

Thalamic neuron theory: meridians = DNA. The genetic and embryological basis of traditional Chinese medicine including acupuncture

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Summary This hypothesis proposes a mechanism by which the genetic information contained in the one-dimensional genome may be converted into a three-dimensional body plan for development. Prior to mitosis of the fertilized egg, the chromatids, after being unpackaged from the chromosomes, link up to form a giant circular loop which is then folded upon itself into a wired-frame structure that embodies the architectural embryological developmental scheme. This intranuclear spatial body design is then translated into a three-dimensional cellular plan surrounding the fertilized egg with the positional value of each surrounding daughter cell preferentially activated by specific spatially oriented gene products diffused through the neatly arranged nuclear pores of the cell nucleus of the fertilized egg. This group of cells of the primitive embryo then leads to the formation of the Spemann Organizer, which directs embryological development of the brain as well as the rest of the body. The Spemann Organizer thus retains control over the CNS which in turn controls the development and functions of the peripheral tissues. The chains of cells that compose the Spemann Organizer, forming a homunculus in the image of the wired frame formed by the chromatids are believed to be the equivalents of acupuncture meridians. To support the hypothesis, evidence is also presented to substantiate the intimate relationships between the acupuncture meridians and embryological development, evolution, the central nervous system as well as the genome. This theoretical model is capable of dispelling the mystery of acupuncture, traditional Chinese medicine and myriads of modern clinical observations, and may have the potential to usher in a multitude of innovative therapeutic methods for many difficult to treat medical conditions.

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INTRODUCTION

It is well known that the genome determines an animal's body plan development and morphology. However, the exact manner in which three-dimensional anatomic complexity is generated from one-dimensionally ar-

ranged genetic codes remains a deep mystery. Phenomena associated with acupuncture have likewise perplexed modern medical minds. The mechanism by which the mere insertion of needles at strategic points of the body relieves symptoms of asthma, affects intestinal motility, rids chronic pain, or even influences gene expression remains unclear. There appears to be no anatomical equivalent to the system of meridians on which acupuncture is based. When these two seemingly unrelated mysteries are pondered together, both at the molecular and clinical levels, a plausible theory that addresses the aforementioned observations materializes.

Received 27 July 2001

Accepted 1 November 2001

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RELATIONSHIP BETWEEN THE MERIDIANS AND THE GENOME

Activating meridians via acupuncture and gene expressions

A number of investigators in recent years have shown electroacupuncture can both activate and suppress expressions of specific genes. The oncogene *c-fos* was found to be expressed extensively in the rostral ventromedial medulla such as the raphe magnus nucleus, gigantocellular reticular nucleus, intermediate reticular nucleus, etc. after electrical stimulation of the needles inserted to acupuncture points Zusanli (ST-36) and Sanyinjiao (SP-6) (1) in the legs. On the other hand, electroacupuncture at the Sanyinjiao point alone was shown to reduce the *c-fos* gene expression in the spinal micturition center of rats (2). In another experiment, arthritis was induced in mice by intradermal immunization with bovine type 2 collagen (C II). These animals were subsequently treated with electroacupuncture at Mingmen GV-4 (a point at the midline in the lower back) three times a week for 3 weeks. An assay of interleukin-1 β (IL-1 β) mRNA in splenocytes and cyclo-oxygenase-2 (COX-2) mRNA in macrophages demonstrates that both the IL-1 β and COX-2 gene have been suppressed by electroacupuncture (3). In another study, electroacupuncture was found to inhibit seizures induced by injecting penicillin into the hippocampus of the rat's brain. The injection of penicillin into the hippocampus normally increases the preproenkephalin (PPE) mRNA by 10-folds in brain structures such as the hippocampus, while electroacupuncture was accompanied by an alteration of the PPE mRNA concurrent with inhibition of seizures, suggesting that electroacupuncture is capable of altering the gene transcription for the biosynthesis of PPE (4). Others have found a combination of electroacupuncture and droperidol (DRO), a dopamine receptor agonist promotes the expression of proopiomelanocortin (POMC) mRNA in the central nervous system and prodynorphin mRNA in the spinal cord (5). Traditional teachings relate the therapeutic effects of acupuncture to the activation of meridians. If this concept is correct, the expression of genes must somehow be related to the functions of the meridians.

The system of meridians and genome are both circular in nature

The circular nature of the primitive genome Bacteria, one of the lowest forms of single cell organisms, usually possess a single chromosome in the shape of a complete loop whereas higher animals commonly have multiple chromosomes containing non-circular DNA in their cell nucleus.

A question not explored by other researchers is whether the ring structure in bacteria conveys some type of advantage to the organism. The author believes the circular nature of the bacterial genome may relate to the cyclical rhythms of nature such as the day and night cycle, the monthly cycle (different phases of moon and tides) and the cycle of the four seasons. The sequential and therefore cyclical activation of genes along this circular gene pathway results in the transcription and subsequent translation of certain genes and production of proteins at specific moments which confers special advantages to the organism to adapt, survive, and reproduce. For instance, the ebb and flow of the tides may coincide with the availability of an environmental nutrient; thus, timing changes in cell membrane permeability would allow a cell to optimally absorb such a nutrient with a greater economy of energy use.

In a string-like DNA molecule, gene activation proceeds lengthwise until it reaches the end which is quite a long stretch from the beginning; whereas in a ring-like structure, the end is the beginning and the cyclical activation can begin anew quite conveniently, affording the ring-like configuration a distinct advantage to perform cyclical functions.

This hypothesis could be tested in the laboratory by opening up a DNA ring at a junction that minimally disturbs the integrity of the adjacent genes and then observing if a cell's ability to respond to diurnal variation of the environment becomes obtunded.

The circular nature of the human genome
Several investigators from 1985 to 1994 discovered that human chromosomes in mitotic cells assemble into ring-like arrays (6-9). Nagele demonstrated that chromosomes in mitotic human cells are arranged into wheel-like rosettes from late prometaphase through completion of mitosis (10,11). More importantly, chromosome homologs (pairs of chromosomes designated by the same number) within these rosettes are consistently positioned on opposite sides and heterologs exhibit reproducible spatial inter-relationships that suggest a predetermined order (Fig. 1). This observation raises the question of whether chromosomes maintain orderly relative spatial relationships during interphase. This seems likely compared to the alternative possibility that chromosomal arrangement is purely random. It would intuitively seem more difficult for chromosomes to reproducibly realign in a predetermined sequence during cell divisions if there were not some persistently maintained physical order.

As an explanation for the presence of chromosome interconnectivity, it seems reasonable to speculate that as simple bacteria evolved into life forms with increasing complexity, the circular string of DNA grew too large

Chromosome Order in Rosettes

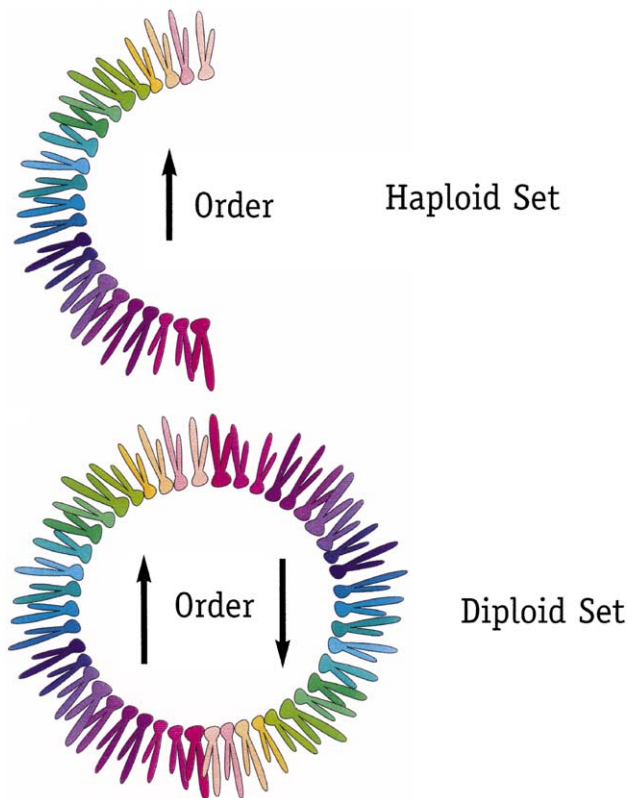


Fig. 1 Chromosome order in rosettes. Each parent contributes a haploid set of chromosomes which is then assembled at the first metaphase after fertilization in an end-to-end fashion into a diploid rosette. The internal order of the 23 chromosomes contained in each haploid is identical so that the homologs from each haploid are consistently positioned opposite one another. (After Nageley R. G. *et al. Chromosoma* 1998;107: 330–338.)

and unwieldy for efficient transcription and replication. The evolutionary solution could have been to separate and repackage this large DNA circle into distinct, yet contiguous sections equivalent to chromosomes, which can be reassembled into the circular configuration during cell division. Therefore, it is quite conceivable that the genomes of all lifeforms possess circular characteristics.

The circular nature of meridians

According to traditional Chinese medicine, meridians are defined as channels for the flow of qi or 'vital energy'. Stimulation of acupuncture points along these pathways adjusts or directs the flow of qi to alleviate a multitude of symptoms associated with various disease states which manifest concomitant abnormal qi distribution. There are a total of 14 of these unique energy channels, as on each side of the body there are 12

meridians in addition to two midline meridians known as the Governor Vessel and Supervisor Vessel (12) (Fig. 2). The Supervisor Vessel connects the mouth to the perineum along the ventral side of the body while the Governor Vessel begins around the perineum and travels up the midline of the back along the spine to the top of the head and then merges with the Supervisor Vessel in the mouth. Each of the 12 pairs of meridians is named after an organ. Half of these that course along the upper extremities are known as the hand meridians; the other half that travel to the lower extremities are known as the foot meridians. These hand and foot meridians also travel along pathways paralleling the body axis (i.e., head and torso). It is particularly noteworthy that the 12 meridians are sequentially linked, forming a complete loop in which the body's energy or qi takes exactly 24 hours to circulate (13). Thus, there are some interesting parallels between the circular spatial arrangement of the meridians and wheel-like structure of chromosomes during mitosis. However, more than interesting conclusions relating to these observations can be drawn when other characteristics of the meridians are studied.

The number of meridians and the number of chromosomes

The number of classical meridians is 12 plus the Governor and Supervisor Vessels for a total of 14. The number of human chromosomes is 46 in a diploid cell and 23 in a haploid cell. On the surface, there seems to be no relationship between these two numbers. Upon a closer inspection, however, an interesting correlation emerges. According to traditional Chinese medicine, each organ corresponds to a meridian. Since there are five solid organs: heart, liver, pancreas (spleen), lung and kidney and five hollow viscera: small intestines, gallbladder, stomach, large intestine and bladder, 10 meridians are accounted for. The two remaining meridians, namely the pericardium and trifoci meridians do not have associated specific organs. In a haploid set, there are 22 chromosomes plus one sex chromosome. If each meridian is equivalent to two contiguous chromosomes, 20 chromosomes are accounted for the solid organ and hollow viscera, leaving one for each of the non-organ-related meridians of pericardium and trifoci. Each haploid then contributes one sex chromosome each to form either the Governor Vessel or Supervisor Vessel. Since the meridians come in pairs, one on each side of the body, the two haploids contained in a cell may each represent the meridians on one side of the body. The question remains as to whether this is a purely coincidental finding or if there is a real physiological and genetic significance.

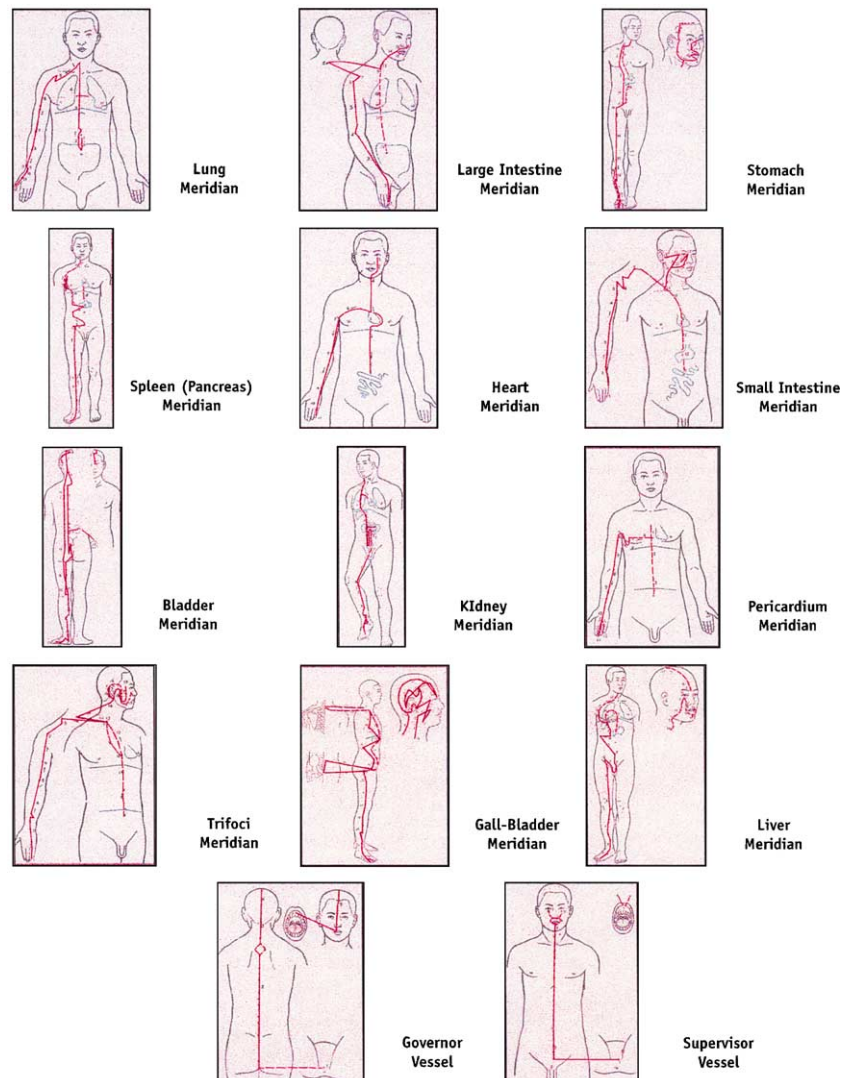


Fig. 2 The 14 acupuncture meridians. The 14 acupuncture meridians consist of 12 pairs of regular meridians distributed on both sides of the body plus the Supervisor Vessel (also known as Ren Mai or Conception Vessel) along the frontal sagittal line and the Governor Vessel (also known as Du Mai) located on the midline of the back. The Governor Vessel and Supervisor Vessel link up to form a loop. Not shown in the diagrams are connections between this midline loop with the regular 12 meridians which are also hooked up end-to-end forming a complete loop. Each meridian on this big loop is activated in 2 hours segments so the vital energy or qi that flows within the system takes exactly 24 hours to circulate the whole loop in the following sequence. The lung meridian emerges from the chest wall and travels along the upper extremity on the volar surface along the radial aspect to the thumb, and returns from the tip of the index finger along the arm on the extensor surface and the radial aspect towards the face as the large intestine meridian, which then connects with the stomach meridian that travels down the front of the torso through the nipples, the abdominal area and all the way along the anteriolateral aspect of the lower extremity to reach the second toe. It then turns around from the medial aspect of the big toe as the spleen (pancreatic) meridian upwards along the medial aspect of the leg towards the body cavity. The energy flow then re-emerges as the heart meridian and exits from the axilla to travel along the ulnar and volar aspect of the arm towards the small finger where it ends and becomes the small intestine meridian, turning back along the upper extremity on the extensor and ulnar aspect towards the shoulder, the scapula, neck, and head. Here it connects with the bladder meridian, which travels down the paravertebral area after bifurcating into two parallel channels down the length of the body towards the hip before merging into one again in the lower extremity and extends all the way to the small toe. The energy flow then returns along the kidney meridian starting at the ball of the foot and travels on the medial aspect of the leg and surges upward paramedianly on the front of the torso to the chest cavity. Once again the energy channel re-emerges this time as the pericardium meridian along the mid-portion of the flexor surface of the arm to the middle finger where it connects with the trifoci meridian that begins on the fourth finger and courses along the midline of the extensor surface of the arm and ends around the ear, where it continues as the gallbladder meridian to zigzag in the head a few times before traveling down the shoulder and the lateral aspect of the body and the lower extremity to the fourth toe. It then returns as the liver meridian from the big toe along the medial aspect of the lower extremity, up the abdomen and thorax and rendezvous with the lung meridian, completing this grand circle of 12 meridians.

RELATIONSHIP BETWEEN THE MERIDIANS AND EVOLUTION

Yin and Yang represent both a philosophical and a biological concept. Yang means sun and Yin means shade, or the lack of sun. As a general rule (except for one instance which shall be discussed later) all Yang meridians are located on the back or dorsal aspect of the body and extensor surface of the limbs; all Yin meridians are distributed on the front or ventral aspect of the body as well as the flexor surface of the extremities (Fig. 2). At first glance, these demarcated domains on the human body do not seem to fit the concept of Yin and Yang as defined by the presence or absence of the sun. However, if one envisions a human walking on all fours much like other animals, the definition of Yin and Yang suddenly comes to light. All the Yang designated areas of the body which include the back, the extensor surfaces of the upper limbs and the posterior and lateral areas of the lower extremities are indeed sun exposed; whereas the Yin designated areas of the body which include the front of the torso and the inside or flexor surfaces of the arms and the medial aspects of the legs are sun shaded.

This observation fits the Yin and Yang description quite well, except for two problems. First, in this posture the forward-pointing entire human face should be a Yang domain while the meridian system dictates that only the portion of the face above the upper lip is Yang and that below the lower lip is Yin, as evident from the course of the Governor Vessel, a Yang meridian and the Supervisor Vessel, a Yin meridian (Fig. 2). Second, the stomach meridian, supposedly a Yang meridian, travels from the face down the front of the torso (a designated Yin area) passing through the nipples. These discrepancies can be quickly resolved by having the human form assume the physical characteristics of a lower life-form such as a dog. With the snout jutting out from the face, the sun-exposed area is indeed above and sun-shaded area below the mouth, hence adhering to the rules of Yin and Yang distribution. In humans, the anterior-posterior dimension is usually smaller than the lateral dimensions. In other words, the human torso is wider than it is thick. In the lower forms of animals, however, this ratio is reversed, making the body thicker than it is wide, as in a horse or dog. If the human torso is squeezed from the side to remodel it into the shape of a dog or a horse, the stomach meridian will now be situated on the side of the body in the sun-exposed or Yang domain.

The meridian system is therefore more congruent with the body plan of lower lifeforms with which *Homo sapiens* share a common evolutionary origin. It is therefore reasonable to assume that the meridian system existed long before the emergence of humans.

RELATIONSHIP BETWEEN THE MERIDIANS AND EMBRYOLOGICAL DEVELOPMENT

Meridians and the germ cell layers

According to traditional Chinese medicine, the symptoms of infectious diseases often evolve in definite patterns (14). First, the Exterior or the Greater Yang system of meridians is involved which includes the most dorsal region of the body in close proximity to the spine; next to be affected is the Half-Exterior-Half-Interior or Lesser Yang system along the lateral aspects of the body, and finally pathology progresses to the Interior or the Radiant Yang system which travels along the front or ventral aspect of the body.

Close inspection of a blastula, an early multicellular embryo reveals that in a process known as gastrulation, cells migrate from the animal pole or dorsal aspect of the blastula, march toward the ventral side or the vegetative pole and then invaginate to form the gut of an animal (Fig. 3). Cells located dorsally evolve into the neural tube belonging to the ectoderm (exterior derm). The ventrally invaginated gut-forming cells are derived from the endoderm (interior derm) and the cells between these two layers represent the mesoderm (half-exterior-half-interior derm). Therefore, the bladder meridian (Greater Yang) corresponds to the ectoderm, the gallbladder meridian (Lesser Yang) to the mesoderm, and the stomach meridian (Radiant Yang) to the endoderm (Fig. 2).

Such parallels are not only anatomical, but physiological as well. The meridian system appears to have a great deal to do with embryological development.

The possible relationship between the eight congregation points and gene loci

According to the principles of acupuncture, there are eight points that are highly useful in treating certain general disorders, each of which is related to a general category of body tissues or functions listed in Table 1 (15).

It has been shown that stimulation of specific acupuncture points can induce expression of certain genes, and the embryological development of various tissues must necessarily be controlled by specific gene complexes. It follows that these so-called congregation points may somehow be related to specific gene loci on specific chromosomes that control the genetic development and functions of the various tissues. As a corollary of this concept, each acupuncture point is equivalent to a portal of access to a specific gene locus on the genome.

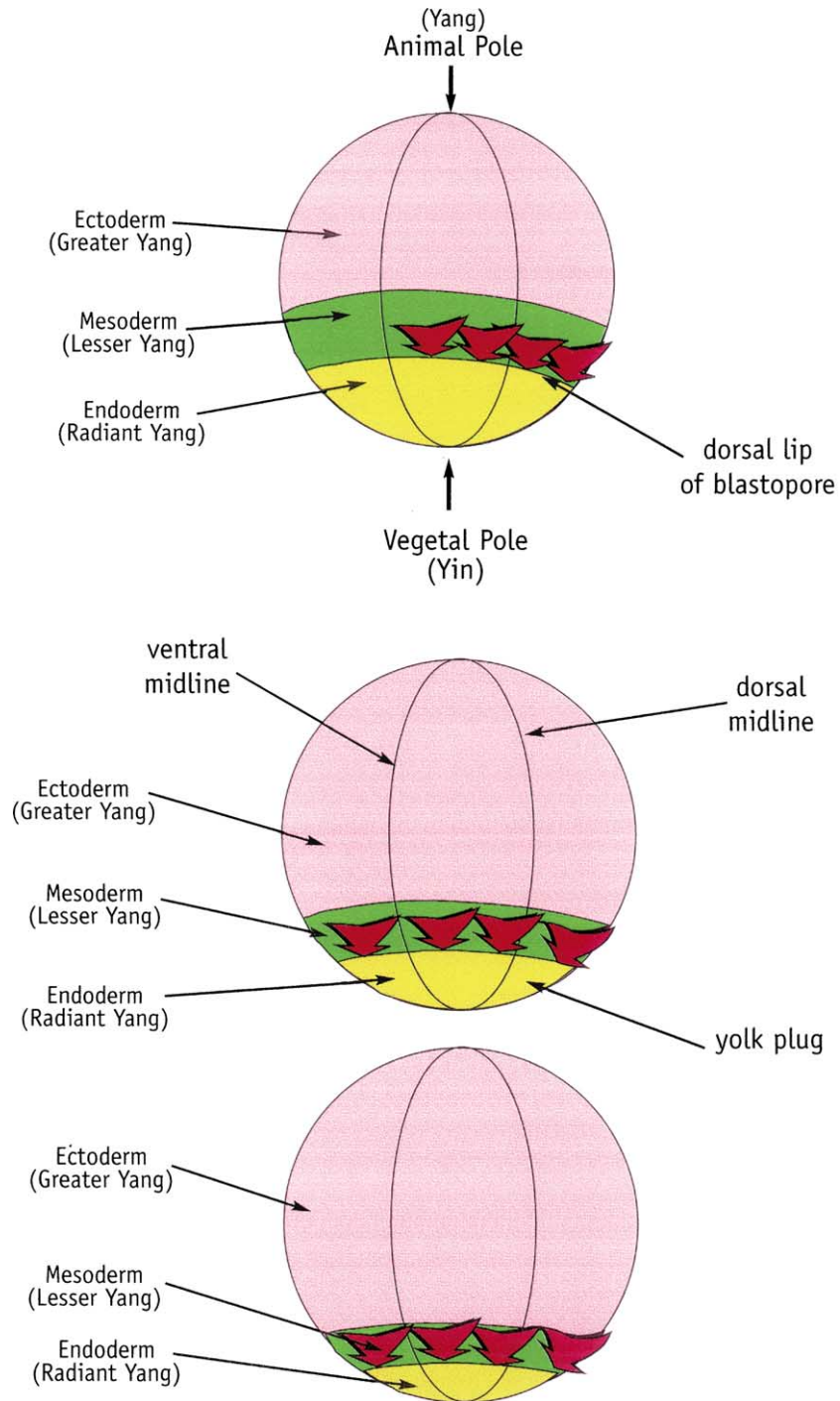


Fig. 3 The equivalence of the three germ cell layers with the three traditional Chinese medicine systems governing the exterior and interior of the body. The three germ cells layers are represented by three different colors. The direction of cell migration in a process known as gastrulation in embryology are from the animal pole (Yang) towards the vegetal pole (Yin). The arrows show the direction of cell migration which pushes into vegetal pole with the most ventral cells, eventually forming the gut of the organism, becoming the endoderm which is equivalent to the stomach meridian or the Radiant Yang system. The most dorsal germ cells become the ectoderm which is equivalent to the bladder meridian or the Greater Yang system, whereas the half-exterior–half-interior mesoderm is equivalent to the gallbladder meridian or the Lesser Yang system.

Table 1 Congregation points and related tissues or functions

Tissues and functions	Name of point	Anatomical location
Solid organs: heart, lung, liver, kidney, pancreas	Zhang Men LV-13 (Express Gate)	The distal end of the 11th rib
Hollow viscera: stomach, large intestine, small intestine, bladder, gall-bladder	Zhong Wan CV-12 (Torso Center)	Approximately midway between the tip of xyphoid process and the umbilicus
Qi (Vital Energy)	Shan Zhong CV-17 (Chest Center)	On the middle of the sternum between the two nipples
Blood	Ge Shu UB-17 (Diaphragm Transport)	Approximately $1\frac{1}{2}$ in. to the side of the spine between the 7th and 8th thoracic vertebrae
Sinews or tendons	Yang Ling Chuan GB-34 (Yang Dune Spring)	Between the tibia and the fibula proximally just below the knee
Blood vessels	Tai Yuan LG-9 (Grand Canyon)	Volar surface of the wrist just lateral to the radial artery
Bone	Da Shu UB-11 (Grand Ventilation)	Approximately $1\frac{1}{2}$ in. lateral to the spine between the first and second thoracic vertebrae
Marrow	Yuan Zhong GB-39 (Suspended Bell)	Approximately 3 in. above the lateral malleolus on the lateral side of the leg

RELATIONSHIP BETWEEN THE MERIDIANS AND THE CNS

Meridians can be considered as part of the infrastructure of certain brain nuclei

Thalamic neuron theory: A hypothesis concerning pain and acupuncture was published in 1977 in an effort to explain the various clinical phenomena associated with both chronic and acute pain and the efficacy of pain management techniques including trigger point injections, nerve blocks, as well as acupuncture (16). What troubles many modern scientists is that the meridians described in traditional Chinese medicine have eluded detection because there are no correlating gross anatomical structures in the body. The thalamic neuron theory (TNT) proposed that acupuncture meridians on the body surface are simply series of peripheral nerve endings along the imaginary lines of the meridians. These nerve endings eventually project onto a small structure in the brain that is organized as a homunculus or miniature human body shape. The existence of various homunculi in the brain was well documented decades ago (17). Since the homunculus represents the entire body, it would necessarily contain the anatomical equivalents of the meridians in the periphery. For instance, the large intestine meridian travels from the tip of the index finger along the outside of the arm to the face. A similar line could therefore be drawn on the homunculus in the brain from its equivalent index finger to face. Applying this concept, meridians can be equated to neuronal chains and acupuncture points on the meridian are merely clusters of specialized neurons.

Using this model, many clinical phenomena associated with not only acupuncture but also modern medical techniques such as trigger point injections and nerve blocks become eminently explainable. When certain segments of the meridians are activated in the periphery through stimulation of specific body points, corre-

sponding neurons in the central homunculus are likewise stimulated, initiating propagation along the nerve conduction pathway equivalent to a meridian, providing an easy account for the so-called referred pain patterns that are oftentimes unrelated to the segmental peripheral nervous system (18). Therefore, the traditional acupuncture meridians are composed of series of nerve endings at the periphery while the substance of the meridians actually exists in the brain as neuronal chains or pathways whose physiological effects are usually observed or experienced at the periphery.

The question now is how many such homunculi are there in the brain and how do they coordinate and function together? We may first consider that the present human brain has evolved from a 'primordial' brain which controlled basic bodily functions and served as a master homunculus. As evolution introduced new complexity and capacity to this ancient brain, it is reasonable to assume that these newer parts of the brain remained intimately connected with the primordial brain or its equivalent, as the newer brain can simply be viewed as the outgrowth of the old brain. As body plans became more complex through evolution, other homunculi must have evolved to take over the monitoring and the control of increasingly complex bodily functions. In the thalamus alone there are different nuclei subserving different sensory functions such as temperature sense, position sense, pain, etc. Logically they all connect to the primordial brain or master homunculus that coordinates and integrates all such functions. This theoretical approach is very useful in explaining why pain is often a complex sensation as feelings of numbness, tingling, burning, and weakness often intermix since these different homunculi or nuclei are interconnected and influence one another. Furthermore, the pain known as reflex sympathetic dystrophy, or complex regional pain syndrome, often spreads from one side of the

body to the other (19,20) and from the upper extremities to the lower extremities and vice versa. This can be explained simply by the capability of a group of abnormal neurons to gradually affect and convert their neighbors into abnormally functioning nerve cells, leading to the spread of pain with mixed sensations.

Modern anatomy and histology have clearly demonstrated that essentially all tissues including bones, blood vessels, tendons, intestines, and organs are innervated. The omnipresence of nervous tissue ensures a two-way dialog between the brain and the local environment of the periphery. All information collected by the peripheral nerves is sent ultimately to the brain. Since the primordial brain or master homunculus communicates and controls the entire brain, it follows that it relates to and controls the entire body. Logically then, the neuronal chains within the master homunculus, which communicates with the meridian-equivalent neuronal chains in other subordinate homunculi, can be considered the master meridian.

It remains speculative at this point as to which brain structure is the equivalent of the primordial brain. However, it seems to be safe to conclude that such structure must be small in size and located near the base of the brain, which is the most ancient part of the brain. Some of the structures in the thalamus, the hypothalamus, or even specific structures including the pineal gland may be viable candidates.

The gross neuroanatomical and neurophysiological equivalence of the meridians

In order to appreciate the roles played by meridians in health and diseases, one needs to look at the meridian system with a global in addition to the microscopic view just discussed. Although the primordial brain has the most seniority in the hierarchy of the brain, it alone cannot possibly deal with all the complex physiological or pathological situations occurring in the various parts of the body. It must somehow delegate its authority to other subordinate neuronal circuits. For this reason, the brain has evolved in many different ways to cope with increasingly complex bodily functions. Still, these new brain structures and functions must relate closely to the original master brain. According to traditional Chinese medicine, the emotional responses of anger or rage, muscular contractions and memory, all useful in fighting and survival, are controlled by the liver–gallbladder meridian (21). From a modern scientific standpoint, the temporal lobe which relates to anger, the motor cortex that controls muscle contractions and the amygdala that retains emotional memories (22) are all components of the liver–gallbladder system.

Hippocampus, a subcortical structure that relates to memory (23) and epilepsy (24) characterized by muscle contractions may also be considered as an offshoot of the gallbladder–liver meridian system that is in turn controlled by the equivalent neuronal chain in the master primordial brain. Consequently, when acupuncture points along the gallbladder meridian are stimulated, a portion of the neuronal chain equivalent to the gallbladder meridian in the master homunculus is activated which in turn activates related subordinate CNS components such as the hippocampus, amygdala, etc. Furthermore, the various functionally linked structures of the brain and peripheral areas including peripheral nerves and organs, may respond in a concerted manner. The meridian system is not only an anatomical entity represented by nerve cell chains within a certain brain nucleus but also a coordinated physiological response network modulating and modulated by the central nervous system.

THE INTERRELATIONSHIP OF GENOME, EVOLUTION, EMBRYOLOGICAL DEVELOPMENT, AND CNS

So far the following relationships have been explored:

- Meridian and genome;
- Meridian and evolution;
- Meridian and embryological development;
- Meridian and CNS.

While the meridian system remains an abstruse concept for modern medicine, the multiple relationships among the various components on the right-hand column of the above list have been clearly established.

The relationship between the genome, embryological development and evolution as illustrated by the HOX and HOM gene and the positional value of cells in embryological development

One of the most potent arguments in favor of the veracity of the theory of evolution is the embryological evidence, as different stages of embryological development generally recapitulate the process of evolution. In the very early stages, the embryos of various species in the animal kingdom such as mammals, reptiles, birds, and fish are remarkably similar in appearance, pointing to a common ancestral origin for these diverse lifeforms. Karl Ernst von Baer, the famed embryologist was said to be unable to distinguish the embryos of birds, lizards or mammals once the labels on the containers had fallen off (25). Recent work in molecular biology has further strengthened this concept.

In recent years, work with fruit flies or *Drosophila* has led to the discovery of HOM genes and later on the HOX genes for mammals that determine the development of the body segments in an anterior–posterior axis. What is exceptional about this gene complex is the fact that the spatial order with which it is arranged on the chromosome, such as the antenna, pedia, bithorax complexes, matches exactly to the order in which they are expressed along the axis of the body (26,27). There is a sequential activation of some kind operating along the axis of this gene complex from head to tail, causing the sequential development of the body segments along the anterior–posterior direction. Essentially, the body plan of the fruit fly is miniaturized along the chromosome. Remarkably, this head-to-tail developmental gene sequence known as the homeobox gene sequence is found in higher and lower forms of animals alike (28). The genes are arranged on the chromosome in a definite sequence with minor variations among different species including human and worm, strongly suggestive of the common origin of all creatures, which all adopt a head-to-tail body plan according to the same blue-print. These discoveries finally provide the biomolecular basis for the observation that ontogeny (embryological development) recapitulates phylogeny (evolutionary events).

Relationship between embryological development and the CNS

The importance of neural tube in embryological development

Embryological studies have demonstrated various anatomical components of the body are derived from the neural tube which is closely linked to the central nervous system, attesting to the role of the central nervous system in directing development.

The neurons are communication specialists

In a multicellular organism, the behavior of cells must be coordinated in order to increase the chance of survival of that organism. Different cells constituting different parts of the organism must share and utilize information in a coordinated manner to thrive. Cells generally communicate with one another by diffusion of chemicals through cell junctions, but this mode of communication is inefficient if the organism achieves any significant size. Nerve cells solve this problem by expediting communications via axons.

In more complex organisms, different cells specialize in different functions. It is often impractical for one group of cells to communicate simultaneously with a multitude of other cells. With the help of nerve cells, however, any specialized cell can simply feed the infor-

mation to nerve cells which receive information from various parts of the body. But what good is it if the information received cannot be acted upon? So the same nerve cells not only can process such incoming information but can also send out signals of instructions to the cells that originate the information. The simple network of neurons of simple organisms eventually evolved into the primordial brain containing the master homunculus, which by necessity must represent the whole body. Not only it is capable of receiving physical signals such as sensation of pain, touch, vibration and temperature, but also chemical signals representing the internal and external environment of the cells which it innervates through the peripheral nervous system. Such chemical signals may be quickly transmitted electrically by depolarization of the membrane of the neuron or slowly and chemically by neuronal retrograde transport (29,30). Conversely, the central nervous system can command actions of the peripheral cells using either the fast electrically activated system, for example, by signaling a muscle to contract in the withdrawal response from noxious stimuli, or the slow chemical signals to direct the peripheral cells to respond to an environmental demand such as the release of neurotrophic factors for muscle hypertrophy in response to exercise. The sensory nerve, in conjunction with the motor nerve or sympathetic nerve, acts as a two-way channel of communication that not only receives physiological information, but also effectuates physical or trophic changes. Such unique properties of neurons make them indispensable in guiding embryological development.

Cell migration and neural networking in embryological development

When the body of an organism reaches a certain critical size, the positional value of an individual cell may be more difficult to ascertain in that it is determined by the diffusion gradient of cellular molecular signals, posing difficulties for embryological development. Like a multinational corporation trying to establish a branch office in some remote area in the globe, it is easier to first send out company executives to set up shop locally before linking up with the headquarters. Similarly, migratory embryological cells often travel to a specific destination in the peripheral area of the body, colonize it, and then make connections with the central nervous system via neurons (31–33). The distance between the brain and the peripheral region may be so vast that a single neuron would not be able to make the necessary connection. As a result, multiple synapses may be needed to complete this channel of communication. Since these migratory cells carry biological address labels, they are conscious of what and where they are at

all times, so kindred neurons are destined to find and make contact with them (34). In this fashion, the construction of the entire body can be carried out smoothly with little tendency for error. The development of the body plan simulates the construction of a house with many rooms. The frame of the house is first constructed, followed by partitioning into different areas, which in turn are subdivided into rooms. Finally, wiring is installed, connecting different rooms to the central electrical panel, much like the establishment of nerve connections between the central nervous system and the periphery. Once again the nervous tissue controls the organization of the entire body.

THE ULTIMATE LINKAGE BETWEEN THE MERIDIANS AND THE GENOME

Upon review of the interwoven relationships of the genome, evolution, embryological development, CNS, and the meridians, it is not difficult to discern that an intimate relationship between the meridian system and the genome must somehow exist. To directly relate the macroscopic meridians on the surface of the body to the genome contained in the nucleus at the subcellular level is indeed a giant step, which fortunately has been substantially shortened by the concept that meridians are equivalent to neuronal chains in certain nuclei in the brain. Still the question remains as to how genes correlate with such neuronal chains. To further this hypothesis, one must first explore how the meridians relate to the architectural design of the body.

The architectural scheme of the master homunculus

It was postulated earlier by TNT that the structure of the master homunculus follows certain basic rules. These concepts, as we shall see later, will ultimately explain the close correlation between the meridians and genes. In order to appreciate the validity of these architectural rules, let us examine some of the long-observed acupuncture phenomena (35,36) that are so perplexing to modern science.

1. An acupuncture point on the vertex of the head known as Baihui (GV-20 or Grand Concourse) is useful for the relief of hemorrhoidal symptoms.
2. The Hoku point (LI-4 or Con-Valley) situated in the web space between the thumb and the index finger is used to treat diseases of the mouth and face. A right-sided problem is better treated with the point on the left hand and vice versa.
3. The Lieque point (LG-7 or Split Space) located on the distal part of the radius near the wrist is effective in relieving pain in the neck.
4. The point between the second and third toes called Neiting (ST-44 or Inner Court) is an effective therapeutic point for headaches and facial problems.
5. The Zusanli point (ST-36 or Leg Three Interior) is a well-known therapeutic point for abdominal problems.
6. The Foot-lingqi point (GB-41 or Foot Near Tearing), located between the fourth and fifth metatarsals in the foot, can be employed to treat painful and non-painful conditions around the waist because it is a controlling point for the belt meridian, an energy channel wrapping around the waist (a separate channel, not one of the 14 meridians).
7. The efficacy of acupuncture points, according to traditional Chinese medicine, often relates to their strategic locations where two or more energy channels (meridians) are merged. One such point is the Split Space point (mentioned in 3 above) where the lung meridian on the arm conjoins with the Supervisor Vessel, the energy channel along the midline of the torso in front. But Split Space point is located at the wrist, far from the chest. How is it possible that this point represents the meeting place of these two channels, one from the arm and the other on the midline of the body?

These curious facts as well as many others can be quite easily explained by the architectural plan of the master homunculus proposed by the thalamic neuron theory with the following rules or features (16) (Fig. 4):

1. Its head is tucked towards its tail or its head is buried into its pelvic region.
2. It has a large head, large hands and feet.
3. The distal portions of the hands and feet are crowded together and juxtapositioned against the face.
4. The distal parts of the limbs cross over to the contralateral side.
5. The whole structure is rolled up in the shape of a sphere.

These rules, though simple and straightforward, are reasonable in the face of available knowledge in biological sciences concerning embryological development. The most spatially convenient and economical way to package the body of an animal is to roll it up into a ball. With this packaging, the head is tucked against the tail in a manner similar to virtually all embryos in the animal kingdom. Generally, the more complex the physiological functions of a body part, the more complex is the neural network, and therefore requiring greater representation in the central nervous system; hence, the anatomical representation of the head, hands, and feet is more extensive. Furthermore, the spherical shape fits into the brain structure very well and is quite consistent with the shape of any brain nuclei.

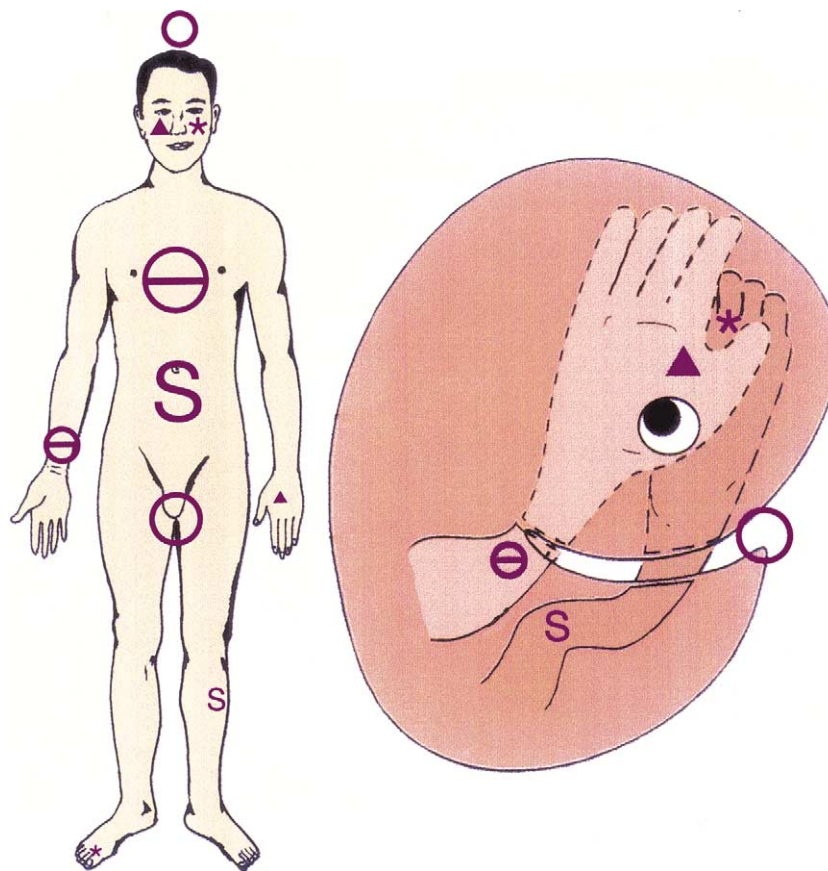


Fig. 4 Explanation of 'the therapeutic effects at a distance' of acupuncture points based on the thalamic neuron theory. The small symbol, for example indicates the location of an acupuncture point and the large symbol Δ indicates the area of pathology treated by the same acupuncture point. The area of pathology and the point used are separated by a great distance. According to the thalamic neuron theory, however, these great distances are more apparent than real because in the primordial brain or the master homunculus, due to its special spatial arrangement, the neurons representing the acupuncture points and the treated areas are actually physically adjacent. For instance, small triangle representing the hoku point between the thumb and the index finger can be used to treat facial problems because the web space of the hand and the face are on the same locale within the master homunculus, as shown on the picture of the homunculus on the right. Other examples include using the point on top of the head to treat hemorrhoidal problems, or using a point below the knee to treat abdominal problems and so on.

Employing this overall scheme, many enigmatic phenomena in clinical acupuncture can be quite easily explained. There may appear to be a great distance between a diseased area and the acupuncture points used to correct the disorder, but in the master homunculus, these points may be in close proximity. Therefore, stimulating the acupuncture point is more or less equivalent to stimulating the pathological area as represented by the neurons in the master homunculus, thereby inducing a healing effect. For instance, a group of hyperexcitable neurons situated on the left face of the homunculus causing left facial pain may be calmed by stimulating the Hoku point on the right hand. This stimulation sends a signal to the right hand of the homunculus that happens to be next to this group of abnormally excitable neurons on the face of the homunculus. This results in a down-regulation of their excitability, hence pain relief. In another example, since

the left hand crosses over to the right side past the midline of the homunculus, the Split Space point falls directly on the course of the Supervisor Vessel in the sagittal plane. Therefore, the point is in fact a meeting place for the two major channels, not unlike the interchange of the two major highways—hence the term convergent point, because it is where two meridians merge together. Due to this peculiar way in which the homunculus is folded, the therapeutic acupuncture point and the diseased area are often overlapped and in fact next-door neighbors. The head-tail configuration accounts for the efficacy of using the point on the vertex of the head to treat hemorrhoidal symptoms. Other puzzling observations quoted in the above discussion can be more clearly elucidated by reference to the diagrammatic approach (see Fig. 4).

As evident in Fig. 2, the lung meridian travels from the torso to the tip of the upper limb, then returns as the

large intestine meridian to the head, then along the length of the body to the tip of the lower extremity as the stomach meridian, then back to the torso as the spleen (pancreas) meridian, completing a set of four meridians. This process is then repeated two more times, eventually hooking up the last meridian (liver) to the first meridian (lung). In other words, it takes three such cycles to complete the circulation of the 12 meridians that, as mentioned earlier, are linked to one another beginning to end (12). This big meridian loop consisting of 12 segments has folded upon itself in several smaller loops which look like a big bundle bent in the shape of a horseshoe (37,38) (Fig. 5). The layout of these meridians looks like a wire-framed sculpture, which triggers the thought that if the big loop of meridians can be folded upon itself to form the architectural framework for the body, why not the long DNA loop, unpackaged from the chromosomes to form the chromatid, be folded upon itself in a similar fashion to become the master body plan for embryological development? This is certainly a

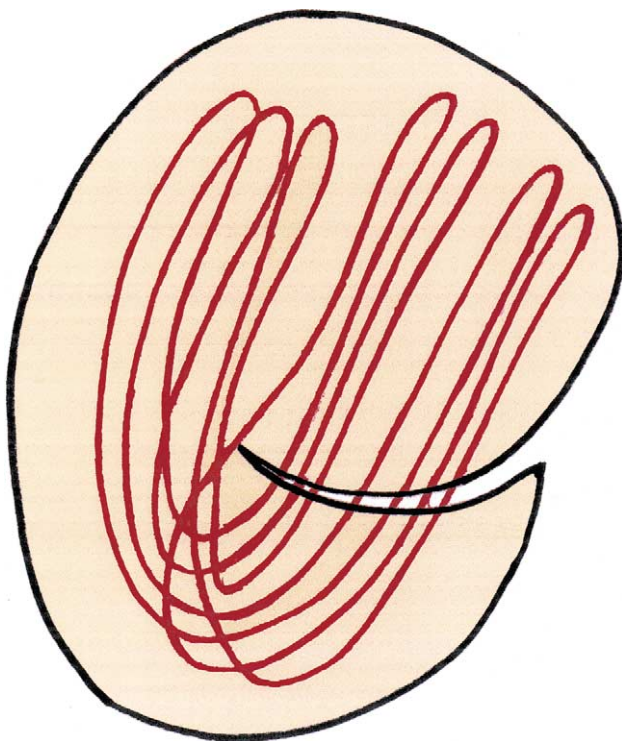


Fig. 5 The folding of the meridian loop. The meridians coursing to and fro along the extremities, the head and torso in parallel take the shape of a horseshoe shaped bundle in the master homunculus. Compare this figure with the right side of Fig. 4. This horseshoe shaped bundle is in fact one continuous circular loop folded upon itself a number of times. The chromatids within the cell nucleus, after unpackaged from the chromosomes may also be a large continuous circular loop, which after folding upon itself several times will appear like a random clump of spaghetti, despite a potentially highly orderly internal arrangement.

good answer to the question we posed earlier of how the one-dimensional genetic codes can be converted into a three-dimensional body plan. If the three-dimensional arrangement of the DNA in fact embodies the architectural plan of the body, how can these codes be translated to develop different parts of the body in an orderly fashion? Before we can answer this question, let us look at some of the recent advances in molecular biology as well as a not so recent experimental observation.

The potential relationship between the primordial brain and the Spemann Organizer

A well-known experiment was performed in 1924 by Spemann and Mangold using the embryo of frogs (*xenopus*). In this experiment, a small chunk of cells from the dorsal lip area of the frog's blastula, which is the ball of cells derived from the multiple cell divisions of the fertilized egg, was surgically removed and transplanted onto another frog embryo. Shortly thereafter, another tadpole develops around this transplanted group of cells forming a separate individual organism (39) (Fig. 6). This small chunk of transplanted cells, known as Spemann Organizer, apparently contains the body plan of a new

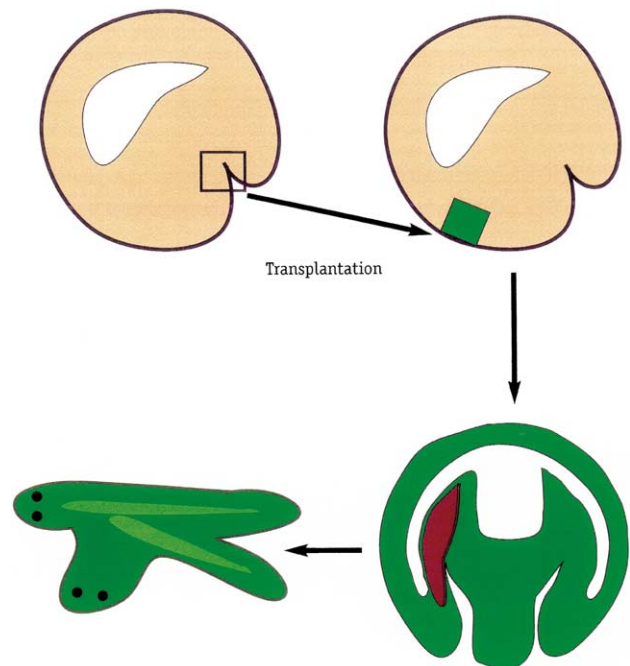


Fig. 6 The Spemann Organizer. The Spemann Organizer, a cluster of cells from the dorsal lip region of the blastopore for *xenopus*, when transplanted to another blastopore, will initiate the development of a second set of body structures in the second blastopore resulting in a siamese twin like structure, as the Organizer actually controls gastrulation (migration of embryonic cells). In other words, the Organizer contains the complete architectural plan of the body.

organism. No study has yet revealed the ultimate fate of the cells composing the Spemman's Organizer. What part of the body will they finally settle in? Could it have later become a key portion of the primordial brain or even the primordial brain itself?

The openings of the nuclear membrane and the cellular endoplasmic reticulum provide the mechanical means to facilitate the determination of positional values in daughter cells

Assuming there exists a highly precise structural order of chromosomes or chromatids within the cell nucleus, certain gene loci would be much closer to areas of the nuclear membrane in the same general 'geographic location' (see Fig. 7). Nuclear pores or the holes on a nuclear envelope have been shown to be distributed evenly in an orderly fashion, sometimes in parallel rows on the surface of the nuclear envelope (40,41). Transcription of

the chromatin underneath a specific nuclear pore produces RNA that can be quickly transported through this specific exit. Through cytoplasmic channels or endoplasmic reticulum, these molecules can be transported to parts of the cell membrane which bear a similar geographic address as the transcribed gene, i.e., the same general longitude and latitude on the cell surface, as those on the surface of the nuclear envelope. The nucleus may be viewed as a concentric sphere within another concentric sphere, the surface of the cell. These unique anatomical features allow a specific gene locus to preferentially export its products through these channels to a neighboring cell, conferring to it a positional value based on the gene products. Likewise on the opposite side of the nucleus, the opposite chromatid in this 'wired framework' produces a different positional value dictated by its gene address. The determination of positional values in such a way is especially important during the early stage of embryological development

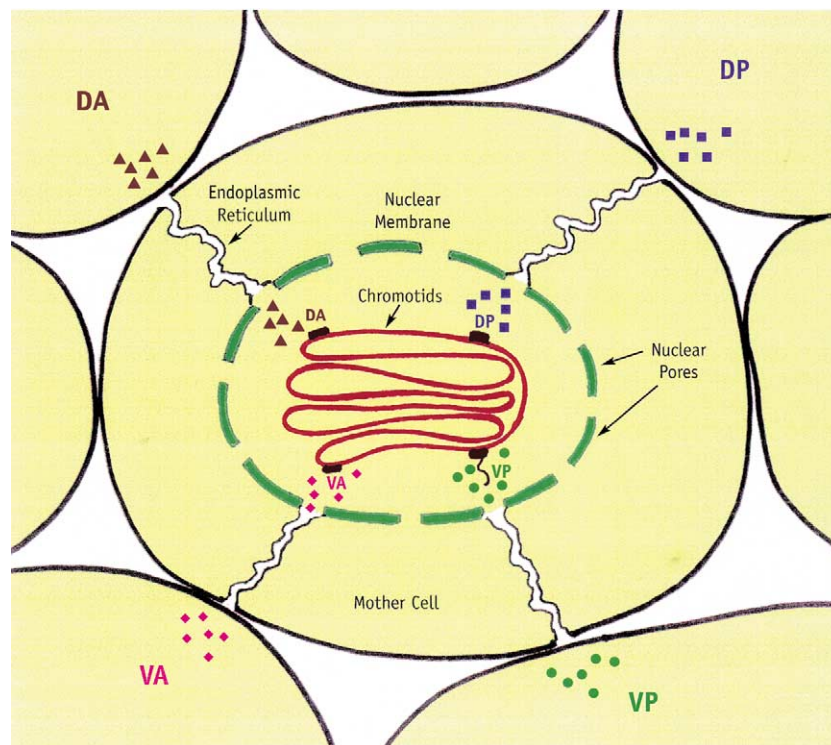


Fig. 7 The translation of the genetic one-dimensional body plan into a cellular body plan. The linear chromatid loop can be folded upon itself to create a scaffold or matrix, much like the wire frame of a sculpture to outline the design of a body plan. The large number of nuclear pores arranged orderly on the nuclear envelope can selectively transport gene products relating to a specific set of genes closest to this pore through the endoplasmic reticulum to the cell surface and to neighboring cells to activate the same genes in these neighboring cells. The relative positions of these cells bear with the mother cell will determine the kinds of genetic information they will obtain. The respective specific gene products will turn each of these cells into a factory for that same gene by activating its selected genetic machinery. For instance, the gene DA situated on the dorsal anterior aspect of the genetic matrix within the nucleus will convert the daughter cell on the dorsal anterior aspect (DA) into a cell that specializes in the production of the DA genes. Another cell that is immediately posterior to this cell DA will therefore activate a gene that is immediately posterior to the DA gene. The cluster of daughter cells will then each have its own positional value as well as specific genes that can be activated according to the spatial order on the genetic matrix within the nucleus, thereby converting the linear genetic information contained in the chromatid into a three-dimensional cellular plan, which is the prime candidate for becoming the Spemann Organizer.

when multiple cells are derived from a single fertilized egg. All the cells surrounding the original fertilized egg receive different positional values that constitute this miniature body plan.

THE SUBSTANCE OF THE RELATIONSHIP BETWEEN THE MERIDIAN SYSTEM AND THE GENOME

From the evidence so far examined, it is possible to propose a hypothesis to elucidate the actual relationship between the genome and meridians.

- First the condensed DNA strands, the long linear molecule with encoded genetic information get unpackaged from the chromosomes during cell division and link up with one another functionally, if not physically, in circular form.
- This long circular loop of DNA is then folded upon itself into a horseshoe-shaped multi-loop framework which is the three-dimensional architectural plan for embryological development.
- This master plan of the body contained in the nucleus of the fertilized egg then signals the surrounding daughter cells after each cell division to assume their respective positional values for the various parts of the primitive embryo. This end result is facilitated by the infrastructures of the nuclear membrane and cytoplasmic channels. The products of a specific gene location on the intranuclear DNA framework are preferentially diffused or transported through corresponding portals in the nuclear as well as cell membranes to adjacent cells, activating the same genes, causing these cells to become specialized in the expression of such genes. For instance, the high concentration of DNA and proteins transcribed from a set of genes on the dorsal aspect of the nucleus close to the north pole of the nucleus will cause the activation of the same genes in a daughter cell that is located on the dorsal aspect and near the north pole of the fertilized egg (see Fig. 7). The positional value given to each daughter cell allows it to specialize in activating only genes of *corresponding address* on the genetic loop contained in the original mother cell. Such a scheme is therefore capable of converting the three-dimensional intranuclear architectural plan composed of the DNA framework into a multicellular, properly spatially oriented but much enlarged copy of the genetic embryological master plan.
- This multicellular sculptured framework, or miniaturized body plan that controls the direction of development may in fact be the precursor of or even the Spemann Organizer itself! This structure may eventually evolve into the primordial brain containing the

master homunculus. Chains of neurons in the primordial brain are therefore the magnified image of the genetic framework embodied in the nucleus of the fertilized egg.

- New generations of brain structures are then formed as outgrowths of this primordial brain and remain neurally connected to it. Concurrently, the peripheral body structures are developed under the direction of the brain, which is in turn controlled by the master homunculus via efferent neural pathways including the peripheral nerves.
- The meridians may be viewed simply as imaginary lines on the body surface consisting of nerve endings ultimately connected to the neuronal chains on the master homunculus through multiple synapses. Different segments of this neuronal chain can be stimulated by acupuncture or other physical or chemical means to send signals to the subordinate brain structures, which in turn influence the peripheral organs and tissues to normalize their functions, hence achieving healing effects.
- In the system of meridians, the Governor Vessel, which travels along the midline of the dorsal surface, or the Supervisor Vessel, which travels from the mouth to the perineum along the midline of the front of the body, determines the body axis as well as the dorsal-ventral configuration. The Governor Vessel corresponds largely to the spinal column which is the key axis around which the body develops. The Governor Vessel may be the gross anatomical equivalent of the homeobox gene.

Modern acupuncture utilizes a numbering system to name the acupuncture points along the course of the meridians. For instance, LI-4 (Hoku point) is between the thumb and the index finger, whereas LI-1 is at the distal part of the index finger, and LI-11 is on the outside of the elbow. Different segments or different points along a meridian can thus be used as address labels identifying the parts of the body to which they belong. Similarly each gene location along the big gene loop folded into the horseshoe shaped bundle can designate an anatomical address. In other words, if the genes on the equivalent position of LI-4 on the big gene loop are activated, this cell would know it belongs to the web space between the thumb and index finger and would behave accordingly. Migratory cells during embryological development, after being given such an address label, may be able to migrate a long distance to settle down at a new home site in the periphery without forgetting its origin. They may even recognize and make connections with kindred neurons that grow long axons in search of them (42,43). This mechanism provides a practical means for cells situated in the periphery of the body to continue to

maintain communication with the 'headquarters' or central nervous system through proper neural networks.

Research performed with *Drosophila* has confirmed experimentally that cells in the early embryo know what body segment they belong to, whether it is the antenna, thorax or abdomen. The cells even know whether they are part of the anterior or posterior segments of the abdomen and can determine such positional values by a combination of genes, with the homeotic complex being the primary determinant. Positional value may also be related to the diffusion gradient of certain cellular molecules (44,45). Consequently, it is not unreasonable to theorize that the first cluster of cells derived from the cell division from the fertilized egg, though similar in appearance, may in fact have different positional values resulting from different gene activations of which the homeotic complex is an example. Therefore, an inherently different address label tells them to which parts of the body they belong. The original cluster of cells, the 'founding fathers' of the master body plan, may have evolved into the Spemann Organizer. Each small group of cells in the Organizer may have activated a specific set of genes and henceforth express those genes indefinitely, whereas the group of cells located anteriorly to the first group will similarly express a set of genes upstream from the first set of activated genes. Likewise, the cell group that is posterior to the first group will express genes posteriorly along the genetic loop. Therefore, in a sequential and orderly manner, the chain of cells will express the genes along the genetic loop. Such an array of cells arranged in an anterior-posterior axis behave like a giant DNA specializing on expressing gene functions in a head-to-tail manner. This primordial conglomerate of cells is the likely candidate for becoming the Spemann Organizer, which in turn is a prime candidate to evolve into the primordial brain or master homunculus as proposed earlier.

According to the present hypothesis, each acupuncture point has a specific location in the meridian system. It is equivalent to a specific address on a neuronal chain in the master homunculus, as well as a specific address in the genome. Stimulation of an acupuncture point is like activating genes or clusters of genes, their gene products as well as the physiological, anatomical and biochemical functions relating to such genes, thereby explaining the versatility of acupuncture in the treatment of myriad diseases.

PREDICTIONS BASED ON THE PREMISES OF THE CURRENT HYPOTHESIS

The entire hypothesis of the TNT has been constructed from well-established scientific principles, clinical observations, and deductive reasoning. The technique of

reverse engineering has been employed here by building a theoretical framework to explain established scientific observations and known clinical phenomena. Interestingly, the utility of this hypothesis is bolstered by its capability of making a number of 'postdictions' which can be defined as predictions after the fact. In other words the hypothesis was originally intended to explain clinical facts relating to pain and acupuncture only. As it turns out, it 'predicts' numerous other clinical phenomena that have already been known, which the hypothesis was not originally designed to explain. However, the single most convincing way of validating a theory is to make predictions that can be verified experimentally. The following are some predictions based on the current hypothesis.

At least one brain structure or nucleus fitting the spatial arrangement of the master homunculus should exist

The most reasonable location of this structure would be at or near the base of the brain that represents the most ancient part of the brain in the course of evolution. This structure might be extremely small but should be larger than the size of the human ovum because it is derived from it. No one has yet found such a structure with its internal organization taking the shape of a curled-up embryo with large head, large feet and large hands crossing over to the contralateral sides simply because no one has been actively looking for it. Conversely, it is technically difficult to experimentally isolate the somatotropic functions of individual neurons. The finding of such a nucleus, however, will go a long way to substantiate the theory.

The master homunculus representing the primordial brain is the remnant or direct descendant of the Spemann Organizer

Few investigators to date have yet queried the fate of the Spemann Organizer that is so important in directing the development of the early embryo. Does the Organizer finish its job and then submerge totally into oblivion, or die an uneventful death? Or does it further develop into a more definitive structure to continue its influence over the rest of the body? Are the component cells of the Organizer the same cells surrounding the fertilized egg initially or do they arise from a different region of the blastula? Teleologically, the same cells that are prime movers of development should remain as directors of bodily functions. Therefore, it is perfectly reasonable for the Spemann Organizer to be the master homunculus embodied by the primordial brain.

The genome is highly organized spatially

From the orderly arrangement of the sequentially located genes on the chromosome in the homeobox gene complex to the rosette formation during mitosis as discussed above, the genome is much more organized than previously thought. In addition, when we apply the meridian model or framework as the architectural blueprint for building body parts, the individual genes must have precise spatial positions within the genome. Based on the TNT hypothesis, individual chromosomes should line up in a predetermined order at the circumference of the rosette during mitosis for all cell types. Even during other phases of the cell cycle, when the chromatids seem to be randomly thrown together like spaghetti in the cell nucleus, there must still exist a very strict internal spatial order. Even before the chromatids condense into seemingly distinct chromosomes, they may in fact be linked to one another via a currently unknown mechanism pursuant to a predetermined sequence at all times. Judging from the head-to-tail sequence of the homeobox gene complexes which direct embryological development in the head-to-tail direction, the most economical way of translating this gene plan into action is by having the axis of the genes aligned with the direction of the axis of body development.

Spatial order and functions of the genes on the human genome correlate with the orders and functions of the meridians

The completion of the human genome project will pave the way to discover the functions of various genes. Theoretical considerations alone should predict the clustering of genes of similar functions serving a specific purpose in nearby gene loci, perhaps even on the same chromosome. The orderly arrangement of the meridians also dictates that genes with related functions will be on the same or adjacent chromosomes. For instance, according to traditional Chinese medicine, the gallbladder–liver system controls not only the liver but also the eyes, muscular contractions, the emotion anger, nail growth, etc. So genes relating to these functions should be found on the same segment of the genetic loop, more likely to be even on the same chromosome or contiguous chromosomes in the rosette formation during mitosis, for instance.

Deciphering the enigma of traditional Chinese medicine

The implantation of stem cells into the brain to treat Parkinson disease is a highly invasive procedure.

Utilizing knowledge of the meridian system and its connection to the CNS, an alternative approach may be found by implanting fetal cells in certain acupuncture points which would generate similar biomolecular signals to the brain via nerve transport. This approach would be much safer and could be easily repeated and may be the key to success in reconditioning neural circuits within the brain. Likewise, the application of therapeutic agents, such as neural peptides or local anesthetics at congregation points such as the blood congregation point and the marrow congregation point could provide correct messages to the CNS to induce remissions in conditions such as aplastic anemia where erythropoetic signals in the marrow have somehow been turned off. Unlike modern pharmacotherapy which distributes potentially toxic drugs to all parts of the body causing many untoward side-effects, this kind of therapeutic message which we shall call 'chemoneuromodulation' could be used with a high degree of specificity with doses far below the threshold of producing harmful effects.

Designing innovative therapeutic approaches

The meridian concept is not only crucial in rendering acupuncture treatments, it is also the very foundation on which a multitude of herbal agents are prescribed. The meridian syndrome describes what happens clinically if a certain meridian of the body has gone awry functionally. Therapeutic agents both of herbal and animal origin are classified according to their therapeutic properties in relation to the meridians. For example, the herb dong quai, a well-known agent in the treatment of women's diseases is considered an active agent on the gallbladder–liver meridian, whereas ginseng acts on heart, stomach, and spleen meridians. Most of the therapeutic agents used in traditional Chinese medicine have dominant effects on the central nervous system. Furthermore, different medical agents cause expressions of different genes, as has been demonstrated extensively experimentally. Likewise, modern drugs can also be classified according to the meridians they interact with. As these meridians can be considered the alter egos of the genome, influencing the functions of the meridians by various physical and chemical means can therefore affect the physiological, anatomical and pathological processes, which are all ultimately controlled by the selective expression of the genome. In fact the efficacy of herbal treatments and acupuncture can be rather amply explained on the basis of traditional Chinese medicine, a body of knowledge derived from the observations of the central nervous system, which acts as a surrogate commander for the genome and its interaction with the environment.

SUMMARY OF THE CONCEPT OF MERIDIANS = DNA

The different chromosomes are actually different segments of the primordial DNA loop originating from the early ancestors of modern man. This one-dimensional loop is folded upon itself into a horseshoe-shaped bundle constituting the scaffold or matrix of the body plan. These spatially oriented genes deliver address labels to neighboring daughter cells. This group of original cells then becomes the Spemann Organizer consisting of chains of cells that specialize sequentially in the activation of consecutive segments of genes, thereby creating an enlarged cellular genetic machine patterned after the gene loop. This organization of cells becomes the master homunculus or primordial brain that directs the growth of the various parts of the brain which eventually connect with the entire body. The nerve endings along the pathways of the meridians on the body, after various synapses, ultimately project onto the neuronal chains of the primordial brain. The meridian system is therefore yet another oversized image of the neuronal chains constructed according to the master plan embodied by the chromosomal framework within the cell nucleus of the fertilized egg. This concept, meridian = DNA explains a multitude of clinical phenomena not only in traditional Chinese medicine but also in modern medicine and provides a theoretical framework from which new therapeutic strategies may be formulated.

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