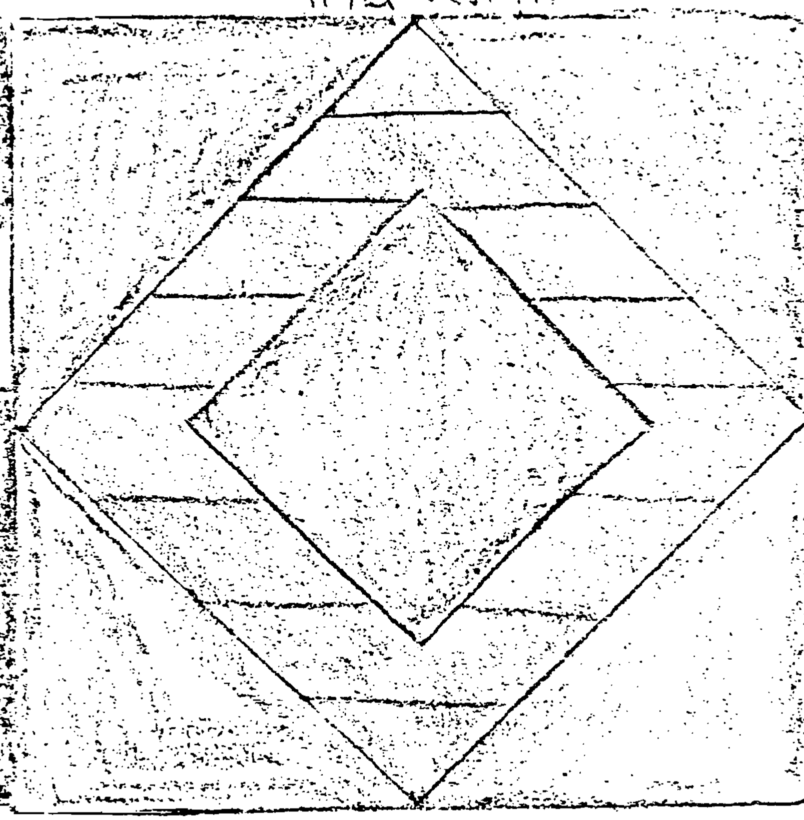
blue ≡
gold □
red ||||
white

Test Design



iii

Trial Design



i

Verbal/spatial Scores in Pre and Post tests,
by subject number

Dominant Nostril		Right Breathing Pre	Post	Diff		Left Breathing Pre	Post	Diff		Relax Pre	Post	Dif
Left	(1)	1.47	1.37	-.10	(2)	1.00	.57	-.43	(3)	.86	.85	-.0
	(4)	1.15	1.20	+.05	(6)	.94	.69	-.25	(14)	.76	1.18	+.4
	(17)	.66	.47	-.19	(22)	1.64	.66	-.98	(20)	.60	.82	+.2
	(21)	1.41	.93	-.50	(28)	1.28	1.19	-.09	(25)	1.93	1.00	-.9
	(26)	1.94	1.83	-.11								
Right	(5)	1.52	1.67	+.15	(11)	.63	.67	+.04	(12)	1.40	1.14	-.2
	(10)	.75	.82	+.07	(7)	1.14	1.05	-.09	(27)	1.21	1.49	+.2
	(13)	.74	.91	+.17	(16)	.82	.79	-.03				
	(30)	.60	.82	+.22								
	(29)	1.12	1.03	-.09								

BIBLIOGRAPHY

Bakan P. Hypnotizability, laterality of eye movement and functional brain asymmetry. Perceptual & Motor Skills, 1969, 28,927-932.

Bakan P. The eyes have it. Psychology Today, 1971, 4, 64-69.

Bakan P. & Shortland, R. Lateral eye movement, reading speed and visual attention. Psychonomic Science, 1969,15,93-94.

Bakan P. & Svorad D. Resting EEG alpha & asymmetry of reflective lateral eye movements, Nature, 1969 223, 975-976.

Basser, L. Hemiplegia of early onset and the faculty of Speech with special reference to the effects of hemispheroctomy. Brain, 85,427-460,1962. cited in Bogen,1969.

Bever, T. & Chiarello R. Cerebral dominance in musicians and non-musicians. Science, 1974 (aug) Vol 185 537-539.

Bogen, J. The other side of the brain,I,II,III. Bull of the Los Angeles Neurological Society. Vol 34, No. 3, July,1969. Reprinted in part in Ornstein, The Nature Of Human Consciousness. (San Fran, W.H. Freeman & Co., NY. The Viking Press,1973

Bradshaw J., Nettleton, N. & Geffin G. Ear differences and delayed auditory feedback: Effects on a speech and a music task. Journal of Experimental Psych 1971,(Nov) Vol 91 (1),85-92.

Brain L. Diseases of the Nervous System. London, Oxford Univ Press, 6th edition,1962.

Broadbent D. The role of auditory localization in attention and memory span. Journal Exp Psych 1954, 47, 191-6.

Broadbent D. & Gregory M. Accuracy of recognition for speech presented to the left and right ears. Quart J exp psych,1964,16,359-60.

Brownstein & Weiner, The SATS. Barrons Education Series Inc 1975, Woodbury, NY 635p.

Brunt M. Goetzinger C. A study of three tests of central function with normal hearing subjects. Cortex, 1968, 4 (3) 288-297.

Carr B. Ear effect variables and order of report in dichotic listening. Cortex, 1969, 5,(1),63-68.

Chowdhury K. & Vernon P. An experiemtnal study of imagery and its relation to abilities and interests. Brit J of Psych,1964,55, 355-364.

Cohen B, Noblin C. & Silverman A. Functional asymmetry of the human brain. Science, 1968, 162, (3852) 475-477.

Connel J. Reciprical Nasal Congestion-Decongestion Reflex. Tran. Am. Acad Opth & Othol,1968,72, 422-

Corso J. Confirmation of the noremal threshold for speech on CID auditory test W-2. J Acoust Soc Amer 1957,29, 368-370. cited in Palmer (1964).

Day M. An eye movement phenomenon relating to attention, thought and anxiety. Perc & Mot Skills, 1964 19,443-446

Day M. An eye movement indicator of individual differences in the psychological organization of attentional processes and anxiety. J of Psych 1967,66, 51-62.

Deikman A. Bimodal consciousness. Reprinted in the <u>Nature of Human Consciousnees</u> Ornstein, Ed 1973

DeRenzi E & Scotti G. The influences of spatial disorders in impairing tactual discriminations of shapes. Cortex, 1969, 5,(1) 53-62

Dharmananda S. Institute for Time Perception Studies. ITPS Report Spring, 1976 Santa Cruz, Calif.

Dikman S, Surrenat & Reitan R. MMPI correlates of localized cerebral lesions. Perc & Mot Skills, 1974 (Oct), Vol 39,2.

Dixon N & Henley S. Laterality effects in perceptual matching: A preliminary note. Perception,1974 Vol 3,(1), 99-100.

Duke, J. Lateral eye movement behavior, J of Gen Psych, 1968,78,189-195.

Doyle J & Ornstein R & Galin D. Lateral specialization of cognitive mode: II. EEG frequency analysis. Psychophysiology, 1974 (Sep) Vol 11 (5), 567-578.

Droland <u>Drolands Illustrated Medical Dictionary</u>. 24th Ed W.B. Saunders Co Phili. 1965.

Dumas R. & Morgan A. EEG asymmetry as a function of accipation, task, and task difficulty. Neuropsychologia, 1975 (Apr), Vol 13 (2) 219-228.

Ehrlichman H & Weiner S. & Baker H. Effects of verbal & spatial questions on initial gaze shifts. Neuropsychologia, 1974, (Mar) Vol 12 (2) 265-277

Ellis H. & Shephard J. Recognition of abstract and concrete words presented in left and right visual fields. J of exp psych, 1974 (nov) Vol 103 (5) 1035-6.

Etaugh C. Personality correlates of lateral eye movement and handedness, Perc & Mot Skills, 1972 (jun) Vol 34 (3) 751-754.

Filbey R. & Gazzaniga M. Splitting the Normal Brain with Reaction Time. Psychonomic Science, 17, 1969, 335-336.

Friedman & Fisher, 1967 as cited in Kripke, 1974.

Galin D & Ellis R. Asymmetry in evoked potentials as an index of lateralized cognitive processes. Relation to EEG alpha asymmetry. Neuropsychologia, 1975 (Jan) Vol 13, (1) 45-50.

Galin D & Ornstein R. Lateral specialization of cognitive modes. An EEG study. Psychophsyiology, 1972, 9, 412-418.

Galin D. & Ornstein R. Individual differences in cognitive mode. Reflective movements. Neuropsychologia, 1974 (vol 12), 3, Jul, 367-376.

Gazzaniga M. The split brain in man. Scientific American, Aug, 1967 p24-29 offprint # 508.

Gazzaniga M & Young. Effects of commissurotomy on the processing of increasing visual information. Exp Brain Res, 3, 368-371. 1967

Geffin G, Bradshaw J & Wallace G. Interhemispheric effects on reaction time to verbal and non-verbal visual stimuli. J of exp psych, 1971 (Mar), Vol 87 (3), 415-422.

Gesell R, Bricker J & Magee C. Structural and functional organization of the central mechanism controlling breathing. Am J Physsio, 1936, 117, 423-453.

Gesell R, Hausen E, & Siskel J. On the electronic nature of stimulation, inhibition, summation and after-discharge of nerve centers. Am J Physio,1947, 148,515-529.

Giannitrapani D. Developing concepts of lateralization of cerebral functions. Cortex, 1967, 3 (3), 353-370.

Gole & Antonovitch. The respiratory rhythm in its relation to the mechanism of thought. Brain,1929, 52, 491, 1929. as cited in Price(1975).

Gole H & Grey W. The objective study of mental imagery.I. Physiological Concomitants. J of Mental Science, 19 , 89,216-222. cited in Price (1975).

Goodman J. Physiology of Yogic Techniques. Unpublished paper, Calif State Coll, San Bernardino,1975 cited in Khalsa & Khalsa,1976

Gordon H. Hemispheric asymmetries in the perception of musical cords. Cortex,1970, Vol 6 (4) 387-398.

Grinker, R. Bucy P, & Saks A. 1959. Neurology Springfield Ill, Thomas, 5th edition.

Gur, R. Conjugate lateral eye movements as an index of hemispheric activation. J of Person & Socal Psych 1975, (Apr) Vol 31, (4), 751-757.

Gur, R & Gur, R. Handedness, sex, and eyedness as moderating variables in relation between hypnotic susectability and functional brain asymmetry. J of abn Psy, 1974 (Dec) Vol 83, (6) 635-643.

Gur, R. & Gur, R. Defense mechanisms psychosomatic symptomatology and congugate lateral eye movements. J of Consulting & Clinical Psych,1975 (Jun),(a) Vol 43 (3), 416-420.

Gur, R & Gur R. & Harris, L. Cerebral activation as measured by subjects lateral eye movements is influenced by experimenter location. Neurophysiologia,1975 (b) (Jan) Vol 13, (1), 35-44.

Head, Henry Aphasia & Kindred Disorders of Speech. Vol I, NY Hafner, 1926; 1963 reprint. cited in Bogen,1969.

Heetricks, D. Observations on the reaction of normal nasal mucous membrane: Am J of Med Sci,174,231,1927 in Dharmananda,1976.

Henschen S. On the function of the right hemisphere of the brain in relation ti the left in speech, music and calculation. Brain, 49, 1926, 110-123.

Hicks, R. Intrahemispheric response competition between vocal and unimanual performance in normal adult human males. J of Comp & Physiol Psych, 1975, (Mar), Vol 89, (1), 50-60.

Hines, D. Martindale, C; & Schulze, S. Lateral body sensativity and lateral eye movements. Percept & Motor Skills, 1974 (Jun) Vol 38, (3, Pt 2) 1293-4.

Jasper H. & Ramy E. The psysiology of lateral cerebral dominance: a review of literature and evaluation of the test of simultaneous bilateral movement. Psych Bull,1937,34,151-165.

Johnson, S. Effects of yoga therapy on conflict resolution, self-concept and emotional adjustment. U of S. Calif,1974, unpublished paper cited Khalsa & Khalsa,1975.

Karczewski, W. Contemporary views concerning central control of respiration. Acta Physiol Pol,1970, Vol 21(5, suppl 1), 61-80. Psych Abstracts #48,1972.

Kent, Grace. Modification of the Kohs Block Design Test. J App Psy, 18: 578-98 Aug I934.

Khalsa, G & Khalsa, S. The science behind the science of Kundalini Yoga. Kundalini Quarterly, Fall Equinox, 1976, p 22-36.

Khalsa G & Raynor M. Kundalini Yoga and psychological corelates: A Pilot Study, Unpublished, University of Calif Riverside,1975.

Kimura D. Some effects of temporal-lobe damage on auditory perception. Canadian J Psych,15,156-165.1961a

Kimura, D. Cerebral Dominance and the perception of verbal stimuli. Canad J Psych,15,166-171 1961b.

Kimura, D. Left-right diferences in the perception of melodies. Quarterly J of Exp Psych,1964, 16,355-8.

Kimura, D. The asymmetry of the human brain. Scientific American, 1973,(Mar), Vol 228 (3) 70-78.

Kinkade, Psychological Abstracts, Kinkade Editor, #48,1972.

King, L. & Kimura, D. Left-ear superiority in dichotic perception of vocal non-verbal sounds. Canad J of Psyc 1972 (jun) Vol 26, (2) 111-116.

Kinsbourne, M. Eye and head turning indicates cerebral lateralization. Science,1972,176,539-541.

Kinsbourne, M. Direction of gaze and distribution of thought processes. Neuropsychologia,1974,(Mar) Vol 12 (2) 279-281.

Kocel K, Galin D. Ornstein R. & Morrin,E. Lateral eye movement and cognitive mode. Psychonomic Sci, 1972, 27,223-224.

Kohs S. THe Block Desing Tests. J of Exp Psych,1920,? p357-376.

Kripke, D. Advances in Sleep Research Vol 1 Ultradian Rhythms in Sleep & Wakefulness,1974, quotes from this book are in the ITPS (Dharmananda,1976).

Magee, C; Bricker J; & Gesell, R. Changes in action potentials of the central mechanism controlling breathing produced by modificatiom of the respiratory act. Am J Physio, 1937,119,370-371.

Milner, B. Visually guided maze learning in man. Effects of bilateral, frontal, and unilateral cerebral lesions. Neuropsychologia,1965,3, 317-338.

Morgan, A; MacDonald, H; & Hilgard, E. EEG alpha: Lateral asymmetry related to task and hypnotizability. Psychophysiology,1974,(May), Vol 11,(3), 275-282.

Morgan A; McDonald P; & MacDonald, H. Differences in bilateral alpha activity as a function of experimental task, with a note on lateral eye movement and hypnotizability, Neuropsycholgia, 1971, (Dec), Vol 9 (4), 459-469.

Morrel, L & Salamy J. Hemespheric asymmetry of electricortical responses to speech stimulation. Science,1971, (Oct), Vol 174, (4005), 164-166.

Myers,1951, cited in Sperry,1961. Myers is unpublished.

Neville, H. Electrographic corelates of lateral asymmetry in the process of verbal and non-verbal auditory stimuli. J of Psycholinguistic Research, 1974, (Apr), Vol 3(2) 151-163.

Nicholson, H. Localization of the central respiratory mechanism as studied by local cooling of the surface of the brain stem. Am J Physiol, 1936,115,402-408.

Ornstein, R. The Psychology of Consciousness, N.Y. Viking Press Inc, 1972

Ornstein, R. The Nature of Human Consciousness. San Fran, Calif, WH Freeman & Co., 1973.

Palmer, R. Cerebral Dominance and auditory asymmetry. J of Psych,1964, 58 (1), 157-167.

Parsons O; Vega, A; & Burn, J. Different psychological effects of lateralized brain damage. J of consulting and clinical psych,1969, 33 (5), 551-557.

Price, A. Heart rate variability and respiratory concomitants of visual and non-visual imagery and cognitive style. J of Research in Personality, 1975, (Dec), Vol 9, (4).

Reinberg, A & Gervais, P. Circadian rhythms in respiratory functions, with special reference to human chronophysiology and chronopharmacology. Bull Physiopath resp,1972,8, 663-675.

Rosen, J; Curio, F; Mackavey, W; & Herbert,J. Superior recall of letters in the right visual field with bilateral presentation and partial report. Cortex,1975, Jun.

Salman et al. Nasal resistence: Description of a method and effect of temporature and humidity changes. Ann Otol,80,736,1971.

Schulhoff, C & Goodglass H. Dichotic listening, side of brain injury and cerebral dominance. Neuropsychologia,1969, 7(2), 149-160.

Schwartz, G; Davidson, R; and Maer, F. Right hemisphere lateralization for emotion in the human brain: Interactions with cognition. Science,1975, (Oct) Vol 190, (4211) 286-288.

Shaffer, R. Cerebral lateralization: The dichotomy of consciousness. International J of Symbology,1974, Vol 5 (2) 7-13.

Shankweiler, D. Effects of temporal lobe damage on perception of dichotically presented melodies. J comp physiol Psych, 62,115-119, 1966.

Shankweiler, D. & Studdert-Kennedy, M. Identification of consonants and vowels presented to left and right ears. Quarterly J of Exp Psych,1967, 19 (1) 59-63.

Sherrod, D. Lateral eye movements and reaction to persuasion. Perc & Motor Skills, 1972, (Oct), Vol 35, 355-358.

Short The objective study of mental imagery. Brit J of Psyc,1953, 44, 38-51

Siegel, S. Nonparametric Statistics for the Behavioral Sciences, McGraw-Hill Book Co, Inc N.Y.,1956

Siri Singh Sahib, Summer & Winter 1972 tape recordings of the talks given by the Siri Singh Sahib.

The Siri Singh Sahib, What is Yoga. Sadhana Guidlines, Winter Solstice, 1976, p4-9 (a)

The Siri Singh Sahib, Half Ong Meditation,Kundalini Lectures Febuary 16,1976.(b)

The Siri Singh Sahib, The art of elevated consciousness, Beads of Truth, #31, p21-23. 1976 (c)

Sonneshein, 1971 as cited in Kripke, 1971

Stedman, Medical Dictionary, 23rd edition, Baltimore, 1976

Sperry, R. Myers, R. & Schrier A, Perceptual capacities of the isolated visual cortex in the cat. Quarterly J of exp psych,1960, 12, 65-71.

Sperry, R, Cerebral organization and behavior. Science, 1961,133,1749-1757.

Sperry, R. The great cerebral commissure. Scientific American, Jan 1964, p42-52, offprint #174.

Sperry, R; Stamm, J; & Miner, N; Relearning tests for interocular transfer following division of optic chiasm and corpus collosum in cats. J comp physiol psych,1956, 49, 529-533.

Stoksted, P. Rhinometric measurements for delineation of the nasal cycle. Acta Oto-Laryng Suppl 109, 159, 1953, In IfPS, Dharmananda.

Strong O. & Elwyn, A. Human Neuroanatomy, Balt, Md, Williams & Wilkin, 1943.,as cited in Bogen,1969.

Wada & Rasmussen. Intracarotid injection of sodium amytal for the lateralization of cerebral speech dominance. J of Neurosurgery,1960,17,266-282.

Wallace,R. & Benson, H. The physiology of meditation. Scientific American, 1972, (Feb) Vol 226,84-90.

Weiten, W, & Etaugh, C. Lateral eye-movements as a function of cognitive mode, question sequence, and sex of subject. Perc & Motot Skills, 1974, (Apr) Vol 38, (2) 439-444.

Wigan, A. The Duality of the Mind. London, Longman, 1844 as cited in Bogen, 1969.

Wood, E. Yoga. Penquin Books, 1973 Edition, Baltimore, Md, 273p.