SCIENCE OF LIFE

Translation of Original Text of Santiago Bovisio

SCIENCE OF LIFE

INTRODUCTION TO THE COURSE [1]

Immersed in the perspective of our day-to-day reality we tend to take life for granted. We seldom have the time or the inclination to ponder its origins or mechanisms. Fortunately, for centuries scientists have been doing just that with their observations and methodology. "Science of Life" is a look into the description of life which scientific inquiry has formulated. Moreover, there are descriptions and concepts in the course that go beyond the present day scope of what science knows. We must remember that there is much that is not yet known or understood. Scientists continue their investigations into the immense body of knowledge that still awaits discovery. The best tool for understanding has always been, and will continue to be, an open and discerning mind.

In the first Teaching of this course a number of different atoms that sustain and constitute the life of human beings is described. As it is stated in the Teaching none of these atoms are yet known to modern science since they cannot be detected by current physical and chemical methods. Therefore, the knowledge of these atoms is metaphysical. Throughout the course phenomena are described that are also in the realm of the metaphysical. That this knowledge cannot be verified by modern scientific technique does not mean it should be rejected. On the contrary, this course provides us with an opportunity to explore knowledge which may be a gateway to our future understanding of what life is.

Over a period of 200 years between the late 17th and late 19th centuries and beginning with the development of the microscope, the fact that many diseases are actually caused by particular microorganisms that can be transmitted from one person to another was discovered. In the 16th century, before any of this had been demonstrated, Girolamo Fracastoro wrote a philosophical treatise about a contagion principal that was passed from one individual to another and caused disease. In the 16th century the idea that some diseases are caused by transmissible agents was in the realm of the metaphysical; by the 19th century, with the advances in science like the microscope and other tools, transmission of disease was physically demonstrable.

There are many other stories of advances in knowledge that moved from the unsubstantiated to the demonstrable, as our ability to measure and detect phenomena developed. In fact, this scenario has been repeated so many times that inherent to the scientific method is the principle that because something cannot be measured does not mean it cannot exist. The natural extrapolation of that principle is that there are certainly things beyond our current capacity to measure. For example, recent advances of science into the mysteries of the vast cosmos and the miniscule subatom reflect a Universe far more mysterious than our sophisticated 20th century mindset may have ever suspected. Nearly 400 years ago Shakespeare reflected this principle of science in a short exchange between Hamlet and the scholar Horatio after Hamlet had spoken with the ghost of his father:

Horatio: O day and night, but this is wondrous strange!

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1 The Introduction and the Comments in this course were written by students of Santiago Bovisio.

Hamlet: And therefore as strange give it welcome. There are more things in heaven and earth, Horatio, than are dreamt of in your philosophy.

LIFE

First Teaching

The Spirit manifests itself in the Universe through Life.

Man is the prototype of Life on Earth.

Life is always Mind, Energy and Matter. This Law can be observed both in the Macrocosm and in the Microcosm, in man as well as in the atom.

Universal Life, the daughter of the Soul of the Cosmos, is the great body of the Spirit of the Universe.

This immense universal body has inseparable parts, although in appearance independent from each other, in the planetary chains. In turn, the planetary chains have their material parts in the different planets; and the physical bodies of all the men from Earth are part of its physical body.

So is, also, molecular and atomic Life.

The atoms that sustain man's life on Earth are:

1. Ponderable atoms.
   Tese atoms give rise to material Life; they continuously attract each other.
2. Imponderable atoms.
   They sustain mental Life; they repel each other.
3. Dynamic atoms.
   They alternate being ponderable and imponderable; they sustain energetic Life.

The interaction between the atoms is maintained by tension, relaxation and equilibrium.

A specific aspect of Life predominates in each atom, but all the remaining aspects are potentially present.

The atoms that constitute man's life are the following:

1. Solid atoms. They have a square shape.
2. Liquid atoms. They have the shape of an inverted half moon.
3. Luminous atoms. They have a triangular shape. They belong to the group of ponderable atoms.
4. Gaseous atoms. They have a spiral shape.
5. Magnetic atoms. They have a circular shape.
6. Radioactive atoms. These atoms belong to the group of dynamic atoms.
7. Mental atoms.

The superman could rely on:

8. Mental atoms of long wave, or Will.
9. Mental atoms of short wave, or Consciousness.

The mental, mental of long wave and mental of short wave atoms belong to the group of imponderable atoms.

All the atoms mentioned in this Teaching are of a subtle nature, not known as yet to the biologists, since they can not be detected with the current physical and chemical methods.

In their totality, these atoms can be called X atoms, to differentiate them from the known atoms, which are called H atoms.

The X atoms are generated by other atoms of more subtle nature which are called X2 atoms.

COMMENTS ON THE FIRST TEACHING

"The spirit manifests in the universe through life."

The most agreed upon scientific theory today concerning the origins of life in the Universe is the so-called "Big Bang" Theory. According to this theory, before the birth of the Universe there was nothing. This "nothing" is referred to as a point of "singularity" —an infinitesimally small point in which the known laws of scientific method and observation do not pertain. For unknown reasons about 10-20 billion years ago, all the matter of the Universe erupted from this single point in an instant. Initially, this matter was homogeneous and undifferentiated, but almost at once it began its evolution into the differences that we see today - from neutrons, electrons, and protons to atoms and molecules, and ultimately to stars and galaxies. Moreover, through the processes of stellar evolution and supernova explosion, the matter of the universe continues to evolve and produce all the material of life that we know today.

"Man is the prototype of life on earth."

The human being occupies a unique place in the Universe. In the realm of size this is certainly true, for science has shown that halfway between the size of an atom and a galaxy is a human neuron (brain cell). In Western thought "man" has always occupied the central role of life on earth. This is described quite clearly in the Bible in the first chapter of Genesis. However, it should be noted that many Eastern religious philosophies and the traditions of native North Americans do not necessarily give man such a central place in this world.

"Life is always mind, energy, and matter."

The oneness of energy and matter is well described in relativistic terms by Einstein's famous "$E = mc^2$". Scientific discoveries into the quantum nature of the atom and into the behavior of subatomic particles specifically verify this unity in the microcosmos. The studies of modern astronomy confirm this as well on the stellar and galactic levels of the macrocosmos. A major quest of scientific investigation presently is to unify all these laws of the Universe under a single "Grand Unified Field Theory." Gravity, electromagnetic radiation, and strong and weak nuclear forces could then be perceived and described as one force. Indeed, this is how it must have been in the beginning at the time of the "Big Bang."

Thus science strives to advance the understanding of the properties of energy and matter. But what of "mind?"

What is this quality of "mind" and how does it come into being? This is a fundamental question, and as yet no scientific theory can give an answer. When does the "inanimate" become "animate"? Indeed, is any bit of matter-energy truly inanimate? How does consciousness originate? How does it work? This knowledge eludes scientists. It is an area in which their methodology is very difficult to apply, though much research is presently in progress in this area. Perhaps the ancients already knew the answers to the presence of "mind" in all of life, though certainly in a more intuitive way. After all, the Hindus viewed the creation of the universe in cycles of "Brahmin dreaming he is Brahmin." In this system, the "mind" doing the dreaming is the preeminent component of the universe. Animistic religions have always acknowledged the presence of a living mind or spirit in everything - rocks, trees, plants, and animals.

"This immense universal body has inseparable parts... and the physical bodies of all men from earth are part of its physical body."

"We are stardust." This familiar quotation has been used in song and poetry. According to current scientific thought, it is quite literally true. Every atom constituting the Earth and all its inhabitants (indeed, our entire Solar System) has been generated from supernova explosions of massive end-stage stars. The universe is mostly empty space and some hydrogen atoms, very little else. In the life of stars, the hydrogen undergoes fusion into helium and energy is released. In some instances at the end of its life span, a star will go "supernova" —bursting apart and subjecting simple hydrogen and helium to collossally powerful nuclear reactions creating the far heavier and diverse atoms that make up our familiar world. These atoms are spewed out far into the galaxy, ultimately to condense into the formation of another star, perhaps with planets, as occurred in the case of our Earth 4 billion years ago.

References and related reading

"A Brief History of Time", Stephen W. Hawking, Bantam Books, 1988.
"Astronomy" magazine, Kalmbach Publishing Co., (numerous articles on Cosmology for the lay person). Recent references: "Beyond the Big Bang", Vol. 20, No.4, p.30, April 1992.
" Galactic Archaeology", Vol. 20, No.7, p.28, July 1992. "COBE's Big Bang",Vol. 20, No.8, p.42, August 1992.

ATOMIC PHYSIOLOGY

Second Teaching

The functioning of the human body depends on the harmony among the different atomic groups.

The elements necessary for the formation and organization of the *ponderable* atomic groups are extracted from the Cosmic Ether through food.

The elements necessary for the formation and organization of the *dynamic* atomic groups are extracted from the energetic aspect of the Cosmic Ether; and those which form and organize the *imponderable* atomic groups are extracted from the Cosmic Ether itself through the Centers of force, or Ethereal Wheels.

The alchemists and medieval physicists called the ponderable atoms "salt", the dynamic atoms "sulphur", and the imponderable atoms "mercury".

The discharge of the ponderable atoms enriches the Earth and its fauna; that of the dynamic atoms enriches the air, the climate and the flora; and the discharge of the imponderable atoms enriches the Earth's aura, the elemental forces of Nature and the life of the collective souls.

It is necessary to take into consideration which part of the body the different atomic groups act on in order to know the origin of the different illnesses.

The ponderable solid atoms provide the body with all the different minerals, the main ones being phosphorus and calcium. Scientists know of the existence of many minerals in the organism, but they do not know them all, because some are present in infinitesimal amounts.

The ponderable atoms influence the skeleton, the muscles and growth. They give vitality to the body. They are eliminated in great quantities through the sperm; or they are reabsorbed by the blood. In the Astral World they have a square shape; and they correspond to the Fundamental Wheel.

The ponderable liquid atoms provide the organism with water, which contributes one third of the total weight of the human body. Water is present in all the fluids of the body, in combination or crystallization with other compounds.

The ponderable liquid atoms are involved in the production of carbohydrates such as glucose and sucrose, as well as in the production of proteins. They especially influence the organs of vegetative life —stomach, intestines, liver, kidneys and spleen— and have significant preponderance in the development of the different stages of life, diminishing slowly with age. They give flexibility to the body. These atoms are eliminated through the kidneys by the urine and through the skin by sweat. In the Astral World they have the form of an inverted half moon; they correspond to the Splenic Wheel.

The ponderable luminous atoms provide the body with lipids such as fats, glycerides, and soaps. They constitute the fatty sheaths which envelop the nerves, are found within the nerve cells and especially influence the sympathetic nervous system. These atoms give heat to the organism and are absorbed by means of the different combinations that they form with the pancreatic juice. They keep the nervous system

in good shape, generating the energy which maintains the body's resistance and adapts it to life.

The ponderable luminous atoms are eliminated by transformation into chyle, through the excrements, by ossification and by internal combustion. In the Astral World they have a triangular form; they correspond to the Solar Wheel.

The dynamic gaseous atoms provide the body with the three fundamental movements: respiratory, circulatory and the peristaltic movement of the digestive system. These atoms have an influence on the lungs, the blood and the digestive juices. They especially form oxygen, which is present in almost all organic compounds. They are in the blood, constituting the matter that gives color to the hemoglobin in the red blood cells. They also form hydrogen which is generated in all processes of organic decomposition.

The dynamic gaseous atoms give movement to the body, and put it in contact with the exterior atmosphere. They are a part of the composition of enzymes and toxins and their elimination takes place through the latter. In the Astral World they have a spiral shape; they correspond to the Cardiac Wheel.

The dynamic magnetic atoms provide the body with acid compounds such as aromatic, uric and bile acids, and with alcohols and esters. The proportion of these substances depends on the magnetic charge, which will determine health or illness of the organism. These atoms have an influence on the different magnetic currents which run in the body through the blood and the two nervous systems. They provide the organism with magnetic lymph and energy. They are eliminated through the blood. In the Astral World they have a circular form; they correspond to the Laryngeal Wheel.

The dynamic radioactive atoms provide the body with the glandular system. They circulate through the magnetic threads that connect the different glands and they alternate between periods of activity and rest. Good glandular function depends on the perfection of this rhythm. These atoms provide the body with the different emotions necessary for life, and through the endocrine movement they give inner sensibility. They are eliminated by the external secretion of the emunctories; they correspond to the Visual Wheel.

The imponderable mental atoms provide the body with the three cerebral masses: the cerebrum (with the spinal cord), the cerebellum and the solar cerebrum. Their centers of force are located in the pineal gland, which is the point of contact with the Spiritual Entity of the being. These atoms provide the brain with the charge necessary to discern. They are eliminated through the superabundant mental waves; they correspond to the Coronal Wheel.

COMMENTS ON THE SECOND TEACHING

"...and those which form and organize the *imponderable* atomic groups are extracted from the Cosmic Ether itself through the Centers of force, or Ethereal Wheels."

The Centers of Power or Ethereal Wheels, also known as Lotuses or by the Sanskrit word "Chakras" (which means "wheel"), have been described in Indian writings about

Tantrik Yoga and are based on the Tantrik nervous system. The "westernization" of the Chakras is an approximate correlation of the Tantrik nervous system with western anatomy and physiology. Chakras have been defined as the subtle centers of operation in the body (of mind, life and matter) or the principles which constitute the bodily sheaths[1]; the psychoenergetic vortices forming the major centers of the body (of life energy)[2]; a series of wheel-like vortices or saucer-like depressions which exist in the surface of the etheric double of man[3]. The etheric double is described as a physical part of the body, invisible to most, which is of great importance to us, for it is the vehicle through which flow the streams of vitality which keep the body alive. The etheric double is visible to clairvoyants as a mass of faintly, luminous violet-grey mist arising from the body and extending very slightly beyond it[3]. The chakras are points of connection at which energy flows from one vehicle or body of a man to another.

The seven wheels listed in this teaching correspond to the seven chakras as follows:

Fundamental Wheel	Root or Basic Chakra
Splenic Wheel	Spleen or Splenic Chakra
Solar Wheel	Navel or Umbilical Chakra
Cardiac Wheel	Heart or Cardiac Chakra
Laryngeal Wheel	Throat or Laryngeal Chakra
Visual Wheel	Brow or Frontal Chakra
Coronal Wheel	Crown or Coronal Chakra

"The alchemists and medieval physicists called the ponderable atoms 'salt', the dynamic atoms 'sulphur', and the imponderable atoms 'mercury'."

The alchemists tried to find or prepare a substance which would turn cheaper metals into gold and silver and which would also cure any ailment and prolong human life. However, the real aim of the alchemists' activities was their own transformation, their accession to a higher state of consciousness. The material results were only a reflection of the final result, which was spiritual. Everything was directed towards the transmutation of man himself, toward his fusion with the divine energy, the fixed center from where all material energies emanate.

The alchemist spent many years deciphering old texts. With the help of patience, humility and faith he gradually began to understand these texts. At this point he was ready to start his alchemic operations. He ground and mixed in a mortar certain ingredients containing sulphur and mercury with an organic acid, and continued with this operation for several months. Then he heated the mixture for about ten days and dissolved it with an acid, under specific light conditions. Next the liquid was evaporated and the solid residue recalcined. He repeated this operation a thousand times, always waiting for a sign. After many years of working at the same thing, when the sign was received, the alchemist allowed the mixture to "ripen", protected from the air and dampness, until the first days of Spring. At this time he placed the mixture in a transparent receptacle which he closed in a hermetic way. The aim was to procure what the alchemist called the "soul" or the "essence" of metals. He heated the mixture, allowed it to cool off, heated it again and continued with this process for months or even years, observing the formation of a blue-black fluid. Finally he opened his receptacle in the dark. On contact with air, the liquid solidified and broke up. In this way the alchemist obtained entirely new substances, unknown in nature, and

containing all the properties of pure chemical elements. The pieces were washed and re-washed for several months. The alchemist kept this water away from light and from any variations in temperature. This water was said to have extraordinary chemical and medical properties. It was the universal solvent, and the elixir that ensured longevity, rejuvenating the tissues.

Gradually, or in a flash of illumination, the alchemist discovered the meaning of his long labor. The secrets of energy and of matter were revealed to him. He established a new relationship between his own mind and the universal mind an passed to another stage of being, attaining a higher degree of consciousness.

"Scientists know of the existence of many minerals in the organism, but they do not know them all, because some are present in infinitesimal amounts."

Minerals are inorganic substances and are basic components of the earth's crust. They are taken up by plants and consumed by animals and humans. In total, the minerals in the human body comprise a mere 4% of body weight. Nevertheless, these various minerals carry out unique and critical roles in bodily functions and enzymatic processes.

It is known that there are more than 60 different minerals in the body, and of these, 20 are currently identified as "essential." The 6 major minerals are calcium, chloride, magnesium, phosphorus, potassium, and sodium. There are also 14 minor or "trace" minerals which are present in lesser amounts. Examples of these are copper, fluoride, iodine, iron, selenium, and zinc.

No doubt, the understanding of how trace minerals participate in the functioning of a healthy body will increase as more is discovered concerning them. Perhaps then, too, we will know more about the necessary dietary amounts and proper nutritional balance among these important substances. Moreover, it is indeed likely that as yet unknown minerals will be discovered which play important roles in the human body. After all, current researchers are just beginning to delve into the complexities of the chemistry and physiology of life.

References and related reading

[1]Arthur Avalon (Sir John Woodroffe), "The Serpent Power", reprint of the 7th edition (based on original edition, 1919); Two works on Laya-Yoga translated from the Sanskrit, with introduction and commentary, 1974. Dover Publications, New York, NY.
[2]Georg Feuerstein, Encyclopedis Dictionary of Yoga, 1990. Paragon House, New York, NY.
[3]C.W. Leadbeater, "The Chakras"; A Monograph, 1971. The Theosophical Publishing House, Adyar, Madras 20, India, Wheaton, IL, USA.
L. Pauwels and J. Bergier, "The Morning of the Magicians", 1968. Avon Books, Stein and Day Publishers, New York, USA.
University of California, "Berkeley Wellness Letter", Vol.2, No. 4, pp 4-5, January 1986, "Wrap-up: minerals".

THE LIVING CELL

Third Teaching

The organism, in its origins, has a cellular form.

Human cells, originally, do not form spontaneously. Rather, they evolve from the union of atoms of subtle matter to the formation of the common cell.

In order to understand the progression of the human cell from subtle to dense matter, it is necessary to become familiar with the theory of the descent of the monads from the Superior Worlds to the Physical World.

When the being dies, it dissociates from its physical body; the body disintegrates, but conserves the original cell that gave it life. This cell is selected by the physical experience of the being's last life. While the ego is dissociating from the ethereal body, during the first forty days after death, this cell is transformed from an H cell to an X cell. In the subsequent forty days, the new X cell is transformed into an X2 cell. But the X2 cell can no longer be intimately united with the ego; the ego has evolved to the Superior Worlds and is united with the X2 cell by a bond that is a mental wave. At the same time the ego is bound to the physical remains by a magnetic wave.

It should be pointed out that the H, X and X2 cells are each formed by atoms of the same denomination.

When the ego has to descend to the Physical World, when the hour of the descent arrives, the X2 cell receives messages and jolts through its mental wave bond which change its habitual X2 rhythm to a denser rhythm. And when the ego, vested with the astral body that will accompany it to the Physical World, forms the ethereal body that will make it able to live with a physical body, the X2 cell is transformed into an X cell. The mental wave that unites the ego and its layers with the cell that will give it life is of short duration.

One example: All the originating X cells are in the same physical vibration when the hour of reincarnation arrives; we have to imagine that there are millions of these cells that correspond to a particular ego; if these cells cannot be transformed into H cells during the period of time when the ego gets closer to its envelopes, they suffer a shock that repels them and causes them to change back into X2 cells. But if the physical wave is adequate, the X cells are transformed into H cells.

The H cell cannot be formed without the physical contribution. During the sexual act, at the moment when the chemical elements for the formation of the H cell exist in the ovaries, the ego can unite with the more subtle X cell. As a consequence, this X cell is definitively transformed into an H cell, beginning the formation of the human being in the womb.

All atoms exist potentially in an original human cell.

The H cell or human cell is made up of five parts:

1. The membrane of the cell
2. The contents of the cell or protoplasm
3. The nucleus, or spherical corpuscle
4. Other secondary nuclei which promote irritability or multiplication
5. Secondary nuclei of super irritability or destructiveness.

The cells display all the forms seen in the Astral World; these forms correspond to those of the different atoms, from the square form of the flat cell to the circular form of the spherical cell.

There are 39 x 10^n cells in the perfect body. The cells grow in number from 27 x 10^n to 39 x 10^n, but they simultaneously are slowly dying. This numerical transformation of cells is called cellular metabolism.

Cellular metabolism is ponderable, dynamic and imponderable. The ponderable metabolism is evolving, progressive and constructive; it tends to provide the perfect number of cells to the organism. The dynamic cellular metabolism is that which maintains living cells by means of digestion, respiration and reproduction. The imponderable cellular metabolism is regressive, degradative and destructive.

Decrepitude originates from the loss of cells.

There are organisms that possess greater vitality; when their cells die they know how to reproduce them. This happens when a natural life is lived.

The diminution of irritability in the cell creates an appropriate environment for super irritability which destroys the cell completely.

COMMENTS ON THE THIRD TEACHING

"In order to understand the progression of the human cell from the subtle to dense matter, it is necessary to become familiar with the theory of the descent of
the monads from the Superior Worlds to the Physical World."

What is a monad? A dictionary definition is given as: "an elementary, unextended individual spiritual substance from which material properties are derived." The term "monad" is used or alluded to in a variety of religious, metaphysical and philosophical contexts, from the Cabala to Plato, to the 17th century German philosopher Leibnitz. Teachings of Cafh which refer to the monads describe them as whole groups of souls which incarnate together. These groups of souls often have to complete in one life tasks begun in another.

Metaphysically, the monad represents the fundamental, ultimate element of reality where spirit and matter have united. This infusion of spirit into matter is said to have occurred in the very beginning of creation, when the "Universal Life Force" or Spirit descended into matter. These monads thus comprise the most basic form of reality, manifesting form and material properties while simultaneously preserving their incorruptible, immutable spirit. Some sources describe the monads as "mindlike substances", though they are also "windowless" and not affected from without. They do not act causally with one another, but they do form patterns that create appearances to our perception.

From these concepts of the monad arises the notion of a fundamental unity between matter and spirit. Applied to the teaching, it is evident that the material atoms composing the cells of our bodies also retain a more subtle spiritual essence. Manly P. Hall (see references) refers to this union of matter and spirit: "Spirit and matter are interdependent terms. One has no significance without the other, for matter is the least degree of spirit, and spirit is the highest degree of matter."

“The H cell or human cell is made up of five parts:”

Although cells are considered to be the building blocks of the body, they are not like blocks or bricks at all. Rather, individual cells behave more like living organisms-“breathing“, taking nourishment, often mobile, and capable of reproducing themselves. Cells of the human body are very small, literally microscopic. The largest is the egg cell which is 0.2 mm across (about the size of a pinpoint), but most human cells are more than 10 times smaller. The Teaching lists 5 components of human cells, but this description only hints at the complexity of the structures and interactions of the cells of the human body.

1. The membrane of the cell

It would be simplistic to think that the cell membrane is merely some sort of “plastic liner” that holds in the contents of the cell. On the contrary, the fine membrane that envelopes the cell (only about 0.00001 mm thick), is an elaborate arrangement of molecules of fat, carbohydrate, and protein. Its function is not only to preserve the cell's internal environment, but this membrane is also selectively permeable, allowing certain substances to pass into or out of the cell as required. Another vital feature of the cell membrane is its rich array of so-called “receptors.” These are protein units which are available to specifically bind a wide variety of substances external to the cell surface. Like a key which fits a specific lock, these external substances (for example hormones, neuropeptides, or antibodies) fit to their corresponding membrane receptor. As a result, the cells are stimulated to carry out specialized functions. In the case of viruses, however, cells may be led to their own destruction since viruses bind to receptors in order to invade the cell and take control of its function.

2. The contents of the cell or protoplasm

The protoplasm (also called “cytoplasm”) refers to the cell contents other than the nucleus. It is not a homogeneous jelly-like substance at all, but rather a complex media filled with anions and cations as well as soluble proteins and other chemicals. In the cytoplasm there is also a diverse mixture of molecular-chemical structures termed “organelles.” These organelles are responsible for a variety of specialized cell functions. A few examples include ribosomes and Golgi complex for protein synthesis and distribution, respectively; lysosomes for enzymatic catabolism; and mitochondria which carry out oxidative/reductive reactions for cellular energy.

3. The nucleus or spherical corpuscle

The nucleus is a discrete membrane-bound body lying within the cell cytoplasm. It is important because it contains the DNA, the blueprint that encodes all the proteins of the body. Thus, the nucleus has ultimate control over cell activities. In addition, it has an essential role in cell reproduction since, prior to cell division, all the chromosomal DNA is precisely duplicated in it. The nuclear DNA is coiled in double helices, but some long, linear strands of DNA molecules are associated with proteins called histones. These enable the DNA to be tightly folded into chromatin. The storage of hereditary material within the nucleus is vast. In the human cell the chromatin material is divided into 23 pairs of chromosomes (46 chromosomes in total), and if stretched out, the DNA would extend more than 3 feet!

4., 5. Other secondary nuclei

It is not clear from the brief description in the Teaching precisely what cell structures and functions correspond to the "secondary nuclei." However, the cell contains "nucleoli", which are irregularly shaped, dense bodies within the nucleus. They have no membranes and consist of fibers and granules. They function in the synthesis of ribosomes which, in turn, will carry out protein synthesis. They change in overall size and shape as cells go through their cycles of growth and division. We could speculate that the nucleoli, along with the cytoplasmic organelles (Golgi complex, ribosomes, lysosomes and mitochondria) are the secondary nuclei of multiplication or destructiveness mentioned in the Teaching.

"In the perfect body there are 39 x 10^n cells."

In describing the number of cells in the "perfect" body, the Teaching does not specify the exact number that is "n." One scientific reference (Microbiology, R. M. Atlas, 1984) states that the number of cells in the human body is approximately 10^{13} (10 trillion). Whatever the number, it is known that this number is only approximate and constantly changes. After all, it has been estimated that every minute nearly 300 million cells in our body die, though most are replaced immediately by the division of living cells. Evidently, our body is not so "fixed" or "permanent" as we might think. It is constantly being repaired, replaced, and recycled.

"Cellular metabolism is ponderable, dynamic, and imponderable."

For decades, efforts to better understand cellular metabolism have been an important focus of scientific research. After all, cells are the basic "building blocks" of the organism. Knowledge concerning the life of individual cells contributes to better understanding of the body as a whole. Although in the human body there obviously exists a vast number of cell types, there are relatively few varieties of cellular metabolism. One medical reference describes three categories of cells in a classification that may correspond in some ways to that given in the Teaching. The three categories described are:

1. quiescent cells - usually non-dividing, but capable of cell division in response to some stimuli, primarily tissue injury. Examples: hepatocytes (liver cells), kidney tubular cells, connective tissue fibroblasts.

2. continuously proliferating cells —"stem cells", progeners of cell populations of limited life span. Examples: hemopoietic cells, epidermis (skin cells), gastrointestinal epithelial cells.

3. post-replicative cells —completely differentiated, no further cell divisions; if damaged these cells cannot be replaced. Examples: neurons (brain cells, retinal photoreceptor cells), cardiac and skeletal muscle cells.

Knowledge of cellular metabolism is important because it may enable scientists to understand aging and death for individual cells and for the body as a whole. Presently, very little is known about this subject. Of course, we can observe how each mammalian species has a pre-determined maximum life span. The shortest is that of the shrew (less than 2 years), and one of the longest is that of the human being (optimally, more than 100 years). This variability is reflected in tissue culture experiments where replicating cells have only a limited number of divisions. This number depends on the cell age and species. After this, the cells cease to replicate and die. But why this is so is not known. Only theoretical speculation is available to attempt to explain this

phenomenon. “Programmed” theories of cell aging point to inborn, genetic inheritance as the predeterminant for quality and quantity of aging. The so called “Stochastic” theories (the word “stochastic” refers to random processes) of aging identify a variety of cumulative injuries that lead to cell aging and death. Postulated mechanisms include errors that lead to the synthesis of abnormal proteins, free-radicals (destructive molecules formed by radiation and ultraviolet or visible light) and on-going somatic mutations (injuries to the genetic make-up of the body cells that have not been inherited). Interestingly, none of these theories is mutually exclusive and, indeed, there may be some overlap among them. Nevertheless, they remain only theories. The fundamental causes of aging and death are still unknown. Scientists continue their research into cellular metabolism with the hopes of someday being able to intervene favorably in the processes of aging and death.

“Decrepitude originates from the loss of cells”

A rather recently described mechanism of cell death currently holds much interest for scientists studying diseases of aging such as Alzheimer's disease, Parkinsonism, and cancer. It is called “apoptosis”, a term derived from a Greek word meaning “a falling off.” It is quite different from “necrosis” which is the more common and better understood process of cellular death. In necrosis, cells respond to injury or stress by swelling up. Eventually they burst, spilling their contents into bodily tissues and creating the familiar inflammatory response observed in arthritis or in other tissue injuries. In apoptosis, the process is quite different. Cellular death seems programmed in a planned and orderly sort of way. Whatever the triggers, the cells change their shape rather than swell, and very rapidly form multiple “bundles” of cell contents wrapped up by the cell membrane. The bundles then separate from one another becoming “apoptotic bodies”. These are then completely digested by the body's own phagocytic “scavenger” cells. The cell contents never enters the body tissues. It is as if the cells undergoing apoptosis have suddenly disappeared leaving no trace. This process has even been described as “orderly cellular suicide.”

In terms of the Teaching it is easy to see that this mechanism of cellular death could explain how loss of cells correlates with the decrepitude of aging conditions. Indeed, perhaps the description at the end of the Teaching is referring to this very process of apoptosis. “The diminution of irritability in the cell creates an appropriate environment for the super-irritability to arise which destroys the cell completely.”

Perhaps a good way to summarize this Teaching and to appreciate the concept of “The Living Cell” is to read the narration presented below. In his essay entitled “The Inner Galaxy”, anthropologist Loren Eiseley describes an incident leading to a profound expansion of consciousness. Eiseley develops a deep awareness of, and a responsibility to, the living cells of his body.

“As I walked, abstracted and alone, toward my office one late afternoon, I caught the toe of my shoe in an ill-placed drain. Some trick of mechanics brought me down over the curb with extraordinary violence. A tremendous crack echoed in my ears. When I next opened my eyes I was lying face down on the sidewalk. My nose was smashed over on one side. Blood from a gash on my forehead was cascading over my face.

Reluctantly I explored further, running my tongue cautiously about my mouth and over my teeth. Under my face a steady rivulet of blood was enlarging to a bright red pool on the sidewalk. It was then, as I peered nearsightedly at my ebbing substance there in the brilliant sunshine, that a surprising thing happened. Confusedly, painfully, indifferent to running feet and the anxious cries of witnesses about me, I lifted a wet hand out of this welter and murmured in compassionate concern, 'Oh, don't go. I'm sorry for what I've done to you.'

The words were not addressed to the crowd gathering about me. They were inside and spoken to no one but a part of myself. I was quite sane, only it was an oddly detached sanity, for I was addressing blood cells, phagocytes, platelets, all the crawling, living, independent wonder that had been part of me and now, through my folly and lack of care, were dying like beached fish on the hot pavement. A great wave of passionate contrition, even of adoration, swept through my mind, a sensation of love on a cosmic scale, for mark that this experience was, in its way, as vast a catastrophe as would be that of a galaxy consciously suffering through the loss of its solar systems.

I was made up of millions of these tiny creatures, their toil, their sacrifices, as they hurried to seal and repair the rent fabric of this vast being whom they had unknowingly, but in love, compounded. And I, for the first time in my mortal existence, did not see these creatures as odd objects under the microscope. Instead, an echo of the force that moved them came up from the deep well of my being and flooded through the shaken circuits of my brain. I was their galaxy, their creation. For the first time, I loved them consciously, even as I was plucked up and carried away by willing hands. It seemed to me then, and does now in retrospect, that I had caused to the universe I inhabited as many deaths as the explosion of a supernova in the cosmos.

Weeks later, recovering, I paid a visit to the place of the accident. A faint discoloration still marked the sidewalk. I hovered over the spot, obscurely troubled. They were gone, utterly destroyed--those tiny beings --but the entity of which they had made a portion still persisted. I shook my head, conscious of the brooding mystery that the poet Dante impelled into his great line: 'the love that moves the sun and other stars.'"

References and related reading

"Molecular and Cellular Biology". Stephen L. Wolfe, Wadsworth Inc., 1993, Chapter 1: Introduction to Cell and Molecular Biology.
"Behold Man". Lennart Nilsson et al., Little, Brown and Company, 1974, p.10: The Cell.
"Geriatric Medicine", 2nd Edition. Cassel et al.(eds), Springer-Verlag, 1990. Chapter 1: "Cellular Aging" by Thomas H. Norwood.
"The Unexpected Universe". Loren Eiseley, Harcourt Brace Jovanovich, 1964. Chapter 8: "The Inner Galaxy", pp. 177-179.
"Medical World News." May, 1993 pp.32-ff.
"Questions and Answers: Fundamentals of the Esoteric Sciences". Manly P. Hall. The Philosophical Research Society, Inc. Los Angeles, California, 1979. pp. 26-28.

THE BLOOD

Fourth Teaching

Blood is a tissue contained in the blood vessels and comprised of intercellular liquid substances and red and white cells.

The blood, in its travels through different series of vessels, flows through two capillary systems: that of the lungs and that of the other organs in general.

The blood has a direct flow which enters the veins, and another indirect flow that goes through the walls of the capillaries and is reabsorbed by the lymphatic vessels.

The lymph is blood that is filtered and charged with special energetic currents. The intestinal lymphatic vessels absorb the intestinal chyle and empty it into the bloodstream via the portal venous system.

Blood, which is the principal source of life of the organism, not only sustains life by virtue of its substance, but also by the harmony of its circulatory movement.

The solid ponderable atoms maintain the harmony of this circulation, which should not be excessively rapid nor excessively slow; good circulation is reflected by the balance in the blood between acid and base. The acidity of blood is determined by a large concentration of hydrogen atoms dissociated in it; the alkalinity by a lower concentration of hydrogen atoms. As a result, not only commonly known causes can bring about physical disorder, but also moral causes influence the acid-base equilibrium, such as sexual abuse and psychic alterations caused by fear. This disturbing influence is manifested during the seven hours that follow meals, being more intense during the first three and one quarter hours and diminishing notably thereafter.

The liquid ponderable atoms maintain the weight and volume of the blood by controlling the circulation; this is carried out through the cardiac rhythm. Disharmony in the weight and volume of blood, besides having a cardiac origin, may have other origins in the glandular and nervous systems.

The luminous ponderable atoms have the function of maintaining the normal proportion of white and red blood cells. A sedentary life, excessively comfortable, can bring about a major or minor leukocytosis. The luminous ponderable atoms also control this proportion of white and red blood cells with the velocity of the circulation which effectively eliminates the old red cells and the white cells that have become useless. If a hemorrhage caused by violent trauma occurs, the circulatory activation produced in response compensates for the loss of these atoms. In certain cases, mainly in the elderly, bleeding is harmful because it is not accompanied by this compensation.

The gaseous dynamic atoms influence the blood by regulating the velocity of the circulatory movement: they accelerate it, slow it, or make it go from fast to slow. A good circulation is reflected in the proper oxygenation of hemoglobin. The heme pigment of hemoglobin captures oxygen in the lungs and releases it in the tissues. A bad circulation, on the other hand, is indicated by an increase in the stroma of the red cells, and by deficient oxygenation of the hemoglobin. This type of circulatory movement depends upon the respiratory rhythm.

The dynamic magnetic atoms maintain the equilibrium between the lymph and the blood, and the lymph, in turn, controls the equilibrium between the cells and the tissues. The equilibrium between the lymph and the blood has to be perfect and is achieved after a series of decreasing oscillations.

Blood coagulates much more rapidly than the lymph. In the blood this process is directed by a current of H atoms from the plasma that directly influences groups of H atoms in the red cells. This causes the red cells to become ordered and stacked so that a proper coagulation can occur.

Lymph has a slower coagulation time because it responds to an alternating current of H atoms and X atoms. If the lymphatic current moves into the blood it brings a disequilibrium in coagulation that can be fatal; this is what happens in certain illnesses that cause hemorrhages. Such abnormal movement of the lymph current is produced when the lymph offers subnormal resistance to its flow into the bloodstream.

The lymph has toxic properties that change according to the regions of the body and organs. When the toxic discharge of the lymph increases and arrives at the laryngeal region, it causes an alteration of the hormonal secretions of the thyroid, and even more so of the parathyroid glands. Because of this disequilibrium an alteration in the normal conversion of the lymphatic X atoms to H atoms occurs. This is due to the fact that the lymphatic X atoms pass more quickly to the blood than the lymphatic H atoms. Some of these abnormalities are maintained in a latent state in mothers, but are inherited by their offspring.

The dynamic radioactive atoms direct the passage of arterial blood to venous blood. Arterial blood is of uniform composition in the circulatory system. Valves of X atoms directed by dynamic radioactive atoms allow blood to pass to the veins and to be transformed from arterial to venous. Venous blood varies in composition according to the organ it comes from. These valves not only direct the transformation of blood from arterial to venous, but also prevent foreign toxic substances of any origin from entering the blood. Besides, if toxic substances were inoculated into the bloodstream in determinate and infinitesimal amounts the valves would transform them into common toxins that would serve to immunize the organism.

The imponderable mental atoms regulate the balanced production of red and white cells in the bone marrow.

COMMENTS ON THE FOURTH TEACHING

“Blood is a tissue contained in the blood vessels and comprised of intercellular liquid substances and red and white cells.”

Indeed, blood is a tissue. It is comprised, on a volume basis, of approximately half liquid (called “plasma”) and half cellular components (red and white blood cells as well as cellular fragments for coagulation termed “platelets”). The volume of blood in the human being is about six quarts. In one cubic millimeter of blood there are approximately 4 1/2 to 5 1/2 million red blood cells, 5 to 10 thousand white blood cells and 150,000 to 250,000 platelets. The term “leukocytosis” mentioned later on in the Teaching refers to an increase in the number of white blood cells (leukocytes). There are many causes of leukocytosis, infections perhaps being the most common.

The functions of the circulating blood are multiple and vital to survival. Foremost among these functions is transport, particularly oxygen transport. Deprived of oxygen many cells will die in just a few minutes as in the case of human brain cells after a stroke or cardiac arrest. But besides oxygen transport the blood also transports glucose, fats, proteins and other necessary metabolic substances to the cells, while at the same time carrying carbon dioxide and other waste products away from cells.

Another function of the circulatory system alluded to in the teaching is the regulation of acid-base balance. This is achieved through a complex interaction of the circulatory system with the lungs and kidneys, and is intended to give all cells of the body the environment in which they function best. This optimal "mileu interieur" is essentially that of sea water, reflecting how life seems to have evolved from the oceans.

Two other less obvious but equally vital functions of the circulatory system are the regulation of body temperature by variation in blood flow to the skin and the fighting off of infections by means of the white blood cells.

"The lymph is blood that is filtered and loaded with special energetic currents."

Although blood travels throughout the body, it can never reach the cells. This is because it is always contained within the walls of the blood vessels through which it flows. Thus, for the cells to receive nourishment, the blood must be filtered in the very smallest blood vessels, the capillaries. Here, due to the pressure of blood flow, nutritious substances are "squeezed" (filtered) into the tissues through the thin walls that line the capillaries. In turn, waste products from the cells diffuse from the tissues back into the capillaries to return to the general circulation. However, after this exchange, about 10% of the fluid and many smaller blood proteins remain with the tissues. This is the lymph, similar to blood plasma but containing only half the protein and no blood cells. The lymph system has a key role in removing proteins from the tissue spaces surrounding the cells. These proteins and other large particulate matter cannot return to the capillaries due to the increased pressure and impermeability of the blood vessels. Instead, they pass to the lymph moving into the readily permeable lymph vessels. The lymph flows more or less passively through its network of vessels to ultimately re-join the blood circulation primarily through the largest lymph vessel, the "thoracic duct", which enters into the left subclavian vein. Without this mechanism of protein removal the tissues would swell massively with body fluid causing death within 24 hours.

Besides "draining off" cellular proteins, the lymph also carries bacteria, other foreign matter, and cancer cells that may invade the body. It is the lymph nodes which are situated along the course of the lymph vessels that contain immune cells to fight off these invasions to the integrity of the body.

The lymph system is intimately related to the blood. It has a variety of vital functions which it performs in relationship to the blood and the circulation as described above. Because lymph is the fluid most directly in contact with the cells of the body, it may have many other as yet unknown properties and functions which correspond to the "special energetic currents" referred to in the Teaching.

"Blood, which is the principal source of life of the organism, not only sustains life by virtue of its substance, but also by the harmony of its circulatory movement."

The "harmony" which the Teaching refers to seems to relate to the physiologic process termed "homeostasis." This is the tendency of all organ systems to function to create and maintain static, constant conditions —the "mileu interieur" mentioned previously. Perhaps nowhere else in the body is this concept better exemplified than in the case of the circulatory system. The heart, lungs, kidneys, liver, brain and central nervous system, adrenal glands, and nearly every organ system influence, and in turn, are influenced by the circulatory system. A detailed discussion of these interactions is beyond the scope of these notes. However, the Teaching does describe several instances in which the equilibrium and harmony of the circulation is disrupted, and a description of these disturbances may help to better understand the diverse functions of the circulatory system.

For example, the acid-base balance discussed in the Teaching is essential to support life. Any disturbance resulting in blood that is too acidic (diabetic ketoacidosis, respiratory insufficiency, etc.) will lead to coma and death. On the other hand, blood that is too alkaline (repetitive vomiting of gastric contents, excess alkali ingestion, etc.) will cause hyper-excitability of the nervous system resulting in muscle spasms, tetany, and even epileptic-type seizures. A common and sometimes striking example of a disturbance of acid-base which perhaps the teaching alludes to is the "hyperventilation syndrome" associated with fear and anxiety. In these circumstances there is unconscious deep and/or rapid breathing which quickly expels carbon dioxide making the blood alkalotic. The result is an unpleasant shakiness, often numbness of fingers and lips, and even the development of muscle spasm and tetany. There is a sensation of tightness in breathing muscles leading to progressive deeper breathing (to get "enough" air) which results in still more hyperventilation. Often, the most effective means to re-establish acid-base balance is to breathe deeply into a paper bag covering nose and mouth. This "re-breathing" of one's carbon dioxide raises the acid content of the blood and can resolve even severe symptoms within minutes.

The proper cardiac rate and rhythm is another essential component of the circulation. The normal heart rhythm is termed "sinus rhythm". It is primarily controlled by the autonomic nervous system. The normal resting pulse rate is variable, but generally is regulated from 50 to 100 beats per minute. Indeed, as the teaching says, the rate must not be "excessively rapid or excessively slow", since pathologically the range of control of the pulse by nerve stimulation alone can be as little as 20 to 30 or up to 250 beats per minute. These extremes will rapidly result in circulatory collapse. Besides potential adverse variations in rates of normal sinus rhythm, there are numerous abnormal heart rhythms as well. One example is ventricular fibrillation. This is the most common arrythmia associated with cardiac arrest, and untreated can result in death within 5 to 7 minutes.

Another example of disharmony in cardiac rate and rhythm is that of emotional fainting which is termed "vasovagal syncopy." It illustrates the interaction of the nervous system and the circulatory system. Disturbing input into the cerebral cortex of the brain (e.g. emotional shock, the sight of blood, etc.) sends messages to lower brain

centers especially to a vasodilatory center and to the vagus nerve. These centers send involuntary signals via the spinal cord to relax blood vessels and slow the heart. Very quickly pulse and blood pressure drop, there is dizziness and a clammy perspiration, and when circulation to the brain is sufficiently diminished, it causes a complete loss of consciousness.

A final disruption of the circulation referred to in the Teaching which serves to illustrate the complexity of circulatory function is that of "a hemorrhage caused by violent trauma." Locally, there is an intense spasm of blood vessels of the traumatized area which in some wounds drastically reduces blood loss. However, when hemorrhage goes on to cause significant blood loss, the sympathetic nervous system is activated--heart rate and contractility increase while blood vessels constrict raising circulatory resistence. This will preserve blood flow as much as possible for the rest of the body. At the same time the "glandular systems" are also activated (notably the adrenal glands) which cause the kidneys to conserve salt and water enhancing the volume of the circulation. All the while, the blood flow to two vital organs (the brain and the heart) is preferentially sustained, even at the expense of such "non-vital" organs as the kidneys and the intestinal tract. Obviously, severe hemorrhage is a serious medical emergency, even more so for the elderly as the teaching states. This is because all these compensatory mechanisms may not be sufficient to sustain life where there is pre-existent disease of the heart, lungs, kidneys or blood vessels.

"If this lymphatic current moves into the blood it brings a disequilibrium in coagulation that can be fatal; this is what happens in certain illnesses that cause hemorrhages".

Blood flows freely through the blood vessels, yet when there is an injury such as a simple cut or scrape, it quickly clots. Obviously, under ordinary circumstances blood coagulates only when appropriate, such as in response to tissue damage. This is because the pathways leading to blood coagulation, though always poised and ready to function, remain inactive until an appropriate "trigger" activates them. The teaching describes "a disequilibrium in coagulation" which seems to describe a clinical condition in which there is an inappropriate activation of the blood coagulation pathways. This condition is known as "disseminated intravascular coagulation" (DIC), also referred to as "diffuse intravascular coagulation", "defibrination syndrome", and "consumptive coagulopathy".

DIC is not altogether rare. In one large general hospital it was estimated that it was present in 1 in 1,000 admissions. Mild, subclinical cases may be overlooked, so the true incidence may be much higher. The causes of DIC are myriad, one text listing over 100 underlying conditions leading to DIC. Among the more common causes are infections, obstetric complications and, on a worldwide basis, venomous snakebites.

The pathophysiology of DIC is not well understood, yet the mechanism common to all cases seems to be "the entry of procoagulant tissue extracts into the blood from endogenous sites ('autoinfusion')". Perhaps this is the same process the teaching is referring to when it states that "...the lymphatic current moves into the blood." At any rate, the results can be devastating because the inappropriate activation of clotting procedes unimpeded. Substances causing blood vessel constriction are released and factors that lyse (dissolve) clots are depleted. Thrombosis may result. Moreover, the

continuous consumption of blood coagulation proteins (clotting factors, fibrin, platelets, etc.), exhausts the capacity of the blood to clot normally. Hemorrhage then ensues resulting in such effects as skin bruising, bleeding gums, bloody urine, nose bleeds, or lung or intestinal bleeding. Acute DIC is a medical emergency and treatment is frequently inadequate to stop the coagulation processes; indeed, DIC is often fatal.

There is also a milder form of DIC termed "chronic" or "compensated DIC." In these cases there is only a mild impairment in blood coagulation, not manifested clinically, but which can be measured in laboratory tests. This condition is frequent in some types of cancer patients. It is also common in pregnant patients. Indeed as one reference states:

> *The clinical and experimental evidence is incontrovertible that pregnancy, the best studied form of hypercoagulability, is associated with an increased propensity for the development of DIC. Indeed it has been suggested that even normal pregnancy is a form of low-grade 'physiologic' DIC, which at term becomes overt for a short time.*
>
> *Moreover, there are a variety of complications of pregnancy that may result in severe DIC, both for the mother and the newborn.*

"...Some of these abnormalities are maintained in a latent state in mothers, but are inherited by their offspring."

The inheritance of various traits including certain abnormalities, follows a particular pattern. The offspring always receive half of their genes from the mother and half from the father. The genes are located in 46 chromosomes in each cell of the body except for sperm and egg cells. Body cells of males have 22 pairs of "autosomes" and one X and one Y chromosome and body cells of females have 22 pairs of autosomes plus two X chromosomes. While the genes on each of the X chromosomes are fully functional, Y chromosomes have only very few functional genes. Each sperm cell carries one set of 22 autosomes plus an X or a Y chromosome; each egg cell carries one set of 22 autosomes plus an X chromosome. When they fuse, the resulting fertilized egg cell has 46 chromosomes.

There are three basic patterns of inheritance: sex-linked (or X-linked), recessive, and dominant. In sex-linked inheritance a defective gene is carried on an X chromosome. Therefore, a female can carry a single defective gene on one of her X chromosomes while the same gene on the other X chromosome is functional, and there is no disease. On the other hand, a male carrying a defective gene on his X chromosome has no functional counterpart on the Y chromosome and, therefore, inherits disease. A male child receives a Y chromosome from the father and an X chromosome from the mother; a female gets one X chromosome from each of the parents. Therefore, a mother carrying a defective gene on one of her X chromosomes has a 50% chance of giving that X chromosome to each of her children. If the father doesn't have disease he will donate a normal X chromosome to his daughters and a "non-functional" Y chromosome to his sons. Thus, sons have a 50% chance of inheriting diseases carried on X chromosomes while daughters have a 50% chance of becoming carriers. Recessive and dominant inheritance are primarily related to autosomes. In the recessive case the autosome from the mother and the autosome from the father must each be carrying a defective form of a gene in order for disease to occur. In this case either a man or a woman can be a carrier. In the dominant case just one copy of a defective gene can bring disease. Therefore, whoever carries even one copy of a defective gene has disease, and there are no carriers.

The Teaching may be describing sex-linked inheritance of the blood-lymph abnormalities because it refers particularly to the mothers as the carriers of latent disease. Only mothers can be carriers of X-linked disease, both mothers and fathers can be carriers of autosomal recessive disease and neither can be carriers of dominant disease.

References and related reading

"Textbook of Medical Physiology". Arthur C. Guyton, M.D., W.B. Saunders Company, 1986.

"Textbook of Physiology", Vol. 2, H.D. Patton et al. (eds.), W.B. Saunders Company, 1989.

"Basic Science Review for Surgeons". Richard L. Simmons and David L. Steed, W.B. Saunders Company, 1992.

"Clinical Hematology", Vol. 2, Ninth Edition. G. Richard Lee et al., (eds), Lea & Febiger, 1993, pp. 1480-ff.

"Hematology". William J. Williams et al.,(eds.), McGraw-Hill Publishing Co., New York, 1990.

THE TISSUES

Fifth Teaching

The tissues are divided into three categories: superficial epithelia, deep epithelia and connective.

The superficial epithelia are renewed totally and are eliminated rapidly; the new cells push out and take the place of the old cells which are shed from the body.

The deep epithelia, since they are localized in the interior of the body and have only indirect contact with the exterior through the blood and the superficial epithelia, are eliminated as liquids and very subtle particles. Although their shape appears to remain the same, their substance changes continuously.

The superficial and deep epithelia are joined by the connective tissue. This tissue constitutes the support of the body. It covers the deep tissues lined by epithelia forming two types of cavities: the ones that receive the deep elements, the muscle fibers and the nervous cells; and the others which resemble internal lakes where the nutrient juices and their derivatives circulate.

Nutrition as well as the chemical properties of the connective tissues are influenced by the dynamic atoms. We could say that the connective tissues receive exterior energy through the superficial epithelia and transmit it to the deep tissues; and, in an opposite way, the connective tissues transmit internal energy to the exterior. All of these processes occur without the intervention of the brain.

The superficial epithelia are constituted by one or more layers of epithelial cells, which lay on vascularized connective tissue. When the epithelium has only one layer of cells, it is called simple; when there are several layers of cells it is called stratified.

The epithelial cells are united to each other by a ground substance. The ponderable atoms exert their influence on these cells. Thus, the epithelia constantly attract and group the cells of the body preventing the entrance of untransformed external atomic vibrations into the body. This is why the superficial epithelia have diverse shapes and resistances according to the action of the external agents to which they are exposed. Sometimes they become strongly defensive, such as with the nails and hair: these allow the direct passage to the body of the vibrations from the rays of light and, therefore, have a characteristic elasticity and transparency.

The deep epithelial tissues respond to the action of the imponderable atoms. The muscle tissue is considered one of these deep tissues. The consistency of the muscle tissue varies, according to the state of the muscle, from very hard to very soft. This special consistency makes the muscles susceptible to easy tearing. For this reason, muscles are protected by other tissues. The elasticity of the muscles is extraordinary; but the muscles would not be useful for their common function if they would not have the sensitivity provided by the nervous tissue.

The imponderable atoms specific for the muscles establish a very short wave within the muscles which is mainly controlled by X2 atoms.

The nutrition of muscle tissue is very active. Contraction of the muscles is voluntary or involuntary.

The nervous tissue is formed by an intimate union of the three types of tissues already described. The ponderable, imponderable and dynamic atoms act together in the nervous tissue.

Three classes of substances form nervous tissues and direct the nervous movement: gray matter, white matter and myelin.

Gray matter is found in the cortical areas of the brain, in the nuclei of the base of the cerebrum, and in the cerebellar as well as spinal nuclei. White matter is found in the tracts formed by the axons of neurons of the spinal cord, cerebellum and cerebrum, of the peripheral nerves and of the sympathetic nerves; the latter nerves differ from the former in that they do not have the protective sheath formed by the fatty third component of the nerves, myelin.

The connection of the nervous elements by the atomic groups is established by electric and magnetic threads which create a magnetic field, wave or way. The different groups of atoms circulate through this field; the imponderable atoms vitalize the ponderable atoms through the dynamic atoms, providing the nervous system with its own excitability.

COMMENTS ON THE FIFTH TEACHING

"The tissues are divided into three categories: superficial epithelia, deep epithelia and connective."

Cells of the body group together to form tissues, and the various tissues form the organs and organ systems. The classification of tissues in the Teaching is comparable to that given by Jacob, Francone, & Lossow (see references). "Tissues are subdivided into four major categories, epithelial, connective, muscle, and nervous." The "deep epithelia" of the Teaching are basically the muscle and nervous tissues.

"It (the connective tissue) covers the deep tissues lined by epithelia forming two types of cavities:..."

There are two major types of connective tissue. The first type can be termed the "loose" connective tissue, which supports blood vessels and nerves, and extends between organs and between muscles. The second type is the "dense" connective tissue. This tissue forms the "internal lakes" referred to in the Teaching, which seem to correspond to body cavities such as the abdominal, thoracic (chest), and pericardial (heart). These body cavities are all lined by serous membranes consisting of a special surface layer of epithelium termed "mesothelium" and an underlying supporting layer of connective tissue. The surface cells secrete a fluid lubricant which reduces friction between the lining of the body cavity and its organ contents. The linings of the body cavities form completely enclosed spaces in which the fluid lubricant flows. Ordinarily the amount of fluid is small, but in some circumstances such as in certain cancers, infections, or in fluid retention, the body cavities lined by mesothelium and connective tissue can hold several quarts of liquid. In some cases the liquid may be removed by insertion of a needle into the affected body cavity as part of a medical treatment. This fluid build-up is called an "effusion."

In addition to these two main types there is also a variety of specialized connective tissues. Examples of these include: cartilage, bone, teeth and lymphoid tissue.

"The superficial epithelia are constituted by one or more layers of epithelial cells, which lay on vascularized connective tissue."

In general, "superficial" epithelial tissues are those composed of cells attached to a layer called the "basement membrane." This layer provides an anchor for the individual epithelial cells to attach to, and indeed, may be at least partially formed by secretions of these cells. Another portion of the basement membrane is a protein-polysaccharide ground substance with reticular fibers produced by the connective tissue cells upon which the epithelium rests. As the Teaching states, epithelium is an avascular tissue (has no blood vessels) and it depends on the connective tissue beneath the basement membrane for its nutrition and waste removal. The basement membrane is an important landmark in the microscopic evaluation of cancers. If a tumor has penetrated through it into the vascular connective tissue beneath, the outlook for the patient is generally worse.

"The epithelial cells are united to each other by a ground substance."

The epithelial cells are attached not only to the basement membrane, but to one another as well. This attachment of epithelial cells plays an important role in the function of the various types of epithelial tissues. There are several types of these cell attachments or "junctions." One type, the so-called "tight junction" has cell membranes fused by strands of membrane proteins. These tissues become almost impermeable to passive leakage and may be found in the lining of the intestine and kidney tubules. Another type of cell-to-cell junction is termed "gap junction." This is a looser attachment which permits an exchange of ions and other substances between cells. A third type of cell junction termed "desmosome" provides a strong mechanical linkage between cells enabling the tissue to resist traumatic forces. Desmosomes are present in tissues such as skin and in the linings of the mouth cavity and the esophagus.

"This is why the superficial epithelia have diverse shapes and resistances according to the action of the external agents to which they are exposed."

There are many types of superficial epithelia in the body. They include: the mucous membranes (such as the lining of the oral cavity), the glandular epithelia (the oil and sweat glands), endothelium (the inner lining of blood vessels), and mesothelium (the lining of the lungs and the pleural cavity).

But the largest and most evident example of superficial epithelium is the epidermis, or outer layer of skin. It is a stratified squamous epithelium. (The inner layer of skin, the dermis, is a connective tissue which contains the blood vessels, nerves, sweat glands and hair follicles of the skin.) In an average sized adult the skin covers 3,000 sq. inches of surface area, weighs nearly 6 pounds, and receives about 1/3 of the circulating blood. It is extraordinary for its protection, strength, elasticity and heat and water regulatory capacities. The skin is constantly shed, but in tiny, fragmented, unnoticed amounts. The cells migrate from the basement membrane where they originate to the skin surface in about 30 days. Indeed, the outermost protective layer of skin is composed of dead cells that are completely filled with a protein called keratin. Its thickness depends on stimulation from mechanical pressures, and where pressure is excessive, corns and callouses may form. Skin color is derived from the pigment "melanin." It is formed in cells called "melanocytes" which are present in the deepest layer of the epidermis. All human skin has the same number of melanocytes.

Variations in skin color are due only to different levels of activity of these melanocytes in the production of melanin.

"...but the muscles would not be useful for their common function if they would not have the sensitivity provided by the nervous tissue."

The muscle tissue (except for cardiac muscle which has its own nerve conduction tissue) is in direct contact with and under the control of the nervous system. This relationship is defined physiologically by the "motor unit", which consists of a single nerve fiber and all the muscle fibers it innervates. The motor unit does indeed act as a unit, since every time its nerve fiber conducts an impulse, the same muscle fibers are activated simultaneously and in unison. On average, 150 muscle fibers are activated by a single nerve fiber. However, this varies greatly depending on the nature of the muscle and the sensitivity required. For example, in muscles that control fine movements there may be as few as 10 muscle fibers activated by a nerve impulse. On the other hand, major limb muscles that carry out only gross movements may be stimulated by motor units that control more than 1,000 muscle fibers. Since in each muscle the nerve fibers are spread out over many dispersed muscle fibers, the firing of a single motor unit causes a weak contraction through a broad area of muscle. It takes the recruitment of many motor units to carry out a maximal muscle contraction.

In addition, the sensitivity of the muscle provided by nervous tissue is also reflected in the phenomenon of reflex action. Probably the best known reflex is the patellar reflex or "knee jerk." When the patient is struck over the patellar tendon just below the knee cap, a quick and involuntary muscle contraction is observed, and the leg kicks out. This occurs because the quick tap of the reflex hammer gives a sensation of "stretch" to the thigh muscle. This stimulates stretch sensitive tissue within the muscle (the muscle spindles) and at once there is a protective type contraction of the thigh muscle. Numerous other reflexes exist which also attest to this interaction of muscle and nerve tissue such as the "flexor" or "withdrawal" reflex, the "tonic neck" reflexes, and the pupillary reflexes of the eye. Evaluation of reflexes, both normal and pathological, gives important clues for diagnosing injuries and illnesses relating to the musculo-skeletal and nervous systems.

"The nutrition of muscle tissue is very active. Contraction of the muscles is voluntary or involuntary."

There are three main types of muscles. One type, the voluntary muscle, is also called skeletal muscle because it is attached directly or indirectly to the skeleton. Under the microscope it has alternating dark and light bands and because of these striations it is also called "striated muscle." The second type is the involuntary muscle which performs actions that are by and large unnoticed, such as propelling food through the digestive tract or dilating and contracting blood vessels and bronchioles. Under the microscope these involuntary muscles lack striations and thus are also termed "smooth muscles." A third type of muscle tissue is that found in the heart, and thus called "cardiac muscle." This muscle is different because it is striated, yet at the same time, it is involuntary. It receives stimuli to contract from its own nerve network located within the heart.

The action and metabolism of muscle cells is well known, including even molecular and enzymatic details. Simply put, the metabolism of the resting muscle is "aerobic",

that is, it metabolizes glucose in the presence of oxygen brought to it by the blood circulation. However, when activity is vigorous or prolonged, the heart and lungs are unable to supply adequate oxygen. Muscle metabolism must then procede without oxygen. This is "anaerobic" metabolism which produces lactic acid in the muscle. Accumulation of lactic acid in the muscles makes them less efficient resulting in rapid fatigue if not compensated. It is said that muscle metabolism is inefficent because in the transfer of chemical energy into mechnical energy nearly 2/3 of this energy is "wasted" as heat rather than in movement of the body. Anyone who has worked outdoors on a hot summer day can attest to this phenomenon.

"Three classes of substances form nervous tissues and direct the nervous movement: gray matter, white matter and myelin."

The nervous system is divided into the central nervous system (CNS), which includes the brain and the spinal cord, and the peripheral nervous system (PNS), which includes the cranial nerves arising from the brain and the spinal nerves arising from the spinal cord.

The nervous tissue is composed of only two principal types of cells, neurons and glia. Neurons are the basic structural and functional units of the nervous system. They are specialized to respond to physical and chemical stimuli, conduct electrochemical impulses, and release specific chemical regulators. Through these activities, neurons perform such functions as the perception of sensory stimuli, learning, memory, and the control of muscles and glands. Neurons cannot reproduce themselves, although some can regenerate a severed portion or sprout small new branches. Although individual neurons may differ in size and shape, they generally have three principal regions: the cell body, the dendrites and the axon. The cell body is the enlarged portion of the neuron which contains the nucleus and the machinery to support the life of the cell. The dendrites are thin, branched processes which extend from the cell body and serve as receptive areas transmitting electrical impulses to the cell body. The axon, or nerve fiber, is a longer process that conducts impulses away from the cell body. Axons vary in length from only a millimeter to as long as a meter or more (such as the axons that extend from the brain to the foot).

Glial cells are supportive cells that aid the function of neurons. Among the several types of glial cells are those that form myelin sheaths around the axons of neurons. Myelin speeds up the passage of electric signals along the axon. It has a white appearance due to its fatty nature. Areas of the CNS that contain a high concentration of myelinated axons thus form the white matter. The gray matter of the CNS is composed of high concentrations of cell bodies and dendrites, which generally lack myelin sheaths.

"Gray matter is found in the cortical areas of the brain, in the nuclei of the base of the cerebrum, and in the cerebellar as well as spinal nuclei."

As stated, the central nervous system is comprised of the brain and the spinal cord. The spinal cord is a slender cylinder of soft tissue about as big around as the little finger. It runs down from the medulla oblongata at the base of the brain through the vertebral column. The central area of the cord contains interneurons, cell bodies and dendrites of motor neurons and the entering fibers of sensory neurons. It is surrounded by white matter, which consists of the myelinated axons of interneurons. These groups

of axons in the CNS form pathways that run longitudinally through the cord. Some convey impulses downward from the brain to the spinal cord, or from upper levels of the spinal cord to lower levels; others convey impulses up from the spinal cord to the brain.

The brain is composed of three main areas: the forebrain at the top, the brainstem underneath and the cerebellum behind the brainstem. The brainstem is the stalk of the brain. Through it pass the nerve fibers that relay signals between the spinal cord and the cerebrum or cerebellum. Information from all regions of the CNS is received in and integrated by the brainstem. A great deal of information is also transmitted out from the brainstem to the rest of the CNS.

The cerebellum consists of an outer layer of cells called the cerebellar cortex, and several deeper cell clusters, the cerebellar nuclei. It is chiefly involved with skeletal muscle functions, coordinating movements and controlling posture and balance. In order to carry out these functions, the cerebellum receives information from the muscles and joints, skin, eyes and ears, and even viscera, plus information from the parts of the brain involved in control of movement.

The forebrain consists of the central diencephalon, the cerebrum and the right and left cerebral hemispheres. Each cerebral hemisphere has an outer shell or cortex, and underlying subcortical nuclei. The cerebral cortex is only about 3 millimeters thick and is made up of gray matter. Yet in this thin layer the most complex integrating functions of the nervous system are carried out: it brings together incoming (afferent) information and forms meaningful perceptual images from it; and it performs the ultimate refinement of control over the voluntary movements of the skeletal muscles. The subcortical nuclei also consist of gray matter and are involved in movement and posture and in the more complex aspects of behavior. In other parts of the forebrain myelinated axons predominate, forming white matter.

Although the cerebral hemispheres are connected to each other by approximately 200 million nerve fibers known collectively as the corpus callosum, they have separate, specialized functions. This is demonstrated in certain individuals with severe epilepsy who have had the connecting corpus callosum surgically cut as a way of alleviating their symptoms. To the casual observer these “split brain” individuals do not show evidence of disability. However, if their hemispheres are separately stimulated by visual images, when they are asked to perform manual tasks (such as drawing or writing), each of their hemispheres will be good at certain tasks and poor at others. For example, the left hemisphere, which controls the right side of the body, is generally the one in which most of the language and analytical abilities reside. The right hemisphere on the other hand has limited verbal ability but it is most adept at comprehension of patterns and part-whole relationships; and at tasks like recognizing faces, reading maps, arranging blocks or drawing cubes. The ability to compose music appears to depend on the right hemisphere while the ability to critically understand it seems to reside in the left hemisphere. People with damage to the left hemisphere may have severe speech problems while their ability to sing remains unaffected.

The nervous elements.

The functional classification of neurons is based on the direction in which they conduct impulses. Sensory, or afferent, neurons conduct impulses from peripheral sensory receptors to the CNS. Motor, or efferent, neurons conduct impulses from the CNS to effector organs (glands and muscles). Interneurons are located entirely within the CNS, bridge afferent and efferent neurons and perform associative or integrative functions of the nervous system. There are two types of motor neurons: somatic neurons which provide both reflex and voluntary control of skeletal muscles, and autonomic neurons which innervate the involuntary effectors —smooth muscle (such as is found in the walls of the bronchioles), cardiac muscle and glands.

Neurons transmit nerve impulses across tiny gaps called "synapses". Transmission across the majority of synapses in the nervous system is one-way and occurs through the release of a number of different chemical neurotransmitters from axon endings. The proper release and uptake of these neurotramsmitters is essential to normal nervous function. Some diseases are due to depletion of neurotransmitters, as in Parkinsonism, where levels of dopamine are very low. This disease, which is a major cause of neurological disability in people over sixty years of age, is associated with such symptoms as muscle tremors and rigidity, difficulty in the initiation of movements and in speech, and other severe problems. Other diseases occur when the uptake of neurotransmitter at the synapse is blocked. This is the case in myastenia gravis where uptake of acetylcholine (ACH) at neuromuscular junctions is inhibited resulting in a variety of muscle weaknesses. The neurotransmitter GABA (gamma-aminobutyric acid) is the most prevalent neurotransmitter in the brain and is involved in many functions including motor control, mood and emotion. Drugs given to treat extreme anxiety —including the benzodiazepines (such as Valium)— act by increasing the effectiveness of GABA in the brain. Drugs that antagonize the actions of GABA, conversely, can produce extreme feelings of anxiety.

The Teaching states that nervous elements are connected by electric and magnetic threads. In fact, the synaptic potentials produced at the cell bodies and dendrites of the cerebral cortex create electrical currents, which can be measured by electrodes placed on the scalp. A record of these electrical currents is called an 'electroencephalogram' or 'EEG'. Deviations from the normal EEG pattern can be used to diagnose epilepsy and other abnormal states, and the absence of electrical activity (a flat EEG) indicates brain death.

References and related reading

"Structure and Function in Man," Fifth Edition, Jacob, Francone, & Lassow. W.B. Sanders Company, 1982.
"Behold Man", Lennart Nilsson et.al., Little, Brown & Company, 1974.
"Human Physiology", Third Edition, Stuart Ira Fox. Wm. C. Brown Publishers, 1990.
"Human Physiology: The mechanisms of body function.", Fifth edition, Arthur J. Vander, James H. Sherman and Dorothy S. Luciano. McGraw-Hill Publishers, 1990.

NUTRITION AND THE BLOOD

Sixth Teaching

Blood is the center of all phenomena related to nutrition. All elements made up of ponderable, dynamic and imponderable atoms are absorbed by the blood which then assimilates, transforms, refines and expels them. Absorption occurs in three different ways: by digestion, by secretion of internal glands and by respiration. After being utilized, the absorbed elements are again expelled by the blood as waste materials in the form of water, soluble substances, and gases, especially carbon dioxide.

However, the most extraordinary function carried out by the blood is that of changing its own production. These changes, which are as yet poorly understood, are the true causes of all phenomena already studied in the organism.

Blood is made up mostly of X2 atoms. X2 atoms are found in the blood in greater quantity than the rest of the atoms so far described, which belong to a more dense category formed by X and H atoms. Blood contains an overabundance of X2 atoms with a corresponding decrease of the more subtle X3 atoms as well as successively superior atoms up to and including astral atoms.

It can be stated with certainty that blood is the only physical element that contains astral atoms free of union with physical atoms, even though in very limited quantity. The being can put himself in contact with the astral and superior worlds by means of these astral atoms. The glands suitable for certain supraphysical functions could not be able to perform them without the contribution of the astral atoms.

The purity of the blood is very important in reproduction, since there is a qualitative and quantitative difference in astral atoms among the diverse races and from individual to individual. The astral atoms increase in the blood concomitant with the spiritual progress of the being and of the race. Furthermore, they are the true producers of the X and H atoms which they manufacture from elements that get into the bloodstream. It is known that the blood attracts and assimilates these elements through the tissues —epithelia and superficial and deep connective— appropriately eliminating them in the same proportion in which they have been absorbed. At times the internal manufacturing of the blood is slow. In these cases the newly made blood eliminates progressively lower quantities or a deficient proportion of the elements that have been assimilated. Traces of what has not been eliminated are left in the tissues, and this is the cause of all organic disturbance, illness, aging, and death.

When the astral atoms increase in the blood, a normal rhythm and a better life are obtained. Therefore, it is of vital importance to the student to maintain his blood in a pure state and to know how to increase the astral atoms in it. These atoms are eliminated through the fundamental plexus (root or basic chakra) and by the reproductive function; they get distributed in the blood because of the small differences in its temperature, which is controlled by the spleen and the splenic plexus (splenic chakra); they increase with the correct respiratory exercise through the solar plexus (navel or umbilical chakra); they multiply among themselves by means of the blood circulation which is controlled by the heart plexus (cardiac chakra); and they increase

in number by absorption of astral elements deposited in the spinal cord, which is controlled by the laryngeal plexus (throat chakra).

When, in exceptional beings, astral atoms increase greatly in number, mental atoms are deposited in the blood; these mental atoms bring the human being closer to Spiritual Liberation, even while he is alive on Earth.

COMMENTS ON THE SIXTH TEACHING

"Absorption occurs in three different ways: by digestion, by secretion of internal glands and by respiration."

The process of digestion is the breakdown of food into subunit molecules that can be absorbed into the bloodstream. Food is chewed and mixed with saliva, swallowed, and then propelled down the esophagus to the stomach. There it is further digested chemically by strong acid and gastric enzymes. The strong acid would destroy the stomach lining if not for the fact that a thick alkaline mucous coating protects it. From the stomach, the mass of digested food called chyme passes to the upper small intestine or duodenum where digestion continues, assisted by bile from the liver which emulsifies fats and by pancreatic enzymes which digest proteins, carbohydrates and lipids. Most of the absorption of nutrients takes place across the lining of the small intestine which has many finger-like projections called villi which tremendously increase its surface area. Each villus is internally vascularized by a huge capillary network that facilitates the passage of nutrients across the intestinal lining into the bloodstream.

The activities of different regions of the gastro-intestinal tract are coordinated by the actions of the vagus nerve and various hormones secreted by glandular cells in the stomach and intestine. The stomach begins to increase its secretion in anticipation of a meal, and further increases its activities in response to the arrival of chyme. The entry of chyme into the duodenum stimulates secretion of hormones that promote contractions of the gallbladder, secretion of pancreatic enzymes, and inhibition of activity in the stomach. Each step in the regulatory process occurs in proportion to the amount and composition of the chyme.

In a basic way, respiration can be considered the process of absorption of oxygen and elimination of carbon dioxide. When oxygen is inhaled, it travels down the trachea to the bronchial tubes in the lungs, and from there into the alveoli, which are thin-walled sacs that exist in bunches at the ends of the very smallest bronchial tubes. Capillaries are found in net-like arrays around each alveolus. Because of the thin walls of the alveoli and the thin walls of the capillaries, oxygen readily passes from the alveoli to the hemoglobin within the red blood cells travelling through the capillaries. The hemoglobin then binds the oxygen and releases the carbon dioxide (CO_2) waste it has brought from the tissues. The CO_2 is absorbed into the alveoli and then exhaled out of the body by means of the bronchial tubes, throat and mouth or nose. The oxygen, which has now been absorbed into the bloodstream, is carried to the tissues where it is released from the hemoglobin in exchange for the waste carbon dioxide excreted from the cells.

"However, the most extraordinary function carried out by the blood is that of changing its own production. These changes, which are as yet poorly understood, are the true causes of all phenomena already studied in the organism."

The formation of blood cells is termed "hematopoiesis." It is an intricate process that can occur in several different types of tissues. In the developing fetus, for example, red blood cells are produced in the liver and to a lesser extent in the spleen and lymph nodes. Later on, towards the end of pregnancy and after birth, blood cell production takes place only in bone marrow. By adulthood, hematopoiesis is limited to only the marrow of the vertebrae, ribs, and the ilia (bones of the hips). With increasing age the marrow generally becomes less active. On the other hand, in certain types of anemias and leukemias blood cell production increases and other tissues may regain the capacity to form blood cells. This synthesis of blood cells in abnormal locations is called "extra-medullary hematopoiesis."

The key to the production of all circulating blood cells (red and white as well as the platelets) is the "pluripotential hematopoietic stem cell" (PHSC). It is an extraordinary cell because throughout one's life it retains the capability of producing each of the different kinds of blood cells. Thus, when these unique cells divide, a portion of them is always retained unchanged in the marrow for future blood cell production. A larger number of stem cells, however, continues dividing and ultimately matures into all the various blood cells. How is this accomplished? It seems that the PHSC's are stimulated to divide and to develop by selective proteins called "growth inducers" and "differentiation inducers." One of these proteins, "interleukin-3", promotes growth and replication of all the types of developing cells, while the other inducers are each specific for a particular kind of blood cell. Moreover, the activity of these inducer proteins is influenced by a variety of factors outside the bone marrow. For example, low oxygen concentration in conjunction with erythropoietin (a hormone made primarily in the kidney) are a potent stimulus to red blood cell production. Systemic infections, on the other hand, will stimulate white blood cell production. Currently, some of these inducer proteins as well as erythropoietin have been synthesized by recombinant DNA techniques. They have proven invaluable in the treatment of a variety of bone marrow deficiencies, particularly those following high-dose chemotherapy.

The stimuli which initiate blood cell production are only part of the complexity of hematopoiesis. There are also a variety of substances which are necessary for the maturation of blood cells. In the case of the red blood cells these substances include iron, vitamin B-12, and folic acid. If any one of these is missing, a corresponding anemia will develop.

In summary, the production of the blood cells by the bone marrow is indeed a complex interraction of a vast array of factors. Either an over- or under-production of cells will result in disease. Appropriate oxygen, adequate diet, proper kidney function, and bone marrow integrity are all necessary for normal hematopoiesis and the healthy functioning of the body.

References and related reading

"Human Physiology: The mechanisms of body function", Fifth edition. Arthur J. Vander, James H. Sherman and Dorothy S. Luciano. McGraw-Hill Publishers, 1990.
"Textbook of Medical Physiology". Arthur C. Guyton, M.D., W.B. Saunders Company, 1986.

THE PELVIC CAVITY

Seventh Teaching

The pelvic cavity is a basin-like cavity at the end of the inferior portion of the trunk; it is formed by a skeletal ring comprised of the sacrococcygeal column and the iliac bones.

In males the pelvic cavity contains parts of the intestines, the urinary bladder, the pelvic portion of the ureter, the seminal vessicles, the vas deferens, the prostate, and the sacral plexus and its nerves; in females, besides the intestines, the bladder, part of the ureter and the sacral plexus, it contains the ovaries, the fallopian tubes, the uterus and the superior portion of the vagina.

In its anterior region the pelvis is delineated by an imaginary line that passes through both anterior/superior iliac spines; and in its posterior region iby the superior border of the iliac bones.

The deposit of the Cosmic Ether is in the interior of the coccyx . There is where the different groups of atoms that are distributed in the secondary centers of this region are formed and organized. The Cosmic Ether vitalizes all the centers of the human body, both primary and secondary.

The coccygeal region contains seven secondary centers which are localized close to where they are expressed:

1. In the posterior base of the scrotum, or the posterior origin of the vulva - the function of this center is to envigorate the organism and to provide it with a youthful appearance.

2. In the anal orifice —this center possesses the property of keeping illnesses away, and its expression consists in the secretions of the anal glands.

3. In the penis or in the clitoris —this center gives the ability to attract the opposite sex.

4. In the inferior end of the corpus cavernosum of the penis and the clitoris- this center stimulates sexual pleasure.and, in the male, ejaculation as well.

5. In the pubic symphysis —this center terminates ejaculation and sexual pleasure.

6. In the superior part of the tunica albuginea of the right testicle or the superior part of the left ovary —this center determines the degree of masculinity of the being.

7. In the inferior part of the tunica albuginea of the left testicle or the inferior part of the right ovary —this center determines the degree of femininity of the being.

All of these secondary centers carry out their specific functions almost autonomously.

The sacral region, in turn, also contains seven secondary centers:

1. In the central portion of the vas deferens or, in women, in the glands of Bartolino - this center allows the rejection or expulsion of that which is not suitable to the sexual nature of the being.

2. In the sperm duct of the prostate gland or in the neck of the uterus —this center allows the body to renew itself integrally every seven years.

3. In the posterior perineum, that is, between the anus and the posterior base of the scrotum —this center regulates the emotions, especially the sexual emotions, either exciting them or tempering them.according to what is more suitable.

4. In the intergluteal crease, between the anus and the coccyx —this center allows communication with the corresponding center in the spinal cord in order to strengthen its vibration.

5. In the seminal vesicles or in the uterine glands —this center allows both sexes to conserve sexual potency.

6. At the end of the vas deferens or, in women, in the round ligaments —this center participates in the sensory aspect of the sexual organs with regard to sexuality.

7. In the urinary bladder —this center regulates continence, especially that of the bladder *sphincter*.

In addition, between the bones and the periosteum of the pelvis seven other secondary centers are found:

1. At the base of the sacrum.
2. In the right iliac fosa.
3. In the left iliac fosa.
4. In the right acetabulum.
5. In the left acetabulum.
6. In the pubic symphysis.
7. In the ischium —this center grants the power of clairvoyance for perceiving the chemical elements of the Earth.

COMMENTS ON THE SEVENTH TEACHING

"The deposit of the Cosmic Ether is in the interior of the coccyx. There is where the different groups of atoms that are distributed in the secondary centers of this region are formed and organized. The Cosmic Ether vitalizes all the centers of the human body, both primary and secondary."

"Kundalini" (coil of rope) is the name given in the Hindu Tantric literature to the divine cosmic energy present in the cosmos and in human beings. In the human body it normally remains quiescent, coiled like a serpent in the lowest chakra, the root chakra or fundamental wheel. The root chakra is at the base of the spine or coccyx and is the etheric center which keeps the "physical vehicle" alive. Hindu writings offer a description of how the Cosmic Ether vitalizes the human body, as follows:

When Kundalini is awakened by the practice of certain exercises, the cosmic energy travels upward along the chakras and energizes each of them as it passes through. The chakras or astral centers have specific functions:

Solar wheel or umbilical chakra —a simple power of feeling

Splenic wheel or chakra —conscious travel in the astral body

Cardiac wheel or heart chakra —a power to comprehend and sympathize with other astral entities

Laryngeal wheel or throat chakra —the power of hearing on the astral plane

Visual wheel or frontal chakra —"astral sight"

Coronal wheel or crown chakra —perfection of all faculties of astral life.

In the root chakra the "Serpent Fire" or Cosmic Ether exists in a dormant or potential state in seven layers or seven degrees of force. When the chakras become vivified by the Serpent Fire, i.e., when the Kundalini Yoga practice allows the Cosmic Ether to rise up through the chakras each becomes a gate of connection between the physical and astral bodies. Thus, at the solar wheel one becomes aware of all kinds of astral influences. At the splenic wheel, one is enabled to partially remember vague astral journeys, sometimes manifested by a blissful sensation of flying through the air. At the heart chakra one is instinctively aware of the joys and sorrows of others, sometimes reproducing in oneself their physical aches and pains. At the arousing of the throat chakra one hears voices or music. Energizing the visual wheel eventually produces clairvoyance. Awakening of the crown chakra allows the individual to leave the physical body in full consciousness. As one Sanskrit writing describes, "When the fire has passed through all these centers...the consciousness becomes continuous up to the entry into the heaven world at the end of life on the astral plane."

"6. In the superior part of the tunica albuginea of the right testicle or the superior part of the left ovary - this center determines the degree of masculinity of the being.

7. In the inferior part of the tunica albuginea of the left testicle or the inferior part of the right ovary - this center determines the degree of femininity of the being."

Gender is normally determined genetically by the presence of a pair of sex chromosomes, "X" and "Y". If both of the sex chromosomes are "X" (XX), the gender will be female. If a "Y" chromosome is present (XY), the gender will be male. Rare maldistributions of the sex chromosomes can result in anomalous sexual and reproductive development such as XXY ("Kleinfelter's syndrome") or X0 ("Turner's syndrome").

However, the sex chromosomes "X" and "Y" do not function directly in the processs of gender expression. Rather, they merely initiate the synthesis of the sex hormones which are the true agents responsible for the differentiation and development of sexual characteristics. The male and female sex hormones have similar chemical structures, both being steroid compounds related to the cholesterol molecule. Indeed, males and females have sex hormones of both sexes, the differences being only in the quantities.

The sex hormones responsible for masculinity are known as the "androgens." They are responsible for features associated with "masculinity" such as growth of body hair (as well as baldness), deeper voice, and increased muscle and bone mass. By far, in males, the major androgenic hormone is testosterone which is produced in the testes. (Minor amounts of other less potent androgens are produced in the adrenal glands, but normally they are of little significance). The developing testes begin to secrete testosterone early in embryonic life, as early as 7 weeks. Without effective production and function of testosterone (for example, in "testicular feminization") only female sexual organs develop in a genetic male. On the other hand, exposure to testosterone in a developing genetic female causes development of male sexual organs. Production of testosterone by the testes normally ceases within 10 weeks after birth, but then resumes at puberty and continues throughout adult life, though diminishing in the

decades after 50 years of age. Testosterone is also produced in the female ovaries though ordinarily in small quantities (amounts less than 10% of that in males). Nevertheless, abnormal ovaries (for example, in polycystic ovary syndrome or in certain types of ovarian tumors) may produce an excess of testosterone, resulting in "virilization", i.e., the development of masculine characteristics in females.

The sex hormones responsible for femininity are known as the "estrogens." They are involved in the development of features commonly associated with "femininity" such as the development of breast tissue, subcutaneous fat deposition of the thighs and buttocks, and monthly ovulation and menstruation. In females, estrogens are manufactured and secreted primarily by the ovaries. (However, minute amounts are also produced in the adrenal glands; and during pregnancy, large amounts are secreted by the placenta.) The estrogens are closely related to the androgens. Both are steroid hormones produced from cholesterol. In fact, when estrogens are synthesized in the ovary, the male sex hormone testosterone is first produced and then converted by granulosa cells of the ovary into estrogens. Rare granulosa cell tumors of the ovaries occur. These produce large quantities of estrogen leading to enlargement of the uterus and irregular uterine bleeding.

Estrogens are also formed in males, though only in amounts approaching 20% of those found in normal females. The exact source of estrogen production in males is not currently known, but increased quantities are present in the fluid of the seminiferous tubules of the testes. It is thought that the conversion of testosterone to estradiol in the Sertoli cells of the testes (analogous to that which occurs in the female ovaries) is one main source. This same production may also occur in other tissues, notably in the liver. Ordinarily, these small amounts of estrogen have no notable physiologic effects in males. However, in severe liver disease where the liver can not inactivate these estrogens, they accumulate in larger amounts. This causes the development of breast tissue in males, a feminizing feature known as "gynecomastia." This conditon is also observed when male patients are given estrogenic medications such as in the treatment of prostate cancer.

In summary, it is clear that every individual has both masculine and feminine sex hormones. Consistent with the Teaching, the source of these hormones is primarily the testes in males and the ovaries in females. Current physiology does not localize more precisely the "centers" referred to in the Teaching, especially with regard to the predominance of the left or right testis or ovary, or of their superior or inferior portions. Nor is it known in what manner these centers carry out their function. Certainly, the expression of masculine and feminine qualities is based on more than the mere presence of "X" or "Y" chromosomes or of circulating levels of sex hormones. Much remains to be discovered concerning the physiology of the "masculine" and "feminine."

References and related reading

"The Serpent Power", Arthur Avalon (Sir John Woodroffe), reprint of the 7th edition (based on original edition, 1919). Two works on Laga-Yoga translated from the Sanskrit, with introduction and commentary, 1974. Dover Publications, New York, NY.
"Textbook of Medical Physiology". A. C. Guyton, W.B. Saunders Company, 1986.

THE ABDOMEN

Eighth Teaching

The abdomen is the region of the trunk between the thorax and the pelvic cavity. On its surface, the abdomen is divided into six parts:

1. the epigastrium
2. the mesogastrium
3. the hypogastrium
4. the hypochondria, right and left
5. the flanks, right and left
6. the iliac fossae, right and left

In the epigastrium are the stomach, the pancreas, the duodenum and the solar plexus, which is formed by the two semilunar ganglia and lesser ganglia. This region corresponds to the Cosmic Ether of the Solar Wheel and has small secondary centers of great importance disseminated in it. In addition, the epigastrium contains the liver and the bile ducts, which are subject to the influence of the Splenic Wheel.

In the pancreas are the centers of personal magnetism. In the head of the pancreas is the negative center of that magnetism; anger and vehemence rapidly use up the energies of this center and the being loses magnetism. In the tail of the pancreas is the positive center; movement of this center increases the physical, psychological, and moral power of the being. And in the body of the pancreas is the regulatory center of magnetism. The excessive use of the two extreme centers brings about illness and death. If an excess of anger is expressed, the negative center of the pancreas excretes substances which act through hormonal pathways upon the kidney; this produces a concomitant increase of urea. On the other hand, the excessive function of the positive center, which results from excessive pride or haughtiness, gives rise to pancreatic diabetes by the action of this center on the whole pancreas.

The stomach has 72 secondary centers distributed in its mucosa. Each one of these centers has a characteristic property in the secretion of gastric juice. The composition of gastric juice is not always the same, rather it varies according to the foods ingested. Many of these centers do not become active, with resulting harm to the organism. In order to move these centers, nothing is better than to eat without gluttony, ingesting a variety of foods each in small amounts. Furthermore, many centers do not function because man has eliminated hard foods almost entirely from his diet.

The duodenum possesses three secondary centers: one in the bulb or entrance, another in the mid-portion, and the third in the distal end. The characteristic functions of these centers is to keep the duodenum free of substances. When the middle center does not function well, serious digestive disturbances are produced by the stagnation of foods within it. Moreover, if food obstructs the duodenum, it interrupts the internal magnetic current.

The solar plexus has the maximum power of the Cosmic Ether of the corresponding Wheel.

The liver has seven secondary centers which correspond to the Cosmic Ether of the Splenic Wheel, whose manifestations are not well known. One of these centers is found

in the right lobule of the liver, which controls the defense against microorganisms that invade the body at any place. The microbes can be carried to the liver alive, dead, dormant, disintegrated, or reabsorbed after previous disintegration. In all of these conditions they are disintegrated and recycled in the right lobule of the liver to form nutrients and vaccines. When this part of the liver does not function normally, microbes invade the organism producing infectious diseases and, in turn, the right lobule itself undergoes an irregular hypertrophy of its cells which finally causes death.

Another secondary hepatic center is found in the left lobule. It is like the "customs officer" of the body, since it directs the absorption and the rejection of the digested substances. This center is altered in all individuals mainly due to the ingestion of preserved foods.

The lobule of Spiegel has a characteristic center of great importance, because with its vibration it continuously gives life and strength to the right and left lobules, in an attempt to alleviate their intensive work. The Splenic Ether that reaches this center comes impregnated with the Ethers of the remaining Wheels; these are not combined, but each is separate from the others and has its own characteristics.

The square lobule has another center which also receives the separate etheric vibrations, reinforcing the action of the lobule of Spiegel. The essential task of the centers in the square lobule and the lobule of Spiegel is to vitalize the right and left centers of the liver so that they can humanize the assimilated substances of vegetable and animal origin.

The fifth center is in the lesser epiploon (lesser omentum). The vibration of this center reflects and transmits to the astral body what is happening in the person's physical body.

The round ligament has the sixth center, which transmits astral vitality from the male to the female in the moment of sexual union; and from the female to the fetus throughout pregnancy. The splenic vein vibrates simultaneously.

The seventh center is located in the bile ducts; it possesses the vibration that produces bile.

The mesogastrium and the hypogastrium contain the small intestine which has 72,000 secondary centers. Each one of these centers produces a different chemical substance. Some of these centers function in the assimilation of food and the rest of them in facilitating its excretion. There are also some groups of centers that, during fasting, extract some elements from the blood which they transform into food in the intestine. Some of these foods are reincorporated in the blood stream, and the excess is excreted. These centers correspond to the Cosmic Ether of the Solar Wheel.

The right and left hypochondria contain the liver and the bile ducts, the spleen, the kidneys, the suprarenal (adrenal) glands and the colon; they correspond to the Cosmic Ether of the Splenic Wheel.

The spleen has a main center of great importance, which regulates all entrance or exit of astral forces to and from the body. When there are many astral atoms in the body, it contracts; when there are few astral atoms, it dilates. After a splenectomy, the being lacks this control.

The suprarenal glands have three secondary centers: the intermediate, the medullar and the cortical. The center of the intermediate tissue is involved in the

coloration of the skin; man could change the color of his skin if he could in some way make this center functional. In addition, this center has an important function in protein and carbohydrate metabolism.

The deeper medullar center is involved in maintaining the soft and flexible quality of the skin. When it stops functioning, the skin becomes wrinkled and less flexible. This is the result of excessive emotions in life, which cause too much adrenalin (produced in the adrenal medulla) to be secreted into the blood stream without being metabolized in the necessary amount. This glandular region is also involved in the production of androgens and estrogens, and through them, in the formation of the secondary sexual features. In men, these depend on the proper functioning of the centers of energy of the deferent ducts, and in women, of the round ligaments. In addition, the suprarenal secretion is responsible, in an important measure, for the psychic characteristics of individuals.

The cortical center makes the skin tougher or more resistant. Furthermore, it is the principal component of the ionic balance, especially participating in the maintenance of the proportions of sodium, potassium, phosphorus and calcium.

The right and left flanks contain the ascending and descending colons, respectively. The ascending colon has seven centers of retentive nature which constitute the last barrier prior to the expulsion of the feces. These centers preferentially absorb the mineral elements. Each center absorbs substances from one of the mineral groups. When there is intestinal putrefaction, these centers work with difficulty, resulting in a weakening of the intestinal walls and favoring parasitic and bacterial infections.

The descending colon has the power of expelling the feces. To do this, it has seven centers.

The right iliac fossa contains the cecum, the appendix and the terminal ileum; the left iliac fossa has the sigmoid colon.

The cecum has three secondary centers: one in the ileocecal valve; another in the beginning of the appendix; and the third in the cecum itself. This last one has the function of separating, analyzing and forming its own compounds with the elements that are present there. These compounds are then absorbed by the wall of the cecum, where a classification of what is noxious and what is acceptable for the organism takes place. All the noxious compounds are expelled.

The ileocecal valve center, called the "invertor", carries to the ileum in retrograde current the substances that have been accepted by the cecal center; one of the purposes of these substances is to immunize the organism against the toxic compounds ingested or produced in the intestinal tract.

The appendicular center has the function of detecting noxious substances that arrive to the cecum and alerting the other centers about their presence.

The sigmoid colon has different secondary centers of motive nature which are used for the expulsion of the feces.

COMMENTS ON THE EIGHTH TEACHING

"In the epigastrium are the stomach, the pancreas, the duodenum and the solar plexus, which is formed by the two semilunar ganglia and lesser

ganglia. This region corresponds to the Cosmic Ether of the Solar Wheel and has small secondary centers of great importance disseminated in it. In addition, the epigastrium contains the liver and the bile ducts, which are subject to the influence of the Splenic Wheel."

According to Tantrik writings the *Tattvas* or "Principles" constitute the bodily sheaths. These Principles are pervaded by *Prana* or Life Energy (the Cosmic Ether referred to in the Teaching may correspond to Prana), and have special centers of predominance and influence, which are the "chakras" or "wheels". There are six main centers of Tattvik operation inside the spinal column and a seventh at the top of the brain. In the physical body they are said to have their correspondences to the principal nerve plexuses and organs. These centers start at the sacro-coccygeal plexus, ascend to "the space between the eyebrows", which some identify as the pineal gland (third eye) and others as the cerebellum, and end at the top of the brain. The seven centers (also reviewed in the Comments on the Second Teaching) are listed from the Fundamental Wheel upwards:

Fundamental Wheel	Root or Basic Chakra
Splenic Wheel	Splenic Chakra
Solar Wheel	Navel Chakra
Cardiac Wheel	Heart Chakra
Laryngeal Wheel	Throat Chakra
Visual Wheel	Brow or Frontal Chakra
Coronal Wheel	Crown or Coronal Chakra

The five lower wheels are the centers of the five physical sheaths. These wheels are thought to be centers of consciousness in the form of extremely subtle forces which influence the various plexuses in the trunk of the physical body. The Visual Wheel is the main center of the Tattvas constituting the mental sheaths. The seventh Wheel is the abode of pure consciousness.

Specifically, the wheels mentioned in this Teaching have been described as follows:

The Splenic Wheel, the second center proceeding upwards from the Fundamental Wheel appears as a vermillion lotus of six petals placed in the spinal center of the region at the root of the genitals, or approximately the sacrum. It has been associated with the prostatic plexus and the sacral plexus. This does not mean that the actual Wheel is specifically in this region of the body, but rather it is the subtle center of the region. (This is also true regarding the anatomical position of the other wheels). Water is the Tattva of this Wheel and the sensation of taste is under its influence.

The Solar Wheel is described as being lustrous as a gem. It is a lotus of 10 petals and its Tattva is fire. Sight is under the influence of this chakra and it's color is red. It has been associated with the lumbar plexus, the epigastric plexus and the solar plexus, and it influences sleep and thirst.

"The composition of gastric juice is not always the same, rather it varies according to the foods ingested."

There are four physiologically active components of gastric juice: hydrochloric acid, pepsin, mucus, and intrinsic factor. Stomach acid is quite strong and functions to kill most bacteria that may enter the gastrointestinal tract with ingested food. Acid is also

necessary to activate the enzyme pepsin, and together these two constituents of gastric juice initiate digestion. Mucus is secreted both as a protective coating for the lining of the stomach, as well as a physical lubricant for the gastric contents known as "chyme." "Intrinsic factor" is a critically important mucoprotein secreted only by the cells of the stomach lining. If lacking, absorption of vitamin B-12 is impaired, ultimately leading to a vitamin B-12 deficiency known as "pernicious anemia" which is fatal if untreated.

After a normal meal, the stomach contains about 1.5 quarts of solids, liquids, and secreted gastric juice. In approximately 3 hours gastric emptying is complete. This complex process is regulated by a variety of factors. At first, even before food reaches the stomach, smell and taste receptors are stimulated which leads to gastric acid secretion. This so-called "cephalic phase" of digestion accounts for about 30% of the secretory response of the stomach to a meal. Next, when swallowed food reaches the stomach, the "gastric phase" is initiated. Buffers in the food (primarily proteins) neutralize stomach acid which along with the gastric distention accompanying a meal, leads to further stimulation of stomach acid secretion. This accounts for an additional 60% of the gastric response to a meal. The "intestinal phase" of acid secretion accounts for the remaining 10% and occurs when products of digestion reach the duodenum (first segment of the small intestine). The mechanisms of this effect are not clearly understood.

It is well known that the type of food ingested has direct effects on the process of gastric secretion and emptying. Proteins, for example, are the major nutrients which enhance gastric acid secretion. During meals, they stimulate a ten-fold increase in acid content of the gastric juice compared to basal levels. Other ingested agents which also stimulate acid secretion include alcohol (if more than 15% ethanol concentration), coffee (including decaffeinated coffee), and calcium (which in the calcium carbonate antacids neutralizes some acid, but can cause a subsequent rebound in acid production).

In terms of gastric emptying, the effect of food intake is equally well-known. Impaired gastric emptying causes symptoms of fullness, nausea, loss of appetite, and even vomiting. The foods which slow gastric emptying the most are those high in calories, especially fats. In addition, extremely large meals can increase distention of the main portion of the stomach which also results in delayed gastric emptying. And since solid food must be reduced to a very small size (less than 1 mm) in order to leave the stomach, it would seem prudent to assist this process by taking the time to chew food well before swallowing. All these known physiological phenomena serve to validate the advise of the Teaching to "eat without gluttony, ingesting a variety of foods each in small amounts."

"The liver has seven secondary centers which correspond to the Cosmic Ether of the Splenic Wheel, whose manifestations are not well known. One of these centers is found in the right lobule of the liver, which controls the defence against microorganisms that invade the body through any possible path."

The liver is the largest organ in the body and is the main center of the body's metabolism. Its unique location between the intestinal tract and the systemic circulation enables it to perform numerous vital functions. All ingested materials (not

only nutrients, but microbes, foreign proteins, drugs, toxins, etc.) absorbed from the intestinal tract enter blood vessels which join to form the "portal vein." This large vein carries these materials directly to the liver where they are "filtered" and then either absorbed or metabolized before entering the general circulation.

The "hepatocytes" comprise 65% of the cell population and 90% of the weight of the liver and carry out the best known functions of the liver. These include storage and release of glucose, metabolism of fatty acids, the synthesis of numerous proteins, as well as storage, excretion, and activation of most vitamins. And finally, it is the hepatocytes that are responsible for the formation of bile acids and for the biodegradation of most drugs such as medications and alcohol.

However, the Teaching also alludes to another lesser known function of the liver, namely its immunologic activity. For the most part these functions are carried out not by the hepatocytes, but by other cell types that are located in the hepatic sinusoids. These sinusoids are like tissue capillaries and contain several different cell types. Altogether, the liver sinusoids comprise 35% of the cells of the liver and about 10% of its mass. The two most important cell types which function immunologically are endothelial cells and liver macrophages known as "Kupffer cells." The endothelial cells form the lining of the sinusoids. They are arranged in a pattern with window-like openings (fenestrae) which, like seives, enable the sinusoids to filter out various substances carried to the liver. In addition, the endothelial cells have the capacity to take up and digest all kinds of molecules and small particles.

Kupffer cells are now thought to originate in the bone marrow and then migrate to the liver where they attach themselves between endothelial cells. From this advantageous location they perform the brunt of the immunologic activities so vividly described in the Teaching. One reference (Oxford Textbook of Clinical Hepatology) describes in equally dramatic form how Kupffer cells perform:

"Kupffer cells function as a waste receptable for all kinds of old, unnecessary, damaged, altered, or foreign material, such as old blood cells, cellular debris, parasites, bacteria, and certain tumor lines. (They) react vigorously to the presence of foreign material by attachment and phagocytosis. In response to these stimuli, the Kupffer cells produce active oxygen radicals, plasminogen activator, proteases, tumour necrosis factor, interleukin 1, interleukin 6, interferon, and a series of eicosanoids, such as..."

It is clear that in the battles of the immune system against foreign invaders, the Kupffer cell possesses a lot of weapons. At this molecular level, the mystery and complexity of these interactions seems to overwhelm our ordinary comprehension.

The suprarenal glands and hormones secreted by them.

The medulla (inner portion) and the cortex (outer layer) of the suprarenal (also called "adrenal") glands are both structurally and functionally different. The adrenal medulla secretes catecholamine hormones, epinephrine (adrenalin) and norepinephrine (noradrenalin). Despite its diverse physiologic functions, it is not essential to life. Epinephrine in general duplicates the effect of sympathetic stimulation of an organ. It is necessary to provide a rapid physiologic response to emergencies such as cold, fatigue, shock, etc. In this sense, epinephrine mobilizes what has been termed the

"fight or flight" reaction, a cooperative effort of the adrenal medulla and the sympathetic nervous system.

Catecholamines do not penetrate the blood-brain barrier; thus, the norepinephrine in the brain must be synthesized within that tissue. L-Dopa, the precursor for catecholamines, does penetrate the barrier. It is therefore used to increase brain catecholamine synthesis in Parkinson's disease. Epinephrine is effective as a stimulant of heart action; in general, it has an overall vasodilator effect, whereas norepinephrine exerts an overall vasoconstrictor effect. Epinephrine causes a relaxing effect on bronchiolar smooth muscle, and it is particularly valuable in the treatment of asthmatic attacks. Drugs increasing catecholamines are used as antidepressants; drugs decreasing catecholamines serve as antihypertensives and tranquilizers.

In contrast to the medulla, the adrenal cortex is essential to life. It secretes steroid hormones, which participate in the regulation of mineral balance (the mineralocorticoids), energy balance (the glucocorticoids) and reproductive function (the androgens or estrogens). The adrenal cortex is stimulated by adrenocorticotropic hormone, a hormone secreted by the pituitary gland as a nonspecific response to stress.

Since it is difficult to define "stress", many people prefer to define it purely physiologically as any stimulus that activates the pituitary-adrenal axis. Thus, even pleasant changes such as marriage, a promotion at work, etc. can be as stressful as unpleasant changes. Accordingly, stress has been called the "general adaptation syndrome", and has been described in three stages: the alarm reaction where the adrenal glands are activated, the stage of resistence in which readjustment occurs, and the stage of exhaustion which can occur if the readjustment is not complete. Specifically, excessive stimulation of the adrenal medulla can result in depletion of the body's energy reserves, and high levels of corticosteroid secretion from the adrenal cortex can significantly impair the immune system. Many studies show that prolonged stress (such as "excessive emotions in life") results in an increased incidence of cancer and other diseases.

References and related reading

"The Serpent Power" Two works on Laya-Yoga translated from the Sanskrit with introduction and commentary. Republication of the 7th edition (based on the original 1919 edition), Arthur Avalon (Sir John Woodroffe). Dover Publications, New York, 1974.

"Essential Medical Physiology", Leonard R. Johnson, Ph. D. (editor). Raven Press, New York, 1992, pp. 481-ff.

"Human Physiology & Mechanisms of Disease", 5th Edition, Arthur C. Guyton. W.B. Saunders Co., 1992, pp. 473-ff.

"Basic Science Review for Surgeons", Simmons & Steed, (editors). W.B. Saunders Co., 1992 pp. 246-ff.

"Oxford Textbook of Clinical Hepatology", McIntyre, et.al. (editors). Oxford University Press, 1991, pp. 97-101.

Regulation of Metabolism. In "Human Physiology", Stuart Ira Fox. Wm. C. Brown, 1990, pp. 580-586.

HEART AND LUNGS

Ninth Teaching

The heart and the lungs correspond to the Heart Wheel. The heart, which is the main organ of the circulatory system and which performs the role of an expanding and contracting pump, has very important secondary centers.

The heart has a center which directs the 49 "negative centers" governing the blood vessels. Moreover, the heart has other secondary centers spread throughout the pericardium. These centers direct the emotions of instinctive and mental nature when thought is transformed into emotion or vice versa.

When thought is transformed into emotion, these centers individually or collectively, cause a center which is found in the orifice of the aorta to vibrate; thereafter, the blood pressure is raised, first due to nervous and then to hormonal influence.

When an emotion is transformed into thought, these centers cause another center located in the orifice of the pulmonary artery to vibrate. This vibration has repercussions on the respiratory rhythm and on the oxygenation of the blood; the blood pressure then drops.

When the being receives or transmits emotions of an astral nature, these have repercussions on the 34 secondary centers localized in the mitral orifice.

The heart has 16 secondary centers; each of its chambers has four of them. The four centers of the right atrium are the purifiers of the blood; they secrete distinct hormones which give a peculiar subtlety, luminosity and purity to the blood that passes through as a result of its purification. The hormones which are secreted by these four centers are of a materialized ethereal substance of simple mineral nature. One of these minerals is an isotope of potassium; another, of calcium; another, of radium and the other, of magnesium.

The right ventricle has four centers which give other characteristics to the blood, enriching it with hormonal substances formed of sodium in combination with proteins and carbohydrates. Without this purification and without this enrichment neither oxygenation nor the discharge of carbon dioxide could occur in the lungs.

The left atrium has four centers, which are in charge of giving the blood as it passes through its special characteristic of cardiac blood. The four centers of the left ventricle complete this transformation, which makes this blood different from that which circulates through the rest of the body.

The lungs have infinite secondary centers which participate in the oxygenation and in the exchange of gases. Five of these are the most important: three are in the right lung and two in the left. The three centers of the right lung are: the inferior center, which attracts atoms of ethereal air; the middle center, which attracts atoms of astral air; and the superior center, which attracts atoms of cosmic air found above the stratosphere. Through these three centers, man places himself in contact with the material emanations of the Universe. Improper function of the right inferior center causes asthma. In animals, only the inferior center functions. In man, the superior center functions better when one is in elevated regions.

The two centers of the left lung are related to the internal air of the body. The superior center keeps the air dissolved in the body fluids, thereby impeding physical illnesses. The inferior center impedes the penetration into the body of heavy atoms from toxic gases produced in the interior of the Earth.

The right lung has a more evolved function and is stronger for resisting pulmonary diseases.

In the bronchi there are also secondary centers, which have the function of impeding the invasion of pathogenic organisms by transforming the toxins that these organisms carry.

Comments on the Ninth Teaching

"The heart, which is the main organ of the circulatory system and which performs the role of an expanding and contracting pump, has very important secondary centers."

It was not until about 1600 that the English physician William Harvey first discovered that the circulation of the blood throughout the body was accomplished by the pumping action of the heart. Actually, the heart is a hollow muscle which consists of not one but two pumps arranged in series. One pump is formed by the right atrium and ventricle and moves blood returning from the body out to the lungs where oxygenation occurs. The second pump, formed by the left atrium and ventricle, is the larger and stronger pump. It takes the oxygentated blood from the lungs and pumps it via the arteries to all the body. These two circulations (termed "pulmonary" and "systemic") are connected by the microscopic capillary vessels present in nearly all tissues. This connection was not recognized until nearly fifty years after Harvey's initial discovery of the circulatory system.

It is interesting to consider what an extraordinary pump the human heart is. In a healthy adult it weighs no more than 8 to 12 ounces and is only the size of one's fist, yet it is capable of pumping 50 to 70 beats per minute and up to almost 200 beats per minute if need be. At rest the heart pumps between 4 and 5 quarts of blood per minute, but during great exertion it can pump up to 40 quarts per minute. In a single day the heart beats 100,000 times pumping more than 8,000 quarts of blood. By the end of a lifetime of 75 to 80 years it will have performed nonstop beating 2.5 billion times while pumping more than 240 million quarts of blood. Indeed, the heart is the main organ of the circulatory system and obviously one that we ought to take good care of.

"When thought is transformed into emotion, these centers, individually or collectively, cause a center which is found in the orifice of the aorta to vibrate; thereafter, the blood pressure is raised, first due to nervous and then to hormonal influence."

How is blood pressure adjusted to the ever-changing needs of the body? After all, the needs of some tissues may increase dramatically such as those of the muscles during exercise or of the intestines during digestion. If just the simple act of standing could create a drop in blood pressure in the brain relative to the legs due to gravity, how then does the brain manage to get the continuous, abundant blood flow that is critical to its function? And what happens when, as the Teaching alludes to, our

thoughts and emotions influence blood pressure as is often the case? What in fact does determine our blood pressure and how is it regulated? The answers to these questions can be found in the concept of the "mean arterial pressure" and in the neural and hormonal mechanisms which closely maintain this pressure.

The mean arterial pressure can be considered as the driving force of blood flow with which nearly all the tissues in the body are perfused. In healthy humans, this pressure is closely regulated and kept constant at approximately 100mm Hg. (Though related, the mean arterial pressure is different from the familiar systolic and diastolic arterial blood pressures measured by means of a cuff placed over larger arteries such as that of the arm.) Whenever more blood flow is needed for a particular organ system, local blood vessels simply dilate to allow this increase. In order to avoid a resultant decrease in perfusion to other tissues the circulation adjusts to keep the mean arterial pressure constant. This is carried out by means of rapid neural reflexes and by more sustained renal and hormonal mechanisms.

For the purposes of understanding the Teaching, the most important neural reflex to consider is that of the "baroreceptor reflex." Baroreceptors are stretch sensitive sensory organs located in the walls of the heart and blood vessels. When blood pressure changes, the degree of stretch changes and these sensory organs immediately send signals to the part of the brain which regulates blood pressure, the vasomotor center. This brain center responds at once by means of sympathetic nerves and vagus nerve influences which alter heart rate and contractility as well as arterial and venous tone and resistance. Thus, blood pressure, particularly mean arterial pressure, is rapidly stabilized by this reflex compensatory mechanism.

The Teaching refers to hormonal mechanisms of blood pressure regulation as well. Unlike the baroreceptors which work on a moment-to-moment basis, these mechanisms work on a more gradual basis to control blood pressure. Some hormones involved in these mechanisms include: (1) epinephrine and norepinephrine from the adrenal glands, (2) vasopressin from the hypothalamus of the brain, and (3) renin-angiotensin which primarily originates in the kidney. Despite a great deal of knowledge of these and other mechanisms of blood pressure regulation, it is interesting to note that the cause of most high blood pressure (essential hypertension) is still unknown. Hypertension is characterized by only a 10% increase in mean arterial pressure, yet the resultant "end-organ" damage can be immense. There are many who speculate that "thought", especially those thoughts associated with stress, may play a significant role in the development or maintenace of elevated blood pressure. Doubtless, other factors contribute as well. However, in terms of current treatment, the previously described neural and hormonal mechanisms have been the basis for the development of all the current medications used to control high blood pressure. Unfortunately, all these medicines potentially have certain bothersome side effects. Perhaps some day we might be able to better control our own blood pressures naturally and spontaneously by learning what we need to do "when thought is transformed into emotion" and "when an emotion is transformed into thought."

The lungs and the respiratory system

The respiratory system serves mainly for the intake of oxygen by the body and the elimination of carbon dioxide. It may be divided into air-conducting and respiratory

portions. The former comprises the tubes which bring air from the exterior of the body into that portion of the lungs where the exchange of gases in the air with those in the blood takes place. These tubes are the hollow passages of the nose, the pharynx (which also connects the mouth with the esophagus), the larynx (which contains the vocal organ), the trachea, and the bronchi of various sizes which form the bronchial tree. The ends of the smallest branches of the air-conducting passages, the bronchioles, are capped by the respiratory portion of the lungs, formed by many small air vesicles, called alveoli. There are more than 600 million alveoli in the lungs. They form clusters, like bunches of grapes around the bronchioles, called lobules. These lobules unite to form larger groups called lobes.

The network of blood capillaries in the walls of the alveoli is separated from the air by a thin, moist membrane which permits the ready diffusion of oxygen into the blood and carbon dioxide out of it. The capillaries in the respiratory portion of the human lungs are estimated to have a surface area of 140 square meters. The lungs eliminate approximately 800 ml of water a day in the expired air; under abnormal conditions they may also remove some other substances from the blood, such as alcohol.

The lungs are paired organs occupying a great part of the thoracic cavity and constantly changing in form with the different phases of respiration. The right lung consists of three lobes and the left lung of two; their outer surface is closely enveloped by an elastic membrane, the pleura, which also covers the inner walls of the chest cavity. Normally, there is no actual space between the portion of the pleura that covers the lungs and that that covers the chest cavity. These membranes are in constant contact. But in certain diseases blood, fluid or air may collect between the layers of the pleura. When this happens, a space develops between the membranes that may compress the lung.

In children the lungs are a pale pink because of their great blood supply. With advancing age the lungs become gray, particularly in city dwellers, due to the inhalation of carbon particles.

The lungs have a large margin of reserve; the body at rest uses a small portion — about a twentieth— of the pulmonary aerating surface.

The pressure within the lungs is that of the atmosphere. The lungs are maintained in a partially distended position by the reduced pressure of the space between the two layers of the pleura. An increase in the size of the thorax, such as occurs with every inspiration, decreases pressure in the pleural cavity; consequently the lungs suck in more air and become larger. This is purely passive activity of the lungs. In expiration, as the thoracic cavity becomes smaller, the pressure in the pleural cavity rises slightly, pulling the lungs into a more contracted state, thus forcing some of the air out.

The lungs are frequently the seat of inflammatory conditions which leave them unimpaired on healing. Examples include bronchitis, an inflammation of the bronchial tubes, which may extend to the lungs causing pneumonia; and pleurisy, an inflammmation of the pleura. In certain infections, however, notably tuberculosis, large masses of pulmonary tissues are destroyed. In this case, healing occurs with the help of connective tissue which forms scars; there is no evidence that the pulmonary tissue can regenerate after destruction.

Bronchitis and asthma are closely related. Asthma attacks are caused by partial blockage of the bronchioles. This blocking results from spasm (contraction) of the bronchial muscles, swelling of the mucous membranes that line these muscles and production of phlegm. A narrowing of the lung airways results. The most common kind of asthma is caused by allergic reactions to ordinary substances such as house dust, airborne pollens, or certain foods. Asthma is also associated with *hay fever*, which is also an allergy.

Emphysema is a lung disease in which the victim has difficulty exhaling. Other symptoms include frequent colds and coughing, excess mucus in the throat, indigestion and shortness of breath. Emphysema damages the small air sacs in the lungs through which oxygen enters the blood and carbon dioxide leaves it. Such damage makes the lungs less elastic and, as a result, some carbon dioxide remains in them after each exhalation, poisoning the body. The victim must breathe increasingly harder to get a normal amount of oxygen into his lungs. In addition, his heart must pump harder to get enough oxygen into the blood. As a result, he may develop a heart ailment that can cause death. Some emphysema victims have blueish skin because their blood contains less than the normal amount of oxygen. Major causes of emphysema are cigarette smoking and occupational exposure to inhaled particles; heredity may also be a factor. **"The inferior center (of the left lung) impedes the penetration into the body of heavy atoms from toxic gases produced in the interior of the Earth."**

Radon-222 is a radioactive gas released during the natural decay of thorium and uranium, which are common, naturally occurring elements found in varying amounts in rock and soil. It is also the second leading cause of lung cancer and accounts for an estimated 14,000 deaths annually in the United States alone. In the past 50 years, extensive epidemiological studies have revealed an increase in lung cancer occurrence with exposure to radon decay products in miners who work deep within the earth. It has been shown that inhaled radon decay products become deeply lodged in the lungs, where they can radiate and penetrate cells lining the bronchi and initiate the process of carcinogenesis. The rate of lung cancer in underground miners is especially high in those who use tobacco products, but even in non-smoking miners there is an increased risk.

Recent investigations have revealed a disturbing observation, namely that besides the occupational risk, there are many in the general population who may be exposed to excessive levels of radon gas. Although outdoors radon is diluted to low concentration in the atmosphere, indoors it can accumulate significantly. Just as in underground mines, certain soil conditions favor the seepage of radon gas so that it can enter residential homes through basement and foundation cracks, drains, and construction joints and accumulate at unsafe levels.

Accordingly, in the United States the EPA has begun to seriously assess the risks associated with radon from residential exposure. A number of reliable test kits are available with which potential toxic levels of radon in the home can be detected. Certainly, further investigation will continue into the extent and prevalence of this health risk. Nevertheless, it is interesting to see how closely this recent public health issue exemplifies the description of the Teaching of "the penetration into the body of

heavy atoms of toxic gases produced in the center of the earth." However, the nature, location, and mechanism of the "inferior center" of the left lung referred to in the Teaching is not clear from present knowledge of lung anatomy and physiology.

References and related reading

"Behold Man", Lennart Nilsson and Jan Lindberg, Little, Brown, and Company, Boston, 1974.
"Essential Medical Physiology", Leonard R. Johnson, PhD. Raven Press, New York, 1992.
"Human Physiology and Mechanisms of Disease", 5th Edition. Arthur C. Guyton. W.B. Saunders Company, 1992.
"A Physicians Guide to Radon", United States Environmental Protection Agency, Washington, D.C., 20460. September, 1993. 402-K-93-008

THE LARYNX

Tenth Teaching

The laryngeal region corresponds to the Laryngeal Wheel. It has a large number of secondary centers that would be difficult to enumerate, but one can become familiar with those of major importance.

The superior vocal cords have four centers: two of these are responsible for the correct opening and closing of the epiglottis. The other two centers regulate secretion of the salivary glands. When these centers are highly developed through certain exercises and the constant practice of Meditation, they cause the salivary glands to secrete substances with delicious flavor. When the centers function deficiently, they cause the production of bitter and disagreeable tasting saliva. The Buddhists say to someone with their mouth wide open in marvel: "Close your mouth, so that no bad spirits can enter, because they have a bad taste." It is assumed that this act of letting the mouth hang open in amazement impedes the proper functioning of the centers of the superior vocal cords.

The inferior vocal cords have 23 centers each one producing a distinct vocal vibratory range. Only seven of these work in humans. If all of them would function we would be able to speak all the languages and emit all the sounds of Nature. It has been observed in the auras of famous singers that they have up to fourteen of these centers functioning.

The larynx has six important centers which open it by means of its muscles, helping to expel the gases that come from the lungs. Of these, two control the air inspired through the mouth and purify it of certain gases; two others do the same with air inspired through the nose; and the two remaining centers are guardians against gases that could enter in other ways.

In the infraglottic region there is a center of great importance that receives an aerial astral vibration that penetrates through there. When this center is highly developed, one can hear astral sounds.

The esophagus possesses three centers located in each one of its three physiologic narrowings. The first, in the cervical narrowing, controls the heat of ingested foods. The second, situated in the aortic narrowing, controls the quality of food in the sense that, if there is a variation in this quality, nausea starts; in persons in prolonged fast, this center secretes a very white mucus that has food value, called in Mysticism "Mana", or "Bread of Heaven". The third center, situated in the diaphragmatic narrowing, controls the volume of food and can produce nausea and discomfort; it is a vestige of the first stomach, produced by the evolution of the animal center.

All of these centers are related to the thyroid gland, where the principal center is found. In the membrane that surrounds this gland there are fifteen other secondary centers related, above all, with body heat. Some, probably about half of them, direct metabolism and the production of iodine in the body. One of these centers is in contact with X2 atoms which supply "the soul" of the iodine. That center functions only when the organism is not overloaded with fatty substances of all kinds, principally esters. If this center would function correctly, one would never suffer from cancer.

Each of the parathyroids has three secondary centers; one influences the origin and metabolism of calcium; another, the origin and metabolism of phosphorus; and the third, the origin and metabolism of an ethereal alcohol that determines the longevity of the subject. These centers are equal in both parathyroids but, in order that they function efficiently, it is necessary that both groups of centers work with the same rhythm. They have a close relationship with the sexual centers. If the parathyroid centers functioned perfectly (which does not yet happen in the normal, contemporary human), testosterone and folliculin would be in equal proportion in each human being. In the humans of today, the right and left groups of parathyroid centers alternate working, taking preponderance over each other for periods of seven years.

COMMENTS ON THE TENTH TEACHING

Saliva

The salivary glands of man secrete 1-2 liters of saliva a day, the rate of secretion ranging from barely perceptible to as high as 7.4 ml per minute at maximal stimulation. Saliva is composed of water, a number of minerals, proteins and phospholipids. The minerals include sodium, chloride, phosphate, potassium, calcium and trace amounts of iodide, magnesium and others. These are the same minerals found in blood plasma, but at about two- thirds the concentration. There are two main salivary proteins: one is the alpha-amylase enzyme ptyalin, which begins the digestion of starch when mixed with food by chewing. The second is mucin, which contributes the lubricating action to saliva. Ptyalin actually reduces starch particles to less than one hundredth of their original size helping to make solid material easier to swallow. Phospholipids may help transport the salivary proteins from their cells of origin in the salivary glands to the saliva.

In keeping the mouth wet, saliva facilitates speech. It is also essential for dental health for in its absence tooth decay is more likely to occur. When secretion is decreased such as in dehydration, the resultant changes in the mouth contribute to the sensation of thirst. The basal flow of saliva in the absence of any particular stimulus is about 0.4 ml per minute. This flow is reduced during dehydration, fear, anxiety or intense mental effort. Saliva dissolves substances, making them available for taste, and is secreted in response to noxious or unpleasant substances in order to dilute them and cleanse the mouth; the bicarbonate content of saliva neutralizes acids. Perhaps, "the bitter and disagreeable tasting saliva" referred to in the Teaching could be explained by a reduced flow of saliva (due to anxiety, for example) which does not cleanse the mouth very well and, therefore, allows disagreeable tastes to build up. Chewing tasteless wax produces about 2 ml per minute (5 times basal flow); when the chewing is on one side the glands on the active side secrete vigorously while those on the inactive side only a little. In general, secretion increases with the amount of material being chewed and with the pressure required to chew it. However, the most effective stimuli are substances that arouse the sense of taste, and of those, acid substances are the most stimulating. For example, acid lemon drop candy is one of the most potent stimulators of salivary secretion. In experiments with different types of substances maximal secretion of 7.4 ml per minute (about 20 times basal flow) was

obtained with a relatively high concentration of citric acid (the acid found in citrus fruits like lemons, oranges, etc.). Smells also stimulate secretion. For example, amyl acetate (the distilled smell of pears) causes secretion at about twice the basal rate.

The universal impression that man's mouth waters at the thought of savory food has not been confirmed by careful studies. For example, the sight of a lemon is believed to be a strong stimulus of a conditioned salivation response. However, one subject whose salivary glands were canulated so that secretion could be measured, experienced no increased secretion when he saw a lemon and watched it being cut, squeezed and sucked by a colleague. When he himself drank 2 ml (less than 1/2 teaspoon) of the juice his secretion rate increased 12 fold. In another experiment, bacon and eggs were cooked within 4 feet of three hungry subjects. In one, there was no increased secretion, and in the other two, saliva flowed only at less than twice the basal rate. One subject reported his mouth to be watering when there was no measurable increase in his rate of secretion. We may be able to account for the notion that the human mouth waters by observing that in the waking state the mouth always contains saliva, although we are usually not aware of it; thinking about food or participating in its preparation simply makes us conscious of it.

"The inferior vocal cords have 23 centers; each one producing a distinct vocal vibratory range."

The larynx (or "voice box") consists of cartilage, muscles, and ligaments. Its largest cartilage, the thyroid cartilage, forms the familiar "Adam's apple". The larynx connects the pharynx (the back of the oral and nasal cavities) with the trachea and lungs. It carries out three important functions related to this critical location: (1) during breathing, it provides a passageway for air to enter and leave the lungs; (2) during swallowing, it responds reflexively (by means of the valve-like "epiglottis") to prevent swallowed materials from entering the airways; and (3) during speech, it allows for the production of sounds.

The highly elaborate communication expressed in human speech is unique to our species, and is derived to a large extent from the rich variety of sounds that the human vocal cords and associated structures can produce. The sounds of speech are produced in much the same manner as the sounds of a musical instrument. In the first step, termed "phonation", the vocal cords are tensed and moved tightly together while pulses of air are expelled from the lungs simultaneously. This causes the vocal cords to vibrate in the same manner as a reed instrument (the saxophone, for example), and sounds are produced. In the next step, termed "articulation", the sounds are modified and resonated. The modification of the vocal cord tones is carried out by the lips, tongue, and the soft palate, and enables the formation of a vast array of vowels and consonants. The resonators, in turn, enrich the tones of speech just as the body of a violin provides a chamber to enhance its musical tones. For human speech, the resonators include the mouth, nose and nasal sinuses, the pharynx, and even the chest cavity. The importance of articulation can be appreciated by observing how difficult it is for ventriloquists to talk without moving their lips, or how different our own voice sounds when we have nasal congestion, or when we pinch our nose shut while talking.

The "vocal vibratory range" of the human voice is extraordinary. Anyone who has listened to an accomplished opera singer can attest to this. In speech or in singing,

voice production depends a great deal on the characteristics of the vocal cords themselves. In adult males, the vocal cords are larger and therefore vibrate at a lower frequency than in females (80 cycles/sec *vs*. 400 cycles/sec), and therefore the male voice is generally lower in pitch. For each individual, the vocal range depends on the capacity to stretch the vocal cords. The tighter (more tense) the cords can be maintained, the higher the pitch. The normal range of tones for the human voice is four and sometimes up to five octaves. In singing, the vocal cords can be trained to produce a "vibrato". This is the result of a regular variation in pitch (rather than a fixed tone) and usually occurs 6 to 7 times per second. Other characteristics of the human voice are controlled by mechanisms other than the vocal cords. Loudness, for example, is a function of the amount of air passing from the lungs through the larynx, while timbre (quality) is a result of individual characteristics of oral, nasal, and pharyngeal resonators. Although the Teaching mentions 23 centers belonging to the vocal cords, it is not clear from current physiology how such centers might act to influence the qualities of voice production described above.

"All of these centers are related to the thyroid gland..."

The thyroid gland is located in the front of the neck at the level of the Adam's apple. It consists of two lobes (one on each side of the trachea or windpipe) connected by a thin strip of tissue called the isthmus. Normally the thyroid gland is small and barely visible at the surface of the neck with each lobe being less than 2 inches in length. However, there are numerous conditions which can cause the thyroid to enlarge. A greatly enlarged thyroid gland is termed a "goiter" and some goiters can become extremely large. For example, goiters associated with chronic iodine deficiency have been known to grow to 20 times normal size. They protrude from the neck as masses almost the size of grapefruits.

The thyroid gland produces thyroid hormone. This hormone is the main regulator of metabolism in the body. It is also crucial to normal growth and development in infancy and childhood. A unique component of thyroid hormone is iodine. In fact, about one-fifth of all the iodine in the body is located in the thyroid. Thyroid hormone, along with its precursors and metabolites, are the only iodine-containing compounds in the body. Thus, the thyroid gland is unique in its active absorption of iodine and this uptake is the basis of several clinical tests which assess thyroid function. The activity of the thyroid itself is regulated by the pituitary gland and by the hypothalamus region of the brain (see Comments on Teaching 11). Measurement of hormones produced in these areas gives further information regarding thyroid function.

Problems of thyroid function occur if the thyroid gland is either under- or overactive. An underactive thyroid has many causes and results in a deficiency of thyroid hormone. Clinically, this is termed "hypothyroidism." Features of hypothyroidism are those of a reduced metabolic rate and may include subnormal temperature, slow pulse, cool dry skin, depressed growth of hair, weight gain, an elevated serum cholesterol, weakness and somnolence. When severe and prolonged, hypothyroidism can lead to coma and even death. An overactive thyroid, on the other hand, results in an excess of thyroid hormone. There are many causes of this condition, which is termed "hyperthyroidism." Features of hyperthyroidism are those of an

excessively rapid metabolic rate and may include fever, rapid pulse, heat intolerance, tremor, and weight loss. When severe and untreated, an extreme state of agitation and psychosis may develop. Death may result from cardiac complications. Obviously, a properly functioning thyroid gland is essential to health.

"Each of the parathyroids has three secondary centers;..."

Typically there are four parathyroid glands in the human being. These are located immediately behind the thyroid gland, one each adjacent to the upper and lower pole of each of the two thyroid lobes. Most often they lie within the capsule of the thyroid gland itself. They are quite small, ordinarily only 6mm x 3mm x 2mm (about the size of a grain of rice).

The function of the parathyroid glands is to secrete parathyroid hormone (PTH) which is the regulator of calcium metabolism. This is accomplished by the action of PTH which influences bones, kidneys, and the intestine. If levels of calcium in the blood begin to decline, PTH is released. PTH rapidly triggers a release of calcium from bones as well as an increased absorption of calcium from the kidneys and intestine. This effect is in conjunction with Vitamin D. The result is a rise in blood calcium levels. As calcium levels continue to rise, parathyroid secretion is suppressed, allowing calcium levels to decline. Thus, a dynamic balance in calcium levels is achieved by PTH and the direct feedback effect of blood calcium concentrations.

A second hormonal feedback loop regulating calcium is that of the hormone "calcitonin" secreted by the thyroid gland. Its effect is opposite to PTH in that it lowers calcium in the blood. However, the effect of calcitonin is extremely weak in comparison to PTH. Nevertheless, the hormone is becoming important as a potential treatment for bone diseases such as osteoporosis where it is desirable to increase the amount of calcium deposited in bone.

Proper functioning of the parathyroid glands with the resultant balance in calcium metabolism is crucial since calcium is one of the major elements of the body. An excess or deficiency of calcium can cause severe consequences. For example, in "hyperparathyroidism" a constant, excessive secretion of PTH occurs and results in a sustained increase of blood calcium levels. If progressive, numerous complications may occur including changes in bone structure, kidney stones, peptic ulcers, weakness, lethargy, coma, and even death from cardiac arrest. In contrast, in "hypoparathyroidism" there is a deficiency of PTH. This may be sudden and severe as, for example, when parathyroid glands are removed during thyroid surgery. Under these circumstances, the level of blood calcium drops precipitously and muscles become hyper-irritable with uncontrolled spasms. This condition known as "tetany" may progress to seizures and death. It is obvious that these four little glands, the parathyroids, are of much greater importance than their tiny size would indicate.

References and related reading

"Physiology of the Digestive Tract" (4th edition), H.W. Davenport. Year Book Medical Publishers, Chicago, 1977.

"The Larynx", Harvey M.Tucker. Theme Medical Publishers, Inc., New York, 1987.

"Behold Man", Lennart Nilsson and Jan Lindberg. Little, Brown, and Company, Boston, 1974.
"Structure and Function in Man", Jacob, et.al. W.B. Saunders Co., 1982.
Physiological Chemistry, 16th Edition, H.A. Harper, V.W. Rodwell, and P.A. Mayes. Lange Medical Publications, Los Altos, California, 1977.
"Human Physiology & Mechanisms of Disease" (5th Edition), Arthur C. Guyton. W.B. Saunders Co., 1992.
"Textbook of Physiology" (21st Edition), Patton et. al., 1989.
"Textbook of Medical Physiology" (8th Edition), Guyton, 1991.

THE HYPOTHALAMIC REGION

Eleventh Teaching

All of the nuclei of the base of the brain, the protuberance, the cerebral peduncles and the cerebellum with its peduncles, correspond to the Visual Wheel.

The brain, with its cortical gray and white matter, corresponds to the Coronal Wheel.

The hypophysis directs all glands of internal secretion; at the same time, the Visual Wheel directs all of the secondary centers previously cited.

Within the sella turcica there are small centers which, quantitatively and qualitatively, correspond to each of the secondary centers already stated. These small centers remain in a latent state until their particular function becomes necessary. This occurs when the corresponding visceral centers are injured by illness or accident.

The hypophyseal (pituitary) gland has many secondary centers.

The *anterior* lobe has fifteen centers which act upon the other glands of internal secretion.

The first of these centers influences the feminine psyche.

The second influences the masculine psyche.

The third is involved in growth.

The fourth stimulates and regulates, according to age, the development and stability of the nuclei of the base of the brain.

The fifth determines the vegetative mental development.

The sixth develops the wealth of ancestral memory in the body.

The seventh prepares those nuclei in the brain which are destined to perfect a more complete mind.

The eighth acts upon the libido.

The ninth acts upon the instinct of procreation and the preservation of the species.

The tenth controls the somatic configuration according to sex.

The eleventh acts upon the thyroid and parathyroids.

The twelfth acts upon fat and carbohydrate metabolism.

The thirteenth is involved in adrenal and pancreatic function.

The fourteenth stimulates the male gonads and the voice.

The fifteenth stimulates the female gonads, the mammary glands, and the voice.

These last two centers are involved in the development of hair.

The centers previously mentioned stimulate or inhibit the secretions of the corresponding organs according to the vibratory frequency.

The *posterior* lobe also possesses fifteen centers.

The first acts on metabolism, mainly protein metabolism, and on the contraction of the smooth muscles of the intestinal and vascular walls.

The second acts on the entire nervous system, enabling it to receive its astral component. This center also regulates the elimination of water by the kidney.

The third acts on the physical and astral components of the blood.

The fourth allows the descent of the being that needs to be born into a determined organism.

The fifth goes into action at the instant of death, permitting rapid abandonment of the physical body.

The sixth determines the normal uterine contractions of labor and childbirth.

The seventh works during sleep, watching over the separation of the astral body.

The eighth controls the elevation of the being towards the mental world, during sleep or ecstasy. It does not function in states of dementia.

[Note: A ninth center was not included in the original Teaching.]

The tenth establishes contact of the individual mind with the cosmic mind. If it were to vibrate continuously, man would master all human sciences and would speak all languages.

The eleventh produces clairvoyant states with regard to past lives.

The twelfth makes the being feel his harmony with certain kindred groups of beings, establishing also the degree and category to which they belong.

The thirteenth vibrates in the close proximity of a Solar Initiate. This is true Communion.

The fourteenth establishes clairvoyance of events in the present time.

The fifteenth is found in the boundary of the pars intermedia and the posterior lobe; it gives clairvoyance of the future, which is Divine Clairvoyance.

All of the energetic currents coming from the pineal gland flow towards the pituitary through the substantia nigra or tuber cinereum. Through there, all of the spiritual forces of the Cosmos, which are filtered through the infinite centers of the pineal gland, penetrate into the human universe.

In the small mineral concretions of the pineal gland are found, potentially, the one thousand centers destined to have complete development after the sixth Root Race. They will begin their development in the last stages of life of the fifth Root Race, preparing man, by means of his physical improvement, to let go of the human category.

The nuclei of the base of the brain, or thalamic region, contain an infinity of energetic centers which live in relation with their harmonious cosmic centers. Each center is the image of a heavenly body; each group is the image of some constellation or planetary system. They form a true microcosmos, where knowledge of the nature of man and his relation with all Creation could be found.

COMMENTS ON THE ELEVENTH TEACHING

"The hypophysis directs all glands of internal secretion."

The term "hypophysis" originates from the Greek "hypo" (under) and "physis" (growth). The term was first used in 1798 by von Soemmening and refers to the location of this important gland at the base of the brain. Actually, the existence of this tiny gland has been known for at least 2,000 years when it was referred to as the "pituitary", a term derived from the Latin "pituita" (mucous). It was believed that mucus was produced in the brain and then excreted by this gland through the nose. A basic understanding of the true functions of this essential gland has developed only during the past 100 years or so.

The pituitary is indeed located in the skull at the base of the brain and is adjacent to the sphenoid sinus which connects with the nose. It is a small, oval, bean-shaped

brownish-red organ 13 x 9 x 6 mm and weighs no more than about 0.6 gm. It is attached to the brain by means of a slender stalk, the pituitary stalk, and is encased in a small out-pouching of the skull termed the "sella tursica" (Turkish saddle). The pituitary gland enlarges during pregnancy. In old age it loses some of its cells though retaining normal function. The anterior lobe is larger than the posterior, accounting for 80% of the size of the gland. The pituitary stalk is of great importance to the gland since it forms a dense bed of blood vessels and nerves which transport to the pituitary a variety of regulating hormones and other active hormones synthesized in the hypothalamus. The close anatomic and physiologic interconnectedness of these two regions is often termed the "hypothalamic-pituitary axis."

The pituitary gland is frequently referred to as the body's "master gland." This is because, as the Teaching describes, it secretes hormones which regulate nearly all of the other endocrine glands of the body. This interaction of the brain (especially the hypothalamus), the pituitary, and the endocrine glands is controlled by means of an elaborate feedback mechanism. There are six well-recognized hormones manufactured and secreted by the anterior pituitary. The two hormones found in the posterior pituitary are actually manufactured in neurons in the hypothalamus. They then travel the entire length of these neurons to the posterior pituitary for storage and ultimately for release into the bloodstream.

The tables below summarize the major known hormones of the pituitary and their function.

Anterior pituitary hormone	**Function**
Thyrotropin (TSH)	Regulates thyroid function
Adrenocorticotropin (ACTH)	Controls the adrenal cortex
Growth hormone (GH)	Regulates growth and affects metabolism
Prolactin (PRL)	necessary for lactation
Luteinizing hormone (LH) and Follicle stimulating hormone (FSH)	Both work to control the gonads in men and women

Posterior pituitary hormone	**Function**
Vasopressin (ADH)	Controls water conservation
Oxytocin	Stimulates uterine contractions at childbirth and also milk release

Obviously, many of the functions described in the Teaching are accounted for in this summary. Others are not. However, considering the anatomic and biochemical complexity of both the pituitary and hypothalamic regions, future research will no

doubt uncover new functions and interactions of this region with other areas of the brain and body.

The Pineal Gland

The small, cone-shaped pineal gland is located in the roof of the third ventricle underneath the cerebrum where it is encapsulated by the meninges covering the brain. In a child the pineal gland weighs about 0.2 grams and is 5-8 mm long and 9 mm wide. The gland begins to regress in size at about age 7 and in the adult appears as a thickened strand of fibrous tissue. Although the pineal lacks direct nervous connections to the rest of the brain, it is highly innervated by the sympathetic nervous system from the superior cervical ganglia located adjacent to the spinal cord.

The principal hormone of the pineal gland is melatonin. A decrease in melatonin secretion in many lower vertebrates is responsible for maturation of the gonads during their reproductive season. Melatonin secretion is highest in children ages 1 to 5 years and decreases thereafter, reaching its lowest levels at the end of puberty; concentrations are 75% lower at this time when compared to levels in early childhood. Whether or not melatonin plays a role in the onset of puberty is highly controversial. Furthermore, while there is abundant experimental evidence that in rats and other lower animals melatonin can inhibit gonadotropin secretion and thus have an "anti-gonad" effect, in other experimental situations melatonin can stimulate the reproductive system. A role for melatonin in the regulation of human reproduction has long been suspected but, because of conflicting and inconclusive data, has not as yet been established.

The pineal glands of some lower vertebrates such as lizards, toads and frogs have functional photoreceptors which, when exposed to light, inhibit melatonin secretion. In mammals, the secretion of melatonin has also been shown to decrease during daylight. However, the inhibitory effect of light on melatonin secretion in mammals is indirect, occurring through nerve tracks activated by light striking the photoreceptors in the eye. Receptors for melatonin have been localized to an area of the hypothalamus termed the "suprachiasmatic nucleus." This area of the brain is believed to be the site of the biological clock, which entrains or synchronizes various processes of the body to a "circadian rhythm" (one that repeats approximately every 24 hours). The rhythm of melatonin secretion may be entrained to cycles of light and dark through the action of the suprachiasmatic nucleus. It is interesting to note that in this regard melatonin has been used to treat the symptoms of jet lag; it has also been used to help reestablish the disturbed circadian rhythm of a blind person. Currently, research is directed toward the potential use of melatonin as a "natural" sleeping pill.

References and related reading

"Harrison's Principles of Internal Medicine" (13th edition), Kurt J. Isselbacher, et. al. (editors). McGraw-Hill, Inc., 1994, pp. 1891-1917, 1921-1930.

"William's Textbook of Endocrinology", (8th edition) Jean D. Wilson and Daniel W. Foster (editors). W.B. Saunders Company, 1992, pp. 221-225, 311-348.

"Human Physiology" (3rd edition), Stuart Ira Fox, Ph.D. Wm. C. Brown Publishers, Dubuque, Iowa, 1990, p. 310.

THE SUPERIOR LIMBS

Twelfth Teaching

The superior limbs have many secondary centers.

The hand has sixteen important secondary centers. The first is placed in the middle of the palm and directs the overall sense of touch; it is the deposit or astral center of the air. The centers from both palms are controlled by the seven cerebral centers of touch, which according to the Solar Tattva, impose a cycle of 52.43 minutes, during which they alternate in their functioning, positive and negative, for periods of 4.43 minutes. This alternation applies to all the centers studied.

In each one of the distal phalanges of both hands, there are secondary centers which are dependent on those of the palms; these centers have a characteristic astral sensitivity. The center of the thumb puts the being in contact with the Visual Wheel of the astral body; when it is well developed, it denotes character and will. The center of the index finger corresponds to the Laryngeal Wheel; it gives an extraordinary sensitivity for orientation in space. The center of the middle finger corresponds to the Cardiac Wheel; its good development gives the faculty of attracting and magnetizing beings. The center of the ring finger corresponds to the Solar Wheel and gives sensitivity for comprehension, mental clarity, meditation and knowledge. The center of the little finger corresponds to the Splenic Wheel; when it is well developed, it prevents danger, and in the hour of death it is the first to lose its sensitivity. The moon influences this center.

In the second phalanx of each hand there is also a center that develops the sensitivity of the Ethereal Body. The good development of these centers favors the intellect. Good development of the center corresponding to the proximal phalanx of the thumb enables the imposition of one's own will and power. The center of the second phalanx of the index finger gives special capability to explorers, travellers, pilots and gunmen. That of the middle finger gives the capacity to love and to heal. The center of the ring finger gives the capacity to deal with matters of economy, to attain success in finances and to have a sense of well being in solitude. That of the little finger allows communication with disembodied beings that move about in the inferior planes.

The center of the proximal phalanx of the index finger, if developed, indicates attachment to terrestrial possessions; that of the middle finger, lust. The center of the ring finger, indicates superstition and avarice and that of the little finger, propensity for violent death and accidents.

In the thenar eminence there is a center that, when well developed, puts the being in contact with the exterior worlds, astral or physical.

There are three secondary centers in the wrist, placed vertically in the middle part. The distal center not only controls the movements of the hand and forearm, but it also indicates the condition of both nervous systems. Its good development is reflected by a well marked first transversal groove. It acts on the cerebral-spinal system until the age of 30. The second groove indicates the same, from age 30 to 60; the third groove, from 60 to 90. Each groove indicates good memory for the corresponding age.

In the anterior, superior third of the forearm there are three principal secondary centers, placed transversally. The exterior one puts the being in contact with astral vibrations of beneficial nature; the middle one, with beneficial mental vibrations; the inner one, with mental cosmic vibrations.

In the anterior part of the articulation of the elbow there is a center that receives bad astral vibrations in very sensitive beings. These vibrations make circulation painful; this is usually confused with articular rheumatism.

In the posterior region of the elbow there is a center that regulates astral heat; it is surrounded by seven auxiliary centers which measure astral calories.

In the armpits there are secondary centers related to the physiological experiences of past lives. When one of these previous states recurs violently in the being, these centers give an alarm, secreting perspiration with a characteristic smell. In each armpit there are 777 of these centers.

In the superior and exterior region of the shoulder there are many centers related to the future development of man, but this is not the appropriate time to talk about them.

COMMENTS ON THE TWELFTH TEACHING

"The centers from both palms are controlled by the seven cerebral centers of touch,..."

Approximately 1 to 2 million years ago in Africa and perhaps elsewhere, an evolving primate species known as "homo erectus" (also known as "the missing link") developed the capacity to walk upright. Offering a better view (all the way to the horizon) and better mobility, it increased the range of the species and great migrations followed. This capacity to walk on the two inferior limbs also had the remarkable effect of freeing up the superior limbs for other functions. Two such functions were grasping and throwing, and not long afterwards the unique ability to fashion tools as well as weapons developed. A complex interplay linking the conceptual and sensory-motor functions of the brain with the mechanically elaborate anatomical structure of the arms and hands allowed this prodigious evolutionary feat. In fact, it has been such a distinguishing characteristic of the human species that some anthropologists have termed man as "The Toolmaker." It has often been thought to be a sign of an advanced intelligence, but based on some tools and weapons that are used by human beings today, perhaps this conclusion is debatable.

Be that as it may, it is indeed a function of the brain, notably the cerebral cortex, to control sensation and motor movements for the limbs of the body. In this capacity, it is interesting to note that a much larger area of cerebral cortex is devoted to the superior limbs than to the inferior. And even for the superior limbs, it is striking to note that most of this part of the cortex has neurons involved with the thumbs, fingers and hands and only a relatively small area for the arms or shoulders. Both sensory and motor neurons connect with the limbs by "crossed paths", that is, the cortex of one side of the brain operates the other side of the body. Thus, for example, if a stroke damages an area of sensory cortex on the left side of the brain, it results in numbness and diminished sensation on the right side of the body.

The Teaching describes a fascinating array of centers in the superior limbs in addition to the neuromuscular relationships discussed above. We are told they carry out numerous functions of both a physical and astral nature. Although present day science does not have knowledge or observations of these descriptions, simple everyday experience can reveal to us what remarkable appendages the superior limbs are. Too commonly we seem to take their function for granted. But if we try to become aware of the underlying complexity of such "simple" acts as writing with pen or pencil, using a knife and fork, or brushing our teeth, we can develop an appreciation for the intricacy and elegance of the human arms, hands, fingers and brain.

References and related reading

"Textbook of Anatomy", A.W. Rogers. Church Livingstone, Inc., New York, 1992.
"Behold Man", Harvey M.Tucker. Theme Medical Publishers, Inc., New York, 1987, pp. 160-163.
"Erectus Rising" and "Ape at the Brink" in "Discover Magazine", Vol.15, No. 9, September, 1994, pp. 80-98.

THE EYES

Thirteenth Teaching

The fundus of the eye has a great significance in the esoteric teachings. It receives potential negative vibrations from the interior of the organism by means of the physical atomic vibrations already studied. These potential negative vibrations reflect the vital conditions of the body. The fundus of the eye also receives positive vibrations from solar light. Those that can be useful to the body are kept in a magnetic field. All positive vibrations collide with each other in the retina and those that are not useful disappear. The useful ones collide with the negative vibrations in the fundus of the eye, giving a characteristic color to this region. The condition of the body can be known from the color, shape and intensity of these radiations.

The secondary centers of the eyes are located in the greater circumferences of the orbits. Here, there are an infinite number of these centers, represented by minuscule glands not known today. If these centers were developed, they could secrete a special liquid that would vivify the retina making it capable of receiving the luminous rays from beyond both ends of the spectrum. Those rays of shorter wavelength would allow the being to see etheric radiations; those of longer wavelength, a denser physical world.

In the anterior chamber, especially in front of and behind the iris, are the introspective secondary centers. They are like small centers or reflectors which allow the being to see the inner physical body, mainly when one of its parts is affected. This supports the old aphorism: "All diseases are seen with the eyes of the soul." In normal beings, in the case of serious disease of an organ, this inner and subconscious vision becomes so intense that it causes the corresponding center (the affected visual point) to vibrate intensely. This produces an almost imperceptible local discomfort, like a soft pain. This symptom is indicative of the imminent fatal outcome of a disease, and, in particular, of the incubation of infectious diseases.

In the cornea there are 72 visual centers. Based on their functioning, the individual has the capacity of distinguishing one object from another, giving to each the exact corresponding color. When the 18 centers of the superior cornea decrease their vibration, the being becomes myopic. When the 18 centers of the inferior cornea decrease their vibration, the being becomes presbyopic. When the 9 lateral secondary centers malfunction, they cause astigmatism.

In the greater circumference of the iris are the secondary centers that detect the cosmic pranic wavelengths, and in the lesser circumference, those that detect the pranic mental vibrations.

Behind the macula, there is a center that synthesizes the activity of all the described centers. When the being is in a state of deep contemplation, these centers vibrate extraordinarily, so that when back in the normal state, the being has the intuition and capacity to interpret the experience lived.

COMMENTS ON THE THIRTEENTH TEACHING

More than any other organ, we rely on the eyes to find out about the world around us. We use our eyes to gain knowledge, to appreciate the beauty of nature, and to enjoy literature and painting. Our eyes help us to carry out almost all activities of daily life.

The eye measures only about 1 inch (2.5 centimeters) across. But it is the only sense organ that can overcome great distances, making the visual world almost limitless. We can see light from stars so far away that their light may have travelled through space for thousands of years.

The eye can see both very bright and very dim light. In daytime, we see the light of the sun, which is millions of times brighter than this paper. Yet in the dark we can see the light of a match far away. With an upward glance, we can see a large part of the universe in the night sky. We can also see objects as small as the point of a pin. Various instruments help us to see even better. With the aid of a microscope, for example, we can see red blood cells which are so small that 60,000 would fit on the head of a pin.

General Structure of the Eye

A number of structures surround the eyeball and serve to protect it. The **eyebrows** and the jutting edges of the facial bones form a protective wall around the eye. The **eyelashes** act as a protective screen that keeps tiny foreign particles out of the eye. The **eyelids** are like movable curtains in front of the eye. They consist of three main layers: 1) the skin; 2) the muscles that open and close the lids; and 3) the **conjunctiva**, a membrane that lines the eyelids and covers part of the eyeball. Closing the eyelids, as in blinking, protects the eyes from injury and regulates the amount of light that enters the eyes. Most persons blink an average of 25 times a minute. Blinking also wipes the surface of the eye clean, and keeps a layer of **tears** over its front. Tears are produced in the **lachrimal glands** that lie under the outer part of the upper eyelid. Two small tubes, the **lachrimal ducts**, open at the inner corner of each eyelid. They continually drain the tears from the eye into the nose.

The **eyeball** itself is spherical, buried in fat, and lies inside the orbit of the skull. Each eye has six **extra-ocular muscles** which work together to move the eyeball. The conjunctiva covers the front of the eyeball, except for the **cornea**, the transparent anterior segment of the eye which permits light to enter. The conjunctiva contains many sensitive nerves which warn us if dust or other particles get under the eyelids. The inside of the eyeball is filled with a transparent, jelly-like substance called the **vitreous humor**.

The surface of the eyeball consists of three layers. The thick and tough outer layer gives the organ its form and protects the delicate inner structures. Its large posterior portion, the **sclera**, is opaque, and at the front of the eye it becomes the clear and transparent cornea. The **anterior chamber** is a small space between the cornea and the lens of the eye. It contains a clear watery fluid called the **aqueous humor**.

The middle layer of the surface of the eye, the **choroid**, contains most of the blood vessels that nourish the eye. Its anterior portion, the **ciliary body,** is the muscular instrument for the accomodation of the refraction of the eye. The ciliary body is connected by fibers to the crystalline **lens,** keeping it in place and controlling its shape.

At the very front of the eye the choroid becomes the **iris,** a thin tissue in front of the lens. Light passes through the **pupil**, a round opening in the iris. The pupil looks like a black circle. Two sets of muscles in the iris change the size of the pupil. This controls the amount of light that enters the eye. To better examine the interior of the eye, doctors sometimes use eye drops to dilate, or enlarge, the pupil. The amount and location of pigment in the iris determine whether the eye looks blue, green, gray or brown.

The **retina** is the inner layer of the eyeball. It is formed by three main cellular types: neurons, located toward the central cavity, light-sensitive cells or photoreceptors in the middle and pigment-containing epithelial cells near the choroid. Light must pass through the layer of nerve cells to reach the photoreceptors. The retina is transparent, but the pigmented epithelium is opaque and forms the first barrier to the rays of light.

The retina has two kinds of light-sensitive cells. These are the long, thin **rods** and the wider **cones.** Rods are very sensitive and therefore allow us to see in very dim light. When we move from a lighted room into a dark room, we can see almost nothing. But after a few minutes, objects in the room become visible. Our vision continues to improve as our eyes become *dark adapted*, or accustomed to the dark. Dark adaptation is the result of the rods' increased sensitivity. In the dark, chemical changes in the visual pigment of the rods increase their sensitivity. Complete dark adaptation usually takes about twenty minutes. *Light adaptation* is the opposite phenomenon. When we have been in the dark for a while, even moderate light seems dazzling and painful. After a few minutes, the eyes become less sensitive. When light stimulates the eye, the rods lose the sensitivity gained in the darkness, and the cones become active. Normally, light adaptation takes only a few minutes. Cones are responsible for color vision.

In man, the optic nerves (one from each eye) cross at the **optic chiasma**, near the base of the brain. From the optic chiasma, nerve fibers coming from the right half of each eye enter the right half of the brain. Fibers from the left half of each eye enter the left half of the brain. Each half of the brain receives an image from both eyes. The brain forms a single image from the images of the two eyes.

The ability of the brain to form a single image from overlapping fields of vision is called *binocular vision.* The slight differences between the image from the right eye and the image from the left eye give man stereoscopic vision, or the ability to judge depth. In order to have proper binocular vision without double vision, or seeing two images, the image of an object must fall at corresponding points on each retina. The extra-ocular muscles direct the eyes in such a way that this occurs.

As a person grows older, the lens of the eye stiffens and loses its ability to change focus. This gradual loss of accomodation is called **presbyopia**. Most persons become presbyopic at about the age of 45, and need glasses for reading.

Most persons are either right-eyed or left-eyed, just as most persons are either right-handed or left-handed. To determine which is your *dominant* eye, hold a pencil vertically in front of you at eye level. With both eyes open, line up the tip of the pencil with a distant object. Close one eye at a time. Whichever eye is open when the pencil remains lined up with the object is the dominant eye. The eyes cannot focus on both the

pencil and the distant object so that both images fall on corresponding points of the retina. When both eyes are open, the brain records the image seen by the dominant eye. It supresses the part of the other image that does not fall on a corresponding point in the retina.

The brain does not see a light until about a tenth of a second after the light is turned on. The image persists about a tenth of a second after the light is turned off. This explains why when a motion-picture projector shows about 24 still pictures on a screen in a second we see continuous movement. Each picture on the screen is presented to the eye before the previous image in the brain fades out.

Defects in the shape of the eye include **hyperopia** (farsightedness), **myopia** (nearsightedness) and **astigmatism**. In farsightedness, the eyeball is too short from front to back so that the point of focus falls behind the retina. The lens cannot bend light rays sharply enough to fall on the retina to focus near objects clearly. Glasses with convex lenses help correct this defect. In nearsightedness, the eyeball is too long from front to back. The focus falls in front of the retina. The lens brings light rays into focus too far in front of the retina to see far objects clearly. Glasses with concave lenses compensate for this problem. Astigmatism is caused by abnormalities in the shape of the lens or cornea. Some light rays focus on the retina but others focus in front of or behind the retina, producing a blurred image for both distant and nearby objects. **Strabismus,** or cross-eyes, is a common defect in children. An imbalance in the action of the extra-ocular muscles causes one eye to turn either in or out. To prevent double vision, the image produced by the eye that crosses is ignored by the brain. This may result in a permanent reduction or loss of vision in the crossed eye. Treatment of strabismus may require glasses, exercises, surgery and covering the good eye to strengthen the weak one.

Many diseases that affect the eye are treatable and, in most cases, can be completely cured. A *sty* is an infection of one of the tiny glands at the edges of the eyelids. *Conjunctivitis* (also known as "pink eye") is an inflammation of the conjunctiva, and *iritis* is an inflammation of the iris. They can be caused by infections, allergies or injuries.

Scarring of the cornea may result from injury or infection and can lead to blindness. The scarred cornea can be removed and replaced by a normal cornea from a donor eye in an operation called "corneal transplantation."

The lens, which is normally transparent, may become opaque so that adequate light cannot reach the retina and vision becomes progressively blurred. This condition, called *cataract* can be corrected by surgery. The clouded lens is removed and the patient then wears glasses or contact lenses, or may have an artificial plastic lens placed within the eye.

An increase of pressure inside the eyeball is called *glaucoma*. This pressure slowly destroys the optic nerve and, if it persists, can lead to blindness. Medication or surgery are available to control most types of glaucoma and preserve vision when the disease is diagnosed early in its course.

A sharp blow to the eye may knock the retina loose, so that it floats in the vitreous humor. Unless surgery is performed quickly, this *retinal detachment* can cause permanent blindness.

Some inherited diseases of the eye which cannot be cured as yet are color blindness, the inability to distinguish between certain colors, and night blindness, the inability to see in dim light. The latter is one manifestation of vitamin A deficiency. More serious disorders leading to blindness are the different forms of retinitis pigmentosa or the syndromes associated with these devastating conditions. A few of the defective genes responsible for these diseases have recently been identified, isolated and characterized, creating the hope that in the near future gene therapy may become a means for the prevention and treatment of these types of retinal degeneration.

References and related reading

"A Textbook of Histology" (8th edition), W. Bloom and D. W. Fawcett. W. B. Saunders Company, Philadelphia, London, pp 635-655.

THE KIDNEYS

Fourteenth Teaching

The kidneys are the organs that produce and excrete the urine. In this task it is necessary to consider the rhythmical function of the kidneys as very important. In certain persons this rhythm is altered; and often, in spite of both kidneys being apparently healthy, only one functions. This is due to the lack of a balanced respiration, since the kidneys respond to the vibration of respiration.

When the kidneys are in good health, they alternate in their work every two hours and forty-five minutes. These cycles can be considered to start at the beginning of a lunar month and at sunrise. For the first three days of the month the left kidney begins functioning, during the next three days the right, and so on successively. Each kidney responds to the vibration of the lung of the opposite side. The right kidney eliminates the surplus of masculine hormones; the left the surplus of feminine ones.

The secondary centers of greatest importance are found in the peri-renal capsule. In that place are the four small centers, arranged in the form of a quadrilateral, which correspond to the sacral plexus. These centers are utilized after copulation in order to expel the as yet unknown hormones that are formed in that moment. These hormones would be harmful if they were to enter the blood stream. Surrounding the four small centers are five other centers corresponding to the splenic plexus, which serve to expel the hormones that are formed from the fear produced by a threatening situation. Surrounding the last mentioned centers there are six small centers corresponding to the solar plexus, which eliminate toxins produced by excesses in food and drink. When the demand on these centers is too great, the lumbar plexus is weakened, giving rise to lumbago and sciatica.

In the interior of each kidney are various types of secondary centers. There are twelve glomerular centers that correspond to the cardiac plexus; they respond to the rhythm of the heart. When man faces imminent death, these centers continue to function until the vibrations received from the cardiac plexus are used up. They also eliminate hormones and toxins produced by violent actions.

In the uriniferous tubules there are sixteen secondary centers which correspond to the laryngeal plexus; while their exact functions are not known they are presumed to be of an astral nature.

There are one hundred known secondary centers in the renal pelvis which correspond to the pituitary and pineal glands; presumably, there are many more. Their functions are of an astral and mental nature.

In the ureters are found secondary centers, corresponding to the sacral plexus, which function when a person defecates or urinates.

COMMENTS ON THE FOURTEENTH TEACHING

"The kidneys are the organs that produce and excrete the urine."

The kidneys are located just behind the abdominal cavity along the back at the level of the upper lumbar vertabrae. They are paired organs; in adults each is about the size

of a fist. The kidneys function with sufficient reserve so that only one kidney is needed to sustain life. For example, the surgical removal of one kidney (nephrectomy) is sometimes necessary. The remaining kidney compensates by enlarging and increasing its work capacity so that no problems occur related to kidney function. However, whether one kidney or two, if kidney function deteriorates and becomes inadequate, disease and ultimately death will result. This is because the kidneys not only regulate the composition of body fluids, but also serve to eliminate most of the body's metabolic waste products. One reference describes the kidneys as the "sanitation stations" of the body.

The functioning unit of the kidney is termed the "nephron." The human kidney has 1 million nephrons and each one is capable of producing urine by itself. A nephron has two parts, a "glomerulus" and a "tubule". The glomerulus contains capillaries and filters fluid from the blood. The tubule then collects this fluid and converts it into urine. The kidneys function in such a way that over 99% of the filtered fluid and most of the minerals are reabsorbed by the tubules and returned to the blood. Thus, although the amount of fluid filtered from blood into the kidney tubules is approximately 180 liters/day, the ordinary urine output for an adult is only about 1.5 liters/day.

Urine consists of approximately 95% water and a variety of substances dissolved in it. Sodium and potassium are two examples of important elements found in urine. Their concentration in the urine results from a need to maintain the proper amounts of these elements within the body. Calcium is also found in urine. It is important because when present in excess concentration, it does not dissolve in the urine. In these circumstances, a calcium kidney stone may form. Besides minerals, many other substances are found in the urine. Bile pigments, for example, are what give urine its color. In diseases in which jaundice occurs, the excess bile pigments give urine a dark orange, almost brown color. Numerous hormones are also excreted in the urine. The Teaching alludes to some of these. The hormones of "fear", for example, may relate to epinephrine (adrenalin) and related hormones. These hormones are generally excreted into the urine in stable amounts. However, in instances of rare tumors (most notably pheochromocytoma), large amounts of these hormones are found in the urine indicating the presence of the tumor and thereby, allowing for early detection. Similarly, corticosteroid hormones and their metabolites relating to male and female hormones are also excreted in the urine. When these are found in large amounts in the urine the presence of gonadal or adrenal tumors is likely.

The extraordinary technology of our age has allowed the development of the kidney dialysis machine. In our society we tend to take this modern medical "miracle" for granted. Nevertheless, as wonderous as this technology may be, it still can't match in ease or efficiency the miraculous cleansing system of our own kidneys.

References and related reading

"Textbook of Physiology" (21st edition), Harry D. Patton, et.al. (eds.). W.B. Saunders Company, Philadelphia, London, 1989.

"Behold Man", Lennart Nilsson and Jan Lindberg, Little, Brown and Company, Boston, 1974.

EQUILIBRIUM OF THE ATOMS

Fifteenth Teaching

In order to maintain the health of the organism and cure illnesses when the vital equilibrium has been lost, it is indispensable to reestablish harmony among the different groups of atoms of the body. This harmony must always exist, according to the ancient saying: "Medici tibi fiant haec tria: mens laeta, requies, moderata diaeta".

The ponderable atoms have a polyhedric form in the physical world; when they predominate, if one could see them, they would appear as a field of many squares forming a grid. Since they influence the skeleton, muscles and connective tissue, they tend to stiffen the joints, remove elasticity from the organism in general and produce arteriosclerosis when their number is greater than normal. Furthermore, when the ponderable atoms predominate over the other atoms they increase in power and reproduce much more readily.

Control of the diet is necessary to diminish the influence of these atoms. At 40 years of age one is in the habit of eating as if one were 20. Calcium, which is the principal component of the ponderable atoms and which in adolescence is quite indispensable, becomes an enemy after age 40. Also, something similar occurs with the rest of the elements, as various illnesses are produced when any of them is in excess. In order to reestablish equilibrium it is not necessary to restrict the total diet, but rather to alternate it, for example, in the following way: during one year meat is eliminated; during the following year one diminishes carbohydrates; during the next year, fats.

The dynamic atoms have a spherical form and are found in a constant number; correct breathing (spontaneous or acquired) maintains this optimal condition. When the dynamic atoms are in numerical disequilibrium with respect to the rest of the atoms the life of the human being is shortened.

The imponderable atoms have different and variable forms and in the current human being they are not found in a stable number. However, in some groups of the sixth sub-race considerable progress toward this numeric stability can be perceived.

If the human being could harmonize the atoms that constitute him, he would be a true god over the earth, a free and happy being; he would not know illness or old age and, as conqueror of death, he would be able to pass to the superior worlds with full knowledge. He would unite pain and pleasure in such a way that for him pain would never reach the point of desperation, nor pleasure reach the point of paroxysm. Instead of clashing between themselves, these two forces would harmonize with each other by a divine paradox in such a way that neither excessive pleasure nor pain would exist. This would give the being the continuous stability of peace and happiness.

COMMENTS ON THE FIFTEENTH TEACHING

"In order to maintain the health of the organism and cure illnesses when the vital equilibrium has been lost, it is indispensable to reestablish harmony among the different groups of atoms of the body"

Although the Teaching may refer to somewhat different types of atoms than the physiology textbooks do, it is still of some interest to consider the table below which compares the quantities (by weight) of some of the most common substances in the human body.

Content in grams of a 70 kg man

water	41,400
fat	12,600
protein	12,600
carbohydrate	300
sodium	63
potassium	150
calcium	1,160
magnesium	21
chloride	85
phosphorus	670
sulfur	112
iron	3
iodine	0.014

"Medici tibi fiant haec tria: mens laeta, requies, moderata diaeta".

This Latin saying means: May the doctors prescribe for you these three things: a happy mind, rest, a moderate diet.

"Since they (the ponderable atoms) influence the skeleton, muscles and connective tissue, they tend to stiffen the joints, remove elasticity from the organism in general and produce arteriosclerosis when their number is greater than normal."

Arteriosclerosis is a term which refers to a disease process affecting one or more layers of arterial blood vessel walls. These changes result in rigid, hardened blood vessels, and give rise to the commonly used term "hardening of the arteries".

By far, the most common cause of arteriosclerosis is "atherosclerosis." This process begins with very subtle damage or injury to the innermost layers of the blood vessel (usually a large or medium sized artery). In response, the cells of the blood vessel wall swell and proliferate at the site of the injury. Soon thereafter, fatty substances (especially cholesterol) accumulate and form plaques along the inner blood vessel wall. Later on, fibrous "scar-like" changes develop and when calcium deposits accumulate, the process is complete. The result is a stiff, narrowed blood vessel which is severely impaired in its capacity for blood flow.

Arteriosclerosis is the major cause of heart attacks, strokes, and peripheral vascular disease. In fact, almost half of all people in the United States and Europe die of complications of arteriosclerosis, most commonly from involvement of the coronary arteries (heart attack). It is interesting to note that the process of atherosclerosis begins at a very early age. Nearly 10% of the surface of the aorta is involved with atherosclerosis by as early as 10 years of age, and by age 30 there is 30% involvement. It seems that all individuals are at risk for atherosclerosis, although those with genetic or lifestyle risk factors develop this disease earlier in life and experience more severe complications.

"Control of the diet is necessary to diminish the influence of these atoms (The ponderable atoms which produce arteriosclerosis)."

It is now well known that the greatest risk factor for atherosclerosis and its complications is a diet high in fats, particularly saturated fats and cholesterol. Additional known risk factors such as cigarette smoking, high blood pressure, obesity, diabetes, and inherited disorders of lipid metabolism all serve to magnify this risk.

A recent clinical study of a large population determined that restricting dietary fat reduces the risk of heart attack. In fact, for every 1% resultant decrease in blood cholesterol, there was observed to be a corresponding 2% reduction in mortality from heart disease. It is also now known specifically that a diet rigidly restricted in fats can not only halt the progression of atherosclerosis, but in some cases actually reverse the process and lessen the extent of blockage in key blood vessels.

Obviously, a necessary aspect of assuming responsibility for one's health is to restrict dietary fats, to be physically active, and to maintain a normal body weight. It is also important to be aware of and to avoid the other coronary risk factors as well. Finally, it is probably a wise idea (at least in certain age groups) to have periodic measurements of one's serum lipids to verify that one is not at a high risk for arteriosclerosis and all its complications. In this regard, prevention is always better. It makes no sense to wait for the first stroke or heart attack to take proper care of oneself. By then it may be too late.

"Calcium which is the principal component of the ponderable atoms and which in adolescence is quite indispensable, becomes an enemy after age 40."

Calcium is one of six major elements in the body. It functions to provide strength and rigidity to the skeleton and teeth. In fact, 99% of the body's calcium is found in bones. However, the much smaller amount of calcium in body fluids is also important since this element plays a critical role in such vital functions as acid/base balance, muscle contraction, and conduction of nerve impulses.

In Western diets calcium is obtained primarily from milk and dairy products. It is well absorbed from these foods. In other parts of the world calcium is derived from different dietary sources, including tortillas made from lime-soaked corn, an Ethiopian grain known as "tef", and fish bones such as those of sardines. Vitamin D plays an important role in enhancing the intestinal absorption of calcium. However, a number of substances interfere with absorption of calcium including cellulose, alcohol, oxalates (found in green, leafy vegetables), and certain medicines. Supplementation of dietary calcium with calcium tablets is frequently necessary.

The Teaching describes an important relationship between age and calcium effects on the body. Indeed, calcium is an "indispensable" (i.e. essential) element. Although it is said that the RDA (recommended daily allowance) for adults is 800 mg/day, there is much variabilty. Pregnant women need 1 1/2 times this amount since the developing fetus needs lots of calcium for skeletal formation, especially in the final months of pregnancy. Moreover, lactating women also need this extra amount for proper concentration of calcium in the breast milk. For infants adequate calcium intake is even more important, the usual requirement being 60 mg/kg/day which is roughly 6 times the needs of adults. In childhood and adolescence, when skeletal development is occurring rapidly, calcium requirements peak at levels higher than for normal adults

(approximately 1200 mg or more per day). Even after puberty, when linear growth has ceased, vertebral bone growth continues into the third decade of life, and calcium remains necessary for health.

Why then, after age 40 as the Teaching says, might calcium become an "enemy?" Perhaps the Teaching refers to the deposition of calcium in a variety of tissues, a process which indeed does increase with age. This deposition is generally a response to tissue injury. Examples include calcium deposits in brain, lung, muscle, cartilage, and a variety of other soft tissues and organs. However, more often than not, these types of calcium deposits do not cause symptoms or disease. Thus, probably the main role that calcium plays as "an enemy" is in its role in atherosclerosis referred to earlier. When deposited along the walls of crucial blood vessels of the heart or brain, it leads to blockages resulting in potentially serious morbidity and death.

Another role for calcium as an enemy after age 40 may not have to do with excesses of calcium, but rather a lack of calcium. This occurs in bones affected by a condition known as "osteoporosis." It seems that by middle age, calcium begins to "dissolve" from bone. This process is accelerated by certain pre-disposing factors such as a slender body habitus, Asian or Caucasian descent, smoking, excess alcohol consumption, lack of exercise or physical activity, and a diet deficient in Vitamin D and calcium. There is a dramatic effect in women at menopause, when levels of the hormone estrogen diminish and result in rapid loss of bone matrix and calcium. In general, by age 75, bone mineral mass has decreased by an average of 28% in women and as much as 10% in men.

As a result of osteoporosis, there is a lack of both calcium and bone tissue, which causes the bones to become progressively weaker. That this lack of calcium is an enemy becomes evident when assessing the health of the elderly. Each year in the U.S. about 1.3 million older people suffer fractures due to osteoporosis. Furthermore, elderly persons with osteoporosis frequently experience a decrease in height due to compression of soft, calcium-deficient bones of the spine. When severe, the posture becomes dramatically stooped resulting in permanent deformity and disability.

To summarize, as the Teaching aptly describes, abundant calcium is absolutely essential to infants, children, adolescents, and young adults. However, it most certainly becomes a detriment to older persons where it seems either to be deposited in tissues where it is not needed or to migrate from the bones where it is needed.

References and related reading

"Textbook of Medical Physiology", (8th edition) A.C. Guyton Co., 1991, p 786.
"Clinical Nutrition" (2nd edition), D.M. Page. C.V. Mosby Co., 1988, pp 580-582.
"Basic Science Review for Surgeons", Simmons and Steed. W.B. Saunders Co., 1992, pp 312-315.
"A Lifelong Program to Build Strong Bones". In "University of California at Berkeley Wellness Letter", July, 1993, pp4-5

SOME EXERCISES TO MAINTAIN THE EQUILIBRIUM OF THE ATOMS

Sixteenth Teaching

The first advisable exercise is useful for increasing the number of ponderable atoms during illnesses. The person exercising, seated with his back to the sun and with the legs and arms crossed, fixes his vision at the level of the chest of his shadow while imagining to be surrounded by a golden aura. He will then slowly move both the hand and the foot on one side of the body alternating with the hand and foot on the other side of the body, and will attempt to breathe slowly and rhythmically through both nostrils at the same time. After 10 or 12 of such respirations he will begin to breathe deeply through the right nostril with the same rhythm as before, mentally counting to 333. After that, he will immediately close his eyes and remain immobile for seven minutes. Then the golden square of the ponderable atoms will appear in his mind. This exercise is beneficial for those who suffer from low blood pressure.

The second exercise is useful for increasing the number of dynamic atoms. It is better to do it during moon-lit nights. This exercise is used in the care of nervous or glandular illnesses. It is practiced while sitting down, looking at the moon or a star, immobile, with the eyes fixed on the selected point; one then breathes strongly through both nostrils imagining to be submerged in water. When one has the sensation of drowning, one will begin to breathe through the left nostril with all one's might, counting slowly to 280. After that the eyes are closed and one will imagine seeing an immense silver sea. Then one will stand and try to walk about 50 meters rapidly, holding the breath as much as possible. When the weather is hot , it is good to do this exercise barefooted, on wet tiles. This exercise is beneficial for hypertensives.

The third exercise is related to the imponderable atoms. It is preferable to practice this exercise lying down stretched out on one's back, with a black cloth loosely covering the eyes, imagining to see a black and shapeless void. One will then breathe 10 times through the right nostril and then 10 times through the left, rhythmically, at the ticking of a clock. Then after inhaling, one covers both nostrils for as long a time as possible. This exercise has accomplished its purpose when the person doing it has seen a multitude of luminous, multicolored, little points. It is excellent for mental rest, for recovery of memory, and for recovering forces spent in exhausting study, so that one can return to studying again.