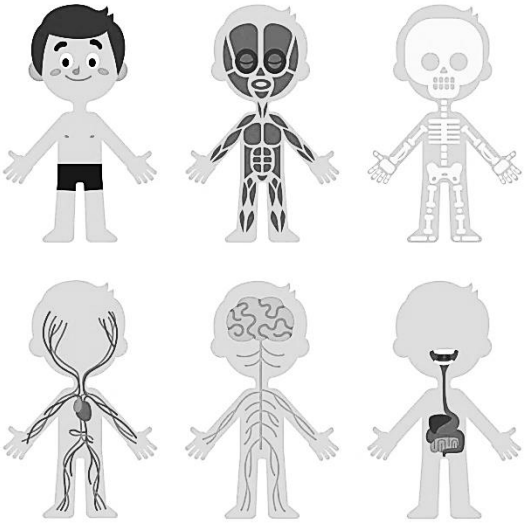
Medical Missionary Health Lesson

PHYSIOLOGY AND HYGIENE



By John N. Loughborough

1868

EXPLANATION OF THE SUBJECT PHYSIOLOGY

WHAT IS THE MEANING OF THE WORD PHYSIOLOGY?

This word is formed from two Greek words, phusis, nature, and lego, to discourse. It means a description of Nature.

OF WHAT DOES PHYSIOLOGY TREAT?

It treats upon the purposes, uses, functions, actions, properties, results, and relations, of the various parts of the living body, in its healthy or normal condition. In other words, it is a description of organized or animate Nature, such as trees, plants, brute animals, and man.

INTO WHAT BRANCHES IS PHYSIOLOGY DIVIDED?

Into Vegetable, Animal, and Human. When treating of plants and trees, it is Vegetable Physiology. When treating of brute animals, it is Animal Physiology. Human Physiology, or that relating particularly to man, is that which we shall treat upon in the following pages.

WHAT IS HYGIENE?

The meaning of the word Hygiene, is health. As a study, Hygiene treats upon what will improve and preserve health, what will impair and destroy health, and what is best calculated to produce a healthy condition of the body.

Does not a work of this kind embrace the subject of Anatomy?

Anatomy treats upon the structure of living things, such as their color, size, form, surface, etc.

WILL THIS WORK, THEN, TREAT UPON ANATOMY?

It will treat upon it only so far as it is connected with Physiology and Hygiene. We design to introduce, in each of these branches, only that which is of use to all classes of persons. The work then must contain something of Anatomy, more of Physiology, and much of Hygiene. These branches are so intimately related to each other, that we do not propose to separate them in this work, but to treat upon the structure, functions, and care of the different parts of the body as we pass along.

WHAT DOES MAN DISCOVER CONCERNING HIS RELATION TO SURROUNDING OBJECTS, AS HE ENTERS UPON THE STUDY OF HIMSELF?

He discovers that his senses, feelings, and faculties, relate him to the whole universe. His well-being certainly demands that such relation should be the most harmonious. The world appears to him full of beauty, and he has eyes adapted to see it, and faculties just fitted to enjoy it. His ears are wonderfully adapted to all sounds, and their harmonious combination in music affords the most pleasing sensation. His sense of smell is related to a thousand delightful odors. His taste finds exquisite gratification from the aliments best adapted to supply the waste of his system. His sense of touch, variously modified in many organs of the body, gives him a world of delight.

WHAT BENEFIT CAN WE DERIVE FROM THE STUDY OF OURSELVES?

It will discover to us, that man, in his nature and faculties, capabilities and conditions, and in his relations to the world in which he exists, is one of the most interesting and important subjects which the human mind has power and compass to investigate. This study also displays to us the wonderful wisdom of God in our formation, and teaches us how we can secure the greatest amount of happiness here, by showing us that true enjoyment in this world can only be secured by the greatest possible freedom from sickness and pain.

HOW CAN SUCH A STUDY TEACH US THE ART OF HAPPINESS?

By teaching us what kind of food, air, and habits of life, will tend to make us sick; what kinds will preserve health; and how we can obtain cheerfulness, and freedom from that health-destroying disease, despondency of mind.

WHAT DOES PHYSIOLOGY DISCOVER TO US CONCERNING THE MIND?

It discovers to us, that to properly understand and care for the mind, it is necessary to ascertain how far the mind is connected with the body; to what extent it is affected by the conditions of the body; and then, again, on what depend those conditions of the body which affect the mind. In order to this, the body itself must be understood in its animal and organic nature, its physical and vital properties and laws, and its physiological actions and affections. This will show us that mind and body are so closely connected that one is affected by the other. So that we cannot habitually possess lively and correct moral feelings, or a sound mind, unless we so live as to preserve a sound body; for true happiness may be properly defined as health of body and health of mind.

HOW, THEN, DOES PHYSIOLOGY TREAT OF THE HUMAN BODY?

As a system, composed of sub-systems, all being called the human system. The whole composed of dependent parts, acting upon each other, but all working together harmoniously.

WHAT, THEN, DOES MAN'S WELL-BEING HERE REQUIRE?

It requires a knowledge of himself, both mentally and physically, and also such a relation of himself to the elements of the external world, and such adaptation of these elements to his own condition, that they may, through the body, act favorably upon the mind.

WHAT IS REQUIRED IN PROPERLY TREATING UPON THE CARE OF THE HUMAN BODY?

To properly treat upon the care of the human body, it is necessary to take into view, and thoroughly investigate, the nature, conditions, and relations of man; to understand the modifying influences of the mind and morals upon the health and morbid sensibilities and sympathies of the system. Man finds himself upon the stage of life, surrounded by innumerable influences, acted upon at every point, and he is continually conscious, not only of his own existence and the action of surrounding influences, but of an unceasing desire for happiness. This desire itself is a living proof that our benevolent Creator has fitted us for happiness, not only in a future state, but here; and he has adapted everything within us and around us to answer this desire, in the fulfillment of those laws of life, health, and happiness, which He, in wisdom and in goodness, has established in the constitutional nature of things.

WHAT ARE THE FACULTIES OF ALL LIVING BODIES?

All living bodies possess those faculties by which their nourishment and growth are effected, and their temperature regulated. The little acorn placed in a genial soil, other circumstances being favorable, is excited to action by virtue of its own vitality. It puts forth its roots, twigs, branches and leaves, till it becomes a giant oak. All the vital operations of the tree are maintained till the vital property is worn out or destroyed, when its death ensues. The tree by nature is fixed to the spot from whence it sprang, - unconscious of its being, without any organs of external perception, or voluntary motion. So far as the vital operations are considered by which chyme, chyle and blood are produced, the blood circulated, the body in all its parts nourished, and its growth effected, its temperature regulated, and all the other functions of organic life sustained,

man is as destitute of animal consciousness as the oak. But in man there are two classes of functions. Besides the class already mentioned, concerned in the growth and sustenance of the body, there is a secondary class, which consists of those functions which minister to the wants of the primary class. This class is established with special reference to the relation existing between those internal wants and the external supplies, and general external relations of the body. This second class of functions is peculiar to animal bodies.

WHAT ARE THE POWERS OF THE VITAL ECONOMY?

The vital economy seems to possess the power of supplying from the common and ordinary current of blood, without any known variation in the food from which it is formed, a large increase of appropriate nourishment for particular structures, and at the same time regularly sustaining the general function of nutrition in every part and substance of the system. From the same chyle various substances are produced, opposite in their qualities, and composed of essentially different elements. The flesh of the rattlesnake is eaten by many as a great luxury, and its blood may be put upon a fresh wound with perfect safety; and yet from that same blood is secreted a poison, which, if mingled with the blood of our system, will prove fatal to life in a very short time.

WHAT OTHER REMARKABLE FACTS ARE NOTICEABLE IN THE ACTION OF THE BLOOD OF THE HUMAN SYSTEM?

From the same atoms that enter into the formation of minerals and vegetables, the living blood is formed; by a different arrangement, in obedience to the laws of vitality in the animal system, from the matter composing this same living blood, the bone of the animal is formed; by a still different arrangement, the animal muscle is formed from the same blood; and by an arrangement still different from the others, from the matter of the same blood is formed the living animal nerve, which is the most remarkable, for its peculiar properties and powers, of any known material structure. All these are purely results of vital power, acting and accomplishing its ends as required by the body.

WHAT IS THE VITAL FORCE OF THE HUMAN BODY?

It is that power placed in the human body, at its birth, which will enable the body, under favorable circumstances, to live to a certain age. It is this which enables the body to rally and bring to bear its energies in throwing off disease. It also battles against those influences that are liable to produce disease. It is spoken of in common-place language as the constitution. Of one it is said, "He will rally from that disease if his constitution is not broken." Of another, "He

cannot rally, his constitution is gone;" meaning that either their vital force has so far been expended, or interfered with by violations of nature's laws, that it no longer has power to battle for the life of the body.

CAN THE ORIGINAL STOCK OF THIS VITAL FORCE BE INCREASED OR DIMINISHED?

It cannot be restored when once expended, but it may be wasted, and life shortened proportionately. If the life force has been measurably wasted, by placing the person in the most favorable relations to life, his days may be protracted to a much greater extent than if he were left to follow out the ordinary habits of life. A realizing sense of these facts should certainly lead us to manifest the greatest care, lest we overtax our energies, waste our life force, and shorten our days.

HOW IS THE LIFE OF THE BODY CONSTANTLY MAINTAINED?

Chemical agents, and the physical laws of nature, are constantly exerting their influence on living bodies, causing an expenditure of vital power, and tending to the destruction of the vital constitution, and the decomposition of the organized matter. Therefore, life maintains a continual conflict with opposing forces; and hence it has been with truthfulness said, "Life is a forced state - a temporary victory over the causes which induce death."

WHAT PECULIARITY IS NOTICEABLE IN THE TEMPERATURE OF THE HUMAN BODY?

The temperature of the human blood is, in a robust man, about ninety-eight degrees; and it hardly varies two degrees from this point, whether the temperature of the surrounding atmosphere be twenty degrees below zero or two hundred and sixty degrees above it. The animal body most completely resists the action of superficial heat and cold. The more vigorous the vital power is in animal bodies, the better are they enabled to sustain the extremes of heat and cold.

WHAT CAN YOU SAY OF THE CARBONIC-ACID GAS THROWN OFF BY THE HUMAN SYSTEM IN ITS ACTION?

Carbonic-acid gas is thrown off in immense quantities by perspiration and respiration, and this, when received into the lungs, without a mixture of atmospheric air, is almost instantaneously destructive of animal life, but the vegetable economy, during the day, decomposes this gas, retains its carbon as

vegetable nourishment, and sets free the oxygen, which is the peculiar principle of the atmosphere that supports animal respiration.

WHAT IS NOTICEABLE IN THE FORMATION OF THE ANIMAL STRUCTURE?

The most simple form of animalized matter composing the living body in the chyle, which is separated from the digested food in the alimentary canal, and enters the capillary tubes, by which it is conveyed to the blood vessels. This pearly-colored fluid, by chemical analysis, is almost wholly resolved into water. As it passes along the vitalizing tubes it becomes more and more albuminous and fibrinous. From the blood the vital economy of the body elaborates all the substances and forms of matter composing the animal body, constructing with marvelous skill and wisdom the blood vessels and the alimentary tube, with the assemblage of organs associated with it for the purpose of nutrition, and the outer walls of the body, with its limbs and organs of external relations. All the solid forms of the body, the bones, cartilages, ligaments, tendons, muscles, nerves, etc., are made from this fluid blood. They may all be reduced to three general kinds of substances: namely, the gelatinous, the fibrinous, and the albuminous, or, the cellular, the muscular, and the nervous tissue. The gelatinous substance, or cellular tissue, enters into the formation of the bones, cartilages, and tendons. It also forms sheaths for every muscle and for every cord of the nervous system. The fibrinous substance enters into the formation of the muscular tissue. The albuminous is the nervous tissue, which is the highest order of organized matter, and is endowed with the most peculiar and wonderful vital properties, and these properties are concerned in the functions of digestion, absorption, respiration, circulation, secretion, and organization, or the process of structure, and the production of animal heat.

WHAT IS THE ONLY ELEMENT OF POSITIVE MOTION IN THE HUMAN BODY?

With very limited exception, if any, the vital contractility of the muscular tissue is the only element of positive motion in the living animal body. Hence the muscular tissue is distributed wherever motion is required. The windpipe, stomach, intestines, heart, diaphragm, and several other internal organs are also supplied with this tissue.

WHAT OTHER ARRANGEMENT IS MADE IN THE HUMAN BODY FOR THE SECURITY AND PROTECTION OF THE ORGANS?

The cavity of the body is divided by the muscular substance called the diaphragm, into two apartments. The upper one is called the thorax or chest, which extends from the neck to the breast-bone in front, and somewhat lower

at the sides and back, and contains the lungs, heart, a portion of the large blood-vessels, and the esophagus, or food pipe. The lower division is called the abdominal cavity, and contains the liver, stomach, intestinal canal, pancreas, spleen, kidneys, etc. There is also a peculiar texture of the cellular tissue, called the serous membrane, which lines both cavities of the body, and is then extended and folded in such a manner as to envelop each organ separately, holding them in a measure in their proper place. This serous membrane in the upper portion of the body is called the pleura. It encloses each lung separately, and by two sheets, extending from the breast to the back, forms a double partition between the lungs. These two sheets are separated at the lower part of the chest to receive the heart. In a healthy state of the body the serous membrane has no animal sensibility. In fleshy people large quantities of fat are accumulated in many parts of this tissue. In a healthy action of all parts of the system, excess of fat never occurs, but waste and supply are equal. It must, from the considerations introduced in this chapter, be a matter of interest to all, to contemplate the subject of the following chapters, to learn what tends to waste our bodily structures, what habits of living will restore their proper action, and how we may thrive in mind and body.

THE HUMAN FRAME

The bones of the body: their construction, number, nature, power, position, and use. - The joints, ligaments, synovia, etc., etc.

OF WHAT IS THE HUMAN BODY COMPOSED?

Of solids in different degrees of density, and fluids that circulate through them.

WHAT IS THE CUBICAL SIZE OF THE BODY, AND WHAT IS THE PRINCIPAL ELEMENT OF ITS COMPOSITION?

The bulk of the body, upon an average, is equal to a cube of a little more than sixteen inches on a side. The principal element of the body is water. The amount of water equals a cube a little more than fourteen inches on a side, or nearly four-fifths of the body.

WHAT ARE THE SOLIDS OF THE BODY?

The solids of the body are bones, teeth, cartilages, ligaments, muscles, nerves, vessels, viscera, membranes, skin, hair, and nails.

WHAT ARE THE FLUIDS OF THE BODY?

The fluids of the body are blood, chyle, lymph, saliva, gastric juice, pancreatic juice, synovia, mucus, and serum. Bile, sweat, and urine are excretions.

WHAT DOES A CHEMICAL ANALYSIS OF THE BODY SHOW?

It discovers to us that almost the entire bulk of the human body consists of Oxygen, Hydrogen, Nitrogen and Carbon. The bones and teeth are more than half phosphate of lime. The teeth also contain carbonate of lime.

ARE THERE ANY OTHER SUBSTANCES FOUND IN THE BODY?

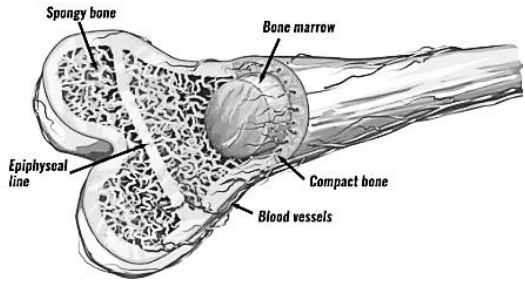
Yes; very small quantities of phosphorus, sulphur, chlorine, iodine, bromine, potassium, magnesium, iron, aluminum, gold, lead, etc.

WHAT IS THE HARDEST SOLID IN THE BODY?

With the exception of the enamel of the teeth, the bones are the hardest solid in the body.

HOW ARE THE BONES CONSTRUCTED?

The bony structure is a dense, sub-fibrous basis, filled with minute cells, and traversed in all directions by branching and connected canals called Haversian, which give room to blood vessels and nerves. These cells are irregular in form and size, and give off numerous branching tubes, which by communicating with each other constitute a very delicate network.



WHAT IS FOUND IN THE CAVITIES AND CELLS OF BONES?

The internal cavities of long bones, and the canals and cells of others, are lined by a membrane, and filled with an oily substance called medulla, or marrow.

ARE THE BONES FORMED OF WHAT WE EAT?

Yes; every part of the body is formed of and from what we eat, after the food has been changed into blood. As the blood circulates through the body, certain portions are secreted or separated from it to supply the several solids and fluids of the body.

IS IT THEN NECESSARY THAT OUR FOOD SHOULD CONTAIN THE CONSTITUENT ELEMENTS OF OUR BODIES?

It is. All substances containing these elements, however, are not proper food. Milk and eggs are supposed to contain nearly all the elements in the human body; but it does not follow from this that we should live wholly on milk and eggs, nor that we should eat lime, or drink lime water, because there is lime in our bones. Fruits, grains and vegetables, contain every element composing the human body, and that, too, in a state easy of being appropriated by our system to build up the structures of the body. But more of this under the head of digestion.

What is the strength of human bones? Human bones, when used as levers, are twenty-two times as strong as sandstone, three and one-half times as strong as lead, nearly two and three-fourths times as strong as elm and ash, and twice as strong as box, yew, and oak timber.

DOES THE QUALITY OF THE FOOD WE EAT AFFECT THE STRENGTH AND SOUNDNESS OF THE BONES?

It does. If our food is not sufficiently nutritious, or is of too poor a quality, our bones will be liable to be soft and diseased. This is the most effective cause of the rickets. As the bones become softened, by the strength of the muscles the body is drawn into unsightly deformity.

What other means injure the bones? Too little exercise in the open air, working in mines, working or living in damp, or poorly-lighted places, sleeping in close rooms, or rooms where the air is stagnant or impure, or keeping our bodies, while laboring, constantly bent, or in any posture which prevents the free circulation of the blood, and the natural action of the vital organs; all these injure the strength and health of the bones. Children, especially, should not be confined in any unnatural position, but be allowed to move freely in whatever direction nature may demand.

How often is it supposed our bones undergo a change? In from one to ten years it is supposed that the entire body, including the bones, undergoes a change. This change is caused by the minute particles that form the body undergoing a state of decay and reproduction. This change, however, is so gradual - particles passing off and others taking their place - that the body, to a great extent, retains its identity through life.

WHERE ARE THE BONES OF THE HUMAN BODY PLACED?

They constitute the frame on which the body is built. They give form and strength to the body, support its various parts, and prevent it from sinking by its own weight; they serve as levers for muscles to act upon, and to defend the brain, heart, lungs, and other vital parts, from external injury, and occupy the same position in the body that the frame does in a building. The muscles, nerves, flesh and skin, are placed upon the bones as a carpenter puts boards on the frame to build the house.

HOW MANY BONES ARE THERE IN THE HUMAN BODY?

The number is variously estimated by different anatomists from 240 to a much larger number. The best authorities, however, give 246 distinct pieces in the body of a grown person.

HOW MANY KINDS OF BONES ARE THERE IN THE HUMAN BODY?

Three: long, flat, and irregular. The long appertain to the limbs, the arms, legs, fingers and toes; the flat inclose cavities, as the brain and pelvis; the irregular are formed mostly about the base of the skull, face, trunk, wrist, and instep. All these forms of the bones are requisite for the situations they occupy, and the respective functions they fulfill.

WHAT IS THE ONLY BONE IN THE BODY WHICH IS COMPLETELY OSSIFIED, OR HARDENED AT BIRTH?

It is that bone which is called the petrous, which contains the organs of hearing. The bones do not become solid till the twelfth year of life.

ARE THE BONES OF THE YOUNG LIABLE TO BECOME OTHERWISE INJURED?

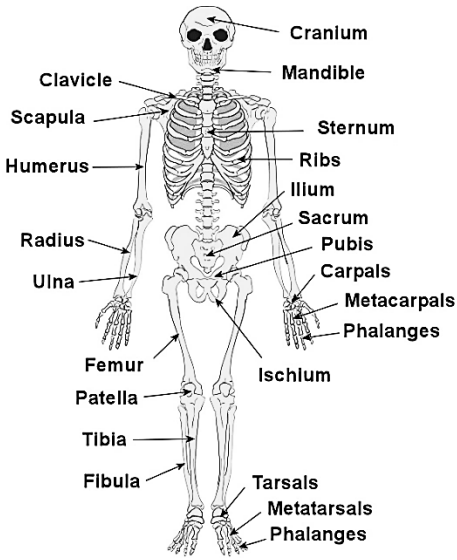
Yes; many persons in making their little children sit alone at too early an age, produce in them a crooked spine. In allowing them to stand or walk before the bones of the legs are sufficiently toughened, their legs become crooked, either bandy-legged or knock-kneed, for life. It is for this reason important that great care should be taken while the bones are soft, that they be not misshaped.

Children should not be urged to walk. They will try to walk themselves when their bones are sufficiently toughened to walk. The flat-head Indians of North America tie hard pieces of board on the back and front side of the heads of their children till the skull hardens in this shape, which causes the head to have its flattened appearance, which it retains for life.

ARE THE BONES OF OLD PEOPLE AS STRONG AS THOSE IN MIDDLE AGE?

No; in most cases the bones of the aged are dry and brittle, hence are more easily broken by a fall than those of younger persons. When the bones of the aged are broken, the process of knitting the bone together, as it is called, goes on, if at all, very slowly. For this reason, it requires two or three times as long a period for one to get about with a broken limb at seventy years of age, as for one at twenty-five or thirty.

HUMAN SKELETON



The figure to the right illustrates the human skeleton. Back bone, at the upper part of which is the axis on which rests the atlas, as it is called; humerus, long arm bone; joint of elbow; ulna and radius, the two bones of the fore-arm; the carpus, or bones of the wrist; metacarpus and phalanges, bones of the hands and fingers; the joint of the hip; the femur, or thigh bone, the longest bone in the body; the lower end of the femur or thigh bone, which is enlarged; the patella, or knee-pan; the tibia; the fibula; the two bones of the leg; the tarsus, or bones of the heel and instep; metatarsus, bones of the foot and toes; the thorax, or bones of the chest, ribs, etc.; and the pelvis; the sacrum, a wedge-shaped bone at the lower end of the back bone; the sternum, or breast bone; the clavicle, or collar bone, which extends across the upper part of the chest, from the upper end of the sternum to the shoulder blade.

WHAT IS THE AVERAGE WEIGHT OF A HUMAN SKELETON?

About one-tenth the weight of the whole body.

WHAT ARE THE BONES OF THE HUMAN SKELETON, AND HOW MANY ARE THERE OF EACH?

Bones and skull	8
Ear	6
Face	14
Teeth	32
Back, vertebral column	24
Ribs, twelve pairs	24
Tongue	1
Upper extremities, arm, wrist, & fingers	64
Breast bone, sternum	1
Pelvis, hip, sacrum, and coccyx	4
Lower extremities, leg, instep, and toes	60
Sesamoid - knee pan, and bones in tendons	8
Total	246

WHAT ARE THE BONES OF THE BACK CALLED?

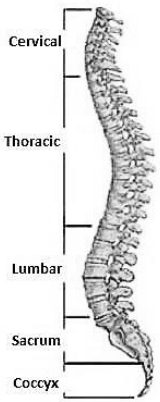
THE VERTEBRAL COLUMN

HOW MANY PIECES ARE THERE IN THE VERTEBRAL COLUMN ?

Thirty-three in the young person, but in advanced life the nine lower pieces unite into two.

WHAT IS EACH OF THESE PIECES CALLED?

Vertebra. Twenty-four of these are called the true vertebrae, the rest are called the false vertebrae, which unite to form the sacrum and coccyx; these last are also concerned with the hip bones in the formation of the pelvis



or basin at the bottom of the trunk, and constitute the base on which the vertebral column rests. Of the true vertebrae, seven belong to the neck, twelve to the back, and five to the loins; and are accordingly distinguished by the terms cervical, dorsal, and lumbar vertebrae, from the Latin cervix, neck; dorsum, back; and lumbar, loins.

WHAT IS THE FIRST CERVICAL VERTEBRA, WHICH SUPPORTS THE HEAD, CALLED?

Because it supports the head, it is called the atlas. This is said to be thus named from the tradition that a giant by the name of Atlas supported the earth on his shoulders.

WHAT IS THE ATLAS?

It is the ring of bones which allow the head to move sidewise as well as backward and forward to some extent on the second cervical, which is called the axis.

ARE THE BONES OF THE VERTEBRAE SOLID?

No; there is a large cavity the whole length of the spinal column for the spinal marrow, and two smaller cavities each side of the spinal marrow, extending down along the back side of the vertebral column, for the spinal cord.

WHAT DO THE BONES OF THE SPINAL COLUMN RESEMBLE?

They have some resemblance to so many rings piled upon one another. This is not an exact resemblance however, for they have several projections from the arch behind; one running directly back, which is called the spine. Two running obliquely backward, with which the ribs form one of their joints of attachment. The vertebrae are therefore so constructed, that when arranged in their proper order, they form both a column of support to the body, and a canal for the spinal marrow. Between all of these bones is interposed an elastic, fibrous cartilage, which, with the surrounding ligaments, unites and binds them to each other in such a manner as to give the column considerable flexibility and elasticity, and at the same time secure to it all the supporting power of a solid bone. Thus it forms a strong upright column, which gives erectness, dignity, and grace to the human body.

HOW DO MANY PERSONS INJURE THE SHAPE OF THE SPINAL COLUMN?

By wrong positions in sitting, standing, or lying down. By sitting considerable of the time, as many do, in rocking chairs, or while writing, bent forward, or with

one shoulder higher than the other. By these ill-habits, this column becomes bent too far forward, or crooked sidewise, causing either round shoulders, or a dropping of one shoulder lower than the other. Some lie on two or three pillows, so that when they habitually lie upon the side they are in danger of causing this same curvature of the spine. In sitting, you should sit back against the back of the chair, with head erect, shoulders back, and the whole vertebral column to the shoulders resting against the back of the chair. In lying down, whether on the back or side, lie with the body, arms, and limbs straight, and the head elevated not more than four inches. You should habituate yourself to sleeping on either side. Frequently changing from side to side is also beneficial. Never sleep lying upon your face.

INTO HOW MANY PARTS IS THE SKULL DIVIDED?

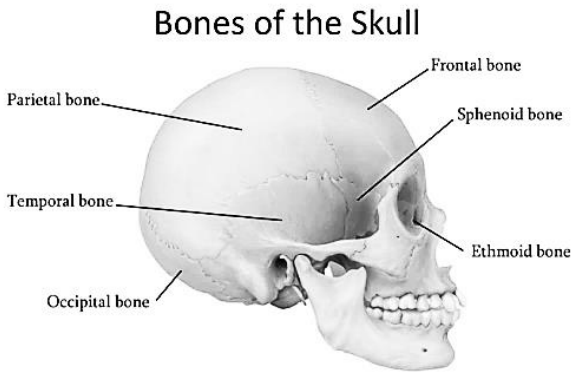
Four; superior, lateral, inferior, and anterior. The superior is the front and upper portion, or that containing the intellectual brain. The lateral, is the sides. The inferior, the base of the head. The anterior, the face.

WHAT ARE THE CAVITIES OF THE SKULL CALLED IN WHICH THE EYES ARE PLACED?

The orbits of the eyes. These are hollow cones for the lodgment of the eyeballs with their muscles, vessels, nerves and glands.

HOW MANY BONES ARE THERE IN THE HEAD?

Sixty-one, above the upper joint of the neck, including the teeth.



HOW MANY BONES ARE THERE THAT GIVE SHAPE TO THE SKULL?

Eight, and these are united together at their edges. These edges which lap into each other somewhat resemble saw teeth. These ragged pieces of bone uniting the parts of the skull together (see Fig. I) are called sutures, from the Latin sutura, to sew, because they look very much like the seam made by sewing two pieces of cloth with the "over-and-over" style of stitch.

HOW MANY BONES ARE THERE IN THE FACE?

Fourteen, besides the teeth.

ARE THERE ANY BONES IN THE EAR?

Yes; there are three bones in each ear, and these assist in conveying sound to the brain.

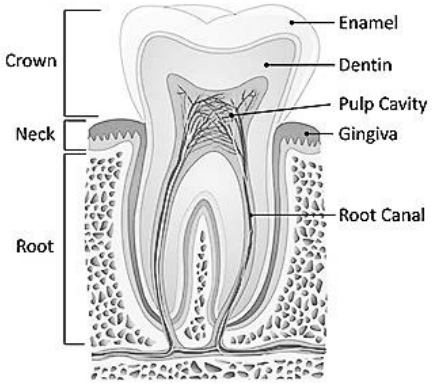
ARE THERE ANY BONES IN THE TONGUE?

Yes; there is one bone at the root of the tongue called os hyoides. It is used to support the tongue and upper part of the larynx, or windpipe.

THE TEETH

WHAT DOES THE FIGURE TO THE RIGHT ILLUSTRATE?

It illustrates the formation of the teeth, their nerves, etc. The infant set are in the jaws, while the outlines of the second set are also observable.



Keep your eye on this figure while answering the following questions.

HOW MANY TEETH HAS THE HUMAN BEING?

The permanent teeth are thirty-two in number, sixteen in each jaw.

HOW MANY PARTS ARE THERE TO THE TOOTH?

There are three parts; called the crown, the neck, and the root. The crown is that part which is seen above the jaw, the neck is that portion clasped by the upper rim of the socket, and the root is that part within the gum and socket, which is fastened to the jawbone.

OF WHAT ARE THE TEETH COMPOSED?

Of a firm crust, called enamel; the tooth bone proper, called the ivory, and a cortical substance, called cementum. The enamel covers the exposed surface of the crown, and the cementum forms a thin coating over the root of the tooth. These become thinner in old age.

ARE THE TEETH, LIKE ALL OUR OTHER BONES, MADE FROM OUR FOOD?

They are; and like the other bones, are composed largely of lime, but unlike our other bones, are exposed to the immediate action of the air and foreign substances.

IN WHAT OTHER RESPECTS DO THE TEETH DIFFER FROM THE OTHER BONES?

They are composed of a much harder material. The ivory of the tooth is much harder than bone, and the enamel is still harder.

WHAT IS THE USE OF THIS ENAMEL?

It gives the teeth strength, as well as hardness, for biting, chewing, and grinding the food; it also prevents injury from these operations, and from the action of acids on the bone of the teeth; it also adds much to their beauty.

IF THIS ENAMEL IS BROKEN, DOES IT FORM ON THE TOOTH AGAIN?

When the enamel is once destroyed it is seldom, if ever, restored again. When it is once broken the teeth are liable to rapid decay. It is important to use our teeth carefully in this respect, and not use them to crack nuts, or bite very hard substances, lest in after time we be deprived of their more important use in grinding our food.

ARE THE TEETH SUPPLIED, LIKE OUR OTHER BONES, WITH BLOOD VESSELS AND NERVES?

They are; and as most people have occasion to know, these nerves are endowed with life, and also an exquisite sensibility, which is the more apparent when the teeth become decayed.

HOW MANY TEETH HAS A YOUNG CHILD?

Twenty; ten in the upper, and ten in the lower jaw.

WHAT CARE IS NECESSARY IN RELATION TO THE TEETH OF CHILDREN?

When a child is from five to seven years of age, the teeth loosen, when they should be immediately removed; otherwise they will prevent the proper formation and regularity of the new and permanent teeth, which are growing under them. Some persons permit their children to eat candies and sweetmeats with their first set of teeth, and manifest but little care for them; but it should be borne in mind that the same nerves and blood-vessels that are

connected with the first set of teeth, are at the same time communicating with the embryo forms of the second set, which are forming beneath them. The nature of the second set in a great measure depends on the nature and care of the first set. Disease of the child's teeth then may cause them many ills in after life.

WHY IS IT NECESSARY FOR THE HUMAN MOUTH TO BE FURNISHED WITH TWO SETS OF TEETH?

The gradual growth of the body, renders it necessary that our little jaws should be furnished with a set of teeth in childhood, which are too small to fill up our jaws when our system is fully developed, and too small to answer the purposes of mastication through life; and hence the all wise Creator has established a law in our system by which the small teeth of our childhood are removed, and their places supplied with a larger, permanent set, which are better fitted for mastication.

WHAT IS THE DIFFERENCE BETWEEN THE FIRST AND SECOND SETS OF TEETH?

The first teeth, or those of a child, only pass through the gum socket which is fastened to the jaw, while the second set grow out of the jaw itself, between the roots of the first set of teeth; so if the first are not removed, the second set must force their way inward or outward between them.

HOW MANY DIFFERENT KINDS OF TEETH HAVE WE?

Three; four cutters, or front teeth, in each jaw; two pointers, or eye teeth, in each jaw; and ten grinders, or back, double teeth, in each jaw; half on each side of the face.

WHAT IS THE MOST IMPORTANT USE OF THE TEETH?

Their leading and most important use is to cut and chew, or grind the food so finely that it may be mixed with the saliva, or the moisture of the mouth, before passing into the stomach.

IF WE HAD NO TEETH, WOULD WE HAVE THE PLEASURE IN EATING WE NOW ENJOY?

No; for then our food would need to be mostly liquid or semi-fluid.

ARE THE TEETH OTHERWISE USEFUL?

Yes; they assist the voice in talking, reading aloud, and singing. If a person loses two or three front teeth, he talks, reads, and sings, in a hissing, disagreeable

manner. The loss of teeth prevents a person from giving the correct sounds of many letters, and from articulating distinctly.

SHOULD WE NOT DO EVERYTHING IN OUR POWER TO PRESERVE OUR TEETH?

Yes; we should never pick nor scratch them with pins or pocket knives; for these break the enamel. Quill or wooden tooth picks may be useful in removing any particles of food that may not be readily reached by the brush, but metallic tooth picks should never be used.

IN WHAT OTHER WAYS ARE THE TEETH INJURED?

By taking into the mouth food or drink which is either too hot or too cold, by smoking or chewing tobacco, by using acid drinks or fruits which set the teeth on edge. Hot substances taken into the mouth serve more directly and powerfully to destroy the teeth than any other cause which acts immediately upon them.

WHY ARE THE TEETH OF EUROPEANS GENERALLY BETTER THAN THOSE OF AMERICANS?

The principal reason is, their food is more simple, and their habits more temperate and uniform, than those of Americans.

HOW CAN WE CARE FOR THE TEETH?

The teeth should be cleansed with a brush or a soft piece of flannel, and tepid water, after every meal, but more especially before retiring to rest, and again after rising in the morning. Some refined soap may be occasionally used, to remove any corroding substance that may exist around or between the teeth. The mouth should be rinsed after its use. Soft water is always best for the teeth. If the teeth are closely set together, drawing a thread between them occasionally will be of great benefit.

WHAT IS THE CAUSE OF THE PAIN CALLED "TOOTH-ACHE?"

When a tooth is so decayed that its inflamed nerve is exposed to the air, it causes tooth-ache. Sometimes food crowded against the bare nerves in eating, produces the same effect.

WHAT SHOULD WE DO WITH DECAYED TEETH?

If any of our teeth have begun to decay, a dentist should be consulted as soon as possible, and the cavities filled with gold. Natural teeth, if partly filled with gold, are always better than artificial teeth. When teeth are past filling, they

should be immediately removed, otherwise they will cause decay in adjoining teeth, give rise to neuralgic pains, or cause maxillary abscess, which is known by a severe and obstinate pain in the face, just below the eye, near the nose. Sometimes this disease causes discharges of offensive matter from the nose, it also produces bad breath, and affects the general health. It may be years in forming, and be mistaken for common tooth-ache.

WHAT IS ANOTHER GREAT LEADING CAUSE OF THE PREMATURE DECAY OF TEETH?

Their disuse. The more the teeth are regularly and properly used for the purposes for which they were intended, that of masticating and preparing the food for the stomach, the more healthy they will be, and the less liable to decay. Experience shows that the teeth decay the most rapidly between the ages of fifteen and thirty. So that youth need to give the most special attention to their teeth.

WHO HAVE GENERALLY THE BEST TEETH?

Those who have the best health. Therefore to assist in preserving the teeth, the stomach and lungs should be kept in as healthy a condition as possible. The proposition we think is correct, that diseases of the nervous system affect the teeth, and also diseased or decaying teeth have a powerful effect upon the general health. The loss of the teeth cripples the natural action of the system - lessens the action of the salivary glands, and to some extent shortens life.

WHAT ARE THE BONES OF THE CHEST?

The sternum, or breast-bone in front, and the twelve pairs of ribs on the side, and these constitute the thorax. See Fig. I.

WHAT IS THE STERNUM, OR BREAST-BONE?

It is that bone which lies directly in the central line of the fore part of the chest; its upper end lies within a few inches of the vertebral column, while its inferior extremity projects considerably forward. It is about eight inches in length, and one and a half inches in width.

WHAT IS THE FORM OF THE RIBS?

They grow out of the spine, or back bone, on the back side, forming a hoop by meeting and being fastened to the breast bone in front.

DO ALL THESE RIBS GROW DIRECTLY TO THE BREAST BONE?

The first or upper seven pairs, grow directly to the sternum. The five lower pairs are called false ribs, and are connected with each other in front by cartilages, or a substance somewhat like bone, but more pliable and spring-like.

ARE ALL THE RIBS OF ONE SIZE AND SHAPE?

No; they increase in length from the first to the eighth, and then diminish in length to the twelfth. In breadth they diminish from the first to the last, except the two lower ones. The first is horizontal and all the rest oblique. The two lower ribs are called floating ribs.

OF WHAT USE ARE THE RIBS?

They are the frame-work of that part of the human trunk termed the chest, in which the lungs and heart are deposited for safe keeping.

IS IT IMPORTANT TO CARE FOR THIS FRAME-WORK?

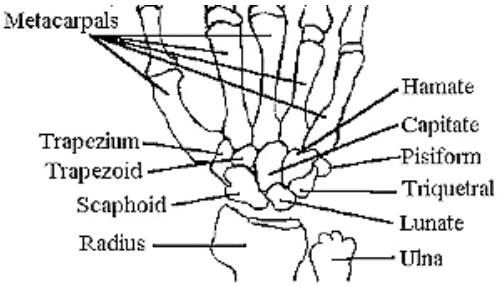
It is. If we wear our clothing too tight, we diminish the size of the chest, crowd the lungs, heart, and other organs, and hinder their healthy action. By sitting, or standing in a stooping posture, the lower end of the sternum is crowded upon the stomach, which injures and weakens it. Men or women who wear tight clothing over the lower ribs must injure their health.

WHAT DO THE BONES OF THE UPPER EXTREMITIES COMPRISE?

They are the clavicle, or collar bone; the scapula, or shoulder blade, a large, flat, triangular bone back of the shoulder; the humerus, or arm bone; the ulna and radius, or bones of the forearm; these two move at the elbow similar to a door hinge. The word ulna is Latin, and means an ell. This bone is so named because in early times it was used as the measure of an ell; the carpus, or the eight bones in two rows across the wrist; the metacarpus, or five bones of the palm of the hand; the phalanges, or fourteen bones of the fingers.

WHAT DOES THE FIGURE TO THE RIGHT REPRESENT?

The carpus: lower end of the radius; lower end of the ulna; connecting cartilage; first row of bones in the wrist; second row of bones; the five bones of the palm of the hand, to the end of which the phalanges, or finger bones are attached.



WHAT IS THE PELVIS?

The pelvis is that part of the human body which is fixed in relation to the rest, and about which all the rest move; beneath it the lower extremities walk, and above it the back bone is movable. It is a collection of bones at the lower end of, and attached to, the vertebral column. The upper part of it serves as a support to the abdominal organs. To the lower sides of it the thigh bones are attached.

WHAT ARE THE BONES OF THE LOWER EXTREMITIES?

The femur, or thigh bone, which is the longest bone in the body; the patella, or knee-pan, which is heart-shaped in figure, and is connected with the lower portion of the thigh bone; tibia and fibula, or the bones of the leg; the tarsus, or seven bones of the ankle; the metatarsus, or the five bones of the foot; the phalanges, or fourteen bones of the toes. The bones of the tarsus and the metatarsus correspond, somewhat, to those of the carpus and metacarpus of the figure above.

ARE THERE ANY OTHER BONES IN THE HUMAN BODY?

Yes; there are what are called sesamoid bones. These are formed in tendons, and are a sort of pulley on which the tendons of the body play. They are also placed over joints. The knee-pan is one of them. There is one of them on the joint of the thumb, and of the little finger, and in other parts.

ARE THE BONES OF THE BODY MOSTLY IN PAIRS?

All the two hundred and forty-six bones of the body, except thirty-four, are found in pairs, or one on each side of the body.

WHAT IS THE CONNECTION BETWEEN ANY TWO BONES CALLED?

A joint or articulation. It is by means of these joints that the various motions of the bones are easily made.

HOW MANY JOINTS ARE THERE IN THE HUMAN BODY?

Over two hundred, all perfectly adapted to their various positions and work.

HOW MANY MOTIONS CAN BE MADE BY THE JOINTS?

The motions of the joints are four. The first is where the bones slip over one another, which is the case in all joints. The second is angular movement, as up and down, right and left, or such motions as you can make with your fore finger sidewise, and by bending and straightening it out. The third motion is circular. It consists in moving the bone around in a circle with the joint as a center, such as you make in whirling your arm around the shoulder joint. The fourth motion is called rotation, such as the moving of the atlas on the axis in the neck.

WHAT IS THE CONSTRUCTION OF A MOVABLE JOINT?

The opposing surfaces are coated by an elastic substance called cartilage, this is lubricated - oiled - by a fluid called synovia, which is secreted in an enclosed membrane or bag, called synovial.

HOW ARE THE BONES HELD FIRMLY TOGETHER?

By bands of glistening fibers, called ligaments. These are mostly short, and attached only to the enlarged extremities of the bones. In such joints as that of the shoulder and hip, there is between the ends of the bones what is called the round ligament. It is a bundle of fibres in the form of a cord. It is used to keep the head of the bone from slipping out of the socket, and at the same time it allows the most perfect freedom of motion.

HOW ARE THE JOINTS KEPT IN THEIR PLACES, OR THE BONES FROM GETTING OUT OF JOINT WHEN THEY ARE MOVED?

There are ligaments formed about all the joints, sometimes constituting bands of various breadths and thicknesses, and sometimes layers of these bands are extended around the joints. These serve the same purpose in the human frame as the pins in a frame building. Instead, however, of clumsy joints being made and pinned together, a few tough fibres and membranes, secure at once, in a most perfect manner, every portion of the frame, and provide at the same time means for its lubrication. Some of the ligaments are situated in the joint, like a central cord or pivot, and some surround it like a hood.

WHERE ARE THE LIGAMENTS PRINCIPALLY FOUND?

The ligaments bind the lower jaw to the temporal bones, the head to the neck, extend the whole length of the back bone in powerful bands, both on the outer surface, and within the spinal canal, and from one spinal process to another; and bind the ribs to the vertebrae, and to the spinal projection behind, and to the breast bone in front, and this to the collar bone, and this to the first rib and shoulder blade, and this last to the bone of the upper arm at the shoulder joint, and this to the two bones of the fore-arm at the elbow joint, and these to the bones of the wrist, and these to each other, and those of the hand, and these last to each other and those of the fingers and thumb. In the same manner they bind the bones of the pelvis together, and the hip bones to the thigh bone, and this to the two bones of the leg and knee-pan, and so on to the ankle, and foot, and toes, as in the upper extremities.

WHAT CAN YOU SAY IN GENERAL OF THE CARTILAGES AND LIGAMENTS?

They unite, and bind the whole bony system together in a powerful manner, so as to possess in a wonderful degree mobility and firmness. The ligaments and cartilages are in health destitute of animal sensibility. They are soft and yielding in early life, and become more dry, rigid, and inflexible in old age.

WHAT OTHER USEFUL CONTRIVANCE IS CONNECTED WITH THE JOINTS?

In all the movable joints the articulating surfaces of the bones are covered with dense and highly-polished cartilages, by which means the joints are enabled to act with great ease and little friction, and at the same time it constitutes a cushion which breaks in a great measure the sudden jar which otherwise would be felt in the head, when walking or suddenly moving the limbs. It protects the brain in the same manner that the springs of a carriage prevent a sudden jolt. Cartilage is also employed separately from the bones in forming some of the cavities, etc., as the larynx, wind-pipe, part of the nose, etc.

HOW MANY KINDS OF JOINTS ARE THERE?

Three: fixed, or such as the joints of the skull and upper jaw, teeth and vomer; 1 movable, such as the shoulder, hip, elbow, wrist, knee, ankle, carpus, and tarsus; intermediate, or such joints as those in the vertebral column.

WHY ARE THE BONES OF THE BODY MOSTLY CYLINDRICAL, OR HOLLOW?

To secure great strength with as little material as possible. Were the bones of the human skeleton made solid, it would be so heavy and cumbersome that it

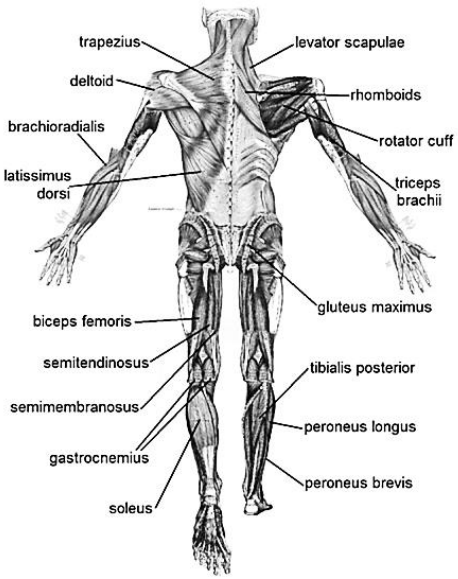
would require a larger amount of muscles, making the body unwieldy, and thus depriving it of its rapidity and ease of motion.

IS THERE ANY OTHER PECULIARITY IN THE BONES NOT ALREADY MENTIONED?

The bones are closely covered with a very firm, whitish-yellow membrane, very smooth, this is called the periosteum. This membrane encloses the vessels which carry nutriment into the bones. It is to this periosteum that the ligaments and tendons are attached, as they cannot fasten to the bone itself. In fever sores and felons the disease begins in most cases in the periosteum of the bone, or the tendons, but if not checked it soon affects the bone itself. Cool baths, or a cool wet bandage upon the affected part during its fevered condition is good. Felons may many times be driven away by keeping the affected part immersed a long time in hot water. But much time and suffering can be saved by cutting a free gash through the felon into the bone through the periosteum. Cut a gash an inch long, at least.

ARE THERE OTHER DISEASES, OR DIFFICULTIES WITH THE JOINTS, OR BONES, THAT WE SHOULD GUARD AGAINST?

Yes; strains of joints, and dislocations, many times caused by wrestling. This is a dangerous exercise, and should give place to milder sport. Inflammation in sprains should be allayed with the cool wet bandage, covered, of course, by dry flannel. Violent jerking of the arms in gymnastics should be avoided, as it is liable to cause synovitis, or disease of the joints.



THE MUSCULAR SYSTEM

The muscles: their construction, number, power and manner of action. - Muscles of the head and face, neck, back, chest, limbs, etc. - Pairs of muscles. - Muscles of the alimentary canal. - Disadvantageous action of muscles. - Rapidity of muscular motion. - Care of the muscles. - Muscular exercises. – Fascie.

WHAT ARE THE MUSCLES?

The moving organs of the body. Their grand peculiarity is their power of contraction, which is as wonderful as anything in nature. This is the element of all voluntary motion, and most, if not all, positively involuntary motion, in the living body. All the great motions of the body are caused by the movement of some of the bones which constitute the frame-work of the system; but these, independently of themselves, have not the power of motion, and only change their position through the action of other organs that are attached to them, which by contracting, draw the bones after them. In some of the slight movements, as the winking of the eye, no bones are displaced. The organs which perform this remarkable work are called Muscles. The red color of the muscles is owing to the presence of the numerous blood vessels which they contain.

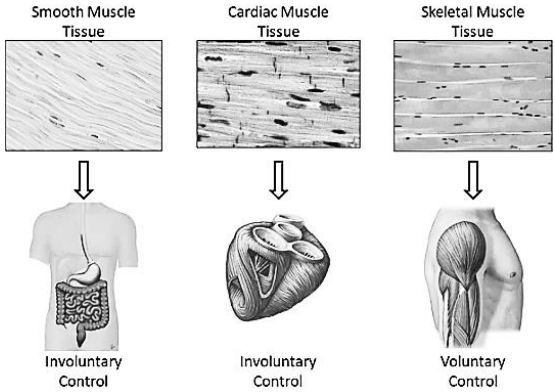
OF WHAT ARE THE MUSCLES COMPOSED?

They are composed of parallel fibers, of a deep red color, constituting lean flesh. Any person can examine a piece of boiled beef, or the leg of a fowl, and see the structure of the fibres and tendons of a muscle.

OF WHAT SHAPE IS A MUSCULAR FIBER?

It is long, round, and fine, like a thread. Any piece of lean meat can be easily divided in one direction into stringy fibers, which, by the use of appropriate instruments, can be subdivided till fibrils are reached, not so large as hairs, composed of a sheath enclosing minute particles, shaped like beads, placed end to end. Some might suppose lean meat had no regular shape, but the above proves that it has.

The lean portions of our bodies are arranged in perfect order, as may be seen by observing Fig. IV, at the head of this chapter.



HOW ARE THE FIBRILS THAT CONSTITUTE MUSCLES HELD TOGETHER?

By a delicate web or sheath, which is perforated with minute tissues or cavities, and these become

so compact together at the ends of the muscles as to form glistening fibers and cords, called tendons, or sinews, by which the muscles are attached to the periosteum, or surface of the bones. A few of the muscles resemble in structure a ribbon; others a cord; others are thin and expanded, so that they resemble a membrane. The muscles present various modifications in the arrangement of fibres, as relates to their tendinous structure.

HOW MANY MUSCLES ARE THERE IN THE HUMAN BODY?

It is supposed that there are not less than four hundred and seventy distinct muscles of voluntary motion in the human body; about twice as many muscles as there are bones. They are nearly all arranged in pairs, each side of the body having the same kind. These are so arranged and adjusted, as to position and connection, that by the contractions of the different pairs, or individual muscles, all the voluntary motions of the lower limbs are performed. The function of respiration - which to a certain extent, is both voluntary and involuntary - also employs some of these muscles.

HOW MUCH OF THE BODY IS MUSCLE?

The greater portion of the bulk of the body is composed of muscular tissue. It is the muscle that gives the body its plump appearance. These muscles not only serve as a means of moving the body, but, in the limbs, they invest and protect the bones, and some of the joints. In the trunk they are spread out to enclose cavities, and form a defensive wall, capable of yielding to external pressure and again returning to its original position.

HOW ARE MUSCLES MOVED?

By contracting, or shortening. When a piece of India rubber has been stretched and you let go of it, it contracts. These cords have power to lengthen and shorten somewhat like rubber. Some muscles in contracting pull at one end, and some at both their ends.

HOW ARE ALL THE ACTIONS AND MOTIONS OF THE VARIOUS ORGANS OF THE BODY PRODUCED?

By the alternate contracting (shortening) and expansion (lengthening) of these muscular fibers. These muscles are so arranged as to act as antagonists to each other, some displacing a part, and some replacing it; and therefore they are termed the flexor and extensor muscles. The flexor muscles are considered to be generally more powerful than the extensor, and hence, when the WILL

ceases to act, as in sound sleep and death, the body and limbs are partially fixed or bent.

OF WHAT ARE THE MUSCLES COMPOSED?

Of bundles of fibers enclosed in a sheath; each fiber is composed of smaller bundles, and each bundle of single fibers called ultimate fibers. By a microscope it is seen that these ultimate fibers are composed of finer fibers called fibrils.

WHAT IS THE APPEARANCE OF THE END OF ONE OF THESE FIBERS THROUGH A MICROSCOPE?

It presents to us an appearance similar to that of the end of a compact bundle of very fine straws.

HOW MANY KINDS OF MUSCULAR FIBER DO ANATOMISTS DISTINGUISH?

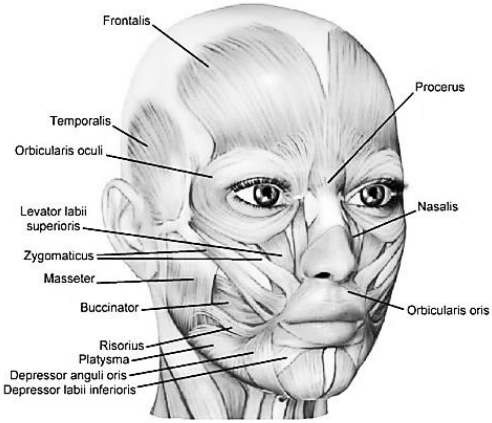
Two: those of voluntary or animal life, those under control of the will; and those of involuntary or organic life, such as are used for breathing and digestion. Muscular fibers of animal life are composed of these bundles of fibrils, while the muscular fibers of organic life are flat, and are held together by fibers which are composed of a dense form of the same tissue. The muscles of animal life are developed on the external part of the body and are mostly attached to the bones, and they comprehend all of the muscles of the limbs and trunk, while the muscles of organic life are formed from the internal or mucous layer, and are situated in the hollow organs composing the respiratory, digestive and circulatory apparatuses.

WHEN THE MUSCULAR TISSUE IS ONCE DESTROYED, IS IT EVER RESTORED AGAIN?

Never; but when the muscles are wounded, with or without the loss of their substance, the breach is healed, and the parts united, by what is called areolar tissue, which is wholly insensible to the action of stimulants.

MUSCLES OF THE HEAD AND FACE

WHAT DOES FIGURE TO THE RIGHT ILLUSTRATE?

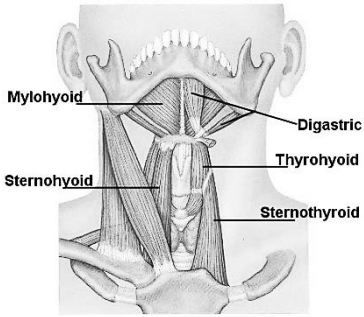


This figure illustrates the muscles of the head and face. muscle moving the eyelids; muscle used in drawing the top of the head backward; point of attachment of muscles used in opening and closing the eye; muscle that draws down the corner of the eyelid; muscle used to expand the nostrils; muscle surrounding the mouth, used in closing the lips; muscle used to elevate the upper lip and expand the nose; muscle used to elevate the upper lip; muscles that pull the angle of the mouth upward and outward, and are used in laughing; the muscle which pulls the lower lip downward and outward; muscle which pulls the angle of the mouth downward and outward, is used in making expressions of grief; muscle that raises and protrudes the chin; muscles used to move the jaw in chewing; muscles which in lower animals move the ear; they have but little motion however in the human body; the covering of a muscle;, muscles which, with their attachments to the neck, are used to move the lower jaw downward; muscles used in the movements of the head and shoulders.

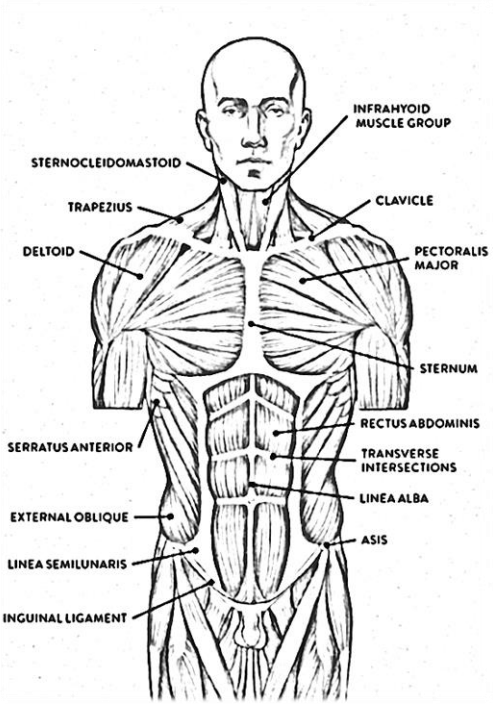
HOW MANY GROUPS OF MUSCLES ARE THERE IN THE HEAD AND FACE?

There are eight groups of muscles, namely: 1 for moving the eyebrows; 3 for moving the eyelids; 7 for moving the eyeballs; 3 for moving the nose; 7 for moving the lips; 3 for moving the chin; 5 to assist the lower jaw in the motions necessary in masticating food. One of these muscles passes over the temple, and is called temporal, from tempus, time, because here the hair begins to turn gray; 3 muscles of the ear. The muscles used for chewing food are attached to the lower jaw, near the joint; if their position was near the front part of the bone they would not contract sufficiently to bring the jaws together.

HOW MANY GROUPS OF MUSCLES ARE THERE IN THE NECK?



There are eight: The first has 2 muscles, used to bow the head forward; the second has 8 muscles, 4 depressors and 4 elevators. The depressors pull down the os hyoides, or bone of the tongue. The 4 elevators raise the os hyoides when the jaw is closed; the third has 5 muscles, and these aid the tongue in all its movements; the fourth has 5 muscles, which are used in swallowing food; the fifth has 3 muscles, used in all the motions of the palate; the sixth has 5 muscles, passing from the sides of the head down on to the breast, used to steady the head, and to lift the ribs as we draw the head backward in inhaling a long breath; the seventh consists of each of those muscles used in varying the tones of the human voice; the eighth has 8 muscles, those of the larynx - Adam's apple; also used in producing articulate sounds. The muscles of the above eight groups, then, are those adapted to move the head and neck on the spinal column, to raise the shoulders, to control the motions of the mouth and throat, and to produce the sounds of the voice.



HOW MANY LAYERS OF EXTERNAL MUSCLES ARE THERE IN THE BACK?

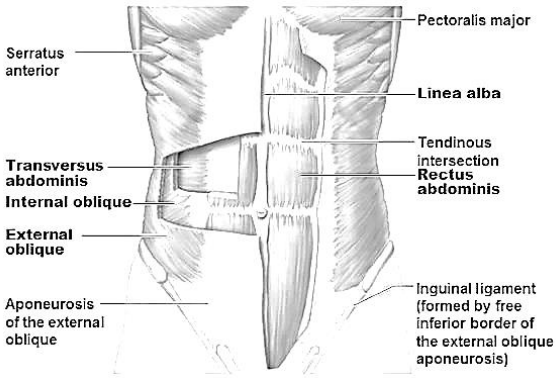
There are six layers, composed of at least thirty pairs of muscles. They give a firm attachment for muscles to move the extremities, and keep the trunk in an upright position. The first layer has 2 muscles and the second has 3, and these two layers give all the different motions to the shoulders; the third layer has 3, some of which are used in raising and

depressing the back portion of the ribs in breathing, and some are used to give the spinal column its slight motion from side to side; the fourth layer has 7 muscles, holding the vertebral column erect, and assisting in steadying the head. When one of the muscles of this character act on one side alone they produce the rotation of the atlas on the axis; the fifth layer has 7 muscles. A portion of these contribute to the support of the back in an erect position. The others produce the rotary and other motions of the atlas on the axis; the sixth layer has 5 muscles. A portion of these raise the back part of the ribs in the inspiration of breath, the others help in supporting the body and holding the bones in position.

HOW MANY CLASSES OF MUSCLES BELONG TO THE THORAX OR CHEST?

There are three classes of muscles belonging to the chest, and these belong also to the upper extremities. The first class is 11 internal muscles; the second class is 11 external muscles. These muscular, cordy fibers fill the spaces between the ribs outside and within the front of the chest, and they cross each other; the third class is situated within the chest, and connects the breast bone with the ends of this first and second class of muscles, and also connects them with the cartilages of the second, third, fourth, fifth, and sixth, ribs. The lower fibers of this muscle connect also with the internal muscles of the abdomen. These three classes of muscles raise and depress the ribs and draw down the cartilages of the ribs, and thus assist in breathing.

HOW MANY MUSCLES REGULATE THE MOVEMENTS OF THE ABDOMEN?



Nine, and the ninth of these is called the diaphragm. It is a partition across the body just below the lungs, with an opening near the center. It separates the thorax from the abdomen. Its point of attachment to the body is just below the ribs. When the diaphragm is relaxed, it presents the appearance of an inverted and irregularly-shaped cup. When in a state of contraction its surface is nearly a plane. This muscle enlarges the chest by depressing its lower surface, as in the

case of holding a full breath in the lungs. The nine muscles of the abdomen assist in drawing down the ribs, in drawing in the small of the back, or in turning the abdomen sidewise. They also diminish by their action the size of the abdomen, and thus assist in breathing.

MUSCLES OF THE TRUNK

WHAT DOES THE FIGURE TO THE RIGHT REPRESENT?

In figure to the right are seen the front muscles of the trunk are muscles used in moving the shoulder; a muscle raising the ribs by the movement of the shoulder. It is this muscle which draws the shoulder forward in a case of diseased lungs; muscles used in raising the shoulder, or in producing its rotary movements; muscles used in movements of the arm and shoulder; muscles moving the ribs in breathing; muscles moving the abdomen, and to bend the body forward. They are used in laughing, crying, singing, and shouting; the principal muscle for throwing the leg forward, called Poupart's ligament. The other numbers indicate the muscles supporting the abdomen, and assisting in the motions of the hip joint.

HOW MANY MUSCLES ARE THERE CONNECTED WITH THE OUTLETS OF THE BOWELS?

There are 8, all acting their part in carrying waste matter from the system.

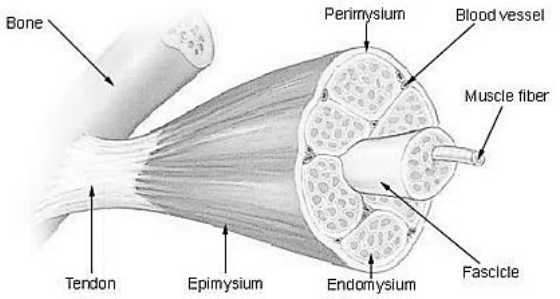
HOW MANY MUSCLES ARE REQUIRED FOR THE MOVEMENTS OF THE ARMS AND FINGERS?

There are about 46 muscles to each arm. And in order that the fingers may be slender, and easily moved, the muscle that moves them is placed in the fore arm, and the tendons for the movement of the hands and fingers are made as slender as possible. Some of these extend only to the wrist to bend it upon the arm. Some of them pass to the very finger ends, passing under a ligament like a bracelet, at the wrist.

HOW MANY MUSCLES ARE THERE IN EACH LEG AND FOOT?

About 52 in each leg and foot, and these are used to make all the different motions of the leg and foot. Some of them are attached to a small ligament at the knee, called the patella - knee-pan - which serves the purpose of a fulcrum over which the cord pulls in moving the lower limb and foot. These muscles are all advantageously disposed of for power, and are so arranged as to hold the limb erect, and to balance the body upon the upper portion of the limb.

HOW MUCH IS IT SUPPOSED THAT A MUSCLE CONTRACTS, AND WHAT IS THE PROCESS OF THE CONTRACTION OF A MUSCULAR FIBRIL?



It is supposed that muscles are capable of contracting about one third their length. This contraction or shortening of the fiber is owing to a change in the diameter of the component parts of an ultimate fibril. This action may be well illustrated by placing a dry rope in water: wetting it increases its diameter but shortens its length. The beaded portions of the fibrils are at rest. The diameters of those portions are greatest lengthwise of the fibrils. When the muscle is contracted, and the beaded portions have their longest diameters crosswise of the fibrils. The natural state of a muscle is what is called its tonicity, and it is supposed to be a constant strain or stretch. This keeps the muscle in a position in which it is always ready for action. Just what the element is that causes the motion of muscle is not yet decided. It is certain however that a good supply of oxygen and electricity in the blood greatly facilitates the action of the muscle, and so muscular exertion can be continued for a much longer time in the open air than otherwise.

WHICH IS THE LARGEST TENDON IN THE BODY?

It is the one which is attached to the calf of the leg, extending down to the heel, and which is used to raise the body upon the toes. It is called the tendon of Achilles, because the great Grecian warrior Achilles is said to have been killed by the wound of an arrow in this tendon.

WHAT IS FOUND CONNECTED WITH THE MUSCLES?

Around the fibrilla of the muscle, but not entering into them, is woven a very beautiful net-work of very fine capillaries, communicating with arteries on the one hand and veins on the other, so that a plentiful supply of blood is constantly poured around the contractile elements of the muscle. Thus its exhausted energies are replenished, and its substance nourished. The veins receive the unappropriated blood, and conduct it back to the heart; and thus a continual stream of fresh arterial blood is poured through all the muscular tissue. By this means the vitality of the muscle is maintained. The involuntary

muscles are even more abundantly supplied with vessels than those of animal life.

WHAT OTHER PECULIARITIES ARE THERE IN THE ARRANGEMENT AND ACTION OF MUSCLES?

Each muscle is provided with one or more antagonistic muscles, or those that produce motion in an opposite direction. The only exception is in a few muscles of the head and neck. When one set of these muscles are contracted, the others must relax, otherwise the body would not move. Medicines that produce nausea, or sickness at the stomach, will relax all of these muscles. Another peculiarity is, that all the component parts of a muscle do not contract at once, but one portion of the fibrils contract, then another, and another, and so on. If the whole muscle contracted at once, its action must necessarily be very short. While the muscle is contracted decomposition is going on, and the blood is shut out of that portion of the muscle; but as different parts of the fibrils take up the process of contraction, there is a partial building up of the muscular structure from the nutriment of the blood, even while contraction of the other parts is taking place.

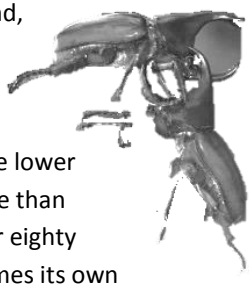
WHAT IS THE ARRANGEMENT OF THE MUSCLES OF THE ALIMENTARY CANAL?

As it is necessary in the performance of the general functions of the alimentary cavity, that there should be motion, as well as innervation and secretion, muscular fibers are everywhere attached to the back of the mucous membrane forming that cavity. The general arrangement of these fibers consists of two layers: the first composed of circular fibers, which surround the meat pipe, the stomach, and the small and large intestines, like rings, or sections of rings; the second layer is composed of fibers running lengthwise of the meat pipe, stomach, and intestinal tube. By the contraction of the circular fibers, the size of the cavity is diminished. By the contraction of the longitudinal fibers the parts are shortened. By their combined action they give the parts an undulating motion. This muscular coat is stronger and thicker, in the meat-pipe and stomach, than in the small intestine, and stronger in the small than in the large intestine. In the rectum, or outward terminus of the intestines, the muscular coat becomes thicker and stronger. In the pharynx the muscular coat is composed of six constrictor muscles, the fibers of which form sheets which cross each other in various directions. By the action of these muscles, both the length and caliber of the pharynx are diminished. In the stomach the fibers are arranged in three different directions: longitudinally, circularly, and obliquely.

The muscular coat of the alimentary organs, and particularly of the stomach and small intestine, is more or less developed in power and activity, according to the character and condition of the food on which the person habitually subsists. That food calling for a proper amount of muscular action in the stomach and intestines increases their strength, while food of an opposite kind conduces to emaciation, and inactivity of those fibers, rendering the action of the stomach and bowels sluggish and feeble.

DO THE MUSCLES ACT AT THE GREATEST ADVANTAGE, OR ARE THEY SO ARRANGED THAT POWER IS SACRIFICED TO SAVE TIME?

The attachment of muscles for the movement of the body is at a great disadvantage. The point of attachment of the muscles which are to move the forearm and hand. If the muscle was attached from the arm to the elbow, more weight could be lifted than with an attachment from arm to the point of attachment of the muscles which are to move the forearm and hand; but it would take more time to lift it as the muscle would have to contract more. And with the present contractile power of a muscle it would not contract sufficiently to raise the hand to the head. The muscles are usually attached near the joints, and as a hand near the hinge of a gate must use great exertion to move it; and as the hand near the hinge moves but little and slowly to move the farther end of the gate rapidly, so with the action of muscles are arranged with reference to saving time, but it is an expenditure of force. All muscular action, as we have shown, is attended with a great waste of muscular fibril, so no more muscular exercise should be put forth than is necessary for health and to accomplish our necessary work. For this reason farmers, mechanics, and all laboring classes, should have their tools handy, and calculate their work to save all unnecessary steps and blows; let the "head save the heel." Houses should be arranged so that the woman's work will be handy, and all useless steps avoided. It will save the health of women who otherwise would be overworked.



A person raising a hundred-pound weight in the hand, exerts a force on the muscle equal to eighteen hundred pounds. The act of leaning over and straightening up is a strain on the muscles of the legs of many thousand pounds. The muscles of some lower animals are much stronger in proportion to their size than those of man. A flea harnessed, will draw seventy or eighty times its own weight, while a horse draws but six times its own

weight. The common beetle bug has been known to throw a weight placed upon it three hundred and twenty times heavier than itself.

WHAT EXAMPLES ILLUSTRATE THE RAPIDITY OF MUSCULAR MOVEMENT?

Some persons have pronounced as many as 1500 letters in a minute, combined of course in words; but to do that, it would require the contraction and

relaxation of one or more muscles to each letter, each contraction occupying not more than one-fiftieth of a second. The wings of some animals must move many thousand times in a minute to produce the humming which is heard while their wings are in motion. Some birds fly 60 feet in a second, while a race horse scarcely exceeds 40 feet in the same time. A falcon of King Henry II, flew from Fontainbleau to Malta in one day, a distance of about one thousand miles. The precision of muscular movement is seen in the rapidity with which a singer can accurately strike notes in any part of the scale. These sounds are all produced by contracting and relaxing the muscles of the larynx.

HOW MAY THE MUSCLES BE STRENGTHENED, AND KEPT IN A HEALTHY CONDITION?

The muscles, to be kept healthy, should be used. Using the muscles increases the flow of the blood through them, and thus the waste, or decomposed particles, are carried off, and nutritive particles are placed in their stead. Plenty of exercise in the open air is imperatively necessary for a healthy condition of body in students, professional men, in-door mechanics, and females. Farmers who work in the open air, if not overworked, enjoy the benefits of the wholesome air of heaven. This exercise should be in a condition free from care, or burdening of the brain, thus giving the blood a chance to flow healthfully through all the system. These exercises in the open air are better, because then the oxygen is freely inhaled into the system, and thus through the blood the muscular system is built up. The air contains more oxygen in cold

than in warm weather, and therefore greater muscular activity can be attained in winter than in summer, and for this reason, other conditions being equal, the body will gain in weight faster in winter than in summer.

WHAT ELSE IS NECESSARY IN RELATION TO MUSCULAR EXERCISE?

Muscular exercise, or labor, is more conducive to health, and more of it can be endured, if it is done gradually, than if a violent exertion is made. After work we need repose. After the muscles have been used violently, or after vigorous exercise, the muscles should gradually be brought into a state of rest. Sleep is the grand restorative after severe muscular exertion; this alone gives back to the muscle its life and strength.

MENTION SOME OF THE MOST HEALTHFUL EXERCISES?

Riding on horse-back, walking, climbing mountains, running up and down stairs, sawing wood, planing boards, rotary motions with both arms extended while the lungs are filled with air, or carefully moving the arms back till the backs of the hands touch if possible.

WHAT SHOULD BE THE POSITION OF THE BODY IN STANDING OR WALKING IN ORDER TO PROPERLY DEVELOP THE MUSCLES?

The body should be upright; with the head, shoulders and hips thrown back, and the breast forward. Constant bending over will cause a round-shouldered, crooked, mean, diminutive appearance. But the appearance is the smallest evil. It causes the bones of the chest to press upon the internal organs of the body, and hinders their healthy action, causes short breathing, and pain in the chest, weakness of the lungs, and finally consumption. A person who stands erect, can stand with more ease, labor better, and travel farther in a day, than one who stoops. Students, when sitting at their studies, or in writing, should avoid a stooping posture. If we always keep the body in a proper position it will tend to make the back bone firm and strong. In all bodily or mechanical labor the body should be bent, or lean on the hip joints; the trunk should be kept as straight as possible.

WHAT CAN WE SAY, IN CONCLUSION, OF THE MUSCULAR SYSTEM?

The muscles of the human system are a wonderful combination of flexible cords, by which, in an instant, the body, or any part of it, may be moved by the will in almost any conceivable direction.

WHAT PROTECTING COAT INVESTS THESE SOFT STRUCTURES, AND THE DELICATE ORGANS OF THE BODY?

They are everywhere invested by bandages, called fascie. They are composed of fibrous tissue of various thickness, and are divided into two classes, called cellulo-fibrous, and aponeurotic.

WHAT OF THE CELLULO-FIBROUS FASCIE?

It invests the whole body between the skin and deeper parts, and affords a medium of connection between them. It is composed of fibrous tissue, arranged in a cellular form. It affords a yielding and elastic structure, through which the minute vessels and nerves pass to the papillary layer of the skin, without obstruction, or injury from pressure.

WHAT OF THE APONEUROTIC FASCIE?

It is strong and inelastic, composed of parallel tendinous fibers, connected by other fibers passing in different directions. In the limbs it forms distinct sheaths, inclosing all the muscles and tendons constituting the deep fascia. In the palm of the hand and sole of the foot it is a powerful protection to the structures.