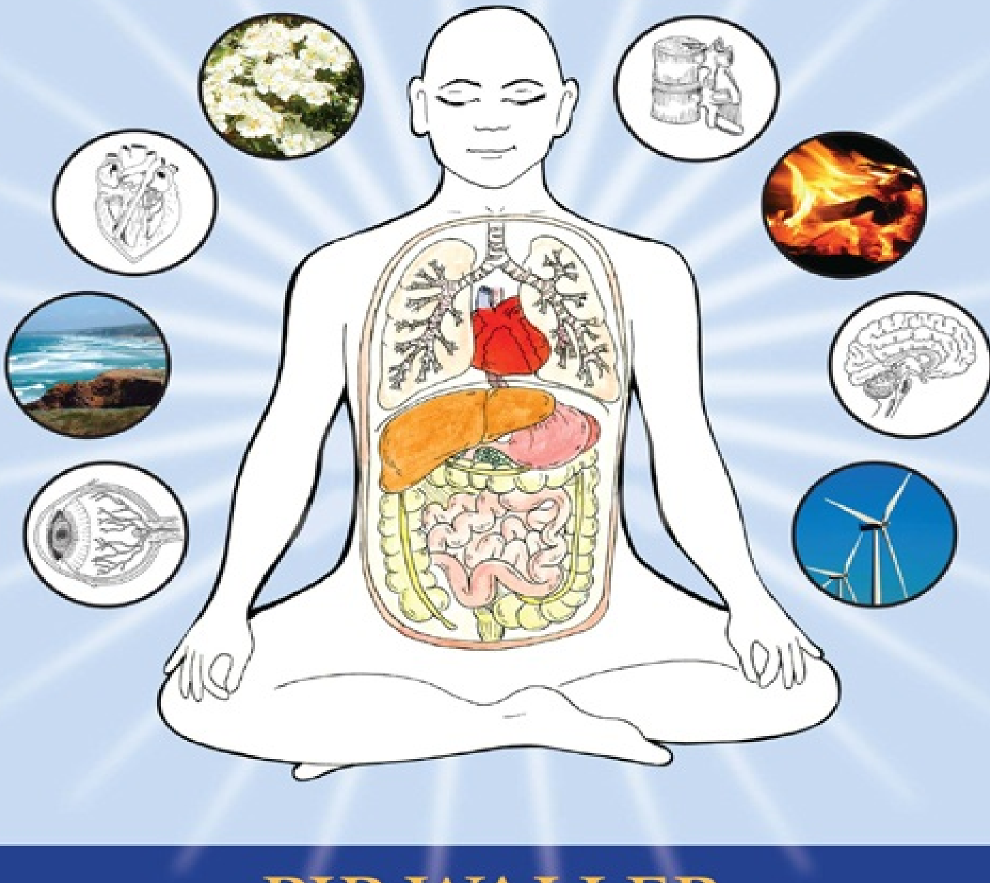
HOLISTIC ANATOMY

AN INTEGRATIVE GUIDE TO THE HUMAN BODY



PIP WALLER

Praise for *Holistic Anatomy*

"Open this book anywhere and read a paragraph; you'll want to read more. Keep reading—You'll enjoy yourself while finding out about the human body. You will also get a glimpse here and there from an unexpected perspective!"

—ELIOT COWAN, author of *Plant Spirit Medicine: The Healing Power of Plants*

"This startling book looks at anatomy, physiology, and pathology in a refreshing new way: holistically and in the context of life and culture.… Highly recommended."

—KATH ANTONIS, medical herbalist, registered nurse, and clinical teacher

"I would wholeheartedly recommend this book to anyone who is even vaguely intrigued by the 'how' and 'why'—and more importantly, the 'what if'—of their existence …"

—KAREN CHAGOURI, editor of *In Touch* magazine, holistic therapist, and doula

"This book is written in a style that is very easily understood, instead of just being factual information. It feels as though Pip is there with you explaining things to you in a way that really makes sense."

—PHIL PEPIN, massage therapist

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This book is dedicated with great love to Alex, the apple of my eye,
and to all my students over the years who taught me
so much and inspired me to write this book.

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Author's Note: This is not a conventional textbook—it roams around through all kinds of subjects, weaving them into anatomy, physiology, and pathology. If you are studying a course of some kind, you will still need your recommended books. This is meant more as an appetizer to get you going.

Medical Disclaimer: The following information is intended for general information purposes only. Individuals should always see their healthcare provider before administering any suggestions made in this book. Any application of the material set forth in the following pages is at the reader's discretion and is his or her sole responsibility.

Contents

About the Author

Introduction

In a sea of anatomy and physiology books, why write another? Mainly to help contradict the notion that anatomy and physiology are dry and boring, and to share more widely my particular style of introducing adults to the miracle of the body, Spirit made flesh, with the many opportunities of philosophizing, chewing the breeze, enjoying the apparent ridiculousness, and otherwise observing how to live well, that this subject abundantly offers.

I will assume that you have very little knowledge, and begin by introducing the body very simply and building on this knowledge to add layers of understanding. The goal is to leave the reader truly understanding something of how the living body works, rather than to cover every detail of current knowledge on anatomy, physiology, and pathology. It seems that many people study A & P to considerable depth—even managing to pass detailed exams on the subject—without ever gaining a real understanding. This book aims to remedy that.

I will attempt here a holistic—and in places more than slightly heretical—anatomy and physiology: that is, an exploration of the mechanisms of action of the body mixed with interesting thinking about emerging sciences such as quantum physics and the new biology, human emotional anatomy, ecological principles, and spiritual and energetic paradigms. You will see that the study of human biology can be linked to broader considerations of how a human exists within, and interacts with, the environment, and experiences existence in emotional and spiritual, as well as physical, terms. Some of what follows is accepted scientific fact, some challenges such facts, and some is just my own ideas and philosophies—based on both my own and borrowed observations. I will conclude with a brief overview of various paradigms of health and disease, including beginning a discussion of what total healing of body, mind, spirit, and global society could mean. I am very familiar with some forms of natural medicine; these are the ones I mention most as examples. The absence of mention of other systems in no way indicates their lack of value—only my own lack of knowledge. I hope that students of these disciplines will forgive this lack and still find this book helpful as an aid to understanding the medical sciences.

As this is *not* intended to be an academic work, I provide almost entirely secondary references, intending where I can to point the reader on to further study. At times I repeat information to aid the learning process. (After all, the main way humans learn is by repetition, repetition, repetition.) You can take it all with a large pinch of salt (after all, our bodies are swimming in salt water), and enjoy the mental meandering, which will help you to remember the plain facts. Actually, I advise you to be vigilant against adopting a fixed position—keep thinking for yourself, and rather than getting attached to one viewpoint, have an open mind and be prepared to adapt your thinking as new information emerges. Modern orthodox medicine offers many examples of what happens when you don't do this. Take antidepressants, for example: In early March 2008, the headlines were full of how they only work for thirty percent of people. But did you know that the entire premise that depressed people have low levels of serotonin in their brains, first theorized in 1967, has never actually been proved, despite many attempts to do so? This theory has been accepted by many medics, including those in the mental health field, and is widely believed publicly, yet it seems very likely to be wrong![1]

The actual physiology herein is at a fairly basic level, without being oversimplified. In places it is more technical than the interested lay reader or healer would need (or like); these readers can skip over the bits that are too detailed and stick to taking in the juicy bits. Students who are required to go deeper will gain a practical understanding of how the body works and then return to their more in-depth textbooks with renewed vigor.

The human being, in body, mind, and spirit, is a beautiful and complex entity—there is always more to be learned. In this spirit, I have included some contradictory ideas that could all be true. I would be very pleased to hear from you with new ideas, information that debunks my own ideas, and any other feedback that adds to understanding our bodies, minds, and existence in this way.

Please contact me via the book's Web site, www.holisticanatomy.com.

This book is intended for:

- Anyone studying, or with an interest in, holistic medicine, particularly those with less than 100 percent enthusiasm for the anatomy and physiology side of things. This book will light your fire!
- People who want to know more about how their body works but don't want to read a straight textbook.
- Those who enjoy science, but feel it can be a little disjointed.

- Healers and energy workers who need to bone up on how Spirit looks when it's in the flesh.
- Anyone with a body and a thirst for knowledge about it, who likes to look at life sideways.

Please feel free to quote from this book, subject to acknowledgment of the source.

SECTION 1

How the Body Works

This section deals with the anatomy and physiology of the body—how the body works, starting with an overview, and then looking at the microstructure and all of the various body systems.

CHAPTER 1

An Orientation to the Human Body

First, some basic anatomical language, and a general orientation.

Just as the universe is a gigantic dance of stars and planets, spinning and turning in mysterious space, so the human body is an incredibly beautiful and complex creation, with millions upon millions of cells, functioning in their different ways to make an integrated whole. (Just thinking about the word "cell," I realized it kind of sums up the separatist, mechanistic approach to life of Newtonian science, which gave birth to modern medicine, which is brilliant in its way, yet lacking in connectedness between the different bits of the body; between the body, mind, and spirit; between a person and the environment.)

Groups of similar cells are found joined together to form tissues. Different tissues together form structures with specific functions, called organs. Organs are associated with various tubes and supporting structures in things called systems. These carry out types of work in the body, like the different departments in a company or the various goings on in a community: communication, control, energy input, waste disposal, transport, production, and so on.

The body exists in a state of constant change and movement. There is an internal balance, known as **homeostasis**, which is constantly monitored and maintained.

This is the Western way of explaining what the Chinese call yin and yang: the complementary opposites that in life are always moving and dancing together in and out of balance. (In Western physiology, homeostasis relates to physical functions only.)

In life there is no stasis—all is continually moving and changing. The chemicals in the body are kept at optimum levels. They move up and down these levels, and by so doing keep our bodies functioning well.

For the purposes of study (and following Western scientific tradition, which loves to separate in order to analyze and classify), we divide the functioning of the body into systems and look at each one individually: the skin; the skeleton; joints and muscles; the heart and circulation; the circulation's companion, the lymphatic system; the lungs; the gut; the kidney and bladder; the nervous system and the special senses; and the reproductive system.

Remember, however, that the parts cannot and do not function alone—all are connected together in their intricate dance to maintain homeostasis. Even though each cell has its individual life and functions, there is an overall coherence. The endocrine and nervous systems are key in this, but not the end of the story; there seems to be an intelligence that runs through the body and mind, connecting and somehow orchestrating it all, which goes beyond what is currently understood by science.[1]

Connected to Each Other and to All Life …

We humans also cannot—and do not—function alone. Our modern world allows the illusion of separateness. I can live in my house, go to work in my car, sit at my desk and work, buy food to cook alone or with my small immediate family, with very little contact with other humans. Recent political trends in Britain positively promoted this idea, with the philosophy "there is no such thing as society—there are only individuals."

The reality is, we are not independent. We are absolutely and completely dependent on each other (interdependent) for our survival, just as we have been since the beginning of time, and just as our cells are dependent on each other for the survival of our body.

Long ago (about three and a half billion years) our ancestors were still in simple chemical form hanging out in the primordial soup, when they noticed that if they hung out together they did better at surviving. Hence the first creatures formed, who then noticed (about a billion years ago) that getting together with each other created yet more opportunities for multiplying. We still carry within our cells **mitochondria**, which were once smaller cells **(bacteria)** that became part of a bigger cell—were swallowed by it, or invaded it. The partnership was successful for both parties and survived to be the building block of our bodies, the modern **cell.***

In the morning, an alarm clock made in a factory across the sea wakes me. I get up and dress in clothes made somewhere else. I eat food grown by people of many countries—packed, transported, and sold to me. Before I even leave the house in the morning I have been touched by thousands of other lives. It is impossible for a human being to be separate. We are connected to each other and to all life, to the earth we live on, as intimately as our cells are part of us. Likewise in creating this holistic anatomy, physiology, and pathology book, I am roaming through body, culture, society, Earth, politics, healing, and spirituality.

Anatomy and Physiology: Structure and Function

The word **anatomy**, from Greek for “cutting away,” refers to the study of *structure:* what does it look like, where is it, how is it put together? The word came from the process of autopsy (cutting up dead bodies), through which much of anatomical knowledge arose. This may account for some of the weaknesses of Western medicine—study of dead bodies cannot give us entirely reliable information about living anatomy.

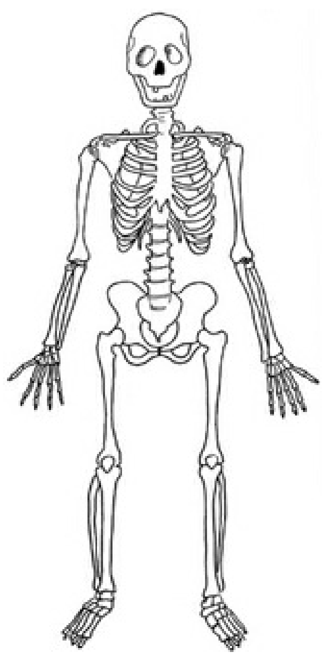

FIGURE 1.1. The human skeleton

Take a look at the pictures of the skeleton in any anatomy book (including this one!). See how big a gap there is between the top of the ilium (hipbone) and the bottom rib. Now have a feel of your own body; see how much space there is between these two bones. You'll find it's considerably less. This is due to the way the skeleton is held and pulled on by the muscles, which makes it different in life and in death. This is not meant as a criticism of traditional anatomical study—but it is important to be aware, as we attempt a study of living anatomy, of the basis of much of this knowledge.

Physiology is the study of life, or *function:* what does it do, and how does it do it? Most of the knowledge modern physiology has gleaned has come from countless experiments on animals.

Anatomy and physiology naturally go together. We say there is a *complementarity of structure and function*—for example, blood flows in one direction; in the veins it flows toward the heart (physiology) because of the one-way valves (anatomy).

Pathology is the study of what can go wrong: *disease*. (Which means "disease," a lack of easy functioning.) There are many different approaches here. This book will introduce some very basic Western pathology, which is extremely good at describing what is happening in the tissues during disease states. We will also briefly explore various holistic models of the causes of disease.

A Hierarchy of Organizational Levels

There is said to be a hierarchy of **organizational levels** in the body. We love to make a pyramid out of a circle! Here they are:

The simplest level is **chemical**. Everything is made of atoms,* combining to form molecules, which combine to form organelles … and so on. There is much more on this to come—brace yourselves!

Next comes **the cell**, bound by a highly intelligent, semipermeable membrane and containing fluid called cytoplasm. All cells have some common functions, but there is enormous variation between different cells in the body. Inside the cytoplasm are found organelles, which carry out the basic functions of the cell—including the mitochondria, nucleus, Golgi body, and endoplasmic reticulum.

Cells and so-called extracellular material (stuff that cells make, is not a cell, and is found outside a cell, such as collagen fibers) get together to form **tissues**. There are four basic types: the lining **epithelial** tissue; **muscle** tissue for movement; **nervous** tissue for communication and control; and **connective** tissue for … connecting. The four tissue types are arranged in various ways in the body, forming its organs, tubes, and supporting structures.

Organs are discrete structures carrying out particular functions. There are many organs in the body, including the heart, lungs, brain, liver, gall bladder, pancreas, kidneys, bladder, and uterus. They are made up from all the different tissue types. Hollow organs, such as the heart, have an inner lining of epithelial tissue, a middle layer of muscle, and an outer covering of connective tissue. The tubes in the body, such as the blood and lymph vessels, ureters, fallopian tubes, windpipes, and gastrointestinal tract, have the same basic structure: an inner lining of epithelial tissue, a middle layer of smooth muscle, and an outer covering of connective tissue.

Organs and supporting structures, like the tubes of the gut and blood vessels, get together to perform whole areas of function in the body, and these are known as **systems**. Systems carry out the functions necessary for life, e.g., the heart and blood vessels make up the cardiovascular system, responsible for transport throughout the body. All the systems work together.

The whole thing is called the **organism**. It's good to remember that, although we break it down into separate parts for study, actually the organism (us!) is a complex being in which all parts work together harmoniously. The maintenance of harmony and balance within the organism is known in Western physiology as **homeostasis** (although this relates only to the body). Uniquely in world cultures, modern Western science does not recognize the existence of Spirit, and is just barely beginning to understand the Mind.

Can you see yourself as part of a highly ordered world—universe, even—with its own control systems and homeostatic balancing mechanisms? This seems far-fetched to modern Westerners, brought up with a purely mechanistic view of the world on top of the Judeo-Christian paradigm of the world being put here for the use of humans, but it is A-B-C (or rock, tree, stone!) to many tribal people living in close harmony with the earth. How would it change things for you to consider yourself related to all, to remember every bacteria as your close kin, to know the rightness not only of *your* existence as a beloved child of the universe, but of every single other, whether human, creature, plant, or rock? This is how the remaining tribal peoples of the earth—keepers of the Old Ways—live.

Water, Water Everywhere …

The human body, like the surface of the earth, is sixty to seventy percent water. This water is found all over the place: inside cells (where it is called **intracellular fluid** or **cytoplasm)**, and outside cells **(extracellular fluid)**. Extracellular fluid (outside of cells) is found both in and out of the tissue spaces. In the tissue spaces it is called tissue fluid or **interstitial fluid**, and this bathes every cell in the body. There is a kind of glue here that holds the cells together and makes a gel of the tissue fluid, called **hyaluronic acid**. There is also extracellular fluid that is *not* found in the tissue spaces; this includes the blood plasma, lymph, and cerebrospinal fluid.

Some bacteria and viruses make an enzyme called hyaluronidase, which breaks down this glue to allow them to move around more freely. The well-known plant Echinacea is "antihyaluronidase"—it can halt the spread through the body of invading organisms by preventing them from ungluing our tissue fluid. Research has found that Echinacea (*Purpurea* and *Angustfolia* are the active species) also increases phagocytosis of foreign matter by white blood cells, increases lymphokines and cytokines that stimulate immune function, is antiviral at least externally (in vitro), is anti-inflammatory and yet improves wound healing, and has some antimicrobial activity.[2]

The Necessary Functions for Life

Maintaining boundaries is done by the skin, and on the cellular level by the selectively permeable membrane of each cell. In Chinese medicine, there is the Wei level—a protective energy that circulates along the meridians at the most superficial level. All energy healing systems have a way to describe a protective energy around the body.

Movement. In animals, muscle tissue allows for movement in the body—not just of our whole body by the skeletal muscles, but also in the digestive tract and the cardiovascular, urinary, and reproductive systems. Interestingly, plants move too, albeit much more slowly than we do. Many grow toward the light and will move as the light moves. Some catch insects, and many have ways to move their seeds across huge distances. Even whole populations can move, in response to changing conditions. For example, with global warming causing increased dryness in the South of England, beech woods are threatened there. However, they are now growing farther north than ever before, so in time, the entire forest will move north.[3]

Responsiveness is the ability to sense changes and react to them. All cells are responsive, but the nerve cells are particularly so and this is what allows them to carry out their functions of communication and control of body activities. Responsiveness is also called irritability—nice to know it's an essential life function to be cranky!

Digestion is the breaking down of food into usable parts.

Metabolism actually means all chemical reactions occurring within cells—breaking things down (catabolism) and building things up (anabolism). This is how we get energy.

Excretion is getting rid of the leftovers, the toxins, and the stuff we can't use.

Reproduction. Some say this is what it's all about! On a cellular level it happens daily as many cells continuously reproduce themselves, and are replicated to replace old worn-out ones. Then there is the more challenging task at the organism level, where whole new organisms are made.

Growth refers to the increase in size, as well as number, of cells within the organism. Many cells start off simple and grow in complexity, changing their makeup as they develop. For example, blood cells all come from one great-grandmother cell that divides and differentiates to become the very different red and white blood cells and platelets. There is also growth outside of cells, as structures such as hair are built up, and fibers are made (in connective tissue, for example).

Body Cavities and Organ Location

The skeleton makes areas of bony protection for squishy internal organs to hide within: the cranium of the skull protects the brain, and the vertebral column protects the spinal cord as it passes down that bony canal. The chest cavity, or thorax, protects the heart and lungs, and the pelvic cavity protects the bladder and **gonads** (sex glands) or ovaries, in women. (Men's gonads, the testicles, as you are no doubt aware, reside outside of the abdominal or pelvic cavity.) The thorax is divided from the abdomen by the **diaphragm** muscle, which domes up from the bottom of the ribs to a central flat tendon.

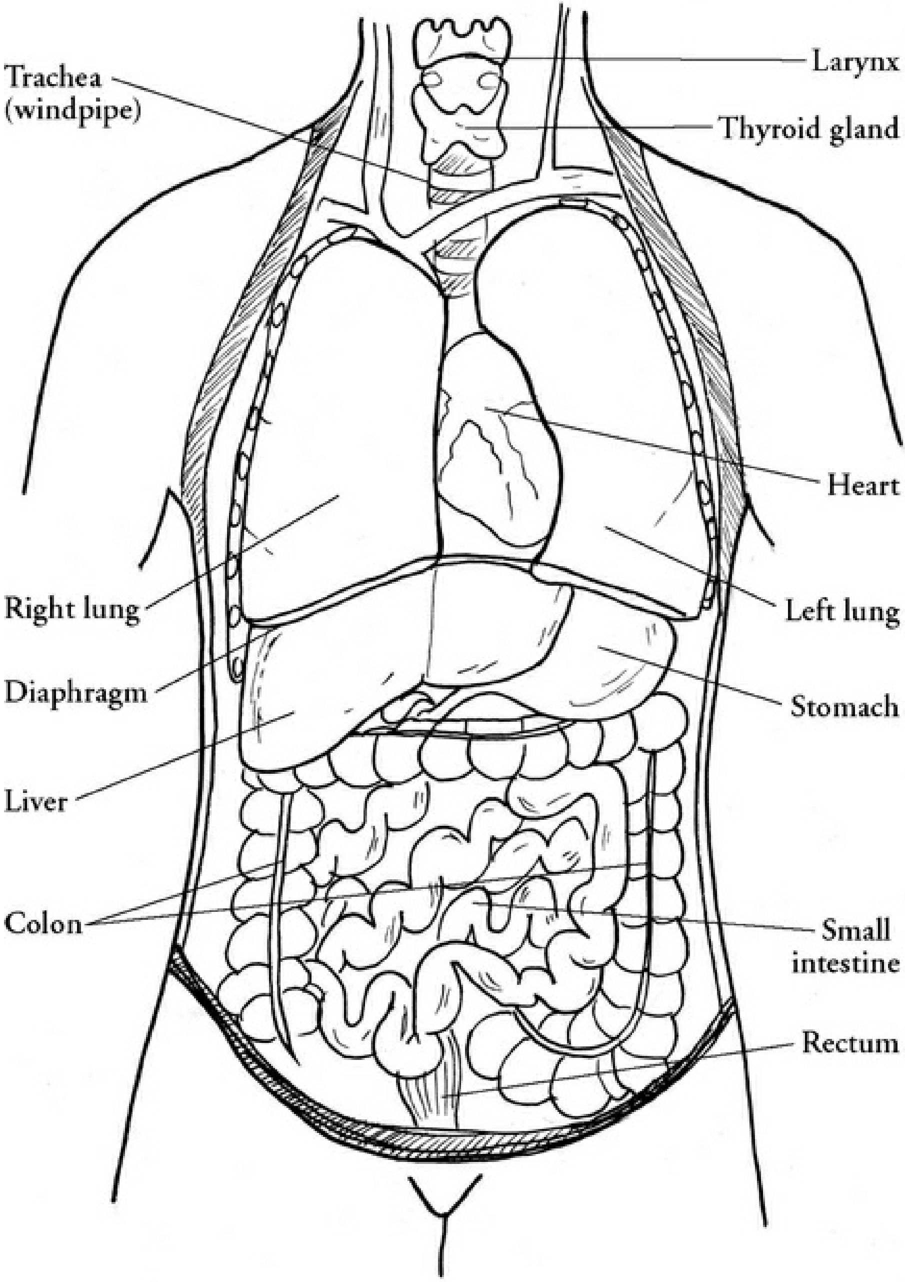

FIGURE 1.2. Location of organs

Beneath the diaphragm, the ribs protect the upper part of the abdominal cavity, and here nestle the kidneys, liver, and spleen. The two kidneys are found on either side at the back—if you put your hands back there on the bottom few ribs, you are directly over your kidneys. The liver takes up the rest of the right side, front and back, with the gall bladder attached below it. The spleen is found toward the back on the left. The muscles of the abdomen at the front and sides, and the spine and back muscles at the back, protect the less vulnerable guts, or intestines. The lower part of the abdominal cavity is the pelvic cavity, containing the reproductive organs and the bladder.

An Overview of the Body Systems

Just take a moment to be aware of your body—your bones and muscles supporting you, holding you up, turning the page, scratching your head. There's probably an ache here and there, drawing your attention to particular muscles. In fact, we often have the habit of noticing our bodies most when they are giving us trouble.

Find a friend and put your head on his or her chest—you can hear the "lub dub" of the heart beating. Feel your friend's pulse: put a couple of fingers inside the wrist on the thumb side, just outside the big tendon you can feel there. This is the radial pulse—a surge of movement in the blood vessels as blood is pumped around the body. Listen to the heart and feel the pulse at the same time; you'll hear the heart beat, then right afterwards, feel the pulse as the heart and blood vessels work in concert with each other. This **cardiovascular system** is the means by which things are transported through the body. Nutrients, waste products, hormones, and, in traditional Chinese medicine, chi energy—all rely on the circulation to get around.

The circulatory system is backed up by the **lymphatic system**, a collection of tubes called lymph vessels that begin in the tissues and, like the veins, drain waste products and water. This lymph fluid is filtered and cleaned by lymph nodes, and eventually returned to the blood. The lymphatic system is also heavily involved in **immunity**, protecting the body from outside organisms, cleaning up toxins, and destroying abnormal cells.

Focus on your breathing for a few moments. Can you feel your thorax (chest) expanding front and back, sides, top, and bottom? Place your hands on each side of your upper chest, with the fingertips touching your collarbone, and your elbows held in to your sides. This is the location of your lungs—are they smaller than you thought? The lungs are one of the most delicate organs in our bodies, part of the **respiratory system**, a series of pipes ending in tiny air sacs, or alveoli, that are surrounded by a network of minute blood vessels. Oxygen is passed from the alveoli into the blood, and carbon dioxide is passed from the blood into the alveoli to be breathed out.

The oxygen is used by your cells to burn sugar and fat to make energy. (See Chapter 2.) We've seen that the respiratory system is how we get the oxygen into the body. What about the sugar and fats? Put your head on your friend's belly and listen. Within moments, you will hear gurgles and pops, signs that the **digestive system** is working to break down food into small, usable parts. When they are small enough, these molecules that made up the food are absorbed into the blood stream. What we don't need is left inside the gastrointestinal tract to be excreted.

Go and take a drink—a large glass of water. What will happen to this water? First, it will cross the gut wall and enter the blood. If allowed to stay in the blood indefinitely, the blood pressure would go up, and the blood would become too diluted. We need to keep the right amount of water in our body all the time. This process is controlled by hormones—chemical messengers—and by the brain. The brain also controls hormone secretion, e.g., antidiuretic hormone is produced by special neurosecretory cells. Hormones from the kidney, heart, and brain control water balance, and the brain controls thirst. We can either preserve water, keeping it inside our body, or bail it out when there is too much. We bail it out using our **kidneys**. These amazing organs filter the blood and produce varying amounts of urine. As well as water, this contains the nitrogen from old worn-out proteins in the form of urea, along with other waste products and excesses. Every minute, the kidneys filter 125 ml of blood, which means that an amount of blood equivalent to all the blood in the body passes through the kidneys in less than an hour.

Hormones are a kind of homemade drugs, crucial to the way the body communicates with itself and controls its activities. They are made in specialized places called endocrine glands, which anatomists mapped out in the nineteenth century, and in various other organs, tissues, and cells all over the body. They are secreted directly into the bloodstream, so they travel everywhere. The **endocrine glands** are the pineal and pituitary in the head; the thyroid, positioned like a bow tie around your neck; the thymus, found behind your breastbone; two adrenal glands, one on top of each kidney; the gonads or sex glands; and the Islets of Langerhans in the pancreas, making insulin. The Islets of Langerhans are not, strictly speaking, an endocrine gland but are one of the other cells and tissues making hormones; these include, among others, the heart, liver, kidneys, stomach, and fat cells.

The endocrine system doesn't do all of the communicating and controlling. It is assisted by the **nervous system**—the brain, spinal cord, and nerves. This system runs its wires all over the body. Close your eyes and wiggle your fingers. What are you *doing?* Your brain is telling your fingers to wiggle—this is the motor nervous system. How do you know you are doing it? Because of your sensory nervous system you can *feel* it. That's basically it—your sensory nerves gather information and feed it to the brain, which decides what to do, and the motor nerves carry out those decisions by telling your muscles to contract or your glands to secrete. Simple!

More on Homeostasis

As I said earlier, in Western physiology, the word homeostasis relates purely to physical functions, especially the control of temperature, blood sugar, and body fluids. The internal organs require a fairly constant temperature for optimum functioning. When the environment is cold, we maintain heat by the blood vessels in the skin constricting (thus we look pale) and by shivering—much of our body's heat is generated by muscles contracting, so shivering is an involuntary way of getting us moving. The heat is transported around the body by the blood, rather like central heating. When we are hot, our skin reddens as the blood vessels in it dilate, allowing heat to leave the body. Also we sweat, which cools us because some of the heat energy in the skin is dissipated, making the sweat evaporate.

For everything to work well, we need the right amount of water in our bodies—too much or too little can cause problems and eventually kill us. Fluid balance is maintained by the kidneys, which filter the blood for nitrogenous wastes (toxic to us, food for plants) and excrete this, along with varying amounts of water, through the tubes of the ureters, into the bladder and out of the body through the urethra.

Most of the energy we need in the body comes from the sugar called glucose; we digest food and absorb its molecules into the blood. We need different amounts of glucose depending on our activity—less at rest, much more during exercise (or intense thinking such as you are doing now). The sugar in the blood gets into the interstitial fluid, and the cells take what they need. The right amounts in the blood are maintained by careful storing of excess glucose (as glycogen by the liver and as fat), or releasing of these stores. The process is controlled by the endocrine and nervous systems using a **negative feedback mechanism**. This basically means that as something rises in the body, whatever caused it to rise will then be decreased. For example, eating food causes your blood glucose to rise, which will also decrease feelings of hunger—although, of course, we can usually manage to enjoy chocolate anyway by disregarding this!

More Negative Feedback

In the world of physiology, negative feedback means that when *rising* levels of a certain thing (say, heat or glucose) are detected by the body (specifically, by some kind of nerve receptor), that information is sent to a control center (usually in the brain), which then sends a command to put something into motion to *decrease* that thing. If it's heat, for example, the commands will be to make the skin flush and to sweat in order to lose heat. If it's glucose, this may be taken from the blood by putting more of it into the cells, and transforming more to its stored form, glycogen.

It's rather like the thermostat in a house: If it is set at 18°C (65°F), when the temperature rises above this, the heating is switched off automatically. If the temperature goes below the set level, the heating is switched on, thus maintaining a constant temperature.

There are a few things in the body that work by physiological positive feedback, which basically means the more there is of something, the more it is stimulated. Childbirth happens like this, with oxytocin (a hormone from the pituitary) causing the uterus to contract, and this then causing more oxytocin to be released in a cascade, leading to birth. Another example is blood clotting, when a clot beginning to form actually causes more blood to clot. Maybe love works in a positive feedback kind of way too—the more there is, the more there will be!

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*It turns out that bacteria often behave in a way that turns the Darwinian "survival of the fittest" paradigm on its head. Not only do they not compete with each other, bacteria actively cooperate, exchanging important information about their environment (this is why they so quickly become immune to antibiotics, even those who haven't themselves been exposed to a particular antibiotic). These distant ancestors of ours are masters of adapting to their environment. (See Stephen H. Buhner's *The Lost Language of Plants*.) Actually, fifty years before Darwin, the man who first put forward the theory of evolution, Jean-Baptiste de Lamarck, emphasized the "instructive" cooperation between organisms and their environment. (See Bruce H.

Lipton, *The Biology of Belief*.)

There are ancient bacteria that do look quite similar to mitochondria—but let's remember that this can only ever remain a theory. We do need to be careful to not just pick the evidence we like to fit the story we like. Rather, the story should form around the unbiased facts, and we should be willing to change the story if necessary. Consider the creationists: They like their story and so only listen to evidence that supports it, and dismiss evidence to the contrary.

*Atoms are made of "subatomic particles" that, according to modern quantum physics theory, are pretty much nothing but some kind of mysterious energy. They are made of energy—incredibly fast moving vortexes of photons and quarks that, when you look really closely, disappear! (See Heinz R. Pagels, *The Cosmic Code: Quantum Physics as the Language of Nature*.)

CHAPTER 2

The Chemistry of Life

The life of the body all starts with the fusion of two cells to make one—the tiny zygote from which all of the amazing cells, tissues, organs, and systems of our brilliant bodies grow. Or is it sex it all starts with? The egg, or the chicken? We'll save sex for later, sprinkling it about here and there to spice up our anatomy life.

Actually, when you get down to it, it's about *chemistry*. Groans often ensue when people hear this word. But chemistry is just the language of the physical world. Chemistry is about how energy arranges itself to form matter. An endless dance of atoms, forming and reforming molecules, which get together with other molecules, which get together with still other molecules, to make … everything! Here is where modern Western science and mystical/religious/shamanic/energetic traditions agree.

Everything That Exists Is Made of Energy

What is energy? It's a word we apply in all sorts of ways—oomph, zest, life force, physical energy, mental energy, emotional energy, spiritual energy, kinetic energy, chi, agni, prana, pneuma, nuclear energy. It is the stuff that allows other stuff to happen.

In Western science, the definition is narrower: Energy is defined as the capacity of a system to do work, and is measurable by instruments. This definition of Newtonian origin (seventeenth century) really came into its own in the nineteenth century, the Industrial Age, and perfectly reflects the work ethic of that time.

Interestingly, in the last fifty years, science has also realized that energy is the stuff that drives the universe, drives every event in the universe, and is in fact the basic constituent of the universe. Although it can be measured and quantified, we have no real idea what it actually is. Physics finds that energy is the most fundamental property of the universe; everything can be created by or dissolved into energy, including matter itself.[1] There is a background buzz of energy everywhere—the so-called zero point field.[2] More on this later.

Consider Einstein's famous equation $E = mc^2$ (energy is equal to matter times speed squared, or the speed of light in a vacuum, which is a constant). It kind of means, energy cannot be destroyed, only move or change from one form to another. The movements and changes in energy are produced by forces, such as by the push and pull of electrical force, and the pull of gravity, which is produced by all the local matter being attracted to all other local matter. We experience this by being attracted to, or pulled, to the earth.

(To do the great Albert Einstein justice, he in no way saw the universe as empty and mechanistic. To quote him: "The most beautiful and most profound emotion we can experience is the sensation of the mystical. It is the power of all true science. He to whom this emotion is a stranger, who can no longer wonder and stand rapt in awe, is as good as dead.")

Ancient spiritual systems throughout the world—including

Vedic knowledge in India, shamanism or Earth-medicine (of which all tribal peoples have a version), and spiritual healing methods—all agree with modern physics on this business of energy being everything, but give it a different slant. Everything that exists is made of energy, including us. Because of this, we can communicate with everything—there is a place within us that can experience and in a very subjective way understand and use this energy. This approach is not separable from living in close harmony with what is all around us: nature. Vedic practice is about realizing one's true nature; realizing that one is pure consciousness, therefore knowing everything, having access to all knowledge from within. Shamanic practices using this principle include weather-working (affecting the weather by dedicated relationship with the weather gods), remote viewing to find animals or plants needed for survival, and uncovering the causes of illness.

The Hopi people have long understood the interconnectedness of life forms, warning that if you kill off the prairie dogs there will be no one to cry for rain. Amused scientists, knowing that there was no conceivable relationship between prairie dogs and rain, recommended the extermination of all burrowing animals in some desert areas planted to rangelands in the 1950s in order to "protect the sparse desert grasses." Today the area (not far from Chilchinbito, Arizona) has become a virtual wasteland (according to Bill Mollison in *Permaculture: A Designer's Manual*). It turns out that all the burrowing animals, from gophers to spiders, create a network of tunnels under the earth that then allow the water deep within the earth to rise and escape as moisture-laden air that forms clouds and thus provides rain. Stephen H. Buhner says in *The Lost Language of Plants: The Ecological Importance of Plant Medicines to Life on Earth* that "indigenous peoples have always had access to the finest probe ever conceived, one that makes scientific instruments coarse in comparison, one that all human beings in all places and times have had access to: the focused power of human consciousness."

Of course, "subjective" is a bit of a dirty word in Western science, which prefers things to be objective, to know how things are in and of themselves. However, more and more data is emerging about the profound effect the experimenter has on the experiment (an experiment being something that looks for objective facts). Just the fact that someone is experiencing an experiment (subjective) can change the result that actually occurs (objective). Therefore a truly objective result seems impossible.

Many people working in the field of holistic medicine consider that totally new research paradigms are needed to properly research the field. Perhaps, in attempting to be totally objective, we may be in danger of cutting ourselves off from the depth and power of our subjectivity, and have it rule us by our ignorance of it.

Some of the energy that powers us humans, enabling us to think and move and learn and love and play and work, is **electricity**. Our cells are powered by electric fields, generated by the positive and negative charges of the particles within atoms, which drive currents of protons through the tiny molecular machines within them. These positive and negative charges are derived from the breakdown of glucose, the body's fuel of choice.

Everything is made of energy, but there are also these things called particles, which seem to be there if you don't look too closely at them! We'll take a quick look at them now.

The smallest particles are tiny. Even atoms are made of very little actual stuff—energy that just whizzes about and acts solid. An atom has three types of particle: protons and neutrons, found together in the center of an atom to form a kind of nucleus, and electrons that whiz around the nucleus.

An atom looks a bit like this. The balls in the center are protons and neutrons; the negatives orbiting around them are electrons. However, real atoms are mostly empty space. If we wanted to make an accurate drawing, we would have to draw the electrons about a mile away!

In this drawing, it looks like the electrons neatly orbit the nucleus, when in fact they don't. In reality, it is not possible to tell exactly where an electron is at a given moment or where it is going. Scientists can calculate the probability that an electron will be found in a given volume of space, but that isn't the same as knowing where that electron is.

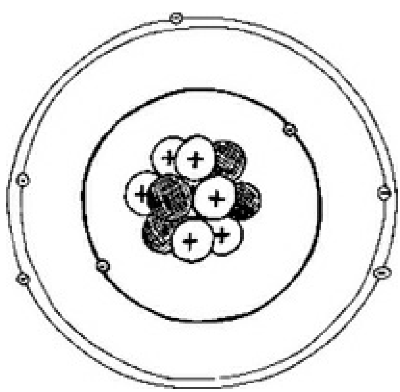

FIGURE 2.1. The Newtonian atom

Electrons, which have a negative electrical charge, are the smallest particles of matter. Then there are neutrons and protons, being neutral and positive, respectively. The electrons whiz around the proton and neutron center of each atom incredibly fast.

What feels solid to us is really not so solid on a particulate level. There are particles called neutrinos that can move at speed straight through large solid objects—like the Earth—and out the other side without being changed at all. These particles form the basis of the universe and modern physicists are discovering some really amazing stuff about them. For example, they appear and disappear *and no one knows where they go*. This is all to do with the zero point field, so-called because physicists cool things down to absolute zero to study particles, making them much slower moving. Another fascinating phenomenon is that if you completely isolate two particles of the same type that are in relationship to each other (known as entrained) and do something to one of them, its relative in the other isolation chamber behaves as if that same thing has just been done to it.

It looks as if quantum physics is beginning to catch up with the ancient shamanic wisdom of all cultures, and say, "Hmmm, the universe really is made of energy, everything is connected, and human consciousness has the power to affect reality."[3]

Well, that's life—the universe and everything. Now back to atoms. Atoms get attracted to other atoms, and then come together and share their outermost electrons—this makes what is called a chemical bond. As soon as two or more atoms are bonded, we call the resulting thing a molecule. Some molecules are very small, for example, oxygen gas (O_2), which consists of two oxygen atoms, or water (H_2O), which consists of two hydrogen and one oxygen atom. Some molecules are comparatively enormous and consist of thousands of atoms bonded together, for example, large protein molecules.

Some atoms particularly like to get together with other atoms—if they were people, they'd be the gregarious party-going types. A prime example of this is oxygen, which loves to mingle.

When a chemical bond is made, it takes energy—you could say that energy is locked up in the bond. When a bond is broken, energy is released. This process of breaking down (catabolism) and building up (anabolism) is what we mean by metabolism. More on this later.

Think of water. If you want to separate water you need to put in energy, e.g., an electric current. However, if you get a load of hydrogen and oxygen together, and put in a little activation energy, you then get loads of energy out (and lumps of metal end up on the moon!). So oxygen and hydrogen are initially in an unstable state and then give up energy to join together in a very stable, but lower energy state.

Chemical reactions occur all the time in the body. All chemical reactions involve energy use or release. In the body these are part of metabolism, meaning a state of change. There are two opposing forces in metabolism that must remain in balance: anabolism (building up) and catabolism (breaking down). Both activities are speeded up by enzymes—protein catalysts that accelerate chemical reactions without themselves being changed in any way. Remember:

- Anabolism uses free energy (e.g., when glucose is clumped together to form glycogen in liver and muscles).

- Catabolism releases free energy (e.g., glycogen being broken down to glucose).

Atoms are classified into discrete chemicals called **elements**. (Remember the periodic table from school? Don't worry—we're not doing that now!) These are seen as the basic building blocks of all the molecular compounds in the world. The traditional view is that an element cannot be changed into anything different, at least not without huge energy input, but when they get together with other elements all sorts of startlingly different substances are created.

At least, this is the case in a test tube. However, according to some research done in the early 1960s by French scientist Louis Kervran, living organisms can and do transmute some elements into others! For example, chickens make eggs with shells almost entirely of calcium, even when their diet is devoid of calcium, as long as they can access potassium, which is but a simple step away from calcium in its atomic structure. (You can read about this on http://www.cheniere.org/books/aids/ch5.htm. Kervran's experiments are convincing, but this work is not accepted scientific fact—yet. It was seen as so way out that few scientists even tried to repeat the experiments, though others have since done similar work.)

There are 112 (to 116) elements in the known universe—and, let's face it, not all that much of the universe is known by us humans. The entire human body comprises mostly only a few of these, arranged in various ways to form molecules, which are arranged into cells and "extracellular" stuff such as fibers and body fluids.

In fact, we are mostly water (sixty to seventy percent of our body weight). When on their own, the elements H and O—

hydrogen and oxygen—tend to exist as gases. When they get together a miraculous liquid, water, is created. Water is the perfect medium for the constant flow and ebb of chemicals; water and the other chemicals that make us up are always moving in and out of the body, in and out of the cells and tissues, and from place to place within the body. Water will allow most things to dissolve in it; it is the universal solvent. We will be hearing much about this amazing substance, which is the basis for life as we know it. Water can be a liquid, or, when very cold, become a solid—ice. When water is boiled, the molecules move so fast they become a gas—steam.

Water molecules have charged ends—they are polar. The hydrogen and oxygen atoms in it share electrons, but the oxygen tends to hog them, so the H end has a slightly positive charge and the O end a slightly negative charge (electrons being the negatively charged particles in an atom).

To be more precise, the water in us is like seawater—a solution of salts in a base of water. Basically, the human body exists in a sea of water and electrolytes—a very similar composition to seawater. The body's internal environment of salty fluids makes it largely electrically charged, as it contains the polar covalent water molecules with many ions—positively charged cations and negatively charged anions. The charged cations—$Na+$ (sodium), $K+$ (potassium), and $Ca++$ (calcium)—have important roles to play in making the **resting membrane potential**, which allows for nerve conduction and muscle contraction. More on this to come.

Electrolytes

Salts are interesting molecules. They are a joining of atoms known as **ions**, which have an overall positive or negative electrical charge in their outer orbit, depending on whether they have lost or gained an electron. As they can be positively or negatively charged, they follow the universal law of opposites—they attract each other—to form a salt. An example is **sodium chloride** (NaCl), a marriage of positively charged sodium with negative chlorine.

Ionic bonding means there has been complete transfer of one or more electrons between atoms, so that ions are produced. Ion means "goer to." For example, sodium chloride, NaCl: When an Na (sodium) atom gets near the Cl (chlorine) atom, the Na atom transfers one of its electrons to the Cl atom, forming an ionic bond, with the sodium end being positively charged and the chloride end negatively charged. When a lot of them join together, which they like to do, they form an elegant crystal lattice structure—a salt cube or crystal like you see in coarse sea salt.

When sodium chloride is in contact with water, the polarity of the H_2O pulls the NaCl molecules to disassociate into individual positively charged sodium atoms ($Na+$) and negatively charged chloride atoms ($Cl–$). All other salts behave in this way in water, and are then called **electrolytes**. The positive cations are attracted to the negative anions, and this attraction is used by the body for marvelous purposes, including the electrical impulses of the nervous system.

One especially interesting thing about chemistry is how completely different stuff can become when it combines with other stuff. Sodium on its own is a silver-white solid substance, while chlorine is a (highly poisonous) gas. Amazing! It's like cooking—you take a bit of this and that, and end up with all sorts of other stuff.

Most major spiritual traditions in the world agree on this basic similarity—everything is made of All-That-Is, or everything *is* God. Allah'ch ba. There is nothing that is not G–d. Great Spirit is everywhere and everything. You can substitute "energy" or "life force" for the word "God," and assume that the alternatives are interchangeable. Of course, religion with its accompanying bigotry and war, has given God a very bad press. Not to worry. This energy, the stuff of life, cannot be destroyed—only changed.

Our bodies, then, are a parcel of salty water wherein various tides ebb and flow, chemicals move around, interact with each other, change and change again. The major element in us is **carbon**. This is found in every being we call "organic" (which doesn't mean "no artificial pesticides" in this instance). Pure carbon can look like coal—or diamonds. Remember Superman squeezing the coal to make a rock for Lois?

Organic chemicals like carbon are nonpolar. Unlike water and electrolytes, which are called inorganic, carbon forms bonds in which the outer electrons are equally shared between atoms. There is no electrical charge present in such molecules.

Organic life is basically plants and creatures—carbon-based life, and their remains. In the West we consider "alive" only those creatures that:

- Require food of some sort to make energy
- Eliminate waste materials
- Use energy to grow
- Reproduce themselves
- Are sensitive to their environment and can move within it

Many other cultures in the world recognize the living energy of everything: plants, animals, rocks, air, mountains, the Earth itself and all the planets and stars, and even plastic and other manmade stuff. These tribal cultures, which have been and still are seen as primitive by the dominant Western culture, consider All-That-Is to be part of a whole—related and connected. Thus the idea that even as our cells, although having a kind of independent existence, are part of us, we are part of the great vast universe (which perhaps in turn is part of …).

If life is seen in this way, it is clear that creating huge piles of toxic rubbish and polluting the seas and rivers of the Earth is as irrational as filling our own bodies with toxins—particularly the kind that are no fun at all, like mercury, aluminum, and formaldehyde, all found, for example, in vaccinations.

Slugs and Snails and Puppy Dogs' Tails? What We Are Made Of …

We are mostly made of carbon, and in addition to this and our seventy percent H_2O, we contain small but vital amounts of other stuff: oxygen (65%), carbon (18%), hydrogen (10%), nitrogen (3%), calcium (1.5%), and phosphorous (1%). The remaining one percent is a mixture of potassium, chlorine, sodium, sulfur, magnesium, silicon, vanadium, copper, zinc, iron, selenium, molybdenum, fluorine, iodine, manganese, and cobalt (nowadays we may also contain lithium, lead, aluminum, strontium, arsenic, and bromine).

Let's look at the main chemical groups in the human body. The element atoms are arranged into molecules of the main chemical groups, including proteins, fats, carbohydrates, vitamins, and minerals. What follows is a closer look at these different types of chemical—what they are, and how they tend to function in the body.

Proteins

Proteins are very large molecules that actually form most of the structure of the body. They are made of **amino acids**, of which there are twenty common types.

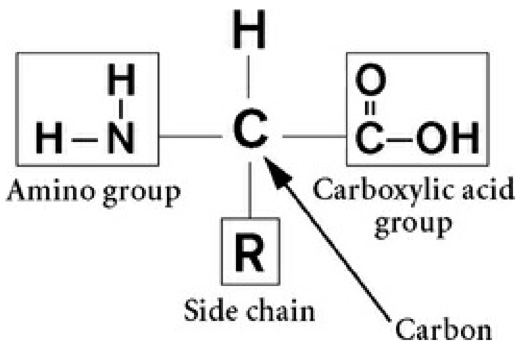

FIGURE 2.2. Amino acid molecule structure

Amino acids contain a nitrogen-containing amine group (NH_2) and an organic acid group (COOH). They may act as a base or an acid.* On average, there are nineteen to twenty atoms in one amino acid molecule.

Proteins are the main structural materials of the body and they have the most varied functions of any molecules in the body. Proteins make enzymes, hemoglobin, contractile proteins of muscle (actin and myosin), immunoglobulins, hormones, and more.

All amino acids are the same except for one part, called the

R group. Differences in the R group give each amino acid its unique properties. Proteins are formed when the amine end of one amino acid links to the acid end of the next. (A water molecule is formed as a result—this is called **dehydration synthesis.)** There are thousands of different proteins in the body; all are made from these various combinations of the twenty amino acids.

Proteins are classified by their appearance as fibrous or globular. Fibrous proteins are quite stable, but globular proteins are not and break down or change in certain conditions, including when the temperature, or the pH,* rises. This denaturing may be reversible, but if the disruption is extreme, it can irreversibly damage the protein—for example, what happens to the white of an egg (made of albumin) when cooked. In this case it is an irreversible process.

The normal pH of the body is 7.4—slightly alkaline. The pH may normally fluctuate between 7.3 and 7.5. Beyond this limit is abnormal; too much acid in the body is called acidosis and too much alkaline is alkalosis. Each enzyme for controlling metabolism has an optimum acid base balance, or pH, to work in, as well as a permissible range of pH, which it must have in order to function at all.

Fibrous proteins include collagen (which is found in all connective tissues including bones, cartilage, tendons, and ligaments), keratin (which waterproofs the skin, hair, and nails), elastin (which gives elasticity where it is needed in ligaments and elastic connective tissue), and actin and myosin (which allow muscle contraction and cell division, as well as transport within the cell).

Globular proteins are functional proteins and play crucial roles in almost all biological processes. They include:

- Protein enzymes, e.g., salivary amylase (which starts starch digestion in the mouth) and oxidase enzymes (among many others)
- Transport proteins such as hemoglobin and lipoproteins (among many others)
- Plasma proteins including albumin, which provides osmotic pressure to the blood, as well as being either a base or an acid, keeping pH balanced in the blood
- Protein hormones such as growth hormone and insulin
- Immune functioning proteins like antibodies, complement proteins, and molecular chaperones

See why it's essential to keep the pH and the temperature of the body within the correct range? Too much acid or heat irreversibly denatures these vital globular proteins, which would then interfere with virtually all of our vital functions. What is really interesting is that globular proteins' shape is not determined by DNA, but by environmental factors. The sequence of amino acids is determined by DNA, but the end shape is made by the way in which positive and negative atoms along the huge molecule are attracted to each other, and move together causing a turn or twist in the molecule. Various things can affect this, including, rather scarily, the microwaves from mobile phones and other wireless technology.[4]

Sugar, the Sweetness of Life

Carbohydrates provide easy fuel, which the body uses for energy and which is easily usable and easily stored. Most cells can only use a few simple sugars, the main one being glucose. The brain can only use glucose and must have a regular supply.

Glucose is broken down within cells (glycolysis), providing two molecules of ATP in the cytoplasm. This, not needing oxygen, is known as anaerobic respiration. Then the mitochondria take over with the Krebs cycle and hydrogen ion transfer to release thirty-four more ATPs (aerobic respiration). More on this later.

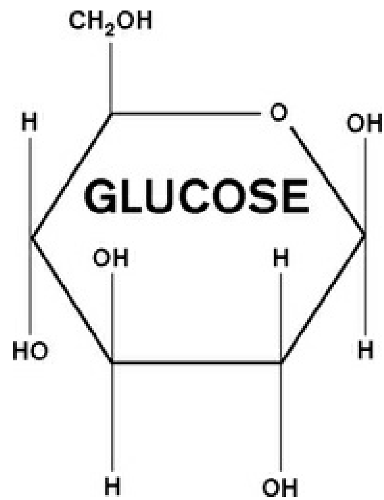

FIGURE 2.3. Glucose molecule

No matter which sugars we eat, the body can convert them to glucose for the brain to use. When not needed immediately for energy production, glucose is stored as **glycogen** in the liver or muscle cells, or converted to fat. Very important, but only very small amounts, of carbohydrate are used for construction, e.g., in the DNA/RNA of the nucleus, or attached to the cell membrane as markers.

Carbohydrates can be sugars or larger starches. **Monosaccharides** and **disaccharides** are the sugars, and

polysaccharides are starches.

The building blocks are simple sugars or monosaccharides. These usually have carbon, hydrogen, and oxygen in the ratio 1:2:1. The important ones for us can have six carbons, being called hexoses (e.g., the blood sugar glucose, which is $C_6H_{12}O_6$, fructose and galactose). Some have five carbons, being called pentoses (e.g., deoxyribose, found in DNA—which stands for deoxyribose nucleic acid).

Disaccharides are double sugars—two monos joined by dehydration (losing a water molecule). One such is sucrose (found in cane sugar), which is made from one glucose and one fructose. Another is lactose (glucose/galactose, milk sugar), and a third is maltose (glucose/glucose). When we digest these they are broken to simple sugars by hydrolysis (adding water).

Got that? Dehydration synthesis is the joining of two molecules by the *removal* of a water molecule. Hydrolysis is the opposite—splitting a molecule into two smaller ones by *adding* water.

Long chains of simple sugars linked together by dehydration synthesis are called starches or polysaccharides. Such molecules are relatively insoluble, and they lack the sweetness of the simple sugars. The two important ones are starch and glycogen. Starch is how plants store glucose and glycogen is how animals store it (in the muscles and liver). There are also oligosaccharides—very important ones for us are the **fructooligosaccharides** (FOS), a class of nondigestible carbohydrates or sugars that occur naturally in a wide variety of foods throughout the plant kingdom. Since they are nondigestible, they pass through the human digestive system virtually unchanged. When these fructooligosaccharides reach the colon, they are used by the good or beneficial bacteria found there (known as bifidobacteria or bifidus) for growth and multiplication. A healthy population of these beneficial bacteria in the digestive tract enhances the digestion and absorption of nutrients, detoxification, and elimination processes, and helps boost the immune system.

Fats

Fats, like carbohydrates, are made of carbon, hydrogen, and oxygen. In the body they are used for energy, protection, construction, and control. They are known as **lipids**.

Neutral fats are what we ordinarily think of as fat. They are the most efficient and compact way for the body to store fuel. Deposits are found largely beneath the skin—this is called subcutaneous fat. We also have quite a bit of fat around each of our organs. These layers of fat provide insulation from heat loss and protection from trauma. Neutral fats are composed of one molecule of glycerol—also known as glycerine—plus three molecules of long-chain fatty acids. These are made up of carbon, hydrogen, and oxygen; and, yes, you've guessed it, they are acids. We can make some fatty acids in the body, but there are a few we can't make—the essential fatty acids of Omega-3 and Omega-6 fame. More on these later in the chapter on nutrition and digestion.

Have you ever had honey and glycerine syrup from the drugstore for a sore throat or cough? Glycerol is a sugar alcohol; it is incredibly sweet and gloopy, demulcent (meaning soothing) to the throat as well as to other places lined with mucous membranes.

Phospholipids are used in making cell membranes. As the name tells you, they are small half-fat, half-phosphate molecules.

Cholesterol is the essential raw material the body uses to make vitamin D, steroid hormones (including the sex hormones and cortisol), and bile salts. And it is an essential ingredient in myelin, which insulates nerve fibers.

Eicosanoids are involved in blood clotting (thromboxanes), inflammation (prostaglandins and leukotrines), uterine activity, digestive function (motility and secretion), and blood pressure (prostaglandins). They are very important chemicals. More on them when we discuss the omega oils in Chapter 11, on diet and digestion.

Nucleic Acids

These are made of nucleotides, which form DNA, the largest molecule in the body. Nucleotides are made of a nitrogen-containing base, a pentose sugar, and a phosphate group.

DNA, or **deoxyribonucleic acid**, is found in the cell nucleus. It is the genetic material that directs protein synthesis and replicates itself before cell division.

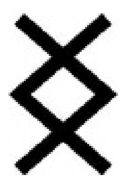

FIGURE 2.4. The rune Inguz

The sugar of the nucleotides that make up DNA is deoxyribose and its bases are adenine, guanine, cytosine, and thiamine. It forms the famous double-helix shape.

Interesting that the spiral has long been a symbol of eternity and continuance. For example, the rune Inguz means fertility, new beginnings, and renewal.

RNA, or **ribonucleic acid**, is formed in the nucleus and copies part of the DNA to carry out its instructions for protein synthesis. In other words, it acts as a messenger. Its sugar is ribose and its bases are adenine, guanine, cytosine, and uracil. Its shape is a single strand, straight or folded.

A protein is a string of amino acids. The spiral DNA unwinds, copies itself to make messenger RNA (transcription), which then is "translated" into a chain of amino acids to make a particular protein.

Vitamins and Minerals

Vitamins are used in tiny amounts in the body for growth and maintaining good health. They are not used for energy or building blocks, but mainly function as **coenzymes** or parts of coenzymes. A coenzyme is a substance that acts with an enzyme to accomplish a particular task, e.g., some B vitamins work as coenzymes in glucose oxidation. Some, such as vitamin D, act as hormones.

Most are not made in the body and must be taken in food—except vitamins D (made in the skin) and K (made by bacteria in the bowel).

There are fat-soluble vitamins (A, D, E, and K) and water-soluble ones (the Bs and C). They are involved in incredibly diverse activities in the body, from bone formation to skin and mucous membrane development and maintenance to blood clotting and antioxidation. Antioxidants mop up free radicals (by-products of oxidation) that cause tissue damage and are implicated in cancer formation and aging.

Some are needed only in minute amounts, so are called trace minerals or elements. However, all are essential for optimum functioning. (There is a basic chart of vitamin and mineral functions in Chapter 11.)

Energy and ATP

The breaking down of sugar to release a little energy is called **glycolysis**, and takes place in the cytoplasm. But the cell is also capable of **oxidizing** glucose—this is called **cellular respiration** (aerobic) and occurs in the **mitochondria**, or powerhouse of the cell. As already discussed, when a chemical bond is broken, energy may be released—the addition of oxygen causes a lot of energy to be freed up. We do not use the energy released from glycolysis and glucose oxidation directly; instead, we lock it up in a substance called **ATP**. You can think of ATP as being like a token or currency the cells of the body have to be "paid" with in order to work. (Sometimes guanosine triphosphate, abbreviated GTP, is used.)

ATP stands for **adenosine triphosphate**. An enzyme called **ATPase** splits one of the three phosphate bonds of ATP, releasing a large amount of stored kinetic energy and producing **ADP—adenosine diphosphate**. Phosphate is a very reactive element. Imagine one of the phosphate atoms in ATP being a person—passionate, argumentative, quick to take offense and flounce off, but with a bit of energy invested in, say, couples counseling, also quick to come back and make up. Each time the bond is broken, energy is released; when the bond is remade, energy is locked up in it.

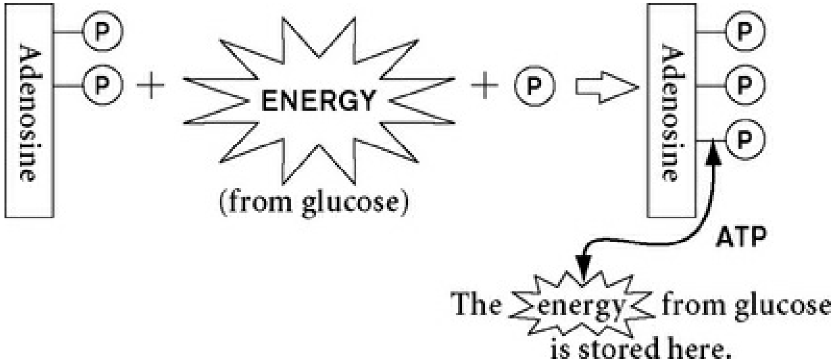

FIGURE 2.5. ATP production

When glucose from food enters the cell, it may be broken down and the energy used to stick a phosphate back onto ADP, thus storing the energy as ATP for later use. This energy storage-release cycle is a continuous process that goes round and round for as long as the cell lives.

ADP + Excess free energy + Phosphate (P) = ATP (stored energy)

And the opposite:

ATP split by ATPase enzyme = ADP + Free energy to do cells' work + Phosphate

The rate at which ATP is made by the cells is referred to as the **metabolic rate.**

Metabolism

Chemical reactions occur all the time in the body. All chemical reactions involve energy use or release. In the body these are part of metabolism—literally, a state of change.

Two opposing forces in metabolism must remain in balance. These are **anabolism** (building up) and **catabolism** (breaking down). Both activities are speeded up by enzymes, protein catalysts that speed up chemical reactions without themselves being changed in any way.

Anabolism uses free energy (e.g., glucose converted to glycogen in the liver and muscles), while catabolism releases free energy (e.g., glycogen converted to glucose).

Enzymes

Most chemical reactions in the body are mediated by enzymes. Enzymes have extremely interesting properties that make them little chemical-reaction machines. The purpose of an enzyme in a cell is to allow the cell to carry out chemical reactions very quickly. These reactions allow the cell to build things or take things apart as needed. This is how a cell grows and reproduces. The cell can be described as a little bag full of chemical reactions that are made possible by enzymes.

When you see a word that ends in -ase, it is an enzyme. Enzymes are made from amino acids, and they are proteins. When an enzyme is formed, it is made by stringing together between 100 and 1,000 amino acids in a very specific order. Many of them also depend on small but vital amounts of minerals. The chain of amino acids then folds into a unique shape. That shape allows the enzyme to carry out specific chemical reactions; an enzyme acts as a very efficient catalyst for a specific chemical reaction, speeding up that reaction tremendously. For example, the sugar maltose is made from two glucose molecules bonded together. The enzyme maltase is shaped in such a way that it can break the bond and free the two glucose pieces. The only thing maltase can do is break maltose molecules, but it can do that very rapidly and efficiently. Other types of enzymes can put atoms and molecules together.

Breaking molecules apart and putting molecules together is the work of enzymes, and there is a specific enzyme for each chemical reaction needed to make the cell work properly. Consider the possible implications of the fact that microwave pollution from wireless technology and mobile phones can affect the final shape of a cellular protein in its formation, and what this could mean when enzymes controlling all aspects of the cell's function are proteins.[5]

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*Acids are H+ (hydrogen ion) donors—they have a tendency to give off their hydrogen ions. H+ are corrosive and dangerous to the body. Bases are H+ acceptors—they accept H+ donated by acids. A weak base accepts just a few; a strong base accepts many. Very strong bases are called alkali. They include lye (used in soap making) and ammonia. They are powerful detergents and dissolvers of greasy, lipid material. Can you think how this makes them harmful to the body?

*pH is measured by a notation of the potential number of H+. A neutral solution is neither acid nor base, e.g., pure water has a pH of 7, which is a notational way of saying $1 \times (10)^{-7}$ g of H+ per liter, or 0.0000001, or 1/10 millionth—the decimal point is 7 places to the left of 1. So a stronger acid is less than 7—i.e., 6, or 0.000001, or 1 millionth, or $1 \times (10)^{-6}$ of a gram of H+ per liter. Just remember: More than 7 is a base; less than 7 is an acid!

CHAPTER 3

Cells and Tissues—Histology

Histology is the study of the structure and function of cells and tissues. **Cells** can be seen as the basic unit in the body—like one brick of Lego in a giant Lego castle.

These cells are grouped together to make **tissues**, of which there are four basic types. You could think of these as being like the foundations, woodwork, bricks, wallpaper, and electric circuitry used in building a house. The tissue types are **connective tissue**, which supports, protects, and connects; **epithelial tissue**, which lines and covers; **muscular tissue**, which provides movement; and **nervous tissue**, which is excitable and conductive, allowing for control and rapid communication of information and commands throughout the organism.

Cells

The cell is the basic unit of activity in the body. You can think of each cell as being like a factory—each one takes in raw materials, processes them, and creates products and waste. Cells are amazing, and should be thought of as being individuals in their own right. An emerging model in biology is that each cell has a consciousness pervading and orchestrating it—the consciousness of the whole organism.

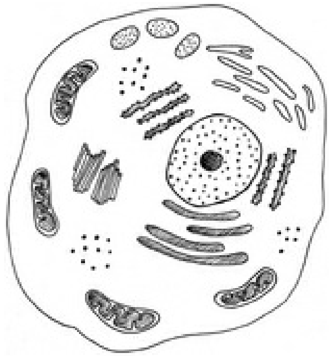

FIGURE 3.1. Basic cell

Our body is made of about **50 trillion cells**. The largest human cells are about the diameter of a human hair, but most are smaller, about one-tenth of the diameter of a human hair. Look at a single strand of your hair. It is not thick, being about 100 microns in diameter. (A micron is a millionth of a meter, so 100 microns is a tenth of a millimeter, which is about 0.004 inches.) Look down at your little toe—it contains two to three billion cells, depending on how big you are.

Bacteria are about the simplest cells that exist today. Interestingly, it seems that looking closely at cells may tell us of our evolution. The **organelles**, or functional parts of each cell, look very like certain bacteria. The theory is that millions of years ago some bacteria, hanging out in the primordial soup, got together with good effect—in other words, found that survival went well in cooperation with each other. Eventually, the first single-celled organism—an amoeba—was formed. Over time, amoebae grouped together successfully to make multicellular organisms, of which we are a wonderfully complicated example. Of course, this can only ever be a theory; it is not possible to really prove by scientific methods what happened all that time ago.

A bacteria is a single, self-contained, living cell. An *Escherichia coli* bacteria (or *E. coli*) is typical. It is about one-hundredth the size of a human cell. Bacteria are also a lot simpler than human cells. They consist of an outer wrapper called the **cell membrane**, and a watery fluid called the **cytoplasm** on the inside. Cytoplasm is about seventy percent water. The other thirty percent is filled with proteins called **enzymes** that the cell has manufactured, along with smaller molecules like amino acids, glucose molecules, and ATP. At the center of the cell is a ball of DNA (similar to a wadded-up ball of string). If you were to stretch out this DNA into a single long strand, it would be incredibly long compared to the bacteria—about a thousand times longer! Very similar to our cells, in fact. On the surface of our skin alone there are ten times more bacteria than our bodies contain cells—our bodies contain about 2 kg (about 4 and a half pounds) of bacteria in normal circumstances.

Every one of the billions of cells in our body has its own kind of independent life; it has its skin or cell membrane, its own need for food, it excretes, makes energy, communicates with other cells, and (in many cases) can reproduce itself. There is an old maxim used in many traditional healing systems: the microcosm in the macrocosm, and the macrocosm in the microcosm. This philosophy, first recorded in ancient Greece, means that patterns found in the largest scale—the cosmos or the universe—are repeated in the smallest—the single organism, the atom, even the subatomic level. We can see reflections of what is in the very small and the very large.

For example, imbalances in a society are the imbalances of the society's individuals writ large, and imbalances in an individual are reflections of the imbalances in society. A single leaf reveals the condition of the whole tree. Holistically thinking, every part of the whole affects every other part. We can benefit from considering the health of our cells. If the cells are healthy and getting their needs met, the whole organism will be well. This concept is gaining more and more ground in the emerging "new biology" of such great thinkers as Bruce Lipton, who says:

> You may consider yourself an individual, but as a cell biologist I can tell you that you are in truth a cooperative community of approximately 50 trillion single-celled citizens.... As a nation reflects the traits of its citizens, our humanness must reflect the basic nature of our cellular communities.[1]

The Amazing Cell Membrane

Each cell is enclosed in an amazing membrane made of **phospholipids**, cleverly designed to be **semipermeable**, to allow some things in and keep some out.

Phospholipids are molecules that have an electrically charged phosphate-nitrogen head, and a neutral fatty acid tail. Two layers of these molecules are arranged so that the electrically oriented phosphate ends face outward in contact with the extracellular fluid, and inward in contact with the intracellular fluid. The lipid fatty acid tails are in the middle of the two layers.

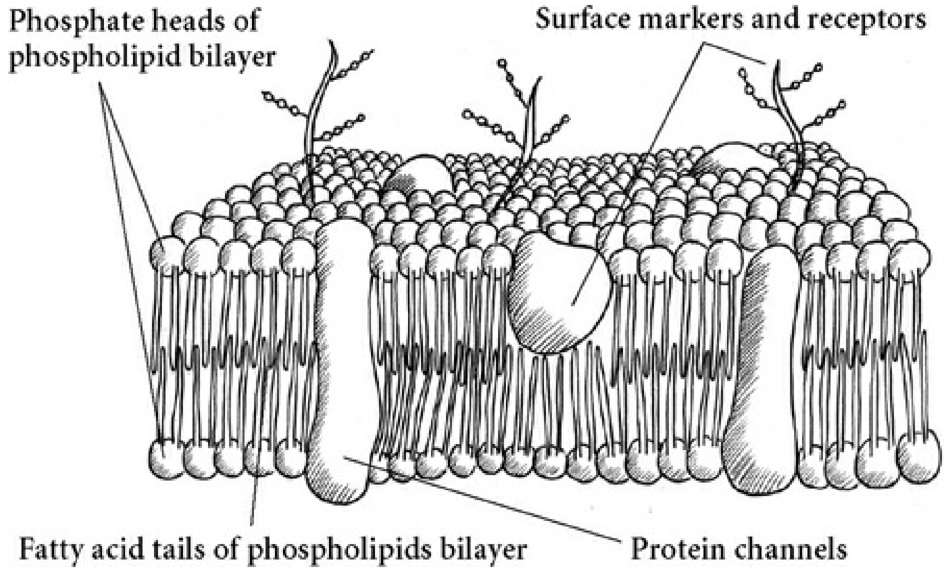

FIGURE 3.2. Cell membrane

Traditionally, the nucleus is seen as the brain of the cell, orchestrating things with its DNA, but in fact, a cell can survive for months without its nucleus, but dies instantly without its membrane. Bruce Lipton eloquently describes this in *The Biology of Belief*, a must-read book for anyone interested in cellular biology. He says that it looks rather like the membrane is the brain of the cell, controlling what goes on, and actually switching genes on and off as needed in response to the environment. The nucleus, with its DNA, while seen by conventional biology as the control center of the cell, is mainly needed for reproduction and so seems to be more like the gonads!

A significant portion of the lipid part of the cell membrane is made of **essential fatty acids**. You will remember that these are called essential because they cannot be made by the body but must be eaten in the diet. For our cell membranes to stay healthy and function at optimum level, we especially need the **Omega-3** fatty acids.*

Because of this **bipolar** attribute of the membrane, it is **selectively permeable**—some things freely cross it, while others do not. Like dissolves like: Because of the layers of fats in the membrane, which are nonpolar, charged or polar particles such as sodium and potassium ions cannot freely cross. An exception to this is water—a pretty exceptional substance. Although water is polar it can still diffuse through the bilayer.

Water enters and leaves a cell according to the osmotic pressure of the fluids inside and outside. If there is more salt in a cell, water will be drawn in and the cell will expand; if there are more salts in the extracellular fluid, water will leave and the cell will shrink. The business of what can get in and out of a cell is very important, as you might think. The membrane also contains structural proteins, as well as special proteins for transporting substances. Protein receptors, which are also in the cell, are being created and reabsorbed all the time, so the membrane is not static in structure but always being adapted and mended.

Getting In and Out of a Cell

There are various ways for substances to cross over the cell membrane and enter or leave the cell. Most of these involve the movement of water as well.

Simple diffusion involves the random scattering of very small particles from a high to a low concentration, down the concentration gradient—oxygen and carbon dioxide do this easily, dissolving through the phospholipid layer as described above. Imagine someone farts in a room full of people—at first there is a high concentration of the smelly gas around that person, but gradually it diffuses through the air in the room until eventually it is spread so far and so thinly that no one can detect it any more.

Facilitated diffusion is a process that honors the concentration gradient, but allows bigger substances that cannot pass through the lipid membrane to cross. Carriers or channels in the membrane are used, creating a kind of gate or turnstile. Substances that cross the membrane in this way include glucose, amino acids, and some ions. Each substance has its own **selective** channel or carrier to allow it to enter the cell. They may either be always open, or may open and close according to chemical or electrical signals.

Osmosis is the diffusion of water through a selectively permeable membrane, moving from where there are low levels of solutes to where there are more of those solutes—in other words, there is this tendency for equalization, seen in diffusion, when a substance will move from a high concentration to a low concentration. If the substance cannot cross the membrane, it will pull water to cross in its direction to dilute it. This pull is known as osmotic pressure. As well as moving through the water-filled channel or pore that runs through the middle of some transport proteins, water can move by thrusting through the lipid layer of the membrane—surprising, since water and fat don't usually mix. The amount of water in and around the cell is controlled by osmotic pressure versus hydrostatic pressure.

Osmotic pressure is the pressure exerted by the presence of a high concentration of particles, such as proteins. The tendency is for equalization, so the strong solution will attract water into it if water can get in.

Hydrostatic pressure is like the water pressure in a hose pipe—if you squeeze the end, you make the tube narrower and so the hydrostatic pressure increases, which pushes the water out more strongly.

Active transport is like facilitated diffusion in that a carrier is used, but to work the carrier must use energy (from ATP). Then it can move substances *against* their concentration gradients. This is like a turnstile that takes money (or a token of ATP) to allow entrance or exit. Sodium ions ($Na+$) and potassium ions ($K+$) pass, like water, through channels in membrane proteins. Sodium ions are present at a higher concentration outside the cell, so they have a net simple diffusion *into* the cell through special sodium channels. Potassium ions are present at a higher concentration inside the cell, so have a net simple diffusion *out* of the cell through special potassium channels. A **diffusion equilibrium** of $Na+$ and $K+$ (where there is a balanced number of each inside and outside the cell) is avoided by an active transport system: the sodium-potassium exchange pump. For every three sodium ions pumped out of the cell, two potassium ions are pumped in. So it is that movement of sodium and potassium is closely linked in the body.

Diuretics, which cause the body to lose fluid via the kidneys, cause loss of potassium and sodium ions too. This was discovered when the first drug diuretics killed people by upsetting their potassium balance. Interestingly, the strong herbal diuretic dandelion leaves are extremely high in potassium.

Vesicular transport moves very large particles, macromolecules, and fluids. The cell kind of extrudes stuff out of itself, or engulfs things that are outside and kind of swallows them. **Phagocytosis** is the word for cells swallowing things. As you might imagine, it takes energy (in the form of ATP as usual) for these processes to work.

Voltage Difference Inside and Outside of the Cell

An electrical charge or **membrane potential** is found across the membrane, and this makes nerve conduction and muscle contraction possible. The membrane potential is caused by a slight difference in electrical charge inside and outside of the cell. It involves sodium ($Na+$) and potassium ($K+$) ions. The effect is that the inside of the membrane is normally at about -70 mV compared to the outside. This is the **resting membrane potential**. It generates our body's electrical field, and is utilized in nerve conduction and muscle contraction.

Membrane Receptors

The cell membrane is covered with proteins called **membrane receptors**, which particular chemicals recognize and attach to, e.g., hormones, neurotransmitters, enzymes, and even drugs. This binding affects cellular activity in a particular way. Only substances that a cell has a receptor for can affect that particular cell. When a substance binds with its receptor, the receptor shimmers and dances and changes shape, transmitting some kind of change or information to the cell.*

The health of a cell and the condition of its receptors are of vital importance. You can have a situation where a person has all the clinical symptoms and signs of a hormone deficiency, but the blood levels are normal when tested. For example, someone can have normal thyroid hormone (thyroxine) levels but have all the symptoms of an underactive thyroid. New thinking is that this could well be due to a problem with the cells' receptors for thyroxine. It is very difficult to study receptors, as there are many thousands at any one time on a cell's membrane, and the cell reabsorbs them and makes new ones in seconds.

Drug addiction and withdrawal can be connected with cell receptors; sometimes the more there is of a chemical that affects a cell, the more receptors the cell makes for it. Sometimes a cell reduces the number of receptors when more of the chemical is present so the cell doesn't get overstimulated. This means that more of a drug is needed to get a similar response. Heroin or morphine, from the opium poppy, is identical to our body's own painkillers (endorphins), so many cells in the body have receptors for this drug. If a person takes the drug, a tolerance builds up, hence needing more and more of it to get the same effect. Then when the drug is withdrawn, the cells are crying out for it, and this is experienced as withdrawal symptoms. The good news is that in time when the drug is no longer present, the cell readjusts its receptors to a normal level, and the withdrawal period is over.

Internal Environment

The cells are filled with a fluid called cytoplasm. (When found in a word, *cyte* always refers to cells.) Outside the cells is a similar fluid called interstitial or tissue fluid. The cell exchanges nutrients and waste products with the tissue fluid. This tissue fluid and cytoplasm is what is meant by the **internal environment** of the body, which is kept in balance by homeostatic mechanisms. What's interesting is that each cell has its own independent life—taking what it needs from the tissue fluid, and putting out waste products as well as anything it makes for exportation—but the cell's primary work is to keep itself going. At the same time, the body's cells are connected and react to things together. There is more and more scientific evidence to back up what seems obvious to anyone with a body and a trust in nature—the fact that there is an innate, overall, underlying intelligence that creates a so-called field of coherence throughout the body.*

Holistic thinking acknowledges that we are also part of a greater whole—just as our cells can have the illusion of separateness, doing their own thing, but in fact being completely affected by the health of the overall organism. So we are part of our family, community, society, the Earth, and the entire universe, completely dependent on the health of the whole for our own best functioning. James Lovelock's Gaia hypothesis describes us as an integral part of the body of the Earth, subject to homeostatic mechanisms just as our own bodies are.[2] It may not be possible for us to remain completely in optimum health while we are part of an unbalanced and unhealthy society—but at the same time, as we become more balanced we will have a healthful effect on the whole.

Organelles

Within the cytoplasm are found the small components of the cell, called **organelles**, or little organs. These include the nucleus, mitochondria, endoplasmic reticulum, Golgi apparatus, lysosomes, centrioles, and packages of cellular chemical products for secretion.

The **cytoplasm** itself is made of proteins in water; there are about ten thousand water molecules for every protein molecule in a cell.

The **nucleus**, surrounded by a nuclear membrane and full of fluid called protoplasm, is where our genetic material is found. This consists of DNA (deoxyribonucleic acid). Arranged in a double helix shape, this beautiful and complex molecule contains the plans used to make all the cells and tissues of the body. Yet it is made of only four varieties of molecule, arranged in countless different ways. When cell division takes place, the DNA unravels, copies itself, and is replicated into two cells. When a particular protein is needed to be made, the DNA plan for it is copied by a sister substance, **messenger RNA** (ribonucleic acid), which goes off and creates the new protein. We share DNA with all other animals—mammals, reptiles, insects—and with plants. In fact, human beings, animals, bananas, and oak trees are at least about forty-two percent the same in terms of DNA. There are only so many basic designs, and all the incredible variety of this beautiful Earth of ours comes from similar genetic roots—everything is our kin, our ancestor. All the other beings really are our relations, as many Native Americans say. Human beings are actually only five percent different from our closest relatives, bonobos monkeys and chimpanzees, and the difference between two humans is a mere 0.01 percent. Time to wake up to our connectedness!

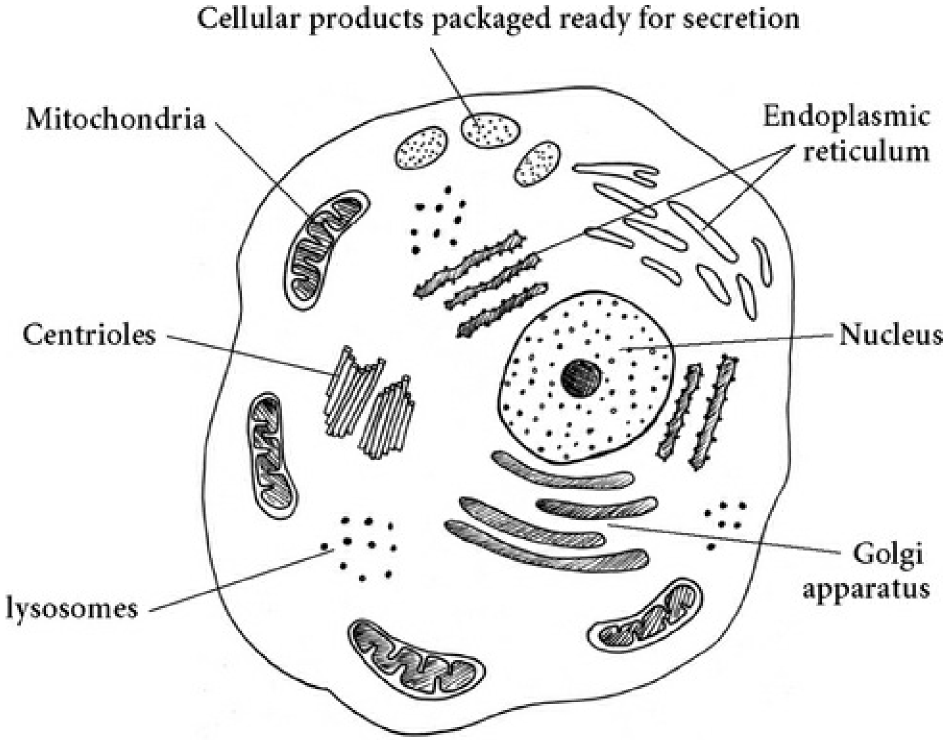

FIGURE 3.3. Contents of a cell

DNA tends to be seen as fixed and immovable; you're born with it and stuck with it. This has been the prevailing trend in mainstream science and is reflected in public perception. However, it really is not true that our genes are responsible for everything. The environment is vital. It is also now known that DNA does not just work from a fixed standpoint. It has the ability to adapt to environment and create new chemicals as needed, for example, antibodies for a new cold virus just encountered. The DNA does not switch itself on and off; it is the cell that seems to do this, in a yet unknown way. Interestingly, only three percent of the uses of genetic material in our genes have so far been analyzed. Who knows what the other ninety-seven percent might be capable of? Also, although there are about 120,000 different proteins in our body, we have only 25,000 genes—not one gene to make each protein, as was hypothesized and would make sense if genes are really in control.[3]

The **mitochondria** are the power stations of the cell. Within them, cellular respiration happens—glucose is oxidized and ATP produced for use in energy-requiring processes.

Mitochondria have an interesting genetic twist: The DNA that makes them is separate from that of the rest of the cell. It seems that the sperm cell from our father uses up all its mitochondria powering itself up to meet the egg of our mother. The egg, on the other hand, is full of mitochondria at conception, and it is these that are passed, mother to child, through the generations.

Through this genetic material it is possible to trace our mother's mother's mother—our female line, back for countless generations. The remains of an ancient female human were discovered in Africa. Although she lived and died an estimated 140,000 to 200,000 years ago, through looking at the DNA in her mitochondria and comparing to that of all *known* races of people alive today, it is possible to see that we all come from her—way back then. She is the ancestor of us all. She is known as mitochondrial Eve. Of course, we don't necessarily literally come from her (and there may well be people who haven't been genetically analyzed who have different mitochondrial genes), but it is sure that the other women alive at the same time as she was either had the same mitochondrial genes (that is, had a common female ancestor to her) or have no living female descendants today. There is some controversy (of course!) about what it all means. If you are interested, do an Internet search for “mitochondrial Eve.”

The **endoplasmic reticulum** is a series of tubes that carries out the day-to-day business of the cell. It is made of a phospholipid membrane that encloses spaces to create sacs. It is here that nutrients are processed, and any products of the cell made. It can have a wide variety of functions depending on the particular cell. Attached to it is an area called the Golgi body.

The **Golgi body** or **Golgi apparatus** processes the waste or products of the cell, packaging it in parcels and sending it off out of the cell.

The cell is full of **microtubules** that form a kind of skeleton within it. These are miniscule hollow tubes networking throughout the cell. Quantum events in the cytoskeleton seem likely to be involved in information arising everywhere in the body at the same time.[4] Small vesicles of powerful enzymes capable of digesting the cell, called **lysosomes**, are also present in most cells. These can destroy a damaged or diseased cell.

Cell Reproduction

There are two ways for a cell to reproduce. One, **mitosis**, is how a living cell reproduces or clones itself. It is a continuous process throughout life. Millions of cells are doing it as you read this. Basically, the cell copies itself, becoming a kind of double cell, then splits into two.

The chromosomes that make up the DNA unravel, copy themselves, and line up on the centrosomes, which have separated onto either side of the cell. Then the cell splits into two parts, each having a full complement of genetic material.

Then there is **meiosis**—this is the very special kind of cell reproduction resulting in a new organism. It requires special gametes or sex cells—the egg and the sperm. Two gametes will fuse to form a zygote, from which the new human grows. We will discuss this more with reproduction.

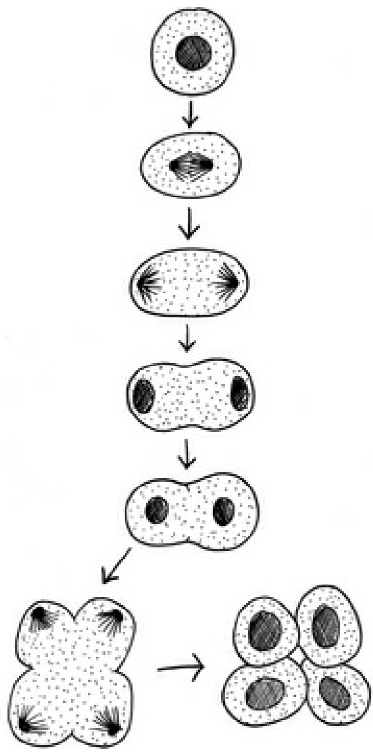

FIGURE 3.4. Cell division

A Visualization Treat for Your Cells

Find a quiet place to relax where nothing will disturb you for fifteen to thirty minutes. Sit comfortably or lie down and breathe gently for a few minutes, saying to yourself as you breathe in, “I breathe in healing, relaxing energy.” and as you breathe out, “I breathe out all tension, anxiety, negativity.”

Also try “every time I breathe out, I become twice as relaxed.”

After a few minutes like this, imagine you are floating along on a cloud of golden light, warm and safely enveloped. Begin to breathe in this healing light. As you breathe, feel the warm, loving, golden energy filling your lungs. It begins to spread through your body, up into your head, neck, and shoulders, down into your arms and hands. It spreads down your back and into your belly. The warm golden healing light fills your pelvis and moves down your legs into your feet. Your whole body is full of warm, healing golden light.

Imagine the cells of your body, billion upon billion, each one filled with this healing golden glow. Imagine one of your cells, anywhere you like. See it, feel it, think it filled with a warm, healing light energy. The cell is expanding, relaxing, happy and joyful as it bathes in the healing light. Every cell in your body is celebrating, enjoying the warm and golden healing light.

Your cells know what to do; your body knows what to do. We are completely as we are supposed to be, and our bodies, minds, and spirits are equipped with wonderful healing mechanisms. Allow yourself to enjoy this knowledge, allow the warm golden light to spread its glow throughout your body, and throughout your mind and spirit. All is well.

Afterwards, gently bring your attention back into the place you are in, and resume your daily activities, knowing you are filled with light and your cells are zinging with joy!

Some cells in the body normally replicate themselves, while others never do. This affects their capacity for regeneration if they have been damaged. Cells that are continually replicating themselves include epithelium, bone marrow, blood, spleen, and lymphoid tissue. Cells that can replicate, but rarely do under normal circumstances, include the liver,* kidney, pancreas, smooth muscle, bone cells, and fibroblasts (which make fibers in connective tissue).

There are cells that *were* considered to be permanent—unable to replicate after normal growth is complete: nerve cells, and skeletal and cardiac muscle. However, science has now found that skeletal muscles have limited powers to regrow due to satellite cells that can grow new cells, and cardiac muscle has modest ability to divide, although injuries to cardiac muscle are usually replaced by scar tissue.

Research is being done into gene therapy and stem cell therapy to enhance this process; natural healers will know that there are many ways to encourage the body's own healing mechanisms. There is a great story in Deepak Chopra's book *Unconditional Life: Mastering the Forces That Shape Personal Reality* of a miraculous healing of a skeletal muscle, back in the days when this was considered more or less impossible by scientific thinking of the day—not that long ago, really.

It was also believed until recently that we do not make new nerve cells. However, a study on rats undertaken in the year 2000 showed that brains continue to grow well after puberty; the adult brain is capable of growth and regeneration. It is not all the downhill tumble to senility we were led to believe![5]

The implications of this knowledge for practitioners of medicine or healing are interesting: If cells are damaged, how easy is it for the body to repair or replace them? What can we do to encourage this process? Also, do we accept that certain things are impossible, or can we hold a belief in the possibility of miraculous healing for our patients? Bearing in mind that accepted physiological facts do turn out to be wrong now and then, it seems reasonable to hold out belief for optimum healing. "Be realistic—plan for a miracle," as the bumper sticker says!

Studies have shown that our beliefs about other people are important—the power of our mind to heal applies not only to our thoughts about ourselves, but to what kind of thoughts we send to others.[*] Our thoughts are shaped by our beliefs.

The best thing is to try it for yourself. There are many interesting books you might use to get started. As well as Lynne McTaggart's *The Intention Experiment*, take a look at

Creative Visualization by Shakti Gawain, and *You Can Heal Your Life* by Louise Hay.

Tissues

As we have said, cells are arranged into tissues, which in turn get together to make the organs and systems of the body. There are four types: epithelial, connective, muscular, and nerve.

Epithelial Tissue

Epithelial tissue covers the surface of the body, lines hollow organs and tubes inside the body, and forms glands. It consists of tightly packed cells arranged in continuous sheets on a basement membrane. They can be either single- or multilayered (that is, simple or compound). Epithelium adheres firmly to the underlying connective tissue via its basement membrane. It continually renews itself; the lower levels divide by mitosis and the older cells slough off. We all have firsthand experience of this with our skin, which now and then we see coming off—at least the dead top layers. Did you know that most of the dirt in the subway (and in your house) consists of human skin cells? Every day a new layer is made, and an old one sloughed off. The multilayered skin takes about thirty days to be completely renewed, while the single-layered epithelial lining of the gut is renewed every day.

There are various types of simple and compound epithelium, named for its appearance. Examples of simple are columnar, squamous, and cuboidal.

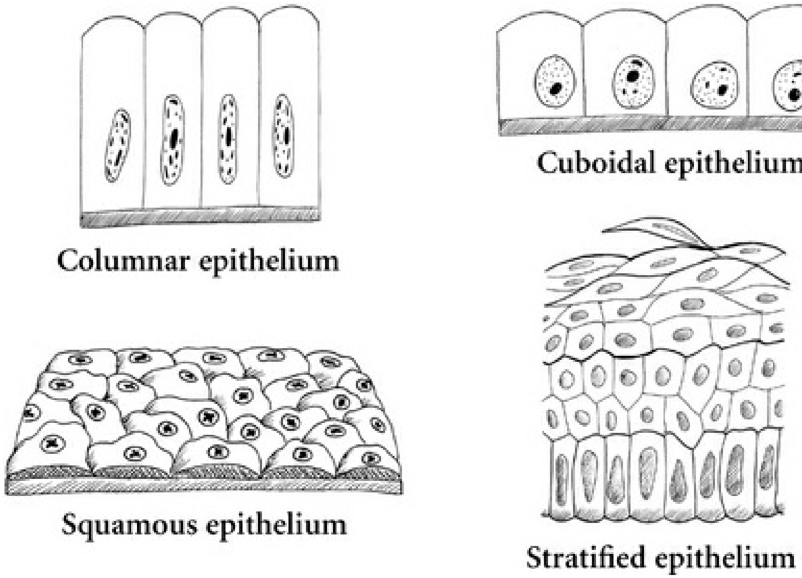

FIGURE 3.5. Epithelial tissue

Examples of compound epithelial tissue include stratified (the skin) and transitional (the bladder).

Sometimes epithelium is **ciliated**. Cilia are small hair-like projections of the cell membrane, which have the ability to move. They are found in the air pipes of the lungs, and in the fallopian tubes.

The epithelium of the lungs, gut, and urinary and reproductive systems forms what are called **mucous membranes**. Interspersed with the epithelial cells are special mucus-producing cells called **goblet cells**.

The ciliated mucous membrane of the lungs is ingenious: Inhaled dust and other particles stick to the mucus, which forms a lining over the surface of the epithelial cells. The cilia constantly move in one direction, shifting the mucus up toward the throat, and when it reaches the throat it can be drawn into the mouth and spat out. This is known as the **ciliary escalator**. One of the injurious effects of smoking tobacco is that nicotine depresses the ciliary escalator, thus preventing the lungs from clearing themselves just when they need it most. Luckily, this effect wears off as soon as smoking is stopped—as the epithelial lining does its amazing job of renewing itself, the cilia work again. This is the reason many smokers cough in the morning—overnight while asleep and without the influence of tobacco, the membrane repairs itself and the lungs begin to free themselves from accumulated toxins and debris. Many a hapless smoker, on noticing that the first cigarette of the day "cures" their cough, is able to fool himself or herself that smoking is healthful. (Actually, the cough is not a symptom—it is the cure, the body's attempt to remedy a harmful situation. This illustrates the very important fundamental holistic principle that symptoms are *not* diseases. Much more on this later!)

Connective Tissue

Connective tissue is the most abundant tissue in the body. A binding and supporting tissue, it often has a very rich blood supply. (This does not apply to cartilage and ligaments; they have no direct blood supply at all, which is why they are white in color.)

The cells of connective tissue are widely scattered in a matrix of extra cellular material. There are many types: areolar, adipose, fibrous, elastic, cartilage, bone, blood, lymphoid, and reticular. Some of these *seem* very different from each other—blood and bone, for example—but if you look at the composition and formation of these tissues, they have a lot in common.

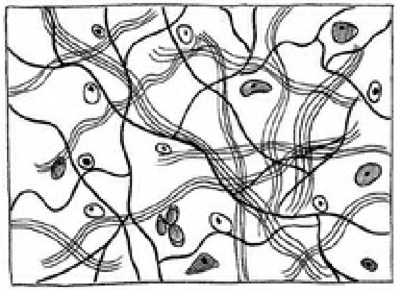

FIGURE 3.6. Areolar tissue

Areolar tissue is found all over the body, like a kind of packaging tissue. Sometimes it is called loose connective tissue. It consists of a ground substance protein and water background, with scattered cells making collagen and elastic fibers. The dermis, found in the skin under the stratified epithelial layer known as the epidermis, is made of this type of connective tissue. What is particularly interesting about it is that it can move from a more liquid to more solid gel state and back—which affects how well substances can diffuse through it.

A technique called skin rolling aims to loosen up the areolar tissue to get fresh fluid into it. Skin rolling lifts and squeezes the superficial layers of fascia underneath the skin, breaking down any adhesions, to release the sticking. It can often be very painful at first, but eases with each skin roll. Lift the skin with the thumb and push underneath and against the forefinger that is anchoring skin and fascia, moving along methodically until you reach the end of the available skin (e.g., from the inferior edge of the trapezius to the superior, or shoulder, edge). It needs to be a continual roll. Then work deeper with massage techniques.[6]

Adipose tissue is basically fat or a collection of cells that fill up with fat. It is useful for protection—padding under the skin (the subcutaneous fat) and around vital organs—and as a very concentrated energy store. And, of course, it gives us women our lovely curves. One of the reasons too much of it can harm us is because it tends to collect around our organs—an excess of fat around the heart makes life a lot harder for this organ. Have you come across the apple-or-pear-shaped thing? Pear-shaped people tend to put most of their fat around their bottoms and thighs, while apple-shaped people tend to deposit fat around their chest and middle. It seems when it comes to carrying excess fat, the pears have the advantage, as the apples will be more prone to gathering fat around the heart, leading to a greater workload for the heart and thus increasing the risk of heart disease. Adipose tissue makes the hormone **leptin** and is involved in regulating our sensation of hunger.

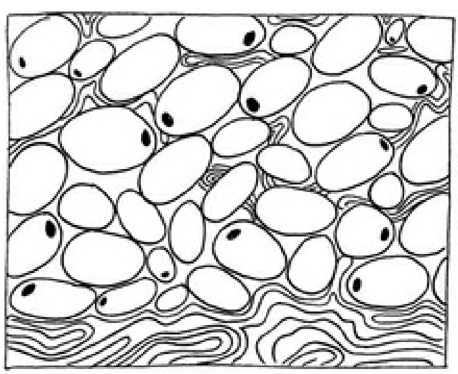

FIGURE 3.7. Adipose or fatty tissue

Fibrous tissue consists of collagen fibers made by cells called fibroblasts. Collagen forms thick ropes with tensile strength. The **fascia** around and within muscles, which comes together to form tendons, is fibrous connective tissue, as is periosteum, the tough fibrous covering of bone. Ligaments are primarily made of fibrous tissue, though they also contain some elastic fibers, as they need to be stretchy. The connective tissue outer coverings of organs are rich in fibrous tissue for protection and strength. Our blood vessel walls are full of it. We'll be hearing more about this important substance.

Elastic tissue does what you might think: It gives stretch and recoil where needed—in skin, lungs, and arteries, for example. The elastic fibers in the dermis of the skin give our skin its ability to snap back when stretched. There is a tendency for this to diminish with age. Having said this, our bodies are of course renewable, with elastic fibers that can be repaired and made new.

Cartilage is amazing stuff—incredibly strong, a little stretchy, and totally flexible. Cartilage is found at most joints, where two bones meet each other. It allows for movement and protects the bones from grating on each other as the joint moves. We have some in our earlobes and nose, and an intricate assortment makes up the voice box, or larynx, which along with the vocal cords enables us to speak. Cartilage is a blue-white color; it has no blood supply of its own, and relies on surrounding tissues to get its nutrients. Because of this, it is slow to heal when damaged. Our first skeleton, formed when we are in the womb, is made of cartilage. As developing embryos, we first make a cartilaginous blueprint of our bones, then we begin to lay down calcium salts to form our bones. At birth our skeleton is mostly bone, with some cartilage left from which the bones grow. We grow throughout childhood, the bones growing from special **cartilaginous growing plates** until they fuse in the late teens or early twenties, after which we will grow no more in height.

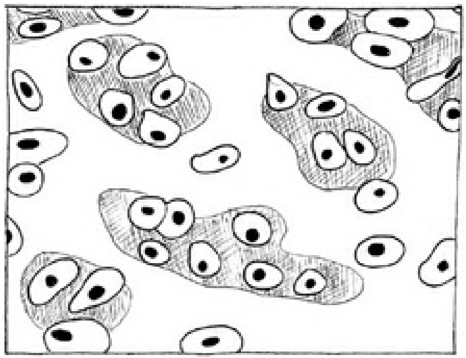

FIGURE 3.8. Cartilage

The body makes the background substance of cartilage, loose and fibrous connective tissue from **glucosamine** (amino acid and sugar mixed). This is made in the body by an enzyme called **glucosamine synthetase**. As we age, this enzyme becomes less effective, which is why healing is slower in the elderly. Studies have shown that taking a supplement of glucosamine daily can help arthritis, aging or slowly healing skin, ligament and tendon injuries, and possibly heart disease and IBS (irritable bowel syndrome).[7]

Bone is what gives structure, shape, and support to our bodies, and protects our vital organs. It is made from cartilage with a beautiful and intricate pattern of calcium phosphate salts laid down within it. Bone is a vital and living tissue; it has a very rich blood supply. It can heal itself well from injuries and breaks by a process of **calcification**—repairing the breaks by laying down lots of calcium.

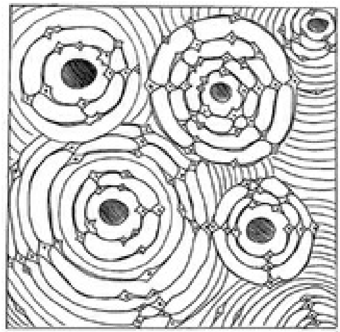

FIGURE 3.9. Bone

If you take a bone from a newly dead body and dissolve all the salts out of it, you are left with a completely flexible cartilage tissue that you could tie in a knot. Throughout life, our bones are reabsorbed and made anew, as we exchange the calcium salts between them and the blood. It's thought that over about seven years the whole skeleton is replaced.

Blood is considered to be a connective tissue. It contains a background substance—the plasma—with cells loosely interspersed in it. Actually, blood cells are made in the bone marrow, so there is one obvious connection.

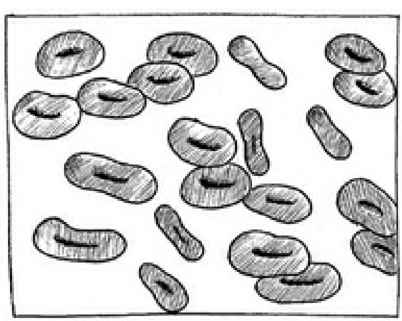

FIGURE 3.10. Blood

Lymphoid tissue, or reticular tissue, is specialized connective tissue found in the lymphatic system, in lymph nodes and vessels. In the lymph nodes it forms a mesh that is filled with the white blood cells of the lymphatic system. Here, debris from the lymph fluid is trapped and filtered out.

A Note on Membranes

A membrane is a special covering that includes connective and epithelial tissues. Our bodies have four main types of membrane: cutaneous, mucous, serous, and synovial. The first three are continuous sheets of covering material made of an epithelial layer closely bound to an underlying bed of connective tissue, and synovial is formed from connective tissue.

Cutaneous membrane refers simply to the skin: a thick layer of compound epithelium over a thicker layer of loose connective tissue containing interesting structures like sweat glands, hair follicles, and so on. The following chapter is dedicated to skin.

Mucous membranes are lovely, wet, slippery membranes made of either compound or simple epithelial cells interspersed with goblet cells over a layer of loose connective tissue. Mucous membranes are adapted for absorption and secretion. Some secrete a lot of mucus (the lung and the gut); some do not (the urinary tract).

Serous membranes contain a layer of epithelial cells resting on a loose connective tissue base. The epithelial cells secrete a watery fluid. They are found in the heart (the pericardium), the lungs (the pleura), and the gut (the peritoneum).

Synovial membranes are found in synovial joints. (These are known as diarthroidal or movable joints in America.) They are made of loose connective tissue, and secrete a special lubricating fluid into the joint capsule.

Muscle Tissue

Muscle tissue has the special property of contractibility, and so is responsible for almost all the movement in the body. There are three types: skeletal, smooth, and cardiac.

Skeletal muscle is what you will already be accustomed to thinking of as muscle—biceps, lats, abs, and the other gym favorites. As the name suggests, this type of muscle moves the skeleton.

Muscle cells contain tiny **microfilaments** or myofibrils made of proteins called **actin** and **myosin**, which lie together in such a way as to be able to move over each other in a ratchet mechanism. In skeletal muscle these are arranged in lines, which makes the muscle look striped under the microscope—hence its other name, **striated** muscle. Each movement of the fibers uses energy as ATP, and much of the heat we generate comes from muscle contraction. It is also called **voluntary** because we control it consciously and voluntarily, unlike the other two types.

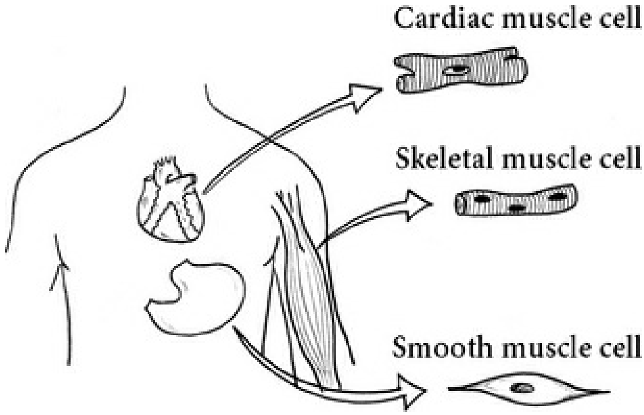

FIGURE 3.11. Muscle tissue

Smooth muscle is under **involuntary** control. Its cells are arranged in sheets, which wrap around tubes and hollow organs in the body. It moves food through the gut, and is found in all the body's tubes and all its hollow organs except for the heart.

Cardiac muscle is only found in the heart. It looks striped, like skeletal muscle, but the cells are a special shape unique to it. It can never rest for long—it must keep on beating all of our lives. It is under **involuntary** control.

Nerve Tissue

Nerve tissue is very specialized. The cells, called **neurons** or nerve cells, are excitable and conductive. This allows for sending messages to do with control throughout the body. This tissue also contains special supporting cells called **neuroglia cells**, or **glial cells**. These are important in that they nourish and protect the neurons and help in regeneration. They form a scaffold all around the neurons.

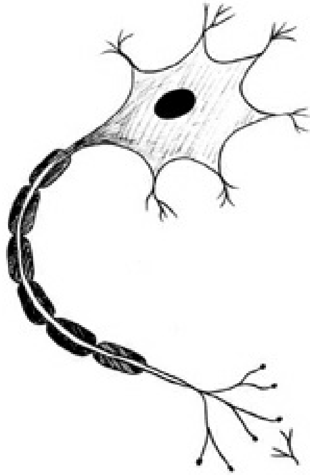

FIGURE 3.12. Neuron, or nerve cell

*Omega-3 is very long and highly flexible. When it is incorporated into the cell membrane, it helps make the membrane itself elastic and fluid so that signals pass through it efficiently. But if the wrong fatty acids are incorporated into the membrane, the receptors can't react as well to their substances.

*Candace Pert describes this beautifully in her fascinating book *Molecules of Emotion: Why You Feel the Way You Feel*.

*Lynne McTaggart's *The Field: The Quest for the Secret Force of the Universe* lays out the evidence coherently.

*The now well-known plant milk thistle (*Psylibum marianus*) has an effect of stimulating regeneration of liver cells.

*One study looked at the power of curses—what happens when we send negative thoughts to another? In the experiment, 195 separate cultures of a fungus were "cursed." Seventy-seven percent showed retarded growth compared to the control group. (J. Barry, "General and Comparative Study of the Psychokinetic Effect on a Fungus Culture," *Journal of Parapsychology*, 1968, 32(94):237–243, cited in *The Intention Experiment* by Lynne McTaggart.)

CHAPTER 4

Between Within and Without—The Skin or Integumentary System

The largest organ in the body, the **integument**, or skin, is an outer protective layer shaping the body. It covers an area of about 22 square feet (2 square meters) and weighs about 10–11 lbs (4.5–5.4 kg). Our skin is the interface between within and without. It protects us from the outside world. Think of all the verbal expressions there are to do with skin—thick-skinned, thin-skinned, skin deep, and so on. How do you feel in your skin?

Feel the exposed skin on your arm—first brush the fine hairs very lightly, then stroke it gently, and then increase the pressure. Now stop and press hard on one place. Pinch it a little—ouch! Vibrate your fingers on one spot. Feel something warm, such as your cat or your dog, your stomach, or the heater vent. Now something cold, such as the wall. Notice the sensations you feel in the skin.

Gently pinch a fold of skin. How is it attached to the tissues below? Does it come up easily in your fingers? Explore different places on your body. Is it the same everywhere, or does it vary?

Look at the thickness of the skin—find a place where it is thin, then find a place where it's thick. Take hold of it and try to get a sense of its thickness. Look closely at it. What can you see? Hairs? Small holes (the pores)? Wrinkles? Scars?

The Skin's Important Functions

First, it creates an obvious barrier and boundary to our bodies, it protects us from the hazards of the outside world. This protective function includes straightforward mechanical protection from injury by the outer dead layer of hard, horny skin and by the nice cushion of deep subcutaneous fat, as well as protecting us from the damaging ultraviolet light of the sun. This protection is afforded by the melanin pigment in the skin, which increases with exposure to sun.

We are also protected from external microorganisms by sophisticated immune responses in the skin. Keratinocytes make interferon, a kind of protein that blocks viral infection. Other cells in the skin, called Langerhans cells, interact with germs that have managed to get through the outer layer of the epidermis. The Langerhans cells then take these antigens to nearby lymph organs and help to initiate an immune response; thus the Langerhans cells have a so-called **messenger** function. This response is disrupted by even the mildest of sunburns—UV radiation disables the presenter cells. This is probably why sun exposure triggers cold sore eruption in infected people.

The skin makes a tough waterproof barrier, which keeps out unwanted visitors and keeps water and nutrients inside. It is the oily sebum that gives this protective waterproof coating to the skin. Sebum is secreted by sebaceous glands into the hair follicles, and spreads over the surface of the skin. Without it, our skin is not supple but becomes dry and cracked. Harsh detergents in soaps and shampoos remove sebum from the skin. This can be irritating, and has the effect of making the skin produce more sebum to replace what was lost.

Toxic "Skin Care" Products

It might surprise you to learn that drugstores and beauty shops are full of products that supposedly make you look beautiful and keep you youthful-looking, but which actually harm your skin as well as our environment. Some of these products are considered more toxic even than some pesticides. There are whole books and lots of research on such harmful products; you can do an Internet search for more information about specific products and types. Here are some general guidelines.

Sodium lauryl sulphate is in just about everything, including baby products. This very strong detergent that can cause eye irritation, permanent damage to the eyes, skin rashes, hair loss, flaking skin, and mouth ulceration. Combined with other ingredients, it can form nitrosamines, which are carcinogenic. Sodium lauryl sulphate easily penetrates the skin and can lodge itself in the heart, lungs, liver, and brain.

Fluoride and **talc** are carcinogenic. Other nasties include **propylene glycol, ethyl alcohol**, and **isopropyl**.

Mineral oil (baby oils are usually made of this) strips the natural oils from the skin and forms an oily film, which prohibits the release of toxins. It can also cause photosensitivity, chapping, dryness, and premature aging. Want to put it on your baby now?

FIGURE 4.1. Hair washed without shampoo

I have never used any soap or shampoo on my son, age four in the photo, taken in 2008. He gets washed in the bath with plain water. His skin is perfect, and his hair looks great—without shampoo stripping the oils from the hair, it is self-cleaning.

The skin doesn't keep out everything, however—small molecules are able to enter the body via the skin, and this absorptive function means some drugs can be administered via the skin, and essential oils applied to the skin will enter the blood stream. (If you don't believe it, try the following experiment: Apply some garlic oil to the soles of your feet. In a very short time, the garlic can be smelled on the breath. It has been absorbed into the blood, and then excreted via the lungs.)

The skin breathes; oxygen and carbon dioxide can enter and leave, but only a very little bit. In Chinese medicine, the skin is known as the third lung.

As you will know if you have eaten a strong curry, the skin also has excretory powers—it is one of our main **organs of elimination**. Sweat can be full of all kinds of things the body wants to excrete. Herbalists use this mechanism in treatment protocols. For example, it's well known that garlic protects us from infection. When we eat garlic, the oil in it, which is the smelly bit, is excreted via the lungs and skin as well as the kidneys. It is this smelly oil that is a powerful antimicrobial. Consuming lots of garlic ensures a good amount of protective oil all over our skin and in our lungs. Many other plants that contain essential oils work in a similar way—most essential oils are strongly antimicrobial.

A team from Manchester University carried out research on essential oils as potential anti-MRSA agents, testing forty essential oils. (MRSA stands for methicillin-resistant staphylococcus aureus; it is the superbug that has become resistant to antibiotics due to their overuse, especially in hospitals. MRSA is infecting and killing with alarming frequency.) Two of the tested oils killed MRSA and *E. coli* quickly, and one worked over a longer term. The university has not revealed the names of the oils, pending funding to develop the project, but one researcher from the university's Faculty of Medicine, Peter Warn, said:

> We believe that our discovery could revolutionize the fight to combat MRSA and other "super bugs," but we need to carry out a trial and to do that we need a small amount of funding—around £30,000 [around fifty thousand dollars].... We are having problems finding this funding because essential oils cannot be patented as they are naturally occurring, so few drug companies are interested in our work as they do not see it as commercially viable. Obviously, we find this very frustrating as we believe our findings could help to stamp out MRSA and save lives.[1]

We regulate our temperature largely via the skin. When we are hot, we get red; the blood vessels in the skin dilate, allowing heat to leave from the surface of the body. The opposite happens when we are cold. Think how much paler everyone looks in the winter. This is not only because tans have faded, but also because the blood vessels in the skin are constricting, keeping the heat in the center of the body. Sweating is also involved in heat regulation—excreting water onto the surface of the skin cools us. You know what it's like in winter when you are shopping—you need to be warmly dressed because it is cold outside, but you go into a warm place and begin to sweat. Go outside again and you feel colder as the cold air touches your sweat.

It is sometimes said that the skin is one big sense organ. We have many sensory receptors in our skin, enabling us to feel light touch, pressure, temperature, vibrations, and pain. Touch is essential for our proper development as infants and young people. Without any touch at all, babies become withdrawn, do not develop properly, and even die. Therefore it is a more than reasonable assumption that quality touch throughout life continues to be necessary in order for a person to be in great health. Sadly, many cultures—including the dominant Western one—have developed in such a way that most people receive very little touch in their lives, and often the little that *is* available is received through sex. This leaves us vulnerable to exploitation of our deepest needs; we are more dependent on sex for contact, and then this need for sex and love is used in advertising to manipulate us into buying more stuff.

Many holistic therapies involve touch. There is no doubt that intelligent, loving touch has immense power to restore and maintain health. Let's all do what we can to reclaim it for ourselves and for each other—not just as something we can get if we pay for it, or through our sexual relationships. Even if you don't usually do hugging, try it and see. Pay attention and identify someone you know who is good at hugs, then practice with that person. You can soon get the hang of it if you persevere. A hug a day keeps the doctor away!

The skin cells make vitamin D by using the power of the sun. Vitamin D is necessary for healthy bone formation. Finally, the skin acts as a storage place; the subcutaneous layer of fat helps to store nutrients, and the vascular tissue of the skin acts as a blood reservoir, storing about five percent of the body's blood.

The Skin's Structures

An outer **epidermis** consists of stratified squamous epithelium. Like all epithelial tissue, this outer layer is continuously regenerating. The outermost layer of **keratinized** cells is dead, and falls off at a rate of about 40–60 million cells per day.

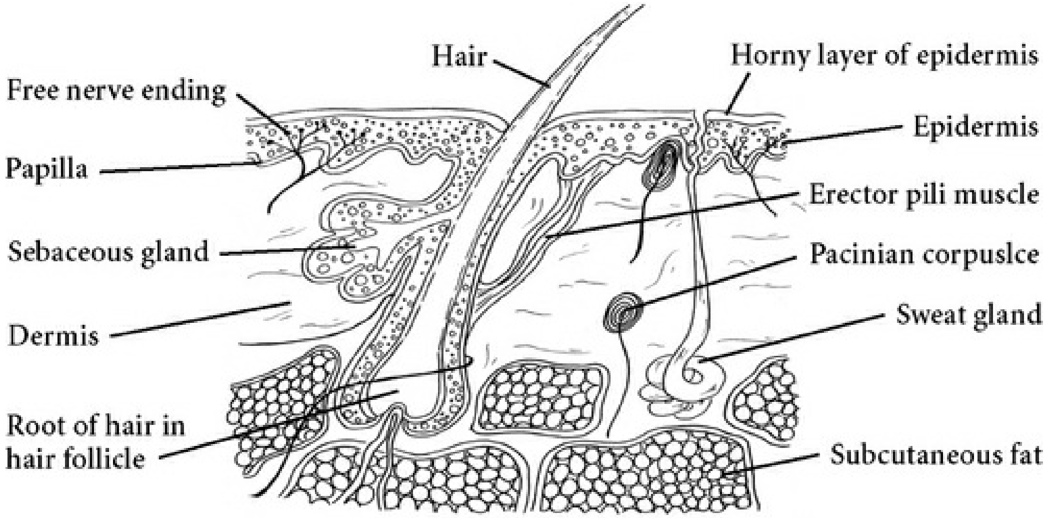

FIGURE 4.2. Skin

The epidermis must be kept richly supplied with blood to allow all that growth to happen. The blood is supplied via the underlying dermis. The underside of the epidermis forms peaks and troughs called the **papillae**. These mean that the first papillary layer of epidermis has an increased surface area, which facilitates blood supply and allows room for lots of nerve endings. These papillae give the skin its characteristic swirling appearance and make our unique fingerprints.

The epidermis consists of various layers, visible under a microscope. From the outside and moving inward they are as follows.

Horny layer (stratum corneum). This is a tough outside layer of dead cells full of keratin. Keratin is the same stuff that our nails and hair are made of. This layer builds up more and gets thicker when used—as happens on the soles of feet and palms of hands. It also gets thicker in response to pressure, so we form a callous on an area of our skin that is used a lot. Where people walk barefoot, the soles of the feet become incredibly hard and horny, able to walk over all kinds of rough ground.

Clear layer (stratum lucidum). Just below the horny layer is a stratum where the cells have almost completely broken down. It looks clear under a microscope.

Granular layer (stratum granulosum). This layer looks granular or speckled. The cells have started to break down, but still some parts of the nuclei remain.

Prickle cell layer (stratum spinosum/malpighian). This layer consists of living cells with intact membranes containing fibrils that interlock. Under pressure they are capable of mitosis—this is how calluses form on the soles of feet and palms of hand.

Germinative layer (stratum germinativum/basale). This deepest layer is where the germination takes place—where the epithelial cells divide and regenerate. It contains some **melanocytes** as well as **keratinocytes**. These melanocytes extend into the next layer up and fill it with the skin pigment melanin. Melanin protects us from damage by UV light, and gives the skin its color.

Below the epidermis is the **dermis**, which is basically connective tissue containing various structures. The blood and lymph supply for the skin is found in capillary loops coming up from the deeper arterioles that lie in the subcutaneous fat. There are hair follicles with hairs complete with erector pili muscles that can pull our hairs to stand on end (such as when we are cold, scared, or excited). Interestingly, women and men have the same number of hairs on our bodies, and humans have the same number as chimpanzees, although ours are obviously much finer!

Attached to the hair follicles are sebaceous glands that secrete sebum into the follicles, waterproofing the skin. Without sebum the skin becomes dry and cracked and is no longer effective as a waterproof barrier. Sebum is to humans what lanolin is to sheep. Shampoo strips the hair of sebum, drying it out (and necessitating the use of conditioner). You can stop using shampoo, and keep your hair clean by washing it with water only and brushing it a lot. Brushing makes the oils move down the length of the hair. When you first do it, your hair will be extremely greasy, because previous shampoo use will force the body to make up for the extreme lack of oil on your hair. After a few months, this settles down. Actually, if you have greasy hair, you can improve it by washing it less often; constant washing of it will be continually stimulating the sebaceous glands to overproduce.

Cousins of sebaceous glands, ceruminous glands, are found in the ear canal and make earwax to protect the ear. Earwax contains antibacterial substances to help protect the ear from infection.

Two little-known facts about earwax:

- You can apply it to those occasional pimples on your face, to get rid of them.
- Cats love to eat earwax.

Also found in the dermis are coiled tubes that open onto the surface of the skin—sweat glands. There are two kinds. Eccrine glands make watery sweat and apocrine glands make thicker, more pungent sweat. Sweat contains the amazing substances called **pheromones**, which have a lot to do with who we find attractive and who repels us, as well as powerfully affecting the endocrine system. Interesting experiments have been done by attaching a piece of lint cotton that had been soaked in other subjects' sweat to the top lip of a group of women for a few hours every day, and noting the effects of this on their menstrual cycle. Apparently, it is via pheromones in our sweat that women's menstrual cycles come into alignment with other women. Interestingly, men's pheromones affect the menstrual cycle too. Women's menstrual cycles change according to the chemical messages we are receiving from those around us.*

The millions of sensory nerve endings in the skin are found in the dermis, including **Merkel's cells** and **Meissner's corpuscles** for touch and **Pacinian corpuscles** for pressure. Some areas of the skin are very much richer in nerve endings than others—compare for yourself how it feels to stroke a one-inch square of your leg, with a one-inch square of your face, especially the skin around your mouth. The face, especially the mouth area, has a particularly high number of sense receptors.

Elastic fibers give the skin its elasticity. This wears out over time, just as your underwear elastic does. Hence the skin of a young person bounces right back when pulled up, and the skin of an old person does not.

Hair and **nails** are made of tightly packed keratinized cells, the same material as the top layers of your skin. Both are alive at the root, from whence they grow. It's incredible to think that keratin can be laid down in different ways to form nails, hair, and hard skin.

As our first line of self-defense, the skin needs to be able to repair itself quickly if damaged. It does this remarkably well due to its rich blood supply. Remember that a good blood supply is needed for healing anywhere in the body—without an efficient transport system, you can't get the building materials on site and the waste taken away.

The quickly dividing epidermal cells reproduce until they touch each other; thus a very shallow cut heals within a few days with no scar. A deeper cut takes more work to heal. The first phase of repair is the inflammatory stage, in which blood loss causes clot formation right up to the surface of the skin. The clot helps hold the sides of the cut together. The inflammatory process means that lots of blood cells are attracted to the area. New capillaries form in the dermis, and epithelial cells migrate to just below the clot. Fibroblasts make scar tissue, and then new epithelial cells are made and laid down with extra collagen fibers. Often a scar remains.

What Can Go Wrong with the Skin

There are more than a thousand skin conditions, the most common being bacterial, yeast, or fungal infections. Also there are noninfective inflammations like eczema and psoriasis. More serious conditions are cancer and burns.

Among the "skin deep" conditions, **eczema** is a common inflammation seen as an atopic or allergic type of condition. The holistic view of it is that it is a cry for help from the body, an indication of imbalance, or something not right deeper within. It can be related to toxicity in the body such as from food intolerances. The orthodox medical treatment for eczema is the application of steroid creams that suppress the inflammation. The holistic view is that this pushes the problem deeper inside. It is common for someone to have eczema as a child, and then later develop asthma after steroid cream use, because the disease has moved farther into the body. When a person is later embarking on a healing process, very often the eczema will return as the illness is leaving their system. This is known as the "law of cure." We will discuss it more when we take a look at five element medicine in Appendix A.

Burns can kill us, primarily because of their effect on the skin, which is largely due to a loss of body fluids containing electrolytes and proteins, resulting in dehydration. Literally, the fluid falls out of us. People who have been burned need an enormous amount of extra food calories daily to replace those lost through the damaged skin—it is not possible to eat enough if the damage is severe, so they are given these through IV and gastric tubes. Infection is also a major problem for people who have been burned.

In Switzerland there are people known as *coupe feu* (the French term literally means "to cut fire"). These people have a special gift to stop burns and heal them almost immediately. The gift is usually, but not necessarily, passed down in a family and only one person at a time in the family possesses the gift. They never charge for their services. Most burn departments in Swiss hospitals have a list of coupe feu people, so that if you come to the hospital with second- or third-degree burns they ask you if you want to phone a coupe feu. You speak to the person on the phone, give your name, where you are, and where you're burned, and the pain goes away almost immediately with very little or any scarring. This tradition has been passed down through generations in Switzerland and parts of France. It even works for sunburn. In the same line of tradition is the *coupe sang*, which stops hemorrhaging and severe bleeding.[2]

Skin Cancer

Many benign **tumors** arise in the skin. For example, warts are **benign** (mild, nonthreatening) tumors caused by a virus. However, some skin tumors are **malignant**—meaning that they will spread and invade other parts of the body. Risk factors include frequent irritation of the skin (by chemicals, infections, or physical trauma like sunburn).

It is now understood that regular exposure to the sun is not the risk it was once thought to be; it might be worse to have only intermittent exposure. Sunscreen and sunblock use have increased enormously, but so has incidence of skin cancer. In fact, skin cancer rates have increased the most in places that people use the most sun creams, leading to speculation that something in the creams themselves may be carcinogenic. The three common skin cancers include melanoma, squamous cell carcinoma, and basal cell carcinoma.

Interrelationships

The skin interacts particularly with the nervous, circulatory, lymphatic, and immune systems in order to maintain homeostasis.

There is a close relationship with the **nervous system**. Although it is actually through sensory nerve receptors that we feel things, all this experience of the outside world is mediated via the skin. As we have said, the skin is one big sense organ, providing the brain with vital information about the world we are living and moving in.

In relationship to the **circulatory system**, it is the skin that mediates change of temperature in the body via sweating and blood vessel constriction or dilation. The lymphatic system has a rich superficial network of vessels draining the skin. Brushing the skin as well as MLD—manual lymphatic drainage—greatly stimulate and help lymph drainage. Thermoregulation is vital for homeostasis; heat speeds up chemical reactions, while cold slows them down, thus affecting **all cells and tissues** of the body.

The skin is a vital barrier in the front line against infection, thus being important for the **immune system**.

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*Martha McClintock, a professor of psychology, provided the first conclusive scientific evidence for human pheromones. Her findings, coauthored with Kathleen Stern, were published in the March 12, 1998 issue of *Nature*.

CHAPTER 5

Them Bones, Them Bones,… Them Dry Bones—The Skeletal System

Actually, living bones could not be more different from the dry old dead bones of the song. In the body, bones are vibrantly alive, and continually changing. They have a rich blood and nerve supply. Bone cells continually lay down, reabsorb, and then lay down again a beautiful pattern of calcium phosphate and calcium carbonate salts in a fibrous network. The more weight-bearing exercise a bone is asked to do, the stronger it gets, by laying down more calcium. This process is so dynamic that when we wake up in the morning after lying in bed all night, our bones are actually less dense than they were when we went to bed.

A layer of dense fibrous connective tissue called **periosteum** covers bone. Into this periosteum knit the tendons of muscles and the ligaments that support joints. The periosteum and the supportive tendons are essentially the same in composition—full of collagen fibers.

Beneath the periosteum is a layer of dense **compact bone**, which gives the bones the appearance of being solid. Actually, they are not. Under the thin layer of compact bone is found **spongy** or **cancellous bone**, which looks like the inside of a sponge. The holes in it are filled with **red bone marrow**, where blood cells are made. In the shafts of hollow **long**

bones is found the **yellow marrow**. Yellow marrow is basically fat. It counts as a storage site in the body.

The functions of the skeleton are: support, movement (accomplished by joint formation and with the help of muscles), protection, making blood cells, and storage of calcium, phosphates, and fats.

Types of Bone

Looking at a skeleton, you will notice that there are different shaped bones. These are classified into **types**.

Some bones, such as the ribs and sternum and the dome of the cranium, are kind of flat. Under these are found important and vulnerable organs, hence **flat bones** are seen as protective.

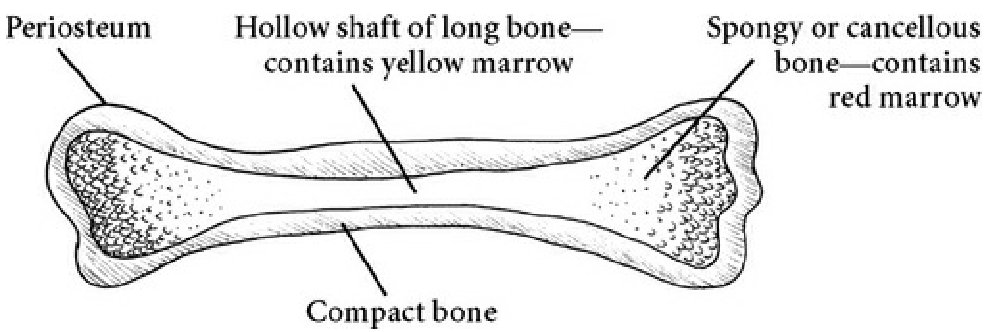

FIGURE 5.1. Structure of long bone

Some bones look like the typical cartoon bone—two bulgy heads and a longer shaft between them. These are called **long bones**, and give us leverage, a massive range of movement, and physical strength. All the bones of the limbs, except the short bones in the ankle and wrist, are long bones—including the three tiny phalanges in your little toe! The **short bones** in your wrist and ankle, called the carpals and tarsals, give flexibility and strength.

The vertebrae do not easily fit into any other category, and so are called **irregular bones**. Finally, there is a kind of bone called a **sesamoid bone**. These are mostly small, of sesame seed shape and size, and are formed inside tendons where they cross joints and need extra strength and support—in the ankle for instance. If you sit with your legs out in front of you and relax your thigh, you can wobble your kneecap, or patella. Now, tense the muscles in your thigh; notice how the patella will no longer move. It is completely inside the tendon of your quadriceps muscle on the front of your thigh—yes, you guessed it, the patella is really just a giant sesame seed.

Bone Formation—Ossification

Bones form in the womb from a cartilaginous blueprint and later continue to grow by a process called **ossification**. This means that initially we make ourselves a skeleton out of cartilage. Feel your ear or the end of your nose. These are made of cartilage, an amazingly tough and flexible material. The ear and nose cartilage has extra elastic tissue, but is otherwise similar to the bone blueprint.

Gradually, during the process of ossification, the bone cells take calcium from the blood (lovingly supplied from your mother's blood via the placenta and umbilical cord), and lay it down in a beautiful and intricate circular pattern to make the bones rigid. Thus inside the bones are found long tubes of calcium salts laid down in concentric circles around a central

Haversian canal. These tubes of rigid material make the bone much stronger than it would be if it were simply solid calcium. Mature bone cells, called **osteocytes**, live in spaces, or **lacunae**, within the matrix of the bone they have made.

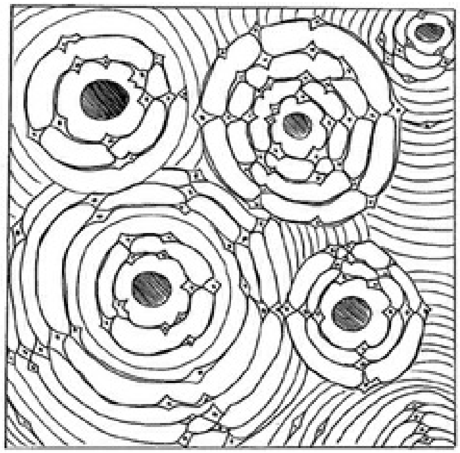

FIGURE 5.2. Vertebral bones, lateral view

If you take a bone from a long-dead creature, what you have is the calcium salts part, after the organic cartilaginous material has rotted away. These "dry bones" are rigid and not at all flexible—therefore they are very easy to snap. On the other hand, if you take a bone from a creature just recently dead, and put it in acid to dissolve out the calcium salts, you will be left with a bone that is completely flexible, but not at all rigid—you can tie it in a knot. It is made of incredibly tough cartilaginous material—you will be very hard pressed to break it or pull it apart.

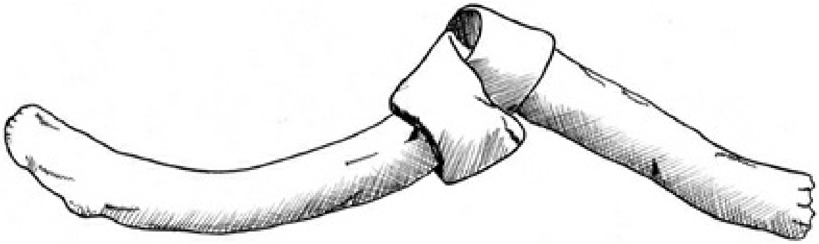

FIGURE 5.3. Bone with calcium salts removed

The living bones in our bodies contain both the tough flexibility of the cartilaginous blueprint and the rigid strength of the calcium lattice. This is an amazingly successful partnership. When we are young we are incredibly juicy. Our bones are flexible and do not easily break; a young person is more likely to sustain a “green stick” fracture on injury to a bone. To see what this looks like, literally take a green stick, a small live twig, straight from a tree, and try to break it. Later on we start to dry out, and this process continues throughout life.

Bone Healing—Calcification

After a break, bones repair themselves through **calcification**, laying down lots and lots of calcium. A bone healed in this way is stronger at the break site than elsewhere, as so much calcium has been added.

Sometimes bones take ages to heal; other times they can heal incredibly quickly. You can speed up bone healing by using the herb comfrey (*Symphytum officinalis*, or “knit bone”). Most effective taken internally as well as applied externally, comfrey contains a substance called allantoin that your body also makes, using it for repair.*

Some Useful Terminology

There may be lots of new words for you in the study of anatomy, and many of them refer to where things are in the body, and how the body can move. If you have ever done any yoga, you will know that there is a position called shavasana—literally, the corpse position. It involves lying on your back, legs loosely apart and arms by your sides, with the palms facing upward to the ceiling. Translate this position to a standing one and you have what is known as the **anatomical position**. The convention in anatomy is to describe things as though the body is in the anatomical position.

Imagine a line drawn straight down the front of the body, from the middle of the top of the head to the groin. This is the **medial line**. Everything found close or toward it is called medial, and everything away from it is called lateral. If you sliced a body in half down the medial line, that is the **sagittal**, or **medial plane**.

If you slice a body down from the top in a plane going from one ear to the other, you get the **coronal**, or **frontal plane**. The front of the body is called **anterior**, and the back **posterior**.

Slicing horizontally at ninety degrees in the middle of the sagittal or coronal planes gives you the **transverse plane**. Below this line is referred to as **inferior;** above is referred to as **superior**. Referring to the arms and legs, close to the trunk is known as **proximal;** away from the trunk (i.e., toward the hands and feet) is **distal**.

Movements also have a special language. Imagine a baby in the womb, in the fetal position with everything curled inward. This is called **flexed**, and movements in this direction are known as **flexion**. The opposite is called **extension**. If you take an arm or leg away from the midline of the body, it's called **abduction**. Returning it in or crossing toward the midline is **adduction**.

The spine can flex forward and extend backward, and it can also bend to the side. Side bending is called **lateral flexion**. When the spine twists around (especially the head), this movement is called **rotation**. Your shoulders and hips can do it too, such as when the toes turn outward or inward; this is known as **lateral** and **medial rotation**, respectively.

Put your hands out in front of you. You can turn them so the palms face the ceiling, which is called **supination**—and makes them in a **supine** position (think of making cups of them for soup). Or they can also be **pronated** to face the floor. The whole body can be **prone** (lying on your front, face down) or **supine** (lying on your back, face up).

The feet can do a few things that are described in particular words. Pointing your toes—planting them to the earth, is called **plantarflexion**. Pointing your toes to the sky and keeping your heels down is **dorsiflexion**.

The Skeleton

The skeleton consists of 204 bones. These are divided into the **axial** and **appendicular** skeletons. The axial skeleton is the axis of the body and comprises the skull, spine, ribs, and sternum. Attached and "hanging onto" this is the appendicular skeleton: the shoulder girdle (collarbone and shoulder blade) and arms, and the pelvic girdle and legs.

The Axial Skeleton

The **skull** consists of the **cranium**, made by a number of fused bones of the face domed on top by the separate parietal, frontal, occipital, and temporal bones that join to each other by close fibrous joints called **sutures**.

The movable part of the skull is the mandible, joined by a synovial joint, the **TMJ (temporo-mandibular joint)**. To feel this joint, put your fingers on your face just in front of your ear, then open and close your mouth to find the joint. Now keep your mouth open and move your jaw from side to side. Is your TMJ tender to touch? Don’t be surprised or alarmed if it is. This is very common. The TMJ can be out of place and cause all sorts of problems. Holistic dentists have a lot to say about your “bite,” which is the way your upper and lower jaw fit together. It seems that breastfeeding is very important for proper development of the mouth and jaws, and therefore for the cranium. It takes a lot more pull to drink from the breast than from a bottle—so bottle-fed babies lose out on this important developmental exercise, as well as in so many other ways. (The numerous benefits of breastfeeding will be elaborated on when we deal with the miracle of reproduction.)

Chiropractors, cranial osteopaths, and craniosacral therapists can help to put right misalignments in the TMJs and the skull as well as other misalignments of the musculoskeletal system, which can cause numerous problems in any part of the body.

The **hyoid bone** gets a mention here because it is the only part of the larynx that is bone (the rest is cartilage). Like a sesamoid bone it is not joined to any other bone. You can find it on your own body by feeling either side of your voice box—find the top of it, and squeeze gently—there is a bone that you can move about a bit. This is the hyoid bone. Feel it go up and down as you swallow.

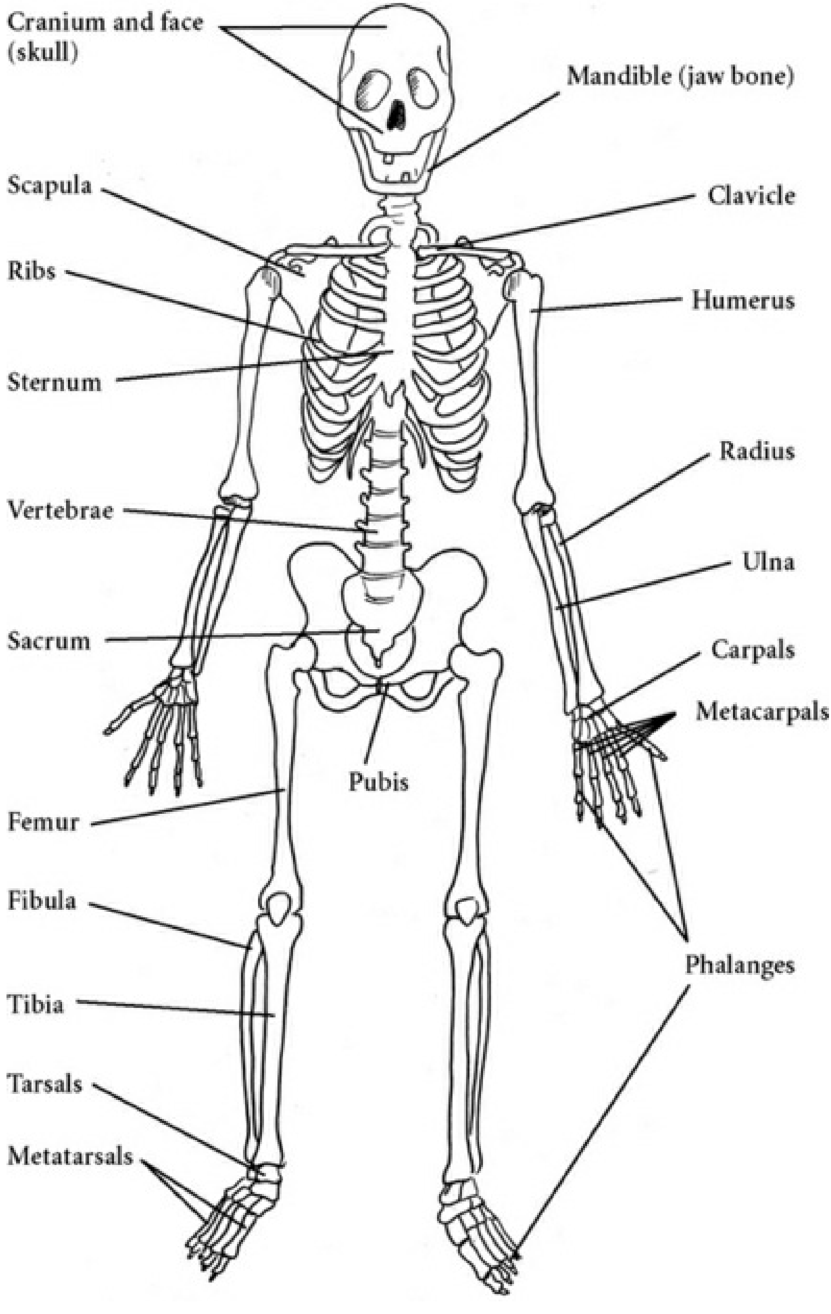

FIGURE 5.4. Skeleton, anterior view

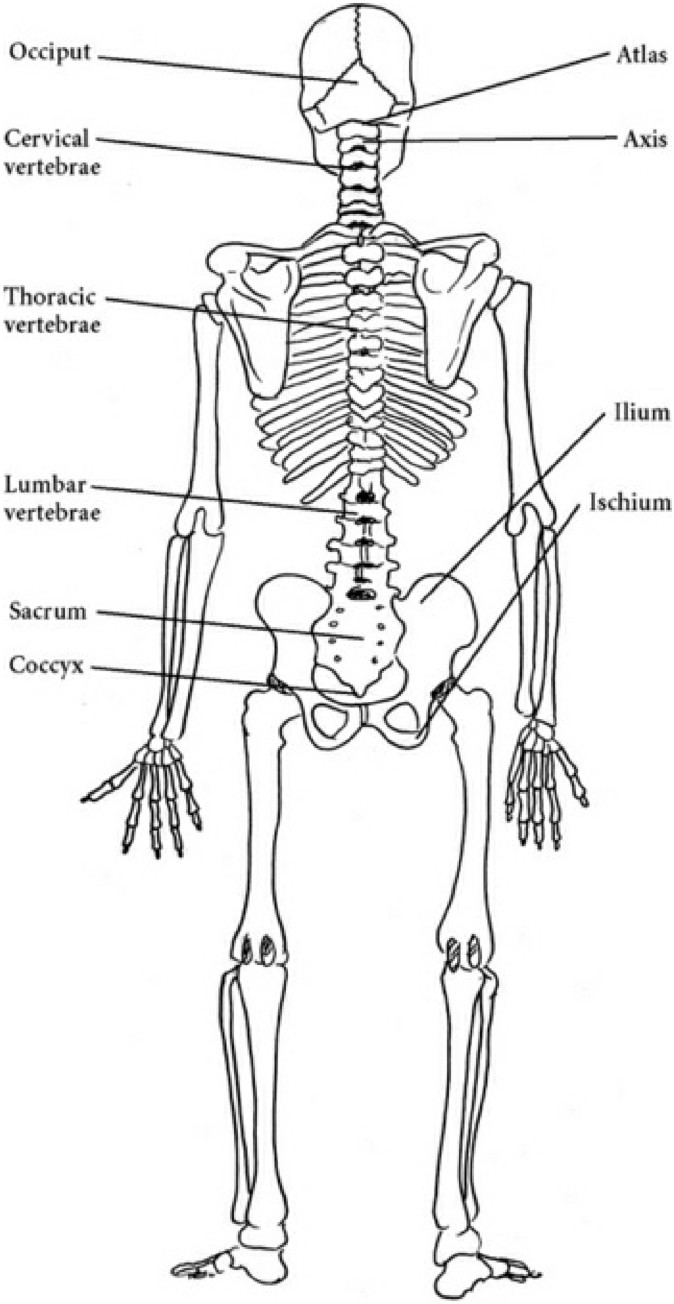

FIGURE 5.5. Skeleton, posterior view

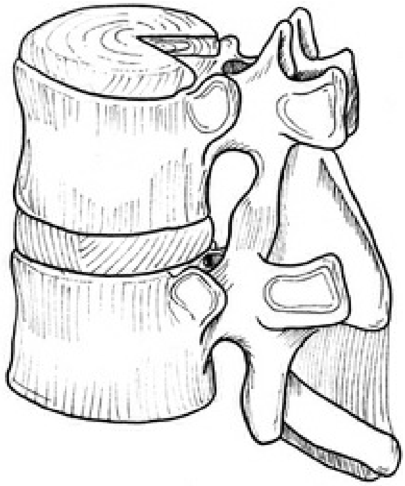

FIGURE 5.6. Vertebral bones, lateral view

The **spine** consists of thirty-three vertebrae. Generally these vertebrae each have a large wedge of bone called the **vertebral body**, a **spinous process** sticking out the back, and **transverse processes** out the sides. The spinous processes are those sticking-out-bits you can see on someone's back. You can't generally see or feel the transverse processes, except for those of the first neck bone—the atlas. Put your fingers in the dip right underneath your ear, between the jawbone at the front and the skull at the back. Just press in, and move your fingers up and down until you feel some hard bony bits underneath them—ouch! They are probably a bit tender. Those are the transverse processes of your atlas.

Between the spinous processes at the back and the transverse processes at the sides there is a bony bridge that forms the borders of a central canal. This is called the **vertebral** or **spinal canal**. It is where the spinal cord is found, completely protected by bone. An intervertebral

foramen either side at each level allows spinal nerves to exit and enter.

The **vertebral** bodies are found deeper in, and stack on top of each other with the vertebral or spinal disks between them. Generally, the bodies get bigger the lower down the spine, due to increased weight bearing.

The vertebrae are named and numbered from the top down:

- Seven **cervical**—C1-C7
- Twelve **thoracic**, T1-T12
- Five **lumbar**, L1-L5
- Five **fused sacrum**, S1-S5
- Four **fused coccyx**

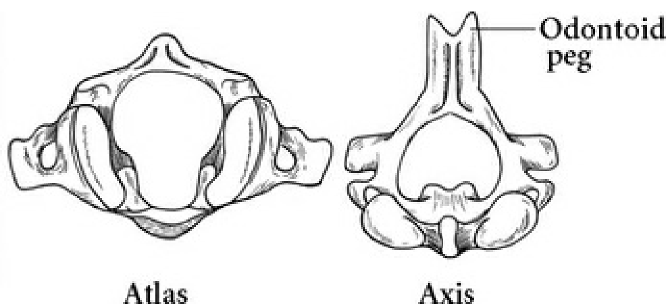

FIGURE 5.7. Atlas and axis (C1 and C2)

The neck is called the **cervical spine**. (You may be familiar with the term cervical smear—a screening test for cancer of the cervix, or "neck" of the womb.)

The first two vertebrae in the neck (C1 and C2) are the **atlas** and **axis**. Remember Atlas, the mythological Greek god who holds up the world? The atlas holds up the head, and has a special joint with the occipital part of the skull that allows extra flexion—in plain terms, nodding. The next one down, the axis, has a big peg sticking up into the round ring of the atlas; this odontoid peg has a synovial pivot joint with the atlas, allowing extra rotation between these two bones—in plain English, shaking the head. There is no intervertebral disk between them as there is between other vertebrae.

The twelve thoracic vertebrae have an extra articular surface for joining with the **ribs**.

The sacrum is one triangular-shaped bone made from five vertebrae that fused together early in our fetal development. It is interesting to compare the skeletons of mammals; there is only the barest variation between the essential designs. Like us, horses and even giraffes have seven neck bones. The dolphin, with no need for back legs, has no bones fused together to make a sacrum. Four-legged animals do not have the marked difference between weight-bearing legs and arms that we (or other animals that spend some time on their back legs) do.

Of course, we have much the same DNA as other mammals, but we also have about forty-two percent the same DNA as plants—a banana, for instance. It occurred to me in Bali, where the banana plant is used for just about everything, that people would relate to this easily. In the West, we have become so disconnected from nature that we have forgotten that everything we need comes from our distant ancestors, the plants.

If you bend your head down on your chest and feel the spinous processes at the bottom of your neck, you can probably feel at least one that particularly sticks out—this is usually C7. If you can feel two sticking-out ones, they are probably C6 and C7. It is possible to find the spinous processes from C2 all the way down to L5 with some perseverance. (On someone else, of course—it is not at all easy to find them on yourself.)

The joints of the spine include the intervertebral disks between the vertebral bodies, as well as joints between each vertebra and the ones above and below made by articular surfaces on the intervertebral arches, which are bridges of bone between the spinous processes and transverse processes. Ligaments support all these joints. As you see, the spine is designed to move. A great many of our problems in this area come about from lack of exercise and movement. Each vertebra should freely move with the one above and below—for most of us, this isn't happening. Instead, whole sections of the spine move together, which puts a lot of pressure on the one spot that is moving.

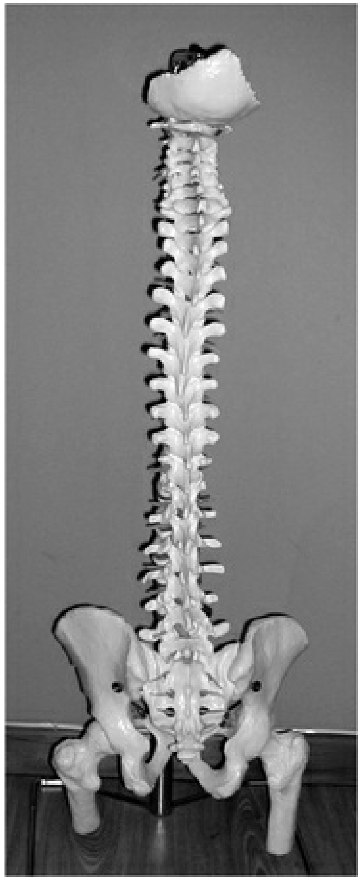

FIGURE 5.8. Model of spine and pelvis

The rest of the axial skeleton is the **sternum** and **ribs**. There are twelve pairs of ribs, coming off the thoracic vertebrae at the back. The first seven, counting from the top downward, are called true ribs and they articulate directly with the sternum via long cartilaginous joints. The next three articulate with the articular cartilage of the one above. Ribs eleven and twelve are free floating; their tips can be felt. Weirdly, ribs eight to twelve are called false ribs. By the way, men and women have the same number of ribs—believe it or not, this is a commonly asked question!

Is Your Spine Moving?

You can find out how well your spine is moving, and consciously begin to improve its mobility, with a simple exercise.

Lie on the floor with your legs bent and your feet flat on the floor. Have a few paperbacks or a small pillow under your head if necessary. Starting with your sacrum, begin to slowly roll your back off the floor, using your legs to push up. Imagine you are moving one vertebra at a time, until you get to your upper back and your shoulders and legs are supporting your weight. Now do the reverse and come down.

Can you move those vertebrae one at a time? Or do you notice places where a great chunk goes up or comes down all together? Practice gently and regularly to improve your mobility. A visit to an osteopath, chiropractic, massage therapist, or Bowen therapist might help to free things up.

The **arms**, or **upper limbs**, consist of two shoulder blades, two clavicles, and two arms (usually). Each shoulder blade, or **scapula**, moves around freely on the ribs; it is not attached directly to the ribs except by muscles. The superior lateral (top outside) part comes over the top of the shoulders, and makes a joint with the lateral end of the collarbone, or **clavicle**, in front of the top of your shoulder. See if you can find it. You can then follow the clavicle to the middle of your body and feel where it meets the **sternum**, or breastbone. The shoulder blade and clavicle make a shallow socket for the ball of the upper arm to join with. This joint is extremely mobile—therefore not very stable. It's fairly common to dislocate your shoulder. It has very lax ligaments to allow a large range of movement, and is supported mainly by muscles. Small children have even less stable shoulders because they have not yet built up muscle strength. This means dislocation can happen easily by, for example, swinging a small child by the arms before he or she is big enough or when a stressed and hurrying adult pulls along a young child.

The arms themselves are composed of three bones: the terribly amusing **humerus** in the upper arm and the **radius** and **ulna** below. If you whack your "funny bone," which is not at all funny, you have hurt the inside of your humerus at the elbow. There is a sensitive nerve very close to the surface there.

The forearm has its two bones lying together like shoes in a shoebox—the ulna is larger at the elbow end and small at the wrist. It forms the point of your elbow. Give it a feel and follow it down to your wrist—is it lateral or medial? Don't forget the anatomical position.

You will find that it lies to the inside. The radius lies laterally. It has a small head at the elbow but makes the larger part at the wrist end. Look at the back of your right wrist—you can see a big knob on the right which is the end of your ulna, and you may not see but you can certainly feel a lump (known as a tuberosity) on the left. This is the **radial tuberosity**, and you can feel it at the front and back of your wrist.

If you keep feeling around your wrist you will realize that there are more lumps and bumps. Quite a lot is going on in there—the wrist itself contains eight small bones called the **carpals**, arranged more or less in two rows of four. Each carpal bone forms a joint with its neighbors, allowing them to slide or glide over each other a little. The radius and ulna make a joint with the proximal row of carpals, and the metacarpals in the hand join with the distal row of carpals. Phew! See what I mean about a lot going on. All these small joints together give the wrist a wonderful range of movement and a lot of extra strength. The small long bones in the palm of your hand are the five **metacarpals**, numbered one to five from thumb side. Take a look at your fingers. They are made of many small long bones called **phalanges**. How many do you have? Count them for yourself.... (There are fourteen—three for each finger and two for the thumb.)

For the sake of completeness and for those who want to know, the carpal bones are, beginning with the side of the thumb and proceeding to the little finger: in the distal row, the trapezium, trapezoid, capitate, and hamate; and in the proximal row, the scaphoid, lunate, triquetrum, and pisiform. Pisiform can be felt on the anterior surface of the medial border of the wrist and can be moved from side to side. The hand *must* be relaxed and hanging there or you can't feel it (one of the forearm flexor muscles inserts into it and if this muscle is working you won't be able to move the pisiform). The hook of the hamate can be felt on very deep palpation over the medial side of the palm, 2 cm distal and slightly lateral to pisiform.

The Pelvic Girdle and Lower Limbs—Hips and Legs

The pelvic girdle is made of two **innominate** bones, each made of three fused bones. Weirdly, innominate bone means "the bone with no name" when in fact each part has a name: the **ischium, ilium**, and **pubis**. Apparently the bone was termed innominate in the olden days when it was impolite to mention a person's pelvic area. The pelvis is joined at the front with a wedge of cartilage between the pubic bones: the **pubic symphysis**.

At the back, each side of the ilium articulates with the sacrum, making the **sacroiliac joints**. All three parts of the rude bone form the socket of the hip joint. Into this deep socket fits the head of the thighbone, or **femur**. This bone, the largest and longest in the body, makes the hip joint deep in the buttocks and groin. You can feel a bone at the side of your hip, which is part of the femur called the **greater trochanter**. The actual hip joint is too deep inside the muscles to palpate directly.

The femur ends in the knee joint, where it articulates with the **tibia** and much smaller ("feeble") **fibula**. In front of the knee joint—protecting it—is found the kneecap, or **patella**.

At the ankle there is a similar arrangement as at the wrist—only here, seven differently shaped **tarsal** bones are found.

The seven tarsals are the talus, calcaneus, cuboid, navicular, and three cuneiforms. The cuboid and the three cuneiforms articulate with the metatarsals. One of the seven tarsals, the talus, articulates with the leg bones. The huge bone forming the heel is the calcaneus. Of the five other tarsals, four of them articulate with the **metatarsals**, making the arch of the foot. Echoing the metacarpals in the hand, the foot has five **metatarsals**, numbered one to five from the big toe side. Number one is much bigger than the other four. Just like the fingers, there are fourteen **phalanges**, three on four smaller toes and two on the big toe. Take a look at your little toe—the phalanges there are tiny, yet even these are so-called long bones, because they have a hollow shaft containing yellow bone marrow and two heads whose spongy bone contains red bone marrow, which is busy making blood cells.

Joints

Bones are joined to other bones by joints, also called **articulations**. Most joints are supported by **ligaments**—tough white fibrous tissue passing from bone to bone across a joint, knitting into the periosteum covering of the bone. The study of these is called **arthrology**. We have mentioned some as we looked at the skeleton. Here we will take a closer look.

There are three basic types of joints: fibrous, cartilaginous, and synovial.

Fibrous joints are fixed joints consisting of tightly strung fibers running between adjacent bones. Example of fibrous joints are the **sutures** of the cranium and the interosseous membrane between the ulna and the radius. In traditional British and American anatomy, fibrous joints are considered to be immovable. However, there is a very subtle and slight movement possible at, for example, the sutures of the skull. Cranial osteopathy and its offshoot craniosacral therapy developed from observation of these subtle movements of the skull during brain surgery. Interestingly, this has been known in Italy since being discovered by Italian anatomist Giuseppe Sperino in 1920. There is a slow rhythm of movement of the skull bones, assisting with circulation of cerebrospinal fluid throughout the central nervous system.[1]

Cartilaginous, or slightly movable joints, consist only of cartilage, attached at both ends of the bone. Examples are the joints between the ribs and the sternum, the pubic symphysis, and the intervertebral disks. During pregnancy, a woman's body produces a hormone called relaxin, which softens up all the cartilage and ligaments. During childbirth the pubic symphysis, the joint of the two pelvic bones at the pubis, can open out by more than an inch to allow the passage of the baby.

Synovial, or freely movable joints, such as the hips, knees, elbows, shoulders, and so on, are the most complicated. More on these below.

The complex synovial joints have a **joint capsule**, composed of a **synovial membrane** secreting synovial fluid, articular cartilage, ligaments, and sometimes bursae and menisci. Syn-ovial means "like egg"—crack an egg, and feel the white of it on your hands; this viscous and extremely slippery substance is what **synovial fluid** is like. **Articular cartilage** is white; if you have ever eaten meat, you will have probably seen the gristle on the ends of the bones in a chicken leg. This is cartilage. Its being white tells us that it has no blood supply—it must get its nutrients from the underlying bone, and from the synovial fluid. Synovial fluid gets reabsorbed and made anew; when you move a joint, it makes more fluid. When you are not moving, the joints dry up. This is why before exercising one warms up the joints by moving them; as soon as we start to move them, the synovial membranes produce more fresh fluid, containing oxygen and nutrients. Thus if we do not move much and have sedentary lifestyles, the joints dry up and stiffen. This then means our cartilage has a hard time getting the nutrients it needs to repair and replenish itself. Cartilage wearing out causes stiffness and inflammation in the joint; this is known as osteoarthritis, or OA.

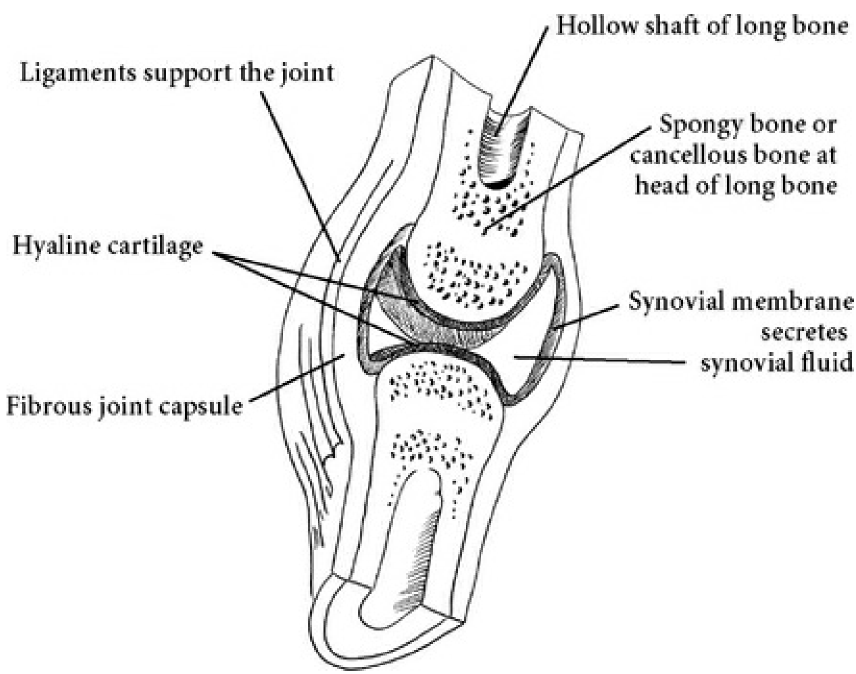

FIGURE 5.9. Synovial joint

Tight muscles around a joint can cause compression of the cartilage, adding to this problem of discomfort and drying up. This is why massage and bodywork can be very effective in treating arthritis and preventing further damage. To keep our joints working well we must keep them moving—use it or lose it! On the other hand, overusing the joints or putting a lot of strain on them can wear down the cartilage and hasten the development of OA, which is a very common condition.*

The joint capsule is surrounded by bands of tough fibrous connective tissue called **ligaments**, which attach into the periosteum of the bone either side of the joint and give it strength and stability. Ligaments contain a little bit of elastic tissue to allow them to stretch and recoil as the joint moves, but they restrict the movement of the joint and should not be stretched too far. Damage from stretching a joint too far is known as a **sprain**. Ligaments also look white—they do not have a blood supply of their own. This means that injuries to them take a long time to heal. If they are badly overstretched, the elasticity may be damaged so that they are never as efficient at supporting the joint again. This is why some people who twist their ankle (spraining it) are more susceptible to further similar injury. The joint is now more prone to overstretching, as the ligaments are not holding it firmly any more.

Some joints have extra little cushions inside them known as **bursae**. Bursa means "purse." These are made of synovial membrane and contain synovial fluid. They can become inflamed and produce lots of extra fluid, causing huge swelling of a joint. Prepatellar bursitis (called housemaid's knee) is an example of this.

The knee joints also have extra bits of cartilage to provide better shock absorption. These are known as **menisci**, and they are wedge-shaped (imagine something like the segment of an orange) so they fit inside the joint capsule. When you are standing up, the pressure on each knee is equal to the pressure on one car tire. Walking doubles this, running doubles it again—I hate to think about jumping! The knee has a medial and lateral meniscus, which are attached by short ligaments. These can be torn or damaged by any sport activity that is especially hard on the knees (football, basketball, high-impact aerobics,… you get the idea).

The different types of synovial joint are named according to their shape or the movements they can do.

Ball and socket. Shaped as the name suggests, these are the most mobile joints of all, able to do flexion-extension, adduction-abduction, and rotation. They can also do a composite movement called **circumduction**. The two ball and socket joints are the hip and shoulder.

Hinge. As the name suggests, these open and close like a door—thus they can do flexion-extension. Examples include the knee and elbow joints and the joints between the phalanges.

Pivot joints allow for rotation only. Think of the joint between your atlas and axis, the **atlantoaxial joint**. The atlas rotates around the odontoid peg of the axis, allowing you to turn your head and look over your shoulder.

Gliding, or **plane** joints allow a sliding movement in one plane. Examples are the joint between the shoulder blade and the collar bone (the **acromioclavicular joint)** and the joints between the carpal bones.

Saddle joints are shaped like a ball and socket joint but there is a little dip in them like a saddle on a horse. Thus, although they allow flexion-extension and adduction-abduction, they do not rotate. There is one at the base of the thumb, between the carpal bone (called the trapezium) and the first metacarpal. Although this joint does not allow rotation, it can do circumduction.

Condyloid joints are shaped like a ball and socket but are oval rather than round. They are capable of flexion-extension, adduction-abduction, and circumduction. An example is the knuckles—the **metacarpophalangeal** joints.

Interrelationships

Bones have an obvious close relationship with the **muscular system;** without the muscles the bones cannot move. The **skeletal system** also interacts particularly with the **endocrine system** and **cardiovascular system**, as well as with the **digestive system** to maintain homeostasis with regard to calcium levels in the blood. Correct levels of calcium are necessary for proper functioning of the **nervous system** and the **muscular system**, including the cardiac muscle of the heart. Blood cells are made in the bone marrow, so the **circulatory system** relies on the skeletal system. The **digestive system** gets into the blood the necessary ingredients for building new bone. Vitamin D, needed for bone production, is made by the **skin**. The **kidneys** help to stimulate production of bone marrow and the estrogen of the **reproductive system** is involved in maintaining bone density.

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*Shamanic or earth medicine also addresses the condition of the energy body—healing the trauma or break here will vastly speed up the physical healing of the bone. There's a great story about this in *Mutant Message Down Under* by Marlo Morgan.

*Don’t forget about glucosamine to provide joints with the raw ingredients for repairing cartilage. The naturopathic approach to arthritis is to go for a detoxing and pure diet. Most people will find considerable improvement with this method. There are also many herbs that support elimination of toxins and the quieting down of inflammation.

CHAPTER 6

Movement—The Muscular System

Muscles can move. In fact, muscles do almost all the movement in the body.* This includes consciously moving the body about as well as the fine movements of the muscles that support us and help us stay upright, which is done by **skeletal muscles**. (These are so-called because they are attached to the bones that they move about.) Under a microscope skeletal muscles look striped because of how the tiny filaments inside them are arranged; hence they are also called **striated** muscles. They are under our conscious control; we can decide to move them at will, which gives them their third name: **voluntary** muscles.

Movement is also needed inside the body, in many of our internal organs and tubes. With the exception of the heart, which is made from its own unique **cardiac muscle**, this movement is carried out by **smooth muscle**, also called **involuntary** muscle. I'm sure you get the idea—we don't need to think about moving them. Smooth muscle is made up of short, spindle-shaped cells arranged in sheets. It forms bands around and along tubes and organs, and can contract in segments—this is how food is pushed along the gastrointestinal tract (GIT), a movement that is known as **peristalsis**. Smooth muscle in the circulatory system helps to move the blood along and also to allow varying amounts of blood into an area—if the muscle wall contracts tightly, less blood can enter; if it relaxes, the vessels dilate and more blood can perfuse into the tissues supplied by those vessels. Contraction of the smooth muscle cells is done by the movements of actin and myosin fibers.

The **cardiac muscle** has to be special, since from within weeks of conception to the moment of death, the heart keeps on beating; the cardiac muscle keeps contracting, around the clock. No time off for a holiday, sleep, or rest. The cells are all linked together with special junctions, as they must contract together in concert to produce coherent movement within the whole heart. The actual movement is again affected by contraction of actin and myosin filaments within each muscle cell.

What we know as the **muscular system** actually refers to the skeletal muscles (those attached to bone that cross joints and move the skeleton around). This chapter focuses on skeletal muscles.

Composition of Skeletal Muscles

Skeletal muscles are made up of bundles of muscle cells called fibers. Under a microscope they look stripy because of the straight-line arrangements of **actin** and **myosin** that lie on top of each other. Actin and myosin cause muscle contraction when they slide over each other, the myosin filaments pulling themselves along the actin filaments. Each muscle cell is wrapped in a sheath of fibrous connective tissue. A bundle of these long muscle fibers is wrapped again in fibrous connective tissue, and a bundle of bundles is wrapped again.

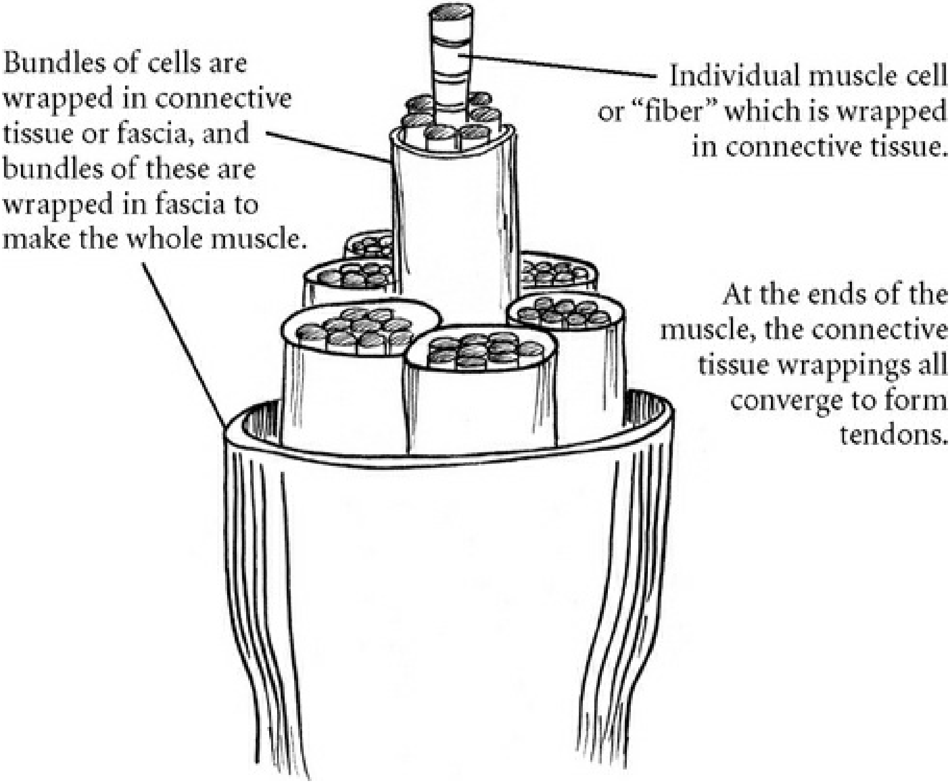

FIGURE 6.1. Structure of skeletal muscle

The whole muscle is wrapped in similar stuff, which is called **fascia**. At either end, where the muscle attaches to the bone, the contractile muscle cells end and the connective tissue coverings continue and converge to form **tendons**. Tendons, as you can feel from you own body, are the incredibly tough and inflexible fibrous tissue that attach muscle to bone.

The Hip Bone's Connected to the Thigh Bone …

So, fascia is the connective tissue that covers and runs right through the muscle, coming together to form the tendons at either end. The tendons knit into the periosteum, the fibrous connective tissue covering of bones that is essentially made of the same stuff as the tendons. Through this fascia, the whole body is connected. Ask a friend to lie on his or her back on the floor. Gently but firmly pull the person's toe, stretching the foot a little in the direction away from the head—and watch the head. You will see that the movement travels all the way up the body. The toe bone, through all the bones and joints and muscles along the way, *is* connected to the head bone.

Fascia runs in sheets throughout our body, connecting all of our structure. It spirals around and through our muscles, covers our bones, makes up our ligaments, and covers all our important organs. There is a soft-tissue bodywork technique practiced by craniosacral therapists called fascial unwinding in which the head or a limb is held gently supported and allowed to move in any direction it wants to. The thinking is that the fascia gets twisted up over the years, and allowing the body to move in this way unwinds it to release stored emotional baggage. Bodywork techniques such as postural integration and Rolfing focus on releasing deep-seated emotional trauma held in the body; it is thought that the feelings are held in the connective tissue. Interestingly, it looks as though meridians, the lines of energy running through the body described by Oriental medicine, run through fascia.*

Muscle Contraction

Each skeletal muscle cell can contract, or shorten, as the microscopic filaments of actin and myosin within slide over each other with the help of calcium. This requires energy in the form of ATP. It's interesting that ATP is also required to remove the calcium and cause relaxation.

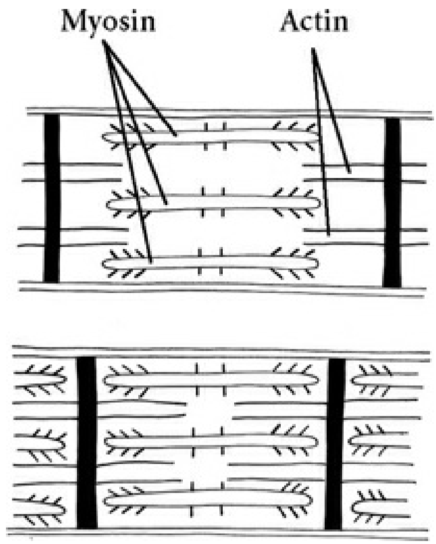

FIGURE 6.2. Actin and myosin

Each cell can only either contract or be relaxed—it's all or nothing. For a muscle to contract more, more individual cells get involved. A group of muscle cells will be innervated by one nerve fiber; in other words, one nerve cell firing will cause a set number of muscle cells to contract all at once. In some parts of the body, we have a lot of fine control over muscles; in these areas, like hands and tongue, each nerve fiber ending will stimulate just a few muscle cells. On the other hand, large postural muscles like those in the legs will have hundreds of cells innervated by one nerve fiber. So, one nerve cell controls anything from a lot to a very few muscle cells. When the muscle cells contract, the two ends of the muscle move toward each other, causing movement between the bones they are attached to.

While you are alive, the only time you could ever have a completely flaccid muscle would be if you were under a general anesthetic, or the nerve to that muscle had been cut. In other words, there are always *some* muscle fibers contracting in a muscle at any one time. This provides what is known as muscle tone. Tone can vary between people, and from one muscle to another.

Sometimes a muscle becomes overtoned, or tense; the cells contract much more than needed while in a supposedly resting state. This can cause the muscle (and the person) to become tired, as more energy is used in the contraction process. The muscle is less efficient and less effective. Also it hurts. Excess tension in muscles is so common in modern life that it has become normal; our sedentary lifestyles coupled with unrelenting stress and the lack of good emotional health are all factors in this. A muscle worked beyond its current ability can become fatigued. Tense muscles, which are already working overtime in their resting condition, are more prone to fatigue.

Aerobic and Anaerobic Respiration

Like other cells, muscle cells make ATP from glucose and oxygen in their mitochondria. In the absence of oxygen, **anaerobic respiration** takes place, by which means the cell can get a little ATP from glucose (by glycolysis), making lactic acid as a by-product. The lactic acid contributes to stiffness in the muscle, and will be either made into pyruvic acid (which the muscle cells can then use to make ATP), or is taken by the blood to the liver and made back into glucose. Muscle cells can also use fats for making energy. Muscles like to store their own sugar supplies as glycogen.*

A muscle that has gone into anaerobic respiration for a time is said to have built up an oxygen debt. To repay this debt, we need to do plenty of breathing to replenish the blood's oxygen supplies.

$$\text{Aerobic respiration } O_2 + \text{Glucose} = \text{ATP} + H_2O + CO_2$$

$$\text{Anaerobic respiration glucose} = \text{ATP} + \text{Lactic acid}$$

FIGURE 6.3. Cellular respiration

White and Red Cells

There are different types of muscle cells. Some look whiter; these do not have a rich blood supply and can operate without a constant supply of oxygen. Some look red, having a good blood supply.

The **white fibers** are very fast but cannot go on and on contracting without a break. These are good at anaerobic contraction and are used for quick, occasional movements. The **red fibers** are slow, use lots of oxygen for aerobic respiration, and are used for postural support. Many muscles have a mixture of these types of fiber.

Smooth Movement

Muscles work together to produce movement in the body. Feel for yourself how it is to extend and flex (straighten and bend) your elbow. Biceps and triceps in the upper arm work together to make these movements smooth.

Let’s take elbow flexion as one given movement. There is a prime mover, or **agonist**—the **biceps brachii**. (Biceps brachii is the two-headed superficial muscle on the anterior side of your upper arm. There is a deeper muscle, brachialis, underneath, which is actually the prime mover in elbow flexion.) The opposite movement to it—extension—is provided by triceps, the **antagonist**. To allow smooth flexion, biceps contracts, while triceps relaxes in a measured way. Without the opposing force of triceps, it would be difficult for biceps to make a careful and controlled movement.

So it is that muscles work together to perform movements. There is also a class of muscles called **synergists** (meaning “go with the energy”). These are all the muscles that contribute to a given movement. For example biceps and brachialis are synergists for flexion of the elbow.

A further category is **fixators;** these are very important muscles that hold some part in place in order to allow the precise movement of another part. For example, in order for biceps to effectively flex the elbow, the scapula must be fixed in position. The main muscles that fix the scapula are the trapezius, rhomboids, and serratus anterior muscles.

So you can see that for any particular movement there are a lot of muscles involved. The coordination of muscle movements is controlled by a part of the brain called the cerebellum.

Muscles as Sense Organs

Muscles have sensory receptors, giving feedback to the brain about what is happening in them. In the words of Deane Juhan in his great book *Job's Body: A Handbook for Bodywork:*

> Muscle tissue is anything but insentient. The muscle spindles and the Golgi tendon organs are extremely sensitive monitors, and between the two of them our central nervous system is kept constantly informed about the activities of every individual motor unit.

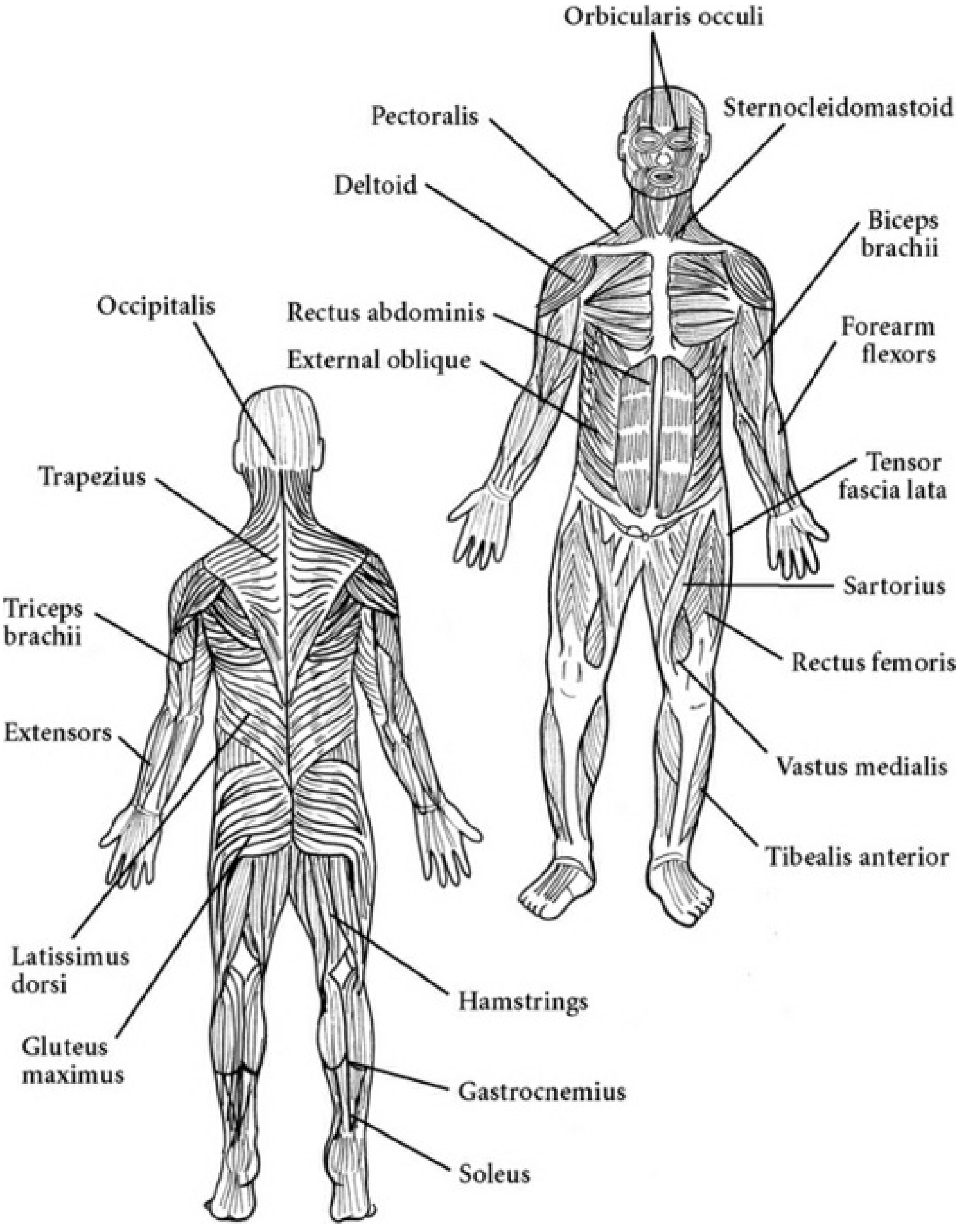

FIGURE 6.4. Superficial muscles, posterior and anterior view

This sensory input is experienced unconsciously, and is integral to the setting of muscle tone and reflex activity. This is key in understanding the effects of massage therapy and other types of bodywork that help tense muscles to relax.

I have decided to leave out detailed descriptions of muscles from this book, although I am including pictures of the main superficial muscles. For more details you might try *The Muscle Book* by Paul Blakey, or the very excellent *Trail Guide to the Body: How to Locate Muscles, Bones and More* by Andrew R. Biel and Robin Dorn.

Interrelationships

There is an obvious close relationship between the muscular system and the **skeletal system**. Without the muscles, the bones and joints cannot move. Without the bones, there is nothing for the muscles to attach to and move. Likewise, there is also a very close relationship with the **nervous system**, without which the muscles cannot move. The muscular system receives its constant supply of nutrients and oxygen via the **circulatory system**, and movement of skeletal muscles helps venous return and movement of lymph, while smooth and cardiac muscles form a significant part of the cardiovascular system. The oxygen needed by muscles comes into the body thanks to the **lungs**, and the nutrients they need come from the **digestive system**. The **liver**, as the "glucostat" organ, involved in control of sugars, has a special relationship due to providing the muscles with glucose. There is also **endocrine** control of glycogen-glucose transformation. In order to contract properly, muscles need the level of calcium in the blood to be right. This involves mostly the skeletal, endocrine, and gastrointestinal systems.

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*One interesting exception is the movement of spermatozoa, or sperm cells, which move using a **flagellum** (the tail of the sperm) that moves by contractile filaments within the cell, making it wiggle. Cilia, the hairlike projections on the epithelium of the lungs and fallopian tubes, also move due to movements of tiny filamental parts of the cells' microskeleton.

*Helen M. Langevin and Jason A. Yandow reported in "Relationship of Acupuncture Points and Meridians to Connective Tissue Planes" that their research found an eighty percent correspondence between the sites of acupuncture points and the location of intermuscular or intramuscular connective tissue planes in postmortem tissue sections.

*Try cutting out refined sugar from your diet. Many people who do this notice a change in how their muscles feel. It's likely that excess sugar puts strain on our muscles by overfilling them with glycogen they don't really need. In Chinese medicine, the Spleen Official (with some of its functions being comparable to those of the pancreas) is in charge of all movement in the body. Excess sugar damages the Spleen Official.

CHAPTER 7

Transport—Circulation and Blood in the Cardiovascular System

We need things to move all over the body quickly and efficiently: nutrients from food, oxygen, and carbon dioxide, waste products (such as urea, which ends up in urine), and the body's own endogenous (internal, home produced) chemicals, such as hormones. If there is damage to repair, or building blocks needed for routine maintenance and growth, then the necessary materials will be transported in the blood. Debris from damaged cells, toxins that have entered the body, or waste products created from normal physiological processes—all of these would be harmful if allowed to build up in the body and are carried in the blood to excretory routes such as the kidney, bowel, skin, and lungs.

Without a good transport system, it doesn't take long to get into trouble. Remember the fuel shortages of the 1970s, or virtually any weather disaster that shuts down roads? Within a short space of time all the bread and milk disappears from market shelves—how can we get food delivered if there is no transport available? If transport is interrupted, the trash collectors cannot come and take the garbage away. Imagine the dirt building up, the smell, and the resulting disease. People cannot get to work, newspapers can't be delivered, electricity and water may be unavailable—a disrupted transport system causes havoc in a very short space of time.*

It is like this in our bodies, where the heart and circulation are in the system that transports what we need. We touched on this when we looked at articular cartilage that does not have its own blood supply and thus takes a long time to heal when damaged. With very few exceptions, every cell of the body is in reasonable reach of a blood vessel.

There are up to sixty thousand miles of blood vessels in our bodies. (Some books state twenty thousand miles, but I'm going with Stephen Buhner, who puts it at sixty thousand in *The Secret Teachings of Plants*.) These vessels are continually being repaired. We can even grow new ones, and we do so in response to increased demand. For example, if we go to a high altitude where the air is thin it is harder for us to get enough oxygen. One of the ways our amazing bodies adapt to this is by making plenty of extra blood capillaries and sending more blood around our bodies. This begins to happen as soon as the demand is felt.

As well as the sixty thousand miles of blood vessels, the cardiovascular system, or CVS, consists of what is usually described as a hollow, muscular, double pump: the **heart**. The heart has two sides, each one moving blood into a different circulation. The right side of the heart receives deoxygenated blood from all over the body and sends this "blue"* blood to the lungs, where it drops off its carbon dioxide and picks up oxygen. The blood, now bright red, returns to the heart in the veins, this time entering the left side. The left heart pumps the blood into a huge **artery** called the aorta, and branches from this artery take blood all over the body, supplying the oxygen needs of every cell. The arteries divide and divide, getting smaller each time. Small arteries are known as **arterioles**.

Tiny arterioles end and open out into a network of microscopic vessels, called **capillaries**. These are made basically of a layer of epithelial tissue one cell thick, so they allow small substances (like water, gases, sugars, amino acids, and other micronutrients) to freely leave and enter. The minute capillaries then join back together as **venules**, which join with others to form larger and larger venules, which join to form **veins**.

Stephen Buhner describes the system of arteries and veins, arterioles, venules, and capillaries as dynamic and vibrant, moving blood along by its own contractions and by a spiraling vortex—a self-sustaining movement circling around a vacuum center, like a tornado, which exists independently of the heart. Apparently, in a chicken embryo the blood can be seen to circulate some time before the heart starts to beat; the heart, when ready, begins to beat in time with the moving blood. The heart monitors the pressure and movements in the circulating blood through sensitive receptors in itself and within the vessels, and adjusts its beating accordingly. The heart stabilizes the blood flow and makes pressure waves that move all the way along the blood vessels.[1]

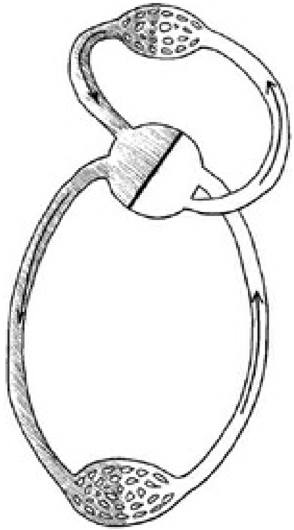


FIGURE 7.1. Schematic diagram of blood circulation

Arteries take blood coming from the heart at high pressure, expand with the resulting increased pressure, and then shrink back to encourage the movement of blood. Their anatomy reflects this: They are very strong and their walls are rich in elastic tissue. Their inner lining is special epithelial tissue, one cell thick, known as **endothelium**. They have a middle layer of muscle, with elastic fibers, and an outer tunic of supporting connective tissue. The inner endothelial lining must be kept in pristine condition to provide a completely smooth surfface for the blood to flow along. Any roughness to the vessel wall will initiate a clotting response. When fatty deposits build up in the walls of arteries, it creates roughness and therefore increases the chances of forming a dangerous clot. Like all epithelial tissue, the endothelial lining of the blood vessels is continually renewed and replaced. One of the things our bodies use for this is **flavonoids**, found in many fruits and vegetables, especially red colored ones—including grapes, bilberries, and blueberries among others. Flavonoids are known to be anti-inflammatory and protective against clot formation. They are probably used for repairing vessels; they prevent fat deposits from building up in the arteries of people with high cholesterol, and help to maintain good health of the veins.[2] Flavonoids have many other benefits—too many to list here.

It is proven that eating plenty of fruit and vegetables daily leads to significantly reduced risk of stroke.[*] This is probably in part due to their flavonoids, **vitamin C** content, and many other constituents. Some very interesting research connects low levels of heart disease with vitamin C; we need vitamin C to make **collagen**, so vitamin C is essential for the proper repair and maintenance of our arteries, as well as any other tissue that contains collagen. (Collagen is found in the skin, bones, teeth, gums, tendons, and ligaments, and gives strength and elasticity to the blood vessel walls. Even the plasma of the blood is a form of collagen—which is more or less everywhere.)

Damage to the inner lining is what initiates the laying down of fatty deposits—called **plaque**—on the artery walls. This is the condition known as **atheroma** and is a major cause of high blood pressure, heart disease, and therefore death in the Western world. Conventional wisdom has it that having too much **cholesterol** in the arteries clogs up the vessels; hence the now enormously widespread use of **statins**, drugs that lower blood cholesterol. But if it were simply a case of this, why is it the large vessels near the heart clog up with fat, not the smaller ones? Here's why: The large vessels near the heart get the most wear and tear, therefore are the most in need of repair. The body is more than capable of carrying out this repair efficiently; it is an expected part of our normal functioning. However, our ability to repair blood vessels relies on us being able to make as much collagen as we need. If we cannot make good quality collagen, it looks like the body tries to repair itself with fat instead.** It has also been suggested that atheroma may be protective against very low vitamin C intake. For example, Eskimo populations have atheroma in winter when no vitamin C is available to them; the atheroma disappears in spring and summer as intake resumes. Researchers presume this may be protective against vascular bleeding.

We humans are the only animals apart from guinea pigs that cannot make our own vitamin C—we must eat it daily to meet our needs. Vitamin C is highest in very fresh fruits and vegetables; if you boil your veggies and don't drink the water, you won't be getting the vitamin C, but throwing it away with the water. We need a very large amount of vitamin C daily. The **recommended daily amount**, or **RDA**, is absurdly low at 70 mg. If you don't have this much you develop the symptoms of scurvy within a few months and die soon after. Many people today have low blood levels of vitamin C.* There is research that shows that people who supplement their diets with high levels of vitamin C have significantly less risk of stroke; those with the highest blood levels of vitamin C were found over nine years to be forty-two percent less likely to have a stroke.**

Why, you might wonder, is vitamin C not the preferred treatment over statin drugs to prevent heart disease? If you consider that the pharmaceutical companies, which are the richest companies in the world (they own the oil companies), put up most of the money for research, and combine this fact with the fact that vitamin C is not patentable and is very cheap to make, you can draw your own conclusions. Or is this an unfairly cynical view? Actually, it doesn't do your heart any good to get too wound up about this. On the subject of heart disease, one free and fun thing you can do to help yourself is to laugh; one study found that the blood supply to the heart is increased by an average of twenty-two percent after a good laugh! More on this later.

The Walls of the Arteries and Blood Pressure

The arteries have a middle layer of smooth muscle tissue, which is thick and strong, and contains elastic fibers. An artery will retain its shape when cut. The elastic fibers allow it to be stretched when new blood enters it with each heartbeat, then to recoil again, which helps to keep the blood moving along. As we age, particularly if we have poor eating habits, smoke, and lead a sedentary lifestyle, the vessels lose this elasticity and become hard. You can understand how, without this elasticity, the blood pressure goes up. The artery cannot stretch as the new blood enters it with the heartbeat, so the pressure rises. The heart muscle must then work harder to pump blood into the arteries against the increased pressure and so becomes overworked. This is how high blood pressure leads to heart disease. Since roughly one-third of all people in the UK and the US will die from cardiovascular disease, keeping this system in good shape is obviously important for achieving a long and full life.

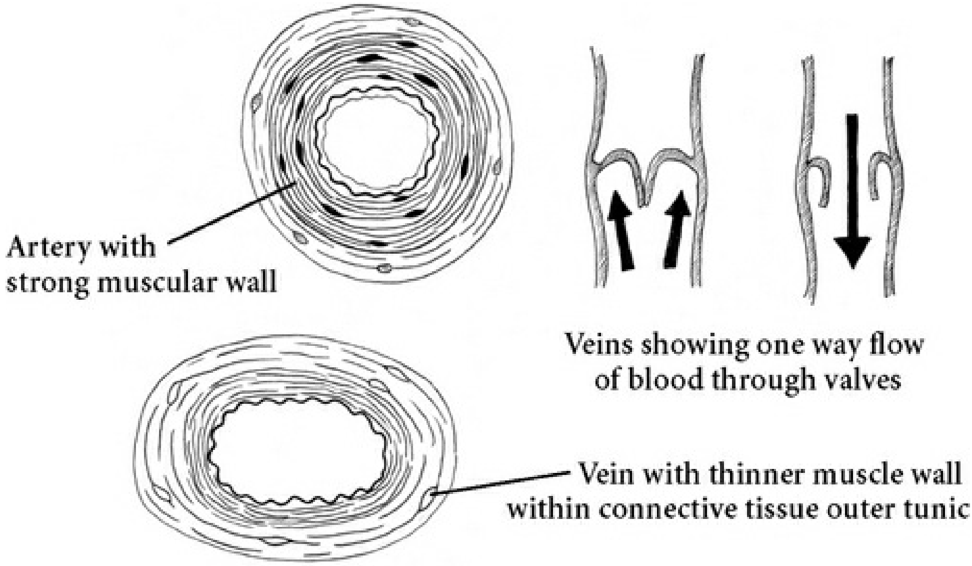


FIGURE 7.2. Blood vessels

Capillaries

We mentioned that small arteries are called arterioles. From the smallest arterioles, capillary beds emerge. **Capillaries** are the smallest of all the blood vessels. They have lost the two outer layers of the arteries, being made simply of a layer of **endothelium**—flat epithelial cells. Capillaries are the only part of the circulation where things can get out of the bloodstream and into the tissue fluid, and therefore into the cells. Most cells in a capillary wall are pretty tightly joined together. There is just a small gap at the junctions between cells to allow some water and solutes to enter and leave. These gaps get bigger when the capillary dilates, making it more permeable. Some capillaries are naturally permeable, having actual pores in their walls. These are found in the gut, where the capillaries receive absorbed nutrients, and the kidneys, which are continually filtering the blood. Then there are capillaries called **sinusoids** in places like the liver—these are particularly leaky, allowing the liver cells free access to all the contents of the blood.

Blood flow into capillary beds can be controlled; the arteriole entering a particular capillary network can shut off the blood supply by contracting a smooth muscle sphincter at the entrance. Thus we can route blood here or there in the body as needed. Blood flow throughout the entire body is also regulated. For example, after eating it's not uncommon to feel sleepy as the blood is routed to your gut and therefore away from your head. When we exercise, blood is routed to the skeletal muscles. This is why it's not such a good idea to exercise right after eating—the muscles have less access to good oxygen-containing blood, so cramping is more likely (if you are swimming and get cramps, the worst-case scenario is you could drown). This kind of overall control is mostly mediated by the nervous and endocrine systems working together. There are also local control mechanisms.

Venules and Veins

Just as capillaries branch out from arterioles, so they later converge and join up to form **venules**—the smallest of the veins. They have a different structure to arterioles because the pressure in them is much lower—the blood pressure gets kind of used up in the capillaries, so venous pressure is next to nothing. The walls of venules and veins, while having the same three layers as the arteries, are much thinner; the middle muscle layer is smaller. Veins also have an ingenious adaptation—they are equipped with **one-way valves**, which open to allow blood to move through toward the heart, then close if the blood tries to go the wrong way. The blood is carried through the venules and veins to return to the heart.

This **venous return** depends on the blood entering the venules from capillary beds and pushing the blood in front of it along, plus a kind of suction at the other end as blood enters the chest cavity on its way to the heart. As we breathe, the pressure changes in the chest help to move the venous blood into the heart—one way in which deep breathing is cleansing. Venous blood is also helped to move by the contraction of skeletal muscles. The deep veins are surrounded by muscles, and as these muscles contract they push on the veins. The valves allow the blood to move in one direction only—toward the heart. So exercise and physical movement are important for keeping the venous return going. People in jobs that involve a lot of standing but not much walking are most prone to getting venous problems like **varicose veins** (caused by incompetent valves). Standing still for long periods means there is no muscle movement in the calves and legs to help venous return, so the movement of blood slows down. When blood pools in the veins, due to standing in one spot for instance, it puts more pressure on the thin-walled veins. If the veins are in poor shape this can stretch the walls and cause the valves to become incompetent. Familial tendencies and habits issues such as poor nutrition, smoking, and sedentary lifestyle are contributing factors to this condition.

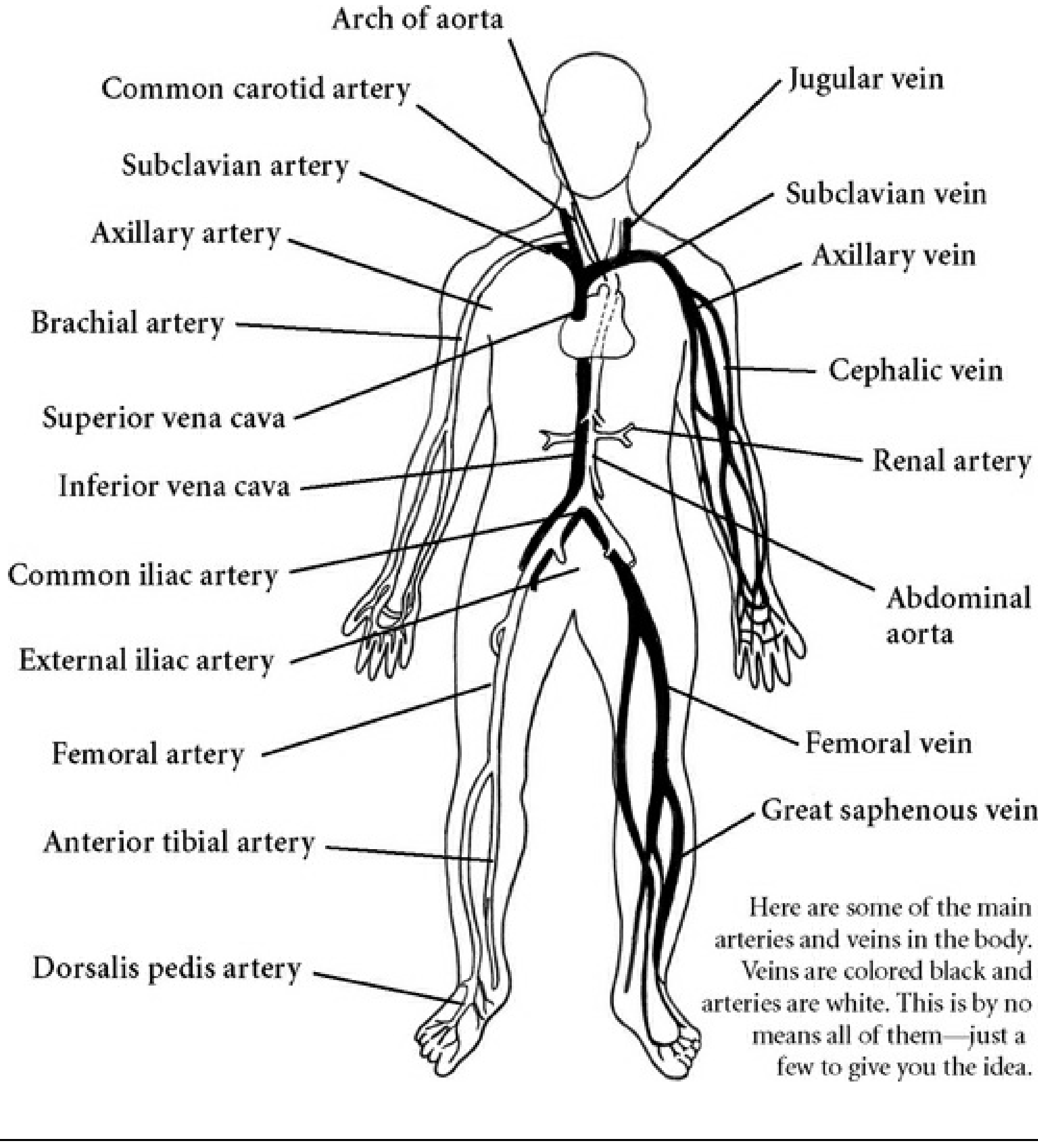


FIGURE 7.3. Position of main arteries and veins

Like arteries, veins need to be repaired and kept in good shape. For this, the body needs plenty of vitamin C to keep collagen production going. There are also many plant medicines that help the health of the veins. (Perhaps the best ones are the remarkable yarrow and the much-loved conker—not the spiky case, which is poisonous, but the nut inside—and bark of the horse chestnut tree.)

The Supreme Controller—The Heart

Found in the chest, between the lungs, being about the size of your fist, the heart is usually described as a hollow muscular organ comprising four chambers, being completely separate on the left and right sides.

When the anatomy of the heart was first being mapped and it was found that the heart is divided into two, this caused outrage among some physicians—to say that the heart was divided was heresy. It was a fork in the road, between the traditional "vital forces" view and the emerging "body-as-machine" paradigm.[3] In the past, the British system of medicine, in common with Chinese and Indian systems, saw the heart as the "Supreme Controller"—the place of one-ness, the place of self, or God within, the place where we connect with the Divine. Such a place can only be whole, never divided. It's a mistake to see the upset of these healers—which included the famous herbalist Culpepper—as evidence of their holding a primitive and ignorant view. Perhaps they could foresee the terrible division of heart and mind that the worst excesses of Western science displays, with its resulting disconnection of people from self, from each other, from rational treatment of the planet that sustains us, from Source.

Interestingly, new work on cellular memories, in particular with regard to the heart, is emerging. It seems that sometimes when a person receives the heart of a donor, he or she also acquires some of the feelings, memories, and preferences of that donor. In one case, the circumstances of the violent death of the donor were played on the memory screen of the recipient; in other cases, names of the donor and the donor's family were remembered.[4] It seems that the heart is indeed much more than a hollow, muscular pump. More on this later.

Having said that, the textbook definition of the heart is a hollow, muscular pump, completely divided into two halves by a muscular wall known as the **septum**. Each side is further divided into two by a one-way **valve**, leading from the smaller entrance halls—the right and left **atria**—to the larger and stronger **ventricles**. The valves are cusped, and the cusps are anchored to the wall of the heart by tough strings (those strings that can famously be pulled on by love perhaps?). Large veins enter the atria: On the right, the **inferior vena cava** brings deoxygenated blood to the heart from the lower part of the body, and the **superior vena cava** does the same for the head and upper body.

The blood is pumped into the right ventricle by the first part of the heartbeat or contraction—known as **atrial systole**. Immediately after this, the ventricle contracts—**ventricular systole**—and the blood enters the **pulmonary artery**. This leaves the right ventricle and immediately divides into a left and right branch, taking blood to the lungs. After this, the heart relaxes as it fills with more blood during **complete cardiac diastole**. In the **pulmonary capillaries** the blood lets go of its carbon dioxide and collects oxygen, and then this oxygenated blood returns to the left side of the heart. Four **pulmonary veins** enter the left atrium, two from the right and two from the left. The oxygenated blood is pumped into the left ventricle by atrial systole (at the same time as blood is pumped from the right atria and the right ventricle), and from the left ventricle into the largest artery in the body, the **aorta**.

The aorta and its branches carry oxygenated blood to the cells of the body. The blood spirals through the body making a kind of symbolic figure eight (the infinity symbol) with the heart at the center. Actually, the blood vessels expand and contract as the blood passes through them, and without this pulse wave the blood could not travel through the circulatory system. However efficient the heart is, without the blood having its own momentum and being helped along by the arteries and veins, the heart would not be strong enough to force blood all the way along. As I said earlier, through studying chicken embryos scientists have learned that in fact the blood begins to circulate even before the heart develops, traveling along a figure-eight path like a vortex, a hurricane, through the vessels. When the heart forms it begins to beat in time with this movement.[5]

The right side of the heart contains blood without oxygen and the left side carries blood with oxygen. These two sides must be kept separate; otherwise, deoxygenated blood gets into the left ventricle and is pumped round the body, as happens when there is a "hole in the heart." Not only is this inefficient; it also means that not enough oxygen is available to the cells of the body, causing fatigue and blueness. A developing fetus does not rely on its own breathing for oxygen, instead receiving oxygenated blood from the mother via the placenta. Our heart is present and beating from a few weeks after conception, but the septum is not fully formed until quite late in the pregnancy. Sometimes there is still a hole in the septum when a person is born—the baby may be blue. However, it can happen that a small hole will close over as the septum continues to grow and form after birth. With medium and large holes, more blood crosses the septum and the hole does not close on its own. Then the baby needs an operation to close the hole.

The entire heart is enclosed in a protective connective tissue sac called the **pericardium**. The outer layer of pericardium is loose-fitting, tough, and fibrous, and is attached to surrounding tissues—the diaphragm below and the great blood vessels above. Inside this is a **serous** membrane, the top layer being attached to the fibrous pericardium, and the deeper layer to the heart muscle. Between these two layers is found slippery serous fluid, which allows the membranes to smoothly glide over each other as the heart beats. The pericardium protects the heart and anchors it in position in the chest.

As you may recall, serous membranes contain a layer of epithelial cells resting on a loose connective tissue base. The epithelial cells secrete the fluid. They are found in the heart (the pericardium), the lungs (the pleura), and the gut (the peritoneum).

Our heart is amazing. It starts to beat, as mentioned, within weeks of conception, and continues to beat, on and on, until the time of our death. The only rest the cardiac muscle gets is a fraction of a second between each heartbeat. The heart muscle is highly specialized to allow it to work in this continual fashion. It also has another amazing modification: an "intrinsic" rhythm. A collection of special cells in the right atrium, known as the **sino-atrial node**, or colloquially as the pacemaker, continually and regularly initiates contraction. The contraction spreads out from here to the left atrium, and the two atria contract together. The contraction is then relayed to the ventricles and a moment later these contract. This happens over and over throughout life. The cells in the heart *want* to beat in concert—one cell alone doesn't quite know what to do, but two cells or more will keep a regular beat, and beat in time with each other.[6]

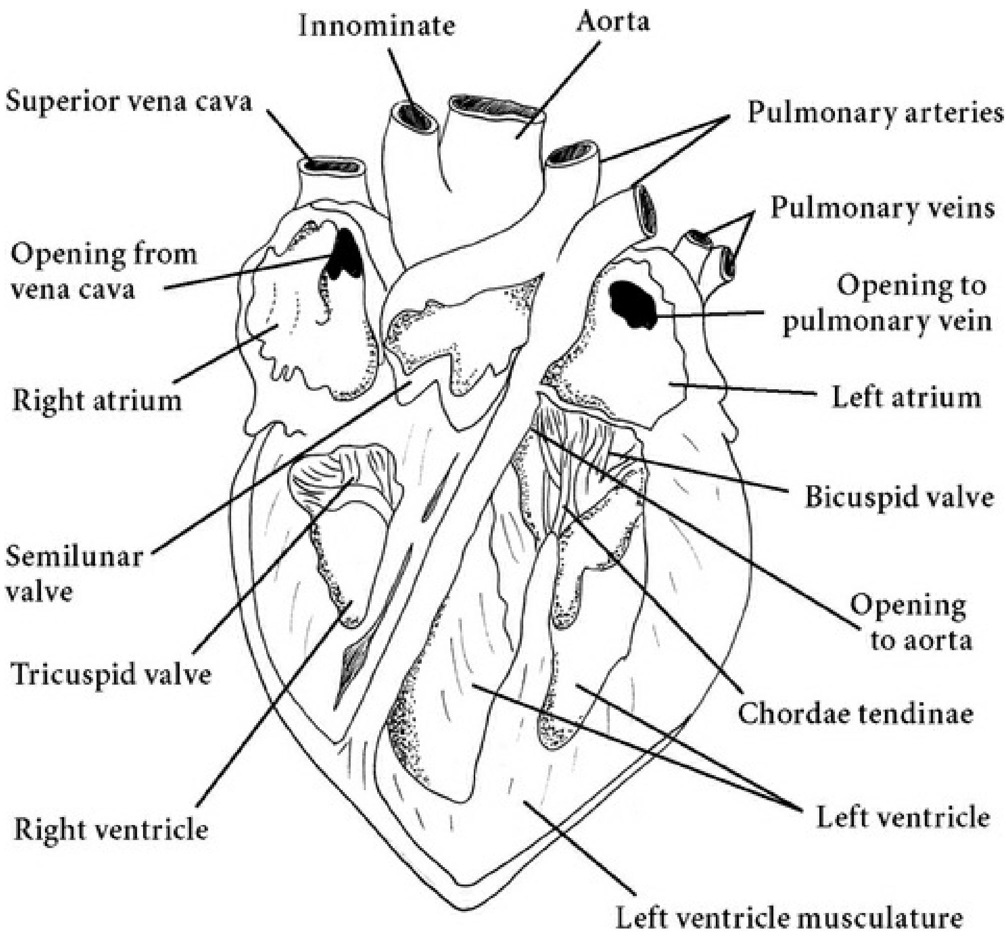


FIGURE 7.4. The heart

If you took the heart out of a body and put it in a bowl full of sugared and oxygenated water, it would continue to beat even though completely separated from the body. In fact, the intrinsic beat of the heart is faster than our normal resting heartbeat; nerves come from the central nervous system and tell it to either speed up (sympathetic nerves), or slow down (parasympathetic nerves). Sometimes people have an artificial pacemaker fitted; this small machine regularly emits an electrical pulse to initiate heart contraction. You can feel the pacemaker just under the skin; it's the shape and size of a largish watch face.

In traditional Chinese medicine, the Heart Official was called the Emperor, or the Supreme Controller, and had the role of sitting in the temple, in prayerful contemplation and connection with the Divine, to steer our lives in accordance with Divine Will. Our lives have a purpose, which we follow as part of the Divine plan, and it is the Supreme Controller, our heart, that keeps us on track. You may be as delighted as I am to learn that recent research actually backs up this view: As well as the cellular memory already mentioned, it seems the heart acts as the "largest brain in the body."

From *The Intention Experiment* by Lynne McTaggart:

> McCraty discovered that (these) forebodings of good and bad news were felt in both the heart and the brain, whose electromagnetic waves would speed up or slow down just before a disturbing or tranquil picture was shown [at random times to people in the experiment].... Most astonishing of all, the heart appeared to receive this information moments before the brain did. This suggested that the body has certain perceptual apparatus that enables it continually to scan and intuit the future, but that the heart may contain the largest antenna. After the heart receives this information, it conveys it to the brain. McCraty's conclusion—that the heart is the largest "brain" of the body—has now gained credibility after research findings by Dr. John Andrew Armour at the University of Montreal and the Hospital du Sacre-Coeur in Montreal.

Armour discovered neurotransmitters in the heart that signal and influence aspects of higher thought in the brain.[7]

Spiritual traditions the world over describe this by saying it's not the brain (the ego) that is making the decisions; we are moved by Spirit, Consciousness, All-That-Is, God, before the brain gets involved.

In truth, the heart is so much more than a mechanical pump. It is an endocrine gland in its own right, producing at least five important hormones (so far discovered). Hormones from the heart include **atrial natriuretic factor** (or peptide) known as ANF, and **brain natriuretic factor** (or peptide) known as BNF, which are made in the ventricles. BNF is activated when we are under stress, leading to protection of the brain from damaging stress chemicals. ANF release is linked to blood pressure. It is a hormone that affects the blood vessels, lymphatic system, brain, kidneys, adrenal glands, pituitary gland, pineal gland, lungs, liver, eyes, and small intestine, as well as reproductive function—in other words, pretty much everything. In addition to this endocrine function and heart-brain aspect, the heart is central in generating the electromagnetic field around our bodies, which allows not only communication within the body, but with all other electromagnetic fields outside.[8]

More about Capillaries

This seems a good place to take a closer look at the tube stations themselves in our underground map of the circulatory system—the capillary beds where fluid, full of nutrients, *leaves* the circulation, and fluid and waste products *enter*.

Imagine a wave coming up on the beach. Picture it whoosh up the sand, linger a moment, then retreat back into the sea. It takes with it all sorts of debris: sand, pebbles, driftwood, seaweed. What happens in our tissues, where the capillaries meet the cells, is a bit like this.

As the heart beats, a pulse wave travels along the arteries, pushing the blood along with it. As this wave of fresh blood enters the capillary bed, the pressure in the vessels forces a wave of water and small solutes (those small enough to pass through the pores of the capillary) to leave the blood circulation and enter what is called the **interstitial space**, which is always filled with fluid. (Interstitial fluid is also sometimes called tissue fluid, or extracellular fluid. It is basically similar to plasma, but without the large plasma proteins such as albumin.) Large things, like the rigid red blood cells and the big, globular **plasma proteins** (which include albumin), must stay in the capillary as they are too big to fit through the pores between the cells. Oxygen, glucose, amino acids, fatty acids, vitamins, minerals, hormones, and so on can all freely leave. Also, white blood cells can leave; though they are big, they can move like amoebae, and squeeze through a tight space. The tissue fluid surrounds cells, which exchange their waste products for nutrients from it.

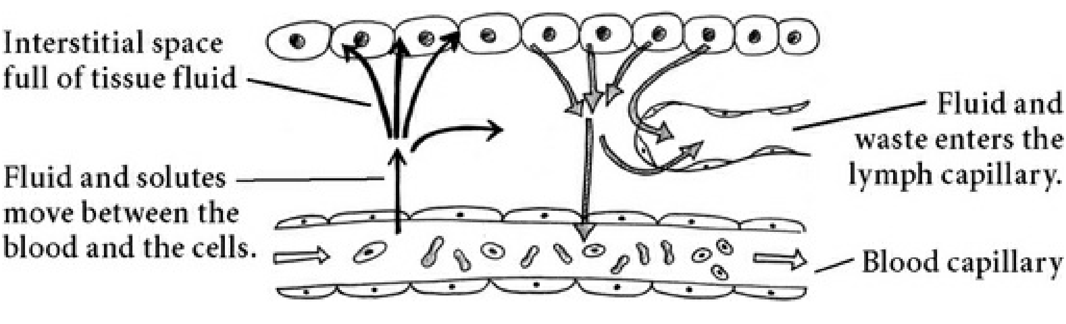


FIGURE 7.5. Capillaries and interstitial space

Toward the end of the capillary bed, as the capillaries are joining up again, something interesting happens. Because the large plasma proteins stayed in the blood, they exert an **osmotic pressure** on the tissue fluid, which pulls water into the capillaries. With the water comes carbon dioxide and the other waste products of the cell. (Remember your chemistry. Fluids like to be equal in strength. The blood is now "stronger" because of the plasma proteins, so it tries to dilute itself by pulling tissue fluid back across the semipermeable membrane of the capillary wall.) Interruption of the supply or amount of plasma proteins in the blood can therefore cause **edema** (water retention or swelling) in the interstitial spaces. For example, a kidney disease, in which the kidneys are allowing protein to leave the blood, or starvation, in which a lack of protein is available, both mean that water will stay in the tissues and not get pulled back into the blood.

Blood Pressure

When your blood pressure is measured, two figures are obtained: the **systolic pressure**, which is higher and noted first (in front of the slash), and the **diastolic pressure**, which is lower and noted second.

The systolic pressure is the highest pressure in the main arteries just after the heart has contracted and pushed more blood into them. The diastolic pressure is the resting pressure, or the lowest pressure in the arteries before systole causes it to rise again.

The common way the blood pressure is taken is with a **sphygmomanometer**. An inflatable cuff is wrapped around the arm and pumped to a pressure greater than the pressure in the arteries. The thorough way of doing this is to first inflate the cuff while taking the pulse, until the pulse disappears. Then go above this, twenty to thirty mmHg. (Blood pressure is measured in mmHg—millimeters of mercury—because old-fashioned sphygmomanometers calculated pressure using a column of mercury.) If a stethoscope is placed over the brachial artery, and the pressure in the cuff slowly let down, when the pressure in the cuff equals the pressure in the artery, some blood can again move through the artery, and this is heard as a pulse—dff, dff, dff, and so on. When the pressure in the cuff equals the lowest pressure in the artery, there is no longer any resistance to the blood pumping through, therefore the pulsing sounds cease. The two figures for blood pressure are the place where the pulsing sound started, and the place where it stops.

High blood pressure is usually symptomless, but you might feel a pounding or tightness in your head, or suffer from a headache in the morning (most people have to have extremely high blood pressure to have the headache). High blood pressure is now judged to be a systolic above 140 and a diastolic above 90. These figures are getting lower and lower —in the 1980s they were 100 plus your age for the systolic and above 100 for the diastolic. There is evidence that treating a person with a sustained diastolic pressure of more than 105 mmHg with drugs reduces their chance of having a stroke. However, for those with mild to moderate hypertension, a study in the 1980s by the Medical Research Council Trial showed that if 850 people are treated with antihypertensive

drugs, either diuretic bendrofluazide or beta-blocker propanolol, about one stroke will be prevented in a year.*
Common side effects for these drugs include gout, diabetes, and impotence. Considering this and the yet unknown long-term environmental impact of pharmaceutical pollution, the wisdom of the trend to increase the numbers of people on these drugs is questionable.

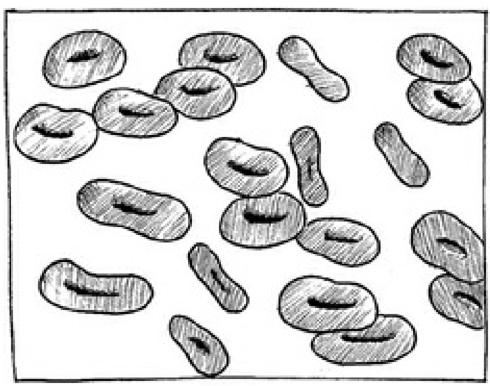
An interesting complication is that it gets more likely that hypertension is misdiagnosed with advancing age. As the arteries harden, they give more resistance to the cuff and therefore produce a false high reading. A study in 1985 showed that half of people over 65 showed a blood pressure of average 16 mmHg lower when measured directly in the artery as compared with a sphygmomanometer.**

Then there is low blood pressure, which is not acknowledged as a disease in conventional medicine in the UK, other than extreme low pressure in response to physiological shock and large loss of blood. In other European countries, such as Germany, and in the United States, lower than normal blood pressure is recognized as a problem. The person may experience dizziness and a lack of energy and ability to concentrate. People may suffer from this if they have low adrenaline output or inappropriate salt loss, for example.

Blood

Blood has always had huge significance for people. It is the river of life, a magical liquid containing the life force. In Chinese medicine the *Qi* (or vital force, sometimes spelled chi and pronounced chee) is thought to follow the blood in its journey around the body. Even Western orthodox medicine recognizes its importance, studying it more than any other tissue. Blood is considered to be a tissue—the only one in the body that is permanently in fluid form. It is made up of many components. Broadly separated into the liquid part, plasma (which is pretty similar to tissue fluid with the important addition of plasma proteins*), and cells. The blood cell types are red cells, white cells, and platelets. Red cells carry oxygen, white cells are a cross between the army and the cleaners, and platelets do clotting.

Red Blood Cells



Red cells, or **erythrocytes**, comprise about forty-five percent of the blood volume. This percentage is called the hematocrit. The norm for men ranges from forty-two to fifty-two percent; for women, thirty-seven to forty-seven percent. Red blood cells are small biconcave, flattened disks—they look like donuts under the microscope. They are made in the red bone marrow (like all blood cells), but by the time they are mature and released into the blood their nucleus has degenerated and completely disappeared. Their shape is maintained by special internal protein structures, which makes them flexible enough to squeeze through small capillaries, always returning to their donut shape. As they age, they lose this flexibility, and after about 120 days they pop when passing through a small vessel. They contain hemoglobin, and very little else. Hemoglobin is a globular protein bound to four molecules of a red pigment, called haem. Each ring-shaped haem carries an atom of iron set in its center like a jewel. It is these iron molecules that like to bind, reversibly, to oxygen. There are about 250 million hemoglobin molecules in just one red blood cell, so each one can carry around a billion oxygen molecules.

FIGURE 7.6. Red blood cells

In the lungs, the blood in the pulmonary capillaries is deoxygenated before it reaches contact with the air sacs, or alveoli. As soon as oxygen diffuses into the blood from the lungs, the **deoxyhemoglobin** grabs it. The blood becomes ruby red. In the tissues, which are asking for oxygen, the process is reversed and **oxyhemoglobin** gives up its oxygen molecules, giving it a purple-red color. Carbon dioxide is transported mainly freely in the blood, although some of it hitches a ride with the globin part of hemoglobin.

The body keeps the number of red blood cells amazingly constant. A hormone (erythropoietin) stimulates their development, and is made mainly in the kidneys (a little in the liver). More of the hormone is released when available oxygen in the kidney tissues decreases. Thus low tissue oxygen stimulates the kidneys, which in turn stimulate the bone marrow.* Because of this mechanism people whose kidneys have failed cannot make enough red blood cells for demand, resulting in anemia.

Anemia is one of the most common conditions causing tiredness. It is a condition in which there is an abnormally low oxygen-carrying capacity in the blood. Having too few red blood cells, cells with too little hemoglobin in them, or cells that are not working properly can cause it. When you are anemic, you feel tired, breathless, and dizzy; you look pale and may be cold. If you feel your energy levels are lower than normal, or lower than they should be, suspect iron deficiency anemia, as it is very common.

Iron is lost from the body in feces, urine, and sweat—0.9 mg daily in men, and 1.7 mg in women (the extra being due to menstruation). So a woman's daily iron requirement is nearly double that of a man.

As well as iron, vitamin B12 is needed to make hemoglobin. Vegetarians need to be particularly aware of this (animal flesh is full of B12, so it is not usually an issue for meat eaters). A favorite way to get it is from yeast extract (Marmite).

Some types of anemia are genetic in origin and result in poorly formed red blood cells. One example is sickle cell disease. The cells are sickle-shaped instead of round, and are less robust—they break more easily. This disease is more common in Africa, among people of African descent, and in places where malaria is common. The sickle cell gene gives protection against malaria.

White Blood Cells

White blood cells, or **leucocytes**, are the only things in the blood that still look like normal cells, having a nucleus and all the usual organelles. They are less than one percent of the blood volume—the white blood count is usually between 4,800 and 10,800 per mm^3 (cubic millimeter) of blood.

White blood cells are the defenders and the cleaner-uppers. They defend us against foreign invaders like bacteria, viruses, and parasites. They clean up toxins and dead or diseased tissues—including cancerous cells. They can move like amoebas and get out of the capillaries into the tissue fluid. We will look at these interesting white blood cells in more detail in the chapter on the immune system.

Blood Platelets

Platelets, or **thrombocytes**, are not really cells, though they are classed as part of the cellular component of blood. They are fragments of a very large cell called a **megakaryocyte**. Basically a bag of chemicals involved in blood clotting, they can become very sticky, to plug up a hole in a damaged vessel wall. They circulate freely but are usually inhibited from action by chemicals secreted by the blood vessel endothelial lining cells.

Clotting involves a complicated cascade of chemical reactions by proteins and enzymes that normally circulate in the plasma. Platelets are triggered to action by any rupture or lack of smoothness in the blood vessel wall or lining. When there is damage, the vessel spasms to slow blood flow through it, then the platelets get sticky and form a platelet plug, and then **coagulation** happens—chemical reactions cause the blood to change from liquid to gel form.

The two things that can go wrong with clotting are bleeding disorders like hemophilia (when the blood cannot clot) or clotting disorders (when abnormal clots are formed with potentially fatal results). If the blood fails to clot, a person can bleed to death even from the most trivial of wounds. If a clot forms abnormally, in a deep vein of the leg, for instance (known as **deep vein thrombosis**, or DVT), some of the clot can break away and travel in the blood stream until it reaches a tiny vessel where it gets stuck. This might happen with dire results in the brain or the lungs. If a clot blocks a blood vessel, all the tissues that depend on that vessel for oxygen die very soon. In the brain this tissue death causes what we call a **stroke**. In the lungs it is known as **pulmonary embolism**.

Blood Types

Like all of our body's cells, the membranes of red blood cells contain marker proteins. Some people's blood will be recognized as foreign by our immune system and some will not, depending on the similarity of our marker proteins. This is translated into what are called blood types or groups. The types are related to the kind of protein markers people have on the membranes of their red blood cells; the markers are known as **antigens**, which refers to their effect on the immune system. You can read the immune system chapter to get this in more detail, but in a nutshell, the antigens are small protein markers that the immune system would recognize as foreign and thus worthy of attacking if the antigens are the wrong kind. The B-cells of your immune system make **antibodies** against any antigen they consider to be unwelcome or dangerous.

Generally there are AB, A, B, and O, and Rhesus types.

Rhesus negative type O blood has the least proteins. People with blood type A have A *antigens* on the surface of their red blood cells and anti-B *antibodies* in their plasma. People with type B have B antigens in the cells and anti-A antibodies in the plasma. Type O blood has no antigens (so can be given to any group), but has both anti-A and anti-B antibodies, so can only receive group O blood safely. O is the most common blood type in the world. People with AB blood have A and B antigens in their cells but no antibodies in the plasma; otherwise, their blood would destroy itself.

Diet and Blood Types

An interesting nutritional idea has been put forward by Peter D'Adamo about blood types or groups. The theory is based on the widely accepted notion that we have evolved from hunter-gatherers; some of us have nomadic herders as ancestors, some have agriculturists. D'Adamo's premise is that type O group members are hunter-gatherers and get on well with meat and vegetables but not so well with dairy. Group A are the agricultural types and like wheat and grains but are not as good with meat and dairy—a good vegan diet is most suitable for type As. The herders or nomads have group B; they have a digestive system that can tolerate all kinds of foods, being the only group who are completely fine with dairy. Group AB is the most recently evolved group, and in terms of diet, D'Adamo recommends one between A and B. He suggests that the different blood groups react differently to compounds called **lectins** in foods.

Many dieticians, nutritional scientists, and doctors say this has no scientific basis. They argue that D'Adamo's hypothesis is based on research by various scientists, with various bits of science gleaned to support his idea, but none of the research completely supports his hypothesis. Also, no clinical trials comparing this to other regimes have been carried out. Apparently, D'Adamo has mentioned trials, but not published any results.

My own experience of diet is that in practice there is no one-size-fits-all food plan. Trial and error are often involved in figuring out a good diet—but it has to be said that a basic whole-food diet with lots of fresh vegetables, fruit, grains, pulses (such as lentils), and fish, with no preservatives, additives, or other toxins, goes a long way to improving most people's health. D'Adamo's blood group diet has clearly helped many people. While there is no clinical research trial showing the blood-group diet's efficacy, there is plenty of anecdotal evidence. That is completely inadmissible in the view of science, but reason enough to encourage someone to try it. If it works for you, that's good—not all useful healing methods have been, or can be, proven in conventional scientific terms.

Investigating Blood

The viscosity of blood is thought to depend largely on the number of red blood cells—too many, and the blood thickens. Conventional blood tests mostly involve looking at blood that is dead—and colored with dyes that may alter its natural appearance. There is a science of looking at living blood under the microscope, using **darkfield microscopy**, which makes it possible to look at living blood and see changes that come about from illness. Interestingly, the 1930s, when it was being developed,* were before the days of processed foods, organophosphate weedkillers, artificial fertilizers, and microwaves. At that time peoples' blood tended to look either well or ill when they had a disease. Nowadays it is apparently rare to find blood that looks healthy. This could well be a physical way of identifying changes in the physiology that indicate a disease process in the making—making it much easier to treat now instead of waiting until something very serious and nasty has turned up in the tissues. People who have their blood looked at in this way can be motivated to then go on a good detoxification program and clean up their diet and lifestyle; after doing this, the blood is reexamined and looks better.

I find this particularly interesting because it is a very physical way of doing what pulse and tongue diagnosis* does—revealing an imbalance even when no **organic disease** can be found by current Western diagnostic tests. Also it is a powerful way to show the surprisingly damaging effects of the modern Western way, full of toxins as it is.

Heart Disease

Cardiovascular disease is the number one cause of death in the United States, as well as in Britain, with one in three people dying from heart attacks, strokes, or heart failure. The medical name for a heart attack, myocardial infarction, tells you what happens—part of the myocardium, the heart muscle, dies. This happens due to that part having its oxygen supply cut off, for example, by a narrowed vessel that can no longer supply the heart's needs.

As you know, muscular tissue is not easily replaceable, so the heart does not habitually grow new muscle, replacing the dead cells instead with scar tissue. Without a well-functioning heart, we cannot live long. So if a heart attack affects a large area of the heart muscle, or destroys an important area of the heart (say, stopping a valve from working properly), a person may die. A smaller heart attack will often leave the heart weaker and vulnerable to further problems.

Risk factors for heart disease include certain diets and lifestyle, which lead to the arteries being in poor shape. This includes a diet with too much of the wrong sort of fats,** too little essential fatty acids, and/or not enough fresh vegetables, as well as smoking and alcohol consumption. Anything that raises the blood pressure is a risk—smoking, being overweight, excess salt, stress, and even stored emotional tension from undischarged emotional pain.

A Note about Salt

The excessive salt in convenience foods is definitely a cause of high blood pressure. Many people are unaware of this fact, especially because the salt manufacturers and fast-food industry go to great pains to suppress and deny it. The tactics over salt are much the same as those used by sugar manufacturers and sugary-food makers.*

It is not just the fact that there is lots of salt in convenience foods. The salt used is also refined salt, which is pure sodium chloride. Natural salt like sea salt is rich in other minerals too. The main problem is eating a highly processed diet that is lacking in vegetables and fruit and full of salt as well as monosodium glutamate and other additives. Salt is essential to the body. If something has gone wrong and the body is losing salt unchecked, it leads to death. If we are eating a natural diet, and not confusing our palate with highly processed artificial flavors, we can more easily trust our instincts to tell us when we need salt or not.

In Finland a salt called Pansalt was developed by Professor Heikki Karppanen of the Institute of Biomedicine, University of Helsinki, to help combat heart disease. Pansalt is now used widely in the country—including in McDonald's burger buns by order of the government! It contains low sodium, high magnesium and potassium, and added lysine to make it taste right. It actually leads to a lowering of blood pressure. Since its introduction, along with getting people to eat more vegetables, deaths from heart attacks, cardiovascular disease, and stroke have fallen by seventy-five percent in Finland.[9]

Drug Problems

The very drugs used to combat heart disease might well be causing it in a different way. In the US, Detroit researchers announced at the 2004 meeting of the American College of Cardiology that in their city the number of cases of heart failure nearly doubled because the cholesterol-lowering statin drugs given to everyone at risk of a heart condition not only suppress cholesterol production as they are designed to do (therefore decreasing fatty deposits in the arteries), but also interfere with the production of coenzyme Q10. CoQ10 deficiency causes wasting of the heart muscle, which has led to more heart failure.

Statin drugs can also damage the liver and kidneys and cause pain and wasting in muscle tissue. A CoQ10 deficiency can also come about from betablockers, some antihypertensive drugs, and antidiabetic drugs.

Looked at from the classical Chinese Five Element perspective, most heart attacks are due to the failure of the Heart Protector to do its job. The Heart Protector, called "the Official in Charge of the Pleasures of the People," protects the vulnerable and sensitive heart by means of ensuring we have lots of good fun and loving connections with others. Science beautifully confirmed this in March 2005, when cardiologist Michael Miller, researching at the University of Maryland School of Medicine in Baltimore, showed that laughter is linked to healthy function of blood vessels. Laughter increased the blood flow to the heart by twenty-two percent in ninety-five percent of people—similar to aerobic exercise. They got people to laugh by watching a funny film, and used ultrasound technology to measure changes in blood flow.[10] Apparently, Dr. Miller got the idea to do the research after observing that his heart patients seemed to be a very serious bunch who didn't laugh much! As well as having a good laugh, other things you can do to reduce your risk of heart disease include moderate regular exercise (like walking), losing weight if you are overweight, eating a Mediterranean-style diet, making sure you have plenty of folate and other B vitamins to lower homocysteine, consuming lots of antioxidant foods (containing vitamins A, C, and E), eating less salt and more magnesium, avoiding hydrogenated fats, and making sure you are not polluted by heavy metals.[11]

Heart Fire

In common with many spiritual traditions throughout the world, the Huichol people of northern Mexico have a special understanding of the importance of the heart, and the element of fire within the heart. The Huichols name this force Tatewari —Grandfather Fire. The fire of love, connection, laughter, transformation—Tatewari is the force in the universe that holds atoms and planets together, the force responsible for attracting us to each other. He is the originator of jokes, fun, and laughter, the keeper of stories. Tatewari's residence within us is the heart.*

Interrelationships

Every other system in the body relies on the **cardiovascular system** to bring needed oxygen and nutrients, and to take away carbon dioxide and waste. There is a particularly close relationship with the **respiratory system** for getting the oxygen into the blood and the carbon dioxide out. Also, pressure changes in the thorax aid the venous return of blood to the heart. The **lymphatic system** is sometimes seen as a part of the CVS; without it the venous system cannot keep up with fluid drainage. The **immune system** is all about white blood cells. The hormones of the **endocrine system** are carried in the blood, and the circulation and heart function are affected by many hormones—indeed, the heart itself makes hormones. The blood carries the products of **digestion**, and brings glucose and oxygen to the **muscles** and all other cells for energy production. Movement of skeletal muscles helps venous return. The **kidneys** filter the blood and keep it clean. Blood cells are made in **bone** marrow, and the blood brings oxygen and nutrients to the **skin**, hair, and nails.

*A philosophy called physicomedicalism was used by many herbalists in Britain in the nineteenth and twentieth centuries—and is still used by some today. An important part of this system involved diagnosing the state of the circulation and improving it, for example, with herbs to relax overtense arteries or tone overrelaxed veins. (See A. W. Priest and L. R. Priest, *Herbal Medication: A Clinical and Dispensary Handbook*.)

*Actually, deoxygenated blood is still red, just not as bright red as blood with oxygen in it. However, the convention of coloring it blue in diagrams makes life a whole lot easier. Veins may look blue from the outside, but that isn't because the blood is. If you chop someone up (don't try this at home!), not even the veins are blue—they just look blue through the skin because the optical properties of skin make the dark red, deoxygenated blood look blue.

*An intake of five to nine servings of vegetables and fruits daily is recommended, and the public should aim toward the higher intakes. *American Journal of Medicine*, January 2008.

**This is the theory of Linus Pauling and his associate Matthias Rath, both physicians. The Pauling therapy for atheroma, or fatty deposits in the arteries, is to take large doses of two substances: vitamin C and lysine.

*A 2004 study found that vitamin C depletion and deficiency are widespread, affecting one person in three. (See "Vitamin C Deficiency and Depletion in the United States: The Third National Health and Nutrition Examination Survey, 1988 to 1994," by Jeffrey S. Hampl, Christopher A. Taylor, and Carol S. Johnston. Doctors Hampl and Johnston are with the Department of Nutrition, Arizona State University, Mesa, and Dr. Taylor is with the Department of Nutritional Science, Oklahoma State University, Stillwater.)

See *American Journal of Medicine*, January 2008, on the relationship of vitamin C and risk of stroke. B vitamins (especially B6, B12, and folic acid) may also significantly reduce vascular disease, due to their lowering of blood **homocysteine, an amino acid acquired mostly from eating meat and considered a heart disease risk. See *Health Defense: How You Can Combine the Most Protective Nutrients from the World's Healthiest Diets to Slow Aging and Achieve Optimum Health* by Paul Clayton.

*The Research Council study was reported in the *British Medical Journal*, July 13,

1985. A huge meta-analysis in 2003 showed that none of the expensive modern drugs were any more effective at lowering blood pressure and saving lives than the older diuretics. (*Journal of American Medical Association*, 2003; 289:2534–2544.)

**Research by Dr. F. H. Messerli and others from the Ochsner Clinic in Louisiana, published in *New England Journal of Medicine*, June 13, 1985. (Taken from What Doctors Don't Tell You, *The Medical Desk Reference*).

*Plasma proteins are made in the liver. The most famous is albumin—the same as in egg whites.

*Interestingly, Chinese medicine has said for thousands of years that the bones come under the jurisdiction of the Kidney Official.

*Dr. Gunther Enderlein was one of the first pioneers in this field. Check out www.darkfieldmicroscopy, a good place to start for more information.

*Pulse and tongue diagnosis is used in Chinese medicine (and other systems) to determine underlying conditions affecting a person's health. Particular characteristics of the pulse or appearances of the tongue reveal particular kinds of problems.

**Many studies have shown saturated fats are bad, but these studies lumped saturated fats in with hydrogenated fats. It turns out that it is hydrogenated fats that are bad, while saturated fats may actually be protective.

*The Sugar Association in the United States and the Sugar Bureau in Britain have waged fierce campaigns against links between sugar and obesity and dental caries. Publication of a report from the World Health Organization on diet and chronic disease was delayed by representations from the sugar industry and forty ambassadors from sugar-producing countries who had been alerted by the industry. (BMJ 18 May 1996: 312:1239–1240.)

*Check out www.sacredfirecommunity.org to connect with people working with Tatewari.

CHAPTER 8

Drainage—The Lymphatic System

The lymphatic system is best thought of in two sections: drainage, which we will look at in this chapter, and cleaning up and defense, known as immunity, which we'll cover in the following chapter.

Commonly described as an adjunct to the venous system, the drainage part of the lymphatic system consists of a series of one-way tubes that start as tiny capillaries in the tissues and join up to form bigger and bigger vessels. These pass through lymph nodes, which clean and filter the fluid (known as lymph). Eventually, the lymph is emptied into the blood circulation at the subclavian veins (just below the clavicles).

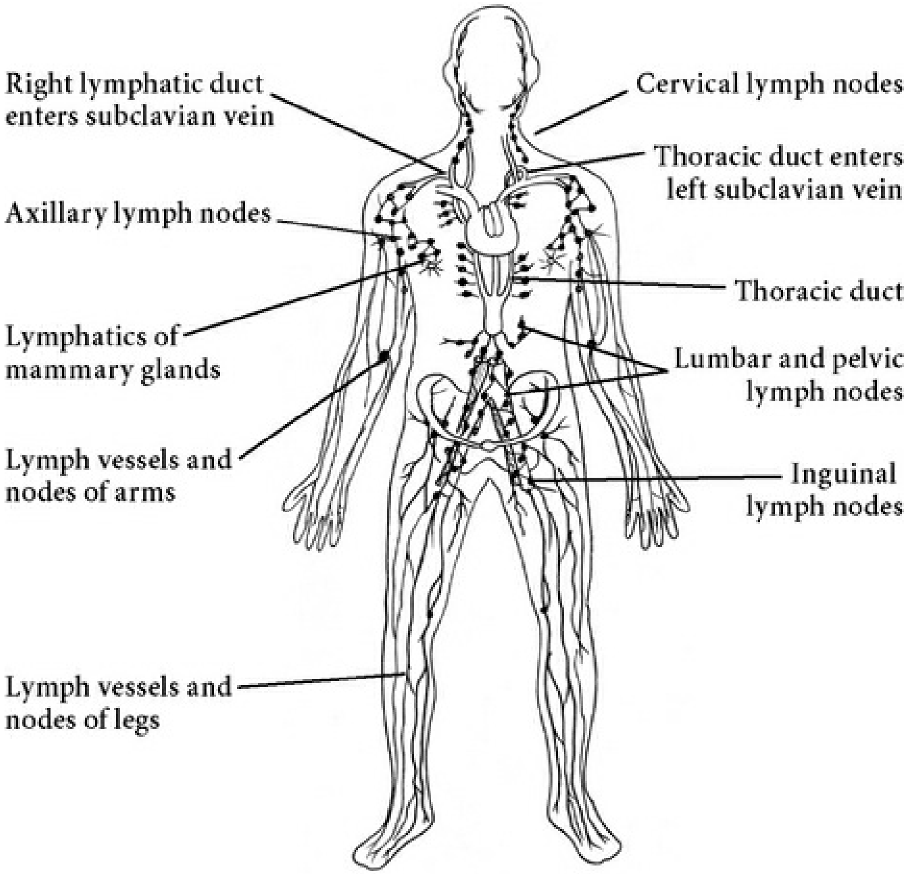


FIGURE 8.1. Lymph nodes and vessels

The **lymphatic capillaries** are similar to blood capillaries in structure, but are extremely permeable. They open up and allow large amounts of interstitial fluid, containing things that are too big to enter the blood capillaries, to flow into them. Once inside the lymph vessels the fluid is called **lymph**.

Lymph is very similar to tissue fluid. Proteins that are too big to enter the blood capillaries can get into the lymph. Also, if there has been any damage or inflammatory healing processes going on, the lymph capillaries become even more permeable so that debris can enter—pus, damaged or dead cells, bacteria or other pathogens (disease-causing organisms), and cancerous cells. Basically, the lymphatic system protects the body by making sure the lymph nodes filter out harmful stuff before returning the fluid to the blood.

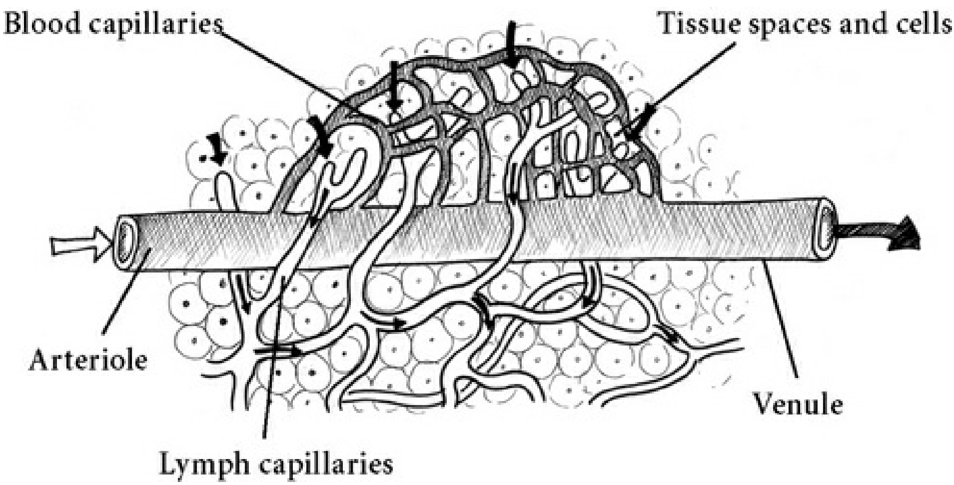


FIGURE 8.2. Lymphatic and blood capillaries

In the digestive system, when you eat fat it gets absorbed not into the blood like other nutrients but into special lymph ducts called **lacteals**, or **lacteal vessels**. This lymph looks milky white. It too enters the bloodstream at the subclavian veins.*

Unlike the blood circulation, the lymphatic system does not have a pump. Lymph is moved through the vessels slowly, sent along when it is squeezed by surrounding muscles—in other words, good old exercise! The vessels have one-way valves like veins that allow flow in one direction only. Pressure changes in the thorax during breathing also help to pump the lymph; here is another cleansing effect of deep breathing. In this way, lymphatic movement is just like venous return, only much slower. Also, there is some smooth muscle in the largest vessels that contracts rhythmically to help push the lymph along. In one day, about 3 liters of lymph enters the blood—about the same amount of fluid that leaves the blood capillaries in the tissues and does not return.

If your lymph vessels get damaged, severe water retention, o r **edema**, occurs in the area normally drained by them. However, your lymph vessels can regrow from vessels remaining in the area, and thus good drainage can be reestablished.

Manual lymph drainage (MLD) is a therapy in which the practitioner uses a range of specialized and gentle rhythmic pumping techniques to move the skin in the direction of the lymph flow. It was developed during the early 1930s by Dr. Emil Vodder, who created a unique range of movements that brought relief from chronic conditions such as sinus congestion and catarrh. Since then MLD has spread worldwide and has become a popular treatment in many European hospitals and clinics. It is now beginning to gain acceptance in the UK and the US as a component in the treatment and control of lymphedema. Manual lymphatic drainage stimulates the lymphatic vessels that carry substances vital to the defense of the body and removes waste products. MLD is both preventive and remedial. It is also deeply relaxing; it promotes the healing of fractures, torn ligaments, and sprains; it lessens pain and can improve many chronic conditions including sinusitis, rheumatoid arthritis, scleroderma, acne, and other skin conditions. MLD may strengthen the immune system. It relieves fluid congestion—swollen ankles, tired and puffy eyes, and swollen legs due to pregnancy. It is an effective component of the treatment and control of lymphedema, assists in conditions arising from venous insufficiency, promotes healing of wounds and burns, improves the appearance of old scars, and minimizes or reduces stretch marks.[1]

There is a particularly important movement for pumping lymph from the feet up the legs; it is the action of going up and down on your toes, as happens when you are walking. Keeping this movement going even if you are unable to walk a lot can very much help the lymphatic drainage in your legs.

Lymph Nodes

When your "glands are up" in your neck—when you are fighting off an infection like a cold—you can feel them as rubbery lumps on either side of your throat. These are not glands, in fact, but lymph nodes.

There are hundreds of lymph nodes in the body. They are discrete masses of lymphoid tissue surrounded by a tough connective-tissue boundary layer. They are found in clusters in your neck, armpit, groin, and behind the knee. They range from a few millimeters to 1–2 centimeters in size in their resting state, but can get very big when they are working to fight an infection.

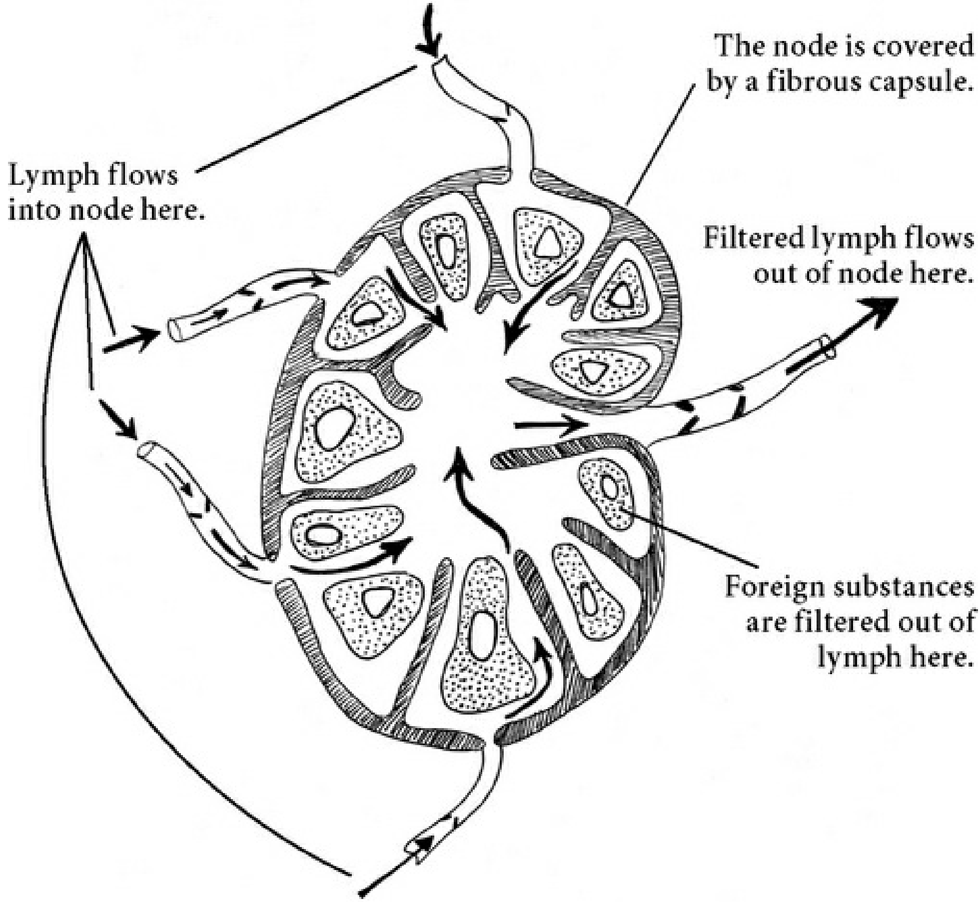


FIGURE 8.3. Lymph node

Inside each lymph node is a network of reticular fibers, a special connective tissue, with many lymphocytes enmeshed among them. B and T lymphocytes are found in the cortex (outer layer) and medulla (inner core) of a lymph node. A few lymph vessels enter one side of the node, and one vessel leaves. As the debris-filled lymph enters the node, the white blood cells within it engulf any foreign particles, old bits of cell, bacteria, viruses, cancerous cells, and such. This engulfment (called **phagocytosis)** is a large part of the defensive ability of our lymphatic system. After engulfment, the cell will attempt to dissolve or break down the engulfed material into small harmless parts. These can then be released back into the lymph. Sometimes there are nonbiodegradable particles engulfed (for instance, heavy metals). These would then be kept in the node, separated from the rest of body inside the lymph cells.

I heard an interesting story about a person with a large tattoo who went to the doctor complaining about a lump in the armpit. The doctor found a very enlarged lymph node and had a little piece of it biopsied to check for cancer. It turned out the node was full of the dye used for the tattoo—the body had decided it was foreign and should be got rid of, but once in the lymph node there was no way the cells could break it down, so they sequestered it there in the node. Our bodies are amazing!

Interrelationships

Interrelationships of the lymphatic system are similar to those of the **cardiovascular system**, to which the **lymphatic drainage system** can be seen as an adjunct. Toxins and excess fluids from cellular processes of **all cells and tissues** in all systems (except the central nervous system) are removed by the lymphatic system. In the **digestive system** there is an extra link, as fats are absorbed into the special lymph vessels called lacteals. Fluid moves through the lymph vessels thanks to the contraction of muscles of the **skeletal system**, as well as the changes in pressure in the thorax during **respiration**.

*This could be a contributing factor to the higher incidence of cancer among meat eaters compared with vegans. Animal foods are high in fat, which will be transported initially via the lymph, making it work harder and possibly overloaded and less able to carry out the general cleaning-up process it is charged with. Also, animal food fat is one of the key storage places for environmental toxins, so perhaps it is due more to these toxins—so many of which are carcinogenic—than to the fact of eating animals per se. Modern farming methods use a lot of pesticides and animal-raising makes wide use of pharmaceutical drugs, so the animals most people eat are full of these.

CHAPTER 9

The Army and the Cleaners—The Immune System

The general view of the immune system is that it is the body's army, fighting off and keeping out invading hordes of disease-causing organisms (called **pathogens)**.

You *can* look at it this way—particularly if your view is that life on Earth is dangerous and we are beset with enemies everywhere we turn. However, there is another approach. The immune system has many functions that can be seen as being more like tidying up and housecleaning than fighting. It *does* protect us from external threat, preventing disease-causing microorganisms from "invading" us and multiplying too much once they get inside our body. Also, it protects us from our own cells if they are dead or damaged, or turn cancerous or malignant. Yet if we remember that bacteria are our ancestors, that we have evolved together for billions of years on this planet, and hold the view that we have a safe place in this beautiful, incredible universe, along with all the other life forms we share it with, does this change things? A traditional naturopathic view is that germs are actually the cleansing agents that help us to recover from toxins or other assaults to the body. Their presence stimulates fever and increases the cleaning activities of our immune system. When their work is done, they become permanent parts of the body, in that the body can now keep them under check for optimum health. As Sara Hamo, Israeli naturopath working in the tradition of The Kingston Clinic, Edinburgh, says, "We get sick when we (our bodies) *invite* germs (the cleansing agents) to come and make order in the polluted body."[1]

Louis Pasteur is generally revered as being the father of modern microbiology. He was involved in early work on microbiology, though the **germ theory** of modern medicine preceded Pasteur by a century, and contemporaries of his were working away on the same lines. Claude Bernard, one colleague, fought with Pasteur over the course of their careers about whether it was the germ or the state of the person that caused disease—Bernard argued for terrain, Pasteur for germs. On his deathbed Pasteur's last words were in support of his colleague's theory: "*C'est le terrain*."[2] Of course, modern medicine ignored this and carried on with germ theory anyway!

When one considers what "terrain" means, bear in mind it is more than the state of the immune system; it is the condition of health (or lack of it) of our organs and tissues, which is related to many considerations, including diet and lifestyle. A great way to get a cold, for instance, is to be overdoing it and need a rest. Many experiments have shown that we don't get colds by being exposed to them—only twenty percent of people will actually catch a cold, even when the cold virus is directly painted onto the mucous membranes of their nose. **Rudolf Virchow**, known as the father of pathology, says:

> If I could live my life over again, I would devote it to proving that germs seek their natural habitat—diseased tissue—rather than being the cause of the diseased tissue, in the way that mosquitoes seek the stagnant water, but do not

cause the pool to become stagnant.[3]

There are other alternative ways of looking at the immune system too. For example, the great philosopher **Rudolf Steiner** suggested that before we are born our spirit chooses the body that will best fit it, then after we are born childhood illnesses help shape that body to become more exactly what we need. Certainly, parents will have observed the leaps of development that come after a period of illness in a young one.

As with all the other systems in this book, we are going to considerably simplify the immune system, which really is an amazingly intricate and complicated operation. Although it is considered to be part of the lymphatic system, in fact, many body systems are involved in its functioning. Unlike other systems, which have very specific tissues and structures, the immune system is made of billions of cells, and even more molecules, spread throughout the body. In addition to the lymphatic system, big contributors to immunity are the heart and circulation, the skin, lungs, kidneys, gut, nervous system, and endocrine system—yes, just about everything!

There are considered to be two main types of immunity: **nonspecific**, or **simple immunity**, which is a generalized defense, and **specific**, or **acquired immunity**, which is a more specialized form of defense.

Nonspecific Immunity

There are mechanisms in the body that will clean up any irritant or abnormal substance that threatens the internal environment. This is a general protection, and includes mechanical barriers such as the skin and the mucous membranes, chemical barriers such as the hydrochloric acid in the stomach, phagocytosis by white blood cells, and generalized mechanisms like fever.

The skin is a vital barrier in the front line against infection. As well as being a straightforward physical barrier to many outside organisms and materials, the skin cells (specifically, the **keratinocytes)** make **interferons**, proteins that block viral infection.

Other cells in the skin, called **Langerhans cells**, interact with pathogens that have managed to get through the outer layer of the epidermis. The Langerhans cells then take these pathogens to nearby lymph organs and help to initiate an immune response, called a **messenger function**. This response is disrupted by even the mildest of sunburns—UV radiation disables the cells that take the pathogens to the lymph tissue. This is probably why exposure to the sun can bring out a cold sore in people who tend to get them.*

Mucous membranes also provide an actual barrier when intact. Those in the gut and respiratory systems can produce copious amounts of mucus that washes away debris. Mucus is sticky, so, for example, in the nose, inhaled dust can stick to it. The mucus dries out, and the debris-filled waste can be removed from the body. (If you travel to London or any other big cities, you've probably discovered you can extract very black snot from your nose. Just think of it as a load of dirt that *didn't* get into your lungs.)

Mucus is thus primarily a way for the body to be rid of toxins or unwanted visitors. It is a gel, so becomes more runny and watery when heated. When we have a fever, therefore, our mucus runs freely, washing away microorganisms and their toxins, as well as internally produced toxins, from the body. Unfortunately, the modern practice is to take antipyretics (medicines that lower fever)—paracetamol in the UK, acetaminophen in the US—at the first hint of any fever. One effect of this is that mucus tends to thicken and remains stuck in the body. In children, the suppression of fever in this way leads to chronic mucus problems like glue ear, sinusitis, or chest catarrh. Mucus can also accumulate in the digestive and urinary systems, where it then can act as food for further growth of bacteria, leading to persistent and recurrent infections.

If you get something in your eye, **tears** are produced to wash it out. Tears also contain a chemical called **lysozyme**, a strong disinfectant. Actually tears are amazing. As well as washing things out, and being a disinfectant, they provide the *only* route for us to excrete stress hormones whole, without the liver having first metabolized them. So when we are stressed the chemical content of our tears changes. Crying is one of our body's helpful ways to protect us from stress. Much more on this later in the chapter on emotional causes of disease.

Earwax is another barrier—both physical and chemical. (Ever tried earwax as an anti-pimple agent? Earwax also contains the powerful antibacterial lysozyme.)

Then there are some quite explosive mechanical ways to get things out of the body—**coughing**, **sneezing**, and **vomiting**. Later on, if something got past the first defenses, diarrhea can wash things out. **Hydrochloric acid** is very inhospitable to life. If there is plenty of it in our stomachs, most germs we eat are instantly killed by it.

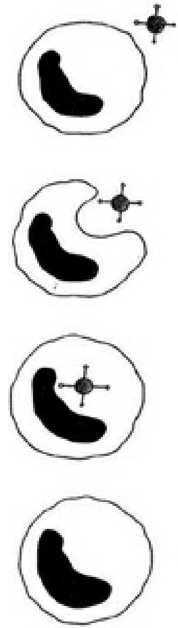


FIGURE 9.1. Phagocytosis

Phagocytosis is a very important defense mechanism, part of both nonspecific and specific immunity. In the case of nonspecific immunity the type of white blood cells known as **monocytes** leave the blood and migrate to the tissues. There they enlarge, become known as **macrophages**, and lie in wait to clear up any foreign matter that comes their way. They approach the foreign matter, engulf it, and then digest it if possible. Large collections of them are found in the liver sinuses, the lung alveoli, and the lymphoid tissue of the throat (tonsils and adenoids) and gut. In other words, they gather at points of entry to the body.

The liver sinusoids are the extra-leaky capillaries that allow the liver cells full access to the nutrients and products absorbed in the digestive tract, which are taken straight to the liver by the portal vein. The macrophages in the liver are known as **Kupffer cells**. The wonderful herbal medicine for the liver, milk thistle, increases the activity of the Kupffer cells.

You can see that if one's nonspecific defenses are strong and vigorous, there would barely even be a need to engage specific immune defenses.

Fever, or **pyresis**, is an important part of the immune response. Initially the body's thermostat in the hypothalamus is reset at a higher level. This causes the first stage of fever, when you feel cold and shivery. There is no sweating, and blood vessels of the skin constrict to keep heat inside, making you look pale, though the skin may be hot to touch. As the body temperature rises, you start to feel hot. This extra heat makes an unpleasant environment for any invading organism, which usually prefers normal body temperature, and it greatly stimulates your own immune response. When the fever "breaks," you sweat profusely as the body seeks to lower its temperature again. Toxins produced by infectious agents and other toxins the body wishes to be rid of are excreted quickly from the body in this sweat, along with viruses. The sheets of a person ill in this way should be changed after a bout of sweating, to avoid leaving the person surrounded by the very germs he or she is trying to get rid of.

There is a lot of fear about fever, especially in young people. Because of the easy availability of powerfully effective drugs that lower fever, there is not the familiarity with fever there once was. Even many health professionals have not seen fever take its natural course. It is true that a small child's temperature can rise very rapidly, and while young ones are developing their immunity as they come across new bugs for the first time, there may be frequent episodes of febrile illness in childhood. But it is unnecessary to treat every childhood fever. The current trend seems to be to dose the child with acetaminophen medicines (like Tylenol). Many parents are encouraged to treat even mild fevers like this, routinely giving such drugs to children from very small babies upward—for teething, or even just for restlessness or resistance to sleep. There are two problems with this: One is that acetaminophen suppresses the febrile response, and therefore interferes with the activity of the developing immune system, as well as with the cleansing of mucus from the body described above; the second is that acetaminophen is a dangerous drug. Studies have found it to be toxic to the liver, even at lower than maximum dose and when given to healthy people. One study found that it caused liver damage in up to forty-four percent of all participants taking it at the standard dose. Acetaminophen has become the major cause of acute liver failure in the USA and Europe. Some of these cases have been the result of unintentional overdose—where perhaps one tablet too many has been taken, or people have taken too much not realizing that it is in each of the several products they are taking (i.e., someone may take a cough medicine, a couple of tablets for the headache, and something for a fever without realizing they all contain acetaminophen). People have died after taking as little as 7 g, just 3 g above the recommended dose.[4] Liver failure usually kills people if they can't get a liver transplant (which is no picnic either).

High fevers in some diseases (like measles) are needed in order to discharge the virus from the body. In a clinical study of fifty-six children during a measles epidemic in Ghana in 1967, it was standard practice to treat every case of measles with sedatives, antipyretics like aspirin and Calpol (Tylenol), cough suppressants, and antibiotics as needed. In the first half of the epidemic thirty-five percent of the children died. The treating doctors noticed, however, that the children who survived were usually the ones who had higher fevers and more severe rashes than the ones who died. Although the ones who died seemed less sick than the survivors at the beginning of the illness, they then later got pneumonia and died. The doctors concluded that the high fever and rash helped clear the measles virus from the body, so they stopped treating the children with sedatives, aspirin, acetaminophen, and cough suppressants. They treated only with antibiotics and blood transfusions when needed. After this change of approach the death rate dropped to seventeen percent. This fits with naturopathic and traditional thinking that diseases like measles become a problem only when they get stuck deep in the body.[5]

In common practice it is considered dangerous to have a fever of 40°C (104° F). The general belief is that this can cause febrile convulsions and even brain damage. When I was researching this book I found that actually only fever as high as 42.2°C (108°F) has ever been known to cause brain damage.[6] Therefore it makes sense to treat fevers of 40°C (104°F), to prevent them rising any higher. Fevers of 41.1°C (106°F) should get immediate medical attention as they are likely indications of severe infection. (Bear in mind that readings under the tongue or arm are lower than internal temperature, and take care if using mercury and glass thermometers that can break.)* However, as a caution, be aware that babies less than two months old are in greater danger from fever. The best way to protect them is to breastfeed and keep them close to home for the first two months. If your baby is less than two months old and has a fever, it's recommended to seek medical advice.

Very few people who have a childhood febrile convulsion will sustain any lasting damage, and actually there is some evidence that people who have a very high fever in childhood are less likely to develop cancer later in life.[**] This makes sense—since cancer is a disease that can be seen as a failure of the immune system, it could very well be true that interference and repression of normal immune functions throughout childhood will affect optimum functioning later. It is not only cancer but other diseases that having the usual childhood illnesses seem to protect us from; measles, for example, has the ability to clear up chronic tendencies, such as recurring respiratory infections,[7] psoriasis, or chronic kidney problems. Until the 1960s, the children's hospital in Basel, Switzerland used to get young people with chronic kidney infections to catch measles in order to heal them.[8] After contracting measles, children who were susceptible to infections were found to be stronger and more resistant, needing less medical treatment.[9] There is evidence that children in the Third World are less likely to get malaria and parasites after measles.[10] Hay fever and other allergies are less likely after measles.[11] There is also evidence that having had measles can protect a person from immune diseases, skin disease, and degenerative cartilage and bone disease.[12]

Below are a some references about fever collected by Hilary Butler of the New Zealand Immunization Awareness Society,[13] printed here with her permission.

Not all fevers need to be treated but many physicians do so to relieve parental concern.[14]

There is overwhelming evidence in favor of fever being an adaptive host response to infection.… As such, it is probable that the use of antipyretic/anti-inflammatory/analgesic drugs, when they lead to suppression of the fever, result in increased morbidity and mortality during most infections; this morbidity and mortality may not be apparent to most health care workers.[15]

Despite our lack of knowledge about its therapeutic mechanism, it has been claimed to be a safe drug, especially for children … paracetamol syrup [infant Tylenol in the US] (presumably for children) is extensively prescribed in large volumes.… There is mounting evidence that paracetamol is not the benign drug that it was formerly thought to be.… We would question the whole rationale of prescribing the drug in near epidemic proportions. If it is to be used as a placebo, then it is a very dangerous placebo.… Paracetamol prescribing for children has been questioned. While there is little concern about its use in the short term as an analgesic, there is considerable controversy over its use as an antipyretic.… There is little evidence to support the use of paracetamol to treat fever in patients without heart or lung disease. Paracetamol may decrease antibody response to infection and increase morbidity and mortality in severe infections.… Too many parents and health workers think that fever is bad and needs to be suppressed by paracetamol when, indeed, moderate fever may improve the immune response.… The use of paracetamol in children with acute infection did not result in an improvement in mood, comfort, appetite or fluid intake.[16]

The data suggest that frequent administration of antipyretics to children with infectious disease may lead to a worsening of their illness.[17]

Use of analgesics were associated with [meningococcal] disease … analgesic use was defined as analgesics taken in the past 2 weeks, excluding, for cases, those taken for identified early symptoms of meningococcal disease. These analgesics were predominantly acetaminophen (paracetamol) products.… Because analgesics showed a stronger relationship with meningococcal disease, the use of analgesics may be a better measure of more severe illness than

> reported individual symptoms.… *We cannot exclude the possibility that acetaminophen (paracetamol) use itself is a risk factor for meningococcal disease* [my italics].[18]
>
> Antipyretics prolong illness in patients with Influenza A.… The duration of illness was significantly prolonged from 5 days (without) to 8 1/2 days (with).[19]
>
> Taking aspirin or Tylenol for the flu actually prolongs the illness by up to 3½ days, say researchers at the University of Maryland. That is because fever may be the body's natural way of fighting an infection and taking aspirin or acetaminophen—the generic name for products such as Tylenol—may interfere with the process. "You are messing with Mother Nature," says Dr. Leland Rickman, an associate clinical professor of medicine at the University of California San Diego. "An elevated temperature may actually help the body fight the infection quicker or better than if you don't have a fever." "Whatever you do, don't give aspirin or Tylenol to children who have the flu or any other viral illness," Rickman said. These results suggest that the systematic suppression of fever may not be useful in patients without severe cranial trauma or significant hypoxemia. Letting fever take its natural course does not seem to harm patients with systemic inflammatory response syndrome, or influence the discomfort level, and may save costs.[20]

Parents who want alternatives to acetaminophen can look to herbal medicine or homeopathy, both of which offer many remedies to help manage fever. Herbs, such as yarrow and elderflower, are **diaphoretic**—they encourage sweating and therefore the lowering of body temperature via the skin's cooling mechanisms. It is better not to use any fever-lowering medicines unless absolutely necessary. One naturopathic approach to fever is to not bring it down too much, but to maintain it at about 38.9°C (102°F). This is thought by some to allow sufficient resolution of the important febrile phase of an illness.[21] There are other views that a higher fever is even beneficial—and certainly there seems to be evidence to back up this possibility. It is regrettable that there is not more research being done in this area; the idolization of vaccination, and the furious dismissal of anti-vaccination arguments by the mainstream, means the loss of good opportunities for research comparing vaccinated and unvaccinated people's long-term health. (In addition, there is the fact that the majority of research is driven by drug companies with the aim of increasing profits—not in proving a drug or vaccine may be unnecessary or harmful.)

Specific Immunity

There are protective mechanisms that confer very specific protection against certain types of invading bacteria, viruses, or other toxic stuff. This type of immunity involves lymphocytes, which have the ability to respond to particular harmful agents and then remember them for another time. Lymphocytes, like all the blood cells, start off life in the red bone marrow. Before they are ready to fight infection they have to mature, and after having matured, they must be activated. There are two basic types of lymphocyte: **B-cells** and **T-cells**. B-cells stay in the red bone marrow to mature, while T-cells are shipped off to the thymus to finish maturing.

As we said before, this immunity is specific—a lymphocyte will be specific for (have receptors for) just one antigen. An **antigen** is something that elicits an immune response—it could be a virus, bacteria, fungus (infectious agents), an allergen such as pollen or house dust, or an abnormal or foreign cell. As there are vast numbers of possible antigens out there (especially considering that microorganisms evolve and each slightly different microorganism is considered a different antigen), you can imagine there have to be vast numbers of different T- and B-cells. The body deals with this by randomly making loads of lymphocytes with receptors that are all slightly different, like snowflakes, until there are so many different types of receptors that there is bound to be one that will be a close enough fit for pretty much any antigen that exists or could exist. But there is a problem here: Because there are receptors for nearly everything, this means that there would also be receptors for parts of our own bodies, and the last thing we want would be for lymphocytes to attack our own body thinking it was an antigen. So to solve this problem, during the lymphocytes' maturation (training, if you like), any of the lymphocytes that look like they may attack the body are weeded out till only the harmless ones remain (harmless for us, anyway!).

So far, so good—we now have mature lymphocytes that are well behaved, and have been let out to wander freely (so to speak) around the body. But there is one final stage—activation. This generally occurs in and around the lymphatic system—when a few of the cells chance upon an antigen the activation process begins. While this is happening, the person experiences the disease symptoms such as fever, malaise (feeling ill), spots, cough, or whatever. On a second exposure, however, no symptoms are experienced because the immune response is so quick, due to **memory cells** having been formed as part of the activation process.

On activation, B- and T-cells form both memory cells and **effector cells**. The effector cells are the ones that go for it right now to rid the body of the unwanted guests, while the memory cells are the ones that hang around ready to fight another day. B-cells and T-cells behave a little differently in how they do their job. Effector B-cells swell up as they make lots of **immunoglobulins**, or **antibodies**. Then they burst, releasing the antibodies into the surrounding blood or tissue fluid. Antibodies are protein complexes, which will bind to an antigen, rendering it more vulnerable to attack from T-cells, and neutralizing it in some way or causing other cells or chemical processes to destroy it.

Effector T-cells can do a few things. Some, called **killer cells**, directly attack antigens—particularly cells that have been invaded by viruses. Others, **helper cells**, go to the B-cells to urge their action.

Immunity can either be inherited or acquired. **Inherited immunity** is inborn—a genetic tendency to be immune has been passed down from our ancestors. Consider, for example, diseases that are not fatal to humans, such as distemper, but which kill dogs. A very sad way to understand this kind of inborn immunity is to look at what happened to native people in the Americas, when Europeans first colonized. Ordinary diseases that are not serious for Europeans, such as measles and even the common cold, were fatal to Native Americans, who had no inherited immunity to them and died in very large numbers.

Acquired immunity can be natural or artificial, active or passive. **Naturally acquired active immunity** is what I have described above—after meeting a pathogen for the first time, an immune response is mounted, including the formation of memory cells. On second exposure, the memory cells quickly kill off the antigen so that no disease is experienced—we have "acquired" immunity. Immunity is also naturally acquired before we are born via the placenta, and after birth via breast milk. Our mother will be making antibodies to all the germs that are around us. If we are fortunate enough to be born at home, she will already be immune to all the germs in our immediate environment, making a home birth safer (in the absence of complications). Our mother's blood will be full of all the necessary antibodies to protect us, and these will be present in the breast milk she makes for us. A newborn baby's digestive tract is not yet mature; the lining of the gut is more permeable or leaky than in an adult, and allows whole proteins to cross over into the blood of the baby. This is so that immunoglobulins (antibodies) can directly enter the baby's bloodstream, giving **passively acquired natural immunity**.

What this also means, however, is that a young human is particularly designed to take only human breast milk as food. When given formula milk made from cow's milk, or given the wrong sort of solid food too early (for example, wheat and cow's milk products), undigested proteins can cross into the blood and set off a sensitivity reaction or allergy. Sometimes allergies are so low level that the effects are not seen immediately, making it harder to figure out the source of the problem. More on this with the digestive system.

Artificially acquired immunity refers to vaccinations and immunizations. **Vaccinations** are the deliberate introduction of pathogenic material, usually weakened or dead, into a person with the intention of triggering an immune response without causing the disease in the meantime. This is an active process. In practice, vaccination is never as effective as actually contracting the disease in terms of conferring lifelong immunity. **Immunization** involves the introduction of amounts of artificially produced (usually in animal hosts) antibodies into the blood. This passively provides immunity for a short period.

The Vaccination Controversy

Reading any conventional textbook, or any brochures from your doctor's office, you will typically see vaccinations heralded as the greatest single breakthrough in modern medicine, saving more lives than anything else. I have never seen any hint there could be any problems from vaccination in a mainstream textbook.

Anyone who questions the safety or efficacy of vaccinations is pilloried as a heretical lunatic who wants to kill children.* Discussion with your doctor about the subject is typically limited to when (not whether or why) to get your booster shot, and it seems impossible to have a relaxed discussion that includes any possibility of doubt regarding the subject.

Everyone has heard bits and pieces about the possible dangers of MMR (the triple vaccine for measles, mumps, and rubella), including how the scientists whose research indicates possible problems being demonized or discredited. But did you know that there is a body of thought that questions the whole premise of safe and effective vaccines? It is too complex to go into in detail here, but I will outline some of the main points, and if you wish you can look further on your own.

Overburdening the immune system. First, consider that the MMR (or other) vaccination makes the immune system work overtime in a way it would never be expected to work naturally; within a few months, a child's developing immune system is expected to make antibodies to measles, mumps, rubella, diphtheria, tetanus, whooping cough, tuberculosis, hemophilus influenza type B, polio, and meningococcus type C —all roughly at the same time. In reality, the body tends to experience one infection after another, not a whole load mixed together. These pathogens never occur all together in nature. Giving all these vaccinations over a few years means that the immune system is never given a chance to rest from having to make specific antibodies. This leads to chronic immune deficiency with respect to reacting to other pathogens —the immunity is committed to fighting the specific antigens in the vaccines, and there is no energy for fighting other infections. In effect, immunity is lowered. Children end up getting lots of other infections they would not normally have (mostly treated by more antibiotics and acetaminophen).[22]

Safety. There is massive underreporting of adverse reactions to vaccinations, including the deaths and serious reactions. It is possible that deaths and serious injuries from vaccines may be up to a hundred times greater than the number reported. In the USA, insurance companies refuse to cover vaccine reactions—and it is these companies that do the best liability studies.

Then there are the possible long-term effects of vaccinations, not just dramatic and obvious immediate problems. Studies have found possible links between vaccines and long-term conditions such as autism, hyperactivity, ADHD, dyslexia, allergies, cancer, and asthma.

Vaccine ingredients include mercury, aluminum, formaldehyde, and phenoxyethanol (antifreeze). Considering the trend for more and more vaccinations to be given to very young babies, and for multiple delivery, there is a likelihood of adverse reactions from these added toxins (which act as fixatives) in the future. Some vaccines are cultured on animal cells, or come from tissue originating from aborted human fetuses.

Efficacy. Medical literature is full of studies documenting vaccine failure. Measles, mumps, small pox, whooping cough, polio, and hemophilus influenza type B (known as Hib, and seen as an important cause of childhood meningitis and pneumonia) outbreaks have all occurred in vaccinated groups. Although vaccinations are lauded for being responsible for low disease rates today, in fact, childhood diseases decreased by ninety percent between 1850 and 1940, well before mass vaccination programs, and in line with improved hygiene and sanitation.

Consider this chart, published in the *British Medical Journal* in April 1983.[23]

Death Rate of Children (Under Twelve) Due to Whooping Cough

Year	No. of Deaths (Per Million)
1860	1372
1910	815
1930	405
1950	5

(Mass vaccination of whooping cough began in 1952)

Getting a disease naturally is more helpful in terms of your immunity. Often, natural acquired immunity lasts a lifetime (as we have all heard about rubella or German measles). Yet the vaccine provides immunity for only a limited time.

When I was a child, if someone had measles, mumps, chicken pox, and so forth, our mums would take us to visit the sick kid so we could get it too. Now it seems all these diseases are so scary that we need to vaccinate or die! There is evidence that getting—and getting over—childhood diseases is part of the development of a healthy immune system. As we have seen, people who didn't get mumps as a child are at higher risk of ovarian cancer; if no childhood measles, a higher risk of some skin diseases, degenerative bone and cartilage disease, and some tumors. It does seem likely that diseases our people have had for countless generations have been involved in the development of our immune system.

The immune system is incredibly complex, and our understanding of it is still very limited. Yet we are happily messing around with millions of people's immunity without a backing of excellent long-term clinical studies and trials, and with a prejudiced system that makes proper debate and study unlikely to happen in the short term.[24]

Auto-Immunity

Some diseases are known as **auto-immune**. In our bodies, all of our own cells and tissues have a marker on them, like a nametag, so that our immune system can recognize them as us. Sometimes something goes wrong with this process, and the lymphocytes fail to recognize our own marker and attack particular cells and tissues, causing inflammation and damage. Examples of this type of disorder include rheumatoid arthritis, psoriasis, multiple sclerosis, some insulin-dependent diabetes, and thyroid disorders.

Auto-immunity is like a civil war in the body. Literally, some part of us becomes the enemy. A theory of auto-immunity is that it is due to a so-called cross-sensitivity from infection. The thinking is that often there are two infections happening at the same time—so the immune system is stretched and gets confused. What seems to happen is that some bacteria and viruses have evolved to have surface markers that are similar to the markers on certain body tissues. A person may suffer an infection, say, in the lung, that the body is unable to completely resolve. Let's say the infectious agent involved in the lung problem has a surface marker very similar to those markers found on the synovial membrane of a joint. The second infection (which could be something very common like overgrowth of *Candida albicans* in the gut) upsets and confuses the immune system, and some white cells attack the synovial membrane of a joint, mistaking it for the organism infecting the lung. Now there is an inflammation of the membrane, which in turn attracts more attention of white blood cells, and so it goes, on and on.[25] Consider the implications of this in the context of overloading the immune system with vaccinations.

Rheumatoid arthritis and ankylosing spondylitis, an arthritic condition of the vertebrae of the neck and thorax, seem to have this etiology (cause). There is often some damage to the gut involved, even to the extent of developing the auto-immune gut disorder Crohn's disease. People who develop sudden-onset insulin-dependent diabetes often do so after having an infection that looks like flu. This can also be the case in those who develop an auto-immune disorder affecting the thyroid. Insulin-Dependent Diabetes Mellitus type I may sometimes be an auto-immune reaction set up by cow's milk protein, which is very similar in appearance to the markers of the islet of Langerhans cells in the pancreas. The theory is that acute infection, accident, or other cause of high stress leads to increased capillary permeability, and then the white blood cells, which have developed an antigen to cow's milk protein, visualize and destroy the islet cells due to their similarity.

Interrelationships

By keeping the blood and tissues clean from diseased cells, and protecting the body from external threat, the immune system is involved with proper functioning of all systems. The immune system is particularly active via the **cardiovascular** and **lymphatic** systems, and the **skeletal system**, where its active cells are made. The **liver** plays a key role with immune cells there, protecting against toxins and foreign substances that gain access to the body via the digestive tract. Our immune system and **emotions** have a particularly close relationship.

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*The herpes simplex virus causes cold sores. You get them initially by contact with someone who has them, and then the virus lurks in your skin cells, where your body tries to keep it down but can't always get rid of it completely. So, every time you are run down and your immunity is low, you get a cold sore. Looked at positively, you get an early warning signal that your system is suffering stress, and can take appropriate action before more serious problems evolve.

*There is a shaman who "lends" his body to the Huichol god Tatewari (Grandfather Fire), who comes and speaks through him. The man's temperature goes up to 106°F when Grandfather is visiting.

**For instance, having a decent attack of mumps in childhood with big, swollen "hamster cheeks," makes a person less likely to develop ovarian cancer in later life. See R. O. West, "Epidemiologic Study of Malignancies of the Ovaries," *Cancer* 1966;19:1001–1007; see also H. U. Albonico, "The Risk of Breast Cancer Is Less Than Half for Those Who Had Measles," *Med Hypotheses* 1998, 51(4):315–320.

*Take Dr. Andrew Wakefield, for example, a scientist who found vaccine-strain measles virus in the guts of some children with autism. He was by no means anti-vaccine, but was demonized for suggesting that the findings should be looked into. The Web site What Doctors Don't Tell You, www.wddty.com, has plenty of information about this.

CHAPTER 10

Breathing—The Respiratory System

In Chinese medicine, developed over thousands of years, it is understood that people need a continuous supply of Qi, or energy, to function. Most of this is gained daily—the Qi of the Heavenly Father comes to us by the lungs and breathing. This mixes with the Qi of the Earth Mother in food to supply our energy needs.

As you know from our study of cellular processes, this is exactly what happens physiologically. Oxygen is twenty percent of air (the rest of air being nearly eighty percent nitrogen and tiny amounts of carbon dioxide and various other gases), and each breath takes in a quarter to a fifth of the oxygen present in inhaled air, which is brought into the body by the action of breathing, taken from the lungs into the blood from which the cells may take it to use in the oxidation of glucose (from food) for ATP production. Thus energy for cellular functions is garnered from the air and the Earth. (Incidentally, in Five Element medicine the taste of the Earth element is sweet. The first taste of Mother is breast milk that is deliciously sweet.)

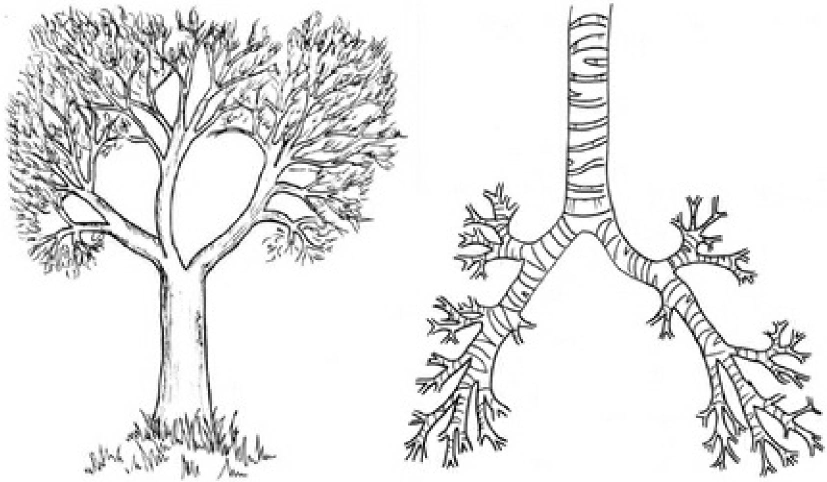

FIGURE 10.1. Comparing a tree to the bronchial tree

The by-products of **cellular respiration** are carbon dioxide and water. Carbon dioxide is sent in the plasma back to the lungs and breathed out. In a wonderfully neat example of the symbiotic relationship between plants and humans, green plants breathe in carbon dioxide and use it for their metabolism, during which they make oxygen, which they breathe out. This is why trees are known as the "lungs of the earth." It's interesting that the bronchial tree of the lungs looks just like an inverted trunk and branches of a tree.[1]

Airways to Alveoli

The anatomy of the respiratory system basically consists of a series of tubes ending in clusters of tiny air sacs called **alveoli** where the gases are exchanged. We'll take a more detailed look, working down from the top.

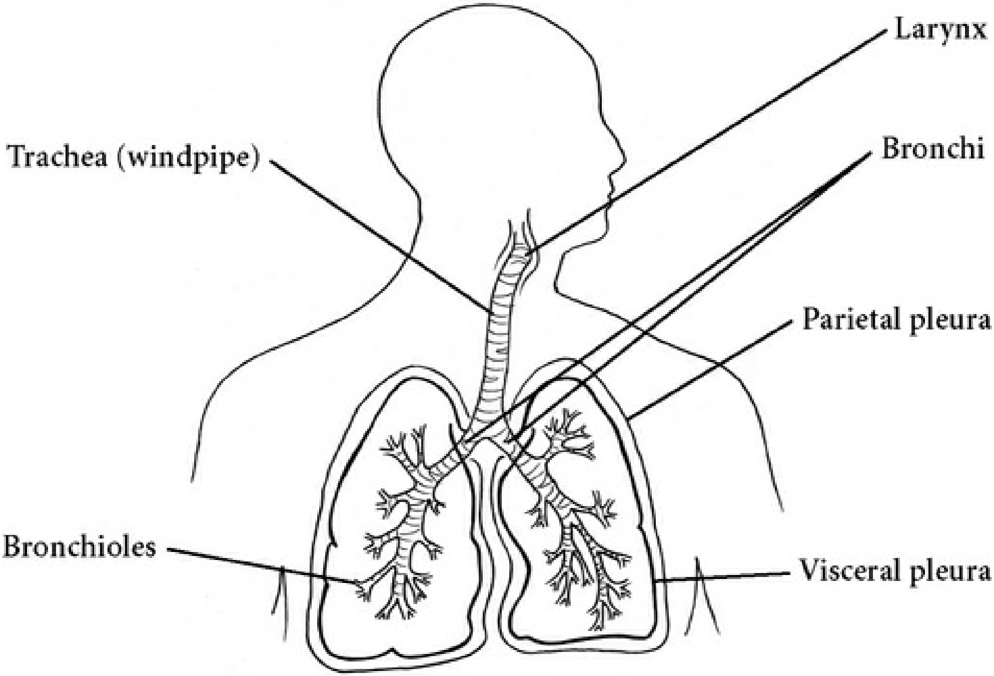

FIGURE 10.2. Respiratory system

The **nose** and **sinuses**. The nose is much bigger than it looks from the outside. The sticking-out part on the outside is made of cartilage, and contains hairs inside the nostrils to catch dust and debris. Two large cavities go from the top of the cartilage part of the nose to deep back into the face; each is a bony cavity separated from the other by a septum. On the walls of each nasal cavity are scroll-like shapes of bone, called **turbinates**, which turn the inhaled air so that all of it comes into contact with the sticky mucous membrane that lines the cavity. Connected to the nasal cavities by small tubes are more cavities, called **sinuses**, embedded in the bones of the face and skull. These too are lined with mucous membranes.

The mucous membranes secrete sticky mucus, so that any bits of dust or debris that gets past the hairs in the nose stick to it. The membranes are also warm and wet, and this heats up the inhaled air and adds moisture to it, making it easier on the lungs. Thus it is said that the functions of the nose and sinuses are to warm, moisten, and filter the air.

At the back of the nasal cavity and going down into the throat is the **pharynx**. This is a common passage for both food and drink, and air. It contains a flap of cartilage called the **epiglottis**, which blocks off the windpipe, or **trachea**, when swallowing food or drink. What happens is that as we swallow, the voice box **(larynx)** is pulled up and the epiglottis pushed down over the entrance to the trachea, thus sealing it off so food doesn't go the wrong way.

The pharynx splits into the **larynx** at the front, where the air goes, and the esophagus at the back, which takes drink and food into the stomach. The larynx is an amazing construction made of the hyoid bone and many pieces of cartilage, as well as the vocal cords, which are moved by muscles. The air passing through the vocal cords, each in different positions and degrees of tension, is what gives us the ability to speak and make so many different sounds.*

The larynx is continued below as the **trachea**, or air tube. This is a strong tube made of smooth muscle plus horseshoe shapes of cartilage, surrounded by connective tissue and lined with ciliated epithelium. The cilia (hairs) on the epithelium gently waft and move mucus up the trachea to the back of the throat, from where we can cough it into the mouth and get it out of the body.

The trachea divides at the sternal angle into the two **bronchi**. These air tubes also have smooth muscle and cartilage walls. The cartilage makes the tubes solid, keeping them open under normal circumstances. One **bronchus** goes to each lung, where they further divide and subdivide into smaller and smaller tubes with less and less cartilage in their walls. When they no longer have any cartilage, but only smooth muscle in the middle layer of their walls, they are called **bronchioles**.

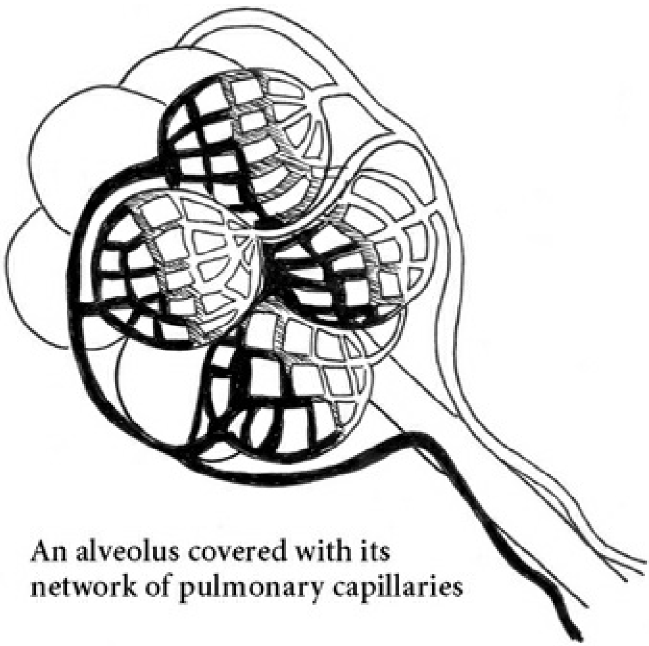

FIGURE 10.3. Alveolus

The smallest bronchioles end in tiny delicate air sacks called **alveoli**.

Alveoli in the lungs are completely surrounded by pulmonary capillaries, which have brought deoxygenated blood from the right ventricle of the heart to the lungs, and will return oxygenated blood to the left atrium. The alveoli are where gaseous exchange takes place. Because the alveoli, like the capillaries, are made of one-cell-thick epithelial tissue, there is only a very small barrier for the oxygen and carbon dioxide to cross. Since oxygen is at a low concentration in the pulmonary capillaries and high in inhaled air, it crosses down the concentration gradient by diffusion from the alveoli into the blood. With carbon dioxide the situation is reversed—the blood in the pulmonary circulation is rich in carbon dioxide and the inhaled air is not, so carbon dioxide naturally diffuses across from the pulmonary capillaries into the alveoli.

The **respiratory membrane** (which comprises the alveoli wall plus the pulmonary capillary wall) is only 0.5-1 micrometer (that is, less than one-thousandth the size of a millimeter) thick in healthy lungs, making gas exchange very efficient. If this is altered by disease in any way (e.g., pneumonia causing waterlogged tissues and thus thickens the membranes), gas exchange is impaired. If gas exchange is impaired, you just can't get enough oxygen into the body, and will feel breathless and tired to the point of literally not having the energy to do things. Also, carbon dioxide can build up, which makes the body too acidic. Changes in the pH of the body can affect many functions, as we discussed in Chapter 2.

A large surface area of alveoli is needed to allow enough exchange—this is impaired in the disease emphysema, when the walls of adjacent alveoli break through, making larger alveoli (with less surface area), dramatically decreasing gas exchange. It also occurs when mucus, tumors, or inflammatory materials block gas flow into the alveoli. The respiratory membranes of adult humans, if spread out, have the surface area of a tennis court. Small babies have much smaller lungs than adults—not just proportionally small to their size, but because there are many fewer branches to the bronchial tree and many fewer alveoli—so their breathing capacity is much less than in adults. This is why being in a smoky environment is particularly dangerous and harmful for children.

The Lungs Themselves

Looked at overall, the lungs are arranged in lobes. The right lung is bigger and is made of three discrete lobes. The left lung is smaller due to the heart taking up space on the left side of the chest, and is made of two lobes. The lungs are smaller than you might expect—put your hands flat on your chest, with the tops of your fingers touching your collarbone on each side. Your lungs take up the space under your hands, more or less.

The lungs are spongy organs contained in the **pleura**—a double sack of serous membrane surrounding each lung. The inner layer of pleural membrane is attached to the lung tissue; the outer layer is attached to the chest wall at the front, sides, and back, and the diaphragm below. Like all serous membranes, the pleura secrete a lubricating fluid. This allows the two layers to slide freely over each other as the lungs expand and contract. There is no air between the two layers of pleura, so there is what is called a **potential space**—it *could* be a space because the layers are not attached to each other, but it isn't, because the two layers stay together in the same way that two wet sheets of plastic would stick together. Getting air in that potential space is called a **pneumothorax**, and is very serious—it means the lung can no longer work properly.

The main muscles of respiration are the **diaphragm** and the

intercostal muscles. The diaphragm is a muscle that is attached all around the bottom of the ribs, and inserts up into a flat central tendon, making a dome shape. The diaphragm completely separates the thoracic and abdominal cavities (although, of course, there are holes for blood vessels, lymph vessels, and the gullet to pass through). When the diaphragm contracts, its central tendon is pulled down, making the thoracic cavity longer. Meanwhile, the external intercostals contract and pull the ribs up and out, widening the chest. As the thorax is made bigger, intrapulmonary pressure (the pressure in the alveoli) drops. As gases like to travel from an area of higher pressure to low pressure, air rushes into the lungs until the pressure in the alveoli is equal to that in the atmosphere.

Then comes expiration: The diaphragm relaxes and rises back up and the internal intercostals pull ribs in and down, making the chest cavity smaller and squeezing air out of the lungs—just like a pair of bellows. This getting the air in and out of the lungs, specifically the alveoli, is called **pulmonary ventilation**.

Three things can influence pulmonary ventilation and thus affect how easy it is to get air into and out of the lungs: airway resistance, surface tension in the alveoli, and lung compliance.

Airway resistance is the friction of the air passages impeding airflow. The smaller or more contracted airways have more resistance, which makes it harder to suck air through.

Surface tension in the alveoli tries to pull the walls of the alveoli together, which collapses them, making ventilation harder. To get air in you need to fight against this surface tension to open the alveoli up. (Think how hard it is to blow up the first bit of a balloon—once you've done a bit, it gets easier.) However, a liquid covering called **surfactant** helps to minimize this surface tension. This surfactant is formed late in fetal development, so premature babies often have trouble breathing if they are born before the surfactant is properly formed.

Lung compliance is the amount of effort required to stretch the lungs and chest wall when you fill the lungs up with air—the less compliance, or stretchiness, there is, the more effort is required to fill the lungs. So lung compliance depends on the elasticity of lung tissue and the flexibility of the bony thorax, and things that negatively affect these can impair breathing, as more energy will be required to force air into the lungs and to force air out again (this is what happens, for example, in fibrous lung disease, which makes the lungs less elastic, and in arthritis, which can restrict bony movement of the thorax).

When someone is suffering from a disorder that is making breathing difficult, all sorts of extra muscles get involved in the process. You can see this in someone with asthma or any restrictive respiratory disease; the muscles in the neck, back, and shoulders will all be working hard to help maximize the space in the thorax. This is a vicious circle in some ways, as all the extra muscles working will require extra oxygen, thus increasing the demands on an already taxed system. You can understand how tired people with a serious or chronic lung problem feel. Not only are they having trouble getting in enough oxygen for their energy needs, but also the disease is actually increasing their needs.

Breathing is described using a variety of lung "volumes."

Tidal volume is the in and out of normal breathing. But sometimes you need to either take in or release extra air—so we have reserves, also described as volumes.

Expiratory reserve volume can allow us, for example, to cough to remove irritants from the lungs (by applying pressured air behind the irritant to force it out). However, even after expiratory reserve volume, we still have more....

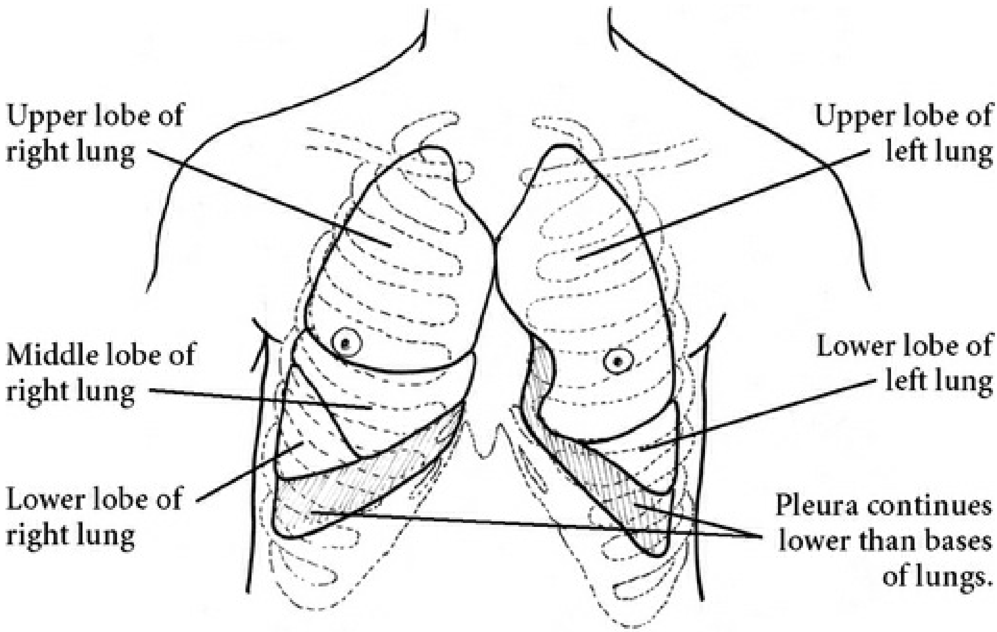

FIGURE 10.4. Placement of the lungs within the chest

Residual volume is what your body will rely on if you've ever been completely winded—it's very difficult to take your first breath afterwards, rather like blowing up a completely empty balloon. Residual volume prevents us from having to inflate a completely empty balloon with every breath! That first breath we each take as a newborn is as hard as this—we have to blow up the lung balloons for the first time. (Consider the barbarity of holding up a newborn human and smacking it to make it cry and take its first breath? This has been thought reasonable practice until frighteningly recently.)

Inspiratory reserve volume allows us to inhale well beyond our tidal volumes, so we can take in extra air for swimming or other demanding movements.

Transport of Respiratory Gases by Blood

Oxygen is carried bound to hemoglobin in the red blood cells with an additional small amount being dissolved in the plasma. (Oxygen is poorly soluble in the water that forms the bulk of the plasma.) Hemoglobin can carry up to four oxygen molecules—when it has already taken up one, it more easily takes up two, and when it has two it more easily takes three and four; when it has four, however, it is fully saturated.

Under normal resting conditions hemoglobin is ninety-eight percent saturated—100 ml of arterial blood contains about 20 ml of oxygen. The amount released when blood flows through the capillaries means venous blood is seventy-five percent saturated, containing 15 ml of oxygen per 100 ml arterial blood. This is called the **venous reserve**—and it means that under conditions of exercise, when much more oxygen is used, more can be unloaded in the capillaries even before any increase in breathing.

Temperature, blood pH, the amount of carbon dioxide in the blood, and other local chemical changes all affect the shape of hemoglobin and therefore influence hemoglobin saturation. Increases of these factors decrease hemoglobin's affinity for oxygen and therefore cause it to offload more oxygen into the blood. All these factors will be highest in capillaries of the systemic circulation, where the oxygen is used. Cells use up oxygen and release carbon dioxide, which also increases acidity in capillary blood. Heat is a by-product of metabolism, so temperature goes up. Thus it is in the place that oxygen is most needed that hemoglobin's affinity for oxygen will be most decreased, therefore more oxygen will be released to be available for the cells to use in respiration. Carbon dioxide is carried mainly as **bicarbonate ions**, but with a little dissolved and bound to hemoglobin, in the plasma. Loading and unloading of it and oxygen are mutually beneficial. How neat is that? This is a great example of the kind of local regulating mechanisms that exist throughout the body.

The Control of Breathing

As we have already said, at different times our need for using oxygen and eliminating carbon dioxide changes. The brain controls breathing via the respiratory centers of the brain stem. The **medulla** has a respiratory center that sets the pace of breathing, exciting the diaphragm and external intercostal muscles to contract, thus turning inspiration continuously on and off, twelve to fifteen times every minute. If this **inspiratory center** is repressed by overdose of alcohol, sleeping pills, or morphine, respiration stops (with obvious dire consequences). Another part of the respiratory center in the medulla seems to contribute more in forced expiration, when more strenuous movements are needed.

Various things can affect breathing (including messages from the higher brain centers about strong emotions, as well as temperature). We can consciously control breathing from the **cortex**, deciding to deliberately speed up or slow down our breathing. The most important chemical factors affecting breathing are changing levels of oxygen, carbon dioxide, and hydrogen ions (acidity) in arterial blood. Chemoreceptors (sensory nerve endings that are stimulated by changes in the chemical environment of the blood, with different types being sensitive to levels of a specific chemical) in the brain and the great vessels of the neck pick up these changes and relay the information to the medulla. This is how we know to increase breathing during exercise, for example.

Chronic Obstructive Pulmonary Disease (COPD)

This is another name for chronic bronchitis and emphysema. COPD almost always occurs in people who have smoked; it is rare in nonsmokers. The main symptom is **dyspnea**—labored breathing, or air hunger—and this gets progressively worse as the disease progresses. Coughing and frequent lung infections are common. Most people with COPD (also called COAD—chronic obstructive airway disease) go on to develop respiratory failure leading to hypoxemia (low oxygen in the blood), carbon dioxide retention, and respiratory acidosis.

If you have COPD, you will generally have either primarily bronchitis, or primarily emphysema. Emphysema sufferers are referred to in orthodox medicine as **pink puffers** and chronic bronchitis sufferers as **blue bloaters**.

"Pink puffers" are people with emphysema who are creating their own continuous positive airway pressure (CPAP) to keep the lungs inflated. The puffing creates back pressure and is like mechanical CPAP used by ventilators in the hospital. These people are their own ventilators! In contrast, "blue bloaters" are not being their own ventilators; they are typically people with chronic bronchitis—they have a cough with sputum for three months of the year or more. A blue bloater cannot get enough oxygen into the body, so begins to get cyanosis, or blueness. Ankles and legs may get swollen and neck veins may look distended. This condition leads to right heart failure. It is not a good thing to have—most blue bloaters die within two to four years.

A Deeper Look at Breathing

As we have already discussed, breathing is a powerful detoxifying process, which can be maximized by deep breathing. To clean the blood from acidic, toxic carbon dioxide, which is a waste product, we need to breathe. To make this a thorough process, deep breathing is recommended. Without being fully cleansed of carbon dioxide the blood cannot carry enough oxygen. Deep breathing also creates a pressure-changing pump in the thorax, which encourages venous return of blood, as well as movement of lymph, especially the emptying of the large lymph vessels in the chest back into the blood circulation (remember, the lymphatic system is the body's major cleansing system). When we breathe deeply, the heart, which is attached to the diaphragm via the pericardium, is massaged and helped with its work. Also, deep breathing pushes the diaphragm down firmly, which massages all the abdominal and pelvic organs, helping to bring in fresh blood and energy, and keep them well conditioned.

There are many different methods and ways to work with breathing. In yoga, working with the breath is of vital importance. **Pranayama yoga** is seen as not just a way to bring more oxygen to the blood and the brain, but to control the vital force, or *prana*. It is a powerful cleansing process for detoxifying the body, mind, and spirit, calming the mind and bringing spiritual growth. Like all spiritual practices, it is best followed under guidance of a teacher or Master.

A group of breathing exercises developed by a Russian doctor, **Konstantin Buteyko**, in the 1950s, help people suffering from asthma and other breathing problems. The benefits were officially recognized and the exercise technique approved as a treatment for asthma throughout the former Soviet Union in 1981. Apparently, in studies of this technique, half of all asthma sufferers are able to reduce their need for inhalers in less than three months after beginning the practice. It involves a simple set of exercises that alternate holding the breath with shallow breathing.*

Asthma is a condition in which the airways narrow by muscle contraction and inflammation. As you know, when the amount of carbon dioxide in the blood rises, you will breathe more. In an asthma attack people panic, breathe quickly, and therefore drop the carbon dioxide level in the blood, causing the airways to narrow (as the body is aware it needs less oxygen), which in turn makes the person panic more, in a vicious cycle. The Buteyko breathing technique alternates deeply held breaths with shallow breaths, and teaches the person to control the breathing more, and also to get used to higher concentration of carbon dioxide in the blood without letting that feeling cause panic.

Interrelationships

The respiratory system provides oxygen for the metabolism of

all cells of the body, thus all the systems depend on it and could not survive without it. The **brain** and **muscles** are particularly big users of oxygen. The **musculoskeletal** system powers the mechanics of breathing with the diaphragm and intercostal muscles, and the respiratory centers for control of breathing are in the **brain**. The **circulatory** system carries oxygen and carbon dioxide from and to the lungs and around the body, including to the tissues that make up the lungs themselves. The detoxing function of this system means that all the cells of the body rely on it to keep at optimum condition.

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*After a tracheotomy, when an opening is made in the front of the neck over the trachea, allowing air to enter the lungs without passing through the larynx, a person must learn to talk by swallowing air and sending this through the larynx to vibrate the vocal cords. A less serious use for this ability is "burp talking," which some school friends of mine loved to entertain with. One expert in this childhood pastime (thanks, Rebecca!) tells me that an easy word to practice with is "bollocks."

*You can go to a trainer to learn how to do the Buteyko breathing technique, which works to break the cycle of panic in asthma sufferers that causes more breathlessness. I found instructions on the Web, at www.btinternet.com/~andrew.murphy/asthma_buteyko_shallow_breathing.html.

CHAPTER 11

Eating and Food Processing—The Digestive System and Diet

We really *are* what we eat. On the physical level, all parts of our bodies are built from ingredients either our mother ate when we were growing inside her, or we ourselves have eaten during our life.

Some parts of our body are permanent; the parts our mother made will have to serve us for our whole lives—there is no replacing them. This includes the eggs in a woman's ovaries, and it used to be thought our skeletal muscle cells, cardiac cells, and nerve cells. (These do seem to have some ability to regenerate, though they do not tend to do so ordinarily.) Although some cells in the body do exist from birth, it is likely that all the contents of the cells get replaced as stuff diffuses in and out, things get repaired, and so forth. So our own state of nutrition is of vital importance to keep our bodies in good shape, and improving our nutrition will always begin to improve things, including in our so-called permanent cells.

Some parts of our bodies can be replaced if necessary and others are made daily as a matter of course. All is made from food. The digestive system breaks down the food we eat—proteins, carbohydrates, and fats, along with vitamins, minerals, and other nutrients—into substances the body can absorb and use for energy, growth, and repair. Proteins are broken down into amino acids, carbohydrates into simple sugars, fats (or lipids) into fatty acids and glycerol.

Basically it's back to chemistry: Foods are large molecules, made by plants and animals, and digestion breaks these large molecules down into small ones (via catabolism) for absorption so the body can use them to make large ones again (anabolism). This breaking down and building up, and the balance between the two, is what is known as metabolism. Some of what follows is similar to that found in the chemistry chapter, which you might like to reread to refresh your memory about the main groups of chemicals found in the body.

Carbohydrates

Carbohydrates include **sugars** and **polysaccharides** (starches). Except for a tiny bit in milk sugar **(lactose)** and glycogen in meat, most carbohydrate comes from plants. Simple sugars come from fruits, sugar cane, beets, honey, and milk. Polysaccharides come from grains, pulses, and root vegetables.

Plants also contain **cellulose**, another polysaccharide. We cannot digest this, but it is the fiber we need to provide bulk for healthy colon function. **Fructooligosaccharides** (FOS) are one type of this fiber called prebiotic—the food for the helpful bacteria that live in our gut. The more helpful bacteria there are, the less room for unhealthy ones.

Humans can be healthy with a wide variety of carbohydrate intakes, and the levels of intake considered normal can vary too. Currently, the recommended range in the West is 125–175 g daily, and these should all be in the form of complex carbohydrates (i.e., not sugar). The British and American diet commonly contains much more than this—one reason for our growing obesity problem.

How the Body Uses Carbohydrates

The main function of carbohydrate is to provide easily stored and used fuel for energy. Most cells can only use a few simple sugars, the main one being glucose. Glucose is broken down within cells to make ATP to be used for energy. When we have enough ATP, glucose is stored as glycogen or converted to fat. Other uses of sugars include making the nucleic acids DNA and RNA. (Nucleic acids are made of nucleotides. These are the largest molecules in the body, made of a nitrogen-containing base, a pentose sugar, and a phosphate group.)

DNA is found in the cell nucleus. It is the genetic material that allows for protein synthesis and replicates itself before cell division. Its sugar is deoxyribose and its bases adenine, guanine, cytosine, and thiamine. It forms the famous double helix shape.

RNA is formed in the cytoplasm and copies part of the DNA to carry out its instructions for protein synthesis. Its sugar is ribose and its bases adenine, guanine, cytosine, and uracil. Its shape is a singe strand, straight or folded.

The Glycemic Index

The **Glycemic Index** (GI) of foods relates to the quickness that eaten carbohydrates get into the blood as glucose. A food with a high GI gets into the blood quickly, which means the pancreas must put out a big wallop of insulin to deal with the glucose. Then the pendulum swings and the blood sugar drops dramatically and you get cravings for more sugar, and thus the pendulum swings again. This generally puts pressure on the body, and can lead to mood swings in susceptible individuals. Some people's bodies seem to react to processed sugar (which is effectively pure glucose) as if it is more like a drug than a food. For these people, eating only complex carbohydrates—including the vegetables, whole grains, and fruits that have a low GI value—can be life-changing.[1]

Foods with a low GI are healthier because they take less of a toll on the sugar-balancing mechanisms of the body. Eating foods with a high GI consistently is one factor that can lead to diabetes, obesity, high cholesterol, and heart disease. The concept of the Glycemic Index was invented by Dr. David J. Jenkins and colleagues in 1981 at the University of Toronto. As mentioned before, carbohydrates that break down rapidly during digestion and quickly enter the bloodstream have the highest GI values. A lower GI value suggests slower rates of digestion and absorption of the sugars and starches in the foods, and probably therefore means the liver has longer to more effectively remove and process the products of carbohydrate digestion, creating lower insulin demand, better long-term blood glucose control, and a reduction in blood lipids. The current methods of GI valuation use glucose as a reference food, giving it a GI value of 100. You can compare this to the foods listed below.

Low GI foods (less than 55): Peanuts, low-fat yogurt, fresh whole fruits (cherries, grapefruit, pears, apples, plums, oranges, grapes, peaches, kiwis, bananas), milk, soy milk, dried apricots, some fruit juices (apple, pineapple, grapefruit, orange), many beans (soya, butter, navy, kidney, black, lima, pinto), many legumes (red lentils, green peas, split peas, garbanzos), some pastas (fettuccine, spaghetti, vermicelli, macaroni, linguine), canned soups (tomato, lentil), some breakfast cereals (Rice Bran, All Bran, porridge, Special K), less-processed grains (pearl barley, rye, bulgur), a few breads (Bürgen soy, oat bran, and mixed-grain breads, plus barley kernel, rye kernel, pumpernickel, and bulgur), root vegetables (yam, sweet potato), fructose and lactose sugars. And a very few sweets: Peanut M&Ms, Snickers bar, jams and marmalades, sponge cake, pound cake, and Dove chocolate.

Medium GI foods (56 to 69). (You may include a few of these foods each day, but again limit portion sizes if you want to lose weight): Some breads (pita, rye, barley, wholemeal wheat), some breakfast cereals (muesli, Bran Chex, Life, Nutri-Grain, Grapenuts, Shredded Wheat), grains (white and brown rice, buckwheat, corn, couscous), root vegetables (new potatoes, beets), popcorn, soups (split pea, black bean, green pea), sweet corn, honey, sucrose and high-fructose corn syrup, cheese and tomato pizza, many fruits (mangos, sultanas, apricots, raisins, melon, pineapple), fruit cocktail, canned apricots. And for dessert: ice cream, angel food cake, shortbread.

High GI foods (70 or more). (Swap these foods for those with a low GI value or eat them together with a low GI food.): White breads (Melba toast, wheat bread, bagels, Kaiser rolls, baguettes), sweetened and highly processed cereals (Cream of Wheat, Cheerios, Corn Bran, Total, Rice Crispies, Corn Chex, Rice Chex), highly processed grains (millet, tapioca, low-amylose rice, instant rice), very sweet fruits (watermelon, dates), breakfast pastries (donuts, waffles, croissants, Danishes, cinnamon rolls), root vegetables (rutabagas, mature potatoes for baking and mashing, parsnips), rice pasta, snack foods galore (corn chips, pretzels, rice cakes), glucose and glucose tablets, maltose and maltodextrin, pumpkin. Dangerous desserts: Vanilla wafers, cakes and cookies too numerous to list.

Fats or Lipids

There are different types of fat. Important in the body are neutral fats and phospholipids, plus some others, like steroids and vitamins A, D, E, and K. Fats are mainly used for energy production, and a little for construction.

Neutral Fats

Neutral fats are called **triglycerides**. They are very large molecules, and must be broken down into their building blocks before absorption. Fats are digested to fatty acids and glycerol then reconverted to triglycerides for transport in the lymph. The length of the fatty acid chain of a fat, and how saturated with hydrogen ions, determines how solid a neutral fat is at a given temperature. Longer chains of **saturated fatty acids** are solid at room temperature, for example, animal fats like lard. Shorter chains with double bonds between carbon atoms are what we call **unsaturated fats**. These are liquid at room temperature, for example, vegetable oils like olive and peanut oils (monounsaturated), or corn, soybean, and sunflower oils (polyunsaturated). Basically, a healthy and balanced fat intake is one in which we eat more PUFAs (polyunsaturated fatty acids) and MUFAs (monounsaturated fatty acids) from vegetable and fish, and less saturated animal fats from meat and dairy products.*

The liver can make most of the fatty acids we need except for **linoleic** acid (from lecithin) and **linolenic acid**. Linoleic and linolenic acids, referred to usually as Omega-3 and Omega-6, are **essential fatty acids**, called essential because the body needs them but cannot make them—they must be eaten in the diet. Current thinking is that many of us are deficient in these essential fatty acids, and when we do eat them, they are likely to not be in the best proportion to each other—we should have a higher proportion of 3s to 6s than we do (ideally about 2:5, two 3s to five 6s—people typically consume a lower proportion of 3s than needed). Essential fatty acids are long-chain polyunsaturated fatty acids from linolenic, linoleic, and oleic acids, being classed in the two families Omega-3 and Omega-6. (There is also an Omega-9 fatty acid. Although the body needs this too it is classed as nonessential because the body can manufacture a little on its own from the essential fatty acids.) The healthiest cell membranes contain a lot of Omega-3 fatty acids that are highly flexible.

It has been found that the composition of tissue, and in particular of the nerve cell membrane, of people in the United States is different from that of the Japanese, who eat a diet rich in Omega-3 fatty acids from fish. Americans have cell membranes higher in the less flexible Omega-6 fatty acids, which appear to have displaced the elastic Omega-3 fatty acids found in Japanese nerve cells.

Phospholipids

These are assembled in the body rather than taken in via the diet, but are included here for completeness. They are modified triglycerides—being diglycerides, with one phosphorus-containing group and only two fatty acid chains. Because of this they are uniquely dipolar, which means they have a nonpolar end (the fatty part) and a polar end, the phosphorus-containing part.

Steroids

These interesting molecules are structurally different from fats but are fat-soluble. The most important naturally occurring steroid is cholesterol, ingested in meat, eggs, and cheese, and a little produced by our liver.

Steroid hormones are a group of chemicals that are made in the body from cholesterol as regulatory substances. There are basically two types: the sex hormones testosterone, estrogen, and progesterone, and the corticosteroids cortisol and family. The type of steroids used illegally by sportspeople wanting to build muscle are anabolic steroids, synthetic versions of the male sex hormone testosterone. They cause increased muscle bulk, lessen fatigue, and can make a person feel euphoric.

Trans-Fats—Mad, Bad, and Dangerous

Ultra-low-fat diets full of processed foods are dangerous. Many companies are now removing **trans-fatty acids**, which are manufactured polyunsaturated fats found in some low-fat margarines and many processed foods. Trans-fats are taken up by the body and used to make cell membranes and tissues where naturally occurring polyunsaturated fats would normally be used, but they impair some aspects of cell function. They compete with normal fats in the body for enzymes, and replace normal fats and oils in **eicosanoid** formation (eicosanoids are fats used to make controlling substances including prostaglandins). It is now known that trans-fats raise levels of unhealthy, heart-disease-causing LDL cholesterol (low-density lipoprotein), and lower levels of the healthier high HDL cholesterol (high-density lipoprotein), as well as increasing triglyceride levels and lipoprotein. They also increase the risk for coronary heart disease, other health problems including skin problems, impaired brain and nerve function, and tendency to develop asthma and arthritis. It is these unnatural trans-fats that are the real problem, not simply saturated fats from animals. Check labels: In the US, “trans fat” appears on the label when present, along with “partially hydrogenated”; in the UK, look for “partially hydrogenated” vegetable oil or “vegetable fat” and avoid those foods.

Which Foods Contain Fats

The most abundant are neutral fats. These can either be saturated fats in animal foods like meat, dairy, and eggs, or unsaturated fats in seeds, nuts, and vegetable oils. We also get cholesterol from the diet, mainly from egg yolk, milk, and meat.

How the Body Uses Fats

Neutral fats are the most efficient and compact way for the body to store fuels. Deposits are found largely beneath the skin. They also provide insulation from heat loss and protection from trauma.

Phospholipids are used in making cell membranes.

Cholesterol is the essential raw material the body uses to make vitamin D, steroid hormones (including the sex hormones and cortisol), and bile salts, as well as myelin.

Essential fatty acids—the Omegas—are used in the body to make important regulatory substances called **thromboxanes, prostaglandins, and leukotrienes**. These are involved in blood clotting (thromboxanes), inflammation (prostaglandins and leukotrienes), womb activity, digestive function (both movement and secretion of enzymes), and regulation of blood pressure (prostaglandins).

Eicosanoids are made from the essential fatty acids gamma linolenic acid (GLA) and ecospentanoic acid (EPA). Looking at the ways in which the body converts linoleic and linolenic acids into the fatty acids that serve as the raw ingredients for **eicosanoids** (prostaglandins, leukotrienes, and thromboxanes) can give us useful information about the importance of essential fatty acids. We will take a look at these Omega-6 and Omega-3 **pathways** here.

The **Omega-6 pathway** starts with **linoleic acid**, a substance that is found in many seed and vegetable oils (sunflower, safflower, walnut, corn, and soya), as well as nuts, organ meats, and human milk. Some linoleic acid is made into **arachidonic acid** (also found in quantities in meat, liver, kidney, egg yolk, and prawns), which is used to make those eicosanoids that have an **inflammatory** effect on the body, as well as being thrombotic (blood clotting) and increasing muscle spasm. Some Omega-6 fatty acids go to make **anti-inflammatory** eicosanoids *before* the inflammatory arachidonic acid is made. One type of Omega-6 that tends to end up as anti-inflammatory eicosanoids is gamma linolenic acid (GLA), found in evening primrose oil, blackcurrant seed oil, and starflower oil. It seems to be the relative *amounts* of the starting materials eaten that will affect the ratio the body makes of anti-inflammatory to pro-inflammatory prostaglandins. If we eat more animal products, more pro-inflammatory prostaglandins seem to be produced. Of course, even if lots of vegetable oils are eaten rather than animal fats, both pro- and anti-inflammatory prostaglandins will be made —we need the inflammatory prostaglandins to keep the body properly repaired and healthy.

The **Omega-3 pathway** is about **linolenic acid** (found in oily fish, as well as linseed, hempseed, pumpkin, and soya bean oil, and dark green leafy vegetables). Only the eicosanoids with *anti-inflammatory*, antithrombotic, and antispasmodic effects are made by the body from this pathway. In addition, **ecosapentanoic acid** (EPA) near the end of this pathway inhibits the conversion of arachidonic acid to the inflammatory eicosanoids because it uses the same enzyme. *So, eating lots of EPA not only provides the ingredients for anti-inflammatory eicosanoids, but also actively reduces the pro-inflammatory ones our body can make*. EPA is one of the important active ingredients of fish oils. This is how they work to help inflammatory conditions such as arthritis, allergic conditions like eczema and asthma, and gynecological complaints. Not only do they encourage the making of anti-inflammatory prostaglandins, but they block the creation of inflammatory ones. This Omega-3 pathway also acts to reduce blood clotting and therefore the risk of heart disease. Plus, EPA is used to make the best possible quality flexible cell membranes, known to be important in the brain but no doubt also having an effect all over the body.

So the idea is to reduce the dietary intake of animal fats in favor of oily fish, and make sure your vegetable oil consumption isn't all sunflower oil, but includes other oils, as well as eating lots of leafy green vegetables.

In summary: *The Omega-3s always end up encouraging anti-inflammation, and the Omega-6s can encourage anti-inflammation or inflammation, while animal fats (from meat and dairy) encourage inflammation*.

Western medical thinking has often been wrong about fat. The early idea was that the problem was with saturated fats, thinking they can clog up the arteries as fatty deposits, called **atheromas**, collect on blood vessel walls. This was seen as a major contributing factor in high blood pressure and heart disease. Also, excess fat in the body means more fat collecting around internal organs, which always need a bit of fat for protection. If a lot of extra fat accumulates around the heart, it must work harder. However, newer thinking is a little more complex than just avoiding all fats. We need to not simply eat less saturated fat (an idea that has led to a huge fat-free-food industry that is missing the fact entirely that the harmful effects of fat are most likely due to trans-fats), but actually eat more polyunsaturated fats from vegetables with an emphasis on the Omega-3s. Remember that this includes eating much more green leafy vegetables too, by which we can give the body ingredients for making more of the anti-inflammatory eicosanoids, thereby protecting it from coronary heart disease and other inflammatory conditions ranging from arthritis to endometriosis and other gynecological conditions.*

Proteins

Proteins are the main structural materials of the body, and have the most varied functions of any molecules in the body. Proteins make enzymes, hemoglobin, the contractile proteins of muscle actin and myosin, immunoglobulins, hormones, and more.

Which Foods Contain Proteins

Proteins make up most of the body, and this goes for animals too, so all animal and fish flesh is high in protein, as are dairy products such as milk and cheese. But plants are the alchemists of the earth; they make amino acids by fixing the nitrogen from the earth into the soil and taking it up to build into amino acids. Think about it: Cows eat only plants, turning grass into all that solid muscle, but we can't do this, not because the amino acids aren't available in grass, but because our digestive system is not able to access them.*

All the amino acids we need are in plants, but in order to get them, some attention is needed to what we eat. Vegetarians need to think about their food groups. There are basically three groups of vegetables: beans and pulses, grains, and nuts and seeds. To get complete protein from one meal, you need to eat two of the three groups together. In other words, peanut butter (nut) on bread (grain); rice (grain) and lentils or peas (pulse); humus (made from chickpeas, a pulse) and tahini (made from sesame seeds). I'm sure you get the idea. Don't let this put you off vegetarianism: Vegetarians definitely live longer than meat eaters, at least in the modern Western world.[2] Soy beans are unusual in that they contain all the essential amino acids—this is why tofu and tempeh are such useful foods.*

How the Body Uses Proteins

Fibrous proteins include collagen, which is found in abundance in connective tissue, including bones, tendons and ligaments, skin, and blood vessels—in fact, everywhere in the body. Keratin waterproofs the skin, hair, and nails. Elastin is what gives elasticity to ligaments and elastic connective tissue, allowing the lungs, bladder, and arteries to stretch and recoil back. Finally, actin and myosin are the fibrous proteins responsible for muscle contraction and cell division, actin also being used for intracellular transport.

Globular proteins are also called functional proteins, and play crucial roles in almost all biological processes. Consider the implications here of increasing microwave pollution: It has been observed that microwaves cause changes to globular protein production in cells and that these changes extend even to the cells' genes.[3]

Protein enzymes include salivary amylase and oxidase enzymes, among many others. There are transport proteins such as hemoglobin (transporting oxygen) and lipoproteins (transporting fats), plus many others. The plasma proteins, including albumin, provide osmotic pressure to the blood, as well as being either a base or an acid, thus keeping pH balanced in the blood. There are also protein hormones, such as growth hormone and insulin, and immune functioning proteins, such as antibodies, complement proteins and molecular chaperones.[*]

Chaperones are proteins that help with the folding-unfolding and the assembly-disassembly of large molecules. When a large protein is being made, for example, chaperones prevent polypeptide chains from joining too soon into a big structure that doesn't function properly. **Enzymes** are catalysts. Most are proteins. They temporarily bind to one or more parties in a reaction, speeding up the reaction but not being changed themselves. Many of them need vitamins and minerals to be made.

Vitamins and Minerals

Vitamins are used in tiny amounts for growth and maintaining good health. They are not used for energy or building blocks, but mainly function as **coenzymes** or parts of coenzymes. Coenzymes are substances that act with an enzyme to accomplish a particular task; for example, some B vitamins work as coenzymes in glucose oxidation. Vitamin D acts as a hormone.

Most vitamins are not made in the body and must be taken in food, except vitamin D (made in the skin in the presence of sunlight) and vitamin K (made by bacteria in the bowel). There are fat-soluble vitamins (A, D, E, and K), and water-soluble (B and C). Vitamins are involved in many incredibly diverse activities in the body, from bone formation to skin and mucous membrane development and maintenance to blood clotting and antioxidation (the mopping up of free radicals, the by-products of oxidation, which cause tissue damage and are implicated in cancer formation and aging).

Minerals are also needed in moderate amounts. These include calcium, phosphorus, sulfur, potassium, sodium, chlorine, magnesium, iron, iodine, zinc, copper, chromium, cobalt, fluorine, selenium, and manganese. Some are needed only in minute amounts, and are thus called trace minerals or elements. However, all are essential for functioning.

Nutrient	Essential For	Found In
Vitamin A	Vision, growth, reproduction, and maintenance of healthy skin	Liver, fish oils, eggs, dairy products. Red, yellow, orange, and dark green vegetables and fruits contain alpha- and beta-carotenes, which are converted in the body to Vitamin A
Vitamin D	Proper formation and maintenance of bones and teeth	D-fortified milk and cereals, cod liver oil, and naturally in the skin when exposed to sunlight
Vitamin E	Antioxidant action, defends cells against damage by free radicals	Vegetable oils, margarine, wheat germ, nuts, seeds, and green leafy vegetables
Vitamin K	Blood clotting	Eggs, cereal, and green leafy vegetables
Vitamin C	Healthy bones and teeth, wound healing	Fruits (especially citrus) and vegetables (especially those in the cabbage family)
Thiamin (Vitamin B1)	Carbohydrate metabolism (energy production)	Whole or enriched grain products, fortified cereals, pork, and organ meats
Riboflavin (Vitamin B2)	Metabolism of protein, fat, and carbohydrates into energy	Milk and other dairy foods, organ meats, and enriched and fortified grains
Niacin (Vitamin B3)	Carbohydrate, protein, and fat metabolism	Poultry, fish, beef, peanut butter, legumes, and enriched or fortified grain products
Vitamin B6	Manufacture of amino acids and red blood cells	Fortified cereals, sweet potatoes, chicken, beef, and liver
Vitamin B12	Energy and amino acid production	Beef, milk, cheese, shellfish, and yeast extract
Calcium	Making and maintaining bones, muscle, and nerve function	Dairy products, leafy green vegetables, sesame seeds, almonds, and calcium-fortified foods (e.g., orange juice, cereals)
Iron	Carries oxygen in red blood cells to body cells	Meat, eggs, dark leafy vegetables, apricots, and molasses

Phosphorus	Supporting tissue growth and repair, major bone component	Milk, meat, poultry, fish, eggs, legumes, and nuts
Magnesium	Energy production and nerve function	Legumes, nuts, whole grains, green vegetables, and chocolate
Potassium	Nerve function and muscle contraction	Fruits, vegetables, meat, poultry, fish, and milk
Folate	DNA synthesis; involved in making protein	Fortified cereals, enriched grains, leafy greens, legumes, and asparagus
Zinc	Cell reproduction and tissue growth and repair	Meat, eggs, seafood, whole grains, kiwi fruit, and pumpkin seeds

FIGURE 11.1. Essential vitamins and minerals

What Happens in the Gut—Digestive Processes

The digestive or GIT (gastrointestinal tract) system consists of a long tube that goes from the mouth to the anus, with various accessory organs that produce digestive enzymes (chemicals that speed up or slow down chemical reactions) and other substances to help with digestion. Digestive enzymes affect reactions involving the breakdown of food and control of digestion.

The tube of the gastrointestinal tract has four layers. The innermost layer is epithelial tissue. The mouth and esophagus have a compound epithelium, but the rest of the tube is lined with simple, columnar epithelium, a single layer of cells, which is replaced every twenty-four hours. Beneath the epithelial lining, which secretes mucus and thus is known as the **mucosa**, is a **submucosa** layer. This is special to the gut, and contains enzyme-producing glands as well as an extraordinarily complex network of nerves.

There are so many nerves in the submucosa of the gut that they are known as the ENS **(enteric nervous system)**. Yes, we really do have "gut feelings"—the ENS produces neurotransmitters just like those found in the brain. There are 100 million neurons in the gut. Every type of neurotransmitter has been found in the gut—in fact, it is here that ninety-five percent of our body's serotonin is produced (so much that it would poison us if it got into the blood). The main nerve controlling gut activity is the vagus nerve, but the gut can influence the brain via this nerve also. Even if the vagus nerve is cut, the gut continues to function and regulate its own activities. The epithelial cells of the gut wall make neurotransmitters, as well as the nerve cells of the submucosa.*

After the submucosal layer is the **muscle layer**, made up of smooth muscle cells arranged in lengthwise and crosswise sheets all along the gut tube. In the stomach there is an extra layer going diagonally.

The outer layer is, as usual, **connective tissue**, supporting and protecting the whole tube. In places, this forms part of a special protective membrane called the **peritoneum**, a serous membrane similar to the pleura of the lung and the pericardium of the heart.

Digestion is said to be carried out in both mechanical and chemical ways. Mechanical digestion involves the physical munching and churning of food, both the obvious chewing and chomping that goes on in the mouth and the more hidden inner movements of the digestive tract. If you put your ear on a friend's tummy, you won't have to wait long before you hear some noises—evidence of the constant movements of the gut.

Chemical digestion is done by the digestive enzymes. These break down food by hydrolysis—by the addition of a water molecule between each bond to be “lysed” or broken, the opposite of dehydration synthesis.

The **accessory organs** are the liver, gall bladder, and pancreas. As well as producing bile to help with fat digestion, the **liver** also processes the end products of digestion, and stores things for future use. In fact, this amazing organ has more than a thousand known functions—and you can bet there are more we don’t yet know about. So don’t be fooled by its being called “accessory”; it is one of our most important and complex organs, and I’ve given it a chapter all to itself. The **gall bladder** is a small muscular sack found underneath the middle part of the liver. The gall bladder collects the bile the liver makes and concentrates it, storing it until a fatty meal enters the small intestine, upon which the gall bladder contracts and squeezes bile into the intestine to help digest fats. The other accessory organ is the **pancreas**, which is crucial for digestive function. The pancreas makes gallons of digestive enzymes daily, as well as hormones involved in keeping the blood sugar balanced.

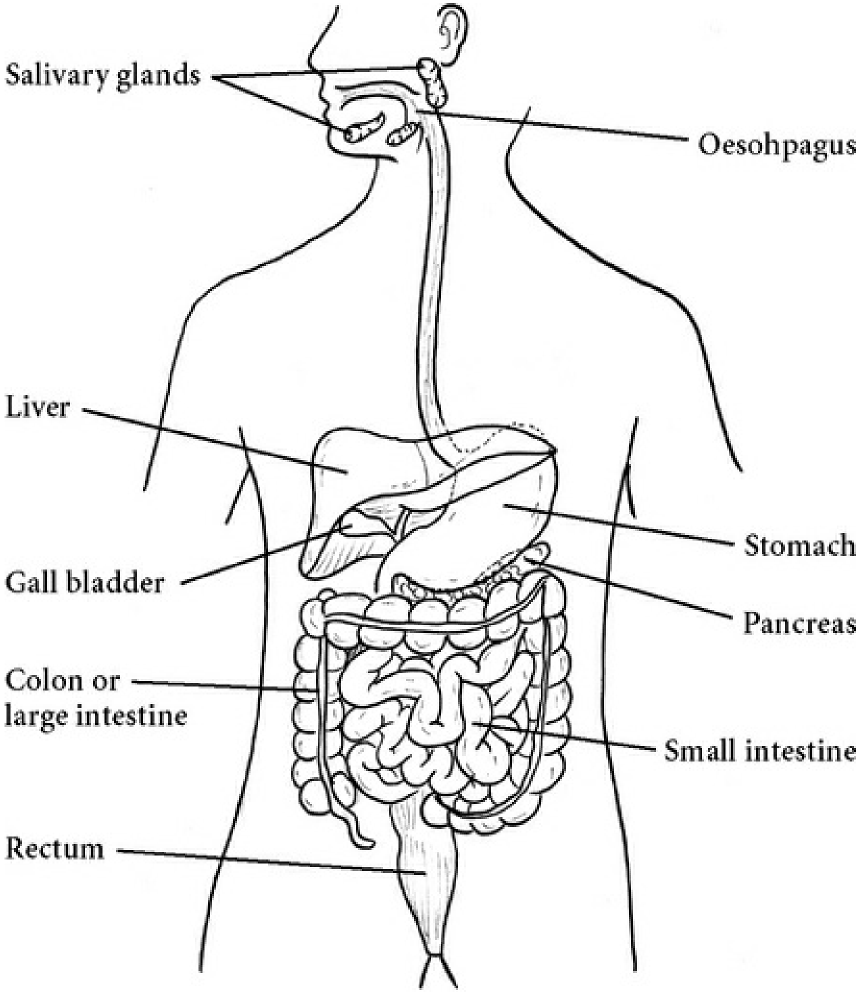

FIGURE 11.2. Digestive system

There are four activities in the digestive system: ingestion, digestion, absorption, and elimination. In plain English this means eating food, breaking it down, taking into the bloodstream what we want, and getting rid of what we don't want. We eat and break down food into component parts by churning it up and mixing it with digestive enzymes, then (mainly in the small intestine) we absorb the bits we want. The rest stays in the tube, and in the large intestine we absorb water from it to make it solid then excrete this unwanted matter as feces. We will now take a look at the processes that go on in each part of the gastrointestinal tract, starting at the top.

The Mouth

Chewing mechanically breaks down food. This mastication involves the thirty-two teeth, the lips, the tongue, and the muscles of the cheeks (called masseter and temporalis).

A small proportion of dentists are interested in looking at dental health in a holistic way—in other words, considering that problems in the teeth can be related to problems elsewhere. There is said to be a correlation between individual teeth and energy lines or meridians in the rest of the body; for example, low-level chronic inflammation from a root canal persisting at the dead root of a tooth (and which may be difficult to detect because the nerve has been killed) can cause problems elsewhere in the body.[4]

Saliva is a watery fluid made and secreted by the three pairs of salivary glands (the parotid, sublingual, and submandibular glands). Saliva contains salivary amylase, which begins starch digestion, breaking down starches to the disaccharide maltose. About 1.5 liters per day of saliva are produced, being a mixture of water and mucus. Saliva also contains lysosyme, a disinfectant that lyses the cell walls of bacteria to destroy them. Production and secretion of saliva is under autonomic control (it happens automatically). Like all other digestive activities, it is stimulated by parasympathetic nerves and inhibited by sympathetic stimulation. This means that when we are afraid, we get a dry mouth. If you concentrate on keeping your mouth full of saliva, you can encourage parasympathetic action in your nervous system. I know of a surgeon who operates without anesthetic, using biofeedback mechanisms to help his patients stay in a relaxed state; one important thing is keeping the mouth full of saliva. A dry mouth increases sympathetic activity and therefore our sensation of fear (in other words, when you get afraid the fear dries out your mouth, and that in turn makes you more afraid). It seems that if the mouth is wet we are less likely to become afraid and tense. Have you ever noticed yourself salivating with pleasure or anticipation?

The presence of food in the mouth, as well as the smell and even the thought, of food, begins this reflex secretion. Swallowing begins as a conscious movement, then as the food reaches the back of the tongue, a reflex automatic swallowing action takes over, continuing as a **peristaltic wave** in the longitudinal and circular muscle layer of the whole of the digestive tube. The first part of this is called the food pipe, or **esophagus**.

The Esophagus

Peristalsis propels food along the alimentary canal; gravity is not required. Generally, it takes about one second per inch for swallowed food to reach the stomach.* The esophagus is designed to withstand a certain amount of rough treatment: it is lined with compound epithelium and its mucosa produces a good layer of mucus with which to protect itself. At the bottom the esophagus passes through the diaphragm, which helps to form a sphincter muscle—the cardiac sphincter (or lower esophageal sphincter)—which should only allow food to pass down into the stomach (except if it should need to open to allow vomiting). If this sphincter stops working properly, a person suffers from reflux of stomach acid into the esophagus, which can cause a painful inflammation, known as reflux esophagitis or heartburn. If the sphincter becomes badly incompetent, part of the stomach can herniate (protrude) through it. This is the very painful condition called hiatal hernia.

The Stomach

The stomach functions as a reservoir. Although a continuous part of the tube, it can close itself off and form a bag by closing the cardiac and pyloric sphincters (the pyloric sphincter blocks the exit of the stomach into the small intestine). The stomach receives eaten food and mixes it with **gastric juice**, containing **hydrochloric acid**. Hydrochloric acid has the incredibly acidic pH of 1, which is so strongly acidic it would burn your skin if dropped onto it. Gastric juice also contains **pepsinogen**, mucus, water, intrinsic factor, and gastric lipase. Gastric juice is secreted in varying proportions as a result of a local hormone called **gastrin** being released by the stomach's g-cells; gastrin is secreted when peptides are detected in food entering the stomach. Thus the amount of acid secreted varies according to the protein content of a meal and by the stomach being stretched.** Gastrin also increases movement in the stomach. This is a neat example of the way the digestive system controls itself. As well as being affected by outside stimulus (such as by the nervous system), activity in each part often stimulates the next section to ready itself for action.

The pepsinogen is activated into **pepsin** by the hydrochloric acid, which also acts as a superior solvent to water. Pepsin must be made in its inactive form, since its function is to dissolve and digest protein, and as the body is made of protein. If it were made in active form it would simply digest the stomach cells as soon as they made it. When the pepsinogen and acid meet, the pepsinogen is activated into pepsin and begins protein digestion. The hydrochloric acid is also a strong disinfectant, killing ingested bacteria and parasites, and it acts as the stimulus to secretion of CCK **(cholecystokinin)** by the duodenum, which in turn causes secretion of **bile** and **pancreatic juice**. To protect itself from the strong acid, the stomach lines itself with a millimeter-thick layer of alkaline mucus.

Once the pepsin begins protein digestion, food is churned into **chyme**, which, within a few hours, enters the small intestine. Stomach emptying rates vary with different meals—carbohydrate meals empty sooner than protein and fat meals. Light fruit and vegetable meals may only stay an hour. Meals heavy on fat and meat could stay up to six hours. The rate of emptying is controlled by nerves and hormones.

The Small Intestine

The small intestine comprises three parts: the **duodenum, jejunum**, and **ileum**. In an adult the whole thing is about 6 meters (20 feet) long, and 1 inch thick. It has the same four layers as the rest of the gastrointestinal tract. The entire population of epithelial cells in the intestine, which has secretory cells as well as absorptive cells, is replaced every few days.

The muscle layer, or **muscularis**, of the small intestine carries out movements called **segmentation** as well as peristalsis (segmentation, is as it sounds, a closing off of small segments of the tube at a time). It is in the small intestine that digestion is finished and most of the absorption of nutrients occurs, so it is perfectly designed for these processes. In the first part, lots of digestive juices are squirted into the duodenum to finish off the digestion of starches, fats, and proteins.

The wall of the small intestine is adapted to give maximum surface area, being folded and made up of small projections called **villi**. Each **villus** contains a central lymph duct, called a **lacteal**, into which fats are absorbed into a network of capillaries that form part of the **portal circulation**. The epithelial surfaces of the villi send up tiny projections called **microvilli**, which further increase the surface area. This all means that there is a vast area of mucosa for digested nutrients to be absorbed by.

Looking at the small intestine in parts, there are three sections. The first is the **duodenum**. About 10 inches long, the mucosal walls here (as well as in the next part, the jejunum) produce two local hormones called **secretin** and **cholecystokinin** (CCK), as well as other regulating hormones. Secretin causes the pancreas to make and secrete a bicarbonate-rich fluid to neutralize the acid of the stomach, and it inhibits stomach functions, slowing things down there—basically opposing the actions of gastrin. CCK acts on both the gall bladder and the exocrine part of the pancreas, causing bile and pancreatic juice to be secreted. These enter the duodenum together at the **sphincter of Oddi**. However, CCK is also a neuropeptide—a neurotransmitter or brain chemical that works in the brain to stop us feeling hungry. CCK also has receptors in the immune system and spleen. It is probable that the effect of CCK on these is to quiet down the immune system. Eating heavily generally does depress immune function, which makes sense as it lessens the chances of newly absorbed foods being treated as foreigners and triggering an immune response.

The **intestinal neutralization equation** expresses the process of maintaining the body's acid-base balance. It is what happens in our small intestine when stomach contents containing hydrochloric acid (HCl) enter it. The acid would eat into our intestinal wall and damage it, but the liver and pancreas make sodium bicarbonate ($NaHCO_3$), which enters the small intestine with bile and pancreatic juice and neutralizes the stomach acid into a very weak acid called carbonic acid.

Hydrochloric acid + Sodium bicarbonate = Sodium chloride + Carbonic acid

(Strong acid) $\longrightarrow$ (Weak base) $\longrightarrow$ (Salt) $\longrightarrow$ (Weak acid)

Exocrine glands secrete into a local area of the body. Endocrine glands secrete into the blood, therefore their secretions (hormones) travel all over the body and can have far-reaching effects. The pancreas has two parts: an exocrine part that secretes digestive enzymes into the small intestine, and an endocrine part, secreting the hormones that control blood sugar into the blood (insulin and glucagon).

Candace Pert has done years of research on neuropeptides, or, as she calls them, the "molecules of emotion."[5] There is a two-way communication between the brain and the body, mediated by these small proteins for which receptors can be found all over the brain and body. This communications network translates into our experience as memories stored in the body, and illness or disease being expressed in our emotions and in our bodies—and this is very much a two-way street. As the ancient Chinese understood, strong emotions can affect our physical functions, but also if our physical functions are out of balance, these in turn affect our emotions.

As we have already discussed, the whole gastrointestinal tract has a vast and complex nervous system of its own, the **enteric nervous system** (ENS), in addition to its parasympathetic and sympathetic supply. Digestive processes are accelerated by parasympathetic stimulation from the brain and slowed down by the sympathetic stimulation of the fight-or-flight response, but many of the processes of digestion are mediated by internal nervous control. The ENS completely regulates peristalsis, and other digestive functions are carried out without interference from the central nervous system. The particular relationship between the brain, emotions, and gut functioning have long been recognized by some systems of natural healing, as well as in common understanding (think of the many references there are to gut feelings, butterflies in your stomach, can't stomach it, and so on).

Pancreatic juice contains enzymes to digest starch, protein, and fat. Bile emulsifies fats. You can think of bile as being like detergent. Have you ever tried to wash up a fat-covered plate without dish soap? The water simply runs off the oil. This is because fats and oils like to stick together, but don't like water. What dish soap does is **emulsify** the fats—it gets in there and separates the fat molecules, encouraging them to mix with the water instead of sticking together. Bile basically does the same thing—it doesn't actually digest the fat molecules (break them down into fatty acids and glycerol), but it separates them out so the lipases—the enzymes that digest fats—have a bigger surface area to work on.

The other parts of the small intestine are the **jejunum** and **ileum**. Digestion is completed here as bile emulsifies fats, and pancreatic juice containing proteases (which are secreted in inactive form and activated by the hormone enterokinase—just like the pepsinogen in the stomach being activated by hydrochloric acid), lipases, amylases, and nucleases continue breakdown of food to its building blocks: proteins into amino acids, fats into fatty acids and glycerol, starches into sugars, nucleic acids into amino acids, sugars, and phosphate.

Absorption of Nutrients

No matter how good your gut is at digesting the food you eat, if you can't then absorb the nutrients into the blood, you will starve. Absorption occurs by passive and active mechanisms. The small intestine wall is folded many times, with villi and microvilli, to create a huge surface area. The nutrients are absorbed across the absorptive cells and enter either blood capillaries, or the lacteal (lymph duct),[*] in the case of fats. The blood capillaries join into venules, which join into veins, which join to form the **hepatic portal vein**. This is a major vein that goes to the liver, ensuring that any substances that enter the bloodstream go first to that amazing organ of detoxification.

Malabsorption

Malabsorption can result from anything that interferes with normal digestion: a problem with bile or pancreatic juice getting to the small intestine or damage to the mucosal lining, for example. The incredibly complex nature of the digestive processes means there are plenty of potential nutrition problems.

Naturopathic medicine and nutritional therapies recognize a lot more complex nutritional deficiencies than does orthodox medicine, which really only considers the most enormous problems, such as celiac disease (or gluten enteropathy). This is a disorder resulting when gluten, a protein from wheat, rye, barley, and oats, is poorly digested and damages the intestinal villi resulting in diarrhea, pain, and malnutrition. Strangely, it seems orthodox medicine has not caught on fully to the importance of good nutrition—think of the food you get to eat in the hospital!

Leaky Gut Syndrome

Whole proteins are not usually absorbed. They are too big to cross the epithelial lining of the gut. Sometimes this lining becomes impaired and "leaky," allowing proteins that would normally not have been absorbed to enter the blood. Strange proteins in the blood upset the immune system, which instigates an immune attack against them. This is how some food allergies and intolerances appear.

Leaky-gut sensitivities are very common in infants as the mucosa is immature—probably deliberately to allow IgA (immunoglobulin A) antibodies in breast milk to reach the infant's blood stream. Also, it is thought that some foods are hard to digest and therefore more likely to be a problem (wheat and dairy, for example). Once there is a problem with one food, the gut wall can be impaired and more foods become problematic. The problem is not so much with the foods themselves, or the immune system, as with the gut.

The Large Intestine, or Colon

After the small intestine, the chyme enters the large intestine, or **colon**, which is about 4.92 feet (1.5 m) long. The colon begins at the lower right abdomen with the **caecum** (from which the appendix comes), then goes up and around the belly, as the **ascending, transverse, descending**, and **sigmoid colons**. Here in the colon is where water and any nutrients left are absorbed from the digestive waste, making it more solid. This waste is known as **feces**. For the colon to work well, we need plenty of dietary fiber in our diet. Fiber, which we used to call **roughage**, consists of the edible parts of plants that our intestine cannot digest and absorb. In the large intestine, fiber is fermented by bacteria to produce gases (carbon dioxide, methane, and hydrogen) and short-chain fatty acids (butyrate, acetate, and propionate). These short-chain fatty acids are absorbed and used by the epithelial cells of the gut wall for fuel, or passed into the bloodstream.

On beginning to eat more fiber a person will often initially get bloated and suffer from gas (wind), but usually the bacteria in the gut soon adapt to the increased fiber and these problems decrease. It is essential for health to have a good colony of bacteria in the gut. There are different types of fiber and we need them all. This means eating fruit and vegetables that contain **soluble** fiber, as well as whole grains and cereals that contain **insoluble** fiber. Fiber helps to prevent constipation (especially insoluble fiber, when taken in with plenty of water), lowers blood cholesterol, and maintains stable blood glucose levels (soluble fiber). A low-fiber diet (such as is eaten by meat eaters who do not eat sufficient fruit and vegetables) is associated with bowel diseases like diverticulitis and even bowel cancer. The type of soluble fiber called FOS (fructooligosaccharide) is a **prebiotic**, which is the food of choice for the healthy, helpful bacteria in the gut. (The helpful bacteria are called **probiotics.)** Eating plenty of this helps to ensure a healthy gut flora (more below).

Some bacteria enter the large intestine at the caecum, even though most should have been killed off by the various acids and digestive enzymes of the stomach and small intestine. These bacteria thrive in the bowel, which is a good thing, as they make B vitamins and most of the vitamin K we need for blood clotting. Some of them make gases called **flatus**, a variety of which can be pretty smelly! Most bowels make about half a liter a day of gas. This can vary depending on the diet.

Naturopathic medicine gives a lot of thought to what is going on in the bowel, asking the question "Is there a healthy gut flora?" This refers to having the right balance of the best bacteria in the gut. These are the same bacteria that make yogurt from milk—**acidophilus** and **bifidobacteria** being the two main types. Good gut bacteria can be established at birth—if we are born in the optimum natural way, our head comes out right past our mother's anus. Any residual feces in the maternal bowel will have been squeezed out while we were being pushed out, so there will be plenty of her gut flora hanging around at the entrance to our world. Then we get put to her breast, right next to her armpit, where there is a particularly high concentration of bacteria living. Thus we get "colonized" by the right bacteria, our mother's (assuming, of course, that she doesn't have a problem with her gut flora). Having a good colony of the right bacteria living with us means there is less room for undesirable, disease-causing bacteria to move in and create problems. Breast milk, by far the best food for infants, promotes the growth of bifidobacteria (which represent ninety-five percent of the bacteria in the gut of a breastfed infant, compared with twenty-five percent in a bottle-fed baby). Breastfed babies are much more resistant to stomach upsets and diarrhea.[6]

Problems here are very common. Being born in the hospital with any difficulties often means we are immediately removed from our mothers, so we don't get that initial opportunity to be colonized by the best sort of bacteria. Antibiotic therapy, while sometimes essential for keeping us alive, knocks out the healthy bacteria of our gut as well as any pathogenic ones (broad-spectrum antibiotics are the worst). Once the helpful bacteria are gone, there is the opportunity for less helpful ones to thrive, plus potentially problematic yeasts such as the Candida that causes thrush and is normally found living with us anyway, but can become a problem if allowed to grow too much.

A diet full of refined carbohydrates and sugar feeds this kind of problem. Hormone therapy such as the contraceptive pill and hormone replacement therapy (HRT), commonly prescribed for menopausal women, also encourages the wrong sort of gut flora. Excessive flatulence—farting—can be a sign that our gut flora is not as good as it could be.

While eating the right kind of probiotic bacteria—like live yogurt—can do us good, in itself it is not an effective lasting treatment for poor gut flora. More effective is to feed our helpful bacteria what they like to eat. This will make them multiply and grow, crowding out the "bad guys." What good bacteria in the gut like to eat are called prebiotics—nondigestible oligosaccharides. These are the plant equivalent of fat—they are how the plant stores energy in a concentrated form. The two main ones are inulin and FOS (fructooligosaccharides, sometimes known as oligofructose). They are found in many plants, the best being chicory root, Jerusalem artichoke, leeks, onions, wheat, bananas, grains, and vegetables. The longer vegetables have been stored in cold storage before ending up on the supermarket shelves, the lower their inulin content.[7]

When fecal matter enters the **rectum**, its incredibly sensitive stretch receptors trigger the **defecation reflex**. If circumstances are favorable the feces may then leave the body via the anus. The defecation reflex is interesting, in that it can be overridden if the time is not convenient. In ordinary circumstances, you can ignore the feeling, and suppress your defecation reflex. Only trouble is, what tends to happen then is that you have trouble going later when the facilities are available. Regularly suppressing the reflex can lead to problems with constipation.

Brown Gold

In rural China of long ago, poo was of great value. Any passing visitor was strongly encouraged to make a contribution to the family's privy before leaving. The toilets were not the water-guzzling systems of today, but dry toilet systems that served as compost bins. The basic model is just a big hole, to which cellulose like hay or straw or sawdust or cardboard is added, along with all the feces and urine.

After only one year of composting, excrement turns into top-quality soil or compost. And after two years, any pathogenic bacteria normally found in feces, such as *E. coli*, have gone. Nowadays permaculture people generally use "humanure" on crops such as fruit trees rather than lettuce, but it is still regarded as one of the best fertilizers in existence.

Many people are horrified by the thought of a simple compost toilet, yet happily put not only enormous quantities of fecal matter into the sea, but also all those brightly colored smelly chemicals called "cleaning" products along with it. Meanwhile, we make artificial nitrogenous fertilizers that take much energy to produce and are quite toxic in ways we are only just beginning to realize, to put onto our crops, which need them because the soil is so depleted (from lack of proper composting). It simply is not good homeostasis!

In traditional Chinese medicine, the colon—or Colon Official—is known as the "Official who brings Purity and Sparkle." Without getting rid of the dregs, the leftovers, the rubbish, there can be no purity and sparkle in our cells and tissues. The Colon Official not only operates in the bowel, but is the energy responsible for removing rubbish or waste from every cell in the body, and indeed from every part of the mind and spirit. A person suffering from a serious colon imbalance can smell really rotten—like rubbish or even feces.

The Peritoneum

Lining the walls of the abdominal and pelvic cavities and surrounding the abdominal organs is a serous membrane similar to the pericardium and the pleura, made of a mix of connective and epithelial tissue. This membrane, the **peritoneum**, is a double-layered membrane with one layer lining the walls and one layer snug to the organs. Between the two layers is a potential space called the peritoneal cavity.

Development of the Digestive System

The very young embryo is flat and consists of three **germ layers**—layers of different types of cells—called the **ectoderm, mesoderm**, and **endoderm**. These layers fold to form a cylindrical body, and it is the internal cavity of this that becomes the cavity of the digestive tract. This tube is closed at both ends to start with. The endoderm at the very front touches a part of the ectoderm called the **stomodeum** (meaning "on the way to becoming the mouth"). These two layers, also called membranes, fuse together to make the oral membrane that then becomes the mouth. A similar thing happens at the other end, with the endoderm fusing with the ectodermal **proctodeum** to make the **cloacal membrane** that forms the anus.

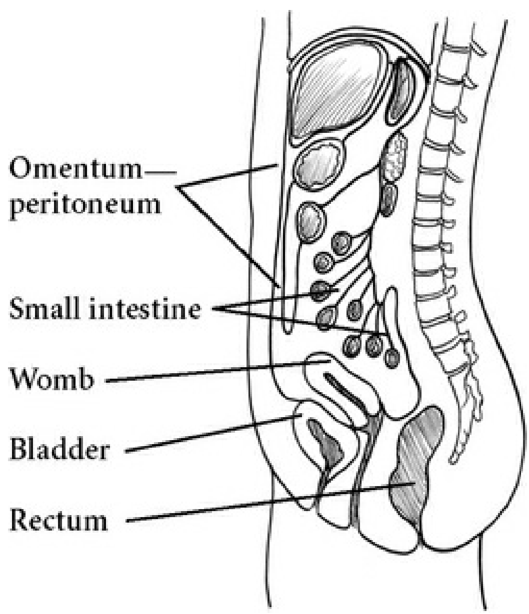

FIGURE 11.3. The peritoneum

By the eighth week in the womb, the tube is continuous from mouth to anus and is open to the external environment at both ends. Soon after this the glandular organs—salivary glands, liver, gall bladder, and pancreas—bud out from the tube. They keep their connections to the tube, these becoming ducts opening into the digestive tract. Although the fetus gets its nutrients from the mother's blood via the placenta, its gut tube practices by swallowing amniotic fluid. This helps the development and maturation of the gastrointestinal tract. Sometimes things go wrong with the development of the gut, including cleft palate, cleft lip, and tracheo-esophageal fistula. These are usually surgically corrected.

A **fistula** is an abnormal connection or tube or opening between two adjacent body tubes that normally are not connected. In this case, there is a connection between the esophagus and the windpipe, which obviously can cause serious problems with breathing when milk enters the windpipe.

The newborn infant grows amazingly quickly, doubling its birth weight in six months. Its stomach is very small (about the size of a walnut), so it must eat little and often. Breast milk is the best food for a baby. The epithelial lining of the infant gut, as discussed with the immune system, is immature and much more leaky than an adult gut. This is probably to allow the passing of the mother's antibodies, which are proteins, into the baby's blood. Many health problems can come as a result of not being breastfed. To avoid likelihood of allergy development, a newborn should have only breast milk for the first six months, or longer if the child shows no great interest in other food and is developing well, and should be best kept away from common problem foods like wheat, sugar, or cow's milk until a year old. Of course, any preservatives, colorings, or other additives should be permanently avoided if possible.

The teeth start to grow when the baby is about six to seven months old, and come in fully by about age two (although the back molars can be later), by which time a baby is eating an adult diet. Most children have a full set of twenty baby teeth by the time they are three. The baby teeth are pushed out by the permanent teeth growing behind them, starting from the age of about five or six and finishing by the age of fourteen, by which time most children will have lost all their baby teeth and will have a full set of twenty-eight permanent teeth. At around age twenty, four more teeth usually grow at the back of the mouth—these are the so-called **wisdom teeth** and complete the adult set of thirty-two.

In **old age** the digestive processes decline. This is explored in more detail in Chapter 18, on aging.

A Healthful Diet?

Opinions vary widely about what constitutes a healthful diet. And I'm sorry to say the average general practitioner or family doctor is rarely a reliable source of information about optimum nutrition. The standard British and American diet is not so healthful: a preponderance of animal fats, wheat, and sugar is not really a good recipe for health. It is strange that the current obesity problem in both countries comes as a surprise to anyone. It's really not enough to just eat five portions of fruit and vegetables a day—aim for ten, if you want to eat healthfully. Basically, aim to cut out additives as much as you can and keep off drugs, including tea, coffee, alcohol, and tobacco. Eat fresh foods, predominantly vegetarian (vegetarians live six to eight years longer than meat eaters). Stick with so-called whole foods—unrefined brown rice, brown pasta, and multigrain breads. Keep sugar to an absolute minimum.

Try and cut out wheat and dairy. Give it at least a month, and then reintroduce them one at a time, to see how you feel. Many people discover they feel better without them.

Drink mainly water. Bear in mind that fruits and vegetables contain lots of water. If you want the flavonoids from red wine, try grape juice instead or eat lots of red-colored fruit and vegetables.

To anyone who says this sounds like a boring diet, I say, why not try for a few months? You can feel so much better on good food that it soon becomes the kind of food you really fancy; feeling lethargic and low from a less healthful diet soon looks less appealing and interesting. If you need help with adjusting to a healthful diet, consult a nutritional therapist.

Here is something to consider about processed "food," adapted from an editorial in the *British Medical Journal* (18 May 1996)[8] about how the food industry resists responding to the need to reduce salt in processed foods, even after the connection with high blood pressure and heart disease has been completely established:

> The world's food and soft drink industry spent over 550 million pounds [about 900 million dollars] on advertising in 1994, compared with less than five million pounds [about eight million dollars] on promoting fresh fruit and vegetables. In Britain, basic cooking skills are in decline as processed foods make up more of the average diet. To counter these forces governments will need to invest substantial resources in health education. The British government should

be congratulated on the achievements of the Health of the Nation [a research project set up in 2003 to track biannually the concerns and opinions of GPs]. But if it is serious about reducing premature deaths from cancer and heart disease it will need to ignore the voices of vested interest and listen to the advice of its independent expert advisors.

Interrelationships

The digestive system delivers the nutrients required by every cell of each of the body's systems, so is vital to them all. The nutrients processed in the gut enter the blood or the **lymph** and are transported around the body by the **cardiovascular system**. Food is moved through the gut by action of its smooth muscle lining, and tone and condition of the **skeletal muscles** is involved in healthy bowel function. The diaphragm massages the abdominal organs and keeps them healthy, and forms part of the cardiac sphincter that stops food from moving up from the stomach into the esophagus. The digestive system works with the **bones** under control of the **endocrine system** to keep calcium balance in the blood right. The endocrine and **nervous system** are very much involved in regulating the functions of the digestive system.

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*Actually, opinions are changing on the saturated-fat question. A lot of the studies comparing the health benefits of saturated and unsaturated fats lumped saturated and trans-fats together, thus invalidating the results. It is more likely that trans-fats and rancid unsaturated fats are the main problems. Even though we have moved away from cooking with lard and butter toward cooking with vegetable oils, heart disease is increasing, not decreasing. Consider also that Eskimos eat very high amounts of saturated fats and yet are very healthy, having much lower incidence of heart disease and similar diseases. As an aside, skimmed milk is dangerous and can lead to prostate cancer and other diseases—a risk that is avoided by using whole-milk products. Further, saturated fats may be more protective than harmful. It is most likely that fresh, organically grown or wild-crafted foods that are unprocessed, or minimally processed, are best. More on this later.

*To get more information on this important topic, take a look at Ruth Trickey, *Women, Hormones and the Menstrual Cycle: Herbal and Medical Solutions from Adolescence to Menopause*, and Paul Clayton, *Health Defense: How You Can Combine the Most Protective Nutrients from the World's Healthiest Diets to Slow Aging and Achieve Optimum Health*.

*There is a way of making a curd from grass and stinging nettles that we can eat to access amino acids. It's called leafu and it involves a lot of boiling and skimming and pressing. You end up with a very dark green stuff that tastes a bit like seaweed and is highly nutritious. According to Michael Cole, via info@leafcycle.co.uk: "The basic principal is to juice lush leafy matter [not gone to seed] and heat the filtered juice just to boiling point. The resulting green scum you skim off and put in … fine cloth and press slowly but very well to get all the fluid out [may take several hours]. You end up with the scum turning into a dark green tablet that can be cut up and added to food."

*Plus, it seems there is a protective anti-cancer effect from eating soy, at least in traditional ways such as in tofu and tempeh as is done in Japan. Levels of breast cancer there, for example, are much lower than in the West. It's likely, however, that soy milk, which is a more recent invention, is not so good. Of course, the Japanese also have a diet very high in Omega-3s, which no doubt has a positive effect.

*The **complement system** is a cascade of chemicals that helps clear pathogens from the body. It is part of the innate immune system; however, it can be recruited and brought into action by the specific immune system. Small proteins circulate normally in the blood, and when stimulated they change to release cytokines, which attack the membranes of pathogens. Proteins in this system account for about five percent of the globulins in the blood.

*Candace Pert discusses this fascinating subject in her book *Molecules of Emotion: Why*

You Feel the Way You Feel.

*Herbalists in Britain used to do the “deglut” test to check the speed of a person’s peristalsis. The patient lies down, and holds a small amount of water in the mouth. The herbalist has a stethoscope over the patient’s stomach, and looks at a watch with a second hand. When the herbalist says “go,” the patient swallows. The time it takes to hear a gurgle as the water enters the stomach is noted. If it takes much less than 7–8 seconds, it may indicate hypermotility in the GIT. If it takes much more than 8–9 seconds, it may indicate slow peristalsis. This would not be used on its own as a diagnosis, but to provide another piece of the diagnostic puzzle.

**Interestingly, the acid secretion is actually controlled by gastrin causing histamine to be secreted, which then affects acid secretion. Thus taking antihistamines regularly canhave an effect on your digestion. Also, the brain uses histamine as a neurotransmitter—it stimulates brain activity, making lots more glucose available for the brain cells, which we need in a tricky situation. This is why *anti*histamines make you drowsy.

*I wonder about the increased incidence of many cancers in meat eaters, as compared with vegetarians. Surely a high-fat diet and eating meat and dairy products daily, as many in the industrialized West do, clogs up the lymphatic system. There must be loads of fat entering the lymph duct, and it seems likely that this extra load would make it harder for the lymphatic system to do its work of cleaning things up.

CHAPTER 12

The Liver

The liver is a very large organ with more than a thousand known functions. Don't worry, we won't discuss them all here! We will look at some of the main ones.

Liver cells, or **hepatocytes**, are arranged in **lobules** around a central vein. Extra-leaky blood capillaries called **sinusoids** (or sinuses) run down to this central vein carrying blood from the **hepatic portal vein** and from the **hepatic artery**. Small **ductules** receiving the bile made by the hepatocytes run the other way from the blood and take the bile to the gall bladder.

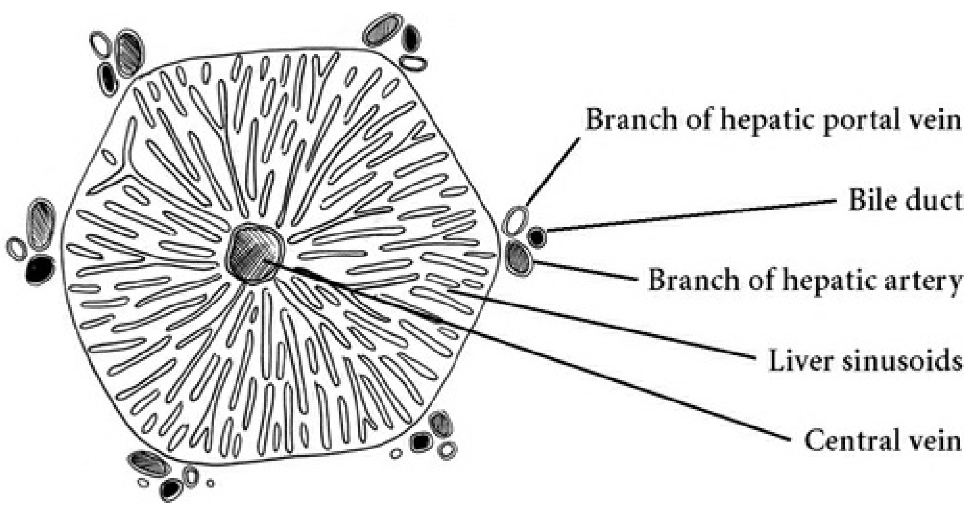

FIGURE 12.1. Liver lobule

Creating Bile

This is one of the main roles of the liver with respect to digestion. The liver lobules are specially arranged to secrete bile. Cells are arranged in a hexagon around a central vein, with a peripheral connection receiving incoming blood into sinusoids (very porous capillaries). This incoming blood is a mixture of blood from the hepatic artery and the hepatic portal vein (the latter containing all substances recently absorbed from the gut). Hepatocytes secrete bile into small channels called **canaliculi**, which then join up to form the **bile ducts**. The bile flows in the opposite direction to the blood, to prevent their mixing. The hepatocytes get the ingredients of bile from the blood; these are water (ninety-seven percent of the bile), plus bile salts that are formed from cholesterol, some inorganic salts like sodium bicarbonate to make the bile alkaline, and bile pigments, which are made from the breakdown of hemoglobin from old red blood cells.

Bile pigment is a water-soluble yellow substance. It is what gives urine and feces their characteristic colors, being either excreted by the colon or absorbed into the blood and excreted in the urine. If there is a problem in the liver blocking bile from entering the gut, this results in jaundice, or yellow skin, due to the pigment building up in the blood, and therefore in the skin. Besides having jaundice, the person will have dark urine but a very light, putty-colored stool or feces; the pigment is all in the urine, being water soluble and excreted by the kidney, but none is in the stool because it cannot get from the liver into the intestines.

After the liver cells make it, the bile goes to the gall bladder, where it is concentrated by water being removed from it, and stored until needed. Some other functions of the liver:

- Making plasma proteins. These include **albumin**, which provides the osmotic pressure of the blood, **fibrinogen** involved in clotting, and **immunoglobulins** for the immune system. Thus a healthy, well-functioning liver is crucial to immunity.
- Making urea. Old amino acids that contain nitrogen are broken down in the liver and **deaminated** (that is, the amino groups are removed); the nitrogen (which is poisonous to the body) is packaged in a convenient water-soluble molecule called **urea**, which can then be excreted by the kidneys in urine. Mixed with cellulose (for example, from cardboard), urea makes wonderful compost—the nitrogen is returned to the soil for plants to use as they make amino acids.
- Detoxifying hormones, drugs, and alcohol. The liver cells take up alcohol that enters the liver and denature it—breaking it down and making it no longer alcoholic. If your liver isn't working well, drinking a small amount of alcohol will make you very drunk for a long time—this is what happens to alcoholics sooner or later. Many special pathways in the liver are involved in breaking down drugs—making them stop working, or converting them into an excretable form. This includes hormones as well as introduced drugs. (Remember, the only way your stress hormones can be excreted whole is in tears—otherwise, the liver must deactivate them. So, do your liver a favor: become a cry baby today!)
- Processing digestive products.
- Storing iron and vitamins A, D, E, and K.

- Storing glucose as glycogen (see the next section).
- Making heat. Due to all the chemical reactions going on there, the liver generates a lot of heat. This can be transported throughout the body via the blood.

The liver has a huge role in the regulation of metabolism. Some of these processes have already been mentioned, but as it is so important it is worth taking a more detailed look at it.

Blood Sugar Metabolism and Its Nervous and Hormonal Regulation

Only simple sugars are absorbed in the gut: glucose, galactose, and fructose. The body likes glucose, so the liver converts galactose and fructose to glucose, and it is normally the only sugar in the blood. The brain *must* have glucose to make energy for its activities. Skeletal and cardiac muscle prefer it too, but can use fatty acids instead.

The liver is known as the **glucostat** organ; it has a central role in keeping the blood sugar balanced. It stores glucose as glycogen when blood glucose is high, and releases it back into the blood as glucose later. The liver stores, as glycogen, one hundred times the amount of glucose as is found in normal blood. A hormone called **glucagon** from the pancreas causes glycogen to release its glucose into the blood when the blood sugar is low. (Muscle stores glucose as glycogen too, but cannot release it back into the blood; the storage is for its own use.)

The liver can also convert excess glucose to fats and proteins. When the glucose in the blood is low, the liver can *make* new glucose from amino acids and from fats, as well as from lactic acid (made in muscle during anaerobic respiration, or glycolysis). The making of new glucose is called **gluconeogenesis**.

Carbohydrate metabolism is controlled by the nervous system and hormones; nerve regulation is mediated in the **hypothalamus**. Low blood glucose (hypoglycemia) a few hours after a meal leads to sympathetic arousal with release of adrenalin and noradrenalin from the **adrenal glands**. These substances, which are both neurotransmitters and hormones, act on the liver to cause glucose release from glycogen, and on adipose tissue to break down stored fat into fatty acids and glycerol. The heart and muscles then use fatty acids for energy, sparing glucose for the brain. Also hunger centers are activated, and the hypothalamus stimulates the **anterior pituitary** to secrete a hormone called adrenocorticotrophic hormone (ACTH), which causes release of cortisol from the adrenal cortex, and growth hormone. These hormones act together to cause stores of energy to be released; glycogen is converted to glucose, triglyceride fats to fatty acids and glycerol. In addition, cortisol promotes the making of new glucose from amino acids in the liver. In addition to the catecholamines (adrenalin and noradrenalin, known in the USA as epinephrine and norepinephrine), cortisol, and growth hormone, the blood sugar is raised by glucagon from the pancreas.

Metabolism and Regulation of Fat

Remember that fats are made of carbon, hydrogen, and oxygen and are actually very like sugars. There are two general types of fats: fuel and structural. The main **fuel fats** are neutral fats or triglycerides. The **structural fats** are cholesterol and phospholipids, used for making steroid hormones, vitamin D, myelin tissue, and cell membranes. Fats are an ideal compact way of storing energy in a small space; they represent much more energy per gram than carbohydrates.

Fatty acids can be oxidized to make ATP or be converted to amino acids, and glycerol can be oxidized or used to make glucose. Glycerol and fatty acids are stored in adipose tissue as triglycerides; more are stored when fatty meals are eaten. Under stimulation from catecholamines (e.g., adrenaline), growth hormone, and cortisone, the triglycerides are broken down to yield fatty acids and glycerol into the blood. Fatty acids are then used by the heart and muscle as a fuel, thereby sparing glucose for the brain, and the glycerol part of the fat molecule is used to make glucose.

Conversely, insulin is the main hormone promoting fat formation, causing glucose to be transformed into fat and stored. There is also a hormone called **leptin** (from *leptos*, Greek for "thin") that is involved in fat formation; it is made by fat cells and then acts on the hypothalamus to decrease appetite and to increase fat-mobilizing hormones like thyroid hormone. A lack of leptin or its receptors could be a factor in obesity—too little leptin means your metabolic rate is lowered since thyroid hormone levels are lowered too. The body thinks times are hard if you have low leptin, as it will assume there isn't much fat because food supplies are low and will drop metabolism to make available energy go further. This is why excessive dieting can over time actually have the contrary result of people being unable to lose weight: the body goes into starvation mode and tries to hang on to every calorie.

Decreased leptin also increases appetite, making dieting more painful. People who are overweight and trying to lose weight need to be aware of this pitfall of severe dieting. Leptin levels are particularly lowered when carbohydrate intake is low—so don't drop these too much when dieting.

As we have seen, the liver is central to fat metabolism. It can store fats; it can convert glucose into fatty acids; it can convert glycerol to glucose and glycogen. It can also convert fatty acids into some amino acids and vice versa. The only thing the liver can't do regarding fats is make fatty acids into glucose. When carbohydrate supplies are low, the liver breaks down fatty acids to a substance called **acetyl CoA** (acetate) to use as fuel. If this is happening a lot, **ketone bodies** are formed. If ketone bodies are being formed, there is a smell of pear on the breath. This happens in fever and dehydration; small children tend to get it very quickly without cause for alarm, but it also happens in untreated type 1 diabetes with potentially fatal results if unchecked—so if you ever detect that pear smell on someone's breath, it's worth checking out what the cause could be.

The liver also forms **cholesterol**. Cholesterol is not used for fuel but for making things: steroid hormones (sex hormones, aldosterone, and cortisol), vitamin D, the myelin sheath around neuron axons, and the waterproof layer of the skin (sebum). Cholesterol is also the main ingredient of bile salts, which help digest fat. Cholesterol is eaten in animal products (egg yolk, liver, fatty meats, cheese), and also is synthesized by the liver. So, cholesterol itself is not a bad thing—it is essential for life.

There are different types of cholesterol in the blood. The first type, **high-density lipoproteins** (or HDLs), are referred to as “good” cholesterol because they actually protect the body against cardiovascular disease. They are made of mainly protein, with a small amount of cholesterol. **Low-density lipoproteins** (LDLs) get the name “bad” cholesterol. Made mainly of cholesterol with very little protein, LDLs are the ones associated with an increased risk of coronary heart disease. LDLs accumulate more in the body when a person eats a diet high in animal fat and low in vegetable and fruit.

Technological medicine’s answer to high LDL levels is the class of drugs called statins. These have an impressive list of side effects, however. A good alternative is to change one’s diet and take in plenty of vitamin C to ensure our arteries have what they need to make the necessary collagen to repair themselves.*

Metabolism and Regulation of Proteins

More than one hundred thousand different proteins are thought to exist in the body. Twenty amino acids make up all these proteins, and the body can only make twelve of the amino acids from fatty acids or glucose; the other eight must come from the diet. Tissues need amino acids for growth, repair, and normal turnover of cellular proteins; membrane receptors and most regulatory substances in the cell are made from protein.

As with carbohydrate and fat metabolism, the liver is central to protein metabolism. Here, amino acids pool and are used to make liver and blood proteins (albumin, globulin, and fibrinogen), as well as glucose, fats, and energy (ATP). There is a second amino acid pool in the blood and a third pool in the tissue cells. As well as making all the nonessential amino acids, the liver can degrade proteins and deaminate amino acids to form urea, a detoxified form of ammonia that is water soluble and can be excreted by the kidney. Tissue proteins are normally not used for energy production except in times of starvation, and even then proteins of the heart and brain are spared.

Growth hormone and insulin promote the making of proteins during growth by increasing uptake of amino acids and synthesis of proteins in muscle and bone. Thyroid hormone affects protein formation in the heart, skeletal muscles, liver, and kidney. Estrogen (one of the female sex hormones) and androgens (the male sex hormones) cause protein synthesis in reproductive tissues. Cortisol also plays a role in regulation of protein metabolism in that it promotes protein breakdown in many tissues during stress and starvation, and in the liver it increases the uptake of amino acids and the synthesis of enzymes used for gluconeogenesis so more glucose can be made there.

Metabolic Heat and Metabolic Rate

All the vital functions or work of the body require energy, produced from oxidation of food to make ATP. This process of making ATP also generates heat, and many of the functions of the body generate heat (e.g., the friction from muscle contraction and the electrical impulses of nerve conduction). This heat is not wasted but travels in the blood to maintain body temperature—like the central heating system in a house, in which the heat from the water boiler is transported throughout the house via pipes and vents.

The **Basal Metabolic Rate** (BMR) is based on how much energy is needed to maintain the body at rest (lying down), in terms of the caloric value of food. It is considered to be about 2,000 calories per day for the average adult. The metabolic rate decreases during sleep and increases during activity. Young people have a small ratio of body mass to surface area, and thus cannot store as much body heat, so need to eat more—they have a higher BMR than adults. As we age, we generally need to eat less as the BMR is reduced. Metabolic rate is increased by catecholamines (adrenaline and noradrenaline), thyroid hormone, growth hormone, androgens, and progesterone. Eating also increases BMR, as does absorption of foods—particularly proteins, which increase the metabolic rate by thirty percent. Leptin, which is produced by fat cells, also increases metabolic rate.

Regulation of Body Temperature, Heat Production, and Heat Loss

Normal temperature for humans (and other mammals) is 37°C (98.6°F). Metabolic heat is generated and travels in the blood around the body. Only the core of the body—the brain and internal organs—is maintained at the normal body temperature. The limbs, in the absence of movement, have only arterial blood to warm them and tend to be at a similar temperature as the external environment—and thus subject to frostbite or overheating.

Skin plays a major role in heat regulation—it can retain and lose heat as needed. You may remember it does this through capillaries constricting or dilating and through sweating (water evaporation). Also, body hair and subcutaneous fat prevent heat loss. The hypothalamus of the brain has a thermostat that reads body temperature and initiates heat gain and loss responses in the skin, as well as causing us to shiver and engage in other activities such as huddling up, curling up, pacing, or lying down when overheated.

Fever is a special case. Toxins from microbes cause white blood cells to release cytokine hormones that reset the hypothalamic thermostat, setting into motion shivering and skin vasoconstriction to retain heat. As we have discussed, fever is a natural defense response—the heat kills off the bacteria. The body cools itself down after killing off microbes by sweating and skin vasodilatation. If a fever is too high (above 42.2°C, 108°F), the brain may be damaged.

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*This approach was developed long ago by Linus Pauling. The Linus Pauling Institute was established at Oregon State University in August 1996 to carry on the work of the institute's antecedent organization, the Linus Pauling Institute of Science and Medicine (located in California from 1973 to 1996). The institute's basic premise is that an optimum diet is the key to optimum health. You can get more information at http://lpi.oregonstate.edu/resagenda/about.html.

CHAPTER 13

Water Works—The Urinary System

With the function of filtering the blood and excreting urea and excess water from the body, the urinary system consists of two kidneys, two ureters, one urinary bladder, and one urethra. (Remember, urea is the nitrogen-containing, water-soluble substance made by the liver to carry nitrogenous waste from broken-down amino acids out of the body.) This system has two main responsibilities: water balance and waste disposal.

The **kidneys** are found at the back of the body, in the top of the posterior abdominal cavity, tucked up right under the diaphragm on either side of the spine. They are protected by the ribs. If you put your hands on your back so that they are flat on the last few inches of your ribs, they will be right over your kidneys. If you gently tap your kidneys, they may feel a little sensitive; if so, it may be good to give them some love. Actually they need some love anyway, tender or not. It's a good practice to get in the habit of rubbing them every day and thanking them for all their hard work.

The **ureters** are tubes that come one from each kidney, and pass down the flanks to empty into the **bladder**, which is found anteriorly (at the front) at the bottom of the abdominal cavity, just above your pubic bone when it's full. (Try poking around there when you have a full bladder—you will certainly feel it!)

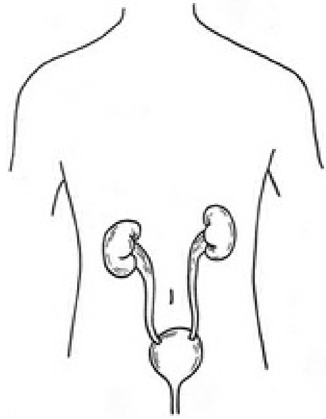

FIGURE 13.1. The urinary system

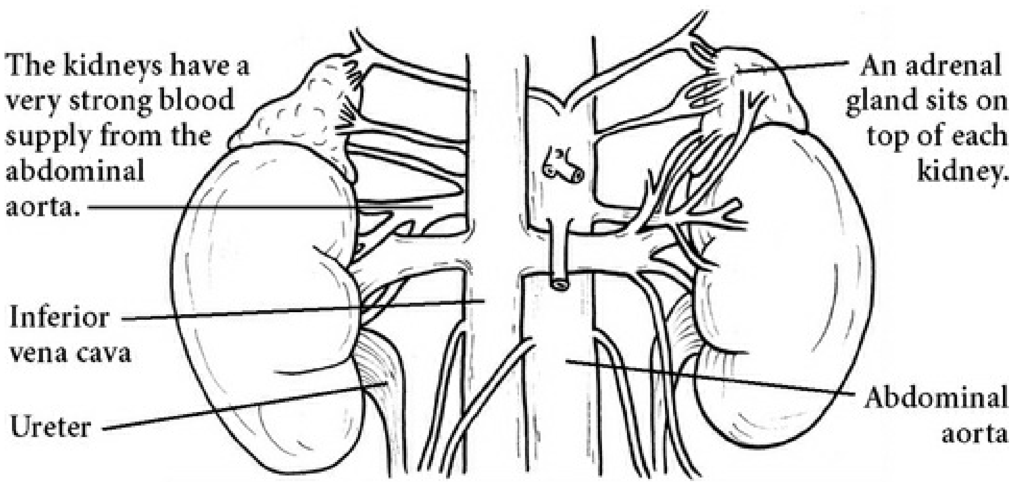

FIGURE 13.2. Blood supply to the kidneys

The kidneys are simply incredible. Every minute they filter 125 ml (one-half cup) of blood. In other words, in less than an hour all the blood in the body has passed through them. Each kidney contains many tiny tubules called **nephrons**. The nephron is the functional unit of the kidney. It is basically a tube that filters the blood. The nephron is quite small—there are about half a million in each kidney.

All small particles (not cells or proteins) in the blood pass out of the **glomerular capillaries** into the Bowman's capsule and thus into the convoluted tubules of the kidney. **Bowman's capsule** is a kind of egg-cup-shaped end of a long tube. The glomerular capillaries, a globular network of permeable, tiny blood vessels, sit inside where the egg would go. Bowman's capsule continues as a tube that leads to the collecting ducts. Proteins and red blood cells are too large to pass out of the glomerular capillaries; therefore they are not normally found in the urine. Important things like glucose as well as varying amounts of water and salts are reabsorbed into the blood from the tubule.

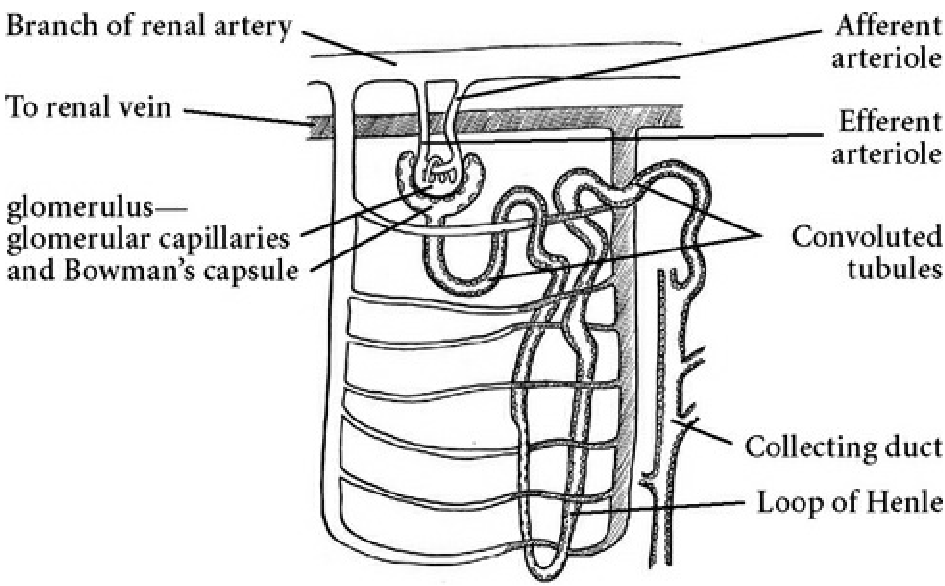

FIGURE 13.3. Nephron

What is left (which contains any wastes or substances the body doesn't need) passes into the **collecting ducts** as urine, and from there out of the renal pelvis through the **ureters** (by peristalsis) to the bladder. The **urinary bladder** is a hollow, muscular, elastic sack that collects the urine until it is time to expel it from the body. During urination, the urine passes from the bladder through the internal and external sphincters, out of the **urethra** to the exterior. Almost all the action in the kidneys happens in the nephrons.

Nitrogen Is Plant Food

Urine, containing urea, a neat little package of nitrogen, is ideal fertilizer for plants. Did you know you can make wonderful compost out of cardboard and urine? Try it for yourself at home if you have a garden; get a crate and make drainage holes in the bottom, then stack cardboard in it, flat sides parallel with the sides of your crate. Add urine regularly—men can do this directly, privacy allowing! You will find that the cardboard (cellulose) will rot down and together with the urine make a fabulous and rich potting compost. Alternatively, pee on a straw or hay bale for a year. Open it up and you will find it changed into excellent compost.*

Some plants (particularly legumes, such as clover, alfalfa, and soybeans, as well some trees and shrubs, such as the alder) take nitrogen from the air and fix it in the soil so other plants can take it up and build it into amino acids. We eat the plants, or animals eat them and use the amino acids for building muscle, then we eat the animals' muscle (meat), and use the amino acids for our protein needs. When we've finished with the amino acids, the liver breaks them down and packages the nitrogen as urea, which our kidneys excrete and which the earth needs as food.

Urine Formation

Urine formation happens in three stages: filtration, tubular reabsorption, and tubular secretion. It is with these functions of the nephrons that the kidneys eliminate nitrogenous wastes (the end products of protein metabolism) and regulate the volume, composition, and pH of the blood.

Glomerular Filtration

Incredibly, 180 liters (48 gallons) per day of filtrate enters the nephron tubules. Nearly all of this huge amount—about 179 liters—is reabsorbed. High pressure exists in the glomerular capillaries because the efferent arteriole that leaves each glomerulus is smaller than the afferent arteriole that enters it.

Due to this high pressure, one-fifth of the fluid flowing through the glomerulus is filtered into the Bowman's capsule. As we saw already, 125 ml per minute enter the capsule and get processed in the kidneys.

A fairly constant blood flow is maintained through each kidney. Mainly this is achieved by the kidney regulating itself. According to need, and changing with variations in the general blood pressure, the kidney's own auto-regulatory processes either constrict or dilate the afferent arterioles (the ones going in to the glomeruli), to decrease or increase the blood supply, respectively. This means that no matter what is happening in the body as a whole, the kidneys can keep doing their work in a measured manner.

Tubular Reabsorption

This is the process by which needed substances are reabsorbed from the tubules into the blood. Basically the filtration process allows all particles in the blood smaller than plasma proteins to pass into the tubules. Some substances, such as glucose, are routinely completely reabsorbed. (After all, peeing out glucose would be like throwing money away.) Others, including sodium and water, are reabsorbed in varying amounts, thus controlling their blood levels. The kidney tubules can reabsorb substances both passively and actively. Some substances travel by diffusion and some need ATP-activated carriers; some, including creatinine and drug metabolites, are not reabsorbed because they have no carriers, are too big, or are not lipid soluble.

Reabsorption of sodium and water is controlled in the distal tubules and collecting ducts by hormones that regulate the amounts kept in the body. **Aldosterone** increases the reabsorption of sodium—and therefore water, which always follows sodium around like a lost sheep. Aldosterone is made and secreted by the adrenal cortex.

Antidiuretic hormone (ADH) increases the reabsorption of water in the collecting ducts. ADH comes from the posterior part of the pituitary gland. There is a disease called diabetes insipidus, in which large amounts of very dilute urine are excreted, not related to fluid intake. This is caused by not having enough ADH, or by the kidneys not responding to this hormone. A diuretic drug called conivaptan inhibits ADH formation and can cause diabetes insipidus.

Tubular Secretion

Tubular secretion is the way the kidney adds substances to the filtrate from the blood or tubule cells. In this way, urea, drugs (e.g., penicillin, which is too big to pass over the glomerular membranes, so must be excreted by secretion), and excess ions are eliminated, and the pH of the blood is regulated by varying amounts of hydrogen ions being secreted into the tubules.

Pharmaceutical drugs are designed to withstand breakdown by the body, in order to exert as strong as possible an effect for as long as possible. This means that sixty to ninety percent of any drug a person takes is excreted into the environment, often by the kidney. Due to this, over the years there has been and continues to be a frightening and ever-increasing amount of pharmaceutical drugs in the water chain of the earth—antibiotics, female hormones estrogen and progesterone, drugs for high blood pressure, and antidepressants, to name a few. Worried? Don't lose sleep over it, but be aware of it and aim to minimize it!

The **renin-angiotensin** mechanism exists to raise a dangerously lowered blood pressure, for example, as you might get if you lost a lot of blood suddenly in an accident. It is triggered by stimuli (including low BP and intense sympathetic nervous system arousal) that cause the juxtaglomerular cells to release renin.

Renin is an enzyme that acts on **angiotensinogen**, made both in the liver and locally in the proximal convoluted tubule. Angiotensinogen releases **angiotensin I**, which is converted to **angiotensin II** by ACE—angiotensin converting enzyme—which is associated with the capillary cells in various body tissues, especially in the lungs. (You may have heard of ACE inhibitors, a class of drug used for high blood pressure. As the name suggests, these block this mechanism and therefore lower the blood pressure.)*

Angiotensin II is a potent vasoconstrictor and activates smooth muscle throughout the body, raising the blood pressure. It also increases sodium reabsorption in the kidney tubules, and stimulates the release of aldosterone from the adrenals, causing still more sodium reabsorption in the tubules. Water follows sodium, so blood volume and therefore blood pressure rise. The afferent arterioles are less sensitive to angiotensin II than most body arterioles, including the efferent, so the glomerular pressure increases. Angiotensin II also stimulates the release of ADH and makes us feel thirsty by activating the thirst center in the brain.

Regulation of concentration and volume of urine is basically done by varying levels of ADH (antidiuretic hormone) from the pituitary. In the absence of ADH, dilute urine is formed. This is the basic level. Then, when ADH levels in the blood rise, the collecting ducts become more permeable to water, which then moves into the blood, consequently forming more concentrated urine.

Dehydration, Diuretics, and Drinking Lots of Water

There are interesting and contradictory theories about water and how much we need. It is common for holistic nutritional therapists to say that most of us are dehydrated—we don't drink enough, and what we do drink is dehydrating. For example, caffeine-containing drinks like tea and coffee are diuretic and make the body lose water; they also are experienced as toxins that need to be excreted, therefore needing extra water to clear them from the body. Alcohol and sugar drinks cause a similar reaction.

Then there are the toxic strains of modern life to contend with: air pollution, food additives, contaminants like pesticides, drugs, nicotine, specific foods experienced as toxins (like wheat or dairy), electromagnetic pollution, and stress hormones. In order to excrete any toxin, the body uses water—remember, nothing moves in the body without it. The idea is that many people are toxic to some degree or other and are therefore in need of water.

Varying amounts are given for needed daily water intake. We've all heard of the proverbial eight glasses a day—that could be a bit of a myth. My nutritional therapist tells me that it's best to drink eight *pints* of water every day in order to restore the body to full hydration. Try it yourself—though it requires many trips to the bathroom, some people do feel benefit from that high intake very quickly. (Note: If you have kidney disease, this much water would be harmful, and some epileptics seem to get more fits if they drink lots of water, so this is not for everyone.) Try taking one or two pints, room temperature, as soon as you rise in the morning. Considering that at night your body can lose up to 1 1/2 pints of water through breathing and sweating, this is a reasonable idea.*

When the body is dehydrated, it may do all kinds of things to try and set things straight. Sometimes it panics and tries to hold onto water, leading to symptoms such as edema (excess water in the tissue spaces, especially seen as swollen ankles or a swollen sacrum after lying down) and high blood pressure. (If the body holds on to water and it thus increases in the tissue spaces, the blood vessels may take on more water. An increased blood volume can cause high blood pressure.) The orthodox treatment for these conditions will be diuretics—drugs that take water from the cells and force the kidneys to excrete it. Of course, if the problem is actually caused by dehydration this treatment will make the situation worse. Actually, a better treatment could be to start drinking more water. Two side effects of diuretics are dizziness and drowsiness. These are actually caused by the brain being dehydrated, causing the cells to shrink. This can cause confusion that makes a person forget to drink or eat, exacerbating the problem and potentially even leading to death, especially among older people who may be isolated and have no one to keep an eye on what they eat or drink (in the modernized parts of the world, that is—in many cultures, elders are still highly valued and taken good care of).

Diuretic drugs work by making the body lose sodium, which water inevitably follows. Along with the sodium, potassium is lost. Depletion of potassium leads to weakness, fatigue, and cramps in the legs. Other trace elements such as zinc and magnesium will also be leached. The effect of this may be more subtle, and therefore less easy to spot, but both are vital for our body's health. Zinc is essential for proper immune function, healing, reproductive function, bone health, and maintaining good blood sugar levels. Magnesium is the so-called anti-stress mineral, helping the circulation and digestion—a lack of it can lead to muscle twitching and cramps, and can cause insomnia, depression, anxiety, and fever.*

Interrelationships

The kidneys are very obviously related to the **circulatory system** in that blood is filtered by the nephrons, and the kidneys are very much involved in regulating blood pressure.

Hormones of the **endocrine system** are largely responsible for controlling kidney activity; renin controls body fluid levels and blood pressure and aldosterone controls mineral balance. The kidneys help stimulate **bone marrow** production. Together with the other excretory systems, the **digestive system** and the **skin**, the kidneys clean the body. The liver and kidneys have a special relationship in that urea comes from amino acids broken down in the liver, and the liver makes other toxic substances water soluble, so they can be excreted by the kidneys.

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*In the civilized West we put our urine, along with copious brightly colored, smelly chemical toilet cleaners, into the sea instead of back in the earth. The really weird thing about this is that we have been brainwashed into thinking this is a "cleaner" alternative.

*The most common side effect with ACE inhibitors is a persistent dry cough. They can also cause a big fall in blood pressure when first used. Other less common side effects are kidney and liver problems, a type of swelling called angioedema, rash, inflammation of the pancreas, hay fever-like symptoms, sinusitis, sore throat, nausea, vomiting, indigestion, diarrhea or constipation, and blood cell changes. (From the Web site of BUPA, a leading British insurance company, www.bupa.co.uk.)

*Israeli nutritional healer Sarah Hamo, who cured her own cancer with radical diet change after being given months to live by the doctor, says that people who have cleaned up their diet and take no toxins in, eating a large amount of fresh vegetables and fruit grown organically, need to drink very little water, and should only drink when thirsty. She says that the more we drink, the harder the kidneys must work. She drinks about thirty glasses of water *per year*! (Sara Hamo, *The Golden Path to Natural Healing*.)

*Nutrients like minerals in the soil in the UK are measurably lower, up to sixty percent, than they were fifty years ago. This is due to modern farming methods that take out more than they put back. This means we are all in danger of deficiencies. (1992 Earth Summit Report.)

CHAPTER 14

Wiring—The Nervous System

Overall control and coordination of body activities is, in traditional physiology, seen as being the realm of the nervous system and the endocrine, or hormonal, system. The two systems are very much interlinked and back each other up well—nervous control being incredibly fast but short-lived and hormone action being slower to happen but its effects lingering longer in the body.

The scientific medical model has it that the brain is in charge of everything, and is pretty much the most important part of our body, with the rest of the body being there as support for it. I find it rather enjoyable that in Chinese Five Element medicine, the nervous system-brain is not so important—rather, the heart is in charge of our life's purpose, while the nervous system has the less important role of responding to danger and so keeping us alive! Eastern philosophies (such as Siddha Yoga) concur with this view.

Western thought also used to agree with this, thinking that the human was controlled by a little man, or homunculus, who lived in the heart. But after dissection of human bodies showed no such little man, the brain was elevated to supremacy. The mainstream, mechanistic view is that the brain is responsible for what we in the West call "mind." This comes out of medicine's reliance on old Newtonian physics to explain the universe mechanistically. Interestingly, as quantum physics is incorporated into biology, more is discovered about what really makes us tick: the mind is understood not only to be in the brain.[1] Emerging work on communication molecules throughout the body has led to the coining of the term “bodymind” to describe our being.[2] The mind is everywhere—a network or flow of communication equally in the tissues of the body as in the brain.

Then there is the issue of whether you think being alive is all there is to it. In other words, is the material reality all there is, or do you hold with a reality that includes a Divine presence in the universe, and within each of us? Eastern philosophies talk about the Universal Mind being the underlying intelligence of everything in the universe, including our bodies and our human minds.

Well, whatever you believe, we will now have a go at introducing and simplifying the functions of the human nervous system. To ease your understanding of this complex system, treat the following information as a kind of jigsaw puzzle—imagine you are taking a look at all the pieces, turning them face up and spreading them out before beginning to build the whole picture. Don’t try to connect them until the end of the chapter, by which time I hope things will have begun to be clearer.

Nerve Cells

The nervous system is all about information control and coordination. Messages are transmitted and received from and to the brain and all parts of the body by special nerve cells called **neurons**.

A neuron has a cell body, which contains the nucleus and usual organelles of a cell—mitochondria and so forth. Projections come off this cell body—**axons** and **dendrites**.

Axons convey impulses away from the cell body, and dendrites toward. Axons can communicate with other nerve cells, or, in the case of the end of motor nerves, with glandular or muscle cells, causing secretion or contraction. The projections, which may also be called the nerve fibers, are sometimes covered with an insulating substance called **myelin**.

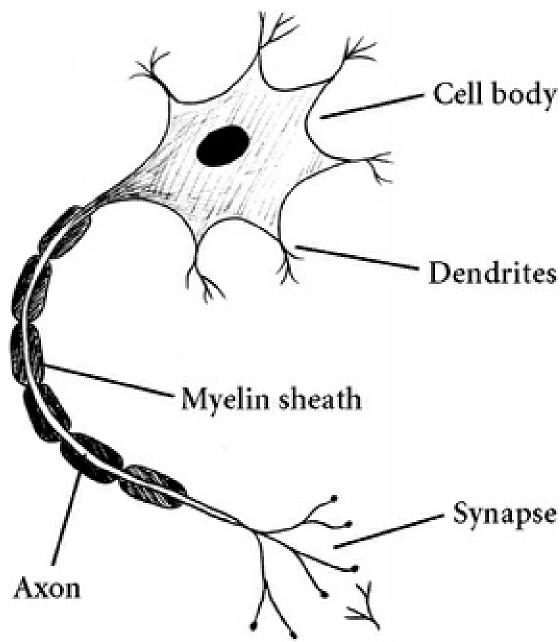

FIGURE 14.1. Neuron, or nerve cell

Myelin looks white. It is a fatty material that insulates the nerve fibers and hugely increases the speed of conduction of a nerve impulse along the fiber. You can think of it as being like the plastic covering the wire of an electrical appliance.

Without the insulation the nervous impulse, which as you will learn is electrochemical in nature, cannot travel in its usual way. Some neurons are designed to work fine without myelin, but those that are normally myelinated must keep the myelin covering in good shape in order to work normally.*

In the brain, a nerve cell may have connections with many thousands of other cells, creating an incredibly complex network of nerve fibers with an enormous number of potential **nerve pathways**. Because nerve cells are permanent—that is, not continually replaced throughout life—it was long thought that we are born with all we will ever have and these degenerate throughout life, making nervous system functioning a downhill affair. Well, it's true that we don't keep on making new neurons, and that brain cells do die off each year, but the good news is that actually throughout life nerve cells make new dendrites, creating more connections with each other. Deepak Chopra suggests this is a physiological expression of the increasing wisdom people may show with age, when the different parts of life and knowledge connect more and more.[3]

There are different types of neurons, depending on whether they convey sensory or motor information or both, and on where in the nervous system they are found. They all have the same basic structure of cell body, axons, and dendrites, but with variations according to specific function.

The nervous system is *structurally* divided into **central** and **peripheral** systems. The central nervous system is the brain and the spinal cord. The peripheral nervous system is all the wiring—bundles of nerve fibers running to and from the central nervous system. *Functionally*, the nervous system can be separated into the **somatic** and **autonomic** systems. The somatic part deals with more conscious body stuff—what we feel from the skin and muscles—plus the so-called **special senses** like hearing and sight, and the deliberate movements we make. The autonomic system deals with the visceral or unconscious stuff (that stuff that we feel "in the gut" or other organs).

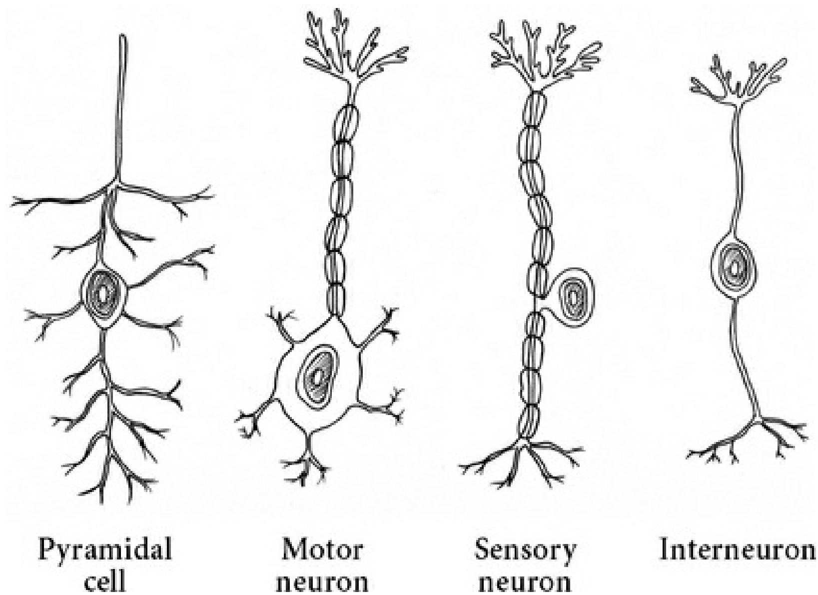

FIGURE 14.2. Types of neurons

Nerve Impulses

Another name for a nerve impulse is an **action potential**. It is all to do with the concentration gradient of sodium and potassium ions. As you know, the cell membrane is selectively permeable and does not allow ions to completely balance out across it. Also there is a **sodium-potassium pump**, which pumps three sodium ions out of the cell for every two potassium ions it lets in. This means that in its resting state, there is a slight increase of positively charged sodium ions *outside* the cell. These like to line up along the cell membrane, attracted to opposing negatively charged ions that line up on the inside of the cell membrane. This creates an electrical charge across the membrane that is called the **resting membrane potential**.

An action potential is a traveling wave of electrochemical (ionic) excitation. In order for one to happen, there must be sufficient **excitement**. There is a threshold below which nothing will happen, but above which will trigger an action potential that is all-or-nothing; in other words, it is always of the same magnitude. When a part of the membrane is excited, it becomes suddenly more permeable to sodium ions; the charged sodium ions outside the cell membrane suddenly rush into the cell as the membrane permeability alters, changing the electrical charge, making it more positive on the inside compared with the outside, opposite to what it is in the resting state. This is called **depolarization** of the membrane. This change in charge then excites the next bit of the membrane, causing it to become extra permeable to sodium and thus exciting the next bit of the cell, and so on, all along the membrane, like miniature waves on a beach. The potassium channels also open, but more slowly, so when they do, potassium rushes out of the cell (down its concentration gradient) and thus decreases the positive ions inside the cell, restoring the membrane to its resting state—this is called **repolarization**.

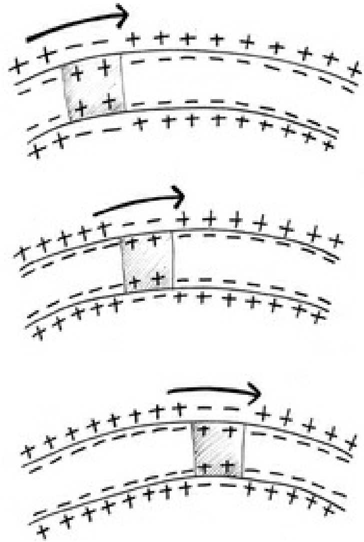

FIGURE 14.3. Action potential

Action potentials occur in nerve and muscle cells; skeletal muscle action potentials come as a result of stimulation by a nerve, and result in actin and myosin sliding over each other to shorten the muscle fiber. Action potentials in nerve cells occur when the dendrites of a neuron produce what is called a **graded potential** after being stimulated. There are protein channels in the membrane of the dendrites that are activated and opened by the graded potential, which causes ions to enter or leave the cell, changing the membrane potential—it can either depolarize the membrane, and thus excite it in a way that could lead to an action potential, or hyperpolarize or inhibit it in a way that makes an action potential less likely to occur. So in order for enough stimulation to occur to lead to a full action potential (or nerve impulse), generally quite a lot of channels in the dendrites must be affected in an excitatory way.

More about Synapses

When the action potential in a neuron reaches the end, it causes the release of a chemical called a **neurotransmitter**, which then binds onto receptors in the next neuron—this is called a **synapse**. There are also electrical synapses, a direct wiring together of neurons, where there are gap junctions through which the action potential travels straight through to the next neuron—these are quicker, providing better synchronization where needed. Synapses, then, are places where one nerve meets another. In the majority of cases, however, the nerve cells do not actually touch; rather, there is a space between them called the synaptic space. As you know, what surrounds all the cells in the body is fluid, predominantly water. Neurotransmitters are made in the nerve cell and stored in tiny bladders called vesicles at the end of the axon. When the wave of electrochemical excitement reaches the end of the axon, the vesicles go to the cell membrane and release their contents into the synaptic space. The neurotransmitters scatter through the fluid between the neurons (across the synaptic space) and, on coming into contact with the next neuron, they bind to a receptor on its cell membrane. This begins an electrical response in the new nerve.

Neurotransmitters are peptides, or small groups of amino acids. They are made in the neuron's cell body and sent down to the end of the axon. In the central nervous system neurotransmitters may be excitatory or inhibiting. Our brains are awash with chemicals stimulating or soothing our nervous systems. There are at least a hundred peptides known to act as neurotransmitters. A chemical called **acetylcholine** is the main excitatory one for the nervous system, as well as at the neuromuscular junction. There are also inhibitory neurons, secreting neurotransmitters that calm down adjacent neurons, making them less likely to fire off an impulse. GABA **(gammaaminobutyric acid)** and **glycine** are two inhibitory neurotransmitters. Other neurotransmitters include serotonin, dopamine, glutamate, aspartate, histamine, noradrenalin, and adrenalin (norepinephrine and epinephrine), nitrous oxide, and adenosine triphosphate (ATP).

Neurotransmitters work by bonding with a receptor, thus preventing another transmitter from activating that receptor, and affecting the membrane potential in some way either to lead to increased or decreased excitement. So different substances can affect how excitable or inhibited the neurons are. As with so many things in life, the outcome has to do with the balance between one way and another—it is not black and white, but a shading of gray that we end up with. In terms of neurotransmitters, they can either cause an **excitatory postsynaptic potential** (EPSP) or an **inhibitory postsynaptic potential** (IPSP), which cause a slight depolarization or a slight hyperpolarization, respectively. In other words, an inhibitory neuron will cause **hyperpolarization** (making the membrane potential more negative), which then makes it harder for another neuron to depolarize the membrane above threshold level and begin an action potential. An excitatory neuron will make the membrane potential less negative and thus toward the threshold level needed to spark a full action potential. All of the many EPSPs and IPSPs of the many dendrites get added together, so to speak, and this decides the result.

The neurotransmitter binding effect is inactivated by either reuptake of it back into the neuron, destruction of it by enzymes, or diffusion away from the receptor and out of the synaptic cleft. Synapses were thought to be the totality of communication in the nervous system and beyond, but in fact there is more to it, since peptides and their receptors seem to communicate not just across the tiny synaptic gap but across vast distances (inches!). Peptides circulate in the body and find their target receptors all over the place, not just within the nervous system.[4] Communication within the body (and probably between bodies too) also relies on very subtle, quantum processes to do with light (protons) traveling through microtubules within the dendrites and neurons. This and other processes explain why thoughts do not arise in one discrete area of the brain and travel neatly around via neuronal pathways, across synapses from one neuron to the next, but instead arise everywhere at once. Quantum scientists figure that there is a kind of Internet of the body that allows simultaneous communication between all the neurons of the brain.*

The Central Nervous System

The central nervous system consists of the brain (also called the encephalon) and the spinal cord, which are surrounded and protected by **meninges**.

Meninges

The **meninges** are special protective membranes made of three layers: the **dura mater**, the **arachnoid mater**, and the **pia mater**. The outermost layer, the dura mater, is very tough and strong. It is joined in places to the inside of the skull and the vertebral canal of the spine. The arachnoid mater in the middle is full of a delicate network of fibers and blood vessels. The pia mater is the soft membrane that is actually in contact with the sensitive brain tissue. Between the arachnoid and pia maters is **cerebrospinal fluid** (CSF), which further protects the central nervous system by acting as a shock absorber. The brain is certainly more protected sitting in its cerebrospinal fluid than it would be if it were banging around in the skull without it. CSF also is found in holes in the brain called **ventricles**, and in the **central canal**, the channel that runs through the spinal cord and is connected with the ventricles. The ventricles of the brain are connected by tiny canals, so the CSF slowly circulates throughout the central nervous system.*

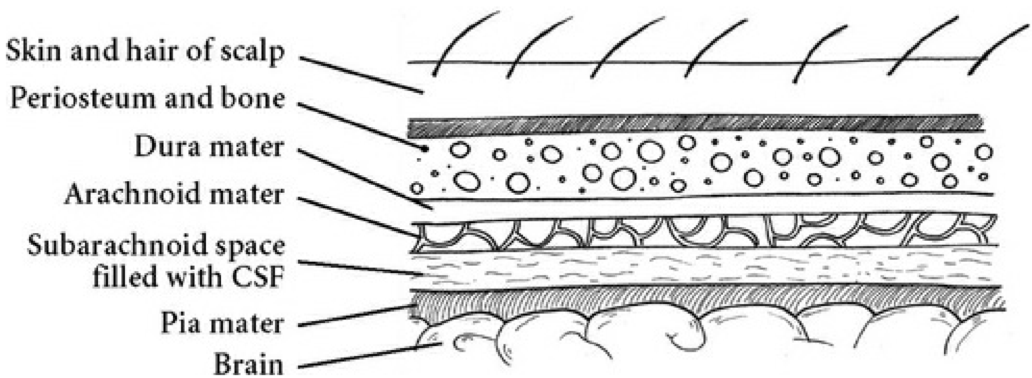

FIGURE 14.4. The meninges

Meningitis is an infection of the meninges. The reason it can be life threatening is that it blocks drainage of CSF, and therefore an increase in pressure around the brain. The skull and spine are rigid, so cannot expand with this pressure. It is the brain, delicately soft and squishy, that is pressed on, causing the terrible headache and other neurological symptoms of meningitis. Because the brain is so squishy, permanent damage can be done to it by this onslaught of pressure.

A friend of mine had meningitis as a young man. The headache was so bad he was banging his head against the wall. In the hospital, a spinal tap (lumbar puncture, where a needle is put into the space between the pia and arachnoid maters in the lumbar region) was performed—as the fluid was drained away into the needle, he felt the headache go too, from the top of his head downward.

The Brain

The brain is the control center. We are going to look at it only very simply. There are literally billions of nerve cells in the brain, all with their axons and dendrites. Parts of the brain look gray—these are cell bodies and unmyelinated axons. Parts of it look white—these are myelinated axons, rapidly taking information to other parts of the brain. Each neuron in the brain can grow many dendrites, some neurons having hundreds, which means that the possible combinations of connections between nerve cells is greater than the number of atoms in the known universe.*

One mechanism thought to be involved in memory is that any particular thought related to learning or memory or moving a leg or speech or taste or anything is associated with a particular combination of neurons firing, called a **nerve pathway**. Remember our membrane potential from the paragraphs about synapses? Here's an interesting thing: The more times a particular pathway is activated, the more likely it is that it gets fired off by some stimulation. The resting potential of the membranes may change to make them more sensitive. In practical terms this means that the more you think a particular thought and use a particular nerve pathway, the less stimulus it takes to trigger that pathway off again and the more you are likely to think that thought. You can think of it like an old-fashioned vinyl record—the more the needle goes round, the deeper the groove. Although this is thought to be one of the ways that memory works, the exact mechanism is not clearly understood. However it could explain why any kind of learning (including that of anatomy and physiology, which you are engaged with at this moment) requires repetition, repetition, repetition. This fact about the brain is definitely worth dwelling on and contemplating; the more you think a particular thought or set of thoughts, the more you will think it. I am sure this is partly how affirmations* work. You might ask "What are my habitual thoughts? Do they serve me? Would I like to change them or am I happy with their habitation of my head?" You can make new positive pathways or collections of neurons that will be more likely to fire off than old negative ones.

Then there are all those neuropeptides and their receptors. Biochemical change at receptor level is the biochemical basis of memory. Cells make and reabsorb receptors all the time in response to their environment. Likewise, the cells can put peptides together very easily in response to need. It's true that our thoughts are affected by our brain chemistry, but it's also true that our thoughts affect our brain chemistry. We can use our thoughts to encourage our brains to make more favorable, "feel-good" neurotransmitters. We can learn to accept all of our emotions and allow them free flow and healthy expression, which prevents them getting stuck—emotions are part of the communication system for our body and mind. (Now you can see why Candace Pert's *Molecules of Emotion: Why You Feel the Way You Feel* is a must-read.)

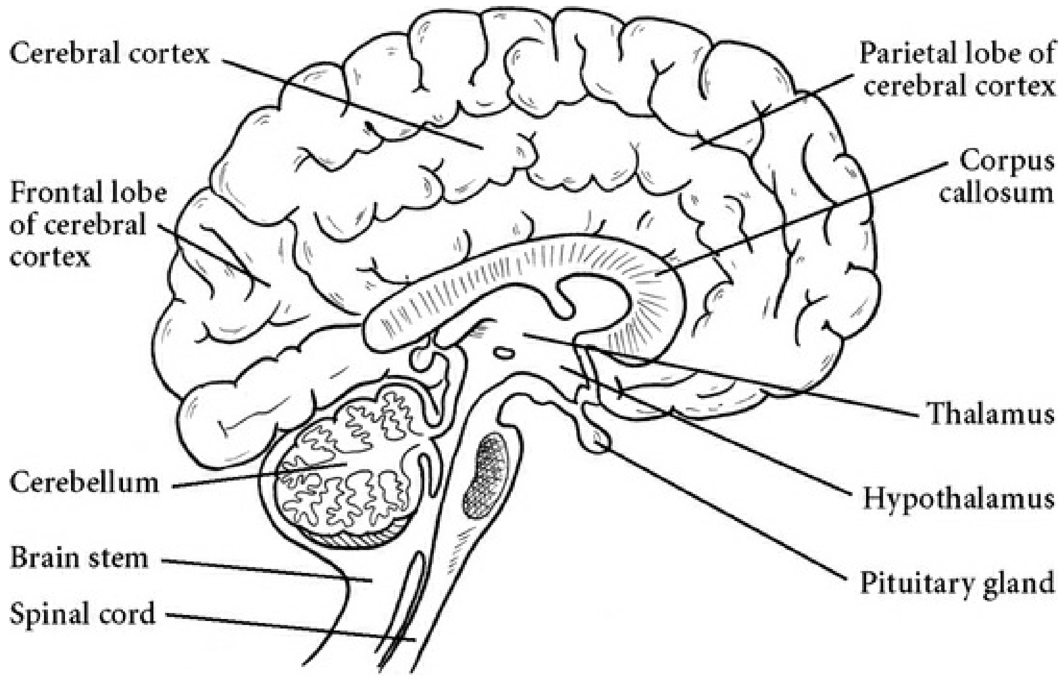

FIGURE 14.5. The brain

The Cerebrum, or Cerebral Hemispheres

This is the seat of what is known as the higher functions—conscious awareness, memory, the special senses (vision, hearing, smell, and taste), speech, and conscious movement. It's what you are using right now to study and think about this information. It includes the **motor cortex**, where control of all voluntary muscles of the body originates, and the **sensory cortex**, where all sensations from the skin, muscles, and joints end up. The **cerebral cortex** has four lobes:

- The **frontal lobe** is associated with reasoning, planning, speech, movement, emotions, and solving problems.
- The **parietal lobe** with movement, recognition, perception of stimuli, and orienting ourselves in space.
- The **occipital lobe** concerns itself with visual processing.
- The **temporal lobe** with hearing, memory, and speech, as well as emotion.

The cerebrum is divided by a deep cleft into the right and left **hemispheres**. Each side functions slightly differently. The right hemisphere is more associated with creativity, music, and mathematics. The left hemisphere is concerned with logical thinking. (You might think mathematics belongs in the left hemisphere with logic, but it doesn't. Perhaps that is why they say that many musicians, especially composers, have an affinity for math, and vice versa.)

A bundle of axons called the **corpus callosum** connects the two sides. Sometimes the corpus callosum is described as larger in women, though this has not been absolutely proven. It is also not proven that a larger one leads to more intelligence, though some say it is. The theory is that if the two hemispheres are more fully connected, our thinking is more connected too. Interestingly it seems that listening to certain kinds of music, like Beethoven, as a very young child, leads to development of a thicker corpus callosum (therefore possibly more intelligence.) Schizophrenic people, especially women, seem to have a particularly thick corpus callosum. (So we can conclude according to this research that people with bigger corpus callosums may be either more prone toward mental skills or mental illness, or possibly both!) Since the brain grows partly in response to how it is used, and boys in our culture may be particularly discouraged from free emotional and creative expression, it may be that this leads to the difference, though the difference is found in rats too. Perhaps the behavior needed for successful rearing of young leads to its development. This is not proven in any way, more a philosophical aside. The whole area of gender difference is fraught with difficulties, since cultural conditioning and expectations begin at birth, or even before if people know they are having a boy or girl. For example, researchers find that boy babies get a massive amount more attention than girls. Although some of the differences between men and women are physiological in basis, many are not and can vary considerably from culture to culture and time to time.

The Cerebellum, or Hindbrain

Located under the occipital bone at the back of the head, the cerebellum (also called the hindbrain) is responsible for coordination of movement and balance. Remember how muscle groups act together for smooth movement? As biceps in the arm contract to flex the elbow, tricep, and extensors, they gradually relax to allow a smooth and controlled movement. It is the cerebellum that coordinates this.

The Thalamus

This is a large area of gray matter deep in the forebrain. It has sensory and motor functions. Almost all sensory information from the body enters it, from where neurons send it to the cortex, which lies above. It is the last relay site of sensation information before the cerebral cortex. The thalamus is also central to emotional experience.

With the thalamus serving as a connector point between sensation and emotion, it is easy to understand the importance of touch to good emotional and mental development—without touch, the young human fails to thrive and may even die if the deprivation is extreme.

The Hypothalamus

This houses the thermostat, which sets the body's temperature. During an immune response, the thermostat will be turned up to allow the body temperature to rise, creating a hostile environment for invading organisms. The hypothalamus is also the regulator of autonomic nervous and endocrine function. It controls the pituitary gland, which hangs from it like a pea on a slender stem, and which in turn controls release of many of the body's chemical messengers, or hormones.

The Amygdala

This is in the temporal lobe of the cerebrum, in that part of the brain located beneath the temporal bones of the skull. It is involved in memory, emotion, and fear.

The Hippocampus

This is found in the medial (middle) part of the temporal lobe. It is important for learning and memory, particularly for converting short-term memory to permanent memory, and also for remembering where things are in space in the outside world.

The thalamus, the hypothalamus, the amygdala, and the hippocampus are collectively called the **limbic system**—considered to be the **emotional brain**. So you can see how closely related touch, emotion, memory, the endocrine system, and visceral functions of the body are.

The Brain Stem

Located at the base of the brain is the brain stem, a kind of thickened spinal cord, which continues from it below. The brain stem contains the control centers for vital functions, such as the cardiac center, vasomotor center, and respiratory centers. It consists of the three parts known as the midbrain, the medulla oblongata, and the pons varioli.

The Spinal Cord

The spinal cord is a continuation of the brain stem, and extends down the spinal column within the vertebral canal. It is as wide as a finger, and, like the brain, is surrounded by CSF and meninges that cushion it from damage. It consists of millions of nerve fibers—axons and dendrites—that transmit information between the body and brain. The nerve fibers in the spinal cord are grouped together in bundles called ascending (sensory) and descending (motor) tracts. The spinal nerves come off the spinal cord, with sensory fibers coming out of the posterior (dorsal) side and motor fibers from the anterior (ventral) side. These sensory and motor fibers join just outside the spinal cord to form the spinal nerves that are part of the **peripheral nervous system**.

The Peripheral Nervous System

The peripheral nervous system consists of nerves and sensory receptors. A nerve is basically a bundle of many nerve fibers wrapped in connective tissue (a similar arrangement to a skeletal muscle being bundles of muscle fibers wrapped in fibrous tissue). Nerves are large enough to be seen with the naked eye, looking like thin white threads. They carry information from the brain and spinal cord to the rest of the body, including the arms and legs. The largest nerve in the body, composed of many thousands of nerve fibers, is the **sciatic nerve**. It is about the size of your little finger at its widest.

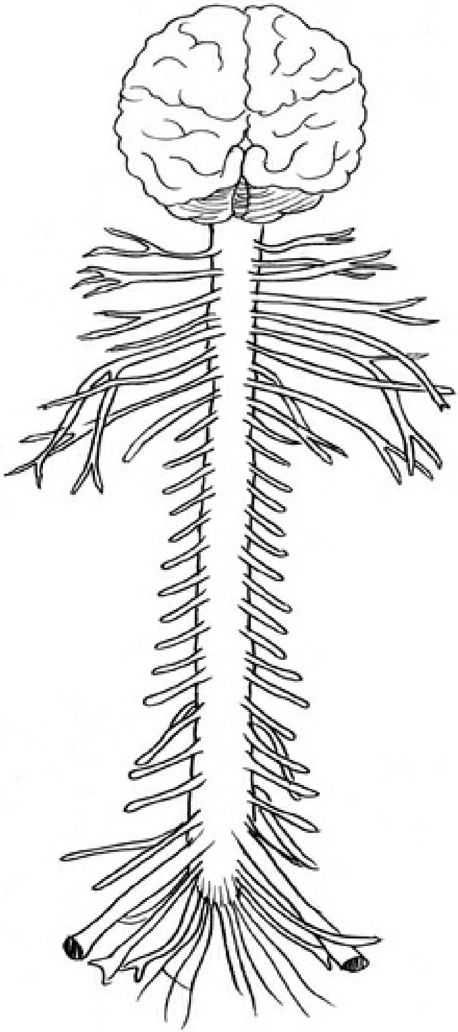

FIGURE 14.6. Spinal nerves

The nerves of the peripheral nervous system are arranged in pairs coming off either the brain or the spinal cord. Twelve pairs of **cranial nerves** leave the brain and supply the head and neck, special senses (e.g., optic nerve, olfactory nerve), and parasympathetic supply to the organs (via the vagus nerve).

Thirty-one pairs of **spinal nerves** leave the spinal cord, supplying the skin and muscles of the trunk, arms, and legs. Peripheral nerves may consist of motor fibers or sensory fibers, or more often a mixture of both.

Motor nerves convey impulses from the central nervous system to the body; these can be orders either for a muscle to contract, or a gland to secrete.

The motor system consists of command areas in the brain known as the **motor cortex**. From here, **descending tracts** go down the spinal cord, being the fibers of **upper motor neurons** bringing messages from the motor cortex. **Lower motor neurons** leave the spinal cord via the ventral or anterior horn via a particular spinal or cranial nerve to go to skeletal muscle, smooth muscle, or gland. These are called effectors.

Tone in muscles is maintained by constant firing of lower motor neurons, which the upper motor neurons inhibit or stimulate as necessary; the resting state of upper motor nerves is stimulated so when an upper motor nerve is damaged, this affects inhibition of stimulation and leads to increased tone. We then see generalized muscle spasm and increased reflexes. However, when a lower motor nerve is damaged, we get flaccid muscles and absent reflexes.

Sensory nerves pick up information from sense receptors and carry it to the central nervous system. Sensory receptors have a structure that allows them to be excited by a particular kind of stimulus, such as light, pressure, or damage. These receptors can be exteroceptors, visceroceptors, or proprioceptors. **Exteroceptors** pick up information about the outside world—like the sensations of the skin and the receptors of the special senses. **Visceroceptors** are in the internal organs and tubes of the body, and let the brain know about internal factors such as blood pressure or the level of carbon dioxide in the blood. **Proprioceptors** are found in tendons and joint capsules, and they give information about where the body is in space. Close your eyes for a moment—notice that you can still feel where you are, how your body is positioned. This is the sense of proprioception.

Sensory receptors can be classified in another way as **mechanoreceptors**, **thermoreceptors**, **photoreceptors**, **chemoreceptors**, and **nociceptors**, sensitive to pressure, temperature, light, chemical changes, and damage to tissues, respectively. Overstimulation of any receptor is painful, so all act as **nociceptors** at some time. The receptors are at the beginning of sensory nerves, which enter the spinal cord at the back (the dorsal root) and ascend to the brain. Some then synapse in the brain stem and some in the thalamus before ascending to the sensory cortex. Others go to the cerebellum.

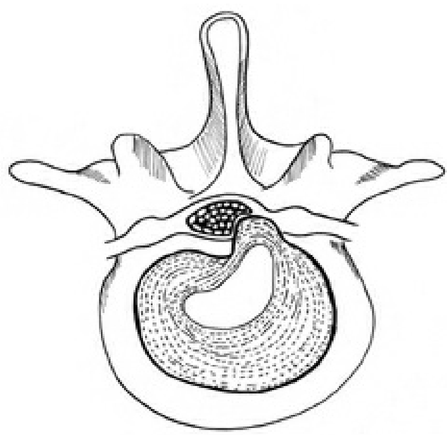

FIGURE 14.7. Slipped disk

A common and well-known problem with spinal nerve roots is that caused by a **slipped disk**, which generally develops for a long time before it actually strikes. The intervertebral disk gets thinner, compressed and weaker, over time, until suddenly it is no longer capable of doing its job of supporting the spine. The rings of fibers in the cartilage that makes up the disk loosen, and the softer center of the disk bulges out (herniates). Because there are strong ligaments to the front and sides of the vertebral bodies, and solid bone where the transverse process comes out at the back, the most likely direction for the disk to bulge is toward the sides and back (postero-laterally), straight into the spinal nerve. The herniated disk presses against the nerve root, and the resulting overstimulation of the nerves within causes inflammation with horrible symptoms including pain, numbness, paralysis, and so-called pins and needles.

The Autonomic Nervous System

This part of the nervous system, thought to be automatic and completely outside conscious control—hence the name—maintains and governs the vital functions of the body, such as breathing, circulation, digestion, and heart rate. There are two complementary parts of it, which work together to maintain homeostasis: the sympathetic and parasympathetic nervous systems. Working in partnership, one stimulates activity in a part of the body, while the other sedates.

The Sympathetic Nervous System

The sympathetic nervous system provides the **fight-or-flight** response to stress. This means making the body ready to either fight or run away from something perceived as a threat to survival. Sympathetic nerve stimulation increases heart rate and force of contraction, ups the blood pressure, speeds up breathing, and diverts blood to the skeletal muscles and the brain, decreasing digestive and sexual activity. The pupils dilate to let in lots of light so you can see well. Adrenalin (epinephrine) is released, which mobilizes the body's stores of glucose and fat and backs up the nervous action. It's all about mobilizing the body's resources to act now.

It's easy to see why our modern stresses are so dangerous to the body's well-being. How many times in your life has it been appropriate or even possible to either fight or run when you've felt stressed? For most modern humans, stress comes in the form of overwork and loneliness; the stress derives perhaps from our childhood or parenting our own children, personal isolation, trying to make ends meet to feed and shelter a family, caring for someone alone, or working in a competitive office environment.

The design of the body favors a strongly physical approach to stress, which should be short-lived and give time to rest and recover and rebuild our reserves. However, today's stresses not only do not require us to fight or flee, but are relentless. They go on and on, without a break, and without the chance to stop and recover in the parasympathetic mode. Of course, we developed a flight-or-fight response in the first place because at the time that's what we needed; perhaps over the years we will evolve a new response that is appropriate to what we need now. Actually, we do have lots of built-in healing mechanisms to help us recover fully from stress, and it is possible to learn to utilize them more fully. More on this in

Chapter 23.

So, what is stress? In terms of our physiology, we only have one response to something we consider stressful: the fight-or-flight response. This is how we react, whether the stressor is an external event (like the appearance of an axe-wielding maniac, nearly getting run over by a bus, someone at work bullying us, a difficult deadline, or a screaming toddler day in and day out) or an internal event (like feeling bad about ourselves, or a thought about a past event that we haven't yet had the opportunity to heal from). Sometimes **stress control** is about reducing our stress intake and increasing relaxation; sometimes it is about changing our reactions to things, so our internal landscape becomes less stressful.

The sympathetic system is also called the **thoraco-lumbar system**, because the peripheral nerves for it come off the spinal cord in the thoracic and lumbar regions, creating what is known as the **sympathetic chain**. You can see that the sympathetic nerves come off the spinal nerves as soon as they leave the spinal cord, and form a chain by which they are all connected. The sympathetic response is an all-over affair; it's not local. It's like the alarm going off on the Starship Enterprise—it happens at all levels, in all parts of the system. It can vary in intensity, ranging from a mild yellow alert to a more serious orange alert or a full-on red alert panic attack.

The fight-or-flight response shows beautifully the interlinking of the nervous and hormonal systems for control of the body's activities. Sympathetic arousal involves the stimulation of nerves going to the adrenal medulla, which leads to the release of the chemical adrenaline (and noradrenalin, to be exact—these are known in America as epinephrine and norepinephrine) into the bloodstream.

Adrenalin and noradrenalin, its twin, are the neurotransmitters of the sympathetic nervous system, being released from the sympathetic nerves at their synapses and neuromuscular junctions. In the sympathetic response, adrenaline also gets into the blood and travels all around the body, acting as a hormone, stimulating or sedating all tissues with receptors for it.

Think back to when you have had a shock. There is an initial jolt, which is the sympathetic nervous system waking up. Soon after, there is a building sensation of excitement or fear as the adrenaline enters your bloodstream and further increases the heartbeat and turns up the fight-or-flight response. When the event perceived as a stress is over, the adrenalin reaction will fade. The liver takes the adrenalin out of the bloodstream and metabolizes it into an inactive and excretable form.

If the stress response is prolonged, the body makes additional provision; the hypothalamus in the brain sends a chemical called a **releasing hormone** to the pituitary gland, telling it to release the hormone ACTH **(adrenocorticotrophic hormone)** into the blood. When it passes through the adrenal cortex, ACTH tells the adrenal cortex to release a hormone called cortisol into the blood. (Cortisol, cortisone, and hydrocortisone are all glucocorticoid hormones made in the adrenal cortex, which also makes the mineralocorticoid aldosterone and some male sex hormones or androgens.)

Cortisol (and cortisone, which is a ketone derivative of cortisol—I am using the terms interchangeably here) basically mobilizes the stored energy in the body to provide increased blood sugar for all the anticipated activity—running, fighting, and thinking. As an extra effect, cortisol is anti-inflammatory; it suppresses the inflammatory response that is part of how the body heals from damage. The cortisol represses this response so that you can carry on. Of course, running on, say, an injured ankle will damage it more, leading to an even greater inflammation when you do finally make it safely back to the cave (or tent or home). (More on inflammation and healing in the pathology section of the book.) It is this anti-inflammatory action of cortisone that has led to its widespread use in modern Western medicine as a symptomatic treatment to suppress inflammation. You can easily see how there would be so many dangerous side effects from using steroid hormone cortisone. As well as the anti-inflammatory effect, externally applied, inhaled, and internally taken cortisone has all the other effects of that hormone in the body. The greatest danger comes from taking it internally.

After a stress response, the body can reach **resolution**, in which case the sympathetic system is turned off in favor of the parasympathetic. However, sometimes the stressful situation is ongoing, or perceived as such, and then the body responds with something called **general adaptation syndrome**, a chronically stressed system with the adrenal glands releasing what cortisone they can. In time, if resolution does not occur, **exhaustion** ensues.

Cortisol and the other stress hormones are damaging to the body. The liver must work extra hard to metabolize these additional toxins. However, there is a wonderful mechanism to help us recover and take the pressure off our bodies and minds when we are stressed—crying! In tears, we can excrete damaging stress hormones whole. This is the only way to get them out of the body without the liver first metabolizing them.

In other words, crying is the cure for being hurt. It's time we reclaimed this wonderful healing process, for both men and women—after all, no-one would be so ridiculous as to say "Be strong, hold on to your pee" or "Real men don't take a dump." Actually it's a relatively recent idea that men shouldn't cry. For most of our history, men have wept as freely as women. It looks like male crying stopped during the Industrial Revolution (when people sought a way to numb themselves and keep on keeping on, being "good workers" or "tireless bosses"). Remember that tears are a brilliant way for the body to excrete the damaging products of stress, and start encouraging them in yourself and others.

If you don't cry enough, and the stress is ongoing and relentless, many physical problems can ensue. The most obvious and common are muscle tension, digestive problems, and high blood pressure. The reproductive system can be disrupted, causing infertility, impotence, menstrual irregularities, and menopausal difficulties. Tight muscles can in turn cause other problems, including poor joint health. These can be expressions of the general adaptation syndrome, which results from chronic stress responses.

There are three stages to **general adaptation syndrome** (GAS). The first stage is **alarm**—the fight-or-flight response. Once the cause of the stress is removed, the body goes back to normal. If the cause for the stress is not removed, GAS goes to its second stage, **resistance** or **adaptation**. This is the body trying to provide longer-term protection. It refers to the HPA **(hypothalamic pituitary adrenal)** axis and secretion of cortisol by the adrenal cortex. If this adaptation phase continues for a prolonged time without periods of relaxation and rest, the result is fatigue, concentration lapses, irritability, and lethargy, as the effort to sustain arousal slides into negative stress. The third stage of GAS is called **exhaustion**. In this stage, the body has run out of its reserves of body energy and immunity. Mental, physical, and emotional resources are empty. The body experiences "adrenal exhaustion." The blood sugar level decreases as the adrenals become depleted, leading to decreased stress tolerance, progressive mental and physical exhaustion, illness, and collapse.

The Parasympathetic System

The counterpart to the fight-or-flight system is the **parasympathetic nervous system**, also known as the **rest-repose system**. This brings the body back to normal, relaxed functioning. It slows down everything except digestion and sexual functions, which it encourages. The parasympathetic system is also called the **craniosacral system** because its peripheral nerve supply emerges from the cranium and the sacrum.

This is the realm of deep rest and relaxation, and is undoubtedly the place where healing happens. All natural systems of medicine emphasize the importance of rest and relaxation in recovery. Indeed, until recently, recuperation and convalescence were better understood by modern medicine too. This is not the case now, where being in the hospital means being awakened at horrible o'clock in the morning, and often repeatedly through the night as well to have temperature, blood pressure, or something else checked. A stay in the hospital is rarely a deeply restful experience.

It seems that the current obsession with productivity—

working away regardless of the cost to health or state of mind —is becoming worse and worse, encouraged by powerful suppressive drugs like anti-inflammatories and anti-catarrhals. When you hear about people having days off sick, the figures are often about how much profit has been lost due to illness. In fact, the Industrial Revolution was fueled by tea and coffee (loaded with caffeine), and modern global capitalism carries on this proud tradition. The empires of Europe, and later, the New World, with the riches they generated from slavery, made the Industrial Revolution possible. Tea and coffee enable people to work more than they really have energy for, especially when sweetened with sugar grown by African people taken as slaves to the West Indies and the southern American plantations and made to work the sugar and cotton fields. Caffeine potentiates and mimics adrenaline in the body, so with its help we can fool ourselves that we have plenty of energy, when in fact we are running on empty. A useful way to think about caffeine consumption is that it allows us to borrow time from tomorrow. Not such a bad thing, as long as the day comes when we have a chance to rest to pay back what we've borrowed. Almost everyone, including our world leaders and governments, keep going on coffee and tea. Does it mean they are really in a state of constant sympathetic arousal? If so, it is no surprise that decisions seem to be made that are reactions in the present, without considering the impact of current actions on future generations.

Feeling exhausted when relaxing is an indication that somebody has been running on the sympathetic system for some time, hence the typical scenario of a hard-working person going on vacation and getting sick. This is why many people prefer an active holiday—to really stop and unwind means to feel the true state of affairs in the body, mind, and spirit. Experiencing the exhaustion and the absence of reserves is not as much fun as the hyper state of adrenaline arousal. Adrenaline can be addictive.

When the parasympathetic system is operating, muscles relax, the mind slows down, and digestion increases. The body concentrates on digesting and absorbing nutrients and on building reserves for future contingencies. If there are no spaces in the stress, there is never an opportunity to properly rebuild. Also, the immune system, being allied to the inflammatory response, is suppressed by the stress response. A diminished immune system has implications on all levels, from being vulnerable to infections to the more sinister lack of protection from cancer.

The emphasis in natural medicine is on encouraging the rest-repose function: deep relaxation and rest, putting the whole being into a place where healing can happen. Massage practitioners and other bodyworkers soon hear direct evidence that parasympathetic stimulation is happening—a client's tummy rumbles increasingly as the person relaxes! Actually, a person who has been years on a stressful adrenaline habit will probably feel tired and ill on beginning to relax. He or she is feeling the true state of affairs in the body, rather than the false energy from being on adrenaline. In time, as the healing progresses and the reserves are built up again, this will pass.

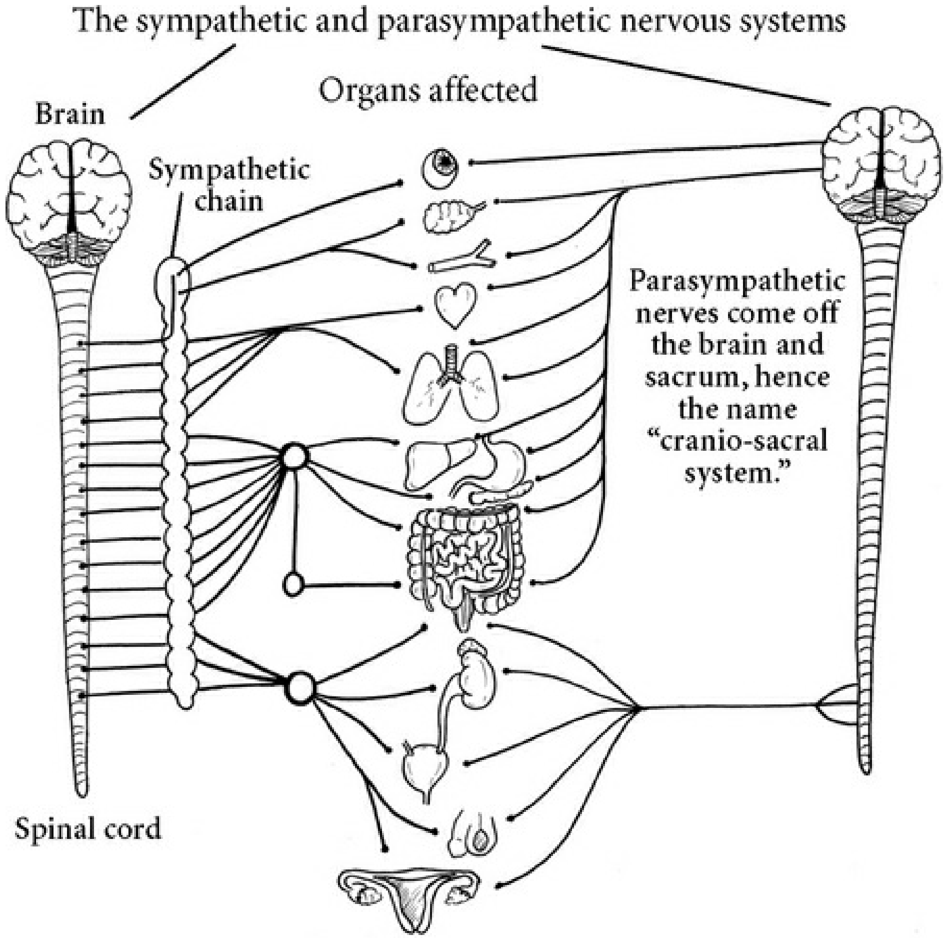

FIGURE 14.8. The autonomic nervous system

Reflex Actions

Reflex actions are very fast responses to possible hurt. A stimulus from the outside excites a sensory nerve, which sends a message to the spinal cord. Here the sensory nerve synapses with a motor nerve to send an order for immediate action. This means that a reaction to a stimulus can come extremely rapidly, without the brain having to make a decision about what to do. One example is the knee-jerk response—when a tendon is stretched suddenly, it will reflexively move to minimize that action. Another type of reflex is dropping something hot, or reacting to a danger when driving before being consciously aware of it.

Some reflexes can be overridden (e.g., drop it, it's hot! NO! I don't want to drop it, it's my favorite casserole dish, and I'll hold on even though it's burning me!). The knee-jerk reflex cannot be overridden.

The so-called **reflex arc** has five elements: sensory receptor, sensory neuron, integration center, motor neuron, and effector. The sensory receptor picks up a stimulus, and this excitation is carried along the sensory neuron to the integration center in the central nervous system where it immediately passes the excitation to a motor neuron, which in turn excites the effector, which is usually a muscle. (Or in the case of some reflexes a gland, for example, when the bitter taste buds of the tongue are stimulated it leads to a reflex increase in secretion of digestive juices.)

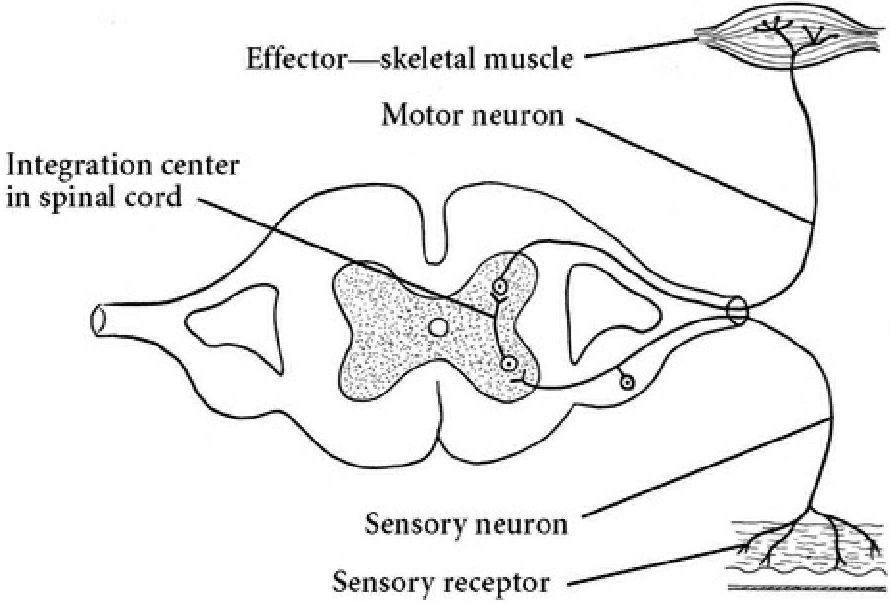

FIGURE 14.9. Reflex arc

Interrelationships

It seems obvious that **all systems** rely completely on the nervous system for their proper functioning. The balance in the autonomic nervous system between its sympathetic and parasympathetic parts profoundly affects **all of the internal organs**, and thus all of the systems. The nerves (like all other systems) receive the nutrients they need for repair and maintenance from the **circulatory system**. Toxicity affects the nervous system very quickly, so it is particularly in need of all the eliminatory systems—**digestive, urinary, skin**, and **respiratory**. The **endocrine** and nervous systems are completely intertwined.

*In people suffering from the auto-immune disease multiple sclerosis (MS), their immune system is attacking the myelin sheaths of nerves. This means that the nerve can no longer work—the message cannot be properly carried. MS can affect both the motor nerves (doers) and the sensory nerves (feelers), so a wide range of problems can be experienced. For example, a person's sight may be lost as the optic nerve is affected, or he or she may lose control over muscles and be unable to walk or use the arms.

*These theories of scientists Pribram, Jibu, Yasue, Hameroff, and Scot Hagan are beautifully elaborated in Lynne McTaggart's book *The Field: The Quest for the Secret Force of the Universe*.

*Craniosacral therapy works with the cranial bones as well as the spine, the skull, diaphragms, and fascia to release restrictions and improve the functioning of the central nervous system. If the bones of the skull are not moving against each other as they should, the circulation of CSF is affected, which in turn can affect anything in the body via the nervous system.

*This wonderful tidbit comes from Deepak Chopra's inspirational and fascinating book *Quantum Healing: Exploring the Frontiers of Mind/Body Medicine*, a highly recommended read.

*Affirmations are statements, always put in the present tense and in the positive, to contradict one's negative beliefs. You don't put an affirmation in the negative ("I can't remember anatomy") but rather turn it around ("I easily remember anatomy"). Affirmations need to be said hundreds and thousands of times every day. After all, you heard the negative stuff over and over again, and now you tell the positive to yourself over and over. They are of use only when you have identified a negative message you are telling yourself repeatedly—the point of the affirmation is to transform those messages. They can really work; try them for yourself.

CHAPTER 15

Glands and Hormones—The Endocrine System

The endocrine system is composed of a series of **glands** that secrete chemical messengers called **hormones** directly into the blood. It works with the nervous system to control and coordinate many body functions and maintain homeostasis. (Remember, homeostasis relates purely to physical functions—control of temperature, blood sugar, and body fluids.) Substances that act as neurotransmitters in the brain and as hormones in the blood are made in many organs and tissues. There is a constant two-way flow of information around the body that the endocrine system plays a part in.

Stephen Buhner says in *The Secret Teachings of Plants: The Heart as an Organ of Perception in the Direct Perception of Nature* (if you read only one more book in your life, make it this one!):

> Nineteenth-century medical practitioners were excited to discover powerful glands in the body that produced substances with marked impact on the body's functioning. These, while located at widely divergent places in the body, were grouped together in what they called the endocrine system.... However it turns out that every organ in the body produces hormones, molecular substances that significantly alter physical functioning.... There is, in fact, no such thing as the endocrine system, and contrary to most medical thinking, the heart is one of the major endocrine glands in the body.

No wonder it is easy to become confused with the endocrine system! As well as being a figment of our imagination, it is a beautiful and complex system of completely different hormones (which could be described as internal drugs) that regulate, with amazing intelligence, many functions of the body.

Most hormones are peptides—small proteins made of amino acids. The steroid hormones are made from cholesterol. Each hormone affects its **target cells** by altering cell activity, increasing or decreasing the rates of those cells' normal processes. Hormones generally can cause one or more of the following effects:

- Altering membrane permeability, or potential
- Stimulating the making of proteins or enzymes in the cell
- Activating or deactivating enzymes
- Producing secretory activity
- Stimulating cell division (mitosis)

Target cells for a particular hormone are those that have receptors for it on their cell membrane. The state of health of the cell membrane and condition of its receptors are crucial for its ability to respond to hormones or other biochemical signals. The actual amounts of hormones are miniscule—so small as to almost not be there. The tiniest fluctuations have massive impact on our physiology.

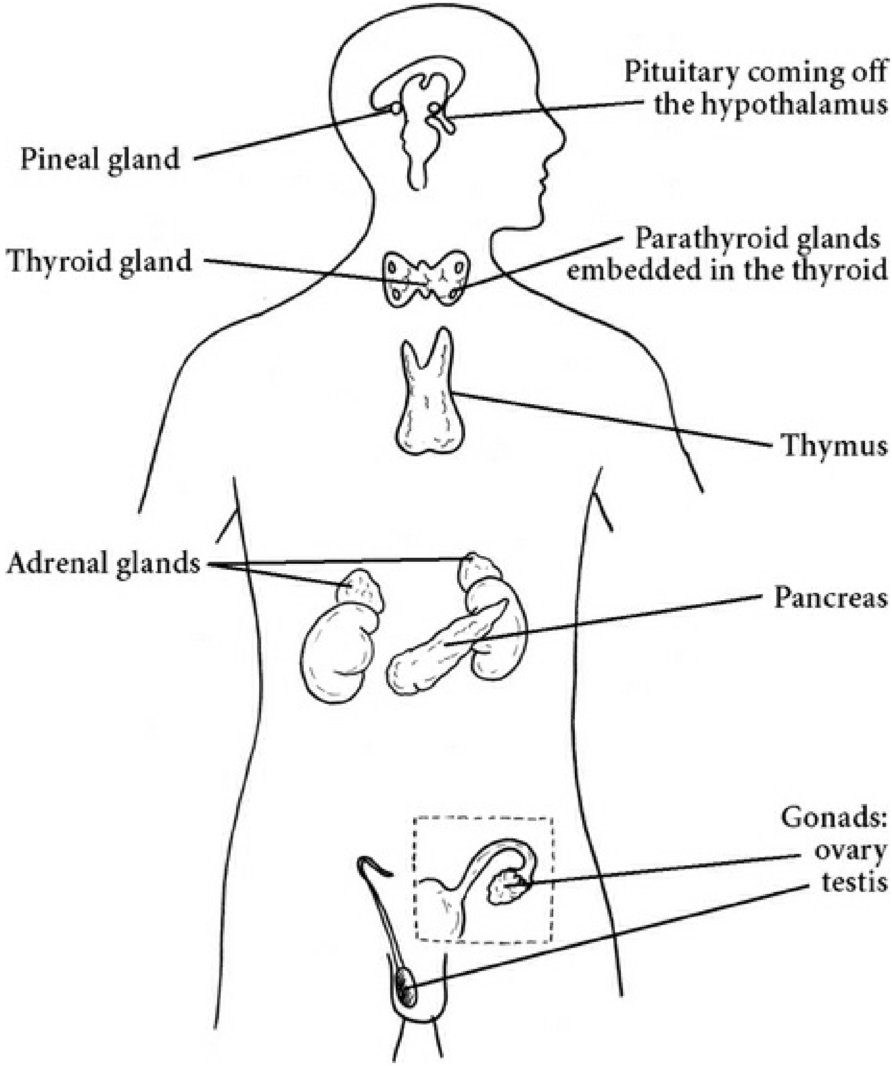

FIGURE 15.1. Endocrine glands

Most hormones are controlled by **negative feedback**. As discussed in our beginning chapters, this means that raised circulating levels of the hormone are detected by receptors, and this information is fed back to the gland, causing a reduction in the release of that hormone. The **positive feedback** mechanism is unusual in health and relates to specific big events such as childbirth, when more and more oxytocin is released as labor progresses.

Control of Hormone Secretion

Many hormones are controlled via the nervous system. The hypothalamus controls the release of pituitary hormones by its own hormones, which are known as **releasing factors**. The pituitary hormones in turn cause the release of other hormones. The autonomic nervous system, especially the sympathetic fight-or-flight response, also increases production of many hormones. As you will remember, it has big effects on the blood sugar hormones like cortisol, insulin, and glucagon, as well as growth hormone, thyroid hormone, and the other adrenal hormones.

Because of the wonderful complexity of the endocrine system, it is easy to become confused about it. Although the best advice is to study *one* gland at a time, here we are introducing the whole lot together. You might find that looking at imbalances helps as a way to learn and remember the actions of hormones; we'll do that in this chapter, as we consider the effects of too much or too little of key hormones.

A very interesting aspect of endocrinology is the strong relationship between hormones, neurotransmitters, and emotions. As discussed already, there are great similarities between peptide hormones and neurotransmitters, with many substances acting as both. They are called neurotransmitters when found in the nervous system and hormones when secreted into the blood. These peptides are also produced by the white blood cells of the immune system. Immune cells, nerve cells, endocrine glands, and many cells, tissues, and organs throughout the body have receptors for them. It is useful therefore to see them as informational substances, by which means the trillion-cell community that we are keeps in touch with its own parts.

The purely mechanical view, which unfortunately seems to still prevail in the medical world, sees emotions as being caused by chemicals. This is a convenient belief for reliance on drug therapy, as it means logically there is no deep obstacle to treating emotional difficulties with chemicals. A different slant, the more holistic one, sees the dance of thought, feeling, and chemical expression as being a two-way street: Our thoughts are continually affecting our chemistry as well as the other way around. Neurotransmitters and hormones are the chemical expression of our thoughts and emotions, in turn affecting our thinking and feeling. This model is eloquently described by Deepak Chopra in his book *Quantum Healing: Exploring the Frontiers of Mind/Body Medicine*, Candace Pert in *Molecules of Emotion: Why You Feel the Way You Feel*, and Bruce H. Lipton in *The Biology of Belief: Unleashing the Power of Consciousness, Matter and Miracles*.

The Pituitary Gland

The pituitary gland is a pea-sized gland attached to the hypothalamus of the brain. It is, in fact, two glands—the anterior pituitary gland and the posterior pituitary gland. Together, they are known as the **master gland**, because it controls many other endocrine glands. It makes a whole list of hormones, detailed below.

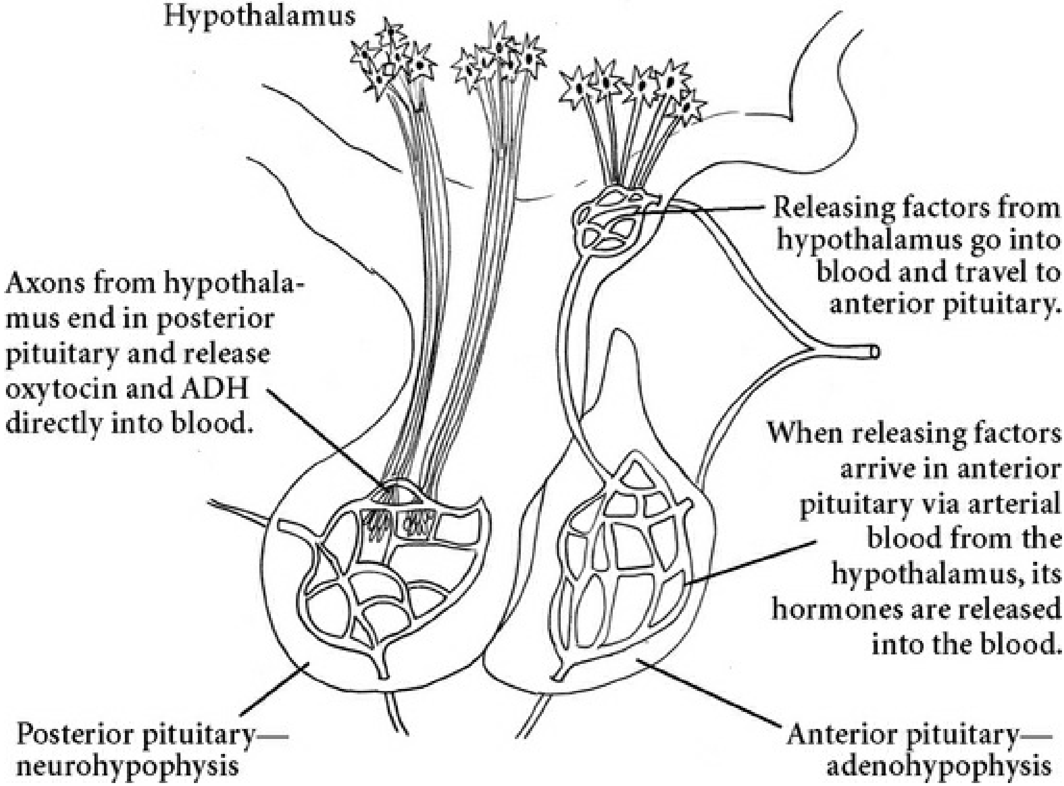

FIGURE 15.2. Pituitary gland

Growth hormone affects the growth and differentiation of cells and tissues, especially bone. Although it is obviously hugely influential in childhood, it is just as essential in adulthood since growth continues throughout life. Tissues are replaced routinely or when damaged, and this cannot be done without growth hormone. There are many other factors involved in growth also. Growth hormone has an important effect on protein, fat, and carbohydrate metabolism as it ensures that proteins are synthesized, fat is broken down to be available for use in energy production, and blood glucose is maintained within the normal range (growth hormone tending to increase it). Undersecretion of growth hormone in childhood leads to the condition called dwarfism, in which mental development is normal but growth of the body is stunted. Oversecretion of growth hormone in childhood leads to gigantism. Later in life, oversecretion results in the condition known as acromegaly, a painful condition where the bones in the hands, feet, and skull grow abnormally.

Thyroid stimulating hormone (TSH) is released from the pituitary when the hypothalamus sends a releasing hormone. TSH goes to the thyroid gland to cause secretion of thyroid hormone.

Adrenocorticotrophic hormone (ACTH), which also has a releasing hormone from the hypothalamus, causes release of adrenal cortex hormones. It is one of the primary **stress hormones**, as discussed in Chapter 14 in the section on the autonomic nervous system.

Gonadotrophic hormones (luteinizing hormone, LH, and **follicle-stimulating hormone**, FSH) control activity in the gonads in men and women. FSH stimulates development of the ovarian follicles, and therefore the ova, or eggs, and production of estrogen in a woman, and sperm production in a man. LH stimulates progesterone secretion in women and testosterone production in men.

Prolactin is responsible for milk production. It begins to be secreted during pregnancy, but the extraordinary high levels of female sex hormones floating around at that time stop it from working. On about the third day after childbirth, there is a sudden and dramatic drop in pregnancy hormones, allowing prolactin to go to work, filling the breasts with milk. This is known as “the milk coming in.”

Melanocyte stimulating hormone stimulates melanocytes in the skin. These are the cells that make the pigment melanin, which makes our skins dark to protect us from the damaging UV rays of the sun.

The above hormones are all produced by the anterior pituitary, or **adenohypophysis**, at the front of the pituitary, which is made of glandular epithelial-type tissue. Inhibiting and releasing factors from the hypothalamus control their release and travel directly to the pituitary in connecting blood vessels. So the nervous system is involved in directing much pituitary, and therefore endocrine, activity.

At the back is the **neurohypophysis**, or posterior pituitary. This is made of nervous tissue, being a continuation of the brain. The following two hormones are actually made in the cell bodies of neurons in the hypothalamus and migrate down the axons, which end in the posterior pituitary, and are released into the body's blood stream when the nerve cells are stimulated.

Anti-diuretic hormone increases water reabsorption in kidneys.

Oxytocin ejects milk from the breast, and makes the uterus contract. The stimulus for its release is the sucking of the nipple—thus breastfeeding right after birth helps the uterus contract and expel the placenta (the blood-rich organ formed by the uterus to nourish and supply the developing fetus with oxygen) and for the months afterwards gets the uterus back into shape. Oxytocin is a hormone that is involved with powerful bonding and loving feelings, important for establishing a mother-child bond. It is secreted from within the brain and from the ovaries and testes as well as by the pituitary—a good example of an informational peptide.

The Thyroid Gland

The thyroid gland is in the front of the neck below the larynx (Adam's apple). It is shaped like a bow tie, with a wing either side and a narrow bridge or **isthmus** between them crossing the throat.

Thyroid hormones—**thyroxin**, or **tetraiodothyronine**, and **triiodothyronine** (having four and three iodine atoms, respectively)—stimulate metabolic rate in cells and promote growth. They affect cellular differentiation, growth, and metabolism—in other words, pretty much everything! It is thought that they increase the efficiency of ATP production by the mitochondria. T4 and T3 (as they are called) promote protein synthesis by acting on DNA, increase carbohydrate absorption rate in the gut, promote fat metabolism, and encourage uptake of glucose by cells for energy production. It is likely that all the cells in the body have receptors for thyroid hormones.

The thyroid gland also produces **calcitonin**, which lowers the amount of calcium in the blood, in its C-cells.

Too much or too little ...

Common symptoms of **hypothyroidism** (too little thyroid hormone) include lethargy, fatigue, cold intolerance, weakness, depression, dry skin, hair loss, and reproductive failure. If these signs are severe, it is called **myxedema**. In the case of iodide deficiency, the thyroid becomes unusually large, and is called **goiter**.

Hyposecretion of thyroxine in childhood causes **cretinism**, retardation of growth and of proper development of the nervous system. (This condition would most likely happen in inland mountainous areas far from the sea, where salt was difficult to obtain and iodine levels in food were low.)

It used to be that underactive thyroid was commonly caused by iodine deficiency—hence the use in herbal medicine of seaweed to treat it. Nowadays this is much less common because table salt is usually iodized and most people have too much, rather than too little, salt. However, underactive thyroid is now even more common. Often there is an auto-immune element to it.*

Remember that the health of a cell and the condition of its receptors are of vital importance. A person may very well have all the clinical symptoms and signs of an underactive thyroid, but the blood thyroid levels are normal when tested. This could be due to a problem with the cells' receptors for thyroxin. The cell membrane being in poor shape could be due to something as simple as dehydration, or a deficiency in the essential fatty acids of which the membrane is made.

Common symptoms of **hyperthyroidism** (too much thyroid hormone) are the opposite: the person is manic, anxious, nervous, an insomniac, has a fast heart rate, is heat intolerant, and often has eye problems that make the eyes bulge. It is called **thyrotoxicosis**. Menstrual irregularities are common with both under- and overactive thyroid. Untreated, both can lead to heart failure.

The Parathyroids

The parathyroids are four tiny glands embedded in the thyroid. They were discovered accidentally after removal of the thyroid gland for overactive thyroid led to terrible problems with calcium metabolism in the body. **Parathyroid**

hormone works with calcitonin (also from the thyroid) to balance blood calcium levels: it increases the calcium levels in the blood by increasing intestinal absorption, decreasing calcium secretion in the kidney tubules and increasing reabsorption of calcium from bone. Calcitonin (from the C-cells of the thyroid gland) does the opposite. Calcium is needed for proper muscle and nerve function, bone metabolism, and the general well-being of cells.

Too much or too little ...

There are no recognized diseases involving too much or too little calcitonin, although this can be present in many diseases. However, too much or too little secretion of parathyroid hormone does occur in disease. Too much parathyroid hormone can happen from a tumor of the parathyroids that secretes the hormone. It leads to abnormally high blood calcium levels, kidney stones, and weak bones. It also occurs secondary to kidney disease. If the kidneys are not able to reabsorb calcium in the tubules, calcium levels will fall, leading to increased parathyroid secretion to try to maintain normal blood calcium. Calcium will then be taken from the bones.

Too little parathyroid hormone leads to a decreased concentration of calcium in the blood, which causes painful muscle spasm, known as tetany, and convulsions. The most common causes are surgical removal of the parathyroid glands and auto-immune diseases, which destroy the glands.

The Adrenal Glands

The adrenal glands sit one on top of each kidney. The adrenal medulla (in the middle) secretes **adrenalin** and **noradrenalin** (known as epinephrine and norepinephrine in the States), involved in the fight-or-flight response. Outside of the medulla is the cortex, which secretes the steroid hormones that regulate the body's use of carbohydrates, as well as salt and water balance. The steroid hormones are **glucocorticoids** (including **cortisone)**, which affect glucose, fat, and protein metabolism, as discussed earlier with metabolism in the chapter on the liver. They do all this by mobilizing energy stores to allow plenty of glucose available in the blood for cellular respiration, and suppression of the inflammatory and immune responses.

Then there are the **mineralocorticoids. Aldosterone** controls the reabsorption of sodium and water in the kidney. It increases reabsorption of sodium and increased reabsorption of water by the kidney tubules, thus leading to decreased water and sodium in the urine and increased potassium excretion by the kidneys.

The adrenal cortex also produces a small amount of **androgens**, or male sex hormones. In women these become important after menopause, when the ovaries are no longer producing estrogen, and a woman's muscle and fat cells can convert the adrenal androgens to estrogen.

Too much or too little …

Too much presence of cortex hormones results in **Cushing's disease**. The most common cause of this is **iatrogenic**—inadvertently resulting from overprescription of steroids by doctors. Natural causes include either a problem in the adrenal cortex or a problem in the pituitary leading to too much ACTH secretion. The clinical features of Cushing's disease include high blood pressure, obesity of the trunk but wasted limbs, round "moon face," thin skin, and metabolic disorders like diabetes.

A deficiency of steroid hormones is known as **Addison's disease**. This most commonly comes after an infectious disease (like TB), or is seen as an auto-immune destruction of the adrenal cortex. It is expressed as lethargy, diarrhea, weakness, and cardiovascular disease.

Lack of aldosterone usually occurs together with too little cortisone in Addison's disease, but it can occur on its own. The resulting electrolyte imbalances and low blood pressure can be lethal, causing heart failure.

The Gonads

These will be discussed in more detail with the reproductive system. The gonads are the ovaries and testes. As well as producing the egg and sperm from which a new human grows, these have an endocrine function. The ovaries produce **estrogen** and **progesterone;** the testes produce **testosterone**.

The female hormones are estrogen and progesterone. Estrogen makes the ovum mature and keeps the skin soft and the hair in good condition, as well as maintaining other female secondary sexual characteristics. Progesterone is the pregnancy hormone, which prepares the uterus for pregnancy and maintains the pregnancy. Testosterone is the male sex hormone, which causes development of the genitalia and secondary sexual characteristics in males, and is involved with production of spermatozoa. Testosterone is partly responsible for libido in both men and women.

Too much or too little ...

Excessive testosterone secretion in women can lead to virilization—an increase in maleness, in other words, becoming more hairy, voice deepening, and so forth. Similarly, too much estrogen in men leads to feminization—the acquiring of female secondary sexual traits. These disorders can come about, for example, from a (rare) adrenal tumor secreting the hormone.

As a normal part of aging, men's levels of testosterone decline over life, and women experience a dramatic drop in estrogen and progesterone production with menopause. But men can also experience abnormally low testosterone levels with the effect of declining libido, erectile problems, low energy, and gynecomastia (the development of breasts). Premature ovarian failure sometimes occurs in women, and causes all the symptoms of menopause in women under forty.

The Pancreas

The pancreas, as well as its exocrine function described with the digestive system, contains groups of cells called the **Islets of Langerhans**, which secrete **insulin, glucagon**, and **somatostatin**. These important hormones control blood glucose levels. Insulin lowers blood sugar by transporting it into cells for use in energy production, and stimulating the muscle and liver cells to store it as glycogen. Lack of insulin is found in diabetes mellitus.

Glucagon is opposite to insulin: it stimulates the liver to convert glycogen to glucose and promotes gluconeogenesis, thus increasing the level of blood sugar.

The third hormone, somatostatin, is less well-known. It decreases the levels of both glucagon and insulin.

Too much or too little ...

Insulin deficiency results in **diabetes mellitus**. This is a very significant disease for humans, with more and more people suffering from it each year. The symptoms of diabetes are constant thirst, constantly needing to urinate, tiredness and lethargy, and unexpected weight loss.

There are two main types of diabetes: type I and type II. **Type I** is known as **insulin-dependent diabetes mellitus** or IDDM. It usually begins in childhood or early adulthood, being due to destruction of the beta cells of the páncreas that make insulin, probably due to auto-immunity. The body is suddenly unable to make insulin. This leads to an emergency situation where the blood is full of sugar but the cells are starving, which causes the symptoms of diabetes: fatigue and weakness, mental confusion, thirst, skin infections, and urinary infections. The excess sugar in the blood is food for bacteria, which easily thrive on it, and the kidneys can't keep up with reabsorbing all the glucose, so the urine also contains glucose.

This type of diabetes is treated by injection of insulin, which must be done every day (sometimes multiple times) for one's whole life. Later (more so if the diabetes isn't managed well) there is damage to the small blood vessels and nerves, with eye and kidney problems. Amputations are common due to losing sensation in the feet and not noticing an infection taking hold until it is too late.

Type II is known as **non-insulin-dependent diabetes mellitus** or NIDDM. This begins more slowly and is associated with our modern diet of excessive sugar and fat. It is the fastest growing disease in the world. It starts with an **insulin resistance**—that is, normal levels of insulin but insulin receptors that don't respond well—and continues with insulin levels getting higher to try and get the receptors to respond, but the receptors keep getting worse. The disease is often controllable by changing the diet. It has been found that people who eat a diet high in fiber, with lots of fruit and vegetables and whole grains, and low in animal fat are much less likely to get diabetes. (Yet, still, eating sugar and fat are not stated as causes, perhaps because some people can eat like this and not get diabetes. In order for it to be an accepted cause, it seems that *everyone* who eats too much fat and sugar, and not enough vegetables, would have to get it. This doesn't make sense, as not everyone who smokes gets lung cancer but smoking is still a known cause.) Obesity is seen as a huge risk factor, although not a cause. The naturopathic view is that the inability of the insulin receptors to respond is likely to be due to the massive and unnatural amounts of refined carbohydrates many people eat today, coupled with high-fat and low-fiber diets. This type of eating basically overwhelms the receptors, which fatigue and become unresponsive to insulin. Diabetes type II can lead to an insulin-dependent form if not checked.

Too much insulin results in **hyperinsulinemia**. This is most commonly seen in type II diabetes with insulin resistance. More unusually it can form a tumor secreting insulin. It can also occur in type I diabetics who take too much insulin. This insulin shock leads to a radical drop in blood glucose levels that starves the brain of glucose and can lead to coma and death. The first sign of this serious situation is usually irrational or aggressive behavior; people close to insulin-dependent diabetics learn to look out for this and know that it is essential to get some glucose into the diabetic who begins to behave in this way. Due to the extreme irrationality, this can literally involve having to sit on them and force sugary stuff into their mouth. If insulin shock happens while a person is asleep, it is particularly dangerous, as coma and then death can result unnoticed.

The Thymus Gland

The thymus gland is behind the sternum. It secretes a group of protein hormones called **thymopoietins** and **thymosins**. These are essential for the development of **T-lymphocytes**, which are involved in specific immunity. The thymus gland is most active in childhood, later atrophying, although it does retain some activity throughout life.

Don't forget to gently tap your sternum daily for a few minutes to stimulate the thymus and therefore maximize your immune system's protection. Although the thymus very much loses activity over the course of life, some small function remains of activating T-cells when you come across a new infectious agent, such as a mutated cold or flu virus. It's possible that tapping the sternum stimulates it a little to keep working as well as it can, and it certainly won't do any harm.

The Pineal Gland

The pineal gland is involved with cycles of night and day. It protrudes in the brain from the roof of the third ventricle, in the diencephalon, which is close to the pons, the cerebellum, and the cerebrum. The pineal gland could be said to be light sensitive; actually, it is fed information about light from the retina, via the suprachiasmatic nucleus. One of the hormones it produces is **melatonin**. As the light decreases, it secretes more melatonin. It has some action in cycles of sleep and wakefulness. Melatonin inhibits the secretion of gonadotrophins from the anterior pituitary, and is involved in sexual development. The pineal gland also secretes some of the neurotransmitter **serotonin**. (Serotonin is made and secreted all over the place in the body, including lots in the brain and the gut.) It slows down activity at puberty, and is often calcified in adults, while still retaining some secretory activity.

Endocrine Glands and Chakras

The chakra system, which originated in ancient India, is about the life force or energy within the body and mind. It is said that all things in the entire universe, from the tiniest subatomic particle to the great spiral galaxies, are spinning wheels of energy. So also the chakras are centers of energy within us; they are wheels or disks of spinning energy based around the spinal column.

Each chakra has a particular sphere of influence, and it is interesting that each can be correlated with a particular endocrine organ as well as with a concentration of nervous activity. Different schools of thought exist on chakras and these vary as to which chakra relates to which gland.* For example, the base chakra at the bottom of the spine is associated with survival. Some put the adrenal glands with this chakra, others the testes. The second chakra, or sacral chakra, located below the belly button, has to do with sexuality and creativity and may be correlated with the ovaries and womb or the testes and prostate. The third chakra, which is about our will and power in the world in relation to others, lies near the pancreas, but sometimes is given association with the adrenal glands. The heart, with the fourth chakra, is at the center of everything and corresponds with our loving connection with ourselves, each other, and all that is. The thymus gland lies here, with its protective immune activity and somewhat mysterious actions. The fifth chakra, in the throat, correlates with communication and creativity, with our voice, and our outward expression of what is within. Wrapped closely around that area is the thyroid gland. A point between the eyebrows is the third eye chakra; in some systems it is associated with the pituitary gland, in others the pineal. The seventh chakra, called the crown, is sometimes associated with the pineal gland and sometimes with the pituitary gland.

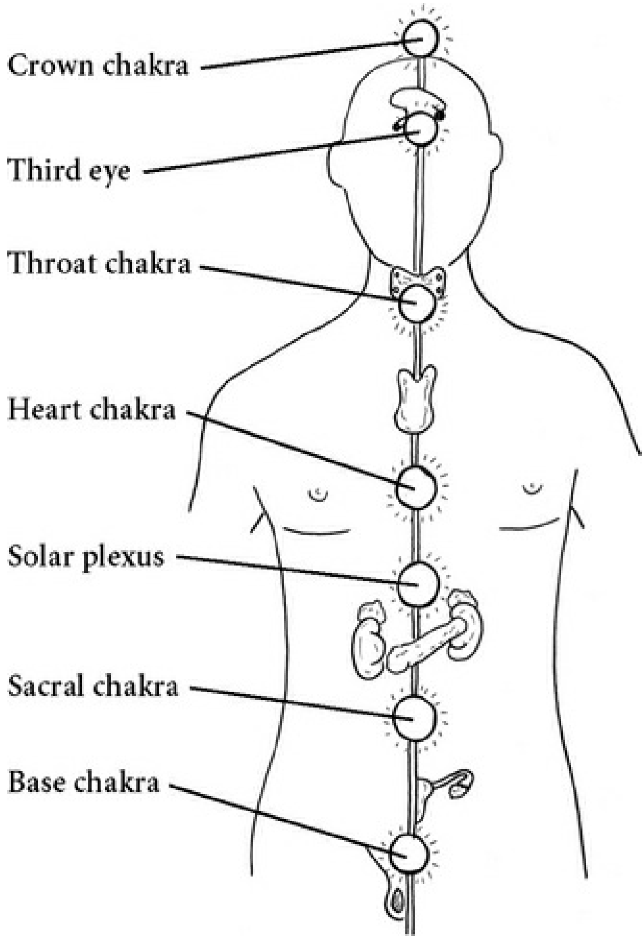

FIGURE 15.3. Endocrine glands and chakras

There are good arguments for both gland associations in the upper two chakras. It makes sense to put the pineal gland with the crown chakra as the crown is to do with our opening and connection to the heavens, to the light above, and the pineal gland is tied closely in with matters of night and day, light and darkness. On the other hand, because of the fact that the third eye is all about seeing—which is very much to do with light and dark—it makes sense also to put the pineal gland with the third eye.

Interrelationships

These are obviously everywhere, because **every system** is at least in part regulated by hormones. It seems also that every system makes hormones too, with more being discovered all the time. As hormones are secreted into the blood, there is a special relationship with the **cardiovascular** system. The **digestive system** absorbs the raw materials for making them, the **liver** metabolizes them once their job is done, and the **kidneys** and **bowel** then excrete the metabolites.

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*It is dangerous to come off drugs for underactive thyroid. It is not possible to substitute herbs for hormone replacement therapy, and this should not be attempted.

*Three books are listed in the Resources that I recommend as sources for information about chakras: Anodea Judith's *Wheels of Life*, Gabriel Cousens's *Spiritual Nutrition and the Rainbow Diet* (republished as *Spiritual Nutrition: Six Foundations for Spiritual Life and the Awakening of Kundalini*), and Gilles Marin's *Five Elements, Six Conditions*. Each provides a different slant on the chakras.

CHAPTER 16

The Birds and the Bees—The Reproductive System

This system is for the reproduction of the species. It's obviously very important. In fact, there is an argument that it's the most important system of all—that the entire organism has developed around the genes' determination to survive.*

It is a fascinating system, and not just because it's about sex! Men and women really have very similar bodies. We all have the same three hormones present in our bodies—progesterone, estrogen, and testosterone. These hormones are steroid hormones, being made from cholesterol like cortisone. In fact, the body mixes and matches them: cholesterol is made into a precursor molecule (called **pregnenolone)**, which can then be made into any of the sex hormones, or any of the adrenal cortex hormones. The actual amounts involved are very small—tiny fluctuations have a huge effect on us.

In a developing embryo, the genitalia look identical until two months in the womb, actually looking more female than male.** At this point, a male baby, if he has testes, begins to secrete testosterone. The presence of testosterone makes the genitalia begin to develop, to look more male: the erectile tissue, which forms the clitoris in the female, and the inner labia, are elongated and join to form the penis; what will be the outer labia in a female join up to form the scrotal pouch that will house the testicles outside the body. (The seam down the middle of the adult male scrotum shows where the two sides knitted together.) The gonads are similar in size and shape, and begin life in the same place, on either side of the lower abdominal cavity. The testes migrate through the inguinal canal—a tunnel through the abdominal muscles—in the last weeks of gestation.

The differences are tiny, yet hugely important for reproduction. You might be surprised to find that the significant difference between us is less about the appearance of the plumbing—known as the **genitalia**—than you might think. In fact, the biggest difference between the sexes can be seen in the functioning of the gonads. In a woman, all the eggs her ovaries will ever make are partially made while she is still inside her mother's body in the first months of gestation. This means that, in a way, our grandmothers have a big part in making us, and we all begin life inside our grandmother's body; the egg that we grew from was made by our mother's mother when our mother was growing inside her. What our grandmother ate, smoked, or drank, as well as how she lived, her stress levels, and nutritional status when she was pregnant with our mother, have an effect on our health and life. This is especially true if we are female, and it will also affect our reproductive lives—the primordial eggs in our ovaries were all made by our mother when she was carrying us.

In contrast, sperm cells are made daily by the testes. The tubules of the testes are made of a specialized layered epithelial tissue that, like all epithelial tissue, is always dividing and growing and replacing its cells. When the cells reach the lumen of the tube they break off from the wall and stay inside—they are the sperm cells. Millions are made daily by the **seminiferous tubules** of the testes.

This is the major reproductive difference. In interesting ways, it mirrors the ancient Chinese concept of yin and yang, female and male energy: the yin is the constant, unchanging, still form. The yang is the changeable and adaptive form.

Before puberty male and female bodies are very similar, apart from the difference in the immature genitals of each. At puberty the sex glands become active under command from the pituitary. The sex hormones cause growth and development of the genitalia and development of the secondary sexual characteristics—pubic hair, armpit hair, and breast development in women; facial hair and deepening voice in men.

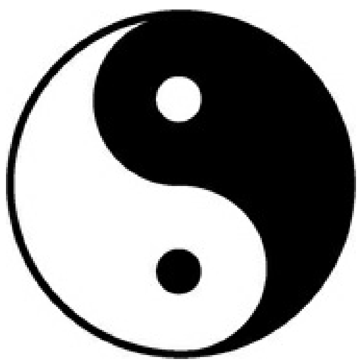

FIGURE 16.1. Yin-yang symbol

It is the **gonadotrophic hormones**—FSH and LH from the pituitary—that stimulate secretion of estrogen, progesterone, and testosterone and make these changes, preparing our bodies for making babies. The hormones cause ovulation and menstruation in women, and sperm production in men.

Gender

For convenience, we will take a look at female and male reproductive systems separately. Many, but not all, human societies have been very rigid in attitudes to gender and the roles for men and women. Although these rigidities have been challenged to varying degrees in recent decades, there is still a lot of work to do to free us from the oppressive notions that surround gender. We are still learning about the real differences between women and men.

Some interesting recent research focuses on the different ways men and women react biologically to stress. After many hundreds of thousands of years as hunter-gatherers, women (being the gatherers) are fitted by biology for community living, for making complex connections and relationships. Women are protected from stress by the feel-good hormone oxytocin, which is all about love and relationship. It seems that women's brains never really switch off—as long as plenty of oxytocin-producing activities are available, we are quite happy with our permanent business. Men, on the other hand, are more designed for hunting—intense periods of strenuous, goal-oriented activity, mediated by testosterone. Men need to rest and switch off, and to succeed in reaching a goal, to keep their testosterone levels high and protect them from damaging effects of stress.

Strict ideas of what a "real" man or woman is, plus distortions and disconnection from spiritual traditions, lead to many, many people feeling not quite right, due to not fitting into these narrow definitions. In biology, it turns out things are not as clearcut as all that. We generally think that there are two sexes, or genders, but in fact there is more variation than you might think. Individuals may have quite different levels of the male and female hormones, affecting the physiology and emotional makeup in all kinds of ways. Some people are born hermaphrodite—possessing both male and female sexual organs.

Sex is almost always determined at conception, by the sex chromosome part of our genes. The sex chromosomes are X and Y. Chromosome X is known as the female and Y the male chromosome. This is because if there is a single Y chromosome present, maleness is the result. The absence of Y (and presence purely of X) leads to femaleness.

Usually the female germ cells (ova, or eggs), have two X chromosomes—XX. Sperm cells have either XX or XY—one X and one Y. The chromosomes' names are given for their shape; literally, the X chromosomes look like the letter x and the Y like the letter y.*

When the egg and sperm meet, each gives one chromosome to the new person. It is the sperm that determines gender—not the egg, which is always female. If a Y chromosome is present, the male characteristics will develop. If no Y, it's a girl. Interestingly, it seems that a very small percentage of the time it is possible for an embryo to start as XX, and then within a few days lose a bit of one of the chromosomes to become Y, so a boy develops.

Some animals, frogs for example, reproduce by **parthenogenesis**—the eggs divide and produce an embryo without fertilization by sperm. In these cases the embryo would always be female and contain only the genetic material of the mother. Apparently parthenogenesis can be artificially induced in any animal ova, but the embryos do not develop fully. However, it is thought to happen naturally sometimes.

Mostly this is thought to be impossible for humans—and it certainly has not been possible to induce artificially.**

Unusual Numbers of Sex Chromosomes

Some people have extra sex chromosomes. These abnormalities are fairly common, only slightly less common than Down's syndrome (an autosomal problem—affecting chromosomes other than sex ones) but often not so visible.

Some women are born with only one X chromosome—XO—and are said to have **Turner's syndrome**. They are usually short in height, and often have webbed necks, small jaws, and high, arched palates in the mouth. The ovaries do not develop normally so they do not ovulate or develop the usual secondary sexual characteristics—they have exceptionally small breasts and are sterile. Nowadays they are given growth hormone when young to make them grow a little extra, and estrogen after puberty to encourage growth of breasts and menstruation, so that they appear relatively normal.

Then there are **metafemales**—XXX females. These woman are usually taller than average as adults, with unusually long legs and slender bodies, but they otherwise appear normal. They have normal sexual development and are fertile, but are usually of lower-range intelligence or may have slight learning difficulties—especially if they are XXXX or XXXXX, which can happen. This condition occurs in about one in one thousand female babies, and more often in the children of older mothers.

Men sometimes have an extra X chromosome—being XXY or, more unusually, XXXY, XXXXY, or even XYXXY. This is called **Klinefelter's syndrome**. Men with this genotype are usually completely sterile, or nearly so, and the testes and prostate glands are small so they produce only small amounts of testosterone. These men usually have relatively high-pitched voices, asexual or more female body shape, breast enlargement, and comparatively little facial and body hair. They are often a little taller than average, and are inclined to be overweight and have learning difficulties as children. They are typically ordinary enough in appearance to "fit in" with no problems. It is not uncommon for the syndrome to be discovered only during investigations for infertility. The symptoms are more extreme if more than one extra X chromosome is present. Again, the syndrome is more common in the children of older mothers.

Then there are the XYY men—the **supermales**. Usually tall and generally appearing and acting "normal," these men are producing high levels of testosterone, so in puberty they are usually slender and have severe acne. Most of these men are unaware of their condition as it has little effect on ordinary life and they are usually fertile. There is no convincing evidence, though some theories, that these men are more prone to violence and aggression.

The Female Reproductive System

In women the **internal genitalia** are the two **ovaries**, two **fallopian tubes**, the **uterus**, and the **vagina**. The **external genitalia** are the **vulva**, or **pudenda** (literally, "that of which one ought to be ashamed," and referring to the external genitalia of either gender), the erectile tissue that is the **clitoris**, the internal and external **labia**, and the **vaginal** and **urethral orifices**.

Strangely enough, the clitoris was not mentioned in anatomy textbooks until relatively recently. And I don't remember it being mentioned in my sex education classes at school in the UK in the late seventies and early eighties. I hope things have improved in this area. As you will see from the section on development later in this chapter, the clitoris is related to the penis and is erectile—in other words, it becomes engorged with blood and highly sensitized during sexual arousal. It is possible for a woman to conceive a baby without sexual pleasure, and without the clitoris, but sexual pleasure is not possible without the clitoris. I would argue that the presence of the clitoris shows that sexual pleasure is a gift from the Divine—we wouldn't have one at all if sex was just about making babies.*

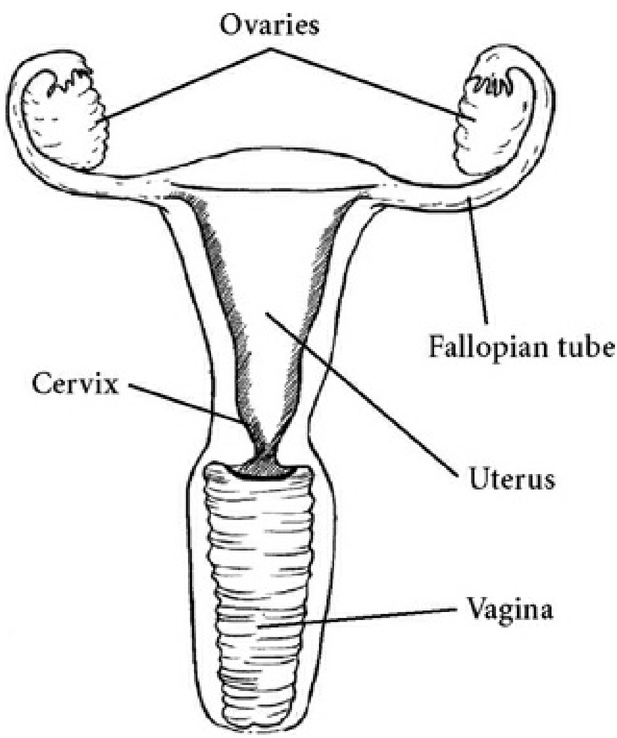

FIGURE 16.2. Female reproductive system (frontal section)

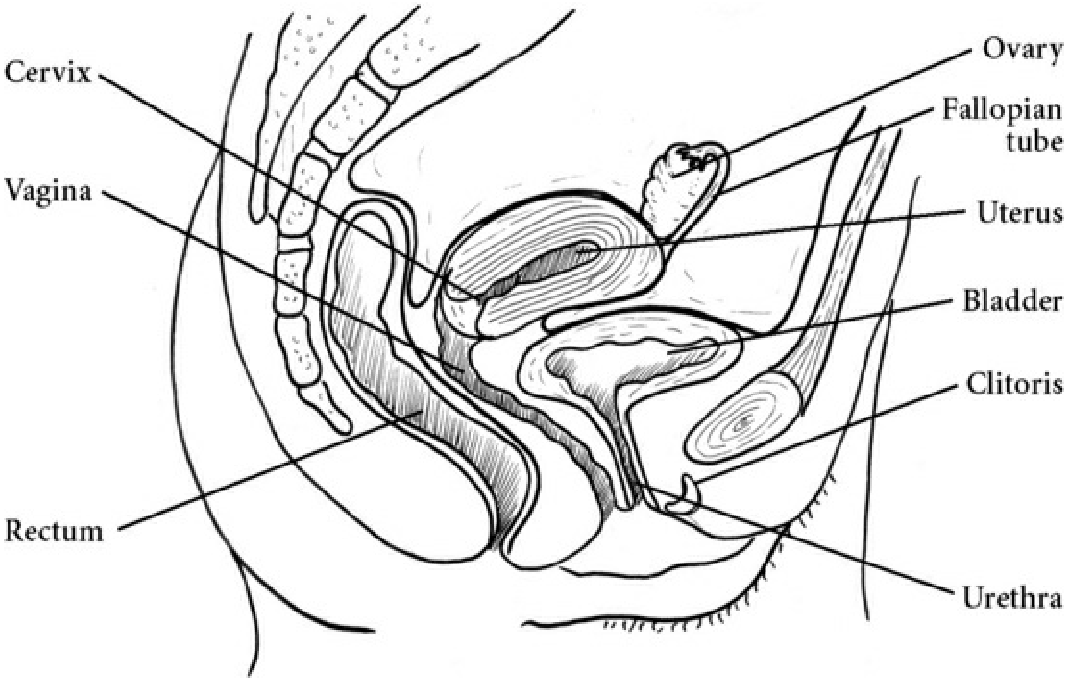

FIGURE 16.3. Female reproductive system (sagittal section)

The ovaries produce hormones that regulate reproductive functions. **Follicle-stimulating hormone** (FSH), from the pituitary, causes the ovary to develop its **ovarian follicles**, each containing an immature ovum, or egg, at the same time stimulating the ovary to produce the hormone **estrogen**, which keeps the skin soft and the hair in good condition, as well as maintaining other female secondary sexual characteristics. These begin to develop at puberty when estrogen is first made and released by the ovary. The breast tissue is stimulated to grow and enlarge—before puberty, boys and girls have identical breast tissue. It is solely the influence of the female sex hormones that makes the breasts grow and develop. The other female **secondary sexual characteristics** include the pattern of female body hair and fat distribution that gives the female body its distinctive shape.

All about Estrogen

There are three main estrogens: estradiol (which is strong and most active), estrone (weaker than estradiol), and estriol (produced by the kidneys from other estrogens, eighty times less active than estradiol). The combined effects of these are usually what we mean by estrogen levels. As well as making the female secondary sexual characteristics and causing the maturation of the ovarian follicle, estrogens influence the structure of the skin and blood vessels and the strength of the bones throughout life.

What estrogen does is stimulate increased cell numbers wherever there are estrogen receptors—for example, in the breast and uterus. It also stimulates each cell to make more receptors, so the more estrogen there is, the more estrogen-receptive cells there are, and the more sensitive each cell is to estrogen. Some tumors are **estrogen sensitive**—this includes some breast cancers as well as benign tumors like fibroids, which are noncancerous tumors in the muscle layer of the womb. **(Benign** tumors are ones that do not spread to other places—those that spread are called **malignant**, and new tumors in other parts of the body that come from them are called **metastases.)**

The ovaries secrete strong estrogen each month after the period, peaking around ovulation and continuing until just before the next period, when production drops. The female body can also make estrone from **aromatization** of male sex hormones made in the adrenal glands. This process happens in the cells of the hair follicles, brain, skin, and bone, but mainly in the muscle and fat cells. This is why after menopause, when the ovaries stop producing estrogen, skinny women may have more symptoms of estrogen withdrawal than those with a bit of padding. It's interesting that after menopause the metabolic rate slows, so the tendency would be to gain weight though one is eating the same amount. Could this be Mother Nature's way of ensuring that postmenopausal women get enough estrogen?

When getting rid of the strong estradiol from the body, it is converted to two metabolites, one of which is "good" and the other "bad" (so called for being involved in some breast cancers). The liver removes estrogen from the blood and puts it into the bile, where it passes into the intestines. Some of this is excreted in the feces, but some can be reactivated by intestinal enzymes produced by gut flora, and reabsorbed into the blood. These enzymes are higher in a woman with a high-animal-fat, low-fiber diet. This type of diet then means higher estrogen levels in the blood.

In addition, there are also **xenoestrogens**, chemicals with strong estrogenlike effects. All groups of man-made chemicals have some: detergents, pesticides, fertilizers, and plastics. So the modern diet, combined with increasing pollution, is increasing estrogen-dependent cancers and fibroids.

Phyto-Estrogens

Many plants contain estrogens. These **phyto-estrogens** have a weak estrogenic effect. The interesting thing is that weak estrogens will bind to estrogen receptors, stopping strong estrogens from binding—therefore in premenopausal women plant estrogens can protect from harmful excess estrogen, and therefore potentially some cancers. Soya is one food full of plant estrogens. In Japan, where a lot of soya is eaten, breast cancer is very rare (although soya probably isn't the only reason for this). In postmenopausal women, however, plant estrogens provide a bit of estrogen stimulus and can protect from symptoms of withdrawal like hot flushes, mood changes and even perhaps osteoporosis.[1]

Menstruation

Menstruation is the cyclical loss of the blood-rich lining of the uterus. Every month this lining builds up, ready to accept and nourish a fertilized ovum. If no fertilization occurs, the lining is lost, shed as menstrual blood.

The ovarian follicles develop in the first half of the menstrual cycle. At the end of this time the follicle is mature and ejects its ovum into the abdominal cavity. In the second half of the menstrual cycle, after ovulation, luteinizing hormone (LH) from the pituitary makes the empty follicle mature into the **corpus luteum** (meaning "yellow body"), which secretes progesterone. Progesterone (literally, "for gestation") is the pregnancy hormone that prepares the uterus for pregnancy by causing thickening of the specialized wall of the uterus. If no conception occurs, then two weeks after ovulation the lining of the uterus is shed as menstrual blood. Menstruation occurs normally every month, from menarche in the early teens until menopause at age forty to fifty, varying from woman to woman.

Many cultures have understood menstruation to be a powerful time for women. In the words of Alexandra Pope from her excellent book *The Wild Genie: The Healing Power of Menstruation:* "Menstruation is power—the power of knowledge, understanding and love of your own mind, body, and soul, the nourishment and nurturing of the Feminine—the Wild Genie."

It is certainly well worth reclaiming menstruation from the mire of weird ideas and disgust of women's bodies that came up with "the curse" as a name for this most intimate and sacred of life's processes—without which none of us would be here.

Many tribal peoples have customs that dictate that a menstruating woman retreat during the bleeding time, or "moon time." Although some cultures have evolved to see menstruating women as dangerous, many see the menstrual period as an extremely powerful and beneficial time. The First American (Native American) customs involve retreat to a moon lodge. It being understood that a menstruating woman is at her most receptive, the women go into the moon lodge to retreat, rest, and dream. When they emerge, they look into their "bowl"—the womb—and see what gifts they have been given by their Spirit. The gift might be a poem or a new recipe, or something bigger for the people, like a vision of where the buffalo are, where the hunters can find food.

I weep to think of the wisdom we in our modern culture have lost, all those gifts from Spirit from all the menstruating women. For us the idea is to ignore our period altogether—put on white clothes, go swimming or horse riding, whatever. No wonder menstrual problems are so very common.

The Goddess

The Old Ways of the island of Britain, like those of all places in all times of old, honored the Goddess, worshipped her three parts that reflect the three stages of life of a woman, and the phases of the moon. First, the young woman is the Maiden, the new moon, a Goddess of spring, of fresh newness and innocence. Her color is white.

Then comes the red blood stage of the Mother, the ripeness of the full moon, the woman and Goddess in her aspect of giving and nurturing the next generation.

With menopause, the end of menstruation, the woman enters the Crone phase. The Crone is the aspect of the Goddess who, with the dark moon, enters the underworld, moving freely in the land of the dead to collect wisdom and secrets not accessible by anyone else. The color of the crone is black. White, red, and black—the colors of the Goddess.

The Charge of the Goddess

Listen to the words of the Great Mother:

Once in the month, and better it be when the moon is full, then shall you gather in some secret place. To these will I reveal things that are yet unknown.

And you shall be free from all slavery.

Keep pure your highest ideal, strive ever toward it, let nothing stop you or turn you aside.

For mine is the cup of the wine of life, and the Cauldron of Ceridwen. Though I am known by a thousand thousand names, yet the whole round earth does venerate me.

I am the beauty of the green earth, the white moon among the stars, the mystery of the waters, and the desire in the hearts of women and men.

Before my face let your divine self be enfolded in the raptures of the infinite.

And know the mystery—if that which you seek you find not within you, you will never find it without you.

For behold, I have been with you from the beginning and I await you now.

—from Doreen Valiente's *Charge of the Goddess*

Women who live together generally will begin to menstruate at the same time. It seems we communicate by

pheromones, odorless volatile components of sweat that signal hormonal activity to each other. There is a belief that women who live without electricity and in sight of the moon generally will menstruate with the dark moon and ovulate when the moon is full.*

Events of the Menstrual Cycle

Days 1–14, the proliferative or follicular phase: FSH and a lesser amount of LH from the pituitary cause the ovary to develop its ovarian follicles, each containing an immature ovum, surrounded by supporting cells. These produce estrogen, which in turn makes the ovum mature. Within the follicles, the ova develop. Each begins as a **primordial follicle**, then become a **primary follicle**, then **secondary follicle**, then **mature (graafian) follicle**. It takes ninety days or more to go from primary to mature. (Ovulation, at day 14 of the menstrual cycle, is of secondary oocytes, or ova.)

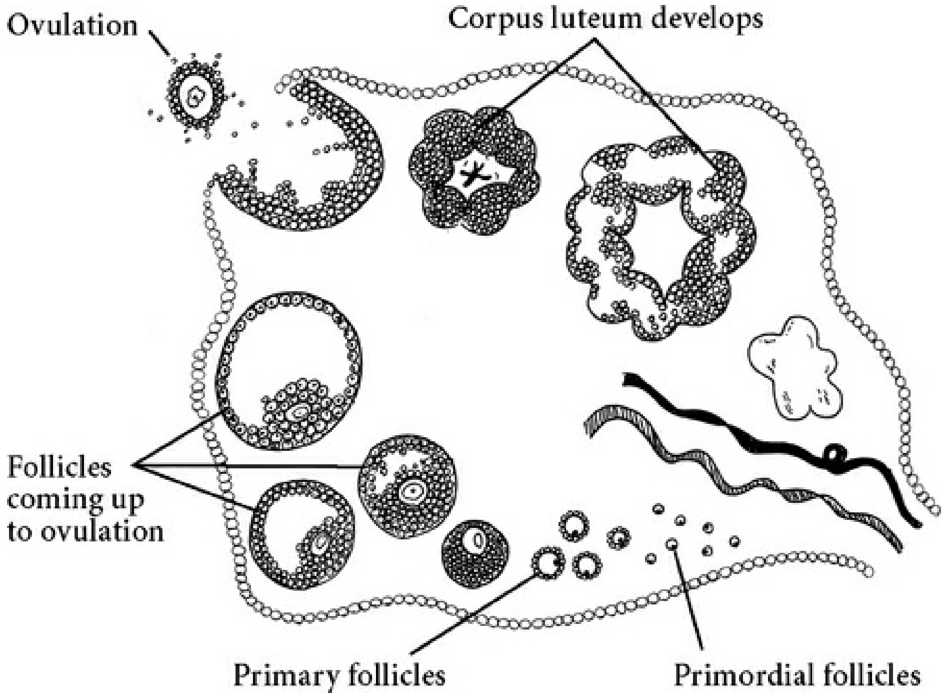

FIGURE 16.4. Ovary

Day 14, ovulation: When blood estrogen reaches a certain level, a **positive feedback mechanism** causes a surge of LH at midcycle; in other words, the more estrogen there is, the more LH is secreted until it reaches the peak of the midcycle crescendo. The surge of LH in turn leads to a huge surge in estrogen, causing an egg cell (or primary oocyte) to be ready to develop further into a **secondary oocyte**. This secondary oocyte is **ovulated**—the follicle bursts and releases its egg cell into the pelvic cavity, and the egg then is usually swept into the uterine tube by the wafting action of these fallopian tubes' ciliated epithelial lining. (The empty follicle then becomes the corpus luteum.) It is only when the secondary oocyte meets a spermatozoa in the fallopian tubes that it is stimulated to complete its development, becoming a large, fully mature **ovum** that is ready for action and can join with the sperm to form a **zygote**. Or not…. (A zygote is the single cell that is formed when the egg and sperm combine, and from which a whole new human can grow.)

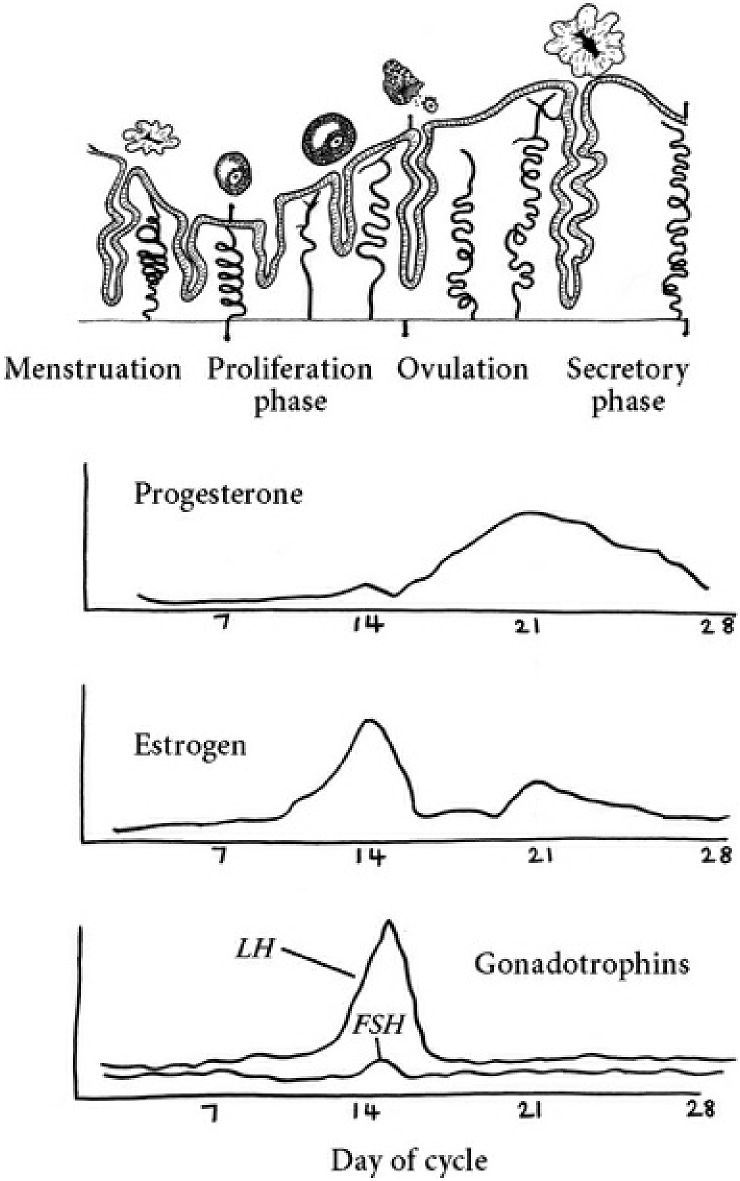

FIGURE 16.5. Menstrual cycle

Days 14-28, the luteal or secretory phase: In the second half of the menstrual cycle, after ovulation, LH continues to stimulate estrogen production and also makes the empty follicle mature into the **corpus luteum**, secreting progesterone, which prepares the uterus for pregnancy by thickening the specialized wall of the uterus, the **endometrium**.

Rising levels of progesterone and estrogen then inhibit the hypothalamic-pituitary gonadotrophic system (meaning that levels of luteinizing hormone and follicle-stimulating hormone, the gonadotrophic hormones, drop). If conception hasn't occurred, the corpus luteum deteriorates and the ovarian hormones drop to their lowest levels before the cycle begins again. The last few days of this phase, if no conception occurs, are known as the **ischemic phase:** the blood supply to the thickened wall of the uterus, the endometrium, is cut off.

Day 1–5, menstruation (beginning of follicular stage again): If no conception occurs, then two weeks after ovulation the lining of the uterus is shed as menstrual blood. The first day of bleeding is called day one of the new cycle.

The hormonal cycle is controlled by positive and negative feedback interactions between gonadotrophic releasing and inhibiting factors from the hypothalamus, gonadotrophic hormones of the pituitary, and the sex hormones themselves.

The Male Reproductive System

We will take a look at the men's reproductive parts now before moving on to what happens when women and men get together. The male reproductive system consists of two **testes**, two **vas deferens, seminal vesicles** and **ejaculatory ducts**, the **prostate** gland, the **urethra**, and the **penis**.

The testes are made of very long coiled **seminiferous**

tubules, which make sperm cells, or **spermatozoa**, under the influence of follicle-stimulating hormone from the pituitary. LH, known in men as **interstitial cell stimulating hormone** (ICSH), causes the interstitial cells found among the seminiferous tubules to make testosterone, the male sex hormone.

Sperm Cells

Spermatozoa have a head (containing genetic material and having the ability to penetrate the ova), a middle section (containing mitochondria for making energy), and a tail that moves the sperm along. There are millions of sperm in one ejaculation, made every day. The sperm cannot move until the last part of their maturation, which takes place in the **epididymis** tubules—the last part of the testes continuous with the seminiferous tubules before and the vas deferens after.

Testes

The testes hang outside the body in a sack called the **scrotum**. This gives the necessary lower temperature that spermatogenesis (making sperm) requires. The scrotum can be pulled up close to the body when it is cold by a special muscle, the **cremaster muscle**, or lowered down in hot weather, to maintain a good temperature for sperm production. If the testicles are repeatedly too hot—as occurs when wearing tight trousers, or sitting all day with a computer at waist level—lowered sperm count, and therefore infertility, can result.

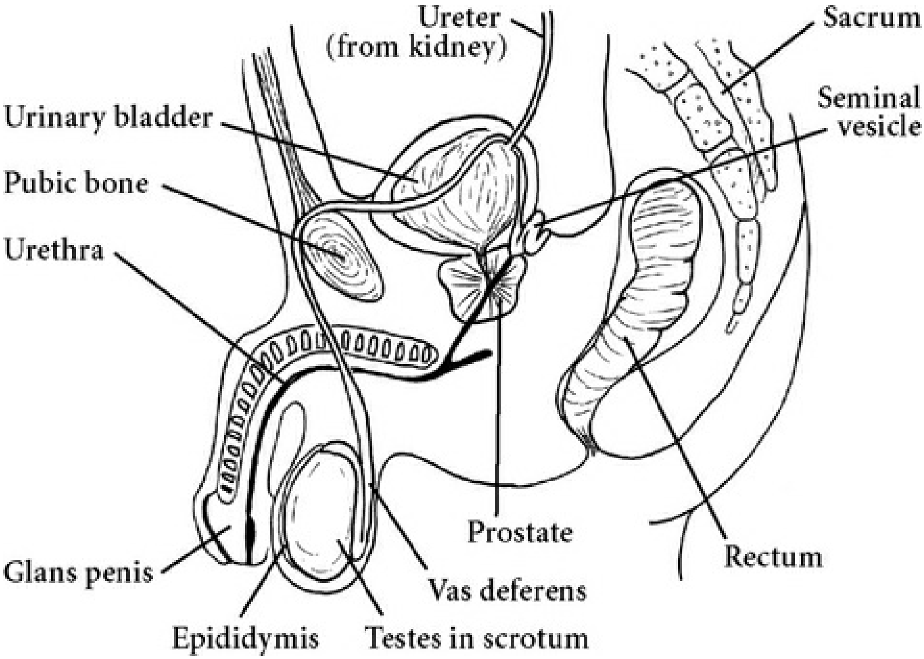

FIGURE 16.6. Male reproductive system (sagittal section)

A tube called the **vas deferens** carries sperm from the testes into the body, via the spermatic cord that passes through the **inguinal canal**, to the root of the penis. Much of the semen, or ejaculate, is produced by the seminal vesicles and the prostate gland. Ejaculate is ten percent sperm, sixty percent and twenty percent secretions from the seminal vesicles and prostate, respectively, and ten percent alkalines and mucus from the bulbourethral glands. The secretions include nourishment for the sperm, fructose, lipids, and amino acids as well as vitamins B and C, and zinc. (It's good for men to eat pumpkin seeds, which keep their zinc stores replenished.)

There are actually different sorts of sperm. One **ejaculate** will contain a whole variety. First out are the sprinters, the sperms in good shape, expected to make it to the egg and achieve fertilization. Next come two different sorts, apparently—dud sperm, which basically block up the female's tubes and stop anyone else's sperm getting in, and so-called killer sperm, which hang around to attack other males' sperm that might show up. (Yes, really! Before drawing any conclusions from this, remember that we are closely related to other mammals and thus share many of the same design features, despite some being not strictly necessary for our own way of life. Remember, we have forty-two percent the same genes as a banana!)

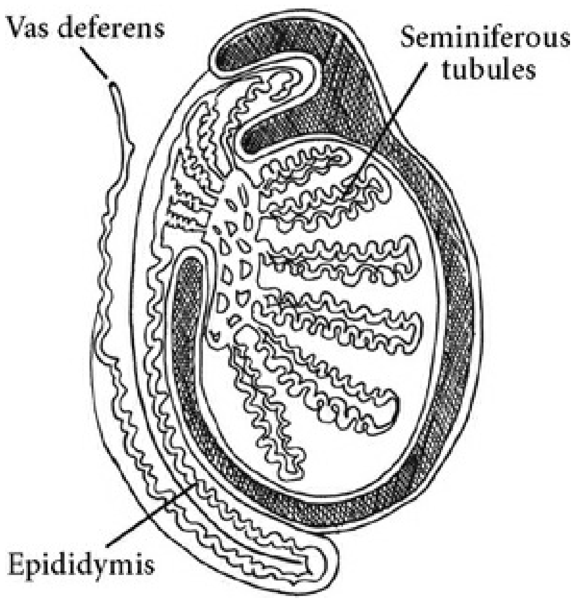

FIGURE 16.7. Testes

Even more interesting is the effect of feelings and pheromones on sperm production. A man who hasn't seen his beloved for a while will increase his sperm production on reunion, but will not if he has casual sex with someone less important to him. This effect of the beloved's proximity can happen even when she is absent, if he is exposed to her pheromones. (Researchers in pheromones do strange things like soak fabric in people's sweat and tape this onto the subject's top lip for so many hours a day.)

The tissue that in a female embryo becomes the womb becomes the prostate gland in a male. The **prostate**, which surrounds, and indeed forms, the first part of the urethra as it leaves the bladder, makes important local control agents called prostaglandins, and adds nourishing fluid to the ejaculate. Its secretions are involved in the maturation and activation of sperm.

The prostate very commonly becomes enlarged in elderly men, leading to a compression of the first part of the urethra and therefore an interruption in bladder control. This common condition is called **benign prostatic hypertrophy**. Herbal and nutritional treatments can do a lot to prevent it becoming a highly troublesome condition. Cancer of the prostate is also common, being the third most prevalent cancer in men. Incidentally, there is an established link between consumption of dairy products and prostate cancer.*

Under normal circumstances, sperm is introduced into the vagina through the penis, which consists of columns of spongy, erectile tissue around the urethra. Although in men, the urethra is the common route for urine excretion and for ejaculation, these functions do not happen at the same time.

The Lord of the Wood—The God

There are Gods of the woods and wild places, with the form of the human male but with horns on their heads. Cernnunos is one—the man with deer's antlers on his head. Pan with the horns of a goat is another. Herne the Hunter is yet another name, and there are horned gods in every culture from Egypt to India. Christianity—along with the Romans—turned these Gods into devils when sweeping through Europe and overthrowing the local cultures and religions, so many people today know nothing of the power and beauty of the Horned One. He is truly a spirit of nature, Lord of the wood, untamed and wild, protector of the creatures of the forests and fields, sexy and passionately alive, full of life, forever untamable. He dies and goes to the Goddess in the underworld each year, to be born again at the winter solstice. (This is why Christians put their own God-is-born festival close to that time of year.)

Sex

Sexual arousal in both women and men is mediated by the parasympathetic part of the autonomic nervous system—via sacral nerves. The neural response triggers vascular changes, creating erection in the spongy body of the penis or the clitoris. A **positive feedback** situation leads to **orgasm**, which is controlled by nerves and smooth and skeletal muscle. Orgasm is accompanied by spasms of the pelvic floor muscles. In men this is usually accompanied by ejaculation, which is the reflex expulsion of semen from the penis. A kind of ejaculation sometimes happens for women too at the moment of orgasm.

Cernnunos

In this untidy mind I roam untamed by certainties, bewitched by sight and sound, by turn of thigh on summer's day, a sigh of awesome love in hillside vision.

I see long-booted dreams of this or that, I find I am free at times to feel the shivers of the web, the warp and wind, in pleasures of a sacred kind I find I am free.

In this unruly world of weaving truths, a maze of crissed and crossed mythologies, the Wyrd begins and ends in words.

The word of God,
unspeakable.
Honey-voiced he speaks
of husky love in moonlit noon,

heavy-hung with longing.
His need makes no promises—
he gives an endless self of
blood and grain and surging spring,
he is a promise.
—Pip Waller

In the words of Thomas Moore, in the introduction to his book *The Soul of Sex*: “Sex is infinitely more mysterious than one usually imagines it to be and it is only superficially considered when we talk about it in the term of hormones and the mechanics of lovemaking.”

Sexual pleasure and arousal are complex areas involving hearts, minds, and spirits as well as bodies. It is easy to get bogged down by the plumbing, seduced by the notion that knowing the right technique is the main part of the game. The best approach to sex is to realize there is no one true way for everyone. Sex can be engaged on many levels. It is too big a subject to get deeply into here, other than to take a quick overall look at sexual intercourse, which can lead to baby making, and the general stages of arousal and orgasm. Take a look at Thomas Moore’s *The Soul of Sex* to go deeper. Now, back to the plumbing:

A Poem on Pollination

Semen is Latin

for a dormant, fertilized,
plant ovum—
a seed.
Men's ejaculate
is chemically more akin
to plant pollen.
See,
It is really
more accurate
to call it
mammal pollen.
To call it
Semen
is to thrust
an insanity
deep inside our culture:
that men plow women
and plant their seed
when, in fact,
what they are doing
is pollinating
flowers.
—Stephen H. Buhner[2]

There are four stages of physical response during sex. The first is **desire and arousal**, also called excitement. All kinds of things can get us in the mood: smells, food, touch, clothes, thoughts. Genital tissue swells—the penis and clitoris become erect and the vagina widens. Lubrication begins in both men and women. Blood pressure and heartbeat go up. You start to feel hot.

The second phase is the **plateau**. This is the increase in sexual excitement building up stronger and stronger and leading to orgasm. Lubrication increases at this time, along with breathing, heart rate, and blood pressure. Flushing of the face and body often occurs and muscle tension increases. The penis swells, the testes draw closer to the body, and the vagina lubricates more as the womb draws into an upright position. The lower part of the vagina (part of the pelvic floor known as the introitus) engorges to its limit. The breasts engorge, especially the nipple, which makes them look less erect. The clitoris moves up against the pubic bone. Continuous clitoral stimulation is needed at this stage for a woman to come to orgasm. Plateau stage can be reached and moved back from several times before proceeding to orgasm—or may not lead to orgasm at all. The stimulation required can happen in many ways, not all of them involving the genitals. In rare and wonderful cases, mental stimulation alone leads to orgasm.

Orgasm—*le petit mort* or "the little death"—is the third phase. Physiologically, men's and women's orgasms are pretty much identical. The pelvic floor muscles around the genitals contract rhythmically, with each contraction taking about 0.8 of a second, some five to twelve times or more. Women usually have more contractions. Female ejaculation—the release of a large quantity of lubricant—happens in some women's orgasms, but not all. At the point of orgasm, the cervix dips with each contraction—possibly into a pool of semen that was delivered to that spot.

Resolution and resting time, when the body slowly returns to its normal state, is the final phase. Blood pressure, heart rate, and breathing drop to below normal levels, and then eventually go back up to normal. The cervix opens for about twenty minutes to allow for passage of sperm, then closes again. The whole body sweats. Tons of endorphins are released, creating very good feelings. This stage can last for minutes or hours. For the majority of men, sexual pleasure or arousal is usually impossible at this time. The length of the resolution period varies from man to man, and is usually longer for older men. Woman, however, are more often able to go back and forth between the plateau and orgasm phases several times.

Often (but not always, of course), sexual arousal with its erection of the penis and clitoris and lubrication of the vulva and vagina leads to sexual intercourse. During sexual intercourse—known as **coitus**—the erect penis is welcomed into the vagina and both partners move, getting up some friction that builds the sexual pleasure. Usually during male orgasm, ejaculation occurs, and millions of sperm carried in the semen are spurted out of the urethra into the vagina. The sperm must travel all the way through the cervix and uterus and into the fallopian tubes to meet the egg. Fertilization (or pollination, as described by Stephen Buhner) occurs in the fallopian tubes.

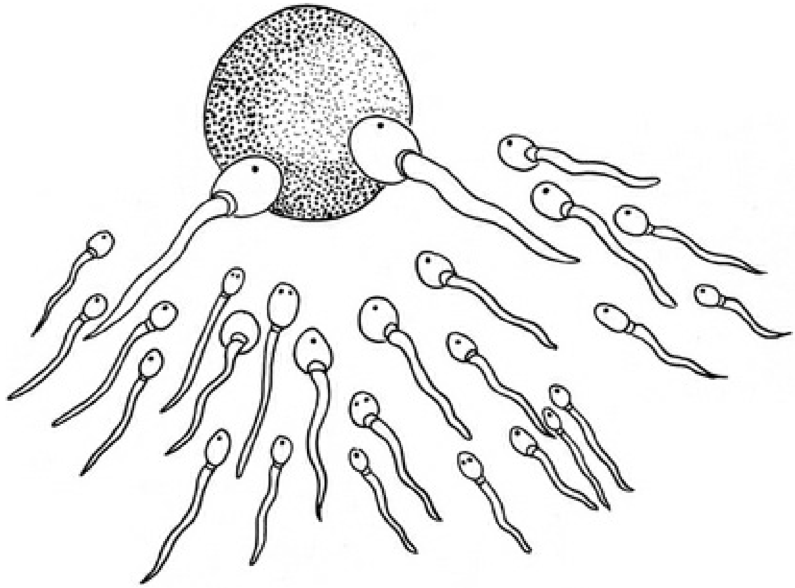

FIGURE 16.8. Sperm and egg

Pregnancy—Fertilization and Development of the Embryo

An oocyte (the proper name for an immature egg that is ready for conception) is viable for about twenty-four hours after ovulation. Sperm may remain viable in the female reproductive tract for one to three days. Assuming they meet at the right time in the right place—in the fallopian tube—conception can occur. The sperm must survive the so-called hostile (acid) environment of the vagina and become **capacitated** (which means fully ready for action, able to have a go at breaking down the egg's outer layer). Many sperm must release the acrosomal enzymes stored in their heads in order to break down the ovum's outer layers. Thus, although only one sperm binds to the egg's receptors, preventing other sperm from penetrating, really the conception is a joint effort. This triggers the final stage of meiosis by the oocyte, and the sperm's and egg's **pronuclei** fuse to form the **zygote.** This is another piece of evidence that supports the concept that the important underlying drive of our nature is for cooperation rather than competition.

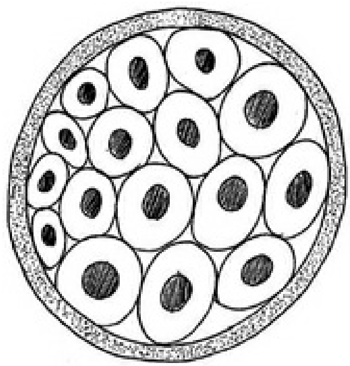

FIGURE 16.9. Morula

The **embryonic period**, lasting eight weeks, then begins. First, the zygote divides and forms a ball of cells—the **morula** (meaning "mulberry"). This becomes the **trophoblast**, which begins to secrete human chorionic gonadotrophin, and leads to the formation of a **blastocyst**. On arrival in the uterus at six days after conception, the blastocyst implants itself into the enriched endometrium the womb has prepared for it. Full implantation takes about a week. During this time the blastocyst has developed into a **gastrula** with three **primary germ cell layers**, and the embryonic membranes develop.

The three germ cell layers, from which all body organs will derive, are the **endoderm, mesoderm**, and **ectoderm**. The ectoderm fashions skin and nervous system, the endoderm forms epithelial linings, and the mesoderm forms virtually everything else. The very young embryo is flat and consists of the germ layers that fold to form a cylindrical body; it is the internal cavity of this that becomes the digestive tract. It continues folding to form the rudimentary body parts.

By the eighth week we are 3 cm (1.2 inches) long. All major brain regions are formed. The liver is disproportionately large and begins to form blood cells at eight weeks. Limbs are present. The skeleton is present as a cartilaginous blueprint and ossification begins. Weak, spontaneous muscle contractions appear. The heart and circulation are fully functional (the heart pumps by the fourth week). All body systems are present in at least a rudimentary form. Now begins the so-called **fetal period**, when we grow mostly in size, and refine the differentiation of organs and tissues.

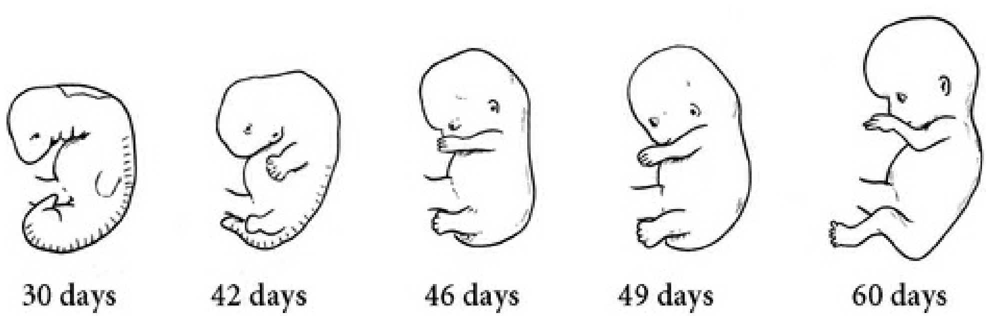

FIGURE 16.10. Developing embryo (drawn from pictures in David Sinclair and Peter Dangerfield's *Human Growth after Birth*)

Abnormalities in the Embryo and Fetus

It is thought that abnormalities in the embryo are responsible for many spontaneous abortions; the body has its own way of detecting and avoiding abnormal development. Genetic counseling of parents known to carry inherited diseases is now established medical practice with the aim of avoiding genetic disease.

One example of this is Down’s syndrome; the chance of having a child with Down’s syndrome is about one in a hundred in women who have previously had an affected child, and at least one in fifty in women over age forty, rising with age. The idea is to dissuade someone from pursuing pregnancy, and, failing this, prenatal (also termed antenatal) diagnosis. Ultrasound scans are routinely given to women at risk, and can detect some abnormalities in the fetus. Distressingly, however, sometimes scans wrongly show abnormalities when all is well and often do not show up abnormalities that are there.[3]

Medical thinking differs from country to country about the safety of scans. For example, in Italy five scans are done of every pregnant woman, but obstetricians in the United States are advised by their professional body to only carry out scans when medically indicated. In vitro experiments show damage to cells when exposed to ultrasound. So far, no problems have been found in vivo, but this does not mean there are none.[*] Maternal blood tests can reveal greater or lesser likelihood of abnormalities. These blood tests are given to all pregnant women in the UK, and made available to all US women with health insurance, unless declined.

FIGURE 16.11. Late-term pregnancy

Amniocentesis is currently offered to all women over the age of thirty-five as well as to those who may carry inherited disorders. A small amount of amniotic fluid is removed around week fourteen to sixteen of gestation. Ultrasound helps to guide the insertion of a needle into the amniotic sac through the mother's abdominal wall, and about 10 ml of fluid is drawn off. The fluid will be checked for enzymes and other chemicals that serve as markers for specific diseases, and it will contain sloughed-off cells from the fetus, which can be examined for chromosomal abnormalities. Abortion is offered when abnormalities are thought to be present. One in a hundred babies will die from problems coming after amniocentesis—whether or not there was something “wrong” with them. The main things found through this technique are Down’s syndrome, anencephaly, and spina bifida.

Chorionic villi sampling (CVS) is another test sometimes done. It involves suctioning off bits of the placenta by a small tube inserted vaginally and guided by ultrasound. It allows testing at eight weeks, but is usually not done until after the tenth week. Like amniocentesis it is an invasive procedure that carries risk to the fetus and mother, for example, increased risk of finger and toe abnormalities.

Ethical Questions

What do you think about all this? When I had my son I thought about prenatal diagnoses and possible abortion a lot. I had had two miscarriages and two ectopic pregnancies, and thought I may never be able to have my own child, so you can imagine it had a particular impact. I decided against having any tests at all (despite being nearly forty, therefore high-risk), because to have an abortion because there was “something wrong” with my child in the end sounds like fascism to me. I was surprised at how completely normal the practice has become—as if to question it at all is extreme or backward in some way. What effect does it have on a woman to abort a baby that her body has decided to carry regardless? What impact does it have on us, to know that we would have been murdered if there had been something considered "wrong" with us?

Interesting questions—and not just for extremist religious groups, but for us all. The so-called social model of disability says that people are "disabled" not by their abilities, or lack thereof, but by the attitudes of the society they live in. How have we come to accept so readily the view that only a person who is productive is of value? Is the worth of a human life really measurable in terms of how we fit in a society that is currently obsessed with amassing worthless treasures at the expense of the very planet we live on? I believe these ideas about who deserves to live and who doesn't are deeply wrong, and damage all of us. If we were more balanced as a society there would certainly be a dramatic drop in the rate of abortions or people considering abortion, as well as in the birth of unwanted children.

When thinking about this and researching, I looked into the disability rights movement. I found a lot of great stuff on the Internet, including a lovely piece called "If Down's People Ruled the World." It eloquently illustrates the goodness and worth of these great people. (See www.nads.org.)

Childbirth

When the baby is ready to be born, the neck of the womb, or **cervix**, is opened up by contractions of the muscular wall of the uterus. This is the first stage of labor, and it usually hurts quite a lot! When the cervix is fully open (typically, “10 cm dilated”), the uterus contracts rhythmically to push the baby out (the second stage of labor—which also stings a bit). As you know, the anterior pituitary hormone oxytocin is the stimulus for labor. During pregnancy, the hormone relaxin has been secreted in large quantities, causing the softening of the body’s ligaments and connective tissue. This allows more openness in the joints, and later on helps to soften the cervix.

After the baby comes out, the placenta is expelled—this is the third stage of labor. Most Western obstetric staff have rarely (or even never, if they are relatively new) seen a natural third stage, since the third stage is typically “managed” by the injection of an oxytocic drug. The trend in modern, orthodox medicine when it comes to childbirth is generally to manage it to the hilt. This has come from the sadness of stillbirth and death of some mothers in labor, and wanting to minimize such deaths as much as possible, but unfortunately it has led to routine interference when none is needed. In fact, delivery of the placenta is a normal part of the process and usually will proceed without a hitch if left to happen. If the baby is put to the breast soon after arriving, its sucking of the nipple will increase contractions in the womb and help to push out the placenta. A mother is also able to feel a contraction happen and then push to expel the placenta. The contractions do not just stop the minute the baby is born.

There are many wonderful books about childbirth (see the bibliography here, or take a look in a good bookstore), and the importance of a natural and gentle arrival when possible. There is also much published material about how medical intervention early in the labor process leads to more and more intervention being necessary. So I won't bang on about this too much. Just a little bit!

What about the pain? First, for most women labor hurts—a lot. But what is this problem our culture has with pain? We are today conditioned to think that pain is a terrible and unbearable thing, and that we should have drugs immediately to prevent feeling any pain at all. And yet pain is definitely a part of a normal life, and the body and mind have mechanisms for dealing with it. Our perceptions of pain are actually a construct of our body and our mind, not something inflicted on the body that our body has to counter. Having a knife stuck in the body is what we have to counter, pain is just the messenger, and the messenger of our body's own choosing. Of course, pain still hurts, but our resistance to it hurts even more.

On the purely physical level, when we are in pain our cells make **endorphins**, the body's own natural opium, which is a very powerful pain reliever. During labor, which generally gets increasingly painful as it goes on, endorphin levels rise accordingly. If pain-relieving drugs are used early in labor, this natural process is interfered with, so more drugs are needed. Incidentally, breathing against resistance, such as in a forced way through your mouth, in and out, as you might when running, increases endorphin production. So getting with the breathing exercises in preparation for labor makes a huge amount of sense.

If you manage not to have any drugs, which unless things are really going wrong is definitely within the capabilities of any woman, as soon as the baby is out and the pain stops you feel fine—tired, but present and alert and not drugged. This goes for the baby too. Since everything in your blood gets to the baby, he or she receives a good dose of all the drugs you take (though it is thought that gas and air leave the mother's bloodstream very quickly, so very little if any gets to the baby).

Pethidine, the anesthetic most commonly used during labor in the UK and the US, gets into the baby's system, leaving him or her drowsy and sedated on birth, which can affect the ability to latch on well and take to feeding. An epidural leaves you more or less numb from the waist down, so you have no pain but also no feeling to assist you to push your baby out, which then opens the way to ventouse (a silicon cup that attaches by suction to the baby's head) and forceps—implements to pull the baby out, which can damage the baby, and in extreme cases even cause death.

I said I wouldn't bang on, so I won't, except to say one thing about elective caesarean section births: Chiropractors and naturopaths (as well as enlightened pediatricians like Michel Odent, who pioneered water births) have long expounded on the importance of a natural birth for proper development of various reflexes. In actually coming down through the birth canal and pushing our way out, important developmental stages are followed. One of these is illustrated by research looking at elective caesareans—in other words, not an emergency life-saving operation, but a decision to have a caesarean at an appointed time instead of waiting for labor to start in the natural way.* Babies born by elective caesarean have a higher mortality (death) rate than babies born naturally.** There is also a much higher level of respiratory distress in such babies—thought to be because hormones like prolactin, released in huge amounts during birth help the final maturation of the lungs.*** Also the squeezing out through the vagina compresses the lungs and pushes out the fluid that they contain before birth.

When the milk comes in is another time when doing the natural thing brings advantages. Over time the uterus shrinks back. Oxytocin, the pituitary hormone that expels milk from the breast, is secreted in response to the nipple being sucked. This hormone also causes the uterus to contract. Thus breastfeeding is good for the mother's body as well as the baby's, as it encourages the uterus to shrink down and tone up after the work of carrying and giving birth to the baby. When the baby first suckles, it gets **colostrum** from the breast. This is a nutritious fluid filled with antibodies. After a few days this is replaced by milk, which is also full of antibodies. This activity, described as the milk coming in, happens after a huge drop in pregnancy hormones with the placenta being gone. The new mother experiences it as a few hours of extreme emotions—crying, anger, and general misery! At the same time, one's breasts have become melon-like as they fill to bursting with milk.

There is a lot of weird stuff about breasts in our modern cultures. In the UK and US breastfeeding is absolutely not yet the norm, despite efforts to increase awareness of its benefits and a slow increase in the number of mothers who breastfeed, and it is not always possible to comfortably breastfeed in public—yet every news stand has magazines and newspapers full of pictures of young women's breasts on display. Breasts are supposed to be a particular size and shape for optimum beauty, leading to more and more women having breast implants (and, increasingly, plastic surgery to improve the appearance of the genitals too!). If you have had this type of surgery you are usually unable to breastfeed. (Some implants are better than others in this respect.)

FIGURE 16.12. Newborn baby

Since breastfeeding is so vitally important to give a person the best possible start in life, it is worth mentioning again here some of its advantages. Breastfed babies are protected from infections of all kind, some of which are life-threatening. Breastfed babies have much less atopic (allergic) disease. Breastfed babies are less likely to die from cot-death or SIDS (sudden infant death syndrome). Breastfed babies grow faster, and become healthier adults, with fewer allergies and easier access to their full intelligence—one study showed an eight-point increase in IQ of people who were breastfed. Breastfed babies get more close contact and warmth from their mothers, and bonding goes better and is more intense.

There are also great gains for the mother. Breastfeeding helps the mother's body to get back to normal. Women who have breastfed have a reduced risk of breast and ovarian cancer before menopause, and osteoporosis after menopause. (The La Leche League is great for information about breastfeeding.)

During childbirth stress hormone levels are enormously high in both mother and baby. In fact, it takes up to six months for the baby's stress hormone levels to drop. This is one reason why new babies cry a lot—they need to release this stored-up stress. The best way to help them is to cuddle them, keep them close, without too much excitement to aggravate them more, but allow them to cry while you hold them and gently reassure them that they are doing fine. Most babies seem to need to cry for about an hour a day or more, and definitely more if they experienced a difficult birth.[4] They really don't need to by shushed for every little noise they make. Imagine how you would feel, if you were trying to tell your loved ones how you were feeling and they kept saying shhhh! while trying to distract you or shoving something in your mouth.

Menopause

Menopause is the cessation of menstruation and the end of the childbearing years. This happens usually somewhere between the ages of forty and fifty, sometimes unusually early in the thirties or later in the fifties. The ovaries stop producing estrogen and progesterone, the remaining follicles atrophy (shrink), and no more eggs are ovulated. The uterus shrinks and atrophies, vaginal epithelium thins, and there is some drying and keratinization (hardening), the vagina changes from acid to alkaline, and breast tissue atrophies. Menopausal symptoms of estrogen withdrawal can include hot flushes and sweats, insomnia, nervousness and irritability, depression, poor memory and concentration, loss of libido, vaginal dryness, joint pains, headaches, and palpitations.

This all sounds a bit grim, taken as it is from the medical model of menopause. There seems even to be a tendency to see menopause as a disease, an unnatural situation, given the modern practice of offering hormone replacement therapy (HRT) to every menopausal woman. In fact, for many women menopause is a powerful initiation into a new phase of life.* The childbearing years are done, and one is liberated from the possibility of pregnancy, which can free up enjoyment of sex now that contraception doesn't have to be considered. In traditional societies that honor women and elders, an old woman is a person of wisdom, a person to look to for counsel. White hair is a sign of wisdom—not something to be hastily covered up with dye to give an appearance of youth.

Good nutrition and herbal medicine, as well as any therapy that improves balance in the body and minimizes stress, can go a long way toward making menopause a positive experience with few symptoms. After menopause estrogen is entirely obtained from conversion of androgens (made in the adrenal glands), which is done by fat and muscle cells. Thus stress will massively increase problems—the adrenal glands being tired from high production of steroid hormones. Medical herbalists often treat women suffering from menopausal distress with adaptogens, herbs that support the adrenal glands, such as licorice and borage.

Interrelationships

The reproductive system is fundamentally related to **all systems** in that the whole body comes from reproduction. The **cardiovascular system** is very important, being crucial in sexual function (erection) and in bringing the needed nutrients for reproductive function. These nutrients come from food taken into the body and processed by the **digestive system**. In men there is a particularly intimate relationship with the **urinary system**. Sexual function and regulation of reproductive activity is mediated by the **nervous** and **endocrine** systems.

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*Richard Dawkins argues this extraordinarily material approach to life in his book *The Selfish Gene*.

**There are some great pictures showing the development of the external genitalia of female and male human embryos on the Internet. For example, check out http://en.wikipedia.org/wiki/Development_of_the_urinary_and_reproductive_organs

*I like to wonder about that extra bit of genetic information on the X chromosome—if you take a quarter away from the X you get a Y. What is all that extra genetic information women have contained in the X chromosome? Is it responsible for our depth of intuition and wisdom, the particular strengths of women? Or does it contain the nutty stuff that can hold us back at times? Of course, I am only playing with these hypothetical. It is very difficult for us to really figure out the important differences of characteristic between men and women—the fundamental ones, rather than the culturally imposed ones. We need to keep an open mind in this area.

**An article at http://ourworld.compuserve.com/homepages/dp5/sex2.htm claims, citing an article in *The Lancet*, there have been cases where at birth doctors found there to be no physical way that sperm could have entered the womb due to obstruction. Pregnancy thus could be due to parthenogenesis or vestigial, usually nonfunctional, male reproductive glands producing some semen and causing self-fertilization. The 1956 theory may have very well have been debunked, but it poses an interesting possibility.

*"What's the difference between the clitoris and the pub? … Most men don't have any problem finding their way to the pub." I generally don't like jokes that belittle one group of people or another, but this one points up the need to know more about this wonderful organ, the clitoris. To increase your knowledge, take a look at www.the-clitoris.com.

*I could not find any research to corroborate this. I invite readers to e-mail me at info@holisticanatomy.com, if they can provide some information.

*Two separate studies published in February 2007 found a link between eating dairy products and prostate cancer. One was the CLUE II study, involving nearly 4,000 men in Washington County, Maryland (*Cancer Causes Control*, 2007; 18:41–50), the other an analysis of more than 29,000 Finnish men taking part in the Alpha-Tocopherol, Beta-Carotene Cancer Prevention Study (ATBC Study) (*Intl J Cancer*, 2007 Feb 2; Epub ahead of print). When researchers looked at the individual dairy products consumed, they found that the risk was higher *only with low-fat milk*—not whole milk or any other dairy. In fact, whole milk had a slight, albeit statistically not significant, protective effect (*Amer J Clin Nutr*, 2005; 81: 1147–54). Accessed 21/7/08 at URL http://www.wddty.co.uk.

*The Web site What Doctors Don't Tell You, www.wddty.co.uk, summarizes a lot of research that questions the safety of scans. Scans have been linked to lower birth rate, more premature births, more dyslexia in later life, and even more deaths. Even for serious abnormalities, the survival rate of babies when this has been picked up on a scan before birth, is no better, and some studies show is even worse than when the baby wasn't scanned and the abnormality not detected until birth.

*In Brazil, where caesareans are extremely popular, one print ad read, "Keep your love passage honeymoon fresh."

***Birth* 2006; 33175. An analysis of nearly six millions births indicates that caesarean babies are nearly three times as likely to die within their first month of life as naturally delivered babies.

[***]Arch *Dis Child* 1997; 77:F237–238.

[*]Lesley Kenton's *Passage to Power: Natural Menopause Revolution* is a great book to help with the reclaiming of menopause as a powerful natural phase.

CHAPTER 17

Experiencing the Outside World—The Special Senses and Touch

The senses are the means for experiencing the outside world—the ways the body can take in information about what is around us. The five senses are sight, hearing, taste, smell, and touch. In medicine the first four are called "special senses," while touch is called a "somatic sense." (Other somatic senses are related to the information we get from within about what our own body is doing, such as proprioception.)

Sight

Sight can be seen as the most dominant human sense, with more than seventy percent of the body's total sensory receptors being the special light-sensitive cells of the retina of the eye. The eye is incredibly complicated. What follows is an attempt to simplify this amazing part of the body, but further study is definitely advised if you want to deepen your understanding.

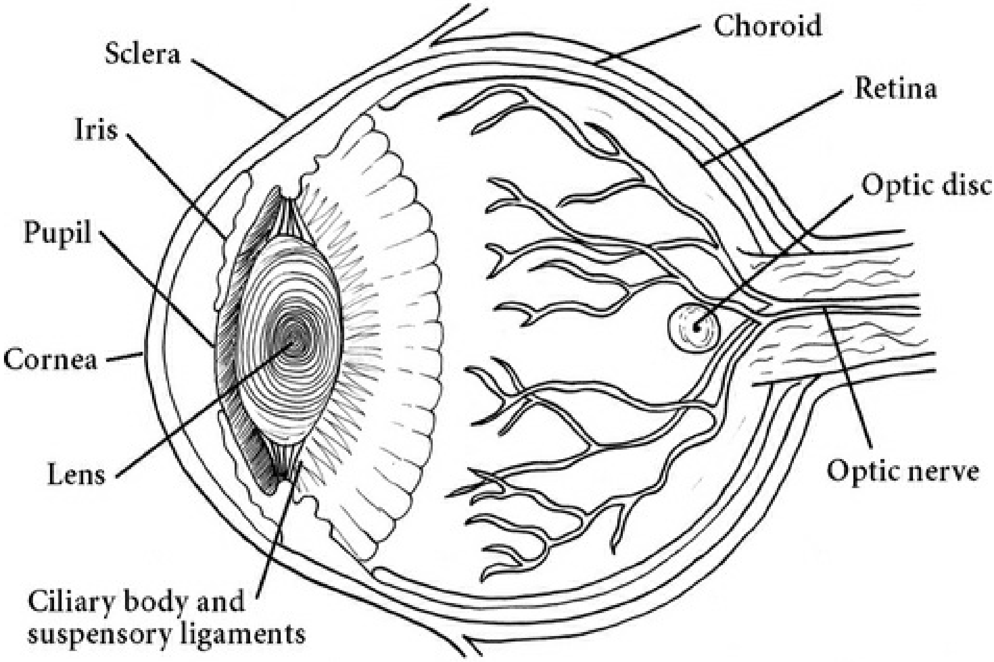

FIGURE 17.1. The eye

Iridology

Iridology is a diagnostic method that uses close examination of the iris of the eye to reveal areas of dysfunction in the body. Each area of the iris relates to a different organ or body part, and certain kinds of marks or discoloration are interpreted to mean particular problems. The general appearance of the iris is also important. If you study people's irises you will see that they look like cloth, with fibers woven together. They range from being very tightly woven like silk to very loosely woven like burlap. Iridologists interpret this to reveal the person's basic constitution. A very tight weave means a very strong constitution; a very loose weave means a weak constitution. Some herbalists (those trained in iridology*) would use this information to judge what kind of dosage and length of treatment to give; a person with a weaker constitution needs lower doses of medication given over a long period of time, and cure could be expected to take some time. Someone with a stronger constitution can take higher doses and more heroic measures, because the body may throw up a strong healing crisis and cure may happen more quickly. (A **healing crisis** is the name given to the phenomenon by which the body, mind, and spirit throw off something that is causing an illness and resolve it like a boil coming to a head. Such crises may be quite varied; they could include a very high fever that finally turns, a chronic inflammation that becomes acute and then resolves, a skin disease that flares up then leaves, and/or an emotional outburst like the crying that naturally accompanies grief and washes the pain away.)

Iridology is generally dismissed as hokum by orthodox medicine, although, interestingly, some iris changes are recognized as revealing pathological changes. For example, a white ring around the edge of the iris, called a corneal ring, usually indicates high cholesterol levels if seen in a younger person, though it is considered a normal sign of aging in an elderly person (when it is charmingly called a “senile” ring).

There are three layers to the wall of the eyeball—which is actually shaped like a ball. The outer layer is tough fibrous tissue; most of it is called the **sclera**, which you can see as the “white of the eye.” This is the layer that holds the eye in shape. Over the colored part of the eye, called the **iris**, is the **cornea**, continuous with the sclera but see-through and more bulgy.

The middle layer of the eyeball is the vascular layer, which is full of blood vessels. The part of this at the front is the iris, which can be seen through the transparent cornea and gives the eye its color.

Continuous with the iris and behind it is the **ciliary body**, to which is attached the **lens** of the eye (via **suspensory ligaments)**. The lens is like the lens of a magnifying glass or pair of spectacles; it can be moved forward and back as needed to focus the light that enters the eye onto the inner layer of the eye, the neural layer. This **retina** contains the visual receptors; these photosensitive receptors are all connected to the **optic disk** at the middle of the back of the eye, which is the beginning of the **optic nerve**, carrying impulses to the brain. The optic disk visually makes a blind spot as it contains no light receptors.

There are various kinds of light. For us humans, our receptive range is called the **visible light range**—it doesn't include ultraviolet and infrared light. If something is either emitting light, or lit by light in our visible range, we can see it because the light enters our eyeball through the cornea and shines on the retina. On the retina are two types of receptors: **rods**, which are light sensitive and can operate in dim light, and **cones**, which need bright light and are color sensitive. The rods and cones are excited by light, and this excitement is passed as a nerve impulse up the optic nerve and eventually to the visual centers of the brain, which then make a picture for us from the information received.

On the outside of the eyeball, where it is open to the elements, is a thin mucous membrane called the **conjunctiva**, which folds back on itself to make the pinky-red layer you can see at the corner of your eye or if you pull your lower eyelid down. If you have plenty of oxygen in your blood, the conjunctiva looks richly red; paleness could be a sign of anemia. If the conjunctiva gets inflamed it produces lots of sticky mucus that gums up your eye—this is called **conjunctivitis**. Babies are more susceptible to it, but luckily there is a very good cure for it—breast milk. All you need to do is squirt some milk in baby's eyes or into a dish and then bathe the eyes with a very soft cloth. (Breast milk is also good for pimples and diaper rash.)

As mentioned above, the lens can be moved by muscles to be in the best position to focus light on the retina, depending on whether the object we are looking at is close to us or far away. In some of us, this mechanism does not work perfectly, and we need glasses to help us see properly. When you can see objects close up but not those in the distance, you are "near-sighted." The opposite, being able to see distant objects clearly but not close ones, is being "far-sighted." As most of us age, we become far-sighted, hence older people find themselves holding things farther and farther away to read them.

Although medicine has gone the route of corrective glasses for sight problems, and drugs or surgery for other problems, some ophthalmic specialists have developed more holistic approaches, which usually involve a mixture of optimum nutrition and eye exercises.* The late Dr. Stanley Evans of the Nutritional Health Eye Centre in Lowestoft, Suffolk, was one ophthalmologist who spent years in Africa and cured many eye problems, including cataracts and glaucoma, with a dietary therapy.[1] Near-sightedness can sometimes be improved with eye exercises, because it is usually due to weakness or poorly functioning muscles around the eye and wearing glasses just makes this problem worse, as the eye becomes lazier. The Bates Method is based on the work of late ophthalmologist Dr. William Bates, who did extensive research in the late 1800s, and combined eye exercises with nutritional advice.[2]

I am not denigrating the amazing advances of modern medicine, which can do miraculous things when it comes to the eye—work in this field is truly amazing. Anyone with an eye problem should certainly consult an eye specialist, even if intending to follow a holistic route also—don't delay, as time can be of the essence in treatment of eye disease.

There are a few other interesting items to mention while we are "looking at" the eyes, like eyebrows, eyelids, and lashes, which protect the eyes by keeping out sweat, bits of dust, and so on. On the rim of the eyelids are special glands secreting sebum that lubricates the eyelids. Underneath the lateral part of the upper lids are found the **lacrimal glands**, which produce the all-important tears. When one cries, some of the tears spill out, and some drain down the **nasolacrimal duct** into the nose—this is why a good cry makes your nose drip and causes you to sniffle. Tears wash the eye and also contain substances (especially lysozyme) that destroy the cell walls of bacteria.

Crying tears because of onions, or because something is in your eye, washes the eyes clean. These tears differ from those we cry when we are hurt, physically or emotionally. Then our tears contain stress hormones, all the substances our bodies produce in large amounts when we are stressed.

Hearing

The ear is the organ that gives us hearing and provides the ability to balance. The structures of the ear translate vibrations in the air (as sound) into nerve impulses. The bit of the ear that you see is called the **pinna**, or outer ear.* This leads into the external auditory canal. At the end of this canal is a membrane called the eardrum, which completely separates it from the middle ear beyond.

The **middle ear** is a cavity in the skull usually filled with air. A tube called the **eustachian tube** connects it with the top back of the throat (the **nasopharynx)**. This tube allows the pressure in the middle ear to stay equal to the pressure outside the body, thus being equal on both sides of the eardrum. When you go up high or down low and your ears "pop," this is the pressure equalizing via the eustachian tube.

You can help this process by sucking, yawning, or swallowing, so in an airplane when ears are feeling the pressure change, sucking a hard candy or yawning can help with discomfort, or for a baby, putting it to the breast.

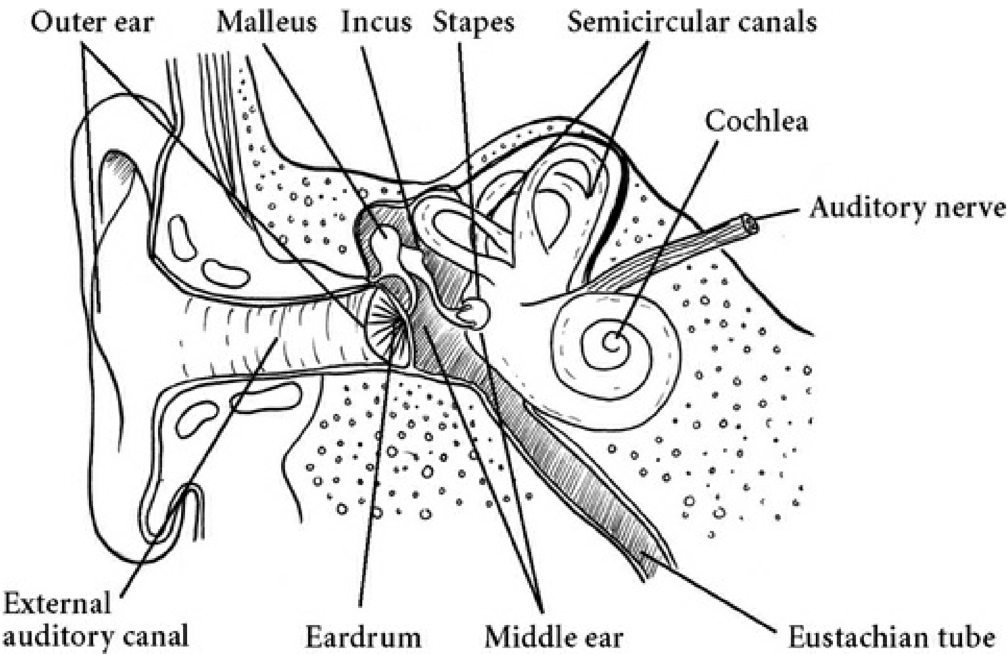

FIGURE 17.2. The ear

In the middle ear three little bones called **ossicles** are found. These are the **malleus, incus**, and **stapes**—hammer, anvil, and stirrup, so named due to their shape. They are joined together and to the **eardrum**, and vibrate as the drum vibrates. At the far end they are attached to a membrane opening into the **inner ear**, where the vibrations are transferred to fluid in the **cochlea**, which is full of sensory receptors that respond to these vibrations. Thus nerve impulses are generated that travel to the brain via the **auditory cranial nerve**, where they are interpreted into sounds.

Also in the inner ear is the area of the **semicircular canals**, which are also fluid filled. As we move about, the level of fluid changes in these canals. This information is conveyed to the brain and used to help us know where we are in space and to maintain our balance.

In both the cochlea and the semicircular canals are tiny hair cells that get moved about by the vibrations in the surrounding fluid, and it is the movement of these hairs that stimulates the sensory nerves of both hearing and balance. Loud noises that cause massive vibrations in the ears, like machinery in a factory or loud music with a heavy bass beat, damage these fine hair cells. This damage is permanent and causes deafness.

Deafness is very common in older people, so most of us think that hearing loss is a natural part of aging. But actually in less developed countries, where there is a lot less noise, there is also a lot less hearing loss in the elderly—most people do not experience it at all. Environmental factors must be a huge part of hearing loss, and loud noise may be the biggest culprit—think how loud the movies are these days. (Next time you go to the pictures, try wearing earplugs. You'll still be able to hear, and your ears will be protected a little.) There are also some drugs that can damage the ears and cause impaired hearing, including some antibiotics, calcium channel blockers, birth control pills, hormone therapies, and anesthetics. By now you will not be surprised to hear that nutrition plays a part in hearing quality—good nutrition can actually protect one against hearing loss from loud noises.

High doses of vitamins A, C, and E, and magnesium—in other words, antioxidants—were found to do this in an animal study in 2005.[3]

Sometimes the nerves of hearing are damaged by viral, vascular, hereditary, or other causes. One controversial treatment for this is a **cochlear implant**, a surgical implant into the cochlea that receives and transmits sound to the hearing centers of the brain. Like all surgical procedures, this carries certain risks, including infection. Ten percent of children and five percent of adults experience complications from this treatment.

There is a movement called deaf liberation, the crux of which is to define deaf people as a linguistic minority, having their own culture and community, rather than as disabled. The social model of disability is applied, seeing society as something that disables people, rather than the disability itself, by not setting up the world in an accessible way. There is diversity of opinion in the deaf community about cochlear implants. Some see them as a form of eugenics and genocide of a people, as a very dangerous and experimental surgery. This camp would view deaf people who decide to get a cochlear implant as giving in to the oppression of deaf people and valuing hearing more than deaf culture. Others see cochlear implants as a choice much like laser eye surgery and feel that it is simply a high-tech hearing aid used for enjoyment and further access to sound but does not affect one's status in belonging to deaf culture.

It's interesting to think about how our culture has developed to be a primarily visual and auditory one. Television, cinema, radio, video games, and the usual way of being taught—being lectured to—mean that our sight and hearing are used a lot more than our other senses. This undoubtedly has an effect on the others, which are more acute in peoples who live in different, more natural, ways.

Taste

Taste is known as **gustation** and we have the **gustatory receptors** to thank for it. There are about ten thousand of these arranged in **taste buds**. They are sensitive to chemical stimulus. The dissolved substance must enter a pore in the taste bud to come in direct contact with the receptors. With four different types of receptor that are found in different parts of the tongue, we are able to detect four tastes: the sweet taste (at the tip of the tongue), bitter (at the back), sour (the middle sides), and salty (the front and front sides).

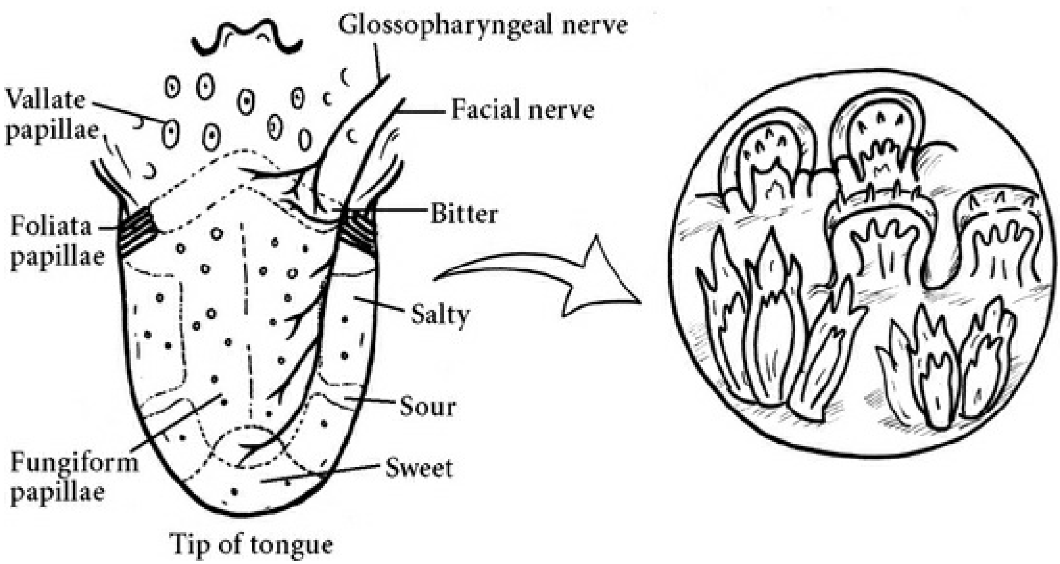

FIGURE 17.3. Taste buds of the tongue

Chinese medicine classically describes five tastes, one for each of the elements: sweet, bitter, sour, salty, and pungent—pungent being things like garlic, onions, and chilis. Actually the pungent taste is due to irritation, activating the nociceptors, from the mildly damaging effect of the hot substance on the delicate mucous membrane of the mouth.

The sense of taste is quite dependent on our sense of smell—if we lose the sense of smell, we are not able to taste satisfactorily. You have probably experienced this yourself when your nose has been blocked up from a cold.

Some taste buds become less sensitive to tastes the more we bombard them, especially the salty ones. The more salt you have, the less you taste and the more you want. If you cut out salt entirely, everything tastes bland for a while. But soon the taste buds will wake up and become more sensitive to variations again. It's worth trying this if you are a heavy salt eater, as excess salt is definitely bad for us in that it can raise the blood pressure, and therefore put strain on the heart, as you will remember from the chapter on the cardiovascular system.

When the bitter taste buds are stimulated, there is a reflex stimulation, via the brain, of digestive processes. Having a bitter-tasting drink a half hour or so before eating primes the stomach to receive food by increasing acid production there, and stimulates the liver and gall bladder to release bile. This is the reason for aperitifs—drinks to take before dinner, which are flavored with bitter herbs. (Bitters, for example, is an alcoholic beverage containing bitter herbs—angostura, cassia, gentian—and some citrus that was originally developed as a patent medicine and later became an aid to digestion often mixed into cocktails.)

Herbs that are soothing to the stomach, on the other hand, are often sweet tasting—marshmallow root, licorice, and milk vetch being three examples. The sweet taste is the taste of the mother, of the earth, and is the first taste we experience in life with our mother's milk.

Smell

We get our sense of smell from **olfactory receptors** in the roof of the nasal cavity. A specialized epithelium there contains many receptors attached by fibers that pass through little holes in the **ethmoid bone** up into the **olfactory bulb**. Here the main nerve tracts are found, which on stimulation relay messages directly to the brain.

The ends of the dendrites of the **olfactory receptors** in the epithelium of the nose form tiny hair-like projections, or **cilia**, which are kept covered by a thin layer of mucus. Chemicals in the air we breathe are absorbed by these olfactory hairs and stimulate a nerve impulse.

Unlike all the other sensory information the brain receives, the olfactory nerves pass straight to the cerebral cortex (all other sense information passes through the thalamus and synapses a few times before reaching the cortex). This makes our sense of smell the most direct of all our senses. It is considered to be the most primitive—that is, the oldest. The part of the brain that interprets smell, the olfactory bulb, is part of the limbic system—that part that deals in memory and emotion—so an odor can trigger a memory or a feeling very strongly. (You will recall that the limbic system receives all information from sensation at the body surface, and is associated with pain and pleasure and all aspects of emotion.

It works closely with the hypothalamus to maintain homeostasis.)

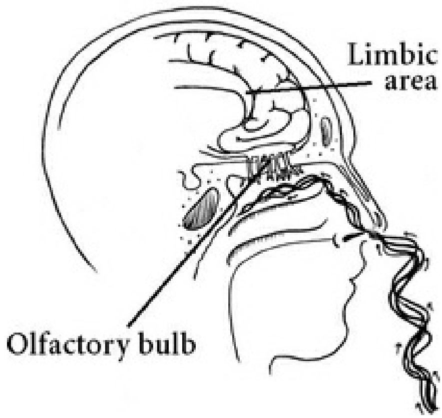

FIGURE 17.4. Olfactory apparatus

Students can utilize the mechanism of smell-as-memory by always having a particular smell around them when studying; that smell can then be taken into an exam situation. (Essential oil of rosemary is ideal for this purpose, as it has a stimulating effect, increasing circulation to the brain.)

Volatile Oils

Aromatherapists work with **volatile** or **essential oils**. These are found whole in plants and easily evaporate (i.e., are volatile, which means they give their molecules to the air). The presence of the oils is what gives plants their aroma. Essential oil molecules are absorbed by the skin and mucous membranes of the body, and are transported in the blood whole, to be excreted largely by the kidneys, lungs, and skin. Thus when you smell an essential oil, it not only tickles your olfactory apparatus to create a nerve impulse, but in addition it is actually absorbed across the olfactory neuron's membranes and so passes directly into the brain.

Touch

As I said in the introduction to this chapter, our feelings and reactions to touch are not considered those of a so-called special sense, but a general sense.

There are six main sensory receptors in skin, each responding to a different kind of touch. The receptors, once stimulated, send their electrochemical message to the cerebral cortex, which interprets the information so that we experience it consciously.

Free nerve endings are the most widely distributed. These respond to light touch, pain, and temperature. They go through the dermis right up into the epidermis. Stroking and rubbing a place we have just banged reduces the amount of pain we experience. This is explained by the pain-gate theory, which describes how we can block sensations of pain by rubbing the place it hurts, because touch messages travel faster than pain messages. When both are simultaneously detected by the free nerve endings, the touch sensations arrive at the brain first, blocking the pain ones. A free nerve ending looks like the end of a motor nerve.

Meissner's corpuscles are oval and filled with highly coiled dendrites. They are found in the lips, the palms of the hand, the soles of the feet, and the genitals, where they detect light touch. Each corpuscle is half in the dermis and half in the epidermis.

Ruffini's corpuscles contain collagen among the dendrites and react to pressure and stretching of the skin. They are found in the dermis.

Pacinian corpuscles in the dermis are sensitive to vibration. They are especially dense in the fingers, genitals, and bladder.

Root hair plexus is a nerve ending attached to the roots of the hairs on the skin. As the hair moves, the root moves and this stimulates the root hair plexus.

All six touch receptors are attached to sensory nerves, which join together in a sensory fiber and leave the skin to head for the central nervous system.

Touch is essential for proper emotional and physical development. Young people who are not touched become withdrawn, do not grow well physically, and may even die.[*] Remember that the limbic system, which is the key part of the brain involved in emotions, pleasure, and pain, receive all information from sensation on the body surfaces. So, whether we are touched with love, intelligence, respect, and sensitivity to our needs, or with violence, disrespect, carelessness, and clumsiness, the part of our brain that deals with emotion gets to hear about it and interpret it. You will not be surprised to hear that modern research is proving the benefits of touch. For example, premature babies who are massaged grow nearly fifty percent more than ones left alone in an incubator, with equal nutritional intake. Also, children between the ages of seven and ten from families that do lots of wrestling and physical play feel much more confident in themselves and better about their bodies.

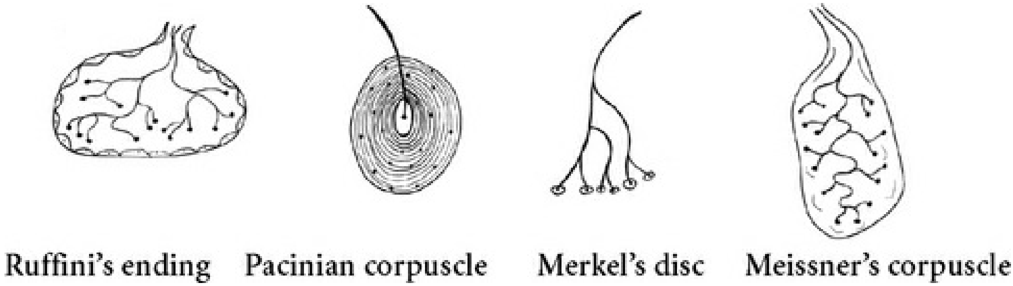

FIGURE 17.5. Sensory nerve endings

It's really very simple: Keep your young ones close to you and cuddle them all the time when they are newborn, then carry on being close for the rest of your lives.

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*Not all medical herbalists are trained in iridology, but those trained by the Self Heal school are. They may be members of the AMH (Association of Master Herbalists), as well as other herbalist associations or institutes.

*Often I wonder why modern medicine is so blocked to so many ideas that seem simple common sense? Can it just be a hyperalertnesss against quackery? Many Brits will remember Dr. Allinson, who developed a wholemeal bread "with nowt taken owt." In the early twentieth century, he said people should eat fiber for their bowels to work properly. He was dismissed as a quack by the profession, so he left medicine and set up as a baker instead.

*A form of traditional Chinese medicine uses acupuncture points on the pinna to treat all the organs in the body. This auricular acupuncture is effectively used to treat addictions and stress.

*Some charming research in the 1950s with baby monkeys showed that a total lack of touch leads to death in infants. A lack of proper touch in infant rats and monkeys has also been shown to increase antisocial and stressed adult individuals. Personally, I find it staggering that anyone should feel the need to prove that infant people need very close contact with their parents by cruelly experimenting on animals.

CHAPTER 18

From Newborn to Elder—Development and Aging

Enormous changes are involved in the growth and development of a human. It is not just a case of the addition of more cells and tissues to become bigger. There are changes in the form of the whole body, as well as in the form of its organs and systems, and there are equally huge functional changes.

Sometimes material is added (like bone and fat), but sometimes growth involves the death of tissues and cells. For example, the thymus gland, large and active up to age six, then gradually degenerates. Orthodox Western texts say that in adults the thymus has little function; indeed, it can be almost entirely replaced by fatty tissue, but perhaps this bit of remaining function is still important. Consider the ancient Chinese practice of tapping the sternum daily to promote longevity. Perhaps tapping, a kind of massage, stimulates the thymus and encourages a slowing of degeneration, or a maximization of the little function that is left. Remember that the thymus is involved in activating T-cells to make them specific for a newly encountered antigen—a type of influenza, for example. T-cells are also key in the body's destruction of cancerous cells. For us to live long into old age we need the immune system to continue to be capable of responding to new challenges as well as keeping us clear of cancer.

At other times growth involves complete replacement of tissues—for example, the milk teeth being replaced by permanent ones, or bone being laid down on its cartilaginous blueprint, then continuously being reabsorbed and made again. Growth takes place throughout life, in many tissues of the body (epithelial tissue being among the most **labile**—meaning that it is always growing and being replaced).

Phases of Growth

There are four phases of growth of the body.[1] At first, in the embryo, we begin to grow mainly in size, without much attention to development of function.

This merges into a second phase (which begins as we enter the fetal stage in the second month in the womb), when there is growth both in size and in differentiation of functional activity. This phase continues throughout childhood and ceases at maturity with the attainment of adulthood, in the late teens or early twenties. During adulthood a third phase occurs, having primarily to do with maintaining functional activity, with growth supporting and allowing this, and repairing loss from wear and tear. The last phase occurs in old age, when growth no longer keeps up, cells are lost without replacement, and functioning may become less efficient as a result.

There are very interesting cultural differences in attitudes and expectations around aging, and there is evidence that our beliefs about aging and the type of life we lead have major impact on the rate of our deterioration. The actual causes of aging are not known, though it is known to occur in all species of vertebrates in a similar manner as it does in us.

Aging can be speeded up or slowed down by various things, but not stopped. In the end, death awaits us, and this is as it should be, as new humans come to take our place. (Cultures that have retained their knowledge that everything that dies returns and that there are dimensions outside of physical reality do not have quite the death phobia that the modern West does.)

Patterns of Growth

Not all systems of the body follow the same pattern of growth. The respiratory, digestive, and excretory systems keep the same size relative to the body during growth. The skeleton also behaves in this manner. But some body systems follow different growth curves.

Lymph nodes and other lymphoid tissues grow rapidly in childhood and are at maximum size by the age of puberty. Then a process of regression and degeneration occurs, so at the age of twenty there is much less lymph tissue present in our bodies than there was at the start of puberty. As noted earlier, this is particularly obvious with the thymus gland.

The **central nervous system** and the organs of special sense, along with the skull that houses them, grow so rapidly in childhood that they reach about ninety percent of their adult size by the age of five or six. At the age of twelve, a child's head is almost the size it will be as an adult. After this the growth of the nervous system is much slower than that of the rest of the body. It used to be thought that nerve cells do not regenerate at all, that it was all downhill in terms of the nervous system and aging, but this is now known to be untrue. It is certain that we can follow activities that keep the nervous system functioning well, including keeping on thinking about new ideas, learning new skills, practicing meditation, and keeping our emotions flowing freely.

Puberty brings particular changes to the **gonads**, thanks to the gonadotrophic hormones from the pituitary and the sex hormones estrogen, progesterone, and testosterone. These changes include the development of the secondary sexual characteristics as well as maturation of the reproductive function, as outlined in Chapter 16. Estrogen and testosterone are also the stimulus for closure of the cartilaginous growing plates of the bones.

Many things affect growth and development. There are factors that are important both before birth, and even before conception, and during childhood and beyond. **Nutrition** is of paramount importance. Not only must we have supplies of enough proteins, carbohydrates, and essential fats for building and energy, but trace elements, vitamins, and minerals are also essential.

Altitude affects growth—high altitudes retard it. **Oxygen deficiency**, at altitude and for other reasons (for example, caused by congenital heart defects and severe asthma), has this effect also. **Poverty** is another factor inhibiting growth, due to poorer nutrition, along with disease and emotional factors. We do not grow without **love**. Children growing up in homes without love may suffer in all kinds of ways, one of which is called psychosocial dwarfism, where growth is stunted in such children, even when injected with growth hormone. If these children are given love, they will begin to grow and catch up with others of their age group.[2] Emotional **trauma** locked in the bodymind can interfere with healthy growth and development.

Prenatal poisoning, such as from alcohol or other drug consumption by expectant mothers, also stunts growth and impairs development. Some of the effects of this do not show up until much later in life, and may even be seen most strongly in the next generations.

Interestingly, and not surprisingly to students of Chinese medicine, a large amount of evidence suggests that growth in height is faster by 2–2½ times in the spring and summer than it is in the autumn and winter. (On the other hand, growth in weight is faster in the autumn than the spring. This makes sense—we need to stock up for winter.)

Descriptions and Definitions of Aging

In a way, aging (known in medi-speak as **senescence)** begins at maturity, a stage on the pathway to death. Just as growth follows different patterns, so does aging.

Cells and **tissues** show some changes with age. Nerve cells are a good example. The idea that they die off at a steady rate is now disproven; some areas of the brain stem are now known to retain their numbers well into old age. Also, a nerve cell of an older person who has continued to learn will have countless more dendritic connections with its neighbors than in youth. Generally the brain, along with other cells and tissues, tends to dry up. (Staying well thus means staying juicy! On a physical level this means staying hydrated by eating lots of fresh fruit and vegetables and drinking water, and making sure to consume plenty of essential fatty acids.)

Bones often lose density (osteoporosis), and thus become more easily broken. Healing is generally slower, probably due to impaired blood supply and nutritional deficiency.

Hearing degenerates. Peak hearing is at age ten, apparently—though you will have understood from the chapter on the special senses that modern life is responsible for a much more rapid decline in hearing than was the case for our ancestors, and is the case in less developed societies. The other special senses—vision, smell, and taste—are also impaired. (Could this be partly because we don't really pay attention and fully use all our senses? Often elders are excluded from ordinary life in our modern culture, plugged into the TV with very little meaningful connection or communication happening. Is it any wonder that many of them give up really listening to anything, not to mention looking, smelling, and tasting?)

Memory and the ability to learn can be observed to be less efficient already in early adult life than in childhood; on the other hand this is not true of everyone. If one's mind is kept free of accumulated emotional distress, the memory tends to work much better.

There are changes in the **cardiovascular system** also—calcium and fatty deposits can build up in the blood vessels, leading to increased blood pressure, making the heart work harder and wear out sooner. **Anemia** is common in the elderly. This may be due to insufficient replacement of old red blood cells, but the fact is that many old people have a diet grossly deficient in iron and other essential nutrients. Lymphocytes are also less in number.

The **lymphatic system**, and thus **immunity**, is one of the earliest to show physiological changes. We can see these in the thymus gland, lymph nodes, and spleen.

The **respiratory system** has reduced capacity due to stiffening of cartilage and therefore less movement in the joints of the thoracic cage. This interferes with breathing and allows secretions to accumulate in the lungs. Also, the elasticity of the lungs is diminished, so vital capacity is diminished due to reduced emptying. These changes manifest as shortness of breath, inefficient oxygenation, liability to infections (bronchitis and pneumonia), and fibrosis of lung tissues. Yoga and meditation practices that encourage deep breathing will minimize the likelihood of this happening.

In old age the **digestive processes** decline in a few ways. The teeth are often impaired or gone, the production of saliva is decreased, and the stomach is less elastic so it is unable to stretch to take in a large meal. Appetite may remain, however, and this can be annoying for the elderly person. Impaired nervous control may disturb the defecation reflex. Peristalsis is slowed, causing constipation, and the colon has more little pouches—diverticula—therefore diverticulitis (when the little pouches get inflamed and painful) is more common. The size of the liver and pancreas are reduced (although the aged liver is capable of regenerating as it does in younger adults). These factors, together with the all-too-common social isolation and difficulty getting about (and thus difficulty shopping and cooking, meaning that many of our elders are undernourished), have impacts in turn on all the other systems.

In the **urinary** and **reproductive systems**, the kidneys become smaller and less efficient, therefore blood levels of urea, sugar, creatinine, and uric acid rise. One in three men older than seventy-have some impairment of the prostate gland. There are also changes in the testes and hormone secretion; although fertility may be retained well into old age. Menopausal changes in women lead to a fall in estrogens secreted by the ovary, which affects the whole of the system: the uterus shrinks and atrophies, vaginal epithelium thins and there is some drying and keratinization, the vagina changes from acid to alkaline, and breast tissue atrophies.

In the **endocrine system**, there is a decline in production of hormones by the thyroid gland, adrenal cortex, and the gonads.

The **skin** thins, loses subcutaneous fat, and is markedly less elastic. Healing tends to be less efficient in the elderly—it takes longer, and scar tissue is less strong. There is a decline in Meissner's corpuscles (the receptors in the skin that respond to light touch), and so the sense of touch is impaired. Hair loss on the skull is widespread in men, although more hair grows in the nostrils and ears. (Nobody knows why this happens.) Fingernails grow more slowly and often become brittle and liable to cracking. (I think that it is possible, even probable, that this is due to deficiencies rather than normal aging.)

It all sounds a bit grim, doesn't it? Especially for us raised in the modern materialistic culture, which idolizes the external appearance of things and values youthful looks more than the beauty of wisdom and age. Many of our assumptions and even experiences of aging are due to our cultural beliefs and attitudes. This really is true. Many experiments have shown that the actual physical signs of aging can be reversed by a change of attitude. It has been found that markers of physical age such as space between the joints of the fingers, eyesight, and hearing will improve when people act and talk as they did when they were younger and more actively involved in life.[3]

It has also been shown that meditating leads to aging more slowly. Robert Wallace did a study in 1978 looking at biological age in meditators. The assessments for biological age Wallace used were blood pressure, acuteness of hearing, and close vision (the ability to see near objects, such as the written word). These are markers known to deteriorate with age. Wallace found that the meditators were five to twelve years younger in biological age than they were in chronological age (the five-years-younger group had meditated for less than five years; the twelve-years-younger group for longer than five years). It seems that the deterioration of age involves a certain amount of choice! A study done in 1980 in three nursing homes near Boston, Massachusetts compared the effects of learning transcendental meditation, practicing a typical relaxation technique, and learning creative word games to keep the mind sharp. On testing after practicing for a while, the meditators scored highest on markers for mental health, blood pressure, and learning ability. But the most amazing thing was that three years later, one-third of the residents had died, but not a single meditator.[4]

As we enter more deeply into old age and therefore get closer to death, we begin to enter more into the realm of the spirit.* It can be said that as newborns and elders we are closest to God, having just come from Spirit, or being closer to going back to Source. Our modern culture is confused about age, about wisdom, and about death—it seems we will do anything to claw back an extra few years, months, or even minutes of life, so great has our fear of death become. Yet there is no getting out of life without death for any of us, and this fearful avoidance and denial of it becomes a fearful avoidance of life itself.

Going Gray

Gray hair is a crown of splendor;
It is attained by a righteous life.
—PROVERBS 16:31

How about going gray? The pigment-making cells of our hair gradually die off, and the hair becomes white, gray, or silver. Have you noticed how few people today have gray hair? It looks to me like an epidemic of covering up. I am beginning to go gray myself now, so this is a topical issue for me! I know that most hair dyes are poisonous—polluting for the environment and actually toxic for us, being absorbed into the body through the delicate skin of the scalp. A study in 2004[5] showed a definite link between longtime use of hair dye and lymphatic cancer. This is not surprising, as you will remember from our toxic toiletries discussion in the chapter on skin that almost all mainstream toiletries contain at least one carcinogenic chemical.

In most cultures, white hair is a sign of wisdom. The modern world, however, has lost respect for the past, and for true wisdom. Looking around us, it might seem that there are few elders but a lot of old folk, since many people spend much of their life concerned with amassing material goods and little else. It's not easy to learn true wisdom, and to grow closer to Spirit naturally, while being focused on looking young, still being able to get it up, and staying on top of the world's latest crazes and crises. I'm pleased to see the initiative called The Elders—Richard Branson's and Peter Gabriel's idea to gather the world's elders to help with global problems. Among The Elders are Nelson Mandela, Desmond Tutu, Ela Bhatt, Gro Brundtland, Jimmy Carter, Muhammad Yunus, Graca Machel, Kofi Annan, Lakhdar Brahimi, Fernando H. Cardoso, Mary Robinson, and Aung San Sui Kyi. They work to promote peace and human rights worldwide and are going on missions to places experiencing difficulties, offering the help of their wisdom and experience in conflict resolution. (See www.theelders.org to find out more.)

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*Rudolf Steiner spoke and wrote about this, as he did about all the stages of life.

CHAPTER 19

Interrelationships—How the Systems (and Everything) Interconnect

Although we have looked at the body systems separately for ease of study, in fact none can properly function without all of the others. We are a whole, not the sum of our parts. Each system is the only one capable of carrying out its particular functions, and all the systems depend on the good functioning of the others for a smooth ride. When things go wrong in one system, the effects are felt everywhere.

We are not composed of separate systems working together like the parts of a machine to make the whole machine operate well. We are alive, dynamic, and completely connected—not just the different parts within us, but we ourselves are a part of the universe, connected in countless ways to all that is. Have you heard of the "butterfly effect"? This is the idea that the flap of a butterfly's wings in one part of the world may ultimately cause a tornado in another—a small change somewhere leads to a chain of events that eventually leads to huge changes. It is not that the butterfly's flapping actually produces the tornado, but certain details of weather can be affected, in a chaotic (unpredictable) manner, by the butterfly, and therefore, of course, by very many other factors.*

We will begin in this chapter by looking at the body, and then extend our view beyond. The holistic philosophy of disease sees illness coming in a particular system or part of the body according to the emotional or spiritual struggles we are having. I am including briefly some of these ideas—not to be adhered to rigidly, but for interest's sake.[1]

How the Systems Interrelate

Most of this has been said at the end of each chapter, and here is connected as a whole.

It is obvious how connected to the muscular system the skeleton is. Muscles are attached to bone, cross joints, rely on the framework of the skeleton for movement, and need the calcium in the blood (reserves of which are stored in bones) to be at the right level for proper functioning. Too little calcium in the blood leads to **tetany**—spasm in the muscles. Too much, and the muscles are overrelaxed.

Muscles are completely reliant on nervous stimulation for movement and tone. Muscles depend on the digestive system to get glucose for energy, which they store as glycogen (as does the liver). Hormones are involved in the control of this process. It is the digestive system that provides nutrients for muscle growth—the amino acids for actin and myosin production. Muscles also need oxygen for making ATP, therefore getting energy to contract—this comes to them courtesy of the lungs and circulation.

The bones are deeply involved with the cardiovascular system. Blood cells are produced in red marrow, and an imbalance of calcium affects the heart, as well as all the other muscles. Too much calcium in the blood affects many systems, as calcium deposits are laid down on bone, and in the kidneys, blood vessels, and other organs.

Nerves make muscles contract to move the skeleton, and each bone has its own extensive nerve supply. It is the digestive system that provides nutrients for making bones (e.g., calcium, phosphorous, and boron, as well as the glucosamine used for repairing cartilage). From cholesterol and sunshine the skin makes vitamin D, which is then used for bone production. There is a deep relationship between the skeletal system and the kidneys, which help stimulate production of bone marrow, while the endocrine system controls calcium balance partly by reabsorption and laying down of bone. In terms of the reproductive system, estrogen is involved in maintaining bone density.

Bones, being ruled by the planet Saturn, are about structure and authority, so problems here can be to do with our relationship to authority or with how comfortable or safe we feel with the structure of our life and the universe.

The skin has important muscles (the pili erectors, which make our hair stand on end) in its dermis, and these are moved by the nervous system. It has a very rich blood and nerve supply. It makes vitamin D for the bones, and has a very small part to play in breathing. If the skin is not able to properly control temperature, all the systems can be affected. Think what it would be like in an office with no heating, or a broken boiler that wouldn't turn off—without a good temperature, it is impossible to work well. If all the pores are blocked, we die because the blockage seriously messes with the body's thermoregulation. Hormones affect the skin strongly, causing acne when in excess for teenagers, or dryness in deficiency for menopausal women. The skin relies on good digestion to receive all the nutrients it needs for constant renewal and repair.

The skin can reflect the relationship between our inner and outer selves. It protects who we are, our sense of individuality and selfhood. Sometimes skin problems like eczema are related to irritation and anger, something burning us up being expressed in the skin. In holistic terms it is quite a good thing for disease to come out in the skin in the sense that it is very superficial—much more serious to have a problem that goes deeper into our underlying organs.

The cardiovascular system is clearly intertwined with the respiratory system, as the blood carries oxygen and carbon dioxide around body, and to and from the lungs in the pulmonary circulation. The lymphatic system works together with the blood circulation to provide drainage at tissue level of fluid and waste. Immunity is so intertwined with the blood circulation and white blood cells as to be completely inseparable. The circulation being the main transport system, it carries hormones, nutrients from the digestive system, and waste products. Blood brings glucose and oxygen to muscles and all other cells for energy production. The kidney filters the blood and keeps it clean. Blood cells are made in bone marrow, and the blood brings oxygen and nutrients to the skin, hair, and nails.

In Chinese medicine, blood and the circulation are of the Fire element, therefore there is a strong association with our ability to feel and express joy and the other emotions freely, in positive ways. Our heart beats the rhythm of the cosmos—it is the place we are connected to the love of and in the universe.

The marriage of lymphatic and cardiovascular systems has been discussed above—one cannot function without the other.

In the digestive system, the lymphatic lacteals in the villi of the small intestine help in fat absorption. Lactic acid and urea formed in muscle cells is drained away in lymph. Movements of the muscles and pressure changes in the thorax in relation to the musculoskeletal system are key for movement of lymph. (Louise Hay says that problems in the lymph system are reminding us to keep the mind focused on the important things in life—love and joy. Holding on to fluids may be about holding onto someone or something from the past.) The immune function part of the lymphatic system is involved with proper functioning of all systems since it protects everywhere in the body from external threat and from internal toxins and abnormal growth. The liver is key in making immunoglobulins and protecting from toxins and foreign substances that gain access to the body via the digestive tract. Our emotions, the endocrine system, and immunity are so closely intertwined that even modern medicine is beginning to take a look, via psychoneuroimmunology. Beliefs about our vulnerability can give us colds and flu, as can being overwhelmed with mental activity and confusion. Anger and irritation that isn't being satisfactorily expressed and resolved can lower immunity and thus come out as an infection.

All body cells require oxygen, brought into the body by the respiratory system. Thus all of the other body systems rely on it. There is an especially intimate relationship between the respiratory system and the cardiovascular system. By its function of detoxing the body, the respiratory system further helps all cells of the body.

In Chinese medicine, lungs are of the Metal element, therefore to do with what is really vital, valuable, and important when all has been stripped away. Because of this association with respect and value, the lungs are also involved in the expression of grief—grief being what we feel when we lose something we value. When we breathe deeply we are inspired, literally—we take in life. Problems with the lungs may be related to not valuing or respecting ourselves, not feeling able to take in life or grief that we are struggling to fully accept—which means feeling it deeply.

The digestive system has links to all systems, as the whole body needs nutrients. In addition to this, the cardiovascular system transports nutrients around the body. Digestion is controlled and aided by hormones. Lymphatic lacteals in the villi of the small intestine are needed for fat absorption. Glucose from digestion is used by muscles to make energy, and muscles in the gut wall do the peristalsis that pushes food along. As we have said, all digestive organs have a very rich nerve supply. The digestive system works together with the bones, the endocrine system and the kidneys, to keep the calcium balance in the blood right. This is needed especially by the muscular and nervous systems for their proper functioning. The digestive system, along with the kidneys, lung, and skin are essential for excretion. Remember the enteric nervous system? This system is so richly supplied with nerves that it is completely and swiftly affected by nervous tension and fear. Indigestion can mean we are having problems digesting and assimilating our experiences.

All the systems are related to the nervous system in some way. For example, breathing is controlled by the brain, and the brain needs a constant supply of oxygen, so the nervous and respiratory systems are interdependent. New research suggests that a lack of oxygen from breathing problems may be the cause of memory problems, attention deficit, and learning and behavioral problems.[2] The cells of the immune system are sensitive to neurotransmitters, with some white blood cells producing them themselves. The lymphatic system is involved in detoxification, so keeps the blood clean; the brain is very sensitive to toxins. The endocrine system is controlled by the hypothalamus. Many hormones affect the brain and thus our moods and emotions. The gastrointestinal tract has so much nerve supply it has its own brain—the enteric nervous system. The nerve cells of this ENS make neuropeptides, with a huge effect on mood. The skin is so full of receptors it is considered to be a sense organ in itself.

Sympathetic and parasympathetic nerves supply all the internal organs of the body and the skin. The nerves do maintenance and repair with nutrients from the digestive system brought to them via the circulatory system. When toxins build up in the body, the nervous system is very soon affected, so the kidney, bowel, liver, lung, skin, and lymphatic systems that work to keep the body clean are crucial to allow good nervous system functioning.

The nerves are about communication, so problems with them can reflect difficulties we might have in this area.

The nervous system works intimately with the endocrine system to maintain homeostasis. The pituitary gland is particularly linked to the hypothalamus, which controls it. Hormones are carried in blood to target organs. Digestion relies on hormones from the stomach, small intestine, and pancreas. As for the reproductive system, hormones govern it—for example follicle-stimulating hormone (FSH) and luteinizing hormone (LH) control sex hormone and gamete production. The mind-body link may be to do with control issues and balance.

The kidneys are related to the circulatory system in that it is blood that is filtered by the nephrons, and the kidneys are key in controlling blood pressure. Hormones control kidney activity—renin controls body fluid levels and blood pressure, and aldosterone controls mineral balance. The kidneys help stimulate bone marrow production. Urea comes from amino acids broken down in the liver.

It has been argued that all systems exist to allow reproduction. Certainly to make a baby all the systems are required, to keep at least the mother's body going in a healthy way through nine months of gestation. There are special links between this system and the endocrine system, which controls reproductive cycles and activity, and the nervous and circulatory systems that are intimately involved with sexual activity and sensation.

Stress, fear for the future, and unconscious aversion to being a parent can interfere with reproductive function. Sexual difficulties often come from guilt and shame about sexual love, anger at a present or past lover, or unresolved abuse issues. Problems with the genitals or reproductive organs may be associated with shame and guilt about sex and beliefs about punishment.

The Interconnectedness of All Life

We can't discuss interrelationships without at least a brief consideration of Mind and Spirit, and indeed the entire universe. Of course, the dominant culture of the West does not support a concept of interconnectedness. If you have been indoctrinated with our modern separatist view, try to suspend it for a moment and allow the following snippets on this vast subject to blow your mind wide open.

Electromagnetic Field of the Earth

As we will explore in Appendix B, so-called primitive people—those who follow the Old Ways—take it for granted that we humans are connected with all that is, an integral part of a magnificent and mysterious whole, where all are affected by each other. Thus we have immense power to affect our universe, and at the same time we are ourselves affected.

Actually, this isn't so far-fetched. All of us living things work on a circadian rhythm of twenty-four hours, a cycle of night and day, with various biological activities following a clock that is in sync with the Earth's rotation around the sun. We also have other rhythms in the body—half weekly, monthly, and yearly ones, for example. Most of the functions of our body systems are affected, and the most amazing thing is that the synchronizer of it all is not within us, but is external: the sun and the planets.* For example, big solar storms change the electromagnetic field of planet Earth. One dramatic manifestation of this is that rates of heart attacks are increased—a surge of heart attacks occurs within a day of a solar storm. Another researcher, M. A. Persinger, found that unsettled and changing weather in space leads to higher numbers of attempted suicides, nervous disorders, and epileptic seizures.*

There are different energies in different places on the earth. The modern term used to describe the stress caused by earth energies is **geopathic stress**.** This is not a new idea. Nostradamus (1503–1566) wrote:

> Where plants perish and animals are absent, there you should not live, the place is unhealthy. You will experience disharmony and lose your poise. However, when you find the place where happy, vital and healthy people live and many old folk are in good health, then stay there, you will soon do without medicine or a physician. The mysterious forces of the Earth will make you healthy.

The historian Plutarch (125–45 BC) also noted:

> Men are affected by streams of varying potency issuing from the Earth. Some of these drive people crazy, or cause disease and death; the effect of others is good, soothing and beneficial.

In the West, these currents are often called **ley lines**. They are known as different forms of earth energy, created by the natural electromagnetic fields that emanate naturally from the earth. Some of these planetary energy networks can be harmful to humans, such as the Hartmann network, a circuit that runs both longitudinally and laterally every couple of meters from north to south and east to west. The Curry network is composed of diagonally running currents that cross on a northeast/southwest and southeast/northwest axis. These networks of earth energy can be felt to a greater or lesser degree anywhere and they can provoke geopathic stress. They can be felt more strongly if there are morphological distortions on the planet's surface, and where the two different currents cross the stress is intensified.

Geopathic stress is caused when the earth's natural energy rising up is distorted and becomes unstable. Ley lines can become magnified, unstable, or distorted by underground streams, mineral concentrations, tectonic movements, fault lines, underground cavities, railway lines or highways, tunnels, construction projects, mines, excavations, and anything else that causes a shock to the earth. Even pylons and street signs can cause geopathic stress if they are badly positioned.

There are also terrestrial rays that are beneficial to human health. These are yang currents known in the West as Schumann waves. Unfortunately, these waves have trouble moving through modern construction materials such as concrete, with the result that they are very weak in large urban areas.

Geopathic stress can cause insomnia, irritability, colds, chronic fatigue, headaches, anxiety, and, over the long term, even serious chronic illness such as cancer. Every single person suffering from cancer or a sleep disorder to whom I [Lucy] have given a consultation, has slept with his or her bed over a geopathically stressed area where two or more currents crossed. Fifty percent of women who sleep on a nodal point or area where the currents cross (i.e., where the geopathic stress is acute) over a long period of time are unable to conceive. Geopathic stress is now considered one of the principle factors in Sick Building Syndrome. The most common indications of geopathic stress are usually resistance to medical treatment, a feeling of being constantly rundown and exhausted, anxiety, nervousness, depression, loss of appetite, insomnia, restless sleep, feeling cold, cramps, chronic fatigue, mild headaches, backache, and tingling in arms and legs. Geopathic stress does not cause an illness as such, but lowers your immune system, so you have less chance of fighting any illness. It prevents your body properly absorbing vitamins, minerals, and trace elements from your food and decreases your resistance to environmental pollution, thus increasing allergies.

To reduce geopathic stress, there are a few options. Earth acupuncture is an effective remedy but the effects must be verified regularly to be sure that the stress has not returned. To perform earth acupuncture, ask the guardian of the place to show you the healing points or use dowsing rods to discover them. Then place copper or iron earth acupuncture pins (like stakes, sometimes with a crystal attached) into the ground in order to neutralize the effects of geopathic stress. Follow your intuition as to which method to use.

Simply placing your bed in a nongeopathically stressed area is the best possible remedy! An easy book on how to detect and avoid geopathic stress is Rolf Gordon's *Are You Sleeping in a Safe Place?* (www.rolfgordon.co.uk).

There are also some materials that are useful in protecting against geopathic stress, such as cork or tatami, which can be placed under beds, especially if the geopathic stress is due to underground water. There are other insulating materials such as mineral sheets that can be used to protect against other causes of geopathic stress and these would be recommended by a good dowser or feng shui consultant.

If you suffer from a lot of geopathic stress, you can purchase a Raditech—a device that you plug into an electrical socket. The device activates certain minerals by applying a small electrical current, thus neutralizing some of the effect caused by geopathic stress. The new devices are much more effective and emit far less electromagnetic radiation. Most people's well-being increases dramatically but some of my [Lucy's] clients have reported only a slight benefit. If you are interested, I suggest that you buy a device that offers a trial period. (For more information and to purchase a Raditech, visit www.dulwichhealth.co.uk.)

Influenced by Our Environment

You are probably not aware of all the different factors that influence you in your home and place of work, nor the impact they have on your life. These influences (of which most are now scientifically proven) include:

- The psychological impact of color
- Visual art
- Ornaments
- Electromagnetic fields (or EMFs) and microwave pollution emitted by computers, televisions, microwave ovens, mobile phone antennae, and so on
- Geopathic stress
- Gases emitted by building materials
- Physical and psychological effects of clutter
- Location and orientation of a place, including the spatial arrangement of furniture
- Air quality
- Lighting

The art of **feng shui** deals with these things and more. The official definition of feng shui, as given by the London Feng Shui Society, is: "… the practice … of analyzing the influence and the interaction between people, buildings, and the environment in order to promote a better quality of life."

Some of these influences, such as geopathic stress, EMFs, microwave pollution, and lighting, can give rise to certain health conditions, such as depression, miscarriages, hyperactivity in children, insomnia, irritability, colds, chronic tiredness, headaches, anxiety, and even serious illnesses such as cancer.

Feng shui rebalances and corrects the energy flow within a place in much the same way that acupuncture works on the body's meridians. When energy is circulating freely, every aspect of your life will be enhanced—health, relationships, job, and so on. The aim of feng shui is to reestablish any lost sense of balance by improving your surroundings. It can bring about a deeper sense of harmony and well-being in your home or place of work.

An integral part of feng shui, called space clearing, aims to free a place of old emotions, the memories encrusted in the walls, and to raise its energy level by creating a sense of harmony with the inhabitants. Space clearing cleans out all the thought forms and negative patterns of behavior that have been left behind by past occupants and which can have a considerable impact on the lives of the people who've moved in. The energy of a place is partly created by the traumas, events, and moods that have taken place there. Every time a strong emotion is felt by someone in a particular place, part of its energy is deposited on the walls.

Sometimes the memories anchored in the walls or the emotional imprints of a place simply don't reflect the hopes and aspirations of the person living or working there. If you feel emotionally blocked or you sense a certain heaviness in your home or workplace, if everything you try seems to turn out badly, or if the projects you undertake don't seem to move ahead, the space definitely needs clearing.

Space clearing clears out the past and releases all emotional imprints, energy cycles, and any useless constraints relating to the history of the space. It raises the level of vibration and helps you to manifest your most heartfelt desires. It brings more light and astral energy into your home or workspace so that you can experience a better quality of life.

Connected with Nature

Edward O. Wilson, writing about biophilia in 1984,[3] said that humans have evolved together with all other life on earth, and our intimate involvement with nature is essential to our thriving. Stephen H. Buhner writes eloquently of this in *The Secret Teachings of Plants:*

> And without this bonding, what is life? What is life without this exchange of soul essence between the human and the wildness of the world? Tasteless food in some dusty and empty place rising in geometric precision out of an empty plain. A mathematical life forced into place by bulldozer and concrete and Man. And what are we then but abandoned and crumpled newspapers, stories without meaning, blowing down some wind-swept, darkened street?

Connected to Each Other

As well as being connected with everything else, we are deeply connected to each other. Countless experiments have proven what we really already know—that we communicate across space, "know" things about each other, and can "see" events at a distance. For example, Dean Radin's experiments from 1997 showed that people being sent healing intention react to it in a physiologically measurable way, and that the more connected two people are, the stronger this effect is. People can become connected in this way quite quickly. If two people attempt to connect mentally, their brain waves and their heart rhythms move into sync together, in an entanglement called **entrainment**. Luckily, it seems that the healthiest rhythms take the lead, bringing the other person into sync with them.*

Then there are some interesting twin studies. For example, the “Jim Twins” from Ohio: These were separated at birth and only met at age thirty-nine. Both were called Jim (named by their adoptive parents), both had a dog they named Troy, they had done similar work and had married twice, first to a Linda then to a Betty. They drove the same car and vacationed on the same stretch of Florida beach at the same time every year. Several pairs of twins have died at the same moment. For example, Peg was killed in a car crash when the steering column entered her chest. Her twin Helen woke up at the same time with chest pain, and died on the way to hospital. The scientist Percy Seymour makes a case for these twins being entrained—a large-scale version of the entrainment of particles described by quantum physics.[4]

Finally, we have the phenomenon of remote viewing—traveling outside of the body to “see” things that are elsewhere. Of course, to shamans this is an everyday activity. But interestingly, the remote-viewing process was developed by researchers at Stanford University under contract to the American government for use in intelligence collection. In autumn 1996, the CIA released information on the so-called Star-Gate program; official confirmation was given that the government had, for twenty-five years, trained and used psychic spies to observe targets in the Soviet Union and elsewhere. Paul H. Smith, a retired Air Force major, says:

> Practiced, experienced viewers can access a target nearly 100 percent of the time. This doesn’t mean they get all the data they were looking for. They retrieve information indicating that they were “there.” However, these experienced viewers regularly obtain extremely accurate, often error-free

information from the target.[5]

This subject, of course, makes a whole book in itself. (Or many books. You might try Percy Seymour's *The Third Level of Reality: A Unified Theory of the Paranormal* and Stephen H. Buhner's *The Secret Language of Plants: The Heart as an Organ of Perception in the Direct Perception of Nature*.) There is ample evidence, out there and in here, about our interconnectedness.

Mind-Body Connections

Then there is the power of the mind. What we see is what we get—and we seem to have a tendency to see what we believe, and filter almost everything else out. There is a lovely story in Deepak Chopra's *Quantum Healing: Exploring the Frontiers of Mind/Body Medicine* about a woman in a lot of severe abdominal pain who had an operation for what were suspected gallstones; when they opened her up she was riddled with cancer, so they just closed her again without being able to do anything. Her daughter, told that there was nothing that could be done and that death would be imminent, asked that her mother not be told, in order that she get some enjoyment from what little life was left to her. The woman was told the operation was a success. Some time later, she turned up to see the doctor, completely healthy, and said: "Doctor, I was so sure I had cancer back then. When I found out it was only gallstones I was so relieved and determined to live my life to the fullest." Many studies have shown that people's beliefs about their health and illness has a significant effect on recovery. We will take a deeper look at this in Chapter 23.

You can see I have just touched the tip of the iceberg here.

There is so much to say on interconnectedness because basically life is in ever-changing, interconnected flux. What conclusions can be drawn from the few bits I have selected to try and open up this subject are left to you, and will no doubt be affected by many interconnected factors about you and your life: what you believe, how connected you feel with yourself and others, how aware of the magnificent beauty and power of nature, how much of that beauty and power has been lost and is continuing to be lost, and your relationship to Spirit, to name but a few. There is much to be gained from expanding our awareness of connection.

Enjoy your explorations.

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*This comes from the work of Edward Lorenz, American mathematician and meteorologist, who did pioneering work on chaos theory.

*Franz Halburg did a lot of this research. See the chapter "The Right Time" in Lynne McTaggart's *The Intention Experiment*.

*Also covered in Lynne McTaggart's *The Intention Experiment*, as well as in her *The Field*.

**The text that follows, on geopathic stress, and the following text on feng shui, were kindly written by Lucy Harmer. You can learn more about her work on www.innerelf.com.

*Lynne McTaggart's *The Intention Experiment* has brought together much fascinating research in this area, and presents it in a very readable way.

CHAPTER 20

Dropping the Robe—Death and Dying

Normally the body, this web of interconnected functions and structures, is kept together by homeostatic mechanisms. If one or more vital functions or parts of the body are lost or damaged, homeostasis cannot be maintained and the whole individual will die. This can happen suddenly or slowly; it can be caused by injury, trauma, starvation, dehydration, or aging. On the cellular level our bodies are always in a state of dying and regeneration, and many of our cells are replaced constantly throughout life. After the body dies, some cells remain alive for up to several days afterwards. Life and death are not as clearly distinct as we might think.

Spiritual traditions—that is, pretty much all systems of thought in the world, with the exception of modern Western science—consider that death is the severing of the spirit from the body. Hence the title of this chapter, which I have borrowed from the cultures of the First Americans (Native Americans). To drop one's robe is simply to let go of the body, the robe the spirit has worn for this lifetime (which is the good red road, that which we travel in the body), and move on to the blue road of spirit.[1]

Spirit is the animating force of the body, which can be particularly seen in the heart and lungs. Spirit keeps the heart beating and the lungs breathing—these are the two vital movements that all other functions depend on for immediate survival. When the spirit leaves, the heartbeat and breathing cease. Most cultures also consider that the spirit continues to inhabit the body for a time after physical death; it does not leave straight away, but takes time to go. Traditional funeral rites are often about helping the spirit to leave, to enter the next world fully and not get trapped here as a ghost.

In all of the physiology books I have looked at, there is nothing about death. Of course, physiology is the study of the functions of a living body, but still, since death is certainly coming to all of us, I find it surprising that it is not a topic generally covered. Sogyal Rinpoche, a Tibetan Buddhist Master, on first coming to the UK, was shocked at the absence of thought about death in our culture. In Tibetan Buddhism it is customary to consider one's own death, to meditate on it and prepare for it, certainly from adulthood on.[2] In many cultures death, as an integral part of life, is something all will be familiar with. In modern Western culture, we do not speak of death, even with the dying. We can be ninety years of age and still be concerning ourselves with the minutiae of life, without ever giving a thought to our death, which we must know is growing closer.

Our dying people are kept out of sight in hospitals or hospices (if they are lucky). During Victorian times the current trend of solemn, buttoned-down funerals began; people strive not to break down emotionally—not to express their grief publicly.

Contrast this with almost every other culture, where if a dead person doesn't get a really good sendoff, which includes a lot of wailing and releasing of tears and grief as well as a rousing celebration of life, the job has not been done properly. For example, the Dagara people of West Africa consider that many tears are needed to wash the deceased's spirit over to the next world. The Dagara also recognize the importance to the living of expressing grief fully—a funeral is an opportunity for everyone to cry and release their feelings of loss publicly, together with everyone else. This is the time for all grief to come out, not only about the person who just died, but about all the loss experienced as living humans. The Dagara rightly understand how dangerous it is for a human being to not cry.[3]

Contrast this with unfortunately all-too-common reality in the UK or the United States, that, when people cry at a funeral they feel obliged to apologize for losing control. People who do not get "back on the horse" very soon after a loved one dies are considered to be stuck or in need of jollying along. Tranquilizers or antidepressant drugs are commonly prescribed for people unable or unwilling to suppress the expression of grief. Our dominant culture (to be sure, there are communities of Old World, African, and native cultures within our dominant Western cultures who see things a bit differently) views suppression of grief as strength, and expression of it as weakness, to the detriment of our physical, mental, and spiritual health. It is very likely that the two world wars of the twentieth century hardened this pattern—there simply was too much grief and no time to feel it and recover fully from it.

Modern medicine measures success by how long a person lives—for example, the so-called five-year survival rate in cancer treatments. Sophisticated machinery can keep people alive or resuscitate a person who has actually died. Designer babies are being made to provide a sibling for a child with a disease who can be kept alive with organ or bone marrow transplants. We will do anything to buy a few more years, a few more months, a few more days. It looks like we have a death phobia. There are probably many reasons for this. One is that so many of us are so full of unexpressed grief we cannot bear to go near the subject of loss; another, that if the material body is all we believe to exist, and with which we are completely identified, then the end of it means complete annihilation.

So, consider this: One day, you and everyone else you know is going to die. This could happen in a variety of ways. In the UK and US, one in three of us will die of heart disease. This could be a heart attack or a stroke, killing us immediately or leading to a slower journey toward death. One in three of us will die of cancer, which can take weeks to years to die from, and can vary from being relatively pain free to being excruciating agony.

What feelings does this bring up for you? It is worth considering the reality of our death, not to get all morbid and obsessed about it but to bring us right up to the reality of life and the present moment, and to put into perspective what is important and what is not important. One thing about death, and about grief, is it sure shows us what matters. All the superfluous stuff is stripped away. We can step up to the moment with dignity, with courage and even with humor, and accept it as the last great adventure, opening our hearts to each moment.* We can let go with grace when the time comes, instead of trying anything to buy more time without regard to the cost of this to our planet or to future generations. When we are driven by fear we are missing out on being fully here, being fully able to enjoy our lives. We may as well sit back and enjoy the ride. We can let go of our loved ones when it is time for them to move on, rather than wasting our last precious time together in pretense and desperate holding. Many native and Old-Ways spiritual traditions emphasize the sense of being aware of death to inform our lives, and very few of them are about judgment when it happens. Maybe the Christian version of what happens, and what is required to get into heaven, has put our culture off going willingly into death, by scaring so many generations with hellfire and damnation!

We can be more scared of things when we don't understand what is happening, so one remedy is to find out more about the process of dying. Another is to go for life and truly live it, opening to each moment in trust, love, and awe at our great good fortune to have any time in an amazing human body on this beautiful earth of ours.

The Process of Dying

Let's take a look at what happens to the body of a person who is going through the process of dying. Deborah Sigrist, in her book *Journey's End: A Guide to Understanding the Dying Process*, describes the changes that take place during dying as occurring in four dimensions—physical, mental, emotional-social, and spiritual.

The body shuts down and physical changes happen with circulation, metabolism, breathing, lung secretions, elimination, and the senses. What may be abnormal in living becomes normal in dying. Death is an experience that comes to each person in a unique way, and it happens to the whole person, not just the body. Pain and suffering, like comfort and healing, can occur in any part of a person—not just the body. In fact, the opportunities for growth in the emotional, social, and spiritual areas are tremendous, even though the body is slowing as the person gradually lets go.

There are many physical signs of dying. The circulation slows as the blood pressure drops and heart rate slows, so hands and feet may feel cool or cold to the touch. The fingers, earlobes, lips, and nail beds may show signs of this diminished circulation and look bluish or light gray. When death is very near, the feet and knees may look mottled—blotchy purple coloring appears. With reduced circulation, the vision may be blurred.

The body no longer needs lots of energy and the digestive system is slowing down, so appetite for food—and later for fluids—lessens. As eating and drinking lessen, the body becomes naturally dehydrated, making the dying person sleepier and less aware of pain and discomfort. Nearer to the time of death, a fever is common.* Secretions in the lungs thicken and gather in the lungs or back of the throat, making breathing sound moist and congested—the "death rattle." Usually this does not bother the dying person as he or she comes closer to death. All kinds of changes in breathing happen—to the rate, rhythm, and depth. There might be periods of not breathing for up to half a minute or more, or breathing may alternate between being slow and shallow, faster and deeper.

The kidneys and bowel eventually stop working, and with dehydration, a smaller amount of urine is produced and is dark in color, and bowel movements become less common. If the bowels do not move for three to four days, this can cause great discomfort.

Hearing is the last sense to go, so it makes sense to always assume a dying person can hear you, even if the person is unable to respond. Gentle touch is always a great way to communicate and to make sure the dying person knows you are there. Close to the hour of death, the skin may feel moist.

Mental and emotional changes also happen during the dying process. With the slowing of circulation and breathing, the brain receives less oxygen. This, together with physical pain, fear, or metabolic changes in the body can cause restlessness, agitation, and occasional or constant confusion. Levels of alertness and awareness may rise and fall. A dying person's attention begins to turn inward, lessening awareness of surroundings. Some people may fall into sleep so deep they cannot be awakened.

Then there are emotional and social factors. Many dying people wish to review their life, looking back in search of meaning and fulfilled purpose. There are often regrets to be felt, forgiveness of self and others to be given, good-byes to people and places to be made. The living can help the dying by being prepared to listen and share in these processes.

Whether a person is religious or not, spiritual considerations are often present when one is dying. People consider the meaning of life, of hope, suffering, and death. Old losses coming up and being grieved, revisiting the past and forgiving it and the people who have hurt us are common activities for someone who is dying. It is not unusual for a dying person to experience a vision of someone who has already died, or a spiritual or religious figure. Dreams of one's ancestors are common.

Each person dies at the right moment—for some, this may be surrounded by others, for others, alone. Some people seem to hold off or bring on the moment of death, dying just after someone from out of town arrives, or after an important anniversary.

What Happens to the Body after Death

After death, the body changes still more. Sometimes the bowel and bladder open and empty immediately. Within four hours, the skeletal muscles become stiff—this is called **rigor mortis**, the "stiffness of death" in Latin. Usually the face stiffens first and the hands and feet later. Maximum stiffness develops in twelve to forty-eight hours, depending on the temperature around the body as well as other factors. (For example, a starving person has less stores of glycogen in the muscles to use in respiration; therefore rigor mortis will set in more quickly.)

What happens in the muscles is that ATP runs out as the circulation stops bringing oxygen and glucose to the cells. The muscle cells do not all die right away—they can continue anaerobic respiration and make some ATP, but eventually will be unable to make more. Do you remember that ATP is used by muscle cells to unlock the contraction of actin and myosin, energizing them for the next contraction? So without ATP, and also with calcium ions leaking all over the place within the muscle cells, the myofilaments cannot be unlocked, and the muscles become and remain strongly contracted.

Rigor mortis only wears off as the cells and tissues begin to decompose. Without normal maintenance, the lysosomes in the muscle cells open and allow their enzymes to escape and begin to dissolve the actin and myosin, thus unlocking the tension. This is the beginning of the process of **putrefaction**—the decomposition of the body after death. Putrefaction is the dissolving of the body by its own enzymes and bacterial action. The body is gradually changed into its chemical components of gases, liquids, and salts. Soon after death bacteria invade the tissues. These are bacteria that in life were normally present in the gut and the lungs. They prefer anaerobic conditions, so as oxygen is quickly absent after death they quickly multiply. The hotter it is the quicker decomposition occurs. Bad-smelling gases are produced as the body liquefies. All in all, a decomposing body does not look or smell great, and the dead are therefore best removed from the vicinity of the living before putrefaction becomes advanced. This is no doubt the reason most religions that evolved in hot countries insist on a quick burial.

Sometimes normal putrefaction does not happen, and a variation called **mummification** happens. This only happens in conditions of dryness of heat, when air can circulate—for example, in the desert, or in a chimney. Instead of rotting away, the body shrivels and is converted into a leather-like mass of skin and tendons surrounding the bones. Internal organs may be decomposed, or occasionally preserved. Newborn infants are small and sterile, so more commonly mummify. As you probably know, the ancient Egyptians preserved the bodies of some of their dead by using processes that encouraged this phenomenon.

Student doctors in the UK and the United States dissect dead people in their first year of study to assist in the learning of anatomy. Consider that medical students, like the rest of us in the West, will have been protected from death and may never have been close to it before. The experience of dissecting a cadaver has the most profound impact on them. Medics are expected to put on a face of not being too bothered by death. Medical students will begin to come into contact with ill people, some of whom will be terminally ill. The dissection of cadavers and involvement in autopsy does not really prepare students for interaction with the dying.

Until recently, many medical schools also had “dog labs” where students practiced operating on dogs. As well as learning about anesthesia and dissecting a living, breathing, bleeding body, the dogs died on the operating table, therefore exposing the students to death. This process has recently been dropped from most medical schools.

Often in the second year of medical training, students participate in an autopsy—the dissection of a dead person in order to determine the cause of death. British law stipulates that any person who dies without having seen a doctor in the preceding two weeks who can confirm cause of death must be given an autopsy—such a law is intended to eliminate foul play.

As a student of herbal medicine, I visited a morgue with a group of fellow students. One of the people being dissected was a ninety-six-year-old woman who had died in her sleep. Because she was healthy and not under a doctor’s care, she had to be given an autopsy. It turned out that she had died from a massive stroke—half of her brain had turned to liquid. This kind of death, most definitely from old age, is the kind many people wish for. It is a shocking but valuable experience to be in the presence of death.

Death in a Nut

(This story is from the great Scottish traveler-storyteller

Duncan Williamson, who died in 2007. I learned it from the book *Death in a Nut* by Eric Maddern and Paul Hess, and repeat it here with grateful thanks to them all.)

Once upon a time there was a boy called Jack who lived with his mother in a cottage by the sea. Jack helped his mother tend the vegetable garden and look after the goat and chickens. He loved to walk on the beach and collect driftwood and other interesting things. One day he got up and his mum was still in bed. He went into her room and she was very sick and pale in bed. “I’m very ill, Jack. I think Old Man Death will come for me soon!” “Oh no, mum, please don’t say that—I couldn’t bear to do without you. I’d be all alone in the world.” “I know, Jack, it’s hard for you. But you’re young; you’ll get married and have your own family. I’m sorry, but I’m so tired, I must sleep now.”

Jack went off to the beach, devastated. As he walked along by the sea’s edge, he saw an old man coming toward him, carrying a scythe. It was the Grim Reaper—Old Man Death himself. As he got close to Jack, he asked, “Do you know the way to the cottage by the sea?” and Jack said, “That’s my mother’s cottage. You can’t go there!” But Death said, “She is ill and in pain, she needs me. It’s her time to go.” “No!” shouted Jack. “You can’t take my mother." And he took Death's scythe and snapped it in two. "You've done it now," said Death, and they began to fight. But the strange thing was, every time Jack hit him, the old man got smaller and smaller. Soon Jack had him in the palm of his hand. He found a hazelnut the squirrels had eaten, and stuffed Old Man Death head first through the hole and into the nut, then plugged the hole with a stick. There he had him—Death in a nut! Jack threw the nut as far as he could out to sea. "There. You won't get my mum now!"

When Jack returned home, his mum was in the kitchen making scones. She said a wind had come through the cottage and left her feeling fine. "Why don't you fetch some eggs for our breakfast, Jack?" So Jack went off to find the eggs, without telling his mother about Old Man Death. When she tried to crack the egg on the side of the frying pan, clunk! it went, and wouldn't break. Clunk, clunk, clunk. She tried again and again, but the eggs would not crack. "How strange," she said. "The eggs won't crack. Go and get me some vegetables from the garden and I'll make some soup for dinner." So Jack brought in some leeks and carrots and turnips. But when his mother tried to slice them, the knife slipped straight off, as if they were frozen solid. "But we haven't had a frost for months. Okay, then, you'll have to kill the cockerel, and we'll have him for dinner instead," said Jack's mother. So Jack caught the cockerel and tried to wring his neck—but no matter how he tried, the neck of that cockerel kept unwringing itself! He took the cockerel in to his mum, and she chopped off his head. The head came off—then flew right back on the cockerel's neck again! Again and again, Jack's mother tried to kill the cockerel; but he simply would not die.

"How strange!" said Jack's mother. "Well, go to town and buy some chops for supper from the butcher," and she gave Jack half a crown, and off he went. In the town, Jack saw a big crowd of people in the Square, but he ignored them and ran into the butcher's to ask for his chops. But the butcher had none. Every time he'd tried to kill a cow that morning, the cow had jumped right up again. Jack told him about trying to kill the cockerel. "You tried to kill one, well, I tried to kill ten!" exclaimed the butcher. "It is all very strange—it's as if nothing will die!"

At that, Jack realized it was something *he* had done. He ran home and told his mother all about putting Old Man Death into the nut. "Oh dear, Jack," said his mum. "You shouldn't have done that. We need Death to live. You better go and find that nut and let him out!" So Jack went and walked along the beach, looking for the nut. He was tired and hungry and cold, and he walked for three days and nights searching for the nut. In despair, he sat by the water's edge. Suddenly he saw it—the nut! He picked it up and pulled out the plug. Out came the Grim Reaper, and as he came out he grew back to his full size. "You thought you could be rid of me, that without me there would be no troubles in the world. But without me, my boy, there can be no life." He asked for his scythe, and Jack told him, "My mother made me mend it. It's by our house." So they went up to the cottage and Jack handed Death his scythe. The Old Man tested the blade with his thumb and said, "You've done a good job, Jack. And because you've been fair with me, I'll leave your mother alone for a while." And he disappeared.

After that, Jack's mother lived to a ripe old age, and when Death finally came for her, Jack didn't mind so much, because he had learned that without Death there can be no Life.

The Grieving Process

It is not only those people who are close to the dying person who grieve. The person dying also undergoes the grieving process to some degree or other, depending on his or her feelings about the life he or she has lived. As we near death, receive catastrophic news, or go through some type of life-altering experience, we go through various stages of grief.

Elisabeth Kübler-Ross defines five stages of grief in her landmark book *On Death and Dying*. These stages don't always come in order, and are not all experienced by everyone, although Kübler-Ross observes that a person will always experience at least two of the stages.

The five stages of grief:

- Denial: It can't be happening to me. It must be a mistake.
- Anger: Why me? It's not fair, someone is to blame.
- Bargaining: If I do this, it won't happen. Let me live to see my child grown and I'll do (whatever) in return.
- Depression: Extreme sadness, lack of motivation or desire to fight anymore. When one melts into this, the big healing tears come with the feelings of loss.
- Acceptance: At last comes the feeling that this is the right time. All is well, I accept.

Meditation on Death

In many cultures it is the norm to be very aware of death, and to meditate on one's own inevitable death in some way. In Stephen Levine's book *Who Dies?: An Investigation of Conscious Living and Conscious Dying*, many ways of working with pain and impending death are presented with compassion and great humanity. You might like to try the following meditation, taken from *Who Dies?:*

Sitting comfortably, your body supported and having taken care to ensure no interruptions, begin by breathing in and out, in and out. Be aware of your body, its sensations, its aches and pains. You are your body, but you are more than your body.

Be aware of your mind, your thoughts: fast or slow, fleeting or persistent. Watch your thoughts. You are your thoughts, but you are more than your thoughts. Who is watching your thoughts? Become the watcher.

Think about your life with compassion and love. Think about your parents. You are their son or daughter—but you are more than that. Think of your children, your family. You are a parent, a spouse. Think of your work. You are a ____. But you are more than your work. When you retire, you still live.

Who is it that will die?

Near-Death Experiences

Near-death experiences happen with about ten percent of people who come close to death. These people might experience traveling down a dark tunnel toward a bright light, seeing their own body from above, vivid memories, or entering another world and meeting loved ones, gods, angels, or spirits. Some people have mystical experiences of melting into the oneness of the universe.

Materialistic scientists (i.e., those who do not accept the existence of the spirit) say that all these experiences can be accounted for by the disorganized activity of the dying brain. This argument does not convince those who have had the experience, or the many people who believe that the soul has an existence that does not depend on the body. Some people who have had a near-death experience have seen details of the hospital ward or accident scene that, being unconscious, they could not have seen with their physical eyes. Skeptics say that the brain changes the timing of these events to make the person feel they happened after the clinical death, when in fact they happened before. Yet as far as I know, MRI scans of a dying person have never been taken, to see exactly what happens in the brain and body.

Helen Graham's book *Soul Medicine: Restoring the Spirit to Healing* begins with a description of what happened to her sister's friend, who was struck down by a mystery virus and lay in a coma. Doctors said she was brain dead and would not survive long off intensive care and life support, but soon after she was moved to a normal ward she recovered consciousness. She had experienced being out of her body. She knew things she could not have known about things that happened as she lay in coma, like knowing a nurse had a new haircut (she could not have seen the old hairdo while in a coma). She also knew things no one else yet knew, like the fact that her daughter was pregnant and that she would give birth to a girl.

To a tribal person living with experience of an ancestral tradition, all this speculation about whether there is an afterlife is hilarious—the existence of the ancestors is not taken on blind faith or on the threat of punishment from some distant god or religious authority, but is directly experienced throughout life.

Religious Attitudes about Death

What follows is a simplified in-a-nutshell look at death from various religious perspectives. Again, each one could be a book in itself and to really penetrate the mystery of it all would take a lifetime of dedication. Allow me to apologize in advance for missing much of importance in my clumsy attempt to give an overview of religious attitudes about death.

The **Buddhist** perspective involves seeing death as the breaking apart of the material we are made of, and as an awakening to our true nature. The dying person's state of mind is of great importance. After death, we may return to the human world, or enter a pure world of bliss, or if we achieve enlightenment, merge with the ultimate nature of mind. Having said that, there are many different schools of Buddhism, each with different takes on death. We can't really understand death from a Buddhist perspective from the outside, partly because Buddhism has a very deep concept of who we really are that is completely different from our Western way. We are both the self and not the self; there is no abiding self. About death, a Buddhist might believe you can never die because you were never born. Then there is the matter of not being able to grasp Buddhism with the intellectual mind to further complicate things.

Christians believe that if you embrace Jesus Christ as your savior, you will have eternal life. Many denominations teach that a time will come when Christ will return to earth and all true believers will be granted eternal life in heaven. There is "a time to be born, and a time to die" (Ecclesiastes 3:2). Some fundamental Christians believe that anyone who has not embraced Christ will go to hell, so missionaries and evangelists try to "save" nonbelievers, even on the deathbed.

Hindus believe in reincarnation; you die, and your spirit leaves the body but will return again in another body. So death is not a calamity but a natural process of the soul. After death, a person may take the path of the sun and merge with the light, not returning to a body. A person who takes the path of the moon returns to a new body, the status and fortunes of this next life depending on his or her deeds and actions in this life, and whether his or her children performed proper funeral rites. Hinduism believes in many heavens and hells, and many gods and goddesses expressing the Divine. Hindus cremate the dead in order to help release the soul. While in the mourning period Hindus do not celebrate festivals as a mark of respect. This gives the mourners time to fully grieve before returning to normal life.

Judaism sees death as natural, and as giving meaning to life. Since Hashem (literally, "the Name"—so called because the name of G-d is considered too holy to say or write in Judaism) is ultimately just, the afterlife must give ultimate justice and redress any apparent unfairness about life. In paradise we finally understand the truth of Hashem. Hell is a greater distance from God, heaven is to be with God. Judaism does not believe a Jew will go to heaven and a Gentile to hell, rather that individual ethical behavior is what's most important.

Muslims gather round to comfort the dying. Burial happens as soon as possible. The body is laid on the right side, facing

Mecca. A person faces judgment from Allah on death. The family of the dead must pay debts as soon as possible, and maintain close and courteous relationships with each other. Prayer and supplication for the deceased is essential, along with visiting graves—the living should remember death and the day of judgment. Only true believers have a chance of attaining paradise, therefore it is important to spread the religion.

The Old Ways of **shamanism** or **paganism**, where they still exist, usually consider reincarnation to follow one's death, when the soul or spirit leaves the body. It is possible for a spirit to be stuck in this world—as a ghost. The correct funeral rites are essential to take care of and help the spirit in its journey. Spirits often will return to the tribe for future lives. Improper funeral rites mean we can be born into any different tribe or culture (this is probably what happened to those of us who feel drawn to a completely foreign culture, even feeling more at home with it than with our own). Some souls remain in the next world, and will give what help they can as our Ancestors, who need our love and offerings.

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*My proofreader for the first edition, Patch Mendes, told me a story about a Hopi man who had lived as a clown, making his people laugh all his life. He faced his death well and his last wish—his last joke—was to ask that his dead body be thrown from a building in the town. Everybody laughed. (If anyone knows any more of this story, I'd love to hear it—it would be good to honor the man with his name.)

*Perhaps we are warmed by Tatewari's love on this part of the great journey. (Remember the Huichol god Tatewari, Grandfather Fire, who speaks through a shaman whose body temperature rises to 106°F when Grandfather is visiting.)

SECTION 2

Health and Disease

There are many models of health and disease in the world. In these three chapters we will look at the basics of orthodox Western pathology, then further explore what "holistic" can mean and take a brief look at bodymind medicine and healing. For those interested in systems that take a completely energetic view of health and disease, Appendixes A and B introduce the energy-based models of shamanism and the Five Element system of traditional Chinese medicine.

CHAPTER 21

A Brief Introduction to Western Pathology

Western pathology is basically an understanding about what is happening in the tissues when things go wrong. It is brilliant in its way; it has taken the art of looking at the physical, molecular level of the body to figure out exactly what is going wrong in a particular disease to a fairly deep level, in a relatively short space of time.

Enormous breakthroughs in physiology have occurred over the last hundred or so years, and more knowledge is being uncovered all the time. However, at present, the study of physiology and pathology has a great weakness that can mostly be traced to a failure to incorporate quantum understanding of the nature of matter and energy into its theories, remaining wedded to the Newtonian perspective of man and universe as machine.[1]

Causes of Disease

Some diseases are classified as being **organic**—these are the ones where it is possible to see a definite change in the tissues and cells, for example, ulceration or inflammation. Some diseases are not possible (yet) to see in this way—these are called **inorganic** disease. There was a time when most were lumped into a strange category called "all in the mind," which at the same time seemed to mean they didn't really exist. As physical imaging and other diagnostic techniques have become more sophisticated, and more understanding of the physiology of stress has emerged, things have been changing. There is a developing movement toward holism in orthodox medicine (at any rate, they certainly try and use the word a lot!); any good anatomy, physiology, and pathology textbook, for example, now takes a look at how the systems interrelate rather than simply looking at them as separate operations.

Having said that, the most common way of classifying diseases is in terms of the body system that they primarily involve. This means there is a tendency to compartmentalize pathology. The health services are also compartmentalized—you will see one doctor for your leg, another for your gut, and still another for your shoulder. Joined-up medicine has not arrived quite yet. Of course, GPs (general practitioners) are by definition generalists. And while, say, kidney disease is classed under nephrology, specialists in this area will be aware of the effect of, and effects on, the rest of the body. (Many articles have been written about the need to more closely integrate the different services for someone with kidney disease in particular.) As a whole, still, orthodox doctors operate as if they are unaware of subtle interactions—especially of diet, stress, and lifestyle—and only consider gross, measurable imbalances as having importance.

The problem with Western medicine is not with pathology; it is more with the fact that it tends to see the first-line changes in tissues as *being* the disease. A list of "causes" reveals only shallow probing into *whys*—rather, it shows a series of *hows*. For example, one cause of disease is inflammation, but inflammation as a cause of disease (and there are very many inflammatory diseases) really just describes what is going on in the tissues. As we discussed in the chapter on the immune system, it is possible to take a very deep look at the causes of infection in terms of looking at the terrain—the condition of the body—but the current orthodox line is that viruses, bacteria, fungi, and so on (the mediators of infection) are the cause.

The body is seen as a machine. This is, as John Ball says in *Understanding Disease: A Health Practitioner's Guide*, both its strength and its failure. Nobody questions the brilliance of Western medicine in life-saving situations—when you are smashed up in an accident, it can put you back together and keep you alive so you can heal, or in extreme acute illness, it can keep you alive until your body can figure out how to right things. It is in chronic illness where the weakness lies, and in overtreating acute illness (which would have been self-limiting, thereby causing problems for the future). Also, Western pathology uses medicines that, while they may have desired effects on a particular target, are largely incompatible with the body, working to control a part of it rather than working with it, and hence causing damage elsewhere. This is the classic mistake of treating the symptoms rather than the cause.

Here is a summary of causes of disease, into which it is possible to categorize most orthodox diagnoses.

Infections are a classic cause of disease; microorganisms like bacteria, viruses, fungi, yeasts, or parasites have entered the body and are using it as a host, causing problems to it. Louis Pasteur, the father of modern microbiology, is reported to have said "*Le terrain c'est tout*" (the terrain is everything), or "*C'est le terrain,*" meaning the state of the body decides whether you get ill. The microorganisms are only taking advantage of an already weakened system. Unfortunately, modern medicine has disregarded this understanding in favor of seeing the microbes as the enemy to be killed at any cost.

Immune disorders, including auto-immunity, allergies, and cancer. Cancer can be considered as a failure of the immune system, because with so much cell replication going on all the time in the body, mistakes and mutations are inevitable—so the production of cancerous cells occurs normally within us. If our immune system is happy and functioning well, these cells will be quickly disposed of before they can make a nuisance of themselves. Auto-immune diseases involve the immune system launching an attack on parts of oneself and allergies involve the immune system being too aggressive in dealing with harmless substances the body comes in contact with.

Trauma, or physical damage to organs and tissues. This can be mechanical trauma, like being run over by a bus or being slowly damaged by repetitive work, or chemical trauma such as happens from environmental toxins like coal dust, asbestos, smoke, pesticides, and food additives.

Stress. Yes, it's official: Western pathology recognizes that some diseases are caused by stress, and many are aggravated by it. You will recall from our section on the sympathetic nervous system how systemic our reaction to stress is.

Nutritional factors, including malnutrition from lack of food and diseases caused by too much of the wrong sort of food. It's interesting that we have now in the West many people with the problem of obesity who are also malnourished,* in the sense of lacking in vitamins and minerals and other essential nutrients.

Iatrogenic, or doctor-induced, disease—that is, caused by the treatment used for another disease. Iatrogenic disease includes problems that come from side effects of drugs, medical mistakes and accidents, and things like picking up an infection in the hospital. For example, a person may be given steroids for asthma and develop osteoporosis as a result. The osteoporosis is an iatrogenic disease. Iatrogenic disease is somewhere between the first and third cause of death in the United States (depending on your stance—the official figures put it at third cause of death, but some critics of the modern medical system put it as the leading cause), and is either the third or fourth in the UK.*

Congenital and inherited disease includes a wide range of abnormalities ranging from Down's syndrome and Turner's syndrome, to hemophilia and sickle cell anemia. Also, many diseases seem to run in families, so have an inherited factor—for example, eczema, arthritis, and some cancers. One school of thought, popular now, puts everything down to genes—if we can isolate the gene responsible for an illness and change or eradicate it, we can conquer that disease. It is very likely that our genes give us the propensity to one type of illness or another, but this does not mean that the genes are causing that disease. Genes themselves are turned on and off by environmental triggers. Most diseases still seem to need environmental triggers of some kind to manifest.

Degeneration—the aging process, wear and tear. An interesting area, since so much of aging is culturally dependent and strongly interwoven with our beliefs and feelings. Some very interesting research has been done showing that the signs of aging, including joint thickening, poor eyesight, hearing loss, and decreasing memory, can be reversed under circumstances that change a person's attitudes and focus. Also good to remember is that two people may have the same level and type of degeneration, such as worn away cartilage in the hip joint, and while one person is in terrible pain and cannot walk, the other has hardly any symptoms at all. Symptoms and signs are not necessarily closely related. (A **symptom** is something you feel and report; a **sign** is something that can be seen or measured. For example, pain is a symptom, swelling is a sign.)

Of course, some diseases are very tricky to fit into these classifications. Western pathology has a great category called **idiopathic disease**—this is a disease having an unknown cause or mechanism. Sometimes problems come about from lifestyle, like pressure sores and wasting in people who are very sedentary. Mental and psychological diseases are often seen as being completely different and separate from physical diseases by orthodox medicine, while at the same time the trend is to assume biochemical changes are the cause of everything. I explore this further in Chapter 23.

Various Disease States

Western pathology focuses on changes in the tissues that come about in disease states—hence a **pathologist** is someone who studies diseases. The term also refers to those people who cut up dead people to examine their tissues and organs to see why they died. Other more holistic systems of medicine usually focus more on what has happened in order to allow the diseased tissue state to arise than on the condition of the tissues themselves.

Various disease states that can be observed in the tissues of the body include such things as inflammation, cell damage or death, and abnormal cell growth. Cells can become swollen and look cloudy, can actually die and break down completely, can abnormally accumulate fat, and can atrophy (that is, shrink in size or number when referring to tissues). One very simple example of atrophy is what happens to skeletal muscles that aren't used. When you break your leg and it is in a cast for weeks without any weight-bearing activity, muscle wasting will cause the leg to be noticeably smaller and more flaccid than the other leg when the cast is removed. Below we will take a closer look at inflammation, which is one of the most universal cell and tissue responses to problematic circumstances.

Inflammation

Many diseases involve inflammation. Inflammation is interesting because, although it often causes many if not all of the symptoms of a disease, it is in itself an important part of the body's healing mechanism. When tissues are damaged or infected, white blood cells are attracted to them in large numbers. First come the **neutrophils** and then the **granulocytes**, both releasing their chemicals to encourage and increase the inflammatory process (histamine, prostaglandins, and others). These cause the capillaries to dilate and become more permeable, allowing protein-rich fluid containing nutrients and building blocks for repair to leave the blood and enter the tissues, along with many white blood cells that will be able to fight any infection and clean up debris from damage. This fluid also dilutes toxic or harmful substances. The swelling also slows down the spread of infection as clotting factors in the tissue spaces turn the whole thing into a gel, making it more difficult for microorganisms to move freely. This is the underlying mechanism behind the swelling you get when you bang your knee, for example.

The classic signs of inflammation are:

- **Swelling** (from extra fluid in the tissue spaces)
- **Heat** (blood brings heat, so with the extra activity going on things heat up)
- **Redness** (extra blood in the area)
- **Pain** (from the pressure on nerve endings caused by the swelling)
- **Loss of function** (well, it hurts and it's swollen, so you can't use it as you would normally)

You can see that although it causes troublesome symptoms for us, inflammation is in fact one of the body's most important healing mechanisms—without it, healing does not happen well. Research has shown, for example, that people taking anti-inflammatory drugs have significantly slower healing time for broken bones. The research hasn't been done on other healing times, but it is likely that all healing times are slowed down by anti-inflammatories. (In fact, sometimes healing is deliberately slowed down by application of steroid anti-inflammatory drugs; for example, with certain eye operations, it is important that healing happens slowly.)

If all goes well, this inflammatory activity means any infection is soon under control, and any damage is repaired with new cells and tissues. Then hoards of **phagocytes** (first neutrophils and basophils, then macrophages) that have entered the area clean up all the debris. Remaining white blood cells return to the blood and gradually the tissue returns to normal. This is called **resolution**. Sometimes the body is not able to resolve the situation, and a chronic inflammation is set up. Sometimes an open sore, or ulcer, forms. Sometimes there is a lot of pus (an attractive mix of dead and alive bacteria and white blood cells) that needs to be discharged from the wound for resolution to occur.

Infection is a common, but not the only, cause of inflammation. Trauma also causes it, and the naturopathic view is that buildup of toxins in the body is a common cause, with the inflammation seen as the body's attempt to remedy things. Many chronic illnesses are basically inflammatory, including arthritis, asthma, eczema, and coronary artery disease (which causes heart attacks).

Various states of inflammation are occurring all the time in the body. They are largely mediated through chemicals called **eicosanoids**, which also mediate their resolution. Remember this from our discussion on essential fatty acids in the chapter on nutrition and diet? Basically, animal fats are used to make the pro-inflammatory eicosanoids, and essential fatty acids—from fish oils, nuts and seeds, and green vegetables—are used to make the anti-inflammatory ones. The diet of our ancestors contained a lot more oils and fewer fats. The modern diet is quite the reverse, so most of us are pushing our bodies more toward inflammation than away from it. Changing the diet away from animal products and toward vegetables and fish can tip the balance back and lead to the end of a chronic inflammation.

One way for the body to resolve a chronic inflammation is to turn up the inflammatory response back into an acute phase—all the extra activity can help resolution. Traditional treatments that use this route of healing include deep heat, mustard plasters, and stinging an inflamed joint with nettles.

(An old country cure for arthritis involved rolling naked in a bed of nettles in the springtime. Ouch!)

The phagocytotic white blood cells will always try to keep any infection inside themselves. In some situations monocytes will be infected, and not be able to destroy the invading organism, but keep it inside them. A bunch of infected monocytes can be surrounded by a bunch of normal ones, and sometimes even the whole thing is then further walled off by a connective tissue capsule. This can happen in tuberculosis (TB) of the lungs, when a **granuloma** like this forms, keeping the TB separated from the rest of the body, while still not able to be rid of it. Such a situation can remain for many years, until at a time when the immune system is low, it is not able to keep it controlled and the infection breaks out and spreads through the body.

This is a very extreme example, but these so-called low-grade infections of all kinds can exist in the body for years. A very common focal point for these is the mouth—a tooth infection, for example. Also viruses like the herpes family can linger in a dormant state then flare up into an active infection at times of stress—expressing as shingles, cold sores, and genital herpes.

Diagnosis of Disease

Many diseases are named with an impressive sounding Latin name that is merely a description of what is happening. Yet we are generally conditioned to be reassured by such diagnoses (or scared by them, depending on the translation). Generally, we tend to have more respect for the practitioner who gives us a nice little tag for our disease—especially if we can barely pronounce the name. You go to the doctor's office with an illness, and you walk away with a disease! Ah, it's bronchitis—the tubes of the lung are inflamed; aha, it's irritable bowel syndrome—the guts are not working properly but no ulcer or growth or abnormality in the tissues can be found.

Diagnosis relies on gathering enough information about symptoms and signs to get an accurate picture of what is going on and come up with the right label. There are, of course, some uses in having the label: it may be possible to get a fairly accurate picture of what is going on in the body and what can be expected if things don't alter. The expected course or progress of a disease is called the **prognosis**.

Symptomatic Treatment

Most treatments in orthodox medicine are deemed successful if they effectively eliminate the symptoms of disease. On the other hand, holistic systems see symptoms as being not the be-all and end-all, but, rather, like the warning lights on your car—if the warning light goes on when you are driving your car, do you stop and disconnect it then drive on, happy that the light is no longer on? If so, you will not then be surprised when some serious problem occurs. Yet we have gone along with the simplistic idea that if a drug has got rid of our symptoms, the problem is gone—even though the drug may cause other conditions, and do nothing to eliminate the cause of the initial problem. Thus iatrogenic disease thrives.

!!!Red Flag!!!—Symptoms Never to Ignore

Depending on your level of training, this will be more or less previous knowledge for you. Many holistic systems of medicine have complete methods of diagnostic and treatment that do not refer to pathological tissue states at all. However, the holistic therapist or healer needs to be thoroughly aware of those red-flag conditions for which a person is best referred immediately to a physician.

Without knowledge of and attention to dangerous symptoms, it might be safer to have the practice of always referring every prospective patient for a medical checkup of symptoms before agreeing to treat him or her holistically. Sometimes the sledgehammer of orthodox medicine will save a life when an imbalance has moved far into the tissues, or a person does not have the strength or resources to effect changes quickly enough to mobilize the innate healing ability. This does not mean that the person would not also benefit from treatment by a holistic system at the same time, however.

Below is a list of red-flag symptoms and signs—not a comprehensive list, but a beginning. The practitioner must always be on the alert to the possibility of serious disease.

- **Abnormal bleeding**. Although by no means always indicative of serious disease, and it is not necessary to whip up fear in your patients about this,* bleeding in an unexpected place should always be investigated. This includes bleeding from the vagina that occurs outside the normal menstrual cycle, bleeding from the rectum (unless it is known that the person has hemorrhoids, which should also be investigated if the bleeding is prolonged or excessive), and blood in the urine, as well as coughing up blood or blood in vomit.

- **Stools** that look like black coffee grounds—this indicates the presence of partly digested blood from higher up the gut
- Loss of appetite or increased **appetite**
- Sudden **weight loss** without dieting
- **Weight gain** when dieting
- Sudden **change in bowel habit**—although a person with IBS (irritable bowel syndrome) may have constant changes in bowel habit without any sinister implications. Bowel cancer can show itself with a change in bowel habit. Be very suspicious if a person who has usually been regular experiences rapid and lasting changes without any major change in the diet.
- Unexplained **vomiting**
- **Lumps and bumps** can be cancer, although not necessarily. Of course, if you agree with Dr. Hamer[**] about emotional shock and conflict causing cancer, you might think it not beneficial to fall into the hands of the orthodox system! At the same time, let's say the cancer was caused by emotional shock or trauma, unless you can give that person sound advice on how to effectively remedy the situation, a simple diagnosis of shock and trauma may be worse than useless. No matter what your thoughts about cause, you would be on very shaky ethical and legal ground if you did not refer someone who had an unidentified lump to an orthodox practitioner. It is always the person's individual choice to decide what to do, should

it be found that cancer is indeed present.

- **Difficulty in swallowing** that can be (but isn't definitely) caused by a tumor
- A **headache** that began gradually and got worse and worse and doesn't go away, or any other kind of pain with this behavior
- **Exhaustion and tiredness** that do not very quickly respond to rest or other treatment. Common medical causes (excluding overwork, stress, depression, and lack of sleep!) include anemia and underactive thyroid, but more sinister underlying disease is possible.
- **Changes in sleeping patterns**
- Interrupted vision of any kind, or pain in, around, or behind the **eye**
- Persistent **cough or breathing difficulties**
- **Waking up in the night unable to breathe** or in paroxysms of coughing, then feeling better for sitting upright (this can be due to heart failure)
- Failure to produce adequate **urine**
- **Constipation** that does not respond to treatment—after not opening the bowels for a week, a person can become very ill

There are others, of course. It is worth repeating here to make sure it sticks that any ill person should be seen by a *fully trained professional* and that signs and symptoms can be easily confused or overlooked. Remember that a little knowledge can be a dangerous thing and don't let your ego get carried away thinking you know more than you really do. At its best, orthodox medicine *is* life-saving.

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*According to Terry Pratchett, this is due to the rider of the apocalypse called Famine having to be more creative in the Western world. See Terry Pratchett and Neil Gaimon's *Good Omens*.

*According to Dr. Barbara Starfield of the Johns Hopkins School of Hygiene and Public Health, 250,000 deaths per year are caused by medical errors, making this the third leading cause of death (after cancer and heart disease) among Americans. This research was published in the *Journal of the American Medical Association* in May 2007.

*Unless carrying out emotion testing in the way of the Five Elements practice. See Appendix A.

**See Chapter 23 for more on Dr. Hamer's work. Also: www.newmedicine.ca.

CHAPTER 22

Toward a Holistic Paradigm

A paradigm is a world-view, a belief structure. There are quite a few to choose from, although you wouldn't think it from what is available in the mainstream. We usually get quite attached to our own, and very easily think it is the only one. In fact, we usually don't even see it as a paradigm—it's just how things are. If we do recognize it as a paradigm, we like to think it is the only sensible one.

Here we will begin to explore the various shades of the meaning of holism. This is intended as an introduction, a call to arms—or, at least, to thinking. I am not answering all the questions here, but rather aiming to develop our concepts of what holistic medicine can mean. There is a lot of dilution going on of the meaning of "holistic," as mainstream medicine tries to incorporate holistic ideas into its practice. This is good and worthy and will probably lead to less suffering for people being treated within that system; at the same time we need not settle for this diluted version of holistic medicine, which is presented as if there is not much more to it.

Deeply holistic paradigms can challenge our existing belief structure if we are educated in the West—as I have said, Western orthodox medicine is unique in the world for not considering the spirit. Spirit is a difficult thing to define—yet somehow, we know what it means. One great description came to me via my teacher Eliot Cowan, world-renowned healer in the Five Element tradition:

> Think of where your body has been today—all the movements it has made from when you woke up to the present moment. Even if it's early in the morning, your body will have been active all the time in one way or another. Now think of where your mind has been—where you have ranged in your thoughts. You will see that the movements of the mind so far exceed those of the body, that really there is no way for the body to keep up with the mind—the mind is too fast for the body to grasp. Well, your spirit is to your mind what your mind is to your body—the mind simply has no way to grasp the spirit, the spirit is too vast, too fast, too beyond, for the mind to get more than a now and then glimpse of it. Yet many of us have had experiences where we came close to feeling things in our spirit—highs, peak experiences, moments of deep peace, deep joy, connection, serendipity.*
>
> Thomas Moore also writes eloquently of the soul or spirit in his books.

Causes of Disease

For most systems of medicine in the world, the spirit is in charge—healing must happen in the spirit and healing comes *from* the spirit. At heart, holism says that a person is a whole, and also a part of the greater whole. Because we are deeply connected both within ourselves and with everyone and everything else in the universe, all these influences, within and without, affect us. You are your body, but you are more than your body—your thoughts and feelings affect your physical reality far more than you may realize. You do not exist in isolation: your relationships, from the beginning of your life to the present, have formed and continue to form you. If your family is sick, you are affected. If your community is sick, you are affected. If your society is sick, you are affected.

As we said above, infections are one classic cause of disease. One might think this would be a straightforward case—microorganisms like bacteria, viruses, fungi, yeasts, or parasites (nits, worms) have entered the body and are using it as a host, causing problems to us. But go a little deeper, and you will want to know the bigger story—what happened to upset our balance so that microorganism could get in and cause trouble? If you gather a bunch of people and literally paint cultured cold virus directly onto the membranes in their nose, only a minority of them (twenty percent) will get the cold.[1] You cannot change this figure by giving them wet feet or blowing cold air down their backs. It seems quite a low figure, doesn't it? (There is research that shows getting chills can double your chance of catching a cold.)

We are reminded that Louis Pasteur, the father of modern microbiology, said on his deathbed that the terrain is everything. In other words, it's not the infectious organism that causes the disease, but the condition of the person affected. Unfortunately, Pasteur's followers were already excitedly rushing off on the path of finding something to kill invading organisms, and this is the path that orthodox medicine is still stuck on. The result of all this is the MRSA and other so-called superbugs, an increase in allergies, and other signs of impaired immunity, plus the yet unknown effects of pharmacological pollution.

Do you get a cold if someone with one sneezes on you? Why is that? Is your immune system really so low, and why is that? Does it have anything to do with what you eat, with high stress levels? Why are you stressed? Is it from your life now, or because emotional trauma in your childhood has left you more vulnerable to stress? Is it simply because you believe you will get a cold? Is it because you really need a few days in bed to rest and take stock? Is it that your immune system is in good enough shape to throw up an acute illness, to help you detox (creating a fever and copious mucus is one way to give your body a good cleaning out)? In other words, is it a sign of weakness to get this cold, or a sign of strength?

To be truly holistic, a physician or healer must make space to think about and try to understand all the factors operating on a person's life (while realizing that, at least on the conscious level, we can never understand everything, and that understanding is not the only source of healing). Even on the apparently straightforward physical level, we can ask what is going on in each organ and system of the body. The traditional case history of modern medicine includes a systemic enquiry into just this.

Taking a detailed medical history of a mature adult will usually require *at least* fifty minutes, and often turns up some things that a naturopath or herbalist will connect to current signs and symptoms of disease. Let's take, as an example, a person who has osteoarthritis (wear and tear of the hyaline cartilage causing inflammation and pain). The orthodox treatment for this will be drug therapy—anti-inflammatories and painkillers, which all have varying degrees of side effects. (A person with osteoarthritis that has been found via x-ray is usually told that the condition is irreversible and nothing can be done.)

A medical herbalist or naturopath spends an hour or more taking a full case history (which might be done even in the medical model, but limited to a typical five- to eight-minute consultation and hardly ever done by general practitioners), and finds that the person is also constipated and has poor circulation. Constipation leads to buildup of toxins in the body, which can lead to inflammation of the joints. You will remember that cartilage has no direct blood supply of its own to carry away toxins, getting its nutrients from the synovial fluid and underlying bone. Bowel function can be improved and the circulation stimulated by herbs, exercise, and massage. These things, added to removal of toxins from and addition of good quality nutrients to the diet, will have a huge effect on the person's symptoms. A naturopath may use chiropractic or osteopathic techniques to balance the bony and muscular body, creating a better alignment—poor physical alignment puts extra pressure on joints and can cause damage. Release of muscular tension around a joint reduces compression and therefore decreases damage and encourages regeneration of the cartilage.

So, even looking purely on the physical level, you can see that one can attempt to be holistic, rather than simply acting to stop the symptom without addressing the cause of a problem. Then there is the emotional and spiritual level to consider.

A Five Element practitioner or a homeopath might take up to two hours to take a detailed history, which will include emotional history, the highs and lows of one's life, likes and dislikes—all in an attempt to feel into the spirit. Stephen H. Buhner brilliantly describes (in *The Secret Teachings of Plants: The Heart as an Organ of Perception in the Direct Perception of Nature*) the technique of using the heart as an instrument of perception—literally feeling into the physical, mental, and spiritual reality of another person to determine (or diagnose) where and how things aren't right. Shamanic practitioners use the dream journey and trance state to gather information about the spirit of their patients.

As you can imagine, there are many questions for holistic therapists to consider. What are their patients eating? How are their stress levels? Do they have families in good shape, time to spend with loved ones, children, and friends, time to play and have fun? Do they have safe, affordable places to live? A life free of worry? Do they have access to good, clean water? What about residues of pesticides and artificial fertilizers in water and foods? Food additives? What about air pollution? Toxic buildup in the environment of chemicals in toiletries, paint, clothing dyes, furniture, drugs? Do people have a feeling of being connected, of belonging, of a meaningful purpose for their lives? Is their work meaningful, useful, and contributing to the good of the whole? Are they treated with love and respect, are they valued, at work and at home? What is at the heart of their problem? Where is their heart at?

These questions and more belong in a discussion of holistic health. You can already see that for most of us, there are not many positive answers to these questions. Holistic medicine, taken as far as it can go, cannot simply mean adding on a nice "treatment" to existing orthodox healthcare—although this is not to dismiss the value of lying in a darkened room being rubbed while nice soothing music plays!

Society's Imbalance and Our Health

One weakness of the "new age" paradigm is its failure to take on the general problems of the dominant cultures—there is an assumption that if we can get everything right for ourselves this will be enough. Well, we can get most things right for ourselves over time, but to go for total healing, global healing is needed, and this means radical change in the way societies are set up. A truly holistic medicine, for example, could never be driven by profit as with the pharmaceutical companies, which fund most medical research.

If you are thinking holistically, can you really use a treatment to save one person's life that will create pollution and damage many others' lives, including generations to come? This is a very difficult question, and there is no clearcut answer, but it is still a question worth asking. At what price are we prepared to save one life, and why? Is our inability to accept death actually creating more death in the future?

Pharmaceutical Pollution

Pharmaceutical drugs are designed to be stable in the body, to not easily break down, for stronger and longer-lasting effects. Fifty-five to ninety percent of drugs will be excreted whole in the urine. Tap water in cities is recycled over and over from sewage plants, and filtration systems are not set up to remove pharmaceutical substances. Thus antidepressants, anticonvulsants, anticancer drugs, antibiotics, HRT, steroids, statins, and blood-pressure drugs have all been found in measurable amounts in city tap water. It is not known how the increasing presence of these drugs in the world's water table will affect us—or all the creatures of the earth and seas, from bacteria and single-celled organisms up. When streams were tested at random in the United States (in a 1999–2000 study conducted by the US Geological Survey), eighty percent were found to contain some antibiotics, steroids, synthetic hormones, or other common drugs.

Lynn Roberts, professor of geography and environmental engineering, was leader of a Johns Hopkins University team studying the scope of pharmaceutical pollution in the United States. Writing in 2003:

> This is an important new research area. Over the past few years, scientists in Europe have found pharmaceuticals in natural waterways, sewage treatment effluents, and even in drinking water. Yet until this year there have been virtually no scientific studies examining this issue in the United States. It's important that we begin to look at this because there are many ways in which pharmaceuticals in the environment could produce undesirable effects on aquatic organisms or even humans.

On March 10, 2008, the US organization Environmental Working Group released expert testimony:

> All of the pharmaceuticals reported in drinking water supplies are unregulated in treated tap water—any level is legal. Not only has the EPA failed to set standards for pharmaceuticals, but also they have failed to require utilities to test for these chemicals. The drug residues in tap water join hundreds of other synthetic chemicals Americans are exposed to daily, as contaminants in food, water, and air, or in common consumer products. EWG found an average of 200 industrial chemicals, pesticides, and other pollutants in umbilical cord blood from 10 babies born in the U.S., indicating that our exposures to toxic chemicals begin in the womb, when risks are greatest.[2]

And this is just the drugs. The whole of technological medicine also pollutes heavily by the waste it produces—incineration of disposable plastics, and radiation waste, for example. Stephen H. Buhner's excellent book *The Lost*

Language of Plants: The Ecological Importance of Plant Medicines to Life on Earth has a few chapters detailing this important area.

We are experimenting with the planet, with our children and our children's children, by pouring huge quantities of toxins of all kinds into the environment. Contrast this to the attitude of many First American tribes—considered primitive by our "civilized"* society, these people have a philosophical outlook that makes it one's duty to consider the effects of any action on the next seven generations.

Environmental and ecological concerns must be a concern of the healer. People can control what they put into themselves in the way of toxic food and drink and drugs. But we do not have the choice to keep away from harmful environmental pollution. Once toxic substances that do not biodegrade are in the world's water, they travel everywhere. Some of them have been found in the fat of polar bears at the North Pole. It begins to look as if some kind of political activism is necessary on the part of physicians and healers. Society needs to be changed in order to allow for peak health of us all.

While we are on the subject of changing society, let's consider one major social factor that has a huge impact on health and life expectancy worldwide. Poverty is the main killer in much the world. Infectious diseases can take hold most aggressively in people whose immune systems are weakened from lack of adequate nutrition and from stress. Poor people in rich countries do not have access to good quality food (organic, for example). Cardiovascular disease, the biggest killer in the developed world, is particularly high in people of African heritage living in northern industrialized countries, where they are subjected to particularly vicious racism. These facts are related. I will say more on emotional stress and high blood pressure in the following chapter, on emotional causes of disease. Actually, once you start talking and thinking holistically, you will see it becomes more difficult to separate everything into neatly labeled topics.

There is also stress in witnessing the oppression and abuse of other people. What is the price we pay here in the richer northern hemisphere of Europe and America, knowing that our wealth is built on the extreme suffering and poverty of the resource-rich but economically impoverished southern hemisphere of Africa? Interestingly, the shamanic or energetic view would be that we are affected by the energy of this even if we are personally unaware of the facts—we are all connected, after all.

A person's inner harmony and access to full healing will be impaired in a grossly imbalanced society such as our own. This is not to say that there are not wonderful things about all societies. But there is a conspiracy of silence, it seems, when it comes to taking a hard look at the reality of modern globalization and capitalism and the price paid for it. A helpful perspective to take is one where we do not blame any group or individual—including ourselves—for the ills of today, instead seeing that societies have a way of perpetuating themselves due to the way people are brought up to fit into them. The more correct perspective is that the enemy is the oppressive, unbalanced society itself, not any particular group—not even those groups that look like they have all the power. It is the society that needs to be changed, transformed.

People get hurt by the imbalances in our society. Look at individuals to see the imbalances of society writ small, and look at society to see the imbalances of individuals writ large. The people in power, the people in oppressive situations over other people, were not born wanting to hurt others—any more than we are born wanting to be hurt. Rather, we are hurt in myriad ways in our upbringing, and learn to acquiesce to it over time as the only way we can figure out to behave. Due to our acquired imbalances, we continue to act in ways that support the unwholesomeness of our society. This applies to those in power as well as those currently in the oppressed position; history is full of examples of people overthrowing tyranny then setting up a new tyranny in its stead. Change must be more fundamental, and involve us all on a deep level. As Gandhi said, "We must be the change we wish to see in the world."

Research

We need to do research in medicine because there is so much misinformation that it has become necessary to figure out what really works and what doesn't; what should be kept, what adapted, and what abandoned. Old ideas that never really worked, new ideas that never really worked—each can become established practice which people are unwilling to let go of. The danger is there for so-called holistic or alternative therapies too.

Research models currently held up as good practice within medicine do not serve holistic health ideals well. The gold standard of orthodox medicine is the double-blind placebo-controlled trial, or randomized controlled trial. People in a randomized study are divided into two groups, one given the active drug being studied and one a placebo—a drug that has no expected treatment value and that looks and tastes as close as possible to the active drug. The people are allocated either active drug or placebo by a code usually generated by computer. The idea is that this randomization makes up for any variation in different participants' illness (like differences in severity or duration of symptoms), so allowing successful statistical evaluation of any difference between the two groups. The "double-blind" bit is that everything possible is done to make sure that neither the patient nor the researchers know which drug (active or placebo) each subject is receiving. This ensures that the beliefs of the patients or researchers about whether they are getting the "real thing" do not interfere with the results.

This one-size-fits-all approach does not lend itself to herbal medicine or homeopathy, for example, which use a highly individual approach to prescribing. A trial in 1998 on Chinese herbal medicine for irritable bowel syndrome showed improvement in two groups, one receiving standardized treatment and the other individually tailored treatment. After sixteen weeks there was no difference between the two groups, but on follow-up fourteen weeks after the treatment ended, only the people who had received individualized treatment maintained improvement. This is a good example of evidence of the value of holistic, individual treatment that aims to treat underlying causes of disease—taking longer to resolve, but with lasting benefits.[3] Yet it was widely reported as showing that standardized herbal treatment is as good as individualized treatment, because the longer-term effects were not considered. It is not easy to design a randomized controlled trial to really investigate individual treatment. Research within complementary medicine is looking for new or adapted research models that can more effectively test holistic medicine.[4]

Other research paradigms are developing that can more properly measure the effectiveness of natural therapies. One of these is called narrative research.

Narrative research is basically about valuing and gathering people's stories about their experience. It is a fairly new research area in nursing where it is recognized that many human factors are important—medicine cannot simply be reduced to a one-size-fits-all treatment strategy divorced from people's experience. As Dr. A. M. Carson (head of the School of Health, Social Care, Sports and Exercise Sciences, North Wales Education Institute, Wrexham) told me:

> Narrative research is a cooperative enquiry that aims at developing and enhancing practice. It resists simplistic techniques, and instead proposes a holistic and organic process where all persons involved in the enquiry have the opportunity to become more conscious of who they are and what they are doing. While standard methodologies aim at the articulation of an objective or subjective reality, narratives want to develop a self-reflective critique of these realities. As such, narrative research is never neutral about its aims and practices, but tries to define these practices in an ethically coherent way.

What Is "Ultimate Health"?

A key part of holistic health paradigms is a definition of health. What is it? Holistic systems do not define health as the absence of disease. Mostly, a model of a fully healthy human is someone who is:

- Full of energy and zest

- Feeling connected and happy, or more accurately, deeply contented, with life and a well-functioning body
- Interested and involved in many things, with a deep sense of the rightness of existence and the goodness of the universe
- Enjoying work and play in a balanced manner, with healthy relationships and healthful diet and exercise
- Taking care of our planet, knowing our deep connection with each other and with all life
- Working to restore, and then to cherish and wonder at the awesome splendor of nature

For most of us, this is not how we feel a great deal of the time, though we may not have a labeled health condition defined by modern medicine. The drug companies (and cosmetics companies, food companies, and, well, everyone!) are cashing in on how bad we feel by inventing more and more "conditions" requiring "treatment"—drugs for personality disorders and to boost sexual performance to extreme levels, for example. This is ignoring the cause of our problems. So what can holistic paradigms offer regarding such "treatments"—what can we do to feel better, to reclaim our human birthright of zest?

The next chapter takes a deeper look at emotional considerations—how emotional hurts affect us and what can be done to fully recover from past hurts. After this are two appendixes that briefly discuss two holistic models—the Five Element system from traditional Chinese medicine and the shamanic perspective. These are by no means the only valuable methods, simply the examples of completely holistic systems that I know most about and can therefore present intelligently. They are also of particular interest because each has a strong emphasis on placing the person into the context of family, community, and society—with a viewpoint that the imbalances in the family, the community, and the wider society heavily influence the individual. This differs from a model that sees people as being somehow inherently flawed and prone to illness and unhappiness.

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*From my own class notes of Eliot's Plant Spirit Medicine class I attended in 2004. To find out more about Eliot Cowan's work, take a look at his *Plant Spirit Medicine: The Healing Power of Plants*.

*Mahatma Gandhi, as you might remember, when asked what he thought of Western civilization, responded by saying "I think it would be a good idea."

CHAPTER 23

Emotional Health—Mind-Body Connections

Human beings are emotional beings. We have all sorts of feelings all of the time. It is fair to say that most of us struggle with emotions, one way or another. Many human societies have evolved in such a way that emotions—their effects on the body, mind, and spirit, and how to improve problems in this area—are poorly understood. This is certainly true in the UK, where displays of emotion are not encouraged—even crying at funerals is not general practice nowadays. Many of us are uncomfortable with emotions, our own or anyone else's. Some of us are numb to our own feelings, cut off from knowing what we feel, even to the extent of thinking we don't have strong feelings at all. Some of us feel awash with emotion and struggle to contain it, often being labeled ill because of our strong feelings.

In fact, this medicalization of human emotions is becoming increasingly widespread as the greedy drug companies seek to find ways to turn *everyone* into a customer.* The trend in psychiatry and in the so-called mental health system is to look to biological or genetic causes for mental disturbances, and advertise products for them as if these biological causes have been found, when in fact they have not.

> When … psychiatric interest groups promote a theory or treatment for

> depression, its aim of selling psychiatry is often beclouded by scientific trappings.… Citizens … are unlikely to protest “they’re trying to sell me shock treatment and drugs” or “they’re trying to get me to pay medical doctors to solve my psychological and spiritual problems.”[1]

It might surprise you to learn that hardly any psychiatrists actually train in any kind of psychological talking therapy, or even counseling.

> If you are educated in the humanities or have a few good self-help psychology books, and if you like to think about yourself and others, you may have more insight into personal growth than your psychiatrist does.… If you have also shared feelings and personal problems with some of your friends, then you may well have more experience and practice in “talking therapy” than your psychiatrist.[2]

It seems the profession as a whole, along with a lot of others, would prefer to blame “faulty” people for their suffering instead of deal with the reality of how we hurt ourselves, our children, and each other with our lack of emotional awareness and with the oppressions that operate within our society. There are, however, many psychiatrists and psychologists who say very clearly and convincingly that the research evidence to support the theory of mental illness having a biological basis—and therefore logically being treatable with chemicals—simply does not exist. (To say the whole field of psychiatry is based on no evidence whatsoever is a huge thing to say; I am paraphrasing Peter Breggin, who has been a psychiatrist in practice for many years. Check him out.[3]) Conversely, there is much evidence about how traumatic events in a person’s childhood and the effects of oppressive cultures do have impact on mental health.

The Stress Factor

Many people are increasingly aware of the importance of our emotions to health and disease. It is now widely recognized that stress causes disease. You might like to read Chapter 14 on the nervous system again; when something is perceived as stressful, the body is stimulated to get ready for flight or fight (the sympathetic response) and the relaxing, healing, restoring aspect of ourselves (the parasympathetic) is suppressed. The stress response is about action *now*—do something quickly to get out of danger. It is not favorable to reflection, to feeling the complexity of our deepest feelings, to figuring out deeper meanings, meditating on the meaning of life, or planning for the future in a rational and connected way.

So far, so good—I don't need to spell out again how the changes in the body that come about during the stress response, maintained long-term, will take a toll on the body and even lead to serious disease. Our modern societies are incredibly stressful—fast-paced and furious, with little time for rest and recuperation. The balance is definitely tipped toward the sympathetic and away from the parasympathetic for most of us. In addition, the kind of activities many of us are engaged in, characterized by a lack of involvement in the body and overuse of the cognitive, brain-based intellectual view of the world leads to a loss of heart coherence. "Coherence" is a term used to refer to connection, harmony, order, and structure within and among systems. Physiological coherence refers to the ways in which the whole human body communicates and stays in alignment with itself and with outside forces. Heart coherence is this phenomenon as it occurs in the heart.

Here it is described by Roland McCraty in a monograph called *Physiological Coherence:*

> It is the harmonious flow of information, cooperation, and order among the subsystems of a larger system that allows for the emergence of more complex functions. This higher-order cooperation among the physical subsystems such as the heart, brain, glands, and organs as well as between the cognitive, emotional, and physical systems is an important aspect of what we call coherence. It is the rhythm of the heart that sets the beat for the entire system. The heart's rhythmic beat influences brain processes that control the autonomic nervous system, cognitive function, and emotions, thus leading us to propose that it is the primary conductor in the system. By changing the rhythm of the heart, system-wide dynamics can be quickly and dramatically changed.
>
> We use the term coherence in a broad context to describe more ordered mental and emotional processes as well as more ordered and harmonious interactions among various physiological systems. In this context, coherence embraces many other terms that are used to describe specific functional modes, such as synchronization, entrainment, and resonance. Physiological coherence is thus a specific and measurable mode of physiological functioning that encompasses a number of distinct but related phenomena. Correlates of the physiological coherence mode, which will be considered in further detail in this monograph, include: increased synchronization between the two branches of the ANS, a shift in autonomic balance toward increased parasympathetic activity, increased heart-brain synchronization, increased vascular resonance, and entrainment between diverse physiological oscillatory systems. The coherent mode is reflected by a smooth, sine wave-like pattern in the heart rhythms (heart rhythm coherence) and a narrow-band, high-amplitude peak in the low frequency range of the HRV power spectrum, at a frequency of about 0.1 hertz.[4]

If the heart is in charge as it was designed to be, the brain entrains to the heart's electromagnetic signals. But when we lose touch with natural environments and become top-heavy, living in our heads rather than our hearts, the heart entrains to the brain and diminished heart function results. As Stephen Buhner describes:

> Increased heart coherence and heart/brain entrainment has shown a great many positive health effects. Increased heart coherence boosts the body's production of immunoglobulin A … [It] also produces improvements in disorders such as arrhythmia, mitral valve prolapse, congestive heart failure, asthma, diabetes, fatigue, autoimmune conditions, autonomic exhaustion, anxiety, depression, AIDS, and post-traumatic stress disorder. In general, in many diseases, overall healing rates are enhanced. One specific treatment intervention study, for example, found that high blood pressure can be significantly lowered within six months—without the use of medication—if heart coherence is reestablished. And as heart/brain synchronization occurs, people experience less anxiety, depression, and stress overall.[5]

Heart entrainment is basically about bringing relaxed, aware attention to one's heart, and to the feelings one gets from observing one's environment, rather than living in a point somewhere in your forehead. When a human being is in a natural, wild environment, with many different things to command attention (meaning more a feeling kind of attention, not a thinking kind of attention), this state emerges naturally. So, holistically thinking, to create balance, ultimately we do need to change things in our societies, to set things up so that there is a lot less stress for everyone, and more natural and wild environments to experience what it is to truly live.

More Healing Mechanisms

Think of the incredible, elegant complexity of the body, with its amazing homeostatic mechanisms. If stress is so bad for us, such a killer, wouldn't we have built-in recovery mechanisms to help us offload its dangerous effects? Good thinking—yes, in fact, we do. One of the most important things for us humans is to connect—we need to connect with ourselves, with our hearts, but with each other. Talking, sharing feelings, showing our feelings with beloved others, is necessary for human health. Let's take a look at what having our feelings means.

Crying, Laughing, and Other Ways of Getting Feelings Out

We have already discussed one of the most powerful healing mechanisms for the human mind and body—weeping. Crying tears is one of the main ways the body can rid itself of toxic hormones that damage the body if allowed to accumulate. Yes, the liver can metabolize them so that the kidneys and bowel can excrete them, but how much better just to excrete them whole in our body fluids? We can do this not only in tears but also in sweat and saliva.* These very physical processes are part of the emotional discharge mechanisms we have, which are there to allow us to completely recover from hurtful or stressful situations.

Another great way of discharging emotion is laughter. Reevaluation counseling** figures laughter to be the main way people can discharge the emotions of embarrassment and shame, light fears, and anger. Deeper fears and hurts are discharged by shaking, sweating, and crying, anger by flushing and sweating, and physical tension and pain by yawning. Talking about our experiences is also an essential part of recovering from past hurts. It seems that when we get hurt in any way, if we don't get to use the built-in healing process of discharge to recover from that hurt at the time, the hurt will linger in our mind and body until we get to feel it. Basically, to feel is to heal.

Norman Cousins wrote his book *Anatomy of an Illness* in 1979, describing his experience of curing himself after he had been given six months to live when suffering from an extreme form of arthritis. He decided to die happy, and spent his time watching comedy movies and laughing. Instead of dying, he recovered, and was back at work after six months. He describes laughter as "internal jogging."

Cardiologist Michael Miller of the University of Maryland found that laughter expands the blood vessels and increases blood flow to the heart by twenty-two percent. After laughing, there are significantly lower levels of cortisol and adrenaline. Laughter has also been shown to increase production of natural killer cells, B-cells, helper cells, and immunoglobulins, and some of these effects remain for hours after a good long laugh. This would back up the observations of reevaluation counseling (also called co-counseling because it is a peer activity), which comes from the experience of thousands of people as they learn to reclaim the healing process of emotional discharge and together laugh, cry, sweat, shake, and yawn away the residues of stressful experiences.

Some studies have found that laughter also helps to relieve pain and even to reduce blood sugar and protect the kidneys in diabetics. The Gesundheit Institute in Virginia, founded by Dr. Patch Adams, a doctor and former clown, uses laughter as its main therapy.*

Releasing Anger

Anger deserves a brief word here as it is one emotion many of us have difficulty with, at least in the UK, where it is not considered good form to express it; as a consequence, many people are full of old unreleased anger and do not know what to do with it, while at the same time it spills out as road rage and tantrums. Anger is an energy of stress, in physiological terms. It is meant to give us the thrust to act, to get out of the threatening situation we find ourselves in. As I have already mentioned, one crucial aspect of the unhealthy impact of stress in our modern lives is that we get all dressed up with no place to go with it; something happens to make us feel threatened and the body naturally has a fight-or-flight reaction; yet we have to just sit there and take the pressure.

Learning ways to push the feelings down, we force anger and frustration to build up in us over the years. We discharge our anger using angry, forceful sounds and movements, heat, sweating, and tears.

To give yourself some space to release some of this energy, you might like to try using your voice forcefully on a daily basis; try shouting into cushions if you are living somewhere you can't shout without freaking out the neighbors. Punching cushions is good too, or hitting the bed or sofa with a baseball bat or tennis racket. If you start to feel very hot, you'll know that anger is discharging from you.

Primal Therapy

Arthur Janov pioneered Primal Therapy in the 1970s and since then his Primal Training and Treatment Center in Venice, California has researched the effects of deep discharge (the full feeling of old emotional wounds and the expression of this pain by tears, sobbing, shaking, and screaming) on thousands of people. Dr. Janov's premise is that many people are hurt early in life by birth trauma and by not having our needs met as very young ones. This "primal pain" is repressed, being too difficult to feel at the time.* Janov goes so far as to say that if we had felt it as tiny ones, we would actually have died from its magnitude—for a newborn infant, to have nobody looking after us is fatal.

Repressed pain does not go away, but lingers in the body and mind. When a person learns to go back early and reexperience past hurts, crying like a baby—hence the "primal scream"—the old hurts can be fully discharged with wonderful effects. Janov's research has shown that these effects can be measured physiologically by changed levels of stress and sex hormones, a dropping of high blood pressure and fast heart rate to normal levels, and improvement in immune function.[6] It is not uncommon for people to grow and mature physically in ways that were previously held back. For example, some women's breasts may develop more, or some men become broader in shape, more hairy, or deeper of voice.

The Bodymind

The term "bodymind" was first proposed by Diane Connelly and reflects the understanding that the body is not separate from the mind.[7]

A whole mind-body medical discipline is emerging—called psychoneuroimmunology, or PNI—around the definite links between the mind and the immune system. Candace Pert's *Molecules of Emotion* is a great introduction to this, as is Deepak Chopra's *Quantum Healing*. Psychoneuroimmunology is a way for science to understand that the mind becomes the body, and vice versa, through myriad connections of the chemical network of communication that continuously runs both ways between brain and body, emotion, thought, and physical function.

There is plenty of research that shows positive thinking and a happy attitude are good for your health. The difficulty for many people is how to actually change one's mental habits and free oneself from the old hurtful ones. Certainly reclaiming the discharge process is a great place to start; these old hurts need to come out so they can stop messing us up. Otherwise, positive thinking and affirmations and the like may serve more to push the painful stuff farther in, with damaging effects on our health. So, lots of laughing and, if you are in good enough shape to listen well to another person, check out www.rc.org for your nearest reevaluation counselors. If not, look for a therapist who knows the value of, and encourages, emotional discharge like crying—rather than one who wants to teach you how to push it down more effectively! This includes steering clear of all counselors who recommend antidepressants to their clients. If they are doing that, they obviously don't have trust in the healing power of their therapy—which may be with good cause!

> Even in a full-time lifetime general practice of psychiatry it's possible to offer help without ever starting a patient on antidepressants. Depressed people don't tend to hurt themselves when they have a good relationship with a therapist and some hope of improvement. I try to help individuals experience their feelings, to understand the sources of their despair, and to overcome their hopelessness, while providing a caring, morale-building relationship and guidance toward more effective ways of living. Often this involves the client

> learning new, more positive values and a more daring, creative approach to life. Nor do I think that I am more effective as a therapist than many others in the field. There are no "great therapists," only great clients.[8]

It's simple in a way—we need to give ourselves and each other permission to feel our feelings without censoring them or pushing them down. The complicated part is that for most of us we have been pushing them down for so long that there is a bit of backlog to clear—lots of old feelings hanging around so long that we might not even know what they were about to start with. They are poisoning us and need to come out and be released.

Meditation

It is possible to change what our minds are focusing on. A good way to learn to take charge of your mind and your thinking is to learn meditation. Transcendental meditation (TM), which involves repetition of a mantra in time with the breath while sitting quietly, has been the subject of more than 600 research studies. Regular meditation has been shown to increase creativity and intelligence, improve memory and perception, sharpen concentration, increase EEG coherence of brain functioning,* reduce stress in several ways, improve the health, reduce the negative effects of aging, improve relationships and self-confidence, improve productivity at work, and decrease crime, conflict, and violence.** Yes, really. A project was undertaken in the 1970s to get one percent of the population in twenty-four different cities meditating, and compare crime rates in these cities with rates in similar control cities (that didn't have one percent of the population meditating). Crime rates dropped in the meditating cities in the year targeted, 1972, as well as in following years.[9]

What We Believe Is What We Get

We need to change our minds, because our beliefs and our thoughts shape our lives and our health. Take the placebo and nocebo effects, for example: If we believe we will get better from a treatment, then we will, even when the treatment has done nothing. If the doctor we trust tells us nothing can be done and we are sure to die, that is what tends to happen. Deepak Chopra's *Quantum Healing* has great stories about both of these effects.

This subject of mind-body medicine is fit for several books at least, and a lifetime of study. So I hope I have whetted your appetite a little and encouraged further investigation. I am sure that much more disease than we realize is due to emotional trauma trapped in the body. There is a huge resistance in the West to such a concept—orthodox medicine, with our support, has taken the "we don't know what causes this" approach to life's problems. We do not want to or know how to take responsibility, and we are provided with many ways to numb ourselves from feelings.

Then there is another problem: If disease is caused by emotional difficulties, does this mean it is a person's "fault" when he or she gets ill? I hope that my presentation in this area in no way encourages this kind of incorrect approach, which is singularly lacking in compassion. To make things as clear as possible, what I am saying is we get hurt—just that. We get hurt, and do not have the help we need to fully recover. The biggest reason most of us get hurt is due to the huge imbalance in our culture and the oppressive patterns running throughout it. It’s not our fault we got hurt, we didn’t ask for it, we would much rather it had not happened. But it did, and these hurts make us sick, whether we believe they do or not. That’s the bad news—the good news is it is possible to heal from them completely, in various ways, most if not all of which (from where I’m standing) seem to involve the discharge process in some way.

Cancer as a Manifestation of Emotional Trauma

There is such a resistance in mainstream society and medicine to consider a connection between cancer and emotional trauma that those who champion it are ridiculed and even persecuted. One such is Dr. Dirk Hamer, prosecuted in more than one country for his pioneering work with people with advanced cancer. This was despite his very high success rate—such that the public prosecutor (Wiener-Neustadt in Austria) had to admit that after four to five years some 6,000 out of 6,500 patients with mostly advanced cancer were still alive.

Dr. Hamer developed testicular cancer after his son was shot dead. He wondered if his son’s death was the cause of his cancer, and began to investigate. He looked at more than 15,000 cases of cancer and always found the following characteristics to be present (these he termed the Iron Rules of Cancer—an unfortunate, rigid-sounding name): The cancer starts with a serious shock experience (rule one), creating trauma and conflict that manifest in the psyche, in a particular area of the brain (rule two), and then the disease appears in a particular organ corresponding to the area of the brain the trauma affected (rule three). He identified themes of trauma, with each showing a change in activity in a part of the brain, corresponding with the organ where the cancer has manifested. He claimed to be able to show a direct relationship between these, with the cancer improving as the brain lesion reduces and the trauma is resolved. He photographed the brain with computed-tomography (CT) scanning, and described the problem area as looking like the surface of water after a stone has been dropped into it. Later on, if the conflict becomes resolved, the CT image changes, an edema develops, and finally scar tissue.

Apparently, Dr. Hamer can accurately diagnose illness—including diabetes—from looking at someone's CT picture. He can also do this with the emotional conflicts that a person experiences. The organ focus of a particular brain change reflects our subconscious associations—and these seem to be very much in keeping with Five Element philosophy. For example, biological conflicts involving water (also other fluids, such as milk or oil) lead to kidney cancer,* fear of death to lung cancer, and mentally swallowing a bigger chunk then we can digest to stomach or intestinal cancer. Dr. Hamer believes that most secondary tumors are caused by the cancer-fear or death-fear resulting from the patient given the cancer diagnosis or a negative prognosis. Another nocebo effect.

Of course, some people are full of cancer by the time they are diagnosed, which doesn't seem to fit Hamer's theory. Hamer says that secondary cancers, if not caused by the stress of the initial cancer, result from other unresolved traumas rather than being related directly to the initial tumor. Hopelessness and despair create chronic stress, which prevents healing of all types. Dr. Hamer's healing program includes finding what the original emotional shock experience was and making sure it is being healed. Sometimes when a tumor is found in someone, it is already dormant and the person has healed from that crisis—but the shock of medical intervention can make that tumor, or another one, grow. If the original conflict is still active, any means to resolve it should be taken—emotional healing therapies, meditation, embracing the grieving process fully if there has been loss. Hamer argues that the worst thing we can do is take tranquilizers or antidepressants for shocking events, as these interfere with our proper healing process.

The New Medicine of Dr. Hamer

By Walter Last[10]

Hamer regards all diseases as consisting of two phases, initially with active conflict followed (if possible) by a healing phase that reverses the conflict program. He does not call them diseases anymore but rather special biological programs. In all he is stated to have worked with over 31,000 patients and found his theories confirmed in every single case without exception. Hamer claims that overall the New Medicine has a 95 percent success rate with cancer. Siemens, the manufacturers of the CT equipment have independently verified the existence of the Hamer Herds in the brain.… Nevertheless, Dr. Hamer faced exceptional persecution.

Under German law the right to practice medicine can be withdrawn if the doctor has diminished mental abilities. This law was used in 1986 by a German district court to withdraw his right to practice. As proof of Hamer's inadequate mental condition the court stated that he was not willing to retract his theories and swear allegiance to the principles of orthodox medicine … he was incapable of converting back to the principles of orthodox medicine: he tried to convince a group of prominent professors of the correctness of his theories only one month before the court case! One year later the same court requested a psychiatric assessment of his mental abilities, which Hamer refused. A court-appointed psychiatrist, without ever seeing him, diagnosed him anyway as being a psychopath.

In 1997 Dr. Hamer was arrested and jailed for 18 months under an obscure natural therapy law introduced under Adolf Hitler to suppress Gypsies. His crime was that he had given free health advice to some individuals who had asked him for his opinion. The public prosecutor had openly stated that all means must be used to remove Hamer from society.

Medical Heretics Beware!

There are serious criticisms of Dr. Hamer and his work. It is not easy to tell from researching this whether he is a saint or an evil quack—both are equally unlikely. It seems that many people who consult him have been through orthodox cancer treatment and written off—told that nothing further could be done for them. My thinking is that he is certainly onto something, but that the reality is that it is not easy for a person to get to the bottom of, and resolve, deep-seated emotional conflicts and pain, not even when being well. To do this while seriously ill with cancer would be even more difficult. I suspect there is a gap between the theory and understanding gained with the scans of Dr. Hamer, and the actual practice and ability of people to resolve their issues in time to halt advanced cancer. However, it is certainly true that vested interests within medicine will go to great lengths to punish those who go against the accepted norm—particularly if that person is a medical doctor. Traitors are worse than the established enemy!

Above all, it is all about feeling our feelings. It's when we push them down and deny them that they make us ill. Feelings are not illnesses—they are normal human responses to our situation. It gets complicated for most of us because we have a lifetime of pushing them down behind us; when we stop, all sorts of old feelings come up, the origin of which has probably been forgotten. Although it can seem unbearable to feel them, feel them we must if we are to regain our full humanness. The unbearable becomes bearable when we face it together. The final word goes to that wonderful and brave psychiatrist and psychotherapist Dr. Peter Breggin, whose book *Toxic Psychiatry* is one of the most important books ever written in this field:

The vast majority of people overcome depression without resort to any mental health services. They do so by virtue of their own inner strength, through reading and contemplation, friendship and love, work and play, religion, art, travel, beloved pets, the passage of time—all of the infinite ways that people have to refresh their spirits and to transcend their losses.[11]

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*Are drug companies really so bad? Perhaps. But here's a thought: To be holistic involves healing conflict, and this no doubt must include the conflict that is felt between alternative and mainstream. If we view big pharma as an enemy, that in itself harms us by generating fear; being afraid of chemicals also harms us. It means we are in some way disconnected from the source; ultimately, it is okay if we become a little bit poisoned, we are still one with the Divine. The thing is, as soon as we see big pharma as being bad, we create an us-and-them scenario, divided into separate camps, until there is a valley between us and we stand on top of our opposing mountains with cannons pointing at each other. The question is how to make peace with something that can be harmful, how to steer others away from that harm while not creating conflict or fear—and how to portray this in a book. Thanks to Mark Jack for this great contribution.

*Remember what was said about having a dry mouth building up feelings of fear? If such feelings are not out, they're in. Producing saliva full of stress hormones means that those internal drugs that lead to more feelings of fear are being excreted instead of getting into the blood to whip up the fearful stress response.

**This began in the 1950s and is now practiced by thousands of people in eighty-six countries. You can find out more on www.rc.org.

*See *What Doctors Don't Tell You* (Dec 2007; 18/9), about what research has shown the benefits of laughter to be.

*Reevaluation counseling would say that young ones would have tried to discharge anger with crying, but most babies are stopped from crying with pacifiers or overeating, or are trained out of it by simply being left to cry it out—which means effectively that the baby gives up on anyone caring enough to come and pushes the feelings deep down.

*EEG coherence is a way of describing how in synch, or not, different areas of the brain operate in relation to each other. The healthiest brains show a high level of coherence (i.e., the areas are more in synch).

**The Web site www.t-m.org.uk has references for many of these studies. They make for a fascinating read.

*Perhaps there will be an increase in kidney cancer soon, with global oil and water supply issues plaguing the planet.

APPENDIX A

A Brief Introduction to Five Element Traditional Chinese Medicine—A Complete Holistic System

The Five Element system is a complete system of medicine. Traditional Chinese Five Element medicine was brought to England in the 1970s by J. R. Worsley, who had traveled widely in China.[1] Its foundations were laid down more than 2,000 years ago in ancient China. Why I am including it here is that one of its great differences from other systems is that symptoms are treated by the practitioner with benign indifference—a diagnosis cannot be made by reference to symptoms at all!

Of course, as patients we don't treat our symptoms with benign indifference. But the Five Element view is that, as part of nature, we are capable of being in complete balance and health, and when things go awry there are signs that a skilled practitioner can read—changes in the sound of the voice, overall color, body odor, and the emotional tone of the patient's life. The diagnosis of a particular imbalance is made on these parameters and not on any symptoms of illness. This is in complete contrast to modern Western medicine, which is largely focused on symptoms.

Like all other systems with their roots in ancient times, the Five Element system is derived from a close study of nature.

At heart, it understands that Spirit is at the root of health—that most imbalance causing disease originates at the level of Spirit. In this appendix I am attempting the merest introduction to the Five Element system, which is an amazingly complex and elegant paradigm. In my descriptions of elemental imbalance, emphasis is on the way they manifest in the emotional and spiritual spheres, rather than the physical. If you are drawn to further study there are excellent books on the subject, as well as courses to learn how to become a Five Element practitioner.

The Elements

The Chinese word that has been translated as "element" really means something more like phase or movement. The elements are great cosmic forces that shape everything in the universe.[2] You can think of the elements as being like the seasons.

As I write this midwinter approaches; outside it is icy cold and beginning to get dark already, though it is only 3 PM. The trees are bare, the landscape bleak. The energy of the earth has gone deep below. Nothing is happening on the surface. Even though the Christmas mayhem is approaching, there is a pull to go quiet, to go within, to do little, to sleep more.

This is not a time for action, for doing, but for being. This is the time of **Water**; rain washes the land clean, snow and ice freeze us into immobility. The color is black or dark blue, the black of night. Water is life, more than any other element—any desert dweller knows this. The absence of Water brings certain death—thus the emotion of water is fear—fear having the function of keeping us alive. Water is always changing and moving, from rain to ice to snow, even in the stagnant pond it is moving as it evaporates into the air to come down as rain on a faraway mountain. There is a mystery to water—where does it come from? Life comes, just as the spring emerges from the earth, out of some great mystery, the original Source.

After this phase of darkness and quiet, of conserving and resting, comes the next—the spring, the time of growth. Everything will erupt with green—a magnificent orchestrated medley of growth. This is the **Wood** element—like a tree, it contains all the others within it. Water is drawn up by the tree, which is made of wood. It takes the heat of the sun to make energy and it grows with its roots in the earth, from which it takes the precious minerals or metals. More than any other element, Wood is the element of healing, of the growth of regeneration as well as development. Wood is upward-moving, surging, vibrant. Wood is determined to grow to its full potential and will push through obstacles that impede on its progress. Thus the emotion of Wood is anger; the emotion that arises in us when our growth is thwarted, the emotion that we can use to assert our boundaries. The color is green.

When the prolific growth of the spring, of adolescence, is over, we reach a period of maturity with the energy of summer. Everything is at its peak. Plants are in flower, attractively drawing insects and bees to them. As days lengthen and grow warmer, we come outside and are drawn to each other, to play and laugh and party. This is the energy of **Fire**—expansive and connecting, the warmth of joy and love, fun and laughter. The red energy of the Heart.

Toward the end of summer, the grass is yellowing and the flowers have turned to fruit. The Indian summer or harvest time of berries and fruits and nuts shows the bounty of the

Earth element, which is all about nourishment and sweetness. Our Mother Earth gives us all that we need for survival; she nourishes us at her sweet breast throughout our lives. The Chinese gave the Earth element the color yellow because of the rich yellow earth of their fertile places.

Then comes a time when the weather changes; a fresh cold sharpness is felt in the air, and we breathe deeply, feeling its purity and quality. Autumn is here, the time of winds and falling leaves, a time when all will be stripped away but the bare essentials. This is the time of **Metal**, with its energy of worth and quality; the precious metals and minerals that plants drew up from the earth will be returned as vegetation dies down and rots away. Metal is the element of purity—and so has the color white.

And so the wheel will turn as the Water of winter comes again to wash the land clean.

These Five Elements exist within us all, each having spheres of influence and controlling functions in our body, our mind, and our spirit. The elements manifest within us as personalities—known as **officials**—who are in charge of various areas. For example, the Water Officials are the Kidney and the Bladder, in charge of the control and storage of fluids. But do not make the mistake of thinking that the officials are just another name for the organs you now know something about; they are this, but they are much, much more. It's best to literally imagine them as people, a great gang of highly skilled and honorable wise ones who are running the show—a kind of spiritual Numbskulls!*

While we all have all the elements within us, we also are all born with one particular mix of elements that is uniquely us, and that shows where our greatest strengths lie—what is the calling of our soul. One element will predominate—though there is an element within an element, and an element within this and so on, so the complete picture has depth and complexity. Our main element will be revealed by the way we most relate to the world, and because of this, because it is the one we are most "out front" with, it is also the one most vulnerable to hurt. When we get hurt the wound happens first in our main element, causing an imbalance. For most of us, this happens at a very young age—even pre-birth, due to the gross imbalances within our society. This original wound is known as the **causative factor**; from it all of our problems originate and can be traced back to.

Because we are part of nature, nature shows our need in natural ways, which become more and more obvious to the trained eye. Each elemental disturbance shows itself in the sound of our voice, a color that comes to certain areas of our face, a type of odor, and a particular flavor of emotional imbalance.

Elemental Emotions

Emotions are central to our existence. The Five Element system has it that a human being is an emotional being, that we are *always* experiencing the world through our emotions. If we are in balance and harmony (which few of us are), we feel appropriate emotions according to the situation.

The general emotional tone for a balanced person is a deep contentment or joy, a feeling of connection to all things and rightness with the world and our existence in it. Candace Pert, neuroscientist, suggests a similar condition—that our natural state is happiness.[3]

Although our natural state is happiness, there are five emotions that will rise and fall within us on top of this basic happiness, depending on what is happening. If something happens to impede our growth, then **anger** naturally arises—giving us the impetus to remove the obstacle and continue our growth. Of course, for British people there is a general cultural imbalance here, as we are in a society that really frowns on anger. The joke is, in New York, if someone steps on your foot, you say “get off my foot”; in London, if someone steps on your foot, you say “sorry”!

When your desires are fulfilled, you feel **joy**—not the same as the deep joy that underlies it all, but a more frothy happiness to do with satisfaction of some want. When someone is in need, the natural emotion to feel is **sympathy**—the emotion of the mother tending to her hurt child, “There there, poor you, tell me all about it.” Actually, in Britain we don’t encourage sympathy much either—the famous stiff upper lip!

There is a feeling of respect in the presence of that which we value, and when we lose something we value, the natural feeling is **grief**.

Finally there is the emotion that is very much connected to feeling alive—**fear**. Since fear warns us to react to danger, it helps to keep us alive.

You can think of the emotions as being like doors—one must always be open, and when one is open the other four are closed. We feel one at a time, and when we are in balance we are able to move with ease from one to another. When imbalance is present, something goes awry with this mechanism. For some people, it’s as if one door is stuck permanently open, and there is only one emotion they feel no matter what the circumstances. For others, one door is locked closed and they simply cannot go there no matter what. For most of us, it is as if there is only one emotion that we most come alive in, though we can go in and out of the others a little.

Diagnosis of the Causative Factor

We are all moving in and out of balance throughout our lives. Here is a very brief introduction to how we uncover a person's causative factor, or CF. As a general rule, the more imbalanced a person is the more extreme the signs described below. This is not to say, however, that a balanced person is like a bland empty page—when in balance, each element has its particular beauty and strengths; the particular gifts we bring to the world are expressed through the power of our elemental makeup.

People with what is known as a **Wood** CF look green, smell rancid, have a voice that shouts or has emphasis, or else lacks all shout, and may be stuck in anger, or unable to express appropriate anger at all. You have probably come across people like this, who sound furious even when just asking you the time, or conversely people who describe even the most terrible outrage against them but without the slightest hint of anger.

Fire people are red, or the lack of red—pale, or gray. The odor is scorched; the sound is that of laughing, or a lack of laughing, the emotion joy, or a lack of joy. One extreme example is a person who tells you with hilarity about how last week he or she lost a job, got evicted, and was diagnosed with terminal cancer. The opposite extreme is the person who talks with absolute flatness about the wonderful vacation just completed.

For **Earth** people, the color is yellow, the smell is fragrant, the voice has a singing quality to it, and sympathy is the emotion that will be pronounced or absent. An imbalanced Earth person might be always looking after others, stuck in permanent sympathy. On the other hand, he or she might be completely unable to understand the suffering of another.

For **Metals**, the color is white, the smell is rotten, and emotions focus around weeping and issues to do with loss or grief, or with a sense of value. Some people are stuck in grief, unable to move on from loss. Others are spiritually impoverished, unable to value anything enough to feel any grief at losing it.

Water people are blue or black, smell putrid, have a groaning voice, may be stuck in fear, or unable to feel fear at all, and go after extreme situations in order to feel something.

The smells are interesting. It is not a person's armpits or feet we are talking about—it is a general overall odor that characterizes us. The smells have a quality, a feeling. When I smell the Wood smell, for example, it's like a punch—I feel an upward movement in my head. Sometimes it really does smell like old oil. Sometimes it would be better described as "green." The Fire smell can be quite spicy, sometimes smells like freshly ironed linen sheets, or can be like anything scorched—even quite unpleasant like burnt rubber. I feel it in my head also, but it moves in all directions, not just upward. The Earth smell I feel down in my tummy, a warmth. Sometimes a person smells fragrant like having perfume or aftershave on, but he or she doesn't. The fragrant smell, like all of them, can be anything from lovely to revolting, sickly and cloying. The

Metal smell, rotten, can be like old rubbish or even like feces. But it can also be like gentle rotted-down compost or leaves in a wood. I feel it like a heavy or low sensation in my throat and the front of my body. The putrid smell of Water is sharp and acrid, almost chemical in nature, like ammonia. It can smell like brackish water or like sweet urine.

Don’t assume, however, that we can all be easily categorized; it’s safe to say there are probably about a billion different types of each causative factor. You can’t stereotype people, and knowing somebody’s CF does not mean you know anything else about that person. What it reveals is what a person most needs at the deepest level to be restored to health.

As I have said, symptoms are not at all useful in making a Five Element diagnosis. This is because each element feeds the next, and is in relationship with the others. Thus if the winter is too mild and the spring too dry, the summer and harvest time will suffer.

“Anything can come from anything” is the Five Element motto when it comes to symptoms. A Fire person might have all of his or her symptoms in the Earth element and no apparent problems in Fire. The diagnosis can only ever be made on sound, color, odor, and emotion. The elements are expressed in the body via the officials. These officials are a team, working together to make the whole body, mind, and spirit function well. Each one has unique areas of responsibility, and each is the only one that can provide that service to all the others. So if one is very sick, all can suffer in different ways. Each element manifests as two officials, but the element of Fire has four. These come in two pairs and take care of the functions of Fire in quite different ways.

The Twelve Officials

The Water Officials are the Bladder and the Kidney. The Bladder is said to be the "official in charge of the reservoirs and reserves of fluids." Fluids must be stored to be on hand when we need them; otherwise, they are not of benefit. The Bladder Official is in charge of this—is, in fact, the only official who is even remotely capable of storing fluids of any kind.

This applies to all fluids in the body, not just urine and water but blood, lymph, tissue fluid, tears, sweat, synovial fluid, cerebrospinal fluid, sexual fluids—even including hormones that are found always in the blood and body fluids. (The bladder in the body is not in charge of all fluids physiologically speaking. Do not try and correlate this all physiologically; this is a completely different system.) Qi, the energy of life itself, is a fluid, in the sense that it flows through the body, mind, and spirit. We always need it, and must always have reserves for the unpredictability of life. The Bladder Official maintains these reserves, thus giving us adaptability—the ability to move with the flow of events. If we don't have reserves, we naturally feel afraid: how will we survive in a crisis? We can be literally paralyzed with fear. The biggest way to deplete our reserves is by overwork, making this a chronic imbalance of the whole of modern society, in which overwork is the norm. The modern world relies on caffeine to fuel unrealistic and unsustainable workloads. Caffeine exhausts the Water Officials—by allowing us to work more than we have energy for. A good way to relate to caffeine is to realize that in using it, you are borrowing time from tomorrow. Eventually, it must be paid back. Overwork is often motivated by fear, so in fact it is a vicious circle—fear leading to overwork, leading to depletion of reserves, leading to fear.

The Kidney is called "an official who excels through ambition and cleverness" and has a lot to do with our intellect and mental clarity. The Kidney is like a spring emerging from the earth. It harbors our ancestral Qi, which is kind of like the sand in our hourglass—at the moment of conception, we get ancestral Qi from our mother and father. We will use up this Qi throughout our life, and when it is gone we die. We can never get any more of it, but we can use it up at faster or slower rates, depending on how we live. Throughout our life we also get Qi from the Earth Mother, through eating, and the Heavenly Father, through breathing.

The Kidney, as controller of fluids, is in charge of cleansing in our body, mind, and spirit. The emotion of Water is fear, and one aspect of this is *awe*—the fear we feel when we come face to face with something huge and mysterious. The aspect of the Kidneys and the Water element of bringing forth life is awesome—mysterious, impenetrable, cannot be made sense of. The Kidney Official is the only official capable in any way of controlling fluids.

The Wood Officials are in charge of growth processes. The Liver is the architect, making all the plans for everything in the body, mind, and spirit. The Gall Bladder is like the building contractor, making the day-to-day decisions to do with carrying out the plans of the architect.

Nothing can happen without a plan. Someone must have the vision, the foresight to figure out what to do in any eventuality. This is the job of the Liver Official, who holds the vision and the blueprint for our lives on the grand scale as well as the everyday. Think of the incredible energy of growth seen in our bodies during childhood. The Liver controls it all. Then, when physical growth is over, growth must continue at the same powerful rate in the mind and the spirit throughout our lives. The Liver, when in good shape, is capable of making plans with strength and flexibility. The Liver is also the detoxifier, and as such is overloaded by drugs and alcohol. If our Liver Official is in poor shape, we may be stuck and unable to see any way out of an intolerable situation, unable to plan—or we may be rigid and bound to overplanning everything, trying to control every aspect of our lives and the lives of others. The Liver Official makes all of the plans for the body, mind, and spirit—it is the only official capable of making any kind of plan.

The Gall Bladder Official is like an air traffic controller, sitting in isolation and thinking carefully to make the decisions necessary to orchestrate and execute successfully the plans of the Liver. To do this, it needs a certain purity. Known as the "upright official of decisions and judgment," the Gall Bladder coordinates all the other officials and pairs of opposites—the right and left, upper and lower, front and back. It is related to order and orderliness. If impaired, we might find it difficult to decide things, or have poor judgment. Or we may be rigid and judgmental, be obsessively overconcerned for purity, and unable to tolerate disorder. On the one hand, feeble decision makers, on the other obsessive overplanners. Habitual lateness can be a Gall Bladder thing, due to difficulty organizing and coordinating enough to be on time, or it can even be a kind of covert aggression—anger being the emotion of the Wood Officials. As you've probably guessed, the Gall Bladder is the only official even remotely capable of making any kind of a decision.

The Fire Officials are different in that there are two pairs of them—one pair is the Heart and Small Intestine, the other the Heart Protector and the Triple Heater.

The Heart is the Emperor, the Supreme Controller, in ultimate charge of guiding us to fulfill our Divine purpose or destiny. Remember that the names of the officials originated in ancient China; then it was seen that the role of the Emperor was the representative of the Divine on earth. He stayed in his palace, protected from everyday affairs, meditating and focusing on God in order to be able to receive Divine guidance regarding the destiny of China. So our Heart Official is kept in splendid isolation, protected from occupation with everyday affairs, to allow her or him to remain in contemplative connection with the Divine and guide us wisely on our journey through life.

The Heart is helped out particularly by two officials—its twin the Small Intestine is the official food taster, the "official in charge of separating the pure from the impure." Nothing passes the Emperor's lips that hasn't first been tasted by the Small Intestine, to ensure no poison gets to the Heart. Remember that the officials are operating on the level of the mind and spirit as well as the body, so all ideas and all energy that come our way are received by the Small Intestine, who then decides whether to let them in or not—whether they are pure or impure. Consider the huge amount of information we modern humans are subjected to through junk mail, newspapers, the Internet, television. All of this information must be sifted through by the Small Intestine to decide whether it is of value for us to take in and digest. You can see how this official can so easily be overwhelmed these days—

like an overworked clerk, sometimes the Small Intestine is made ill and even simply gives up because of the terrible burden of work put upon it. This can be a very serious situation because without a well-functioning Small Intestine Official, a person becomes completely unable to discern, to tell the difference between right and wrong. One way this shows up might be choosing to make terrible relationship choices—the person is unable to tell what would be good or bad for him or her. On the physical level, if the Small Intestine Official is not well, you might have a person who, although eating a very good healthy diet, is poisoned and toxic because the Official absorbs everything that should be excreted, or is malnourished because the Official is unable to absorb anything at all.

At the extreme, you even have sociopaths and people such as pedophiles who are so confused that they try to get adult love from children. In the Five Element view, they are not monsters to be punished, but people in such a terrible state of imbalance that they cannot tell what is good or bad—these are people in great need of healing. The Five Element system says that people are and behave only as the condition of their Officials allows them. The Small Intestine Official is the only one that can distinguish right from wrong, pure from impure.

The other pair of Fire Officials is the Heart Protector, known as the "official in charge of the pleasures of the people," and the Triple Heater. These are two officials who do not really have equivalents in terms of organs, although the Heart Protector is sometimes called the Pericardium, and sometimes Circulation/Sex—its two areas of physical functioning.

The Heart Protector is the second official with the express job of protecting the Heart Official. The best way of doing this is to have an open loving heart and have a lot of fun! The Heart Protector loves a party, and loves to connect in a loving way with others. It is this function of warmth and joy that is able to afford our Heart the best protection (remember the research we discussed about laughter being good for your heart?).

Most of what we think of as heart disease is in fact a problem with the Heart Protector failing to do its job. It's ironic that when we get hurt, we can have the tendency to shut down, to avoid getting close again in case we get hurt some more, when this is the very worst thing we can do in terms of looking after our Heart. When a person's Heart Protector is not working well, we can feel the most terrible vulnerability, feeling the slightest casual unkindness like a blow to the heart.

The Triple Heater is like the heating engineer—it keeps the warmth (and Qi) circulating evenly around the body, mind, and spirit, maintaining all areas at the right temperature for all the officials to function well. You can feel it directly on the body by feeling the "Three Jaios" (or "Three Heaters")—placing a hand so that the fingers touch the belly below the umbilicus and the thumb above it, and the other hand over the heart, and then comparing the temperature in each area. The three should be pretty much the same, neither too hot nor too cold.

Known as the "official of balance and harmony," the Triple Heater is responsible for the warming us up—not just physically, but mentally and emotionally. Think of an orchestra warming up to get the various instruments in tune with each other, or a gathering that warms up to be a whole, rather than separate individuals—this is the province of the Triple Heater. On a mental and spiritual level, when the Triple Heater is not working you might see a person who blows hot and cold, incredibly enthusiastic one minute and cold and uncaring the next. Someone may be unable to maintain relationships, or indeed any project, for lack of continued enthusiasm.

Since the Earth element is about the bounty of our Mother Earth and about nourishment, naturally the Earth Officials are those in charge of receiving nourishment—the Stomach—and of transporting this sweetness throughout the being—the Spleen/Pancreas. So if our Earth Officials are in good shape, we are well nourished and have a deep sense of security. If not, we may be voraciously hungry, unable to get what we need, deeply insecure, angry and vicious at our lack, or smothering and overnurturing to compensate for our lack.

The Stomach Official is the "official in charge of rotting and ripening"—just as the physical stomach receives food and digests it ready for the small intestine to absorb, the Stomach of the mind and spirit receives ideas, experiences, and energy and digests them, and then makes sense of them so we can fully absorb them. In this way the Stomach is about understanding—chewing over our life experiences and making sense of them. Without a balanced Stomach, we might worry endlessly, chewing the same thoughts again and again without satisfactory conclusion. We may be unable to properly understand our experiences, and in extreme cases even be cut off from reality.

The Spleen Official can be simplified as having a fleet of little yellow trucks that transport everything around the body, mind, and spirit—nourishment, blood, nerve impulses, energy, everything. When the Spleen Official is not working, we see signs of stuckness on the one hand, and overactivity on the other. Memory may be poor, as it is the moving function of the Spleen that is responsible for bringing the memories from their storage place to the forefront of the mind. Nothing can move without the Spleen Official.

Finally, the Metal Officials—the Lung and the Colon—are responsible for maintaining purity in the body. The Lung brings in the pure, rarefied energy of Heaven, the energy of quality and respect and all that is worthwhile in life. The Colon removes the waste and the dross, and in this way maintains purity and sparkle in every cell of our body and our being.

A person who has a problem with the Colon Official gets polluted, negative—literally "full of shit." Sometimes a person might be filthy in the body, the home, the language. Sometimes the opposite is seen—an obsessive cleanliness. Some people become champion grudge-bearers; this is a kind of mental or spiritual constipation. Others may show the imbalance with an obsession about status and worth, having a need to impress.

The Lung Official is about worth and quality, and is what allows us to take in essence and quality. So an imbalance may be seen as an inability to receive a compliment and expression of appreciation of one's worth. In Chinese medicine the skin is known as the third lung, so problems with the lungs may be seen in the skin quality.

Five Element Treatment Protocol

Actual treatment within the Five Element system involves much more than strengthening the causative factor, important though this is. There are, for example, blocks to treatment that must first be addressed. First, **aggressive energy** is a serious and unnatural condition that, untreated, will eventually result in death. This condition can be detected by subtle changes in the pulse. There is also something called **husband-wife imbalance** that can cause terrible symptoms in the body, mind, and spirit—and is also detected from the pulses. Then there is **possession**—an invasion of the mind and spirit by some foreign entity. Risk factors for this condition include underlying poor health, terrible emotional or physical shocks, and drug and alcohol abuse. You can see that it could be fairly common in today's world! If possession is suspected, a practitioner treats this first before doing anything else, as it will completely block all healing otherwise.

This appendix is, as I have said, just the briefest introduction to the Five Elements. To study them completely is a lifetime's work. I'm repeating this to make it absolutely clear that there are many, many important things missing here and I am not pretending to do anything more than skim the surface. If you want to learn more, there are excellent books and courses on the subject.* You can get Five Element constitutional treatment as acupuncture or as Eliot Cowan-style Plant Spirit Medicine.* I definitely advise trying it for yourself: it will transform your life in ways you can't even begin to imagine.

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*British readers of a certain age may remember a comic book story about the Numbskulls—funny little men who live in your head and run the various operations of your body.

*For example: Angela Hicks and John Hicks, *Five Element Constitutional Acupuncture;*

J. R. Worsley, *Classical Five Element Acupuncture;* Nora Franglin, *Keepers of the Soul: The Five Guardian Elements of Acupuncture*.

*To find a PSM practitioner in the UK and Europe, go to www.plantspiritmedicine.org.uk; in America, www.bluedeer.org/psm.html. To find a Five Element acupuncturist, go to www.sofea.co.uk, www.acupuncture-coll.ac.uk, or www.fivelement.com.

APPENDIX B

Spiritual Cause of Disease—The Shamanic Perspective

At the close of this book I'd like to say a little about the ways of our ancestors, the Old Ways, the ways of the Earth and of the ancient gods of this planet of ours.

The shamanic paradigm, common to all indigenous cultures throughout the world, sees the universe as being a whole, completely interwoven entity. Everything is alive and has energy, or Spirit, and all things are connected. We live in constant relationship with everything—our family, tribe, community, society, the animals and birds, insects, all creatures, along with the spirits of nature, plants, the land, fire, air, and water. The idea is to be in harmony with all, that disease—dis-ease—comes about when the energy or relationship between people and themselves, their community, or their environment is not right.

There are ways for a person to live in right relationship. Ancient ancestral traditions involve detailed knowledge about how to live thus, as well as having an effective treatment system for when things go wrong, including those kind of emotional and spiritual diseases for which modern Western medicine is at best ineffective, and at worst (and all too often) downright destructive.* In this appendix I will give a short overview of the shamanic perspective.

Everything that exists is made of **energy**. This physical reality of ours to which we are so attached is one aspect of this dream of life, but it is not as solid as we believe. There are other realities too, known as the spirit world, the other world, the next world, the world beneath the water—what Michael Harner calls **non-ordinary reality**.[1] We can access the realm of non-ordinary reality through our nighttime dreams and through waking visions. There are many methods for connecting with non-ordinary reality, often involving drumming, rhythm, song, dancing, and the burning of sacred herbs.

Michael Harner researched shamanic cultures throughout the world after having a profound shamanic experience when studying a tribe as an anthropologist. Instead of dismissing his experience, he realized something real had happened and began to look into it, to try to understand it. Finding that rhythmic drumming is an integral part of most shamanic practices throughout the world, he undertook research on the effects of this on a person's brain waves and found that the effects are to put the brain into theta waves—a trance state. It's interesting that electronic dance music (trance, acid house, techno, to name a few types) uses drumbeats of the same frequency as shamanic drumming.

In indigenous cultures, everyone knows that dreams are real and important. Everyone dreams. Our ancestors, spirit guides, animal spirit helpers, angels—all can come to us through our dreams, giving us the help and guidance we need. To keep the clearest spirits coming through, there are ways to purify and cleanse ourselves, and to protect ourselves from negativity.

In intact indigenous cultures, people all have initiations to identify them strongly to the spirits, to ensure their rightful place in the tribe.[2] These initiations are essential to growth and maturity. Without initiation, a person does not easily become a proper adult and grow spiritually throughout life. (Compare this with Western "civilized" society, which has many old people but very few Elders—and a lot of furious young people who know at a very deep level they are being short-changed on guidance and meaningful initiation into adulthood.)*

Everyone dreams. But some are called to go much deeper. These are people who become shamans, seers, diviners, medicine men or women, witch doctors,** or sangomas (literally, "people of the song," traditional healers from South Africa). The word in common usage now to identify them is shaman—a word that comes from the Siberian language. Since it is now fairly common to refer to any of these medicine people as a shaman, I will do so here.

A shaman is one who has been called to something extra—to deep work with the other realms. It is not a glamorous calling; it involves much hard work and sacrifice. Most people in indigenous cultures do not seek it out, as it is not an easy path at all. The shaman really belongs to the spirits, and to the community; it is a life of service. The shamanic perspective is that all disease involves some kind of problem with non-ordinary reality. Broadly speaking, we can say there are three types of problem that manifest in illness; these are described in the next paragraphs.

A person can have lost some of his or her vital force, energy, spirit, or soul—this is called **soul loss**. This can cause depression, tiredness, depletion, confusion, a sense of not feeling all there, and other problems. The remedy is called soul retrieval.

Second, people can have some energy attached to them that doesn't belong to them, is not theirs. This is called an **intrusion**. It can involve daggers of negative energy that have been thrown at us, or us holding parts of someone else's energy that we've taken from that person unknowingly, or more seriously, what are called entities getting attached to us. Entities seem to have a life of their own, and they suck on our life force to survive here. The biggest one I have ever seen was in a casino; it was as big as a house, and was involved in sucking people into gambling addictions. Entities are often involved in addictions. Some seem to be big globs of the energy of negative emotions, nasty happenings. You can often feel the unpleasant vibe or energy in a place where horrible things have happened. Intrusions can manifest as pains in particular parts of the body, feeling dirty or yucky, bad dreams, fear, and even a feeling like something is inside you. The remedy is called extraction.

Third, there are problems with our **ancestors**. Considered an essential part of all indigenous traditions, our ancestors have passed through here before us, and want to help us. Our love and honoring of them feeds them, nourishes them, and shows them where we are so they can help us as much as possible. Think for a few minutes about your own family; do you know the names of your grandparents and great-grandparents? How do you feel about your family line? Are you proud, ashamed, angry, disappointed? Can you feel the love and support of those who came before you, or do you feel disconnected from your roots? Are you aware of unfinished business among your ancestors? Is there trouble that has been passed through the generations? What are your strengths from your ancestors? These are important shamanic questions.

Remember that no matter what else your ancestors did or didn't do, they survived, and because they survived, you are here, with this most precious life.

In some traditions* the word *ancestor* includes all the spirits who are helping you, which would also include the gods. Those who have issues about the word *god* may think of the gods as being powerful natural forces. There are gods and goddesses of everything—fire, water, the earth, the stars, rice, the forest, mountains, and so on. It is possible to offend the gods by not honoring them. On the other hand, having them on your side is a good idea. I'm very conscious as I write that this is all seen as superstitious mumbo jumbo by the dominant culture in the West. We don't seem to have a culture of "as you sow, so shall you reap" any more. Our actions have only physical consequences. Yet the more I have become immersed in shamanic practices and ceremony, the more I have experienced the power of working in this way. Honoring and praising your ancestors, including the gods, gets results!

Shamanic healers may remove intrusions and banish entities, bring back lost soul parts, and help to restore good relations with the ancestors. Some kinds of healing can be thought of as household shamanism—the kind of safe shamanism that everyone can have access to. Shamanic journeying falls into this category. The shamanic dream journey is an easy and safe method for anyone to learn to deepen the connection to the spirit world, and to become aware of helpers and allies. The journey is in your spirit. When journeying, the body is made comfortable and things set up so as not to be disturbed. The journey feels at first as if it is happening in your imagination—like a visualization. At its best it becomes more like a dream—a powerful waking vision, in which you are fully participating, which you are not controlling but are making decisions within.

People may journey to meet their so-called power animal. Having a strong connection to a power animal is seen as crucial by most tribal peoples. In fact, some say if your power animal is with you, you can't die! Animal spirits are usually found by journeying to the lower world, which is accessed by going down a tunnel from this world (the middle world). It's a bit like Alice going down the rabbit burrow, and coming out into a completely new world where different rules apply. Different animals offer us different medicine. For example, hedgehogs are protected by their spines, so are able to be innocently friendly and playful. Foxes are cunning and good at getting around unnoticed. Badgers are very fierce and protective, and also like to dig up roots—which makes them herbalists, healers of the body. Eagles and kites and other large birds of prey can fly very high, and have excellent eyesight—so they can see far, see the whole picture, take us high into the spiritual realms.*

You get the idea. Animals are, of course, our ancestors—probably in the genetic sense as well as the shamanic sense. They love to help us. Plant spirits also are keen to help. In fact, everything we need for our physical survival comes via plants. This fact is hidden from most of us in the modern world, but it's true none the less. Plants are extraordinarily generous to us and love us despite our poor treatment of them. We can look to plants for all kinds of help—with our minds and spirits, with restoring harmony to our bodies, and with our basic survival needs (food, shelter, warmth, oxygen production). Plant spirits are traditionally accessed via the lower world, as well as directly in the middle world by hanging out and tuning in with them.**

Allies and spirits in human form can also be safely connected with by the lay person. These may be met anywhere, but often in the so-called upper world—the heavenly realms, which one gets to by going up from the earth in one's spirit body. Of course, if you just go up, you get to space and other planets. To get to the upper world, you must pass through a barrier, which often appears as a kind of membrane. (This membrane does not exist in ordinary reality—you won't crash into it while flying a plane. You need to be traveling outside of your body in the realm of non-ordinary reality to encounter it.) Once through the barrier, you are in the upper world, a weird and wonderful place full of all kinds of landscapes.

It is also possible to travel in non-ordinary reality in the middle world—you can go in your spirit body to visit friends, to look for lost objects, to do distant healing, to check out the energy of a place or person, to see if your expected visitor is nearly arriving, to check that your car has not been stolen—the shamanic journey has many possible applications.

Household shamanism can and should be practiced by pretty much everyone. We all benefit from having our lives enriched by direct personal contact with our guides, allies, and ancestors. Some people are called to take things farther, and this is where it gets tricky for us modern people. Traditionally, deep shamanism would only ever be undertaken by one with a calling, who would then follow an arduous and dangerous training program, usually lasting for years, with a teacher who had in turn been fully initiated in an ancestral tradition that had its roots in the beginning of time. This is deep shamanism, and some paths still remain unbroken. However, nowadays many of the ancestral traditions have been lost. Certainly our own northern European ways were scattered years ago, by the Romans and later by Christianity.* This means that most of us have no access to proper shamanism, anchored to an ancient lineage. Many people today practice shamanic healing without having been initiated in an ancestral tradition (myself included). There is a place where this is okay—there is some middle ground, between everyday household shamanism on the one hand, and the dangerous and very powerfully effective deep shamanism on the other. It is important to recognize the limitations of this, and for the shamanic practitioner who is not affiliated to an ancient tradition to be aware of these limitations and difficulties. Shamanic practices are only partly about techniques. Mostly, they are about building power. No matter how powerful an individual may be, this is as nothing compared to the power of an ancient and unbroken lineage.

I hope this has whetted your appetite to find out more about shamanism. These ancient ways are an important part of our human existence—without them we are seriously in trouble. There are some excellent books in the recommended reading list for further study, but the best thing to do is put the books away and spend as much time as possible in nature. If you are interested I encourage you to learn to journey. You can do this alone, but also find a course or workshop to attend and learn in a group—much more fun as well as being safer and more effective.** Enjoy the journey!

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*Peter Breggin's *Toxic Psychiatry* describes the barbaric Western treatment of such disease eloquently.

*A great organization called the Mankind Project recognizes this problem and offers powerful initiations into manhood for men; see www.mkp.org.uk. It has a sister organization, Woman Within, offering initiations for women; see www.transitionseurope.com.

**Witch doctors in Africa traditionally helped people who had been harmed by witches, who practice negative or dark magic. However, in the UK in recent years, the word witch has been reclaimed by those who seek to practice the old pagan ways of this part of the world, and does not mean a person who practices the "dark arts."

*Such as the Xhosa tradition of southern Africa. To find out more about this tradition, see sangoma John Lockley's Web site, www.african-shaman.com.

*There are various books on animal medicine. For example: Jamie Sams and David Carson, *Medicine Cards: The Discovery of Power through the Ways of Animals;* Lucy Harmer, *Discovering Your Animal Spirit*.

**To learn about plants as healers, Eliot Cowan's *Plant Spirit Medicine: The Healing Power of Plants* is a good start. Also Elizabeth Brook's works, including *A Woman's Book of Herbs*.

*Some traditions remain, such as the way of the bee masters and mistresses. See Simon Buxton's book *The Shamanic Way of the Bee*.

**You can check out my Web site, www.thedreamingbutterfly.com, and Lucy Harmer's, www.innerelf.ch. Or look on the Internet for the Sacred Trust, which offers great workshops. Open your heart and pray sincerely to find the right teacher and place for you to learn, and you'll find it.

Resources

Here is a list of the publications and sources I have found useful. If you want a traditional anatomy and physiology textbook, I suggest you visit a bookstore with a big selection and take plenty of time to browse until you find one that is readable and provides the depth of information you require. Here, first come publications, alphabetically by author, followed by a list of useful Web sites.

I have used *** to indicate my favorite, even life-changing, books, to make sure you don't miss them.

Recommended Reading

Alcamo, I. Edwards, and Bergdahl, John. *Anatomy Coloring Workbook*. New York: Random House, 2003.

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Recommended Web Sites

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www.african-shaman.com. About sangoma John Lockley.

www.bluedeer.org. To find a plant spirit medicine practitioner in the US

www.breggin.com. The wonderful Peter Breggin's Web site.

www.btinternet.com/~andrew.murphy/asthma_buteyko_shallow_breathing.html. About Buteyko breathing for asthma.

www.ccst.co.uk. About craniosacral therapy in the UK.

www.cheniere.org/books/aids/ch5.htm. About French scientist Louis Kervran, working on elements changing to other elements.

www.darkfieldmicroscopy. About looking at living blood with a special type of microscopy.

www.drpaulclayton.com. For nutrition expert Paul Clayton.

www.dulwichhealth.co.uk. To buy a Raditech, a device to help reduce geopathic stress.

www.en.wikipedia.org/wiki/Development_of_the_urinary_and_reproductive_organs. Shows pictures of developing fetal genitals.

www.ewg.org. Web site of Environmental Working Group, with good information about pharmaceutical and environmental pollution in the US.

www.innerelf.ch. Lucy Harmer's Web site, about feng shui and space clearing.

www.leafcycle.co.uk. About Leafu, protein food from grass and nettles, from Michael Cole.

www.lhmeridian.co.uk. Lorraine Horton's site for Meridian School of Massage in Birmingham.

www.manchester.ac.uk. About essential oils active against MRSA.

www.mkp.org.uk. The Mankind Project, initiation for men.

www.mnwelldir.org/docs/history/biographies/louis_pasteur.htm. A history of Louis Pasteur.

www.nads.org. American site of National Association for Down's syndrome.

www.newmedicine.ca. About Dr. Hamer's controversial cancer theory and treatment.

www.nimh.org.uk. National Institute of Medical Herbalists, finding a herbalist in the UK.

www.ourworld.compuserve.com/homepages/dp5/sex2.htm. David Pratt Virginal Reproduction, 2003. About parthenogenesis.

www.plantspiritmedicine.org.uk. To find a plant spirit medicine practitioner in the UK.

www.rc.org. About reevaluation counseling.

www.rhs.org.uk. Royal Horticultural Society, about trees and climate change.

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www.sustainablehealthsolutions.co.uk. Recipe for linseed tea.

www.thedreamingbutterfly.com. Pip Waller's site offering shamanic courses.

www.theelders.org. About Global Elders.

www.t-m.org.uk. For referenced studies about meditation.

www.transitionseurope.com. Woman Within, initiation for women.

www.upledger.com. About John Upledger and craniosacral therapy.

www.vran.org. About fever and vaccinations.

http://www.whale.to/cancer/last.html. Walter Last, *The New Medicine of Dr. Hamer.*

Notes

Introduction

1. Leo J. Lacasse, “Serotonin and Depression: A Disconnect between the Advertisements and the Scientific Literature,” *PLoS Med* (2005; 2/12: e392). doi:10.1371/journal.pmed.0020392.

Chapter 1: An Orientation to the Human Body

1. Lynne McTaggart, *The Field: The Quest for the Secret Force of the Universe*.

2. Simon Mills and Kerry Bone, *Principles and Practice of Phytotherapy: Modern Herbal Medicine*.

3. Royal Horticultural Society Web site: www.rhs.org.uk/research/climatechange/trees, accessed Feb. 2008.

Chapter 2: The Chemistry of Life

1. Heinz R. Pagels, *The Cosmic Code: Quantum Physics As the Language of Nature*.

2. Lynne McTaggart, *The Field: The Quest for the Secret Force of the Universe*.

3. Ibid.

4. Bruce H. Lipton, *The Biology of Belief: Unleashing the Power of Consciousness, Matter and Miracles.*

5. Ibid.

Chapter 3: Cells and Tissues–Histology

1. Bruce H. Lipton, *The Biology of Belief: Unleashing the Power of Consciousness, Matter, and Miracles*.

2. James Lovelock, *Gaia: A New Look at Life on Earth*.

3. Bruce H. Lipton, *The Biology of Belief: Unleashing the Power of Consciousness, Matter and Miracles*.

4. The theories of Karl Pribram, Kunio Yasue, Stuart Hameroff, Scot Hagan, and others, are described in Lynne McTaggart, *The Field: The Quest for the Secret Force of the Universe*, pp. 91–96.

5. MLA University of Illinois at Urbana-Champaign. Study of Rats' Brains Indicates Brain Continues to Grow After Puberty, *ScienceDaily* (April 12, 2000). Retrieved March 2, 2008, from www.sciencedaily.com/releases/2000/04/000406091914.htm.

6. From Lorraine Horton of Meridian School of Massage, www.lhmeridian.co.uk.

7. From the excellent book *Health Defense: How You Can Combine the Most Protective Nutrients from the World's Healthiest Diets to Slow Aging and Achieve Optimum Health*, by Paul Clayton.

Chapter 4: Between Within and Without–The Skin or Integumentary System

1. Medical Research News, Tuesday, 21 Dec 2004, www.manchester.ac.uk.
2. Thanks to Lucy Harmer of the Innerelf Centre, Switzerland, for this information. See www.innerelf.ch.

Chapter 5: Them Bones, Them Bones,… Them Dry Bones–The Skeletal System

1. John Upledger, *Your Inner Physician and You: Craniosacral Therapy and Somato-Emotional Release*. You can find out more from the Upledger Institute, upledger@upledger.com.

Chapter 7: Transport–Circulation and Blood in the Cardiovascular System

1. Stephen H. Buhner, *The Secret Teachings of Plants: The Heart as an Organ of Perception in the Direct Experience of Nature*.
2. Simon Mills and Kerry Bone, *Principles and Practice of Phytotherapy: Modern Herbal Medicine*.
3. See the introduction in Graeme Tobyn's *Culpepper's Medicine: A Practice of Western Holistic Medicine*.
4. Paul Pearsall, *The Heart's Code: Tapping the Wisdom and Power of Our Heart's Energy: The New Findings About Cellular Memories and Their Role in the Mind/Body/Spirit Connection*.
5. Stephen H. Buhner, *The Secret Teachings of Plants: The Heart as an Organ of Perception in the Direct Experience of Nature*.
6. Ibid.
7. Printed here with kind permission. Lynne McTaggart, *The Intention Experiment*.
8. Stephen H. Buhner, *The Secret Teachings of Plants: The Heart as an Organ of Perception in the Direct Experience of Nature*.
9. See Paul Clayton's Spring 2008 newsletter, www.drpaulclayton.com.
10. Research by University of Maryland Medical Center presented at the Scientific Session of the American College of Cardiology, March 7, 2005, in Orlando, Florida.
11. From *The Medical Desk Reference*, edited by Lynne McTaggart.

Chapter 8: Drainage–The Lymphatic System

1. From the Web site of MLDUK, an organization of manual lymphatic drainage practitioners, www.mlduk.org.uk.

Chapter 9: The Army and the Cleaners–The Immune System

1. Sara Hamo, *The Golden Path to Natural Healing*.
2. You can read all about this on the Internet. For example: www.mnwelldir.org/docs/history/biographies/louis_pasteur.htm.
3. Robert O. Young, *Sick and Tired: Reclaim Your Inner Terrain*.
4. According to *The Lancet* (2006; 368: 2395).
5. Edda West, “Is Fear of Fever Hurting Our Children?”
6. Anthony R. Torres, “Is Fever Suppression Involved in the Etiology of Autism and Neurodevelopmental Disorders?” *BMC Pediatr* (2003; 3:9).
7. Drs. Buehler and Wolff, cited by Anita Petek-Dimmer, “Does Systematic Vaccination Give Health to People?” (2002). Accessed 13 June 2008 at www.whale.to/a/petek.html.
8. V. Chakravati, in *Annals of Tropical Paediatrics*, 1986, cited by Anita Petek-Dimmer, ibid.
9. K.-R. Kummer, in *Der Merkurstab*, 1992, cited by Anita Petek-Dimmer, ibid.
10. I. Rooth, in *The Lancet*, 1985, cited by Anita Petek-Dimmer, ibid.
11. Lewis, et al., in *Clin Exp Allergy* (1998, 28/12:1493–1500); M. Paunio, in *JAMA* (2000; 283:343–346); S. O. Shaheen, in *The Lancet* (1996; 347:1792–1796). Cited by Anita Petek-Dimmer, ibid.
12. T. Ronne, in *The Lancet*, 1995, cited by Anita Petek-Dimmer, ibid.
13. Thanks to Hilary Butler of the Immunization Awareness Society (2002). These references were collected and published in *Waves* (14/4). I accessed them during May and June 2008 at www.vran.org/news-art/articles/fear-of-fever.htm
14. *Eur J Ped* (1994 Jun; 153(6):394–402). www.vran.org/news-art/articles/fear-of-fever.htm.
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18. *Ped Infec Dis* (Oct 2000; 19/10:983–990). www.vran.org/news-art/articles/fear-of-fever.htm.

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21. Christopher Menzies-Trull, *Herbal Medicine: Keys to Physiomedicalism Including Pharmacopoeia*.

22. Yubraj Sharma, "Vaccination—Controversy, Safety and Side Effects."

23. And found in Sara Hamo's *The Golden Path to Natural Healing*.

24. See Lynne McTaggart, *The Vaccination Bible;* Viera Scheibner, *Vaccination: 100 Years of Orthodox Medical Research Shows that Vaccines Represent a Medical Assault on the Immune System;* and Alan Philips, *Dispelling Vaccination Myths: An Introduction to the Contradictions Between Medical Science and Immunization Policy*.

25. Simon Mills and Kerry Bone, *Principles and Practice of Phytotherapy: Modern Herbal Medicine*.

Chapter 10: Breathing–The Respiratory System

1. Thanks to Joyce Withers for inspiration for this. See her book *The Virgin Stones*.

Chapter 11: Eating and Food Processing–The Digestive System and Diet

1. Kathleen DesMaisons, *Potatoes, Not Prozac: A Natural Seven-Step Dietary Plan to Stabilize the Level of Sugar in Your Blood, Control Your Cravings and Lose Weight, and Recognize How Foods Affect the Way You Feel.*
2. "Vegetarian Diets and Longevity," *BMJ* (1996; 313:775—779). Cited at www.earthsave.org/health/rxhealth.htm.
3. "European Union Risk Evaluation of Potential Environmental Hazards from Low-Frequency Electromagnetic Field Exposure Using Sensitive In Vitro Methods," *What Doctors Don't Tell You* (2006; 17/7).
4. "Teeth and Gums the Root Cause," *What Doctors Don't Tell You* (2009; 25/3).
5. See Candace Pert's *Molecules of Emotion: Why You Feel the Way You Feel.*
6. *Health Defense: How You Can Combine the Most Protective Nutrients from the World's Healthiest Diets to Slow Aging and Achieve Optimum Health*, by Paul Clayton.
7. Ibid.
8. Fiona Godlee, "The Food Industry Fights for Salt."

Chapter 14: Wiring–The Nervous System

1. Bruce H. Lipton, *The Biology of Belief: Unleashing the Power of Consciousness, Matter and Miracles.*
2. Candace Pert, *Molecules of Emotion: Why You Feel the Way You Feel.*
3. Deepak Chopra, *Quantum Healing: Exploring the Frontiers of Mind/Body Medicine.*
4. Candace Pert, *Molecules of Emotion: Why You Feel the Way You Feel.*

Chapter 16: The Birds and the Bees–The Reproductive System

1. Ruth Trickey, *Women, Hormones and the Menstrual Cycle: Herbal and Medical Solutions from Adolescence to Menopause*.
2. Reproduced with grateful thanks to Stephen Buhner from his outstanding book *The Secret Teachings of Plants: The Heart as an Organ of Perception in the Direct Perception of Nature*.
3. "The Inaccuracy of Antenatal Scans," *The Lancet* (1998; 352:1568–1568, 1577–1581). Accessed from www.wddty.co.uk.
4. Althea Sulter, *The Aware Baby: A New Approach to Parenting*.

Chapter 17: Experiencing the Outside World–The Special Senses and Touch

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2. Peter Mansfield, *The Bates Method*.

3. D. Yamashita, H. Y. Jiang, C. G. Le Prell, et al., “Post-Exposure Treatment Attenuates Noise-Induced Hearing Loss.”

Chapter 18: From Newborn to Elder–Development and Aging

1. David Sinclair and Peter Dangerfield, *Human Growth After Birth*.
2. Deepak Chopra, *Quantum Healing: Exploring the Frontiers of Mind/Body Medicine*.
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About the Author

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In 2000 she started The Dreaming Butterfly (www.thedreamingbutterfly.com), an organization that offers courses in shamanic healing and transformational practices. She currently lives in North Wales, UK.

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