Gravitation and the vestibular system as a source for development and for sustained health

"Further , we must ask what is the force that holds together the earth and the fire which tend to travel in contrary directions; if there is no counteracting force, they will be torn asunder; if there is, this must be the soul and the cause of nutrition and growth". Aristoteles (On the Soul)

"Depart from evil and do good, this is all that God desires of man, and it is the entire purpose of His Creation." Rabbi Luzzatto

Introduction

The Gravitational Force and the Nervous System

" The force of gravity prevails continuously everywhere on this planet and is of prime importance in permitting the nervous system to perform all aspects of its function".[1]

The influence of the gravitational force upon development and the importance of a well functioning vestibular system have been neglected thus far but are of interest in the research into a science of consciousness. Already Myrtle McGraw suggested that the challenge of overcoming gravity heightened consciousness.[2] Also the work Paul Schilder is clearly pointing in that direction.[3]

It is also of interest when it comes to the issue of sustainable health. We are in constant conflict with gravity. Therefore our evolutionary history can teach us how to get in better harmony with the gravitational force and with ourselves.

The most common connection between the gravitational force and the human nervous system is the vestibular system. The vestibular apparatus is the organ that detects sensations of equilibrium. "As Stanley-Jones (1960)[4] has pointed out, the sensory receptors of the vestibular apparatus in the inner ear responding to the force of gravity are non-adaptive and are the most important energy source for increased neuronal activity ".[1] The first parts are formed during the third week in utero and the system is functioning around the 8th week. This is also the time when the fetus´ first movements are detectable. Already Humprey (1965) pointed out a close correlation between structural and functional development in this part of the nervous system.[5] However, Prechtl (1984) does not believe the fetus has the capacity to respond to vestibular stimulation[6] while Odent´s (1986) opinion is "The vestibular system of the fetus is constantly being stimulated when the mother is walking , dancing, changing her position and so on".[7]

"Each function develops while the nervous system and its executive mechanism grow. The functions that are fully matured , or nearly so, at birth, remain strictly localised in the organs and in the nervous system. The breathing function, all the vegetative functions, the reaction to gravity, the circulation, in short, all the

elements of functions that need little or no apprenticeship, and no further growth of their material support or the nervous tissue concerned, continue to be localized. The localization of all the functions that need growth of the body, and in particular those that need growth of the nervous tissue and apprenticeship, becomes more and more diffuse at each successive level of maturity. At maturity, all these functions are practically a property of the whole organism, and the destruction of any nervous mass or organ, no matter how great the mutilation may be, cannot completely eliminate or abolish the function".[8]
Another connection between the gravitational force and man was proposed when Mittelstaed (1992) found gravity receptors in the human trunk.[9]
A third connection comes from Prigogine (1984) "But recall the Bénard cell; from a mechanical perspective , its instability is the raising of its center of gravity as the result of thermal dilatation. In other words, gravitation plays an essential role here and leads to a new structure in spite of the fact that the Bénard cell may have a thickness of only a few millimetres. The effect of gravitation on such a thin layer would be negligible at equilibrium, but because of the nonequilibrium induced by the difference in temperature, macroscopic effects due to gravitation become visible even in this thin layer. Nonequilibrium magnifies the effect of gravitation".[10]
"…/ I think that gravitation plays a more complementary role than a unifying role. In other words gravitation keeps things going. In thermodynamics, gravitation disturbs equilibrium, you cannot speak about equilibrium including gravitational forces. That comes from the long range character of the gravitational forces".[11]
A forth connection is offered by Pettigrew (2004): "I will conclude with a speculation on the role of neuronal mechanoreception in the detection of tiny gravitational forces that was first stimulated by observations on the gravity-anomalous mountain environments of Buddist retreatist meditators, but which receives support from diverse directions, particularly the new evidence for extreme sensitivity of mechanoreceptors that could signal small gravitational changes. Gravity may provide a new arena for the interaction of the physics and biology of consciousness".[12]

Primitive Reflexes or Fundamental Movement Patterns
We were born equipped with a set of fundamental movement patterns traditionally called primitive reflexes.[13,14] According to Touwen ,[15] primitive because the infant´s brain is considered underdeveloped compared to the adult brain and reflex because the infant´s brain is considered working on a reflex basis. Touwen´s conclusion is that the concept of primitive reflexes is wrong. The infant's brain is to complex to be explained in terms of primitive and reflexive. Instead of viewing the brain as a strictly hierarchical system we must understand it as a dynamic whole. He writes "How can the development of a complex system such as the central nervous system be conceptualized so that the entire system is involved in the developmental process? For an explanation, it is

possible to borrow from the field of thermodynamics. The developing nervous system can be considered as an 'open system', that is, it exists and grows because of continuous influx of energy and information.[16] An open system is not in equilibrium, but in a 'dynamic'state".[15]
As a consequence of Touwen's argument I find it more appropriate to use the concept of fundamental movement patterns instead of primitive reflexes.[17]

The Gravitational Force and Fundamental Movement Patterns
During the first years of life the subcortical activity is gradually followed by an increase of cortical influence.[18] The fundamental movement patterns (fmp) are supposed to be inhibited.[19] Vestibular stimulation and stereotypical movements, both of which are brain stem functions,[17,20] seem to be of great importance in this process.[21] The vestibular system is most sensitive to stimulation between 6 and 12 months.[22] This is the time when crawling, creeping and walking occurs. Fmp in their crudest form will be laid to rest, only to show up again in emergency situations. If the process of inhibition is incomplete and one or more of 'the reflexes' remain, partly or totally, uninhibited there will likely be problems.[23,24,25] Fmp acting from the subcortical level will continue to influence the person's movement behaviour. Through lack of vestibular response the psychological behaviour will also be affected[17,26] as "Emotions and instincts are linked to the activity of the primitive brain".[27] Instead of being an open system the nervous system will act as being a partly closed system.

Higher Cognitive Levels
At Vestibularis™, a school of fundamental movement education, in Mönsterås,Sweden, more than 600 children and youngsters with sensory motor problems have been trained according to the method Education in Balance™.[17] Most of our clients are healthy individuals with normal intelligence.
As the training moves along there is always improvement when it comes to movement behaviour. Also, as the nervous system is becoming more integrated, we find in our clients an increased awareness and a better ability to use higher cognitive levels. Our clients are gaining more insight and they are becoming more aware.[26]

Method

Over view and Initial Assessment

Clients at Vestibularis are mostly children and youngsters with concentration problems and / or learning difficulties. Presently the average age for starting the program is 9.4 years and for completing the program 12.1 years. Approximately 20 % are girls and 80 % are boys. The main hypothesis behind the training is that uninhibited fundamental movement patterns are a hindrance to further physiological and psychological development.

A set of fundamental movement patterns and postural reactions are tested as well as the client's ability to roll, creep, crawl and move in an erect position (Gross Motor Milestones). The ability to cope with rotation is also tested. Each test is scored from 0 to 4. '0' stands for no difficulties while '4' stands for severe difficulties.[28]

Criticism and Support

Touwen argued whether or not the reactions should be called reflexes.[15]

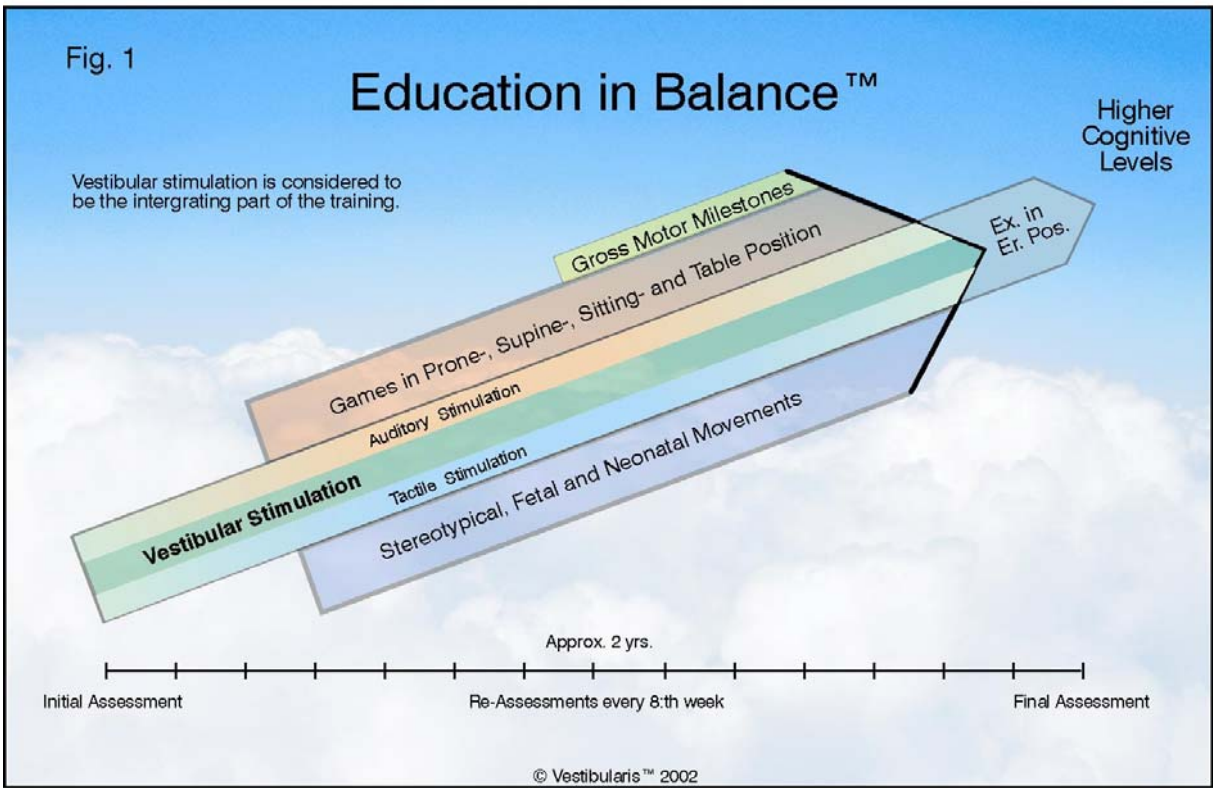
It has also been discussed whether or not they have a clinical value and if so, when? [29,30,31,32]

Capute's opinion that the reactions are the same in both infants and adults find support in different studies.[33,34,35,36,37] Burra et al (1980) also reported of reversible primitive reflexes in a case of adult psychosis.[37]

"Teitelbaum and his coworkers have pointed out tellingly, that recovery often parallels the sequential development of the behaviour in infants".[38]

Education in Balance ™

Training at Vestibularis follows the method Education in Balance[17,26] with the special aim of giving the nervous system a second chance to 're-connect' and to mature. The training is divided in into five integrated parts and follows the sequence of neural development. Contrary to main stream medicine we train our clients below the functional level. That is, we start with exercises in prone and supine positions (Fig 1).



1. Stereotypical,[39,40] fetal and neonatal movements. Devised by Blythe, Goddard Blythe,[24] Niklasson and Niklasson ,[28] following the patterns of the 'Primitive Reflex' system (fmp). "The early movements of the fetus and neonate, which were previously viewed as passive byproducts of rapid neural wiring are now viewed as interactive, that is, having a reciprocal effect on the underlying structure and function of the central nervous system".[23]
"During his development, a human being has to reproduce, or rather summarize, the process of evolution, particularly the stage in the womb. It is as if the history of life was imprinted on a kind of memory".[27]

2. Vestibular stimulation, we have found to be of importance for the integration of the stereotypical movements into the nervous system.[20,28]
"Stimulation of the vestibular nuclei generates muscle tone and liberates the nervous system from these infantile reflex patterns".[21]

3. Games with the special aim of enhancing muscle strength and body awareness.

4. Tactile stimulation.

5. Gross motor milestones. The unfolding [41] of rolling, creeping, crawling, walking and even talking [28] mirror the child's ability to defy the gravitational force.[42,43]

6. Exercises in an erect position. The last part of the programme is balance training on the functional level.

The client is training at home fifteen minutes a day according to a specially devised program and is re-assessed every eighth week during a period of at least 2.5 years.

7. Auditory Discrimination Training (ADT) is running parallel to the sensory motor training.

Final Assessment
The whole set of fmp and postural reactions as well as gross motor milestones and rotations are tested. Each test is scored 0 – 4.

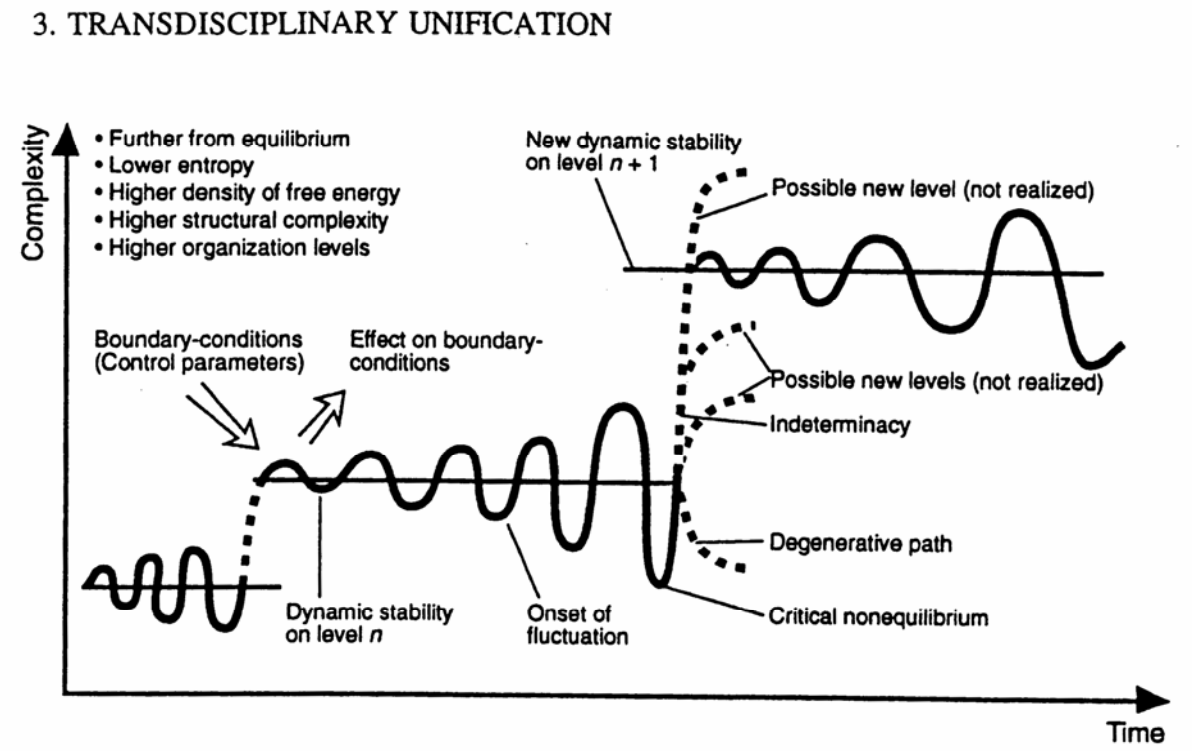
Result

The training follows normal infant sensory motor development - stressing the importance of vestibular stimulation for inhibition of the fundamental movement patterns.
During training we can observe that our clients, regardless of age, are following the same developmental pattern when it comes to psychological as well as movement behaviour.
At the end of the training we find it empirically evident that, as the fmp are suppressed, the Postural Reactions and the Gross Motor Milestones unfold. The Gross Motor Milestones are bifurcation points in the nervous systems' history.
Our preliminary results in a group of 60 children give measurable support to the hypothesis that it is possible to give the nervous system a second chance to mature despite age of the client.[28] These observations have fortified my opinion that we are pre-programmed concerning motor development.
During training we also experience that our clients' ability to handle vestibular stimulation improves. Their behaviour improves as well as their self-esteem. They also, in general, perform better at school and at work.

Discussion

Gross Motor Milestones have been imprinted fylogenetically through our evolutionary history and will unfold ontogenetically when the nervous system is stimulated properly and sufficiently. 'The "historical path" along which the system evolves as the control parameter grows is characterized by a succession of stable regions, where deterministic laws dominate, and of unstable ones, near the bifurcation points, where the system can "choose" between or among more than one possible future'.[10]

Fig 2



With kind permission from Floris books[44]

I speculate that 'fully developed',true, Gross Motor Milestones will make the nervous system more flexible and more easily restored if injured. Rolling, creeping and crawling will act as girders. The body in up-right position will also be in better harmony with the gravitational force. Therefore, the unfolding of motor milestones during the first year of life, or later, makes a difference.
An infant should be able to lift his head in prone to be able to develop creeping and crawling. If gravity is stronger than the infants ability to lift his head, 'true' creeping and crawling would not unfold. Development will use a different path which will give other bifurcation points. One risk might be that these bifurcation points are not as stable as the original, true, ones.

I speculate that one reason for choosing a different developmental path is that the vestibular system and the body's gravity receptors are unable to respond properly to the gravitational force. They will in various degrees fail to transmit the energy / force which is necessary for bringing the nervous system in harmony with gravity. When properly stimulated it will take the growing child about fifteen years to reach this harmony.[3]
Vestibular activity is a driving force when it comes to motor development as well as to mental development.
The developing nervous system is an open system and an open system is far removed from equilibrium and in a dynamic state. Vestibular stimulation will energize the nervous system, make it oscillate and move further from equilibrium. These oscillations might be what we see as mood swings and as improvement and impairment during training. These oscillations will also unfold the different sensory and motor milestones.
Regarding mental development Llinas wrote: 'So we have developed this simple rule that sort of brings together everything into one single entity we call the self. *It stands on the vestibular nucleus and pokes its head into the brain* - it has an up and a down to it, it has a visual component, a sound component, and so on'.[45]
Bergström, who has done influential research on the brain, has this view; "So 'matter' refers to the representation of material objects in the cortex and 'psyche' or 'consciousness' refers to the activity of the brain-stem. The 'self', then, refers to the *interaction* of these two brain processes – in this sense the self is between the 'psyche' and 'matter'. The 'self' refers to a third type of brain process which arises when the brain-stem activity ('psyche') and the cortical activity ('matter') meet".[46]
It is reasonable to believe that sensory motor development and mental development go hand in hand and that "thinking is a bodily function".[47]
Schilder (1935) wrote "We have only to add that where there is a vestibular after sensation it becomes the carrier of the ego. It is in this respect more important than the body-image based on other senses".[48]
Jaynes (1984) wrote: "At the present, a plausible nominee for neural substrate of consciousness is one of the most important neurological discoveries of our time. This is that tangle of tiny internuncial neurons called the reticular formation, which has long lain hidden and unsuspected in the brainstem".[49]
"In essence,then, the reticular formation provides the nervous energy to support the body against gravity. But other factors, particularly the vestibular apparatus, control the relative degree of extensor contraction in the different parts of the body, which provides the function of equilibrium".[50]
"Because the vestibular nucleii are intervoven into the reticular formation, any vestibular process may effect the entire reticular formation, while an activity anywhere in the reticular formation may influence vestibular responses".[21]
"Other phylogenetically old and early developing pathways, such as some of the reticulospinal tracts, probably participate also, as has been suggested earlier (…)

for internuclear connections probably reach cells of the reticular formation early in development, since the reticular formation is an old system phylogenetically (…)".[51] The reticular formation is not fully myelinated until after puberty. This brings us down to cellular level. Pribram (1999) wrote: "One of the most striking facts regarding neurons is that, when stimulated, neurons produce more RNA than any other tissue in the body (Hydén,1961)".[52] An interesting observation is that Hydén used vestibular stimulation in this experiment.[1]
One challenge for further studies would be to try to find a gravity receptor within the cell. If so, a very small charge in each cell will result in a huge gravitational charge in the totality of the human body. Finding the receptor might be helpful for the solution of the hard problem of consciousness, the problem of experience. " It is widely agreed that experience arises from a physical basis, but we have no good explanation of why and how it arises. Why should physical processing give rise to a rich life at all?"[53]
In the book of creation, Sefer Yetzirah, one answer is given."It is only in a physical being that good and evil can exist together. Although they are at opposite poles spiritually, they can come together in the physical man. One reason why God created man in a physical world was to allow him to have full freedom of choice, with both good and evil as part of his makeup. Without a physical world, these two concepts could never exist in the same being".[54]

Referenses

1. Hydén H. Biochemical Aspects of Brain Activity (1961). In: Pribram KH, ed Brain and behaviour 3, Memory mechanisms. Harmondsworth: Penguin Books Ltd, 1969.

2. Dalton TC. The ontonegy of Consciousness:John Dewey and Myrtle Mcgraw´s Contribution to a Science of Mind. *Journal of Consciousness Studies* 1999; **6:**3-26.

3. Hubbard DG, Wright CG. The Emotion of Motion. Functions of the Vestibular Apparatus. In: Shaskan DA, Roller WL,eds Paul Schilder. Mind Explorer. New York: Human Sciences Press.INC, year unknown.

4. Stanley-Jones D.& K. The Kybernetics of Natural Systems: A Study In Patterns Of Control. London: Pergamon Press,1960..

5. Humprey T. The Embryologic Differentiation of the Vestibular Nuclei in Man Correlated with Functional Development. In: Kirikae I. Vestibular and Ocular problems. Tokyo: University of Tokyo,1965.

6. Prechtl HFR. Continuity and Change in Early Neural Development. In: Prechtl HFR, ed Continuity of Neural Functions from Prenatal to Postnatal Life. London: Spastics International Medical Publications, 1984.

7. Odent M.Primal Health:A Blueprint for our Survival. London: Century Hutchinson Ltd, 1986.

8. Feldenkrais M. Body And Mature Behaviour. Tel-Aviv: ALEF Ltd, 1988.

9. Mittelstaedt H. Somatic versus Vestibular Gravity Reception in Man. In:Cohen B, Tomko DL, Guedry F, eds Sensing and Controlling Motion:Vestibular and Sensorimotor Function. New York: Annals of the New York Academy of Science vol 656, 1992.

10. Prigogine I, Stengers I. Order out of Chaos. London: Heinemann, 1984.

11. Prigogine I. Is Future Given. Singapore: World Scientific Publishing Co.Pte.Ltd, 2003.

12. Pettigrew J. Exploring Consciousness Using Perceptual Rivalry,with a New Proposal Linking the Physics and Biology of Gravity. Toward a Science of Consciousness 2004. Consciousness Research Abstracts.*Journal of Consciousness Studies*.

13. Capute AJ, Shapiro BK. Motor Functions: Associated Primitive Reflex Profiles. *Developmental Medicine and Child Neurology* 1982; **24:**662-669.

14. Capute AJ, Shapiro BK .Primitive Reflexes: A Factor in Nonverbal Language in Early Infancy. In: Stark ed Language Behaviour in Infancy and Early Childhood. Elsevier North Holland,Inc,1981.

15. Touwen BCL. Primitive Reflexes-Conceptional or Sematic Problem? In:Prechtl HFR,ed Clinics in Developmental Medicine No 94.Continuity of Neural Functions from Prenatal to Postnatal Life. Oxford: Blackwell Scientific Publications Ltd,1984.

16. Jacob F. Evolution and Tinkering. *Science* 1977; **196:**1161-1166.

17. Niklasson M. The Reaching of Higher Cognitive Levels Seems to Require the Overcoming of Gravity-A Description of a Method for Sensory Motor Training. Poster presentation. Toward a Science of Consciousness. Skövde,Sweden 2001.

18. Vygotsky LS. Psychology and Localization of Functions. *Neurpsychologia* 1965; **3:** 381-386.

19. Capute A, Accardo PJ. Developmental Disabilities in Infancy and Childhood. Baltimore: Paul H Brookes Publishing Co, 1991.

20. Guyton AC. Basic Neuroscience: Anatomy and Physiology. Philadelphia: W.B Saunders Company, 1991.

21. Robbins J. Vestibular Integration Man´s connection to the Earth. *Somatics* 1977; **Autumn:** 27-36.

22. Ornitz EM. Normal and Pathological Maturation of Vestibular Function in the Human Child. In: Romand R,ed Development of Auditory and vestibular system. New York: Academic Press, 1983: 479-535.

23. McPhillips M, Hepper PG, Mulhem G. Effects of Replicating Primary-Reflex Movements on Specific Reading Difficulties in Children: a Randomised, double-blind, controlled Trial. *The Lancet* 2000; **355:** 537-541.

24.Goddard S. Reflexes, Learning and Behaviour.Eugene, Oregon, U.S.A: Fern Ridge Press 2002.

25. Schilder P. Contributions to Developmental Neuropsychiatry. New York: International University Press, Inc, 1964.

26. Niklasson M. Childhood Playing is One Precursop for Sustained Higher Cognitive Skills and for Emotional Well Being. Poster presentation. Toward a Science of Consciousness. Tucson, Az 2002.

27. Odent M. Water and Sexuality. London: Arkana, 1990.

28. Niklasson M, Niklasson I. Evaluation of the Method Education in Balance. In work.

29. Scherzer AL. Primitive Reflex Profile (letter). *Developmental Medicine and Child Neurology* 1985; **27:** 126-127.

30. Editorial. Forgotten Symptoms and Primitive Signs. *The Lancet* April11 1987: 841-842.

31. Keshavan MS, Yeragani VK. Primitive Reflexes in Psychiatry. *The Lancet* May 30 1987: 1264.

32. Keshavan MS, Vikram Kumar YA Critical Evaluation of Infantile Reflexes in Neuropsychiatric Diagnosis. *Indian Journal of Psychiatry* 1979; **21:** 267-270.

33. Jacobs L, Gossman DM. Three Primitive Reflexes in Normal Adults. *Neurology* February 1980; **30:**184-188.

34. Huber SJ, Paulson GW. Relationship Between Primitive Reflexes and Severity in Parkinson´s Disease. *Journal of Neurology, Neurosurgery and Psychiatry* 1986; **49:**1298-1300.

35. Paulson G, Gottlieb G. Developmental Reflexes: The Reappearance of Foetal and Neonatal Reflexes in Aged Patients. *Brain* 1968; **91:** 37-52.

36. Basavaraju NG, Silverstone FA. Primitive Reflexes and Perceptual Sensory Tests in the Elderly-Their Usefulness in Dementia. *Journal of Cron. Disease* 1981; **34:** 367-377.

37. Burra P, Powles WE. A Typical Psychosis With Reversible Primitive Reflexes. *Can.Journal of Psychiatry* 1980; **25**.

38. Kolb B, Whishaw IQ. Fundamentals of Human Neuropsychology. New York:W.H.Freeman and Company,1990:716.

39. Thelen E. Rhytmical Stereotypes in Normal Human Infants. *Animal Behaviour* 1979; **27:**699-715.

40. Thelen E, Fischer DM. The Organization of Spontaneous leg Movements in Newborn Infants. *Motor Behavior* 1983; **15:** 353-357.

41. Bohm D. Unfolding Meaning: A Weekend og Dialogue With David Bohm. London: ARK PAPERBACKS, 1987.

42. Fay T. The Origin Of Human Movement. *American Journal of Psychiatry*. 1954-55.

43. McGraw M. Development of Neuromuscular Mechanisms as Reflected in the Crawling and Creeping Behaviour of the Human Infant. *The Journal of Genetic Psychology* 1941; **58:** 83-111.

44. Laszlo E. The Creative Cosmos: A unified science of matter, life and mind. Edinburgh: Floris Books, 1993: 59.

45. Llinás RR. i of the vortex: From Neurons to Self. Cambridge,Ma: The MIT Press, 2002.

46.Bergström M. Meaning and the Living Brain. In Pylkkänen P, ed The Search for Meaning. Wellingborough, Northamptonshire,England: Crucible,1989; 124-154.

47. Cotterill R.M.J. Cooperation of the basal ganglia, cerebellum, sensory cerebrum and hippocampus: possible implications for cognition, consciousness, intelligence and creativity. *Progress in Neurobiology* 2001: 1-33.

48. Peto A. To cast away. *Psychoanalytic Study of the Child* 1970; **25:**401-416.

49. Jaynes J. The Origin of Consciousness in the Breakdown of the Bicameral Mind. Boston: Houghton Mifflin Company, 1982.

50. Guyton AC. Structure and Function of the Nervous System. Philadelphia: W.B Saunders Company, 1972.

51. Humprey T. Some Correlations between the Apperance of Human Fetal Reflexes and the development of the Nervous System. In: Progress in Brain Research. New York: Elsevier Press, 1964: 93-135.

52. Pribram KH. Brain and the Composition of Conscious Experience.*Journal of Consciousness Studies* 1999; **6**, May: 19-42.

53. Chalmers DJ. Facing up to the Problem of Consciousness. *Journal of Consciousness Studies* 1995; **2, 3:** 200-219.

54. Kaplan A. Sefer Yetzirah. The Book of Creation. In Theory and Practice. York Beach,ME: Samuel Weiser,Inc.1997.