A MANUAL

FOR

STUDENTS OF MASSAGE

BY

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MEMBER OF THE INCORPORATED SOCIETY OF TRAINED MASSEUSES

THIRD EDITION

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TO

DR. J. MADISON TAYLOR

OF PHILADELPHIA

AS A TOKEN OF GRATITUDE

FOR HIS KINDLY INTEREST AND HELP
PREFACE TO THE THIRD EDITION

For the third time my little Manual of Massage starts out again, and I trust on a path of increased usefulness, owing to the considerable additions, which, with the help of several medical men, have now been made.

Since its first appearance the sphere of massage has increased so much that the scope has necessarily been enlarged.

This small textbook is only intended to supply fundamental knowledge, and a general view of the ground covered by massage and allied treatments. It in no way pretends to supersede the *personal* tuition essential for acquiring the practical knowledge of massage, and should be regarded as a basis on which an ever-increasing superstructure can rest.

My thanks are especially due to the following medical men: Dr. J. Sawyer, of Birmingham; Drs. Hulbert and Freyberger, of London; Drs. J. Madison Taylor and C. de M. Sajous, of Philadelphia; Dr. R. W. Bowling, of Los Angeles; also to the authorities on anatomy, physiology, and manipulative therapeutics, whose works have been consulted.

For the diagrams, which so greatly enhance the value of this volume, I am indebted to Miss A. M. Stenning and Dr. Dupuy.

M. A. ELLISON.

Los Angeles, California,
June, 1909.

[ vii ]
MEDICAL PREFACE

It is a great pleasure to me to write a preface to Miss Ellison’s useful work on massage. I have carefully read through the chapters on the anatomy and physiology of the body, and have found there an embodiment of simplicity, clearness, and accuracy. The whole work is evidently the outcome of diligence and perseverance in overcoming the many difficulties which necessarily attend the study of both the theoretical and practical sides of massage.

There can no longer be any doubt as to the utility of massage as a therapeutic agency, and any effort made towards the cure of diseases by Nature’s means should be hailed with delight by the public, as well as by the medical profession. The muscles, forming as they do such a large proportion of the body, have a powerful influence upon health, yet their condition is very apt to be overlooked both by the profession and the laity, and thus a potent means of cure becomes neglected. Those who have made a special study of massage and muscular movements have been themselves astounded at the remarkable results obtained by the practice of a good system, not only in nervous disorders, but also in cases of affections, and even diseases, of the vital organs, and in deformities from muscular weakness, which is the commonest cause of spinal curvature. This becomes at once evident when one realizes the important role that muscles play in the human organism. They supply about four-fifths of the heat, and have been aptly called the furnaces of the body. If the fire burns low by reason of their flabby condition, is it to be wondered at that the functions of the body are badly performed, and that the tissues are badly nourished? Again,
by muscular movements, either active or passive (as in massage), the different organs are stimulated, the heart beats more vigorously, and the circulation is improved; the lungs do more work, the chest becomes expanded, and more oxygen is supplied to the blood; the digestive organs become more active, and their peristaltic action being increased, the food passes through the body at the proper rate, and sluggish digestion (the foundation of much of the ill-health of the present day) disappears. As the muscles improve in tone, so do the nerves which supply them with the power of contraction, and so also do the motor centres in the brain and spinal cord, to which these nerves are attached. Lastly, the very important function of excretion, by which the waste products are eliminated, depends upon muscular activity, and unless it is effectively accomplished the blood is not purified, and the tissues, instead of being properly nourished, become weakened and unable to fulfil their allotted task.

I conclude these few remarks by wishing the author the success that she so richly deserves.

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"To face"
CHAPTER I

MASSAGE VIEWED GENERALLY

Massage is a scientific method of treating disease by means of systematic manipulations, and is very different from the ordinary shampooing or medical rubbing, which can be acquired without any definite training.

The name is probably derived from the Arabic mass or mass’h, to press softly, though its present form comes to us from the French masser, to shampoo. A study of the classics shows us that shampooing was in great request amongst the ancients, especially after any great exertion. In the Sandwich Islands, and also in India, it is still applied for the relief of fatigue. In Hawaii passive movements, called lomi-lomi, are bestowed as an act of hospitality on honoured guests or distinguished visitors.

To go back still farther, there are traces of its use amongst the Chinese 3000 b.c.

The wise words of the great Hippocrates may be carefully considered by all masseuses: ‘Rubbing can bind and loosen, can make flesh and cause parts to waste; hard rubbing binds, soft rubbing loosens; much rubbing causes parts to waste, moderate rubbing makes them grow.’ The rubbing here spoken of is not the haphazard manipulation of the present-
day rubber or shampooer, but the skilled movements of one trained to the work.

Much of the modern treatment by massage is due to the influence of the Swedish and German systems of physical education, and, amongst others, perhaps the following may be mentioned as pioneers: Ling, von Mosengeil, Metzger, Klein, Shreiber, Kellgren. For what are termed the Swedish movements, we are mainly indebted to Professor Ling.

In our own day massage has been much employed in the United States and in England by many well-known medical men—Weir Mitchell, Douglas Graham, Playfair, Eccles, Kellogg, Fletcher Little, Stretch-Dowse, Murrell, etc.—whose literature on the subject is valuable.

In England, speaking generally, massage is practised on somewhat different lines from those prevalent abroad. It is mainly curative, and patients prefer to be treated in their own homes rather than to attend a gymnasium, therefore the masseuse proper gives chiefly passive movements, or, if active or duplicated ones are added, they must be such as require no gymnastic appliances or secondary assistance. Moreover, she usually masses directly on the skin, and much importance is therefore attached to a warm, sympathetic touch and a supple dexterity of movement, which help to promote that subtle intercommunication between operator and patient which undoubtedly takes place, but can hardly be described.

The effects of massage, speaking generally, are:

1. To increase the circulation locally and regulate it generally, and thus help to eliminate the waste products from the body, also to relieve congestion and strengthen the muscles.
2. To increase the nutrition of the skin and tissues.
3. To improve the tone of the nervous system and increase functional activity.
4. To cause reabsorption of exudations and the removal of adhesions.

In fact, it helps to bring the body or part locally affected to the normal condition. The tendency of therapeutic agents of the present day is towards simplicity and assisting
Nature in bringing about her own cure; massage is eminently one of these agents, and should proceed on her lines.

The requisites for training a masseuse are good definite teaching and plenty of practical work under supervision.

The theoretical part should include an elementary but sound knowledge of anatomy, with special attention to the position of the organs and the superficial muscles, and also of the nervous system. The object of this little book is to provide the necessary information for beginners in a small compass, and to save the time and expense involved in seeking this essential amount of preliminary knowledge from larger books, such as Gray’s ‘Anatomy,’ Sparkes’s ‘Artistic Anatomy,’ Huxley’s or Halliburton’s ‘Physiology,’ and the like. Later on students will doubtless be sufficiently interested in their work to acquire increased knowledge direct from more advanced text-books. This part can be learnt alone (though a few lessons are a great help), and repeated visits to a hospital museum will be found most helpful. Those living in London should go to the Museum of the Royal College of Surgeons in Lincoln’s Inn Fields, where the public are admitted on Fridays (10 to 4) and on Saturday mornings (10 to 1).

In addition, a knowledge of elementary physiology is necessary, for such a complicated machine as the human body cannot manifestly be manipulated successfully by one who knows nothing of its functions.

The practical work can only be learnt from a good teacher, and cannot be hurried over; continued and persevering practice can alone give the dexterity which will command success. After a good foundation has been laid, practice is the main point, especially under supervision, if possible.

The personal requisites for a masseuse are:

1. **Health**; not necessarily robust health, for often very strong people lack the delicate, sympathetic touch required for successful manipulation of neurotic patients in particular. Still, a healthy condition of mind and body is essential, for the work itself is by no means light, requiring a certain amount of muscular force and energy; a delicate, suffering woman cannot expect to do much good to another suffering
piece of humanity, even when she has acquired the requisite skill. No one with skin disease of any kind or any perceptible deformity should attempt the training.

2. Soft, pliable hands, not too thin or bony. Hard, red, coarse hands are not compatible with massage, and all rough work must be avoided by a masseuse.

3. Intelligence and aptitude; for massage is not the easily acquired art that some imagine, and requires much tact and observation in its adaptation to individual cases.

4. Refinement and culture. The last-named qualities, though not as essential as the preceding, are much to be desired, especially for Weir-Mitchell cases, in which the patient is so dependent for companionship on her nurse and masseuse; also in any resident case, where some amount of nursing is required from the masseuse; but such should never be undertaken except by one who has combined a definite training in nursing with massage.

A high moral tone must be kept up at all costs, as much harm has been done to the profession by the misbehaviour of such as do not possess the requisite balance of mind and moral worth, which help so much towards the conscientious discharge of work.
CHAPTER II
THE HUMAN SKELETON

The human skeleton is divided into—

1. The head.
2. The trunk.
3. The limbs or extremities.

There are more than 200 bones in the adult, which protect the various organs, support the weight of the body, and are active and passive agents of locomotion.

They may be—

1. Long, as those of the extremities, which are mainly for purposes of locomotion.
2. Flat, as the sternum, cranial bones, ribs, chiefly useful for protection.
3. Short, as the wrist and ankle bones, which combine strength with limited action.
4. Irregular, which includes all those which do not come under the preceding heads; e.g., vertebrae.

The Head.

The Head includes—

(a) The skull or cranium, consisting of eight bones, which are practically united in the adult.
(b) The face, which consists of fourteen bones.
(c) The tongue-bone, or hyoid, to which the tongue muscles are attached.

[ 5 ]
The Cranial Bones are—
1 Frontal.
2 Parietal (roof).
2 Temporal.
1 Occipital (back of head),
1 Ethmoid (sieve).
1 Sphenoid (wedge). See Diagrams 1, 2.

The bones of the skull and face are joined immovably in the adult by sutures, which are generally serrated (see Diagram 1). They are—
1. Coronal, which lies in a transverse direction between the frontal and parietal bones.
2. Sagittal, between the two parietal.
3. Lambdoidal, between the occipital and two parietal.
4. Squamous, uniting the temporal and parietal.

In infants the bones are separated by spaces devoid of bone,
and there are two spots at the top of the head where the space is considerable, called the anterior and posterior fontanelles.

The **Frontal Bone** (resembling a cockle-shell) has a *vertical* plate, forming the forehead, and a *horizontal* plate, which enters into the formation of the roof of the orbits and the nose.

In the horizontal plate are to be observed the *nasal notch*, with which the bones of the nose articulate; below is the *nasal spine*, which forms part of the roof of the nose; on either side the *supra-orbital arches*, and above the latter the *superciliary ridges*, which form the eyebrows. On each superciliary ridge is a notch or hole for the passage of the supraorbital nerve.

On the outer side of the supra-orbital arches are the *external angular processes*, for the articulation of the malar or cheek bones, and behind them are depressions for the lachrymal glands (see Diagram 2).

The frontal bone articulates with 12 bones in all: 2 parietal, sphenoid, ethmoid, 2 nasal, 2 superior maxillary, 2 lachrymal, and 2 malar.

The **Parietal Bones** form by their union the sides and roof of the skull; their outer surface is smooth and marked by the parietal *eminences*, the inner by depressions and furrows for the convolutions of the brain and its arteries. They articulate with five bones: with one another, and with the occipital, frontal, temporal, and sphenoid.

The **Temporal Bones** are at the side and base of the skull, and present three portions: squamous, mastoid, and petrous.

The *squamous* (scale) is the thinnest part, and projecting from it is a long, arched outgrowth of bone, the *zygoma*; behind the zygoma is the *glenoid cavity* for the condyle of the lower jaw.

The *mastoid* (nipple) is the knobby process at the back of the ear.

The *petrous* (stone) contains the essential parts of the auditory organ.

The temporal bones articulate with five others: occipital, parietal, sphenoid, inferior maxillary, and malar.

The **Occipital** is at the back and base of the skull. It has a protuberance for the attachment of the ligamentum nuchae
Diagram 2.—Skull.
and a large oval aperture, the *foramen magnum*, for transmitting the spinal cord and its membranes, the spinal accessory nerves, and the vertebral arteries. On either side of it are *condyles*, for articulation with the atlas, the first of the spinal vertebrae (see Diagram 3). The occiput articulates with 6 bones: 2 parietal, 2 temporal, sphenoid, and atlas.

The *Ethmoid* (sieve) is at the base of the skull between the orbits, and forms the upper part of the nasal cavity (see Diagram 4).

The *horizontal* or *cribriform plate* is between the two
orbital plates, and is perforated by numerous holes or foramina, for the passage of the olfactory nerve filaments. It has a projection resembling a cock’s comb, called the
crista galli (see Diagram 5). It articulates with eleven bones of the face, the sphenoid, and the frontal.

The **Sphenoid** resembles a bat with wings spread and legs hanging down. It has a central portion or body, with two greater and two lesser wings, extending outwards on each side, and below each are the two pterygoid processes and a spinous process (see Diagrams 6 and 7). In front of the body is the ethmoidal spine, for articulation with the ethmoid, a groove for lodging the olfactory nerves and foramina for the passage of the optic nerve branches; also a depression, the sella Turcica, or Turk’s saddle, containing the pituitary body which Professor Sajous has demonstrated is the source of the vital principles (see chapter on Ductless Glands). The sphenoid articulates with all the other cranial bones, and binds them together.

The **Bones of the Face** are 14 in number, of which the first 7 are the most important (see Diagram 2). They are—

2 Nasal.
2 Superior maxillary (jaw).
2 Malar.
1 Inferior maxillary.
2 Palate.
2 Lachrymal.
2 Turbinated.
1 Vomer (ploughshare, forming the nasal septum or division).

The two **Nasal Bones** form the bridge of the nose, and articulate with the frontal, ethmoid, superior maxillary, and with one another. There are no muscles directly attached to them (see Diagram 2).

The **Superior Maxillary Bones** are important because parts are very liable to disease; each assists in the formation of three cavities—the roof of the mouth, the floor and outer wall of the nose, the floor of the orbit—and also enters into the formation of the zygomatic and sphenono-maxillary fossae. Its interior is hollowed out to form the cave or antrum of Highmore (see Diagram 2). It has an alveolar process, with sockets for the roots of the upper teeth; a palatine process.
forming part of the floor of the nostril and the roof of the mouth, a *nasal* process forming the lateral boundary of the nose, and a *malar* process forming part of the zygomatic fossa. They articulate with nine bones: the frontal, ethmoid, *nasal*, malar, lachrymal, inferior turbinated, palate, vomer, and with one another.

The Inferior Maxilla (see Diagram 8) constitutes the lower jaw, and is the largest and strongest bone of the face. It is developed in two parts, which afterwards unite, the point of union being called the *symphysis*. It consists of a
The human skeleton consists of a curved horizontal portion, the body, and two perpendicular rami, and looks like a horseshoe. The lower part of the body forms the chin, which is particularly strong, and the upper part has an alveolar process for the lower teeth. The upper border of the ramus has two processes separated by the sigmoid notch; the anterior process is called the coronoid, the posterior the condyloid, by which it articulates with the temporal bone.

The Malar Bones form the prominence of the cheek, part of the outer wall and floor of the orbit, and part of the temporal and zygomatic fossae. They are four-sided, and have four processes: the frontal, orbital, maxillary, and zygomatic (see Diagram 2).

The Palate Bones are at the back of the nasal fossae, between the superior maxillae and the pterygoid processes of the sphenoid. They assist in the formation of the floor and outer wall of the nose, the roof of the mouth, and the floor of the orbit, and somewhat resemble the letter L. They articulate with six bones: the sphenoid, ethmoid, superior maxillary, turbinated, vomer, and one another.

The Turbinated Bones are found in either nostril, and each consists of a layer of thin spongy bone, curled like a top or inverted cone. They serve to give greater surface to the mucous membrane, and to transmit the olfactory nerves. They, with the ethmoid, form the three nasal divisions:

1. Upper meatus.
2. Middle ,,.
3. Lower ,,.

They articulate with four bones: ethmoid, superior maxillary, lachrymal, and palate.

The two Lachrymal Bones are the smallest and most fragile, and are situated at the inner and lower border of the eye, presenting a grooved appearance for the support of the nasal duct. They articulate with frontal, ethmoid, superior maxillary, and turbinated (see Diagram 2).

The Vomer, or Ploughshare, is a single bone, situated at the back part of the nasal fossae, forming part of the septum of the nose. It articulates with 6 bones: the sphenoid,
ethmoid, 2 superior maxillary, 2 palate, and with the cartilage of the septum (see Diagram 9).

The Hyoid, or Tongue-Bone, placed in the upper part of the neck, is shaped like an expanded V; the tongue muscles are attached to it (see Diagram 10).

The Trunk.

The skull rests upon the Spinal Column, which is an organ of support and protection (see Diagram II).

It consists of 33 Vertebrae, viz.:

- 7 Cervical (neck).
- 12 Dorsal (back).
- 5 Lumbar (loin).
- 5 Sacral (rump).
- 4 Coccygeal (tail).

The first 24 are sometimes alone termed vertebrae, as they are movable and distinct from one another; whereas the 5 sacral and 4 (sometimes 5) coccygeal are firmly united in the adult to form 2 bones—the sacrum and the coccyx.

A vertebra (from verto, I turn) is a simple complete segment of the vertebral column. Each consists of 2 essential parts an anterior solid segment, or body, and a posterior
segment, or arch. The arch is formed of 2 pedicles and 2 laminae (plates), supporting 7 processes (see Diagram 14):

- 2 Upper articular processes.
- 2 Lower ,, ,, 
- 2 Transverse processes.
- 1 Spinous process.

The arch encloses a cavity called the vertebral foramen, through which the spinal cord passes.

The vertebrae are connected by the articular processes and
intervertebral cartilages or discs, which act as buffers to prevent the transmittal of shocks. The transverse and spinous processes serve as levers for the attachment of muscles, which move the different parts of the spine. Between the vertebrae are apertures through which the spinal nerves pass in pairs from the cord.

The Cervical Vertebrae are the smallest; their transverse processes are perforated by the vertebral foramina, trans-

Diagram 12.—First Cervical Vertebra (Atlas), from Above.

mitting the vertebral artery, vein, and plexus; their spinous processes are short and bifurcated, bodies small. The ones to be noted are—

1. The first, or Atlas, so called because it supports the
globe of the head. It has neither body nor spinous processes. It has an anterior and a posterior arch, two lateral

Diagram 14.—Dorsal Vertebra, Left Side.

masses, is fixed to the occiput by ligaments, and articulates with its condyles (see Diagram 12).

2. The second, or Axis, the pivot on which the head rotates. Its chief characteristic is the strong, prominent,

Diagram 15.—Dorsal Vertebra.

tooth-like process, the *odontoid*, which fits into the ring of the atlas, and receives the occipito-axoid and check ligaments (see Diagram 13).
3. The seventh, which is called Vertebra Prominens, from its very long and prominent spinous process, ending in a tubercle for the ligamentum nuchae.

The Dorsal Vertebrae vary somewhat. Their bodies are triangular, and have on either side facets for articulation with the head of the ribs; pedicles almost on a level with the upper margin of the body; laminae broad and thick; spinous processes long and oblique; transverse processes clubbed, having facets for articulation with the tubercle of ribs; spinal foramina small and round (see Diagrams 14 and 15).

The peculiar ones are the first, ninth, tenth, eleventh, and twelfth.

The Lumbar Vertebrae are the largest, their bodies broad and thick, spinous processes horizontal, pedicles strong, laminae short. The fifth lumbar is characterized by having a body much thicker in front than behind, and by the greater size and thickness of its transverse processes (see Diagram 16).

The sacrum and coccyx are really pelvic bones.

In the Sacrum five, and sometimes six, vertebrae are fused in one, and the whole forms a strong wedge-shaped bone between the two hips. It varies somewhat according to sex, and also in individuals, especially with regard to the depth of curvature. It is curved upon itself, is placed obliquely, and its upper extremity, projecting forwards, forms with the last lumbar vertebra the promontory, or sacro-vertebral angle.
Its central part is directed backwards, and so gives increased capacity to the pelvic cavity. It articulates with the ossa innominata at the sacro-iliac synchondroses (see Diagrams 11 and 17).

The Coccyx (cuckoo) has been compared to a cuckoo’s beak, and consists of four or five imperfect vertebrae (see Diagram 11). This is less movable in the male than in the female.

The vertebral column in the adult presents four curves, two convex and two concave.

The first is short, in the cervical region, with convexity forwards, and is least marked (see Diagram 11).

The second in the dorsal region, with concavity forwards.

The third in the lumbar, with convexity forwards.

The fourth in the sacrum and coccyx, with the concavity forwards.

The Pelvis (basin) is the girdle of the loins which supports the contents of the abdomen (the bladder, internal organs of generation, the intestines, and several large blood vessels and nerves), and transmits the weight of the body to the lower limbs. It is formed by the union of four bones—the right and left os innominatum (or hip-bone), the os sacrum, and the os coccyx (see Diagram 17).

Each Innominate Bone (so called from bearing no resemblance to any known object) has a deep round cavity, the acetabulum (or cotyloid), into which the head of the femur fits; it is made up of three bones—the ilium, the ischium, and the os pubis—which are united in the adult (see Diagram 18).

The Ilium (ilia, flank), so called from its supporting the flank, is the broad expanded portion running upwards from the upper and back part of the acetabulum, and forms the prominence of the hip. It has a crest, a wing which forms the iliac fossa (depression), and four spines, 2 anterior (superior and inferior) and 2 posterior (superior and inferior); below the latter is the great sacro-sciatic notch, transmitting the great sciatic, pudic, and gluteal vessels (see Diagrams 17 and 18).

The Ischium forms the lower and back part of the inno-
minate bone. It has a thick solid portion, (a) the body; (b) the tuberosity, a large rough eminence on which the body rests in sitting; (c) the ramus, a thin ascending portion curving upwards and forwards, which articulates with the pubis and helps to form the obturator foramen or thyroid.
The latter is a large hole nearly covered by membrane, but in the upper part there is an aperture for the passage of the obturator nerve and bloodvessels. By this means the pelvis is lightened (see Diagrams 17 and 18).

It contains also a spine for the attachment of the gemellus superior and levator ani muscles and the lesser sacro-sciatic ligament, and the lesser sacro-sciatic notch, transmitting the muscle, its nerve, and the pudic vessels and nerve.

The Os Pubis has a body and two branches or rami; the upper assists in forming the acetabulum, and the lower articulates with the ischium. The upper surface is bounded by a sharp ridge, the ilio-pectineal line, which marks the brim of the true pelvis. The part above is called the false pelvis, because it is bound in front by abdominal wall, and not by
bone. The end of the pectineal ridge is called the spine, and the part between it and the inner extremity is the crest.

The two pubic bones unite in front by a fibro-cartilaginous disc, and so form the symphysis (growing together) pubis.

The outlet, or lower circumference of the pelvis, is irregular, and has three eminences—the point of the coccyx and the tuberosities of the ischia. They are separated by notches—the pubic arch in front, and the sacro-sciatic on either side, which position should be maintained.

Diagram 19.—Thorax, Anterior.

In the erect position the pelvis is placed obliquely (see Diagrams 17 and 18).

**Differences between the Male and Female Pelvis.**—In the female the pelvis is lighter and broader, the sacral promontory is not so prominent, the sacro-coccygeal point is movable, the outlet and inlet are larger, the pubic arch is wider, the obturator foramina are smaller.

The Chest, or Thorax, is a bony, cartilaginous, beehive shaped cage, which contains and protects the principal organs of circulation and respiration, the oesophagus, thoracic duct, also the pneumogastric, phrenic, and splanchnic nerves.
In front it has the breast-bone, or sternum, twelve ribs, or costae, on either side, and twelve dorsal vertebrae behind.

The **Sternum** may be divided into three parts: (a) the upper, or manubrium (handle), to which is attached the collar-bone, or clavicle, and the cartilage of the first and part of the second rib; (b) the middle, or gladiolus (sword),
to which the cartilages of the remainder of the second and of all the other true ribs are attached; (c) the lower, or ensiform, which usually remains cartilaginous till late in life (see Diagram 19).

There are twelve pairs of **Ribs**, or **Costae**, attached by facets to the twelve dorsal vertebrae. The upper seven pairs are called **true ribs**, because they are attached directly by costal cartilage to the sternum in front. These are more easily broken than the so-called **false ribs** (the eighth, ninth, and tenth), which are joined by cartilage to the seventh (true) rib, and so indirectly to the sternum. The remaining pairs of false ribs (eleventh and twelfth) are often called **floating ribs**, and are not joined directly or indirectly to the sternum, and have no costal cartilage, but are joined like the others to the dorsal vertebrae behind. The false ribs are less liable to fracture, because they are more yielding. All the ribs have a head, neck, and shaft, and are in a sloping plane.
from behind, forward, so that when raised in the act of respiration the chest cavity is increased (see Diagram 20).

The thorax is separated from the abdomen by a muscular partition, the **Diaphragm**, which contains three air-tight openings—(1) *Aortic*, for the aorta, vena azygos major, and thoracic duct; (2) oesophageal, for the oesophagus and

pneumogastric nerves; (3) for the inferior vena cava (see Diagram 21). It has also two crura transmitting the splanchnic nerves and the vena azygos minor.

The **Clavicle**, or **Collar-bone** (*clavis*, a key), is the long *S*-shaped bone by which the shoulder-blade (and the arm) is kept in place, one end of which articulates internally with
the sternum and the cartilage of the first rib, and the other externally with the acromion process of the scapula, or shoulder-bone, by means of facets. If broken, the shoulder falls forward and downward (see Diagram 22).

The **Scapula**, or **Shoulder-blade**, is an irregular, broad, flat, triangular bone with three processes, and situated on the posterior and lateral portion of the thorax, from the second to the seventh ribs. The processes are—

1. The *spine*, or ridge of bone, on either side of which are the supra- and infraspinatus fossae (ditch).
2. The *acromion*, by which it articulates with the outer end of the clavicle.
3. The *coracoid* (a crow), so called from its resemblance to a crow’s beak. It has three borders and three angles.

It has also a shallow socket, the *glenoid cavity*, into which the head of the humerus fits. It is deepened by a wall of cartilage, and the joint is secured by ligaments, and protected by the acromion and coracoid processes (see Diagram 23).

**Bones of the Upper Extremities.**

They are—

1. The humerus.
2. The radius.
3. The ulna.
4. Carpal bones (8).
5. Metacarpal (5).
6. Phalanges (14).

The **Humerus** is a long cylindrical bone, consisting of head, neck, two tuberosities, shaft, and lower extremity.

The *head* is hemispherical, and fits into the glenoid cavity of the scapula by a ball-and-socket joint.

The *anatomical neck*, round which a capsular ligament passes to secure the head to the glenoid cavity, is immediately under the head; the *surgical*, just below the constricted part under the tuberosities.

The *tuberosities* are the greater, or outside, and lesser, or inside. Between the tuberosities is the *bicipital groove*, down which the tendon of the long head of the biceps passes.

The *shaft* has a depression running downwards and out-
wards, called the musculo-spiral groove, containing an artery (superior profunda) and a nerve (musculo-spiral).

The lower extremity has two condyles, an outer and an inner, the latter being the larger; behind it runs the ulnar nerve, which is sometimes compressed and gives rise to what is popularly known as ‘hurting the funny bone.’ There are two articular surfaces: the outer for the radius, and the inner, or trochlea, for the ulna.

The trochlea is a pulley-like articulating surface for the greater sigmoid cavity of the ulna; above it at the back is the olecranon fossa, which receives the summit of the olecranon process, and at the front the coronoid fossa, which receives the coronoid process of the ulna (See Diagram 24).
The **Radius** (spoke-wheel) is the outer bone of the forearm. It has a head, neck, shaft, and lower extremity.

The *head* articulates with the humerus and ulna.

The **neck** has a ring-like ligament for securing the bone in its place, called the *orbicular* ligament.

The **shaft**, on the inner side, has a *tubercle* or tuberosity,
for the insertion of the biceps muscle. The outer side is thick and round, but tapers to a thin edge on the inner side, and faces the thin edge of the ulna, between which the interosseous membrane for the attachment of muscles is placed.

The lower extremity is much larger than the head, and articulates with two of the wrist (carpal) bones, the scaphoid and semilunar. On the inner side is a small depression, called the sigmoid cavity, where it articulates with the ulna, and by means of which it glides round the ulna when the hand is pronated. It has externally a small projection, called the styloid process, also grooves for the passage of tendons (see Diagram 25).

The Ulna (a measure) has a shaft and two extremities, and there is a deep cavity at the upper extremity, with a smaller below, called the greater and lesser sigmoid cavities.

The trochlea (pulley) of the humerus fits into the greater sigmoid cavity, and forms the perfect hinge-joint of the elbow; the lesser sigmoid cavity receives the head of the radius. On either side of the greater sigmoid cavity are processes. The front one is called the coronoid process, the back the olecranon, forming the prominence of the elbow. The latter prevents the radius bending too far back. The shaft has a sharp angle for the interosseous membrane. The lower extremity has a styloid process (see Diagram 26).

The Carpal Bones, eight in number, are arranged in two rows of four, and united by ligaments.

<table>
<thead>
<tr>
<th>First Row</th>
<th>Second Row</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scaphoid (boat-like).</td>
<td>Trapezium (square).</td>
</tr>
<tr>
<td>Semilunar (half-moon).</td>
<td>Trapezoid (table-shaped).</td>
</tr>
<tr>
<td>Cuneiform (wedge-shaped).</td>
<td>Os magnum (large bone).</td>
</tr>
</tbody>
</table>

They articulate with the radius above, and with the metacarpal bones below, and, being built up like the
walls of an arch, are strong, firm, and yet mobile (see Diagram 27).

The **Metacarpal Bones** (five in number) articulate with the carpal and the first phalanges. There are fourteen **Phalanges**—three in each finger, and two in the thumb.
Bones of the Lower Extremities.

The Thigh-Bone, or Femur, is the longest, largest, and strongest bone in the body, as it has to receive the whole weight of the trunk and upper limbs. It has a head, neck, two trochanters, shaft, two tuberosities, and two condyles.

The head is globular, and fits into the acetabulum of the os innominatum, forming a ball-and-socket joint, being kept in place mainly by the ligamentum teres, which is attached to it in a small depression on the head.

The neck has an oblique position between the head and the shaft. As life advances, the weight of the body bends
it almost to right angles with the shaft, and fractures easily occur.

The *trochanters* are two prominences below the neck, which afford leverage to muscles for the rotation of the thigh. The trochanter major is large, irregular, and situated on the outer side of the neck; it gives attachment to the gluteal and other muscles. The trochanter minor is conical, and gives insertion to the psoas and iliacus muscles.

The *shaft* is almost a perfect cylinder, and has a rough line going down the central third of its posterior surface, called the ‘*linea aspera*.’ It has 2 inter-trochanteric lines to the anterior of which the capsular ligament of the hip-joint is attached.

The *tuberosities* are on either side of the shaft towards the bottom, and at the extreme end there are two *condyles* (knuckles) for articulation with the facets of the patella and with the tibia. A deep notch between the condyles is for the crucial ligaments, which limit flexion and extension (see Diagram 28).

The *Patella*, or *Knee-Cap*, is a small, flat, triangular bone, situated to the front of the knee-joint, which is a hinge joint. On its posterior surface are two facets for articulation with the condyles of the femur, the outer one being the broader and deeper. It is sometimes viewed as a sesamoid bone (see Diagrams 29 and 30).

The *Bones of the Leg* are the tibia and fibula.

The *Tibia*, or *Shin-Bone*, forms the front and inner side of the leg, and is so called from its resemblance to a musical pipe. It has a head, two tuberosities, tubercle, shaft, and extremity.

The *head* has two flat surfaces for articulation with the
condyles of the femur. Between them is a ridge called the spine, to which are attached the crucial ligaments and the semilunar cartilages. These cartilages rest between the condyles of femur and head of tibia; they deepen the cavities for receiving the condyles, and act as buffers to prevent shock. In injuries to the knee-joint they are liable to slip out of place. At the back of the external tuberosity is a smooth surface for articulation with the head of the fibula. At the back of the internal one there is a depression for the insertion of the semi-membranosus muscle. Below the head in front is the tubercle for the attachment of the ligamentum patellae; the latter is really the continuation of the tendon which brings the quadriceps extensor muscles to the patella.

The shaft is triangular, broad above, but decreasing in

Diagram 31.—Fibula and Tibia, Anterior View.
size towards the slender part, where a fracture often occurs. It then enlarges towards the lower extremity. It has three surfaces and three borders. The most prominent border is called the crest, or shin, which, with the inner surface, is devoid of muscle.

At the extremity is the internal malleolus, which helps to form the inner ankle.

The tibia articulates with the femur, fibula, and astragalus.

The Fibula (buckle), or Splint - Bone, is the long and slender outer bone of the leg. It has a head, a shaft, and an extremity, and is parallel with the tibia, to which it is attached above and below, in order to increase the strength of the leg without adding to its weight.

The head is of an irregular round shape, and articulates with the tibia. On its outer side is a prominence projecting upwards, the styloid process, giving attachment to the tendon of the biceps femoris muscle. The shaft has three surfaces and three borders for the attachment of the interosseous membrane and various muscles.

The lower extremity, or external malleolus, inclines forwards, and joins the outer part of the ankle. It articulates with the outer side of the astragalus.

The Foot consists of—

1. Tarsus.
2. Metatarsus.
3. Phalanges.

The Tarsal Bones are:
Calcaneum, or Os Calcis (heel-bone).
Astragalus (die), used by ancients as dice.
Cuboid (cube-like).
Scaphoid (boat-like).
Internal, Middle, and External Cuneiform (wedge-shaped).

These articulate more or less with one another. Being small and numerous, they distribute the shock, and lessen the pressure falling on the foot.

The Metatarsal Bones are five in number, and articulate with the tarsal by one extremity, and with the first row of phalanges with the other. They resemble the metacarpal bones in formation, but are longer and more slender.
The **Phalanges** of the foot resemble those of the hand in number and arrangement.

**Sesamoid Bones** are small rounded masses, cartilaginous in early life, and osseous in the adult, developed in those tendons which exert a great amount of pressure upon those parts over which they glide. Examples: Patella, first phalanx of the thumb, and great toe. They vary in individuals.

**Bone Tissue.**

Bone is composed of two kinds of tissue:

(a) Compact, which is the outer layer, resembling ivory.

(b) Cancellous, the inner layer, which consists of slender fibres arranged like lattice-work.

Each bone is covered by a fine membrane, the *periosteum*, inflammation of which is called periostitis. On the surface of the bones are foramina, or openings, into which the periosteum dips to allow nerves and bloodvessels to pass into the interior of the bone; it receives the insertions of tendons and ligaments. In children’s bones there is a large proportion of organic matter, so that they are somewhat cartilaginous and easily compressed; but as adult life is approached, the percentage of inorganic matter increases, and is so high in old people that their bones become brittle, fracture easily, and reunite with difficulty.

**Joints.**

A **Joint** consists of bone, cartilage, synovial membrane, and ligaments.

**Cartilage**, or **Gristle**, tips the ends of the bones that form movable joints, and is a firm, flexible, extensible, tough, elastic, whitish substance.

**Synovial Membrane** is a thin layer of connective tissue well supplied with bloodvessels, secreting from its cells a transparent yellowish-white or reddish fluid, resembling white of egg—*synovia*, which lubricates the joints, and keeps the cartilage smooth.

**Ligaments** consist of bundles of white fibrous tissue, flexible, pliant, but tough and strong, by which the movable bones are connected and kept in right position.
Exceptions are found in the ligamenta subflava and the ligamentum nuchae, which consist of yellow elastic tissue.

**Joints**, or articulations, are of three varieties—synarthrosis, or immovable; amphiarthrosis, mixed, having limited motion; diarthrosis, movable, having free motion.

The **Principal Forms of Movable Joint** are—

1. Ball-and-socket, consisting of rounded heads fitting into rounded cavities or sockets; they admit of motion in every possible direction.

2. Hinge or ginglymus, resembling a common hinge, and only permitting two motions—backward and forward in one plane. They may be (a) single—examples: elbow, knee, and
ankle; or (b) double (saddle-shaped)—example: metacarpal bone of the thumb articulates thus with the trapezium.

3. Pivot, formed by projections or processes on one bone, on to which another bone fits and turns, or in which the first turns on its axis. It admits of partial rotation only. Examples: Odontoid process of the axis (second vertebra), and the anterior arch and transverse process of the atlas; the junction of the radius and the ulna.

The **Kinds of Movements** admissible in joints are—

1. Gliding, the most simple, and sometimes only, motion permitted, as in tarsus and carpus.

2. Angular, occurring only between long bones; may be in four directions— forwards and backwards (flexion and extension), inwards and outwards (adduction and abduction).

3. Circumduction, the limited degree of motion which takes place between the head of a bone and its articular cavity, whilst the extremity and sides of the limb are made to circumscribe a conical space, seen in the hip and shoulder joints.

4. Rotation is movement of a bone upon its own axis, the bone retaining the same relative situation with respect to the adjacent parts as in the articulation between the atlas and the axis, where the odontoid process serves as a pivot around which the atlas turns, or rotation of the radius upon the humerus, also in the hip and the shoulder.

When the hand is carried by the radius round the ulna, the movement is called pronation and supination (*pronation* palm downwards, *supination* palm upwards).

**Tissues.**

The other chief tissues are—

*Fibrous* or *connective*, uniting other tissues, enclosing muscles, nerves, bones, helping in the formation of tendons, ligaments, walls of bloodvessels, etc.

*Muscular* or *contractile*, forming the fleshy covering of the skeleton.

*Nervous* or *conductile*, controlling the other tissues generally and transmitting impulses.
CHAPTER III
THE RESPIRATORY SYSTEM

The Organs of Respiration are the mouth, nose, larynx, trachea (or windpipe), bronchi, and lungs. Accessory to these organs are the diaphragm and intercostal muscles. The air enters either by the nose (which is preferable), and passes into the naso-pharynx through the posterior nares, and then reaches the upper opening of the larynx, or it passes through the mouth and fauces. In either case it is both moistened and warmed.

The Larynx, or orifice of the windpipe, is the organ in which the voice is produced; it consists of nine cartilages, connected by ligaments and moved by muscles. The largest cartilage is the thyroid (shield-shaped), which forms the Adam's apple of males. Just below it is the cricoid, resembling a signet ring, and surmounted by a pair of small cartilages, the arytenoid (pitcher), to which the back ends of two fibrous bands, the vocal cords, are attached, their front ends being attached to the thyroid cartilage.

Two folds of mucous membrane above the true vocal cords are called the false or upper vocal cords, the space between being the ventricle of the larynx. It possesses a narrow canal or pouch, where foreign substances often lodge, and produce irritation and coughing till ejected.

The entrance to the larynx is the rima glottidis, or chink of the glottis, which is guarded by the epiglottis, a leaf shaped cartilage, which, in swallowing, is said to close the larynx, and so prevent food from entering.
The Trachea (trachus, rough), or windpipe, is the principal air-tube of the lungs. It is a cartilaginous and membranous tube about 4½ inches long and ¾ inch in diameter, kept open by sixteen to twenty imperfect rings of cartilage, extending from the level of the fifth cervical to the fourth dorsal vertebra. Their ends are united behind by muscle and membrane, where the trachea comes in contact with the gullet or oesophagus, and so facilitate swallowing.

On either side of the lower part of the larynx and upper part of the trachea is a solid gland-like organ about 3 inches in length, but without any duct, the two lobes of which are united across the middle line over the third and fourth rings of the trachea by an intervening portion called the isthmus. This is the thyroid body, or gland. It consists of minute vesicles containing a yellow glairy fluid, surrounded by a plexus of capillaries, and invested by a thin capsule of connective tissue, projecting into its substance, and dividing it into irregular masses. Its blood-supply is very rich. The parathyroids are small, brownish-red bodies about ¼ inch in diameter, close to the thyroid gland. (For functions of both, see Ductless Glands.) In front of the lower part of the trachea is the thymus, another similar body, which is present in children, but disappears gradually as age advances.

The trachea divides into two short Bronchi, the right and left, whose general structure resembles that of the trachea, except that their cartilaginous rings are entire. The right bronchus is rather larger and more horizontal than the left. Each of these bronchi, after entering its lung, divides and subdivides dichotomously (by constant double forking), like the branches of a tree, into all parts of the lungs, and form the primary, secondary, tertiary, and ultimate bronchial tubes.

The cartilages become gradually smaller, and ultimately disappear, so that the smaller tubes may be almost closed by the contraction of their muscular walls. The tubes terminate in infundibula, or lung sacs, about ¼ inch in diameter, whose walls have tiny pouches or dilatations called air-cells, or alveoli, about inch in diameter. Surrounding these are numerous capillaries of the pulmonary arteries, whereby the blood is brought into close relationship with the air, and
is oxidized by the process called endosmosis or osmosis—i.e., the property by which rarer fluids are attracted through a porous division into a cavity or space, containing a denser fluid. All the air-passages are lined with ciliated mucous membrane, the cilia (resembling hairs) of which keep up a continuous wave-like movement, and so drive dirt and mucus outwards.

The Lungs are large spongy, elastic bags, which fill the cavity of the thorax on either side, except the space occupied by the oesophagus, the heart, and its bloodvessels. They are covered with a smooth lining membrane, the pleura, which also lines the inner surface of the chest and the upper part of the diaphragm. The former lining is called the visceral pleura, the latter the parietal (from paries, walls of a house). The intervening or pleural cavity is lubricated with serous fluid, which increases in amount in pleurisy, or inflammation of the pleura, and may become filled with pus, as in empyema, the result of suppuration of the pleura. The right lung is rather larger than the left, and has three lobes or divisions, which again subdivide into lobules. The left has only two lobes, and is smaller, narrower, but rather longer, in order to accommodate the heart. The upper conical part of each lung is called the apex, which is close to the first rib, and the base rests upon the diaphragm. Between the apex and the base is the root of the lung, by which it has connection with the heart and trachea. The bronchus, pulmonary arteries, and veins, nerves (phrenic and pneumogastric) and lymphatics, together unite in the formation of the root.

The lungs weigh about 24 ounces each, and their normal capacity is about 200 cubic inches of stationary air and 30 cubic inches of tidal air—i.e., the amount inspired and expired each time an average adult takes a breath (about 1½ pints). The spirometer is an instrument which measures the quantity of air expelled by one continued forcible expiration, which is called the vital capacity of an individual, and this varies with age, size, etc., depending especially on the mobility of the chest walls.

In ordinary inspiration the chest is enlarged vertically by the contraction and lowering of the diaphragm; laterally and
antero-posteriorly by the contraction of the levatores costarum, the external intercostals, and part of the internal intercostals. Expiration is mainly due to the elastic recoil of the lungs, ribs, and diaphragm, by which they return to their former position.

In extraordinary respiration the abdominal and other muscles attached to the ribs are also brought into play.

Respiration may be costal or pectoral, as in women, in whom the upper part of the chest is mainly the seat of movement, or diaphragmatic, as in men, in whom the diaphragm chiefly effects the movement required.

The following table will show the main difference of the chief constituents of respired and unrespired air, per 10,000 parts:

<table>
<thead>
<tr>
<th></th>
<th>Air unrespired</th>
<th>Air respired</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>7,900</td>
<td>7,900</td>
</tr>
<tr>
<td>Oxygen</td>
<td>2,096</td>
<td>1,630</td>
</tr>
<tr>
<td>Carbonic acid</td>
<td>4</td>
<td>470</td>
</tr>
</tbody>
</table>

In addition, we may notice that respired air increases in temperature, and is nearly equal to that of the blood before it leaves the chest.

The increase in carbonic acid varies in amount according to age, sex, respiratory movements, season of year, period of day, food, exercise, atmospheric conditions, etc. The volume of air expired is less than that inspired, owing to the amount of oxygen absorbed, which is more than the carbonic acid exhaled. The watery vapour is increased, and a small quantity of ammonia added, also the organic matter is increased to the extent of about 3 grains in twenty-four hours. The total quantity of air passing in and out of an adult at rest in twenty-four hours is about 686,000 cubic inches, and in a hard-working labourer 1,563,390 cubic inches.

The number of respirations in a healthy adult is fourteen to eighteen per minute, and the proportion to the heart-beats is usually one to four, but this is not always maintained.

Oxygen is not only necessary for respiration, but also for oxidizing the various food-stuffs taken into the body in order to maintain its proper supply of energy and heat. Good air is even more essential than good food.
CHAPTER IV

THE DIGESTIVE SYSTEM

The Alimentary Canal (from alimentum, nourishment).—
The alimentary canal is a musculo-membranous tube about 30 feet in length, extending from the mouth to the anus. It is lined throughout with mucous membrane, and has the following subdivisions: mouth, pharynx, oesophagus, stomach, small and large intestines, the first three being above the diaphragm, the remainder below it. The accessory organs of digestion are: teeth, salivary glands, liver, pancreas, and spleen.

The food, having entered the mouth, is crushed and ground by the teeth, which in the adult are 32 in number, each jaw containing 16, viz., 4 incisor, 2 canine, 4 bicuspid, 6 molar. The milk-teeth (temporary or deciduous) are only 20 in number: 4 incisor, 2 canine, 4 molar in each jaw.

In the mouth the food mixes with saliva, the product of three sets of salivary glands:

1. Parotid, in front of and below the ears.
2. Submaxillary, in the lower jaw under the mouth.
3. Sublingual, under the tongue, to the front of the submaxillary.

In saliva or spittle there is a substance called ptyalin, a ferment which makes the starch in food soluble by converting it into sugar, but has no action on proteids, fats, or sugar. It has no digestive power before the sixth month of life. Saliva lubricates the food, and so facilitates swallowing,
and its mechanical function is to keep the mouth moist, and thus to aid in speaking, mastication, etc. About 2 pounds of saliva is secreted in twenty-four hours in a normal state. After insalivation and mastication the food passes to the back of the mouth, where it is seized by the muscles of the pharynx, and passed on to the oesophagus, the epiglottis having meanwhile protected the opening into the larynx, and the uvula (the extremity of the soft palate) the cavity between the nose and the mouth.

**Peristaltic Action** is the movement which takes place throughout the whole of the alimentary canal. Its muscular walls alternately expand and contract, and thus its contents are grasped and passed onwards in a worm-like movement.

The **Pharynx** is about 4½ inches long, and has seven openings: the two posterior nares, leading to the nose; the two Eustachian tubes, connecting the ear with the nasopharynx; the larynx, the oesophagus, and the mouth.

The **Oesophagus**, or **Gullet** (meaning food-carrier), is a musculo-membranous tube about 9 inches long, passing through the diaphragm, which conveys the food to the cardiac (heart) orifice of the stomach. After entering the pharynx, swallowing is an involuntary act, the food being forced down by muscular contractions, aided by gravity, and in the case of liquids mainly by atmospheric pressure. The sides of the oesophagus and stomach wrinkle up when inactive.

The **stomach** is, when distended, a large, hollow, muscular, bagpipe-shaped organ, with a capacity of 3 to 5 pints of liquid (in the adult), being about 12 inches long and 4 inches broad. It is on the left side of the abdomen, just below the diaphragm, to which it is attached by ligaments.

The right-hand lower end communicates with the small intestine, and is called the **Pylorus**. The space between it and the cardiac opening is called the **lesser curvature**, while the lower, longer border is the **greater curvature**. In front of this is a fold of peritoneum, forming the great **omentum**.

The **Peritoneum** is a smooth, shiny membrane which lines the abdominal walls, and also envelops all the abdominal organs, thus enabling them to glide over one another without friction. It is divided into two sacs: the **greater**, extending
over the anterior two-thirds of the liver, behind and above the stomach; below, behind and in front of the great omentum. The lesser, or cavity of the great omentum, extending behind and below the liver and stomach, and within the great omentum. The part surrounding the small intestines,

Diagram 33.—Viscera of Thorax and Abdomen, from the Front.

and attaching them to the spinal column, is termed the Mesentery.

In addition to the peritoneum, the stomach has three coats:

a. The muscular, by which peristaltic action is carried on.
b. The submucous, in which the bloodvessels and nerves ramify.

c. The mucous, which is wider than the others, and hence lies in folds, or rugae, when empty. It is covered with tiny pits, or alveoli, into which dip the mouths of the gastric glands, or follicles, which secrete the gastric juice.

Gastric Juice is a clear, pale-coloured, slightly acid liquid, which converts proteids (see Food, Chapter V.) into peptones, and thus renders them soluble, and capable of absorption through membrane. It has powerful antiseptic properties, and arrests the conversion of starch into sugar. It consists mainly of pepsin, hydrochloric acid, salts, and water. The secretion of both saliva and gastric juice is under the control of the nervous system, and is largely affected by the nerves of special sense (sight, smell, etc.), and great shock can prevent secretion entirely.

By being rolled about in the stomach (where are two streams, moving in opposite directions), and acted upon by the gastric juice, the food is now reduced to a semi-fluid, greyish substance called Chyme, in which state it passes through the pyloric valve (strengthened by a rounded sphincter muscle) into the small intestine.

The Small Intestine consists of three parts:

Duodenum (twelve);
Jejunum (jejimus, empty);
Ileum (eileo, I thirst)

—the whole of which measures about 20 feet. The mucous membrane of the whole intestine is covered with small, simple glands called after Lieberkühn, which produce an intestinal juice (succus entericus): also racemose glands, called after Brunner. In the small intestine there are in addition globular glands called after Peyer, which are the seat of disease in typhoid fever. Peculiar also to the small intestine are the transverse folds of mucous membrane called valvulee conniventes, covered with tiny villi (hair nap), into the centre of which dip the absorbent vessels of the intestines, the lacteals. The valvulae conniventes delay the food in its transit, and so give time for the bile and pancreatic juice to
mix with the chyme, and also afford a larger space for absorption. Into the upper part of the duodenum the bile flows through the common bile-duct, either from the liver or its store-house, the gall-bladder.

**Bile** is a pale yellow, very bitter, slightly odorous, alkaline fluid, which is continually being secreted by the liver to the amount of 1 to 2 pints per diem. It consists of water, solids (bilin), cholesterin, mucous and colouring matter, salts. Its main function is to aid the digestion by neutralizing the acidity of the gastric juice. It is a natural purgative and antiseptic, and promotes peristaltic movement. When it passes back into the blood-stream a jaundiced condition is produced.

**Pancreatic Juice**, the product of the pancreas, or sweet bread, is alkaline, colourless, tasteless, and secreted at the rate of ¾ pint daily. It acts powerfully on the starches (amyloids) which have escaped the action of the saliva (1) by a ferment called amylolysin; it aids the digestion of fats by emulsifying them (2) through a ferment named steapsin; it acts on the remaining proteins, not formed into peptones by the gastric juice of the stomach, (3) by the ferment trypsin (see Ductless Glands).

In the small intestine the food, or chyme, is converted into **Chyle**, a white, milky-looking fluid. This colour is due to the minute fatty particles suspended in it. All the digested portions of the food are absorbed by the lacteals (see Lymphatic System), and any surplus and waste matter is forced along by peristaltic movement till the **Large Intestine** is reached through the **ileo-caecal valve**. The latter is formed by two folds of mucous membrane, and prevents regurgitation. The large intestine (6 feet long) is divided into the

- Caecum (*caecus*, blind);
- Colon (*koilos*, hollow);
- Rectum (straight gut).

The **Caecum** is a kind of blind alley about 3 inches long, from the lower part of which hangs a narrow worm-like tube, 4 inches long, varying in size and position in individuals,
called the *vermiform appendix* (inflammation of it is termed ‘Appendicitis’).

The **Colon** commences at the right side of the lower abdomen, passes upwards to the liver (forming the ascending colon); it then crosses horizontally to the left (*hepatic flexure* and transverse colon), and, descending to the left (*splenic flexure* and descending colon), makes an S bend, termed the *sigmoid flexure*. The undigested and non-nutritious parts of the food having gradually assumed a more solid character, and acquired in the caecum the characteristic faecal odour and colour (the product, probably, of lactic acid), then passes into the **Rectum**, and leaves the body at the *anus*, which, like the pylorus, is guarded by a sphincter muscle.

Defaecation is both voluntary and involuntary in its action, the second lumbar vertebra being the chief nerve centre for it.

**Other Organs of the Digestive System.**

The **Liver** is the largest gland in the body. It weighs about 3 pounds to 5 pounds, is 10 to 12 inches long, and 6 to 7 inches broad. It is incessantly secreting bile to the amount of 3 to 5 pounds per diem. It also secretes *Glycogen*, a substance elaborated from the blood, which is capable of passing into glycose or liver-sugar, when animal ferment is present in animal starches, which is a source of vital energy to the body. The liver lies on the right side of the abdomen, just below the diaphragm, with which its upper surface is in contact, whilst its lower surface touches the small intestine and the right kidney. It contains five *lobes*, formed of lobules, which are small granular bodies, the size of a pin’s head, clustered round the hepatic and portal veins; it has also five fissures, and is supported by five ligaments. The *cystic duct* carries the bile secreted when digestion is *not* going on to the gall-bladder, which thus acts as a reservoir.

The **Gall-Bladder** is a pear-shaped membranous bag, about 4 inches long and 1 inch broad, capable of holding 8 to 10 drachms of bile. The *hepatic duct* conveys the bile, secreted while digestion is proceeding, direct from the right and left lobes of the liver (the two chief lobes), and this,
uniting with the cystic duct, which communicates with the gall-bladder, forms the *common bile-duct*, which passes obliquely into the duodenum.

The **Pancreas**, or **Sweetbread**, lies behind the stomach, across the spine, and is a tongue-shaped, milky-white gland, secreting about ½ pint of liquid per diem. It has been called the salivary gland of the abdomen. This pancreatic juice passes through a duct about 6 inches long into the duodenum.

The **Spleen**, or **Milt**, is a flattened, oval-shaped, reddish body, lying to the left of the stomach, and consists of friable, spongy substance. Its use is uncertain, but is probably to act as a reservoir for the extra supply of blood required for digestion, and for the elaboration of white corpuscles. Its secretion tends to keep cholesterin (a fatty substance found in the bile) in solution, preventing the formation of gall stones. It is a ductless gland.

**The Lymphatic System.**

The **Lymphatic** or **Absorbent System** consists of the thoracic duct, the right lymphatic duct (the two main trunks which receive the contents of the lymphatic vessels and capillaries), and the lymphatic glands, where the lymph is elaborated.

Their function appears to be to receive that portion of the chyle which is absorbed in the intestines through the lacteals (the lymphatic vessels of the intestines), and to appropriate that part of the *liquor sanguinis* which is not required by the tissues for nutrition, and which in the form of lymph is remixed with the blood. The lacteals empty their contents into a large cavity, near the last dorsal vertebra, called the **Receptaculum Chyli**, which is really a dilatation of the thoracic duct, the terminal or main trunk, which, passing through the diaphragm, ascends in close proximity to the spine up to the neck, where it joins the left subclavian vein, having collected lymph and chyle for the whole body except the right arm and lung, right side of the head, heart, neck, and thorax, and the convex surface
of the liver. The latter are drained by the right lymphatic duct, about ½ inch in length, and terminating in the right subclavian vein. It is very similar in structure to the veins, and has valves. The whole body is permeated with the lymphatics, with the exception of the non-vascular structures—hair, nails, cuticle, and cartilage.

The lymphatic glands are a very important part of the circulation, for it is in them that the lymph is strained and lymphocytes formed, which enter the blood-stream, and help to protect the body from infection by digesting the disease germs.

The most important and accessible glands are found in the bend of the elbow and of the groin on the inner and upper part of the thigh (the inguinal); in the popliteal and axillary spaces; on the sides of the neck below the jaw (the cervical); behind the ear (the mastoid and occipital).
CHAPTER V
THE EXCRETORY SYSTEM—FOOD

The Organs of Excretion are the kidneys, sweat-glands of the skin, intestines, and lungs; the latter have been already described.

The Kidneys are placed one on either side of the spinal column, close to the last dorsal and first two or three lumbar vertebrae, the right kidney being a little lower than the left on account of the position of the liver. Each kidney is about 4 inches long, 2½ inches wide, 1½ inches thick, and weighs about 4½ ounces.

The bent or internal border is turned backwards towards the spine, and the whole is outside the peritoneum. The middle of the internal or concave side is called the hilus, and here the renal artery (a branch of the aorta) and nerve enter, and exit is also given to the renal vein and ducts. From the blood thus passing through the substance of the kidneys water is abstracted and waste products eliminated. Attached to each kidney is a ureter, an excretory duct, about 16 to 18 inches long, and the diameter of a goose-quill, which conveys the urine from the kidney to the bladder. They enter the bladder side by side in an oblique manner, passing between its coats for about 1 inch, and so preventing a back-flow.

The suprarenal capsules are two small yellowish bodies, found just above the kidneys, about 1½ inches long, and having a rich blood and nerve supply. (See Ductless Glands.)

The Bladder is an oval bag, situated in the pelvis, immediately above the symphysis pubis. It is the reservoir for the urine, which is continually being secreted by the kidneys.
and conveyed to the bladder by the ureters. When the bladder is emptied, its contents are conveyed outside the body by the urethra, the entrance to which is guarded by a sphincter muscle. When the bladder is distended, it is about 5 inches long and 3 inches wide, and can contain one pint and upwards of fluid.

**Healthy Urine** should be clear, pale yellow, acid, with a specific gravity of 1020. An average quantity per diem is 2 to 3 pints.

It consists mainly of water, urea, uric acid, various animal products, saline and gaseous substances. The quantity and composition depend on the time of day, the amount and quality of food, temperature and moisture of the atmosphere, individual temperament, etc.

**Micturition,** so far as it is a voluntary act, is performed by the abdominal muscles contracting and pressing on the abdominal viscera (organs), which has a reflex action on the muscular coat of the bladder. The act is completed by increased urine, which quickens the stream and expels the last drops from the urethra.

**The Skin.**

The skin and kidneys have to some extent similar functions, and are capable of acting vicariously, their relative activities being in inverse proportion.

The functions of the **Skin** are—

1. To protect deeper tissues and to bind together the superficial organs.
2. To act as the sensitive organ of touch.
3. To aid in regulating the temperature of the body.
4. To aid as a secretory, excretory, and absorbing organ.

It has two chief layers:

- **a. Superficial, epiderma, or cuticle.**
- **b. Derma, corium, or cutis vera.**

Within and beneath the derma are several organs with special functions.

The **Sudoriparous Glands,** which excrete perspiration and so carry off excessive or latent heat. Small quantities are constantly being given off in the form of invisible vapour,
which is called *invisible* perspiration, whereas when its escape is prevented or it is given off rapidly it is *sensible* perspiration. The watery vapour thus thrown off is twice the amount expelled from the lungs in expiration, and a certain amount of carbonic acid and urea is also eliminated thus (from 1 to 2 pounds daily). A definite amount of oxygen and other substances is also absorbed.

The *Sebaceous Glands* (*sebum*, lard) secrete fatty matter, which keeps the skin moist and supple, and hinders too rapid evaporation from the surface. They are most numerous about the hair follicles, the face, around the anus, and the apertures of the nose, mouth, and external ear, and are specially active in negroes and the natives of warm climates.

The *Hair and Nails* are really modifications of the epidermis, which is composed of several strata of cells of various shapes and sizes, like the epithelium of the mucous membrane lining the mouth.

The *Sense of Touch* is conveyed through the papillae, or small conical processes on the dermis, in the centre of which there are bloodvessels and nerve fibrils; they are most abundant on the fingers, palms of the hands, and soles of the feet.

**Food.**

The functions of *Food* are—
1. To supply material for building up and repairing the body.
2. To maintain its heat.
3. To produce energy.

*Milk* is the only food that answers the requirements of our bodies, and is sufficient for infants or for adults in illness; but in health more is required.

A mixture of the different food-stuffs is desirable and economical.

They may be divided thus:
1. Nitrogenous, proteids, or albuminoids.
2. Non-nitrogenous.

   *(a)* Fats, or hydrocarbons.
   *(b)* Amyloids, or carbohydrates.
   *(c)* Minerals.
1. **Nitrogenous.**—Examples: Meat, poultry, game, fish, milk, cheese, eggs, wheat, legumina. Their function is the construction of new tissues and the repair of bodily waste, hence they are called flesh-formers.

2. **Non-Nitrogenous.**—Subdivided into three classes:

   (a) **Fats.**—Examples: Butter, lard, suet, oil. Their function is to give heat, to produce energy, and to aid the digestion of other foods, any excess being stored up. They are known as heat-givers.

   (b) **Amyloids.**—Examples: Sugars, starches, found in many vegetables and fruits. Their function is to aid the fats in producing and maintaining heat, and they appear to be also a source of fat.

   (c) **Minerals.**—Water enters into the construction of all tissues, and assists in the removal of waste products. Being a solvent, it aids digestion, and is a food-carrier; and by evaporation it helps to regulate the temperature of the body, which is in health about 98.4°F. Salt is necessary for existence, and aids in the formation of gastric juice and bile in particular; 200 grains is the average daily amount required, a large proportion of which is supplied in food. Carbonate and phosphate of lime are necessary for the bones and teeth, and salts of potash for the purification of the blood and the prevention of scurvy.

Dr. Letheby says that the following proportions of food may be taken for an adult man in healthy condition:

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>In idleness</td>
<td>180 grains.</td>
</tr>
<tr>
<td>In ordinary work</td>
<td>307 &quot;</td>
</tr>
<tr>
<td>In hard work</td>
<td>391 &quot;</td>
</tr>
</tbody>
</table>

On an average, about 4,000 grains of carbon and 300 of nitrogen are necessary, and this can be secured from ¾ pound of meat and 2 pounds of bread, or from 1 pound fatless meat and 1 pound fat (or sugar).

The average total daily receipts are:

- Solid food... ...... 8,000 grains.
- Water ... ... ... 37,650
- Oxygen ... ... ... 13,000 "

58,650 "
The average total daily expenditure:

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lungs</td>
<td>...</td>
<td>...</td>
<td>20,000grains.</td>
</tr>
<tr>
<td>Skin</td>
<td>...</td>
<td>...</td>
<td>11,750 &quot;</td>
</tr>
<tr>
<td>Kidneys</td>
<td>...</td>
<td>...</td>
<td>24,100 &quot;</td>
</tr>
<tr>
<td>Intestines</td>
<td>...</td>
<td>...</td>
<td>2,800 &quot;</td>
</tr>
</tbody>
</table>

58,650 "

The nitrogenous or proteid portion of food is acted upon by the gastric juice in the stomach, and is converted into peptones and absorbed by the mesenteric veins. Any remainder is peptonized by the pancreatic juice, and absorbed by the intestinal veins.

The fats are acted upon by the bile and pancreatic juice of the intestines, which neutralize the acid of the gastric juice, and convert them into an emulsion, capable of absorption by the lacteals, and they thus pass into the blood through the thoracic duct.

The amyloids are acted upon by the saliva in the mouth, and so become sugar (maltose), which can be absorbed by the veins of the stomach. The remainder are converted into sugar by the pancreatic juice and succus entericus, and absorbed in the intestines.

Water is absorbed through the whole length of the alimentary canal, and alcohol is carried direct to the liver and absorbed in the bloodvessels. Salts are absorbed in the stomach, if soluble in acid; if not, in the small intestine.
CHAPTER VI

THE CIRCULATION

Circulation (circulo, I encompass) is the process by which the blood is conveyed to every part of the body. Blood is—

1. The source of nutrition, maintenance, and secretion.
2. A storehouse of latent chemical force for heat and vital power.
3. A means of conveying oxygen and carrying away refuse material.
4. An agent for warming and nourishing the whole body.

Blood consists mainly of—

(a) **Red Corpuscles**: pale yellowish, circular, biconcave discs.

(b) **White Corpuscles**: colourless, semi-transparent, nucleated bodies, the proportion of which in health is only 1 to 500 of red corpuscles.

(c) **Liquor Sanguinis**, or blood-plasma, the liquid in which the corpuscles float.

Blood outside the body soon coagulates, and the pale yellowish, greasy, albuminous liquid which is squeezed from the clot in its formation is called *serum*. Blood is conveyed by means of arteries, veins, and capillaries, and the main force that impels it is the heart.

The **Arteries** convey blood from the heart to the tissues, and as a rule it is pure and bright red in colour, due to the chemical action of oxygen, combined with colouring matter—see Ductless Glands—(haemoglobin), and also to the mechanical condition of the red corpuscles. If blood runs slowly from an artery, it may be as dark as venous blood, also under the
influence of chloroform or in asphyxia. The walls of the arteries, excepting the very small ones, have three coats:

1. Internal or epithelial.
2. Middle or contractile, mainly muscular.
3. External or areolar, mainly connective tissue.

**ARTERIAL SYSTEM.**

The chief arteries are arranged thus.

The **Aorta**, the main trunk, which, after leaving the left ventricle, proceeds upwards for about 2 inches, then arches backwards to the left side, passes over the root of the left lung, descends through the thorax on the left side of the spine by the diaphragm into the abdomen, terminating opposite to the fourth lumbar vertebra.

**I. Arteries of the Head and Neck.**

The pulmonary artery conveys blood from the heart to the lungs, dividing into right and left pulmonary.

**Arch of Aorta:** Right and left coronary, innominate (right common carotid, right subclavian), left common carotid, left subclavian. Common carotid bifurcates into external and internal.

**External Carotid:** Superior thyroid, lingual, facial, occipital, posterior auricular, ascending pharyngeal, superficial temporal, internal maxillary.

**Internal Carotid:** Tympanic, ophthalmic, anterior cerebral middle cerebral, posterior communicating, etc.

**Subclavian:** Vertebral thyroid axis, internal mammary, superior intercostal.

**Vertebral:** Lateral, anterior and posterior spinal, inferior cerebellar, bulbar, basilar.

**CIRCLE OF WILLIS.**

*(Important Anastomosis at Base of Brain.)*

|---------|-----------------------------|-----------------------------|-------------------------------|-------------------------------|----------|

**II. Arteries of the Upper Extremity.**

**Subclavian** becomes axillary at first rib.

**Axillary** becomes brachial at lower margin of teres major tendon.
Brachial bifurcates into radial and ulnar ½ inch below bend of elbow.

Radial and ulnar form deep and superficial palmar arches. Arteries anastomose round shoulder, elbow, hips, and knee-joints. The longest is between the subclavian and external iliac and the crucial at the great trochanter. The arteries are usually placed in deep protected situations in close proximity to bones, from which they derive their names, or in deep cavities.

III. Arteries of the Trunk.

The descending aorta has the following branches:

Thoracic: Pericardiac, bronchial, oesophageal, posterior mediastinal, intercostals (nine on each side).

Abdominal: Phrenic, coeliac axis (gastric, hepatic, splenic), superior mesenteric, suprarenal, renal, spermatic (or ovarian), inferior mesenteric, lumbar, middle sacral.

Common Iliacs: (a) Internal (anterior trunks: Superior vesical (bladder), obturator, inferior vesical or vaginal, middle haemorrhoidal, uterine, internal pudic, sciatic. Posterior trunk: Ilio-lumbar, superior and inferior lateral sacral, gluteal.

(b) External: Muscular, epigastric, circumflex iliac. Becomes femoral at Poupart’s ligament.

IV. Arteries of the Lower Extremity.

Femoral: Superficial epigastric, circumflex and external pudic, deep external pudic, profunda femoris (external and internal circumflex perforating), muscular, anastomotica magna. Becomes popliteal at opening in adductor magnus.

Popliteal: Muscular, cutaneous, superior and inferior articular. Bifurcates into anterior and posterior tibial at popliteus muscle.

Anterior Tibial: Posterior and anterior recurrent, external and internal malleolar, dorsalis pedis, ending in plantar arch.

Posterior Tibial: Peroneal, muscular, internal calcaneus, internal and external plantar. Ends as plantar arch.
VENOUS SYSTEM.

The Veins are more numerous, larger, and thinner-walled than the arteries. They collapse when empty, whereas the arteries remain stiff and firm. The valves, or pocket-shaped pouches, form a distinguishing feature in many of the veins, their use being to direct the blood towards the heart, and by distending when the blood flows back they make a species of partition, and so prevent further back-flow. The blood, laden with impurities and waste products, and of a dark purple colour (due probably to the amount of carbonic acid it contains), is carried by the veins to the right auricle of the heart. The following have no valves: Venae cavae, hepatic, portal, renal, uterine, ovarian, cerebral, spinal, pulmonary, umbilical, and the small veins.

Veins return the blood from the capillaries to the heart, and all carry carbonized blood, except the pulmonary, which, going direct from the lungs to the left side of the heart, naturally carry oxygenated blood.

The pulmonary form two main trunks from each lung, usually opening separately into the left auricle.

The deep veins accompany the arteries often in the same sheath, and have the same names. The secondary—such as radial, ulnar, etc.—have each two veins, called venae comites. Many veins are irregular in origin, so cannot be accurately described, and differ in individuals; they anastomose even more freely than the arteries.

Sinuses are venous channels, different in structure, but answering the same purpose. The interior of the cranium is drained by sinuses, formed by the separation of the layers of dura mater. The chief are superior and inferior longitudinal, straight, lateral, occipital, circular (around the pituitary body), superior and inferior petrosal, and basilar.

The external and internal jugulars—having received the facial, lingual, pharyngeal, superior, and middle thyroid, and occipital—unite with the subclavian to form the innominate at the root of the neck, into which the vertebral, thyroid, mammary, and superior intercostal enter.

The superior vena cava is formed by the union of the
two innominate veins, thus receiving the blood from the upper half of the body (above the heart), and enters the upper part of the right auricle.

The veins of the hand, forearm, and arm are superficial and deep:

1. Superficial (in the fascia) are external and internal dorsal, and palmar, which form cephalic and basilic, and, uniting, form axillary.

2. Deep are digital, introsseous, palmar uniting in deep radial and ulnar, forming brachial, and joining axillary.

The azygos substitute the venae cavae where these are deficient, being connected with the heart. They are right azygos, left lower and left upper azygos.

The spinal veins are in four sets (1) dorsi-spinal (emptying into the vertebral, intercostal, lumbar, and sacral); (2) meningo-rachidian; (3) venae basis vertebrarum; and (4) medulli-spinal.

Veins of the lower extremity are also superficial and deep.

1. Superficial, internal or long saphenous, external or short saphenous.

2. The deep external and internal plantar (forming posterior tibial), dorsalis pedis forming anterior tibial, which joins posterior tibial, forming popliteal, which becomes femoral, and finally external iliac, which joins with internal iliac (posterior pelvic veins—viz., gluteal, sciatic, pudic, obturator, etc.) to form common iliac.

The inferior vena cava extends from the union of the common iliacs, passes along the front of the spine, through the diaphragm to the right auricle, receiving en route the lumbar, ovarian (or spermatic), renal, suprarenal, phrenic, and hepatic veins.

The cardiac veins return blood from the heart tissue to the right auricle.

The Capillaries (capillus, a hair) are very tiny blood vessels, which are the termination of the smaller arteries and the commencement of the smaller veins, practically the intermediary bloodvessels, which connect the arteries and veins. Their average diameter is only $\frac{1}{3000}$ inch.

The Pulse in the arteries is due to the jetting movement
of the blood caused by the contraction and dilatation of the muscular walls of the heart. Part of the force is exercised on the walls of the bloodvessels, which are consequently distended and elongated. This beat or movement is sensible to the finger placed on the artery, and still more so to the sphygmograph (describing the pulse), a delicate little instrument by which the pulse-tracings are taken.

The terms 'greater' or 'systemic,' 'lesser' or 'pulmonary,' and 'portal,' are used in describing certain portions of the circuit.

The **Greater (Systemic) Circulation** is the course taken by the blood from the left ventricle through the arteries, capillaries, and veins to the right side of the heart, by which nutrition is carried to every part of the body.

The **Lesser or Pulmonary Circulation** is that between the right side of the heart, through the lungs and back to the heart again. It is in the lungs that the blood is aerated, for the pulmonary capillaries are spread over the blood-vesicles, and, by osmosis, oxygen is absorbed from the air into the blood and carbonic acid is given off. Thus the **pulmonary veins** (four) contain purified bright crimson blood, which they take to the left auricle.

The **Portal** is that part of the systemic circulation by which the blood distributed to the stomach, spleen, pancreas, and intestines, is united in the portal vein, and, laden with the products of digestion absorbed in the above-named organs, passes into the liver. Here it supplies material from which bile is secreted. The capillaries, having permeated every part, unite in the hepatic veins, which open into the inferior vena cava.

The heart supplies the muscular force which keeps the blood in circulation, assisted by the elastic walls of the arteries, the pressure of the muscles among which the veins flow, and the movement of the chest in respiration. The right direction is determined and maintained by the action of the heart valves.

The **Heart** is a hollow, conical, fleshy bag about the size of its owner's closed fist. It is situated about the middle of the thorax between the lungs, and extends over to the left
side, resting on the diaphragm. It is composed mainly of muscular tissue, which partly resembles the tissue of voluntary and partly of involuntary muscles. The upper part, the base, is broad; the lower, the apex, is tapering, and tilts forward during each ventricular contraction, thus forming the heart-beat, which is felt between the fifth and sixth ribs, about 3 inches from the sternum. It is enclosed in a kind of double bag, the pericardium, between the two layers of which is a fluid called serum. Inflammation of the pericardium is termed pericarditis. The endocardium is the inner membranous lining of the heart, inflammation of which is called endocarditis.

The heart has two distinct sides, separated by a septum or muscular wall. The right and left sides have each two chambers: an upper one, with thin walls, the **Auricle**; and a lower, with thicker walls, the **Ventricle**. Each cavity contains from about 4 to 6 ounces.

The auriculo-ventricular opening, between the right auricle (auris, ear) and right ventricle (venter, belly or cavity), is guarded by a valve, the **Tricuspid** (having three cusps or folds), and that between the left auricle and left ventricle is the **Bicuspid** or Mitral (resembling a bishop’s mitre) valve. Attached to these cusps are fine cords (chordae tendinae), which arise from small muscular pillars (columnae papillaris) in the ventricles; the latter by contraction pull on the fine cords and so help to close the valves.

When the ventricle is full, the valves close tightly to prevent regurgitation. In certain forms of heart disease the closure is not quite perfect. The opening from the right ventricle into the pulmonary artery is also guarded by three crescent-shaped valves, the **Semilunar**, also that from the left ventricle to the aorta, which is called the **Aortic** (also semilunar) valve.

The Course of the Blood is, then, as follows: The superior and inferior venae cavae (the latter crowned by a rudimentary valve, the Eustachian) having brought their contents into the right auricle, it contracts, forces open the tricuspid valve, and the right ventricle is dilated with its contents. When full, the tricuspid valve closes, the ventricle contracts,
and expels its contents through the semilunar valve into the pulmonary artery, which, branching off to the right and left lung, carries the blood for oxidation to the lungs. By means of the pulmonary veins (which in this instance carry bright red blood) the blood is returned to the heart, this time entering the left auricle. By contraction it passes on its contents through the bicuspid or mitral valve into the left ventricle. The contraction of the left ventricle (whose walls are very thick) sends the blood with great pressure through the aortic or semilunar valve into the aorta (from eiro, I suspend), which has its exit at the upper or right-hand corner. The two small coronary arteries, which nourish the substance of the heart, branch off just outside the aortic valve, and the coronary veins communicate direct with the right auricle.

The two auricles and the two ventricles act synchronously (i.e., at the same time), their contractions constituting the Systole (sustole, a drawing together), and their dilatations the Diastole (diastello, I expand), of the heart.

When an artery is wounded, the blood flows in a jet-like, broken manner, and pressure should be applied on the side nearest the heart. When a vein is wounded, the blood flows in a continuous stream, and is usually darker in colour; in this case pressure should be applied on the side farthest removed from the heart. If in any doubt, apply pressure over the wound itself.

The Vasa Vasorum are the bloodvessels which carry nutrition to the walls of the arteries and veins themselves.
CHAPTER VII

THE MUSCULAR SYSTEM

The Muscular System forms half the weight of the body, and 75 per cent, of it is water, so we may say that it consists of two parts—a fibrous, contractile, solid portion, and a serous or watery one.

Muscles constitute the fleshy covering of the frame, and are red, owing to the large number of bloodvessels which permeate them. Muscles may be (1) voluntary and striped in formation, in which case they act in accordance with the impulses of the will, and are mainly attached to bony levers; or (2) involuntary—smooth or unstriped. They then act independently of the will, and are often hollow, causing the contraction and expansion of the cavities, as in the alimentary canal, the bladder, coats of the arteries, of the excretory ducts, larger lymphatics, trachea, etc. Their contraction in the hair sacs makes the hair stand on end, and also causes goose-skin.

1. Voluntary, Striped or Striated Muscle is composed of a number of long, parallel, cylindrical fibres (called ultimate muscular fibres), in which there are no vessels or connective tissue, but each is enclosed in a tough, elastic, transparent membrane—sarcolemma. Bundles of these fibres, called fasciculi, are connected together in a sheath of connective tissue. Bundles of fasciculi thus united make up a muscle of voluntary striated texture. All muscles are covered by a fibrous membrane called the fascia. Each single ultimate muscular fibre may be split up longitudinally into fibrillae, and transversely into tiny discs.
2. **Involuntary, Non-Striated, Smooth Muscle** is composed of minute, elongated, spindle-shaped, nucleated, contractile cells $\frac{1}{600}$ to $\frac{1}{300}$ inch long, which are not striated, nor do they contain any sheath or sarcolemma, although they form longitudinal fasciculi. Such muscles have a vermicular movement, called *peristalsis*.

The muscle fibres of the heart resemble in some respects the fibres of the voluntary muscles.

Sometimes the muscular fibre is arranged in a circular band or ring, and in this case its contraction closes a central aperture, whilst its relaxation allows its opening. This is called a **Sphincter Muscle**; *e.g.*, the pylorus and the anus.

The voluntary solid muscles consist of a body and two extremities, one of which is attached to a fixed bone, and is called the **Origin** of the muscle, and the other to a movable bone, which is the main seat of action, and is called its **Insertion**. The latter extremity, the insertion, is usually attached to the bone by means of a tendon, consisting of a tough, flexible, whitish band of fibrous tissue; *e.g.*, the tendo Achillis, which attaches the gastrocnemius (calf muscle) to the os calcis (heel bone).

Some muscles have a flat termination, called **aponeurosis**, consisting of fibrous membranes destitute of nerves; *e.g.*, the latissimus dorsi.

Muscles usually take their names from their function, shape, or position, sometimes from the number of heads or parts into which they divide; *e.g.*, the biceps.

The power of contraction possessed by a muscle is called its **Tone**, and when this power is lost or impaired it may often be worked up by massage, electricity, or by an irritant (blistering).

Muscles may be in a state of activity, repose, or rigor mortis (a stiffening which sets in soon after death, but passes off after a few hours). If a muscle is overtaxed, a **Tremor** is often the result.

**Tonic Spasm** is caused by persistent contractions of a muscle or series of muscles; if of the entire muscular system, it is called **Tetanus**.
When the contractions are intermittent, the spasm is called **Clonic**, and **Chorea** is a spasmodic contraction of certain muscles (mainly flexors).

**Bursae** are the small sacs of fluid inserted between the tendons and bones, which thus diminish friction.

*(For table and diagrams of Muscles see end.)*
CHAPTER VIII

THE NERVOUS SYSTEM

Nervous tissue is formed of two structures:

1. Grey, in which nervous impressions and impulses originate.
2. White, by which these impressions and impulses are conducted.

1. Grey nervous substance is composed of nerve cells, or ganglionic corpuscles, imbedded in a species of nerve cement, called neuroglia. The cells are of various sizes and shapes, but the largest is not more than \( \frac{1}{250} \) inch. They form the central body of the neuron, having each one or more processes, according to the number of which they are termed unipolar, bipolar, and multipolar. One of these is longer than the others, and is called the axon, neuraxon, or axis-cylinder, as it becomes the centre of the nerve fibre, while the shorter ones are termed dendrones or dendrites, being intimately associated but independent.

2. White nervous substance, or nerve fibre, contains two kinds of fibres: (a) medullated, or white; (b) non-medullated, or grey.

(a) Medullated or white fibres have the essential axis-cylinder (the prolongation of the nerve cell) surrounded by a medullary sheath (white substance of Schwann), with constrictions (nodes of Ranvier.) These are enclosed in a primitive sheath (neurilemma), which is absent in the fibres of the brain and spinal cord. A bundle, or funiculus, of such fibres is held together by endoneurium, each surrounded by perineurium.
both formed of connective tissue; several funiculi are collected into larger bundles, fasciculi, which are connected by a common membrane, the epineurium, the whole then constituting a nerve. Nourishment is provided by a minute system of capillary bloodvessels, the medullated fibres in the epineurium being the nervi nervorum, or nerves of the nerves. This arrangement is analogous to the muscle fibre, with its endomysium, perimysium, and epimysium. These medullated fibres form the white part of the brain and spinal cord and the greater part of the cerebro-spinal nerves.

(b) The non-medullated, grey, or gelatinous nerve fibres (fibres of Remak) have also an axis-cylinder, but it is enclosed in a nucleated sheath (of modified neurilemma), splitting into fibrillse about half the size of the medullated, having many nuclei, which sometimes form the only covering. These predominate in the sympathetic ganglia and in some of the cerebro-spinal nerves (excretory olfactory).

Both medullated and non-medullated fibres are often associated in a common nerve trunk.

The axis-cylinder (neuraxon) carries impulses away from the cell; the dendrites bring impulses to it, and being in contact with the end-brushes of other neuraxons, receive and transmit impulses from them, there being thus intricate relation, but no real connection; the purpose of the nervous tissue being to receive impulses from within and without the body, to transfer and modify them, to send out impulses to control the vital functions, and to maintain the rhythm between each and every part, thus keeping the individual in harmony with his surroundings.

Terminations of Nerves.—Their origin or central termination occurs from the nerve centre by one or two roots, sometimes widely apart. The peripheral terminations of sensory nerves are in minute fibrillae (of motor nerve in special terminal organs), end-plates of striped voluntary muscular fibre, end-bulbs (of Krause), tactile corpuscles (of Wagner), Pacinian corpuscles, etc.

Ganglia are separate small collections of nerve cells, connected with one another, with the cerebro-spinal axis and its nerves. They consist of nerve cells and nerve fibres, invested
with a membranous covering (a continuation of the perineurium), sending processes into the interior of the ganglion to support the bloodvessels supplying its substance.

They form a connected series along each side of the spinal column anteriorly. They are found on the posterior roots of all the spinal nerves; on the sensory root of the fifth cranial; also on the facial, auditory, glosso-pharyngeal, and pneumogastric nerves (see Cranial Nerves).

The function of the Nervous System is innervation—i.e., the generation and transmission of motor impulses, of sensation, thought, volition, and emotion—and in each exercise of this function brain tissue is burnt or oxidized. The nervous system consists of two parts, which are intimately connected, viz., the Cerebro-spinal and the Sympathetic or Ganglionic.
CHAPTER IX

THE NERVOUS SYSTEM—Continued

The Cerebro-Spinal System.

This may be divided into—


The Brain consists of—

1. The Cerebrum, or brain proper, which is the seat of sensation, volition, emotion, and powers of the mind. It is divided by a large longitudinal fissure into two hemispheres, and each of these into three lobes—the anterior, middle, and posterior. Its surface is convoluted, by which the surface of the brain is increased, and thereby the quantity of grey cortical matter in which the generation of nervous force takes place. Intelligence appears to increase with the number of convolutions and the depth of the fissures (sulci). If this grey external matter is attacked by disease, the mind becomes affected first.

   Outside the grey matter of the cerebrum is the cortex, the seat of motor areas for the head, arms, lower limbs, and trunk. It is also the seat of consciousness and of special senses—auditory, visual, olfactory, tactile. It both gives and receives nervous impulses, and all voluntary acts probably depend upon it alone.

2. The Cerebellum (little brain) lies beneath the hinder
part of the cerebrum, and is apparently the regulator of the muscular system, or co-ordinate action, and of preservation of equilibrium. It is connected with the remainder of the cranium by bands called crura, two of which ascend to the cerebrum, two descend to the medulla oblongata, and two (crura cerebri) blend together to form the pons Varolii.

3. The **Pons Varolii**, or bridge of Varolius, is a commissure in front of the medulla oblongata, which connects the two halves of the cerebellum, and unites the medulla with the remainder of the encephalon (brain).

4. The **Medulla Oblongata** (oblong marrow), or spinal bulb, extends from the lower border of the pons Varolii to the upper part of the spinal cord—it is, in fact, like a dilatation of the spinal cord within the cranium. It is about 1 inch long, ¾ inch wide, and ½ inch thick. Nerve fibres from the opposite halves decussate (*i.e.*, cross over one another), so that injury to one side of the head often causes paralysis of the opposite side of the body. The pons Varolii and medulla oblongata are essential to life, and if cut or mutilated instant death ensues.

The principal reflex centres of the medulla are closure of the eyes, sneezing, coughing, mastication, secretion of saliva, deglutition, sucking, vomiting, dilating the pupil of the eye, some of the muscles of the orbit and eyelid, respiration and innervation of the whole respiratory apparatus, accelerating and inhibiting the cardiac nerves and fibres; possibly vaso-motor, vaso-constrictor, and vaso-dilator (*see* Ductless Glands, Pituitary Body), spasm, and sweat centres also.

The brain is protected by the skull and enclosed in three membranes, called meninges (inflammation of which is called meningitis).

1. **Dura Mater**, the outer, which is tough and fibrous, adhering closely to the inner surface of the skull.

2. **Pia Mater**, the inner, which is the supporting membrane to the brain, supplying it with blood and dipping into its furrows (sulci).

3. **Arachnoid**, the middle, serous, delicate, transparent membrane, which lines the preceding passes over the con
volutions, thus forming a bag, in which the cerebro-spinal fluid is contained.

The latter fluid acts as a cushion, moistens the surface of the cavity, prevents concussion, and partially regulates the amount of blood to the brain.

In the spinal cord the *dura mater* is only slightly attached to the vertebral canal, and does not form the periosteum, as in the skull. The *pia mater* closely surrounds the cord, sending out prolongations along each pair of spinal nerves, and dips into the fissures of the cord; it is composed of connective tissue and bloodvessels.

The *arachnoid* is in two serous layers, parietal and visceral, being separated from the pia mater by the subarachnoid space, containing the cerebro-spinal fluid (about 2 ounces).

The average weight of a man’s brain is 54 ounces, and of a woman’s 45 ounces; the maximum weight is said to be 64 ounces.

**Structure.**—The brain is composed of grey and white matter, the grey being the dynamo, or seat of intelligence, and the white conveying afferent and efferent impulses. In a section of the brain we notice the grey is outside and the white inside, but in the spinal cord it is *vice versa*.

The **Spinal Cord** extends from the foramen magnum at the base of the skull to the first lumbar vertebra, where it branches off into a number of filaments, the *cauda equina* (horse’s tail). It is about 16 to 18 inches long, varies in thickness in different parts, and weighs about 1 ounce. It is cylindrical in shape, and has two enlargements in the cervical and lumbar regions, where the grey matter increases.

In a transverse section of the spinal cord we see two crescents of grey nerve matter, placed back to back, and divided by two longitudinal fissures, the *anterior and posterior median*, but united by a commissure, in the middle of which is a tiny canal. There are postero-lateral and posterior intermediate fissures also on each side. Each crescent has two horns (*cornua*), an anterior and a posterior cornu, which give off tubular nerve fibre to form the roots of the spinal nerves.
Those from the two anterior cornua develop into \textit{motor} nerves, those from the two posterior into \textit{sensory} nerves, the latter having each a ganglion. The anterior and posterior bundles of fibre coalesce in the intervertebral foramina and form the trunk of a mixed spinal nerve. Thus thirty-one pairs of spinal nerves are given off, which divide and subdivide, going chiefly to the muscles, skin, articulations, and viscera.

There are four columns, two on each side of the cord—posterior and antero-lateral. The white substance surrounds the grey, and is of medullated fibre (longitudinal, oblique, and transverse), with bloodvessels and neuroglia. It has nerve tracts extending along parts of the cord and into or from the brain: three efferent motor or descending fibres—the direct or pyramidal, the crossed pyramidal, and the antero-lateral tracts; three afferent, sensory, or ascending (cerebellar)—the ascending, lateral, and Goll’s column.

\textbf{Afferent Nerves} are those which carry impressions, mainly of pressure, contact, temperature, or pain, to a nerve centre, often called \textit{sensory}.

\textbf{Efferent} are such as carry impulses from nerve centres for motion, secretion, or nutrition (trophic), often called \textit{motor}.

When a sensory or afferent nerve fibre carries an impulse to a nerve centre which results in a motor impulse being sent through an efferent nerve fibre, \textbf{Reflex Action} is induced.

This is essentially involuntary, though it may often be started, controlled, or directed by the will, the nerves involved belonging to the cerebro-spinal or the sympathetic, or to both. It may be natural or acquired, and when in the cord may be simple, spasmodic, or co-ordinate, affecting large groups of muscles for definite action. The reflexes are divided into three groups when used for the detection of spinal diseases: superficial, including the skin; deep (tendon reflexes, as in the knee-joint); and organic (under control of the will, as micturition, etc.).

There are twelve pairs of nerves given off from the brain, which are counted from before backwards:
THE NERVOUS SYSTEM

Cranial Nerves given off in Pairs.

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>Olfactory (sensory)</td>
<td>Upper part of nose.</td>
</tr>
<tr>
<td>II.</td>
<td>Optic (sensory)</td>
<td>Inside of eyeballs.</td>
</tr>
<tr>
<td>III.</td>
<td>Motor oculi (motor)</td>
<td>Muscles of eye.</td>
</tr>
<tr>
<td>IV.</td>
<td>Trigeminal (motor)</td>
<td>Superior oblique of eye.</td>
</tr>
<tr>
<td>V.</td>
<td>Trigeminal (motor)</td>
<td>Eyeballs, orbits, lachrymal glands, skin of face, jaws, front of tongue.</td>
</tr>
<tr>
<td>VI.</td>
<td>Abducens (motor)</td>
<td>External rectus of eye.</td>
</tr>
<tr>
<td>VII.</td>
<td>Facial (motor)</td>
<td>Nearly all facial muscles.</td>
</tr>
<tr>
<td>VIII.</td>
<td>Auditory (sensory)</td>
<td>The inner ear.</td>
</tr>
<tr>
<td>IX.</td>
<td>Glossopharyngeal (mixed)</td>
<td>Tongue, soft palate, and pharyngeal muscles.</td>
</tr>
<tr>
<td>X.</td>
<td>Pneumogastric (mixed)</td>
<td>Pharynx, larynx, trachea, lungs, liver, stomach, heart, intestines, and at auditory meatus.</td>
</tr>
<tr>
<td></td>
<td>Vagus, or wandering</td>
<td></td>
</tr>
<tr>
<td>XI.</td>
<td>Spinal accessory (motor)</td>
<td>Muscles of neck and back.</td>
</tr>
<tr>
<td>XII.</td>
<td>Hypoglossal, or lingual (motor)</td>
<td>Muscles of the tongue.</td>
</tr>
</tbody>
</table>

(For list of Spinal Nerves, see end.)

Sympathetic Nervous System.

This consists of—

I. Two gangliated cords in front and on each side of the spinal column, beginning in the ganglion of Ribes on the anterior communicating artery at the base of the brain, and ending in the ganglion impar in front of the coccyx.

II. Three plexuses: Cardiac, solar or epigastric, and hypogastric.

III. Smaller ganglia.

IV. Nerve fibres.

All these are closely associated with the vessels, viscera, and glands; they are also related to the cerebro-spinal system.

The Gangliated Cords have—

Cervical Ganglia (3). (1) Superior: Opposite 2nd and 3rd cervical vertebrae, its branches forming carotid, cavernous, and pharyngeal plexuses, and superior cardiac nerve.

(2) Middle: Opposite 6th cervical vertebra. Gives off middle cardiac nerve.
Inferior: Between neck of 1st rib and transverse process of 9th cervical. Gives off inferior cardiac nerve.

Thoracic ganglia (11 or 12), on each side, resting against heads of ribs, except two last (on side of bodies of 11th and 12th dorsal). Branches from 3rd and 4th to posterior pulmonary plexus, or 5th or 6th upper ganglia, go to the thoracic aorta, 6th and 7th lower ganglia form the three splanchnic nerves.

*Great Splanchnic* formed from branches 6th to the 10th, connecting with the upper six, perforates crus of diaphragm to semilunar ganglion of solar plexus.

*Lesser Splanchnic*, from 10th and nth with above to solar plexus.

*Smaller or renal splanchnic*, from last thoracic ganglion passes through diaphragm to renal and solar plexuses.

Lumbar ganglia (4), help to form aortic and hypogastric plexuses; go to bodies of lumbar vertebrae and their ligaments.

Pelvic ganglia (4 or 5), in front of sacrum unite in ganglion impar, communicate with sacral nerves, help to form pelvic plexus and one on middle sacral artery, and join branches of other side in front of sacrum.

**Sympathetic Plexuses.**

*Cardiac.*—At the base of the heart, and divided into—

Superficial: Formed from branches of the pneumogastric and filaments from the deep cardiac plexus. Its branches form anterior coronary (heart) and anterior pulmonary plexuses, and accompany bronchial tubes.

Deep: Formed from cardiac nerves of cervical sympathetic ganglia and branches of laryngeal and pneumogastric. It lies in front of bifurcation of trachea and behind arch of aorta. Its branches help to form anterior and posterior coronary, anterior pulmonary plexuses, and go to the right and left auricles.

*Epigastric or Solar* (often spoken of as the Abdominal Brain).—Behind stomach, in front of aorta and crura of diaphragm; surrounds cceliac axis and part of superior
mesenteric arteries. It has two principal ganglia—semi
lunar—situated on each side of it, close to the suprarenal
capsules.

This plexus and its associated ganglia receive the great and
small splanchnics and branches from the pneumogastric.
It sends branches which form the following plexuses:

Phrenic: Supplying phrenic artery, diaphragm, and supra
renal capsules.

Suprarenal: Supplies capsules.

Renal: Supplies kidneys and inferior vena cava.

Coeliac: Supplies coeliac artery and subdivides into gastric,
hepatic, and splenic plexuses.

Gastric: Supplies lesser curvature of stomach.

Hepatic: Supplies hepatic artery and portal vein; also
other arteries of the stomach.

Splenic: Supplies spleen and pancreas.

Superior-Mesenteric (artery of same name): supplies area
of pancreas and intestines.

Aortic: On sides and front of aorta, between origin of
superior and inferior mesenteric arteries; sends branches to
hypogastric, plexus and inferior vena cava; supplies lower
intestines.

Hypogastric formed from branches of aortic plexus and
lumbar ganglia, in front of promontory of sacrum, between
two common iliac arteries. It bifurcates into the two pelvic
or inferior hypogastric plexuses which supply organs of
reproduction, bladder, and rectum.

The vaso-motor nerves are probably derived from both the
sympathetic and cerebro-spinal systems; they have influence
over the smooth, unstriped muscular tissue of the intestinal
and arterial walls, thus regulating their tonicity, and, conse-
quently, their blood-supply and nutrition.
CHAPTER X

PRACTICAL MASSAGE

All the manipulations may be classified under four heads, the names of which come to us through the French language, viz.: Effleurage, Petrissage, Massage a Friction, Tapotement.

i. Effleurage (effleurer, to skim over) is a stroking movement, performed mainly with the palm of the hand, with a varying degree of force, in a centripetal direction (i.e., from the extremities towards the body or heart). It may be applied to nearly every part of the body. It acts upon the superficial circulation, dilating the vessels locally, exciting skin reflexes, and also stimulating the skin muscles. If applied with force, it acts powerfully on the veins and the lymphatic circulation. It is therefore calculated to increase the pulse and the local temperature. The movement should follow the muscular fibres, and should be frequently applied, in turn with other movements. In massing a limb, the hands should stroke alternately with a fair amount of force up to the joint, and then down again very lightly, to be ready for the next movement, avoiding any thin surfaces of bone, like the shin, and moulding the fingers lightly to the contour of the limb, leaving the main pressure to the palm.

The tips of the fingers are used for stroking round the joints (for sprains and rheumatism, etc.).

All strokings should be performed rather briskly.

Effleurage very lightly performed probably contracts the superficial vessels locally, and in cases of spinal neuralgia
may cause intense pain, whereas very firm stroking relieves it.

2. **Pétrissage** (*pétrir*, to knead) consists in picking up part of a muscle, adipose or other tissue, with both hands, usually alternately, and then pressing it. As a rule, it is best to take up the part between the fingers of one hand and the thumb of the other, alternately, changing rapidly without raising the hands, in a gliding fashion and in a slanting direction, giving a billowy appearance. Care must be taken to proceed uniformly, avoiding a jerky motion, and passing rapidly, but almost unconsciously, along the muscle or group of muscles.

This movement must not be attempted over the immediate surface of a bone, but should be restricted to the fleshy parts of limbs, the neck, loins, and muscular parts of the back. Superficial kneading with the tips of the fingers and thumbs may be used over parts only thinly covered also. The thick part of the arms, legs, and thighs may be lightly rolled between the palms of the hands, somewhat like handling a rolling-pin when making pastry, but not at all heavily.

Pétrissage is a powerful stimulant to secretion, and helps to arouse dormant nervous energy. Its action is powerful in eliminating waste products and effusions, especially by means of absorption through the lymphatics. The pulse rate is decreased, but it becomes fuller and stronger.

3. **Massage à Friction** is a movement in which the fingers or thumbs move in a series of small circles.

   It is used—

   (a) Around swollen joints to promote absorption.
   (b) Over the forehead or spine as a soothing movement, to relieve pain or promote sleep.
   (c) To stimulate the deeper muscles about the spine in cases of lateral curvature or weakness of the back muscles; in these cases the thumbs are used on either side of the spine, working downwards and outwards with firm pressure.

4. **Tapotement** (*tapoter*, to tap).—Any kind of percussion comes under this heading. It may be performed with the
tips of the fingers, the ulnar borders of the hands, the palms, or the backs of the fingers with the hands lightly clenched or cone-shaped, so as to contain a cushion of air. It is essential, in one and all of these, that the movement is from the wrists, and that the strokes are in rapid succession. Perhaps the most important is the hacking movement, resembling chop-sticks on the piano, but it is preferable for the second, third, and little finger to be slightly flexed, so that all three tips of those fingers strike the surface at once. This movement should be practised carefully, always starting with the left hand (which is usually the one to lag and get out of rhythm), and flinging the hand back as high as possible without moving the arm.

Tapotement causes involuntary muscular contraction, and is a great stimulant to the nerves. It is applied with good effect on any fleshy part, such as the glutei, the abdomen (if no tenderness), the thigh, etc., and also with great care on either side of the spinal column and over the liver. It is also used in the cardiac region, but this should not be attempted by masseuses, except those of large experience.

**Vibrations** are a form of percussion. (See chapter on Vibrations.) They are used mainly to stimulate nerves or deeply-seated organs. Two or three fingers, the whole hand, or in some cases both hands, are placed over the part to be treated. The masseuse must concentrate her force without leaning her weight on the patient until her hand or fingers give a rapid vibratory movement.

Massage is found useful, as a rule, in the following cases: General debility, anaemia, imperfect circulation, rheumatism, certain stages of neuritis (inflammation of the nerves), paralysis (not in the spasmodic stage), neuralgia, sprains, fractures, stiff joints, asthma and certain diseases of the respiratory organs, dyspepsia, constipation, chorea, writer’s cramp, tennis elbow, insomnia, haemorrhoids, enlarged liver, obesity, lumbago, sciatica, torticollis, gout, synovitis, spinal curvature, and various deformities.

It is contra-indicated in skin affections, tumours, and purulent inflammation, diseases of the kidneys, during severe constitutional or local disease, and some affections of the
bloodvessels or lymphatics. Abdominal massage is contra­
indicated during pregnancy.

In certain poisoning cases, such as acute chloral or chronic
morphomania or dipsomania, massage has been found bene­

cicial.

The **Hands of the Operator** should be kept white and
soft, and not used for any rough or dirty work. At night a
mixture of white of egg and 1 or 2 grains of alum may be
used. In cold weather chaps may be prevented by the use
of dry oatmeal to absorb all moisture after washing the hands.

If called to any cases affected with specific disease, an
antiseptic, such as carbolic soap or oil of cloves with lard,
should be used.

A skilled masseuse does not usually require either a
lubricant or powder. Should a lubricant be used, very little
is sufficient to enable the hands to move smoothly. It may
be required in some cases when the skin is rough, dry, or
hairy, when there is great emaciation, or with the delicate
skin of an infant. Opinions differ as to the lubricant, some
prefer an *animal* oil, as, for example, lanoline cream mixed
with almond-oil; others a *vegetable* oil, such as cocoanut-oil,
the next best; if a *mineral* oil, *white* vaseline is considered
the best.

If the masseuse should suffer from damp hands, she may
find it necessary to use a little powder, but it should be as
little as possible. If much powder be used, the glands of the
patient’s skin may become clogged, and so their work of
excretion and secretion will be hindered. Massage should
always be applied directly to the skin of the patient.

The masseuse must be careful to cover up each part of the
body that has been massed, and not to expose more than is
absolutely necessary at a time. The patient must be placed
in as comfortable a position as possible, and made to relax
every muscle. It is of no use trying to mass any muscle in
a state of contraction. When the tension is great, special
relaxation movements should be given. For general massage,
the patient should be wrapped in a blanket, wearing a flannel
dressing-gown made loose, or a special massage-gown in
which the sleeves are made to unfasten in the seams and tied
with strings, and the lower part like a divided rational skirt, also with strings at the side. This prevents any unnecessary exposure and keeps the patient warm. The temperature of the room should not be less than 60° F., and 70° F. is preferable.

In giving General Massage—i.e., massing the whole body except the head—the following procedure may be adopted:

It is perhaps as well to start with the lower extremities, as so many patients are ordered this treatment for imperfect circulation as well as other ills, and have cold feet almost invariably.

Having made your patient quite comfortable and covered every part except the foot, and your own hands being perfectly clean and warm, take hold of the foot with both hands, with the thumbs on the top and the fingers behind, and squeeze it gently but firmly, moving your hands slightly after each squeeze. Then place your thumbs on the muscles over the metatarsal bones and instep and rub round, each thumb moving in an opposite direction, whilst the fingers support the foot underneath and steady the hands. Then take each toe separately and work the muscle with your thumb on the top, and stroke it sideways with the thumb and first finger, whilst the other hand holds the foot steadily. The fourteen phalanges may be adducted and abducted separately if you have time, or en masse from the metatarsal joint. The whole foot is then rotated, the bottom of the leg being held firmly just above the malleoli with the free hand.

The palms may also be placed one on the dorsal the other on the plantar surface, and removed in opposite directions with deep pressure.

The tips of the fingers should rub round the ankle-bones, and the sole of the foot be rubbed very firmly with the palm of the hand.

Now proceed to the leg. Place your hands on the muscle on either side of the shin-bone, thumbs in front, and roll the muscle round, thinking more of moving the muscle than the hands; in fact, both go together if you are grasping it in the right way.
Then roll the muscle lightly between your hands, treating the leg somewhat like a rolling-pin, but having it in front of you. Then knead in the ordinary way (see Petrissage) all up the calf, giving light effleurage between the other movements, rather to the side, to avoid the bony surface.

Now we arrive at the knee. The muscle on either side of the patella is grasped and rolled like the leg, only here you do not move upwards. The thumbs work in opposite directions, as on the metatarsal bones, but more gently. The tips of the fingers work firmly but gently underneath the joint, where weakness is often felt. If there is any stiffness, work deeply with your thumbs all round, trying to rub away any little deposits or to break down small adhesions. Place one hand above and the other below the knee, and draw the muscle to the centre.

On commencing the thigh, give effleurage up the whole length of the limb first, one hand on the outside up to the great trochanter, and the other inside as far as can conveniently be reached. Knead and roll the muscle well, much as you did the leg, only much more vigorously, as you have a larger amount of muscle to work upon. When rolling, the hands may be crossed, after drawing up the muscle on either side, and so moving the muscles in an opposite direction. If there is any special weakness in the hip, or sciatica, turn your patient on to one side and work well with the thumbs all round the joint and up the sciatic nerve. Percussions are very useful on the calf and the thigh.

The hands and arms may be taken next, the movements being much the same as for the lower extremities. The tendons should be firmly stroked in an upward direction, and special attention given to the deltoid, moulding the hands to the adjacent bones.

The chest may next be attempted. Let your patient lie with the head and shoulders slightly raised, and place your palms on the muscles over the clavicle, and the tips of the fingers just over the shoulder; work gradually downwards towards the breasts,' moving the muscle in a rotary direction firmly, but never with much pressure, taking care not to press at all on the breasts. One hand moves now over the
sternum from below upwards, whilst the other works from right to left, or *vice-versa*, about 2 inches below the clavicle across the chest, the combined movement looking like a \(T\)-rule.

Then work the breasts in a circular manner, the hands touching quite gently, also rub from the outside border towards the nipples. This is specially useful when the breasts have become swelled and knobby with retained milk. The over-burdened milk-ducts may be relieved in a few minutes by this movement being carefully performed. In this case the lumps must also be rubbed away under the axilla. To drain the lymphatics work from the nipple towards the axilla.

Then stroke very firmly across the stomach, one hand following the other rapidly with long, firm strokes from the left side to about the centre of the body at the waist. If possible, have your patient on a narrow bed, so that you can work from either side. If this is not practicable, choose the right side of your patient, as you should be on this side for the abdominal massage. Direct the patient to flex her knees and separate them; if needful, place a pillow below.

Work well over and under the ribs.

The liver should be well stroked like the stomach; kneading, rotary and tapotement movements are also useful.

Work with the tips of three fingers in small circles round the navel or umbilicus, gradually increasing the area downwards. Place your hand flat in the centre of the abdomen, and, with the other hand fixed on the top of it, move the muscle round and round very firmly, but not letting the weight of your arm be felt.

Then place the ulnar border of your hand along the ascending colon, well within the haunch-bone, the tips of the fingers facing the lower extremities. Then glide the radial side and forefinger along the transverse colon, and slip the tips of the fingers along the descending colon. This describes almost three sides of a square, and must be dexterously performed, regulating the pressure, which should be even throughout, to the thickness of the abdominal walls and the condition of the patient.
The whole surface may be kneaded and percussed if the patient can stand it, the general motion being from right to left. The skin may be gently rolled from side to side, and the ulnar borders of the hands drawn rapidly across in opposite directions.

Next turn your patient into the prone position, placing a pillow under the chest and waist, directing her to rest her elbows on either side of the pillow, or to put the arms straight down by the sides, and relax the back muscles as much as possible. If this position is not possible, let her lie as far over on the side as she can. Uncover the back nearly down to the waist, and have a shawl handy to cover up any part not being worked upon. Give effleurage briskly; then work the muscles from the top of the shoulder downwards, always moulding your hands to the bones and relaxing the grasp over thin surfaces. Knead the muscles all over, not forgetting the sides, with the serratus magnus and intercostal muscles.

There are several special movements for the vertebral column, which may be used in turn with those for the whole surface, but never for more than a minute at a time, or they prove irritating. One is to pass the hand firmly along the spine from the waist upwards, and then descend, pressing the first and second fingers one on each side of the spinous processes. This is done slowly and with a good deal of gentle pressure. Make a series of small circles with the tips of the fingers, beginning at the cervical vertebrae to the waist, also slowly and with a certain amount of pressure. Give very deep thumb-strokes between the vertebrae, and follow as far as possible the intercostal nerves. Stroke very firmly, one hand succeeding the other all down the spine in a kind of gliding, soothing fashion, which helps to induce sleep, and may be done the last thing.

The gluteal region now calls for attention, and demands a good deal of vigour, as the mass of tissue is large. Place one hand over the other (as in the abdominal massage) on one of the buttocks, and move it round and round. Then the other. The whole should be well kneaded and percussed. Draw the hands across in opposite directions.
palms downwards. Rub well in the small of the back with the palm and thick part of the thumb, and percuss lightly. Percussion may also be applied all down the spine (one hand on each side) and over the liver, but with great care, and only from the wrist, otherwise you will be disgraced by your patient having bruises.

In ordinary cases of massage, except in the case of stiff joints, no actual pain should be given; if there is, you are probably not doing your work properly, or, at any rate, not adapting it to the individual patient. The more observation you have and the more you study each patient’s temperament, the sooner you will acquire that adaptability which, after proper training, makes you a really good masseuse, and also gives variety and interest to your work, raising it from that mechanical, monotonous occupation which some deem it, to the art which it really is or should be.

Of course there are many other movements, only some of the principal ones being named here, and each good teacher has her own special manipulations, which are the result of her experience and study.

As is before mentioned, no one should attempt to learn the practical work except from a competent teacher, and certainly not by herself, for that is impossible and fraught with danger. The hour or hour and a quarter generally ordered must be as equally divided as possible, say about ten minutes to each lower, five to each upper extremity, seven to the chest, and the remainder divided between the abdomen and back.
CHAPTER XI

PRACTICAL MASSAGE—Continued

By massing Stiff Joints adhesions may be broken down and exudations dispersed, but the treatment must be very gentle at the beginning. In such cases it is wise to mass the neighbouring muscles first, and, after the whole limb has been treated, then attack the joint, and use all your knowledge and experience to avoid any unnecessary pain. This is one of the very few cases in which some small amount of pain is almost inevitable. Before going to such a case, study the structure of that special part if your memory is at all hazy about it, and don’t grudge the trouble and time involved in a visit to the Royal College of Surgeons’ Museum if in London, or to any good medical museum within reach, where the exact position of the muscles and ligaments can be so accurately studied, as well as the bony structure. The skeleton in position shows so distinctly what one cannot learn from the separate bones even. Anatomical charts are also a great help.

Do all you can to gain the patient’s confidence, as very often the fear of pain makes her shrink or insensibly stiffen the muscles, and in some cases the actual cause of stiffness may have disappeared, and it is only weakness and timidity that prevent movement. Have a picture in your mind of the structure of the part affected, and, after massing the surrounding parts, give active and passive movements. The operator and patient may alternately resist when the first stiffness is overcome.
Lawn-Tennis Elbow is due to a sudden strain of the muscle (usually the triceps or anconeus) and a possible strain of the elbow-joint, caused by a certain stroke at tennis, almost invariably a back-hander. Special attention should be given to the vicinity of the external condyle of the humerus, the orbicular ligament, and the back of the upper arm. The use of a sling for a few days is advisable.

Sciatica.—After gently kneading and stroking the whole limb, let the patient be turned on to her side, and give deeper massage with percussion along the course of the nerve. Especial time and attention should be given to the lower part of the back and to the buttocks. When the patient has again turned on to her back, place the leg on your shoulder, and stretch the nerve as much as possible. This may also be done by taking the heel in the palm of the right hand, and placing the left firmly below the buttock, and then stretching in contrary directions. The leg and thigh should also be flexed extended, and rotated vibrations are very useful.

The patient should rest the foot of the weakened side against a footstool, and, keeping the knee stiff, should bend forward from the hips as far as possible.

Facial Paralysis.—All the muscles should be worked with the fingers, using only the tips, and fixing the thumbs on the cranium or the lower maxillary bone. The thumb, covered with a clean handkerchief or small piece of lint, may be put inside the mouth, and the muscles worked between it and the fingers outside. Light percussions and vibrations are also useful.

Habitual Constipation (see section on Constipation).—Use all the abdominal movements you know (being sure to flex and separate the patient’s knees first). When kneading over the colon, work first about the splenic flexure and down the descending colon, then from the caecum to the sigmoid flexure, with pressure always towards the rectum. Turn the patient on her chest, and percuss the sacral region well and knead the glutei deeply. The patient lying on her back, flex the thighs well over the trunk, and circumduct the hips singly; flex and extend the legs with resistance. Encourage the patient to do some simple calisthenics before breakfast if
possible—bending forward, backward, and laterally from the hips, keeping the knees straight and the hands on the hips.

**Flat Foot.**—Apply careful and systematic massage of the whole foot, adduction, abduction, and rotation; walking on tip-toe as long as possible, then resting for a few minutes; walking on the outside edge of the foot. Discourage the patient from standing with the toes much turned out. With the feet straight side by side, rise on tip-toe, then bend the knees as much as possible, rise on tip-toe again, and then resume first position, not allowing the heels to touch the ground during the movement, but balancing on the toes.

**Bronchial Asthma.**—All the chest and back movements, strokings of the neck and kneading, also percussion of the top part of the chest, begun very gently and gradually increasing in force, keeping away from the breasts. Tell the patient to take deep and full inspirations, and very gradual expirations, preferably with the mouth shut throughout.

During the inspirations place your hands over the ribs, and encourage your patient to raise them as much as possible, and during the expiration press your thumbs under the lower ribs at the edge of the diaphragm. Suggest to your patient to take as deep and full breaths as possible several times a day.

Extend the patient’s arms on a line with the shoulders, and make the hands meet in front of the chest, keeping the elbows quite stiff, the patient resisting the movement. Return to the first position on a line with the shoulders, the operator resisting with her fingers placed across the back of the patient’s hands. Stand above the patient; rotate the arms over her head. The Schott (arm and trunk) movements, with and without resistance, are also useful.

Massage is beneficial in asthmatic cases, because, the superficial circulation being improved, the congestion of the mucous membrane of the bronchial tubes is reduced, and probably there is a reflex action on the pulmonary branch of the pneumogastric nerve, produced by the counter-irritant—massage.

**Varicose Veins.**—Some forms of this weakened condition of the venous walls profit very much from massage. The
patient’s lower extremities should be elevated considerably in a graduated plane, and then the calves should be stroked with the rounded palms from below towards the knees, the pressure being very gentle at first, but always firm, the thighs in the same way; then turn the patient on her side or chest, and follow the course of the dilated vessels very gently with the soft part of the thumbs. This must be very carefully done, and no undue amount of pressure exercised, as the parts are very tender. The internal saphenous vein is often varicosed; it is found on the inner side of the leg, between the internal malleolus and the internal condyle of the femur; it then proceeds along the inner side of the thigh, and joins the femoral vein close to the artery of the same name. Attention should also be paid to the ankles, which are usually also in a congested state, and strokings all round these enfeebled parts should not be omitted. Very gentle vibrations are also beneficial, given, of course, without pressure.

The patient should be advised to raise the feet higher than the trunk several times a day, if only for a couple of minutes. The doctor may also approve of the castors at the end of the bed being raised on small blocks of wood, with a rounded hole to keep the castors steady, so that during the night the distended vessels may be somewhat relieved.

Lateral Curvature.—All the movements for the back, especially those down the spinal column. On the convex side of the curve roll the back muscles with one hand, with pressure towards the spine, whilst with the other hand pressure is made against the hip on the opposite side. On the concave side knead deeply with the finger pads, in order to stretch contracted muscles; at the same time the opposite side of the spinal column must be firmly supported with one hand. If this is not done, the deep movement on the concave side might increase, or cause rotation of the vertebrae. Oström’s book on ‘Massage and the Swedish Movements,’ and Dr. John Mitchell’s most recent work (vol. vi. of Cohen’s ‘Therapeutics’) should be consulted for the active and passive movements of the limbs, for all cases where move
ments are specially ordered, and those for lateral curvature in particular. If the wrists and arms are strong enough to support the weight of the body, suspension on a cross-bar, or even hanging on to the top of a door, is found useful.

The patient may lie on a table or couch with the head and trunk projecting beyond the table, the feet being tightly held over the instep by an assistant. The patient then bends backwards as far as possible, the operator resisting slightly with one hand at the back of the neck, and the other straightening the spine. The patient then raises herself to the first position, the hands on the hips all the time. The same movement may be performed in the prone position. If found too severe at first, the patient may lie on the floor, and raise the trunk, without bending the knees, from the horizontal to the vertical position, the hands on the hips; this may also be done in the prone position.

Lateral bending, with resistance on the convex side, is useful either sitting or standing; also trunk turning, with resistance in the sitting position, the hands at the back of the head.

Exercises with Dowd’s machine or Whitely’s exerciser are often found very effective, but the patient should always rest between each movement, preferably in the horizontal position. Several hours a day (in sections of half an hour or three-quarters of an hour) should be spent lying flat and perfectly straight, or on an inclined plane. Complete rest to the spine, and relief from pressure to the intervertebral cartilages, are the chief points aimed at by this passive treatment, strengthening of the enfeebled muscles by the movements and massage. It must be remembered that a single curvature is often quickly followed by a secondary compensatory one, therefore there should be no delay in treating the first signs of curvature and removing the cause. Games and outdoor sports should be encouraged to develop the whole muscular system, but guard against overfatigue.

**Writer’s Cramp.**—General massage for the whole arm. Give special attention to the extensors of fingers and arm, as they will be weak from want of use. Apply deep pétrissage
to the muscles which form the ball of the thumb. Work deeply with the fingers or thumbs at the back of the neck over the cervical plexus. Raise the arm and stimulate the brachial plexus, to be reached by slightly lifting the clavicle. Give exercises, such as abduction and adduction of fingers, flexion and extension of fingers and of arm, giving resistance to the movement during extension.

**Recent Fractures.**—Massage and passive movements are often used with excellent results in the treatment of recent fractures. The objects of the treatment are: To prevent muscular spasm; to promote the absorption of effused blood and lymph; to prevent the formation of adhesions.

If the leg be fractured, the side-splints must first be removed, and then gentle upward stroking is applied to the limb for five to ten minutes. The masseuse must steady the knee with one hand whilst she strokes with the other, taking in as much of the circumference of the limb as possible.

After the first two or three days, according to the directions of the surgeon, passive flexion and extension is also applied to the toes, and later to the ankle. The masseuse must place one hand over the seat of fracture whilst giving these movements.

Any time after the fourteenth day the surgeon may order the removal of the splints, the application of ordinary massage, and passive movements for the knee.

With a fracture of the fore-arm the same plan would be adopted, the back splint being removed daily for smooth stroking; passive movements of fingers and hand would be given at an early stage of the treatment.

**Fracture of Patella.**—Smooth upward stroking must first be given to the surrounding muscles whilst one hand steadies the patella. The contraction of the quadriceps extensor would tend to draw upward the severed fragments of bone, therefore these muscles must be manipulated with great care and caution. Gentle lateral movement of the patella is given to prevent it from adhering to the femur.

At the end of a fortnight flexion and extension of the knee is often attempted, during which the upper part of the patella must be firmly supported by one hand.
Dislocations.—Two of the main objects to be gained by giving massage in a case of recent dislocation are the prevention of adhesions and the prevention of muscle-wasting. If massage has not been ordered at first, and the joint has been kept at rest, the masseuse must then do her best to get rid of the adhesions which will have formed, and to restore the muscles which govern the joint, and which will have wasted from want of use.

With a recent dislocation, effleurage only is given for the first day or two after reduction; then gentle petrissage and passive movements. If it be a dislocation of the shoulder, abduction of the arm should not be tried for some time. The deltoid in this case will be the muscle that has chiefly suffered, and it will not have sufficient strength to oppose the strong adductors; consequently they might displace the head of the humerus, drawing it inwards. No active movements should be given for at least a week.

Sprains.—At first effleurage only is given, beginning above the joint and afterwards passing lightly over it. If possible, this should be done for about ten minutes two or three times in the course of the day. If it be a sprained ankle, the leg should be slightly raised by means of a pillow or a comfortably padded sloping board. Hot fomentations are often applied before massage, or a douche given of alternately hot and cold water.

After the first day or two friction movements with the pads of the fingers can be used around the bruised and swollen parts, also passive movements of the toes, and later of the ankle.

The leg can shortly be treated by massage in the ordinary way, and thereby the effused blood from the injured part will be more speedily absorbed.
CHAPTER XII

VIBRATION TREATMENT

This form of treatment, sometimes called vibra-massage, produces a recurrent change of position, and induces a succession of waves, sending impulses through a definite area, causing increase, decrease, or inhibition of the nervous action. Formerly these were given manually, and though the most fatiguing of all movements to the operator, this method is still adhered to by some past-masters in the art; but many medical men and masseuses are only too glad to avail themselves of the efficient and labour-saving mechanical vibrators of the present day.

Those whose energy is diminished by having to treat patients in their own homes, usually adopt the portable variety, and amongst these, perhaps, the Shelton is the most practicable, weighing only three pounds, and which, while of limited size, produces a strong vibration, capable of considerable modification.

The results claimed for vibratory treatment are—
1. Increased blood and lymph flow.
2. Increased nutrition and general metabolism.
3. Increased heat.
4. Stimulation of organs of secretion and excretion.
5. Relief of contraction and congestion.
6. Inhibition and relief of pain.
7. Removal of exudations and increase of lymphatic activity.
8. Stimulation of the vaso-dilator and constrictor nerves.
It must be remembered that with a large vibrator the results are often obtained much more quickly than with a lighter one, and yet the latter may be quite as effective in the long run, especially with very sensitive patients.

Each machine is supplied with various applicators or vibratodes, adapted for use to various parts of the body, and differ according to the maker. Only the indiarubber ball or other light forms should be used on the head and neck, or on very sensitive parts, until the initial soreness has disappeared through inhibition or relief of symptoms.

The following principles, on which Dr. J. H. Taylor, an authority on the subject, lays great stress, should always be remembered:

‘The degree of force of processes applied must be appor tioned to the degree of irritability of the different parts of the body, and must be the greatest to the least irritable parts. Sensitiveness to impression is an approximate measure of irritability. Ludnitz found that motor nerve fibres are paralyzed sooner than sensory by continuous pressure.’

Corsets and all thick clothing should be removed, and a period of one to one and a half hours should intervene after a meal before treatment, and preferably two hours, in the case of abdominal applications. The patient must be in a thoroughly relaxed position, cushions, etc., being used to support limbs, if no assistant is at hand, and the prone position employed for back treatments.

A superficial interrupted vibration is given by lightly touching the parts for a few seconds, and then followed by a period of rest three or four times as long as the time of contact.

This produces a soothing, sedative effect, suitable for evening use, whereas a deep, interrupted vibration, em ploying light, moderate, or heavy pressure, is more stimu lating in character, and tends to produce renewed energy. This is especially used for oedema, swelling, pain, congestion, and many joint affections.

If continued too long and with too great pressure, a condi tion of nerve exhaustion follows, which is to be carefully avoided.
Vibratory stroking is attained by passing a vibratode lightly over the surface in certain directions. The speed, rate, and stroke can be tested on the operator’s own cheek or forehead. For this a small rubber ball or disc can be used.

Pilgrim considered that there are centres or stations of intelligence or direction within the cord that can and do attend to and direct the exercise of sensation and will do so without necessarily calling the brain into requisition; also that the various organs are controlled through nerve centres in the spine. Irritation in a distant part is reflected back to the nerve centre in the cord, and is there disclosed by the sensitiveness of that nerve or nerve centre to pressure.

The accompanying table at the end of the book will show how these nerve centres to the different parts can be reached.¹

**Constipation.**

An almost universal ailment needs special comment, and the treatment of constipation will be one of the most constant calls on a masseuse’s skill and patience.

Owing to the artificial life we lead, the irregular hours and constant strain of life, the digestive tract has a hard time of it, and is rarely in an absolutely normal condition.

A very common primary cause is malnutrition, which prevents the muscular peristalsis, essential to natural evacuation of the bowels; the overworked nerves refuse to carry the impulses, and drugs are promoted to take their place. Lack of biliary or other digestive juices is another cause, but there are many others, and the real one must be sought.

Much of the success of after-treatment depends on the preliminaries. If the physician has not already arranged the diet, inquire into this, and make sure that it is of a character which will promote peristalsis, that the residue is sufficient and non-fermentable, and meals are taken at regular hours. Insist on a sufficient quantity of water (2 to 3 quarts) being drunk daily, at the end of or between meals, and that the

¹ For a complete study of vibration treatment, students are referred to ‘Mechanical Vibration and its Therapeutic Application,’ by M. L. H. Arnold Snow, M.D.
patient goes to stool at the same hour daily, preferably before commencing the day’s work. Administer yourself (or give exact orders as to procedure) a. full colon irrigation, first emptying the rectum by a small injection, then washing out the large intestine by one or two large injections (3 to 4 quarts) of quite warm water, in which is dissolved 1 drachm of salt to the pint. By preference a rectal tube, well oiled, should be slowly and carefully passed up, and in very obstinate cases ½ pint of olive oil should be injected the last thing and retained, which has both an aperient and nutritious effect. Having cleared out the bowels well, give the ordinary massage movements for constipation, beginning with a mild treatment and gradually increasing the pressure and duration. Vibration treatments are very helpful, not only over the abdomen (especially to solar plexus), but to the spinal nerve centres (see table). A rectal application is often used for these cases, but it should be very carefully applied, and when in motion, or the intestines may be over-stimulated and exhausted. The last movements should be on the spine, not on the abdomen.

The patient should be urged to go through some free exercises, before dressing, on an empty stomach. Forward, backward, and lateral bending of trunk; throwing the arm forward, backward, and sideways, and high stepping, are especially to be recommended. Treatments should be given daily, and, if necessary, an injection, to secure a full movement.

The following recipe for bran biscuits has been found very efficacious, several of which should be taken at night, and if insufficient, a few more before the midday meal:

1 pound common bran.
1 pound Graham, Hovis, or any flour used for making brown bread.
1 egg beaten up.
A little baking-powder and sugar.

Mix into a paste with cold milk, and bake the biscuits in a brisk oven. No salt should be used.

A small cup of black coffee (where coffee is liked and
digested) is often efficacious, taken the first thing in the morning.

It is impossible for the body to be healthy when the bowels are only moved (partially only in most cases) by artificial methods. If an immediate movement of the bowels is advisable, very deep and continued pressure on the sigmoid flexure is often effectual, combined with a vibrating movement.

In patients with very thick abdominal walls the fat should be pulled to one side, in order to get a better grip on the intestinal walls. If manipulation causes hysterical contractions, try placing the patient on her side, with the thighs well drawn up, or seated astride on a chair with a high back, on which she rests her arms and head. Though only limited movements are permitted by this posture, the muscles become accustomed to being handled, and the patient’s attention being diverted, she remains relaxed, and the ordinary position can be assumed later on without difficulty.

Constipation and many other forms of dyspepsia and abdominal troubles are caused by enteroptosis, or prolapse of the abdominal organs. Kellogg strongly advises the following procedure:

Patient lies with the head (not the shoulders) well elevated, the knees drawn up, and takes several deep breaths, expanding the abdomen well with each breath.

The operator stands with her right side to the patient, facing her feet, and places a hand in each groin, the hands resting on the ulnar borders in the direction of Poupart’s ligament. They are then moved slowly upwards, the ulnar borders being pressed as deeply as possible into the pelvis and grasping as much as possible of the abdominal contents, which are then drawn forcibly upwards. A shaking or rolling movement should alternate, and the lifting should be executed from three to six times.

Inspiratory lifting is also beneficial.

Patient, lying as above, with hands at the side, takes a full breath, breathing as deeply as possible. She then exhales; but, instead of drawing in the breath again, she makes
a strong inspiratory effort, with the glottis closed, without admitting any air. The whole inspiratory force is thus used for lifting the abdominal contents, whilst the operator assists her by carrying out the preceding movement simultaneously. A few ordinary respirations are then taken and the process repeated. The stomach and kidneys are replaced in a similar way during expiration, and held in place during several successive ordinary respirations.

Massage given with the patient in the knee-chest position, the masseuse standing above her, is often beneficial for prolapsed uterus. Applications of electricity, especially the sinusoidal current, are advantageous, but must be administered by a thoroughly competent person.

For cases of hiccough the bed should be raised at the foot, causing compression of the diaphragm by the abdominal contents, and pressure given on each side of the neck, just above the collar-bone, about 1½ inches from the centre, or pressure against the front part of the transverse processes of the third, fourth, and fifth cervical vertebrae.

In cases of weak abdominal walls which do not yield readily to treatment, some kind of support is helpful. Dr. J. Madison Taylor considers that this can only be done satisfactorily ‘by encircling the pelvis between the brim and the greater trochanters by a strong belt, keeping the upper and lower edges practically parallel. It should be adjusted with extreme care over any well-fitting, suitable corset, marked, and then sewn on. The direction of support is then, from the firm basis of the most powerful tissues in the body, horizontally and uniformly upward. Thus the pelvis is held firmly in its normally horizontal position. The vertebral column is encouraged to remain at a right angle to this, practically vertical, which is its normal position. The belt is made of firm webbing and is carried down in front to support the under surface of the abdomen. No perineal bands are required. This belt will support equally well a thin or a pendulous abdomen. My own experience with it (in neurasthenic and many other conditions) engenders enthusiasm for this device in ameliorating a variety of conditions not at first obvious—dyspepsia, loss of motility, ptosis, venous stasis, dilatations, obesity.’
In gouty and rheumatic cases there is probably a want of balance between the intake of food and the power of the body to utilize it, and so these waste products have to be eliminated. In acute stages patients cannot be manipulated, but medicines and hot packs are given, and later on the masseuse is needed. Whenever possible, dry heat applications are a great auxiliary. The Dowsing apparatus, in which both light and heat are combined, has no bad after effects. After such an application, when the perspiration has ceased, massage has a beneficial effect, and greater mobility will result than when either is used alone. At first very gentle manipulations must be given with the pads of the fingers, especially round the joints and over tender areas. All adjacent muscles should be worked upon, leaving off with long upward stroking movements. Plenty of stretching must be given and no same movement continued for a long period.

For rheumatic arthritis De Bier’s hyperaemic method is much in vogue. If the special apparatus is not available, rubber or webbing, 2½ to 4 inches broad, should be bound tightly above the joint beyond the one affected, thus causing a greatly increased blood-supply. When discomfort, just short of pain, is felt, remove this and administer massage. The arteries should be pulsating well, the skin warm and red, with a bluish tinge.
CHAPTER XIII

NAUHEIM OR SCHOTT TREATMENT

The home of this treatment is Nauheim Bad, a small town not far from Frankfort-on-the-Rhine.

Its waters had been used since 1835 for gout, rheumatism, scrofula, and diseases of the spinal cord, but it was not till 1872 that the place came into prominence owing to the skill and popularity of the Doctors Schott, who drew attention to the curative properties of the waters for many cases of heart disease. A series of exercises (modifications of some of Ling’s) was formulated by them which, given alone or in combination with the drinking and bathing waters, have been found very valuable for many cardiac cases.

A very successful imitation of the Nauheim waters can be made by the addition of certain minerals to ordinary water dissolved in a full-sized bath; but it must always be remembered that a natural spring water bubbling out of the rock full of carbonic acid, used in its habitat, with a correspondingly fine climate, can never be really replaced.

The following constituents and quantities have been found suitable for cases ordered to undergo this treatment, but are open to modification according to the wishes of the medical practitioner:

Three preparatory baths are often given, containing 3 pounds chloride of sodium (common salt), 6 ounces chloride of calcium, the amount of water being 40 to 50 gallons at a temperature of 95° to 98° F.
The *effervescent* baths can be given in the following strength:

**Mild.**

- 4 pounds chloride of sodium.
- 6½ ounces chloride of calcium.
- ½ pound bicarbonate of soda.
- ¾ pound hydrochloric acid.

**Medium.**

- 7 pounds chloride of sodium.
- 8 ounces chloride of calcium.
- 1 pound bicarbonate of soda.
- 1½ pounds hydrochloric acid.

**Strong.**

- 10 pounds chloride of sodium.
- 10 ounces chloride of calcium.
- 2 pounds bicarbonate of soda.
- 3 pounds hydrochloric acid.

These effervescent baths are gradually increased in strength till the maximum is reached, according to the number ordered. They are usually given in sets of three with an interval of one or two days, until the course eighteen to thirty is completed.

The salt is placed at the bottom of the bath, and the chloride of calcium dissolves best when melted in a jug of very hot water, which is then added to the water in which the salt is dissolved, the whole being well stirred. In painted or porcelain baths it is essential to have a slight excess of alkalinity, and to put in the bicarbonate of soda (well mixed in a basin) first. When adding the acid, it is advisable to open the stopper just above the water, and to get rid of the fumes, before the patient enters the bath.

In both England and the States, convenient tablets for preparing the baths can be obtained, containing the bicarbonate of soda and the hydrochloric acid, the other ingredients not being included. In this case the tablets should be placed on tinfoil or saucers at the bottom of the bath.

The body must be immersed to the neck, and the head
should be preferably supported by a strap or other con­
trivance (several of which are on the market), and thus
prevent a feeling of insecurity, owing to the buoyancy of the
water. If desired, a thin towel can be floated on the surface
of the water. The temperature of the water must be
regulated by the patient’s temperament and habits, the
increase of effervescence being attended by a decrease of
temperature, varying usually between 85° and 98° F. The
duration is eight to ten minutes for the first bath, and
gradually increased to twenty or even thirty minutes. A
warm sheet and towel should be in readiness, and a good
rubbing should be given by the nurse. The patient should
then rest for a definite period, well covered up, and some
light refreshment should be given. The temperature, pulse,
and respiration should be taken before, during, and after the
bath, and carefully charted, also a note made of the reaction.

A very careful estimate should be made of the patient’s
power of reaction, for the regulation not only to the tempera­
ture and duration of the bath, but also of the rest in the
recumbent position afterwards.

A slight sense of oppression is often experienced in the first
few baths, as if hoops were encircling the thorax, but it soon
disappears, especially if the patient’s attention be diverted.
Flying pains in the larger joints are occasionally complained
of, and severe attacks resembling acute gout are brought
on, caused by a gouty diathesis, possibly previously un
recognized.

A ticklish sensation is caused by the carbonic acid bubbles,
which cover the surface of the body, and should be rubbed
off from time to time. A ruddy tinge appears on the skin,
and a feeling of warmth is usually experienced.

If there is a persistent feeling of chilliness, add more hot
water. If continued when resting, apply hot-water bottles to
the extremities. These symptoms do not necessitate a
cessation of the baths, but a modification of them and
reaction will be gradually cultivated.

The baths and exercises should be given only by a perfectly
competent person, preferably a nurse (at least, in serious
cases), who is trained to keen observation, and would early
recognize any untoward symptoms, and would take prompt and immediate action without alarming the patient. Two hours must elapse after a meal.

Cardiac cases for which this treatment has been found beneficial are: Stenosis of either or both mitral and aortic valves; incompetence of either or both with dilatation; dilatation through myocarditis, haemorrhage, or after constitutional anaemia; fatty or weakened heart, especially after influenza; congenital mitral insufficiency; patent foramen ovale; angina pectoris, whether of neurotic or organic origin.

The contra-indications are mainly: arterial capillary fibrosis, small granular kidney, thoracic aneurism, and extensive aortic insufficiency.

The Nauheim baths and exercises are also very valuable for the following: Excess of uric acid following acute rheumatism of the muscles or joints; gout; rheumatic arthritis; anaemia (chlorotic, malarial, or "secondary"); asthma; blue discoloration and coldness of extremities; painful menstruation; habitual headache associated with uric acid; lumbago; Bright’s disease; nephritis with failing heart, and dropsy.

A little gentle massage is also very beneficial, and passive and active exercises can be added by degrees.

The effects of the baths, speaking generally, are, after a short interval: Retardation of pulse; increase of volume; contraction of the heart, beginning on the right side; slower and deeper breathing, bringing a sense of lightness and relief to the chest; a better colour of the lips and improved facial aspect are noticeable, and the liver shows a considerable diminution in size. There is also marked diuresis, which is usually maintained.

The constituents of the waters produce an irritation on the nerve-endings in the skin, which is conveyed to the nerve-centres, and thus affect the whole system. The arterial circulation is increased by the lessened peripheral resistance, and the venous congestion diminished by the larger quantities of red blood, for which there is freer circulation.

Besides the brothers Schott, the following authors have issued literature on the subject: Bezly Thorne, Tyson, Broadbent, Greene, and others.
Exercises.

The exercises are all resistive, and are usually given in the standing position, though some are occasionally given to patients in bed by way of strengthening the heart for the baths and further exercises.

They must be given with the greatest care, observation, and tact, the following symptoms being the signal for instant cessation, support, and rest, with possible continuation within a few minutes: Palpitation or hurried breathing, dilated nostrils, pallor or flushing, perspiration, drawing down of corners of the mouth, yawning.

The strength of the patient, the condition of the muscular and nervous system, as well as the actual form of disease, must all be taken into consideration, and the skill is shown in proper regulation of the amount of resistance and the duration.

Arm Movements.

The operator faces the patient and keeps a close watch over the pulse and countenance.

1. Both arms are stretched out in front on a level with the shoulder, care being taken that the elbows are fully extended, then taken sideways as far as possible, and returned to position, resistance being given alternately at back and front of patient’s wrist with the operator’s fingers. There must be no pressure on the bloodvessels.

2. Operator’s position, side of patient. Flexion and extension of forearm, palms upward, alternately; resistance front and back of wrist.

3. Operator’s position, front of patient. Arms raised upwards from side, palms downwards, till thumbs meet above the head; resistance back and front of wrist.

4. Operator’s position, front of patient. Backs of hands uppermost, fingers clasped and raised from abdomen above head; resistance back and front of hand.

5. Like No. 1, with clenched fists.

6. Like No. 2, with clenched fists.

7. Operator’s position, side of patient. Circumduction of arms alternately, operator resisting with one hand for
half-circle, with the other for remainder, clasping patient’s hand.

8. Operator’s position, behind patient. Arms raised from the sides and carried upward and backward as far as possible; Resistance back and front of wrists.

g. Operator’s position, side of patient. Arm extended; supination and pronation of wrist; resistance by clasping hand.

10. Operator’s position, front of patient. Flexion and extension of hand, with resistance on back and front.

11. Operator’s position, front of patient. Arms raised from front and extended overhead; resistance on radial border in ascent, on ulnar border in descent; the operator’s hand being gradually slipped till on level with the shoulder, when the whole ulnar border of the hand rests on the operator’s palms.

Leg Movements.

1. Operator in front. Flexion of thigh on abdomen as high as possible; resistance on knee and below sole or under thigh.

2. Operator kneeling at side. Extension of leg forwards, backwards; return to position; resistance front and back of ankle.

3. Operator in front. Flexion of leg on thigh; resistance back of heel and front of ankle.


5. Operator in front. Flexion and extension of foot; resistance instep and sole.

The patient is steadied by holding the back of a chair.

Trunk Movements.

1. Operator at side. Forward flexion and extension from hips; resistance on sternum and upper dorsal region.

2. Operator in front. Lateral flexion; resistance hand under arm and the other on opposite hip.

3. Operator in front. Trunk rotation; resistance by one hand in front of advancing shoulder and other behind
receding shoulder. Flexion, extension, and lateral bending of head can also be done in the same way.

The same movement should not be repeated, and, between each, there should be an interval of rest, from thirty to sixty seconds. The exercises should not be hurried over in any way, about thirty seconds being allowed for each movement. At least one and a half hours should have elapsed since the last meal. All restrictive articles of dress must be removed, and the patient be lightly but warmly clad.

The simplicity of the movements should not lead the patient or operator to think all the movements can be given straight off. If properly done, a very definite amount of fatigue may be induced, and any over-exertion or strain must be guarded against; especially must the exercises involving the raising of the arms above the head be given with the greatest precaution. The height must be regulated by the ability of the right heart to receive blood, returning with increased volume and pressure from the uplifted arms.

If any inclination is shown to hold the breath, directions to count in a whisper should be given.

The exercises bring into play almost every group of voluntary muscles, and in cases of cardiac dilatation, the oblique measurement is sometimes decreased ¾ to 1½ inches, and the vertical one of the liver 2 inches. The effects are similar in some respects to those produced by the baths.

Sir W. Broadbent suggested that the dilatation of the capillaries in the exercised muscles is continued to the arterioles, and from thence to the arteries, thus relieving the heart, while the deep-seated organs, especially the pelvic viscera and liver, are relieved of congestion. Pressure on the heart being thus lessened, it can contract more fully on its contents, and so derive from the coronary circulation the material needed for repair of tissue. The patient must never take either baths or exercises when fatigued.
CHAPTER XIV

LOCOMOTOR ATAXIA

Sooner or later a masseuse is bound to be called upon to treat patients suffering from tabes dorsalis, a disease in which degeneration of the posterior column of the spinal cord takes place. One of its most prominent symptoms is locomotor ataxia, involving the loss of co-ordination, or power of control, over the limbs, more especially those of the lower extremity.

Medical men, both in Europe and America, have for many years made use of various re-educative movements for the relief of this distressing condition, with satisfactory results; but it is to Dr. Fränkel that we owe a well-defined, varied, and comprehensive system of movements. ¹

Dr. Fränkel does not claim that the disease itself will be influenced to any extent, but that the ataxic condition will be improved, and in many cases surprisingly so. His system is based on the principle that the central nervous system can be re-educated by repeated exercises in order to receive distant impulses from the limbs as to position, and in this way a nerve tract is made, the muscle being simply the area over which it travels. The same exercises are, therefore, constantly repeated, but the greatest care must be shown in stopping before the fatigue-point is reached. They are always

¹ His work on this subject has been translated and modified by Dr. Freyberger, and published by Messrs. Rebman, Ltd., London, to whom I am indebted for permission to mention some of the simpler exercises, whilst referring students for a full and complete study to the original work, ‘Treatment of Tabetic Ataxia by the Aid of Gymnastic Exercise.’
LOCOMOTOR ATAXIA

performed very slowly, and none repeated more than four times.

There are four definite stages in the condition:

I. Patient walks freely, with or without support, but the walking shows considerable alteration, the gait being uncertain and the movements exaggerated.

II. The patient leans on a companion’s arm, walking alone being impossible.

III. Walking is impossible, but the patient can stand.

IV. Walking and standing are both impossible.

The following points should be also noted: The degree of inco-ordination in the corresponding limbs, which may vary considerably; the alteration in the stability of the trunk by abnormal movements of the joints; the inability to control the trunk muscles owing to loss of power in the hip-joints and spinal column; loss of sensibility in the fingers, making the holding of a stick quite a difficulty; the weight of the body appears poised on the stationary leg, and the body pulled over when the step is completed.

The early symptoms of locomotor ataxia may be recognized by the manner of walking up and down stairs, the tendency being to put down the whole length of the foot instead of the normal use of the toe-balls only, and also the anteflexion of the trunk.

It is very important that these educative exercises should be started as early as possible, and the patient should be urged to avoid any over-exertion, and to be out of doors for several hours a day without fatigue. The patient should be lightly but warmly clad, without any restrictions to the circulation, and for the walking exercises strong laced boots are advisable. At first he guides his actions by sight, but later on he becomes able to do them without looking, and finally with his eyes closed.

The hands and feet are first exercised singly, then alternately, and finally in combination, and in opposite directions. The initial movements are extremely simple, but the patient should be urged to concentrate his attention solely on them.

The exaggerated movements are gradually controlled, and more advanced exercises are added by degrees, always bearing
in mind that the patient’s powers of mind and body are impaired, and that what would appear a very simple action, involving little effort to a normal person, is really causing considerable exertion; therefore frequent pauses for rest must be made.

The attendant or masseuse must show unlimited patience and ceaseless observation, remembering that such patients are liable to fall without the least warning; hence support must be always ready, but not given unnecessarily, or the patient will not rely entirely on himself, which is essential.

When able to try standing and walking exercises, the movements, which united produce the action of getting up and walking, must be firmly and repeatedly impressed on his mind.

In getting up from a chair the legs must be drawn back, the body bent forward, the trunk and thighs extended, and a continuation of this movement completes the action.

In walking to the right—(1) The body rests on the left leg; (2) body leans towards the right, and the right foot is brought down; (3) the whole weight is on both legs; (4) body rests on right leg, and the left heel is lifted off the ground; (5) the body moves to the extreme right, freeing the left leg; (6) resumption of original position after the step has been completed.

The following are some of the simpler exercises for the lower limbs, the patient lying on his back on a bed or couch, the body resting on a low bolster, and the head raised so that he can watch each action closely:

**I. Series of Exercises for Lower Extremities.**

1. Flexion of leg at knee and hip joints. Extension.
2. Flexion of leg at knee and hip joints. Abduction, adduction, extension.
3. Flexion of leg at knee and hip joints to half angle. Extension.
4. Flexion of leg at knee and hip joints to half angle. Abduction, adduction, extension.
5. Flexion of leg at knee and hip joints. Voluntary halt during flexion.
6. Flexion of leg at knee and hip joints. Halt when order given.
8. Flexion of leg at knee and hip joints. Extension, halt to order.
12. Both legs half flexed simultaneously. Abduction, adduction, extension.

These movements must be performed very slowly, avoiding the staccato tendency. The worse leg is exercised more than its fellow, and the heel slides up and down on a smooth surface of the bed or couch.

II. Series.

The heel is now kept some inches above the bed.
1. One leg is flexed till the heel is resting on the groove of the other limb, between the patella and thigh. Extension.
2. The heel is placed on the patella, then touches above the patella, and a halt made.
3. The heel touches the middle of the tibia, the ankle, and the toes.
4. First placed on patella, then raised and placed on middle of tibia, ankle-joint, and toes.
5. Place heel direct on the patella.
6. Place heel right angles with the thigh.
7. Both limbs flexed, the knees and malleoli in apposition; the toes are then exercised.

The following exercises will also be found useful:
Walk a few steps forward with a cane, then backward half the distance.
Lay cane aside, spread the feet a little, and with hands on the hips stoop down as far as possible, bending the knees.
Raise the arms above the head, and then try to touch the toes.
Flexion of trunk forward, then to left, and back to original position. Ditto to right.

The hands may be exercised by practising five-finger exercises, taking care to raise each finger as fully as possible, and to concentrate the mind on each movement.

Dots may be made at each corner of a sheet of paper and one in the centre, which are to be connected by lines from the right and left, also with parallel lines.

Coins may be placed on the table and gathered into a heap by each hand separately.

In no case should vigorous and thorough massage of the whole spine be omitted with special attention to the lower dorsal and lumbar regions, preceded by alternate cold and hot douches or sponging, accompanied by slapping, given, of course, from the wrist only.

Seat the patient on a low table or on the floor, with the legs extended; then forcibly depress the head towards the knees by pressure on the head and back of neck, not more than two minutes.

Finally, the patient should be encouraged to walk and do his standing exercises with the eyes closed. When able to stand and walk fairly steadily, various additional movements in combination are introduced, such as springing, prancing, walking with flexed knees, etc.

At the Orthopaedic Hospital, Philadelphia, small obstructions are used, such as sticks resting on small wooden pegs on the floor, which will yield easily if knocked against. The upper limbs are then exercised by catch-ball, in which a punching-ball is employed, which is thrown sometimes high, sometimes low, the patient being first in a sitting, later on in a standing, position. Ball-boards and other kindergarten devices can be utilized for the hands, also copying exercises.

A masseuse would, of course, ask for special instructions from the medical practitioner in charge of the case as to the form of exercises and their duration, and always being on her guard against over-fatigue of the muscles.
CHAPTER XV

THE WEIR-MITCHELL TREATMENT

This is the name given to systematic treatment of neurasthenia and other cases by rest, seclusion (more or less rigidly enforced), passive exercises, and increased feeding. In addition to these remedies open-air treatment is sometimes employed. Dr. Weir-Mitchell, of Philadelphia, was probably the first to combine these therapeutic measures, which had already been used individually, and hence his name is used in connection with the treatment, which has also been carried out by various doctors (Dr. Playfair in particular) with equal success on this side of the Atlantic.

It has been found especially beneficial for those (their number seems daily increasing) who are ‘ever weary, thin, and thin-blooded,’ and whose muscular and nervous systems are doing their work with ever-increasing difficulty. In such the demand for nutrition is ahead of the supply, or the supply is incomplete as to quality, and the complicated machinery soon gets out of gear and the wheels of life run heavily.

In these, as in all cases, the increase of fat alone is not the object, but improvement in the quantity and quality of the blood. Increase in wholesome fat is always marked by improvement in colour also. Fat varies with sex, climate, habits, seasons, time of life, race. For example, before puberty the average male weight is above that of the female. At the age of twelve both sexes are about equal. During the child-bearing period a female usually loses weight, and afterwards regains it, until, at the age of fifty, the maximum

[111]
is reached. Many experience a loss of weight during the menstrual period. Any sudden increase or decrease in weight is a symptom not to be ignored, and for either a more or less modified course of Weir-Mitchell treatment is frequently ordered. The following hints may be of use to those who are to follow out the doctor’s directions, as nurse or masseuse for the case.

As a rule, some amount of isolation is almost essential for all cases in which nerve and muscular power are low. Patients have a much better chance of recovery when their moral and physical surroundings are completely altered, and their wills are for the time being in abeyance. The doctor will give distinct directions as to whether any letters are to be written or received, or visitors admitted. The tendency is towards deciding each case on its individual merits; with some, the anxiety about friends and family affairs is so intense that it is found to be wiser to allow some little intercourse with, perhaps, one judicious friend or relative, who can be trusted to allay anxiety and present news in its most favourable aspect, leaving the patient possibly weary, and yet relieved in mind, and so better able to respond to the treatment.

It is, then, essential that the nurse should be refined and bright, young rather than middle-aged, capable of gentle but firm control, intelligent, and able to talk of something apart from ‘cases.’ She will often be required to read the paper to her patient, or give her an epitome of the news, if her reading aloud is found irritating or exhausting. One who has plenty of small-talk and can write a good letter is usually appreciated. ‘Saving common-sense’ is especially valuable in dealing with all nerve cases, and one who can rule and influence her patients for their own good without allowing her power to be unduly felt, is possessed of a gift that cannot easily be acquired.

The Period for Treatment varies from six to twelve weeks. For the first few days the patient is usually on milk diet—sometimes on skimmed, sometimes on whole, milk. The amount varies from 1 to 2 quarts per diem.

If skimmed milk is ordered, which is often done in cases of overweight or hypernutrition, it must be thoroughly
skimmed, and in any case should be fresh twice a day, and kept covered in a cool, well-ventilated place, removed from the least smell. It should be given warm or cold, but not boiled, except in cases of diarrhoea, and should be sipped slowly. If the dairy supply is not quite above suspicion, it may be sterilized, by placing the quart supply for the half day in a fireproof vessel inside a saucepan of boiling water, kept simmering for at least half an hour. If there is nausea, add tea, coffee, cocoa, caramel, or salt, only sufficient to flavour it. In cases of acidity, give alkalies (bicarbonate of soda, lime-water, barley or rice water, 1 drachm to 1 ounce of milk, or Benger’s Pancreaticus, 1 minim to 1 ounce of milk. This exclusive milk diet often causes sleepiness, a white thick fur on the tongue, an unpleasant taste in the mouth, constipation, and yellow stools. The nurse must be prepared with boracic or other mouth-wash, simple enemata, unless the doctor orders aperient medicine, and with any amount of cheerfulness and good-temper, for this is usually the most trying week of the period. The patient’s digestive organs are being prepared for the passive exercise and full diet which follow. About the sixth day the patient often experiences a sense of comfort, a better capacity for digesting food, a growing hope of final cure, and becomes more contented with her surroundings—all encouraging signs for both patient and nurse.

At this period Raw-Beef Juice is often ordered, which may or may not be continued during the whole time. It is prepared thus: Chop up very finely or pass through a mincing-machine 1 pound of raw lean beef; place it in a bottle or stone jar, with 1 pint of cold water and 3 to 5 drops strong hydrochloric acid. Stand it on ice or in a cool place all night, and in the morning set the bottle or jar in a pan of water (temperature 110° F.), and keep it for two hours at this temperature. Then strain through a stout cloth until all the liquid is abstracted. This beef-juice is given in two or three portions daily. If the colour is objected to, use a coloured glass, or stir in a small quantity of Liebig’s Extract of Beef or Bovril. Some have a great dislike to the raw taste; in this case the beef may be roasted on one side only before being cut up.
Liquid Beef Peptones may be prepared as follows, according to Gerard’s prescription:

- Lean beef, finely minced: 8 ounces.
- Pepsine: 60 grains.
- *Dilute* hydrochloric acid: 2 drachms.
- Water: 1 pint.

These are all mixed together and left to digest for three hours, at a temperature of 130° F.; then neutralized with bicarbonate of sodium and strained.

After the first week, or even sooner, Solid Food is added by degrees, until the maximum is reached, when the diet sheet may be much as follows:

- **7 a.m.** Small cup of black coffee.
- **7.30.** Porridge, with milk or cream (preferably).
- **8.** Breakfast: Cocoa, eggs, fish or bacon, and fruit,
- **9.30.** Milk, 10 ounces.
- **11.30** Beef extract.
- **12.** Milk, 10 ounces.
- **1 p.m.** Lunch: Meat, two vegetables, light pudding.
  - Burgundy if ordered.
- **3.** Milk, 10 ounces.
- **4.30.** Milk, 10 ounces.
- **5.30.** Beef extract.
- **6.30.** Milk, 10 ounces.
- **7.** Dinner.
- **9.** Milk, 10 ounces.
- **10.** Milk, to ounces.

Raw and stewed fruit are given liberally, and pears are found particularly suitable. If an attack of dyspepsia seems impending, only half the amount of food is given, or milk diet is returned to for one or two days.

At the end of the first week, if not earlier, Massage is begun, lasting only thirty minutes at first, and gradually increasing to one or one and a quarter hours twice a day. A certain amount of Electricity is often given in addition, usually the induced current, both, of course, being minutely regulated according to the medical directions.
Massage must not be given till an hour and a half or two hours after a meal, otherwise the nervous and muscular impulses will be diverted from the work of digestion. In general massage the order of procedure is variously ordered by doctors. If no distinct order is given, it may be well to start with the lower extremities, as many patients suffer with cold feet, then proceed to the upper limbs, the chest, abdomen, and back. Especially at night it is advisable to end with the back, by way of inducing sleep, and also to draw away any superabundance of blood from the abdominal cavity, induced by friction of the abdominal walls. It is preferable for a nurse and a masseuse to be in attendance, and not both combined in the same person, as otherwise the work is too heavy, and the patient may lose ground by injudicious management during the nurse's inevitable absence for exercise; also the variety is better for the patient, and more satisfactory results are obtained. When the patient is convalescent, change of air is often recommended, and the nurse who accompanies her may be required to continue the massage for a short time daily.

The patient should be discouraged from talking about her present or former ill-health, and a healthy tone of mind, as well as body, induced by all reasonable means.

Massage should be given midway between meals, as a rule; but if the patient suffers much from insomnia, the dinner-hour should be at six, and the second hour or one and a quarter hour's massage should be given at half-past eight. As soon as the patient appears drowsy, give milk or beef extract, and end up with long, firm strokes down the spine, the light having been turned low, and all preparations for the night being made in order not to disturb the patient again. In this case milk should be given (or egg nogg) during the night, if an opportunity occurs. During the menstrual periods, massage of the limbs only should be continued. Even local massage has often the effect of inducing menstruation before the ordinary time. Some patients perspire at the beginning of massage, but this symptom usually passes off.

In Weir-Mitchell cases, perhaps more than in any others, the masseuse’s power of adaptability is tested. The amount
of force to be used must depend entirely on the patient’s strength and condition of nerve and muscle. Massage should never be painful to her, though it may be irritating and annoying at first. Some people have an intense antipathy to be handled, and unless the sense of power and skill of the masseuse is brought home to them, and good results are experienced, they will resist the treatment almost insensibly.

When the patient is ready to get up, the limbs should be exercised after the Swedish system, massage being discontinued gradually. Be very careful to guard against taking cold. The patient should be wrapped in a blanket for her daily sponging, and warm towels should be at hand.

**Stimulants and Medicines.**—The doctor may order 1 ounce of whisky in milk during the day, a glass of dry champagne or red wine. Iron in some form is usually given when the patient is on solid diet, subcarbonated or lactated iron, sometimes pyro-phosphates, and usually some aperient—watery extract of aloes, extract of cascara or ox-gall. When the patient is allowed to sit up, strychnine or arsenic tonics are often given. If there is any precipitation of urates after a full meal, the amount of food should be lessened. No alarm need be felt if the rapid increase in blood should result in nasal haemorrhage. For very thin patients cod-liver oil is often prescribed half an hour after meals, and malt extract is found very beneficial. Small doses of olive oil, if it can be taken, are found very beneficial, being laxative and nourishing.

As a rule, the winter and spring months are preferred to the summer for this treatment, as massage is found less exhausting then, and more food can be taken. If the patient is to be treated in lodgings, they should be chosen in a well-drained, well-built house in a quiet neighbourhood. If strolling musicians will try their powers of stimulation, or a barking dog ‘make night hideous,’ recourse may be had with a neurotic patient to a pad of cotton-wool over each ear. It is absolutely essential that the food should be good and wholesome, well cooked, and daintily served. A dirty serviette or greasy glass will create distaste, even nausea,
and the nurse should make a point of critically inspecting the tray before the patient glances at it.

A light, airy room, with a sunny aspect, should be chosen, and a comfortable bed with springs and a firm horse-hair mattress is decidedly an advantage. The nurse and masseuse should arrange their respective hours, and work amicably, and if any friction should arise, it should be carefully kept from the patient’s knowledge, and a bright and cheerful manner maintained in her presence as far as possible. In all respects the patient’s interest should come first, and even personal inconvenience should be ignored in order that good results may be obtained, and some very useful lessons in self-discipline are often learnt by the nurse, as well as the patient, in the course of a Weir-Mitchell case.

Seeming trifles assume large proportions when people are in a very weak state. Creaking shoes, a fussy or condescending manner—in fact, any special mannerism—may keep the patient back in a quite unexpected way. One hears of patients who worry themselves for days because the nurse, perhaps inadvertently, asks some question, which in health would be answered without effort or thought, but in sickness is brooded over in an utterly inexplicable way.

A nurse or masseuse is, of course, bound to carry out solely the wishes of the attendant physician, but as he or she may be of the more progressive school, it is helpful for her to know the line of treatment that may be adopted. Hence the following extracts will be suggestive, giving expression to the more modern views on the ‘rest-cure,’ and will afford food for thought:

1 Accuracy of diagnosis is a paramount requisite in dealing satisfactorily with any derangement, but it is pre-eminently necessary that the physician shall enjoy the privilege of adequate time and opportunity to study those complex problems involved in the psycho-neuroses. In far the largest proportion of those who have suffered from protracted ailments or illnesses there has arisen an involved mental state, compounded of real and inferential maladies. The

1 Taken, by kind permission, from an article by Dr. J. Madison Taylor in The Monthly Cyclopaedia and Medical Bulletin.
solution can only be reached by a nice degree of awareness in which psychology is on a par, or indeed above, the utmost scientific resources of pure medicine. Nowhere is the employment of systematic, deliberate, exact, and consistent therapeutics more needed than in these involved cases of protracted ailments. . . . The first desideratum, too often overlooked, is to indicate a plan of life calculated to place the body in a condition of increased receptivity to agencies designed to enhance and conserve the auto-protective forces. This is the *sine qua non* of economy. . . .

The physician is often confronted with conditions compounded of physical and mental exhaustion so severe as to thwart normal physiologic responses to remedial agencies. The problem then is to secure cellular stability, and render it possible to so modify the overwhelming perturbations of vital rhythm as to permit rational measures to stem the tide of destructive changes and definitely turn the inherent forces towards restoration. The most efficacious means of securing this state of physiologic receptivity, both for psychic and physical cellular adjustment, is to place the sufferer at absolute rest, to seclude from all outside influences—family, mail, news, and the like.

It may be helpful to outline my personal concept of the essential points in this system of cure acquired by many years of experience as the personal assistant of the master.¹

First of the contra-indications. By far the larger part of those psychoses so prevalent should receive judicious regulation of function, educative suggestion, followed by systematic motor education, especially in the lines of useful labours. It requires some acumen to differentiate the fictitious neurasthenic phenomena from constitutional or acquired enfeeblement.

Imperative irrepressible ideas, persistent or morbid questionings, doubts, the endless “whys and wherefores,” apprehensions, the multitudinous phobias, mental agitation, diffused emotional disturbances, hallucinating manias, cloudy memory pictures, defective orientation, anomalies of sense perception, of character and action, vacillation, insistent

¹ Dr. Weir Mitchell.
perplexities, religious obsessions, and the like psychasthenic phenomena, are better treated by educative suggestion, suitable occupation, and motor training. This is true even where these are complicated by functional derangements, such as insomnia, anomalies of movement (“tics”) of digestion, of lungs, and especially of heart and circulation, of genitalia; restlessness, exaggerated indolence, intermittent painful states, and the like.

Neurasthenia is described by many clinicians as a psychopathic condition characterized by—(1) abnormal mental and physical fatigue; (2) impairment of the associative memory; and (3) sensory disturbance of psychic origin. The symptoms are liable to wide variation.

The abnormal fatigability leads to hypersensitiveness to all stimuli, emotional anomalies, parasthesias, elementary hallucinations, inexact and partial; to irritability, distractibility, inability to fix or maintain attention. Hence follow despondencies and hypochondriacal ideas, and all largely influenced by external impressions. These are the conditions best controlled by full rest treatment; but when abnormal fatigability is present, no matter what the other phenomena, it may be best to employ rest for a time. There is thereby afforded opportunity for deliberate observation and accurate diagnosis, to form opinions as to the length and completeness of treatment, and the special needs of each . . .

The central point of the rest treatment is dominant, educative suggestion, “moral orthopaedia” (Dubois), a wise training of the patient whose salient characteristic is maladaptation between his own consciousness and environment; impairments in powers of right thinking, willing, feeling, doing.

Not all cases of psychasthenia need rest treatment, but isolation, like “moving the previous question,” cuts off debate, places the individual in the first stage of hypnosis, which, by eliminating the life of customary relationships, enhances receptivity, not only of mind but of body.

By absolute rest, isolation,\(^1\) forced and regulated feeding,

\(^1\) Isolation means radical separation from home and family. No compromise here can be entertained, or failure is assured. Any other house may serve, but at a distance is best.”
we can best plough and harrow the ground, enrich the soil, and then proceed to sow the seeds of right thinking, feeling, willing, and acting. This is the key to the situation: To place the psychically entangled individual, whose central defect is weakness, in the best possible attitude for educative suggestion and bodily repair. Time, abundant time, is required, with ample opportunity to slowly but surely conserve the budding growths of vigour and wholesome mindedness. Who gets well the soonest, and remains most permanently benefited? Always the most obedient, the most intelligent. When the dissociation or disintegration of personality, the psychic instability, is corrected, the infinite changeability mitigated, the fundamental physiologic functions restored to a normal rhythm, we can then proceed to deal hopefully with the abnormal fatigability and other neurasthenic substrata. If the getting of a patient to bed is not easy, as often happens, the putting on the feet after some weeks is no light problem; that is, to do so safely and permanently. Here we may use as analogy the apt definition by Richard Croker. He says: “That man is an honest man who, when bought, will stay bought.” To restore is only the beginning; to make and keep well and self-reliant is the real object.

‘Health is, among other good things, the state of equipoise between consciousness and environment.

‘Among the chief agencies of the after-cure is motor education and persistence in right doing. Psychic right direction in the months and years to come is of more real importance than even the preliminary though radical measures. Here shall the counsellor stand or fall, according to his judgment, his personality, his persistence.

‘Yet more than all does ultimate success depend on the inherent wisdom of the patient, his or her capacity to realize the need for good counsel long maintained.

‘The Nurse.—The most important factor, next to the wisdom and tact of the physician, is a suitable nurse. Not only must she qualify technically, but intellectually, and in that far higher sphere which is inexacty described as the realm of common sense, since it is one of the rarest of gifts.
Her business is to maintain a symmetrical, consistent, daily routine, and keep the patient all the time busy “guessing,” supplying just enough conversation, but not too much information or explanation. Patients often remark that the rest treatment was among the busiest periods of their lives. All this keeping busy is essential. The patient is, and should be, passive; in extreme cases absolutely so, all “doings” being performed by others. At first the nurse actually places food in the recipient’s mouth. Conversation had best be of the simplest. Part, and not the least part, of the cure is the selection of the topics; the character of their pursuit is the duty of the nurse under hints supplied by the physician. I remember Dr. Mitchell once telling me a most significant incident. The patient was the daughter of a Catholic physician, who stipulated that the nurse should be a devout Romanist. Whereupon I was directed to install a pink-cheeked Presbyterian. Old lines of thought need to be firmly set aside and new points of view presented. Suggestive education is paramount. In this the nurse is the constant, if not the chief, agent.

‘ Medicines.—A good clinician can be entrusted safely with the administration of needful drugs, and he is the more successful when working with such tools as he is familiar. Few are needed; this process rendering them relatively unnecessary.

‘ In this connection it is well to refer to the suggestive summarization of the pathology of neurasthenia as presented by Sajous in the March Cyclopedic. Neurasthenia is recognized to be a vasomotor neurosis, the prominent feature of which is relaxation of all arteries. This he explains as due mainly to exhaustion of the sympathetic centre and the resulting relaxation and loss of propulsive power of the arterioles. The tissues thus become imperfectly oxygenized and nourished; hence follows the mental torpor, habitual fatigue, adynamia, gastro-intestinal atony. Various clinical classifications are suggested, describing varieties of functional disturbance; but whatever the multitudinous symptoms, certain features are common to all which depend on varying degrees of hypothyroidism. Hence he recom
mends small doses of desiccated thyroid (not more than one grain three times daily), and often in combination with small doses of strychnia and full amounts of an assimilable form of iron, such as the reliable Blaud’s pill. Hence follows improved tone in, and nutritional power of, the blood.

‘Massage, Passive and Active; Educational Movements.—The efficacy of massage is so great that it surprises me to hear the measure sometimes belittled. The reason, as I have pointed out (New York Medical Journal, February 8, 1907), is that few clinicians take the trouble to study the subject, and hence are victimized by inferior operators, who, failing to get adequate guidance and direction, produce valueless or even hurtful effects. Suffice it to say that while aiming to improve both psychic and physical conditions, we have a powerful ally in judicious scientific methods of awakening the dormant kinesthetic centres by motor and sensory stimulation. It is most necessary in treating the victims of disuse, or misuse of bodily and mental functions, to restore normality in the realm of both correct sensation and motion. Receptive centres have here become dormant, vitiated, or exhausted; the cortical sensory and motor centres need to be brought into normal relation with the rest of the controlling centres, hence of the whole field of consciousness. As Pershing says (Journal of the American Medical Association, May 11, 1907) : “Having awakened some degree of normal sensibility, the cure (of hysterical paralysis, etc.) will be completed by exercises in voluntary motion. But preliminary to these any inhibitory fears must be overcome.”

‘Furthermore, above and beyond effects to be achieved by general massage and regulated (passive and active) movements, there is a vast field of potentiality in judicious nerve pressures, direct, distributed, and alternated, whereby extraordinary effects can be wrought in regulating vasomotor reflexes, hence on blood-distribution, etc. This last is rightly the province of the skilled physician, and should be performed by him, or, at least, under his direct supervision.’ (See chapter on Nervous Cases.)
CHAPTER XVI

THE SWEDISH SYSTEM

This is far too wide a subject to be treated in a small handbook of this description, but the following remarks will supply some general information interesting to the masseuse who wishes to be an courant with all that concerns her metier.

This system, as taught and practised in Sweden, is four fold—educational, medical, military, and ^esthetic.

(a) **Educational**—intended for those in good health, by which the general physique is developed and the body strengthened to resist disease. This branch is given in all the schools, both primary and secondary, throughout Sweden.

(b) **Medical**—used for curative and partially preventive purposes, of which massage is only a part.

(c) **Military**—for use in the army.

(d) **AEsthetic**—mainly intended for dramatic students.

Whether or not the whole credit of founding this system is due to P. H. Ling, there is no doubt that he formulated it on a scientific basis, and it is often called by his name. Although he may have been indebted for much of his knowledge and for some of his movements to the works of preceding authors, and undoubtedly made a study of all the known literature on the subject from the times of the ancients to his own day, yet the main credit is due to him of establishing a definite system of physical training and remedial manipulation in his own country. About the same time steps were taken in Germany and France with the same object.

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It was entirely owing to his persevering efforts that the Royal Gymnastic Central Institute was founded by the Government in 1813, of which he was president until his death, in 1839. This is the principal training-school for gymnasts, and no one in Sweden may teach gymnastics or practise massage independently, without a certificate from this institute or from the medical faculty. The course of training, which is free, extends over two years, and includes instruction in anatomy, physiology, pathology, and hygiene, as well as in the theory and practice of gymnastics. At the end of that period examinations are held and certificates of proficiency granted. In each course there is a vacancy for one English woman, but knowledge of the Swedish language, sufficient to understand lectures and general instruction, is a *sine qua non*, also a certificate of health. If desired, special courses in curative movements and massage (on payment of fees) can be obtained from former lecturers at the Central Institute, who have specially devoted themselves to therapeutic treatment in their own institutes, such as Dr. Arvedsson and Herr Liedbeck. One noticeable feature about the Swedish system is its adaptability to young and old, weak and strong, healthy and diseased, also the beauty and grace of many of the movements. A few simple ones such as are given in Oström’s little book on massage are useful in conjunction with massage, but it would be both foolish and wrong for anyone to attempt to treat patients on this system without a full training.

At the Zander institutes there are ingenious mechanical appliances which take the place almost entirely of human operators. It is, however, a matter of opinion whether any mechanism *can* take the place, with uniform success, of manipulations regulated by a trained and observant brain. In the case of healthy people requiring definite exercise, such treatment is undoubtedly valuable and practicable.

For those who wish to take up physical education as a whole, it may be mentioned that a full and thorough training may be obtained at Madame Bergman Osterberg’s college (Dartford Heath, Kent). This course (two years) is mainly intended for those who wish to become teachers of gym-
nasties and leaders of outdoor games at girls’ schools and colleges. In England the distinction between a masseuse and gymnast is perhaps more widely marked than abroad, where the two are usually combined in the same person. By some this distinction is considered preferable, as the characteristic qualities necessary for each branch are not always found in combination, but there is no doubt that the field is wide for skilled workers in both educational and curative treatment.

There are many trained teachers of the Swedish movements in England, to whom application can be made by masseuses wishing instruction in this special branch.
CHAPTER XVII

DUCTLESS GLANDS

Until two years ago, when Dr. Sajous, of Philadelphia, issued the first part of his important work, ‘Internal Secretions,’ very little was definitely known of the functions of the ductless glands. He has proved conclusively that they are of vital importance to the human body, and its future medication and manipulation will probably be largely modified as a result.

What is now known as the ‘adrenal system’ consists of:
(1) the pituitary body; (2) the suprarenal capsules; (3) the thyroid glands (including the parathyroids).

The pituitary body is a small organ about the size of a pea, situated on the top of the spinal column in the sella turcica, immediately below the base of the brain, and carefully protected on all sides.

As regards the bodily functions, it is more important than the brain itself, for when the cerebral hemispheres are removed, none of these functions are impaired; but if the pituitary is removed, they cease, and death ensues. It is, therefore, termed ‘the somatic brain’—i.e., the governing organ of all vegetative functions. It governs the spinal system, including the grey substance of the base of the brain, pons, bulb, and spinal cord, with all the nerves, both cranial and spinal, derived from them, though subsidiary centres are also present in the brain and cord.

1 The diagram and notes were taken, by kind permission of the author, from the above-mentioned work.
It consists of two lobes, anterior and posterior, with a small partition. These are not secreting glands, but the

Diagram 35.—The Innervation of the Adrenal System.

*a*, Pituitary body containing adreno-thyroid centre; *b*, thyroid gland, supplied by nerves (*e*-f) derived from the pituitary; *c*, adrenal nerves, derived from pituitary body via the medulla, cervical cord (*d*), spino-sympathetic branches and the splanchnic nerves (*ggg*).

*anterior* is a lymphoid organ, which, by means of a centre in the posterior lobe and a nerve path in the spinal system, the
upper dorsal, sympathetic ganglia, and splanchnic nerves, governs the functional activity of the adrenals (or supra renal capsules), and hence all the oxidation processes of the body; it also controls the function of the thyroid glands.

The posterior lobe is the seat of the highly specialized centres governing the general vegetative functions, and of each organ individually. It receives all impressions of ordinary sensibility—pain, touch, muscular sense—initiated in any organ, including the mucous membrane, skin, and hair; on it all emotions, shocks (psychical or traumatic), concus sions, etc., react.

One of its most sensitive centres is that of the sympathetic nervous system, regulating the arterioles and the amount of blood to the capillaries of all organs, including the brain and nervous system. The mechanism of vaso-dilatation and func tion is dependent on it, and it is also the sleep centre.

In the partition is a sensory or test organ, the representative in man of the osphradium, by which molluscs test sea-water. This reacts under the influence of poison brought by the blood or leucocytes, and increases the functional activity of the adrenals and thyroids. Thus, the bacteriolytic and antitoxic powers of the blood and the phagocytes are increased, and the sensitiveness of all cells, including bacteria, making them vulnerable to the phagocytic attacks.

The secretions of the thyroids and parathyroids form Wright’s opsonins and the agglutinins.

The adrenal system acts, therefore, as an immunizing mechanism, capable of forming auto-antitoxin from the internal secretion of the adrenals (adrenoxidase), of the pancreas (trypsin), of the spleen and leucocytes (nucleo-proteid), and of the thyroids (thyroidase, or Wright’s opsonin).

Our vulnerability to disease, especially of the infectious

1 Leucocytes: white blood-cells.
2 Bacteriolytic: producing a substance in the blood which is capable of destroying bacteria.
3 Phagocytes: cells that destroy micro-organisms.
4 Opsonins: a substance in the blood which makes the bacteria more susceptible to the action of phagocytes.
5 Agglutinins: certain active substances in the blood that cause a clumping together of typhoid and other bacteria.
type, depends entirely on the efficiency of the adrenal system, and the most fatal (e.g., cancer, tuberculosis, pneumonia, Asiatic cholera, bubonic plague) are those which interfere most with its activity or paralyze its test-organs; while those diseases grouped under a gouty diathesis (gout, migraine, neuralgia, sciatica) are due to a long-continued lessened activity. Special points to be noted are:

1. The adrenal secretion (adrenoxidase) absorbs the oxygen of the air and carries it to the tissues, thus promoting pulmonary and tissue respiration.

2. It contains a ferment which endows all other body ferments with their properties, and enables the leucocytes to convert food particles into living proteids, and when worn out their granulations are emptied into the vacuoles of the lymph spaces and used for the production of nerve energy.

3. The internal secretion of the pancreas (trypsin) and of the spleen (nucleo-proteid) is brought by the splenic vein to the liver, is there absorbed by the leucocytes, and, uniting with glycogen, is carried to the tissue cells for their special functions.

4. Hence the process of absorption and general nutrition is dependent on the adrenal system.

In order to stimulate these ductless glands, manipulation can be given to improve their blood-supply, for they will carry on their own important role if the blood and nerve supply is kept free and unobstructed.

The thyroid ganglion is connected with the 4th, 5th, and 6th cervical nerves; the suprarenal capsules with the 12th dorsal and upper lumbar; the pituitary body with the carotid plexus, hence manipulation of these areas would be highly beneficial.
CHAPTER XVIII
SURFACE MARKINGS

The following descriptions and diagrams of the surface markings of the thoracic and abdominal viscera are taken, by kind permission, from Dr. J. E. H. Sawyer's work on 'Physical Signs.'

Regions of the Thorax.—The anterior surface of the chest is divided, by means of the right and left margins of the sternum, into right, median, and left portions, which are subdivided into the following regions:

<table>
<thead>
<tr>
<th>RIGHT</th>
<th>MEDIAN</th>
<th>LEFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supraclecular.</td>
<td>Suprasternal notch.</td>
<td>Supraclecular.</td>
</tr>
<tr>
<td>Clavicular.</td>
<td>Upper sternal.</td>
<td>Clavicular.</td>
</tr>
<tr>
<td>Infraclecular.</td>
<td>Lower sternal.</td>
<td>Infraclecular.</td>
</tr>
<tr>
<td>Mammary.</td>
<td></td>
<td>Mammary.</td>
</tr>
<tr>
<td>Infracammary.</td>
<td></td>
<td>Infracammary.</td>
</tr>
</tbody>
</table>

The posterior surface is divided as follows:

<table>
<thead>
<tr>
<th>RIGHT</th>
<th>MEDIAN</th>
<th>LEFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suprascapular.</td>
<td>Interscapular (on each side of spine).</td>
<td>Suprascapular.</td>
</tr>
<tr>
<td>Supraspinous.</td>
<td></td>
<td>Supraspinous.</td>
</tr>
<tr>
<td>Infraspinous.</td>
<td></td>
<td>Infraspinous.</td>
</tr>
<tr>
<td>Infracapular.</td>
<td></td>
<td>Infracapular.</td>
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</tbody>
</table>
**The Lungs.**—The anterior margins meet behind the sternum, on a level with the lower portion of the 1st costal space. The anterior margin of the *right* lung passes vertically downwards, behind the sternum, to the left of the middle line, to the level of the 6th costal cartilage. The anterior margin of the *left* lung diverges from the right at the level of the 4th costal cartilage (sometimes lower); it then runs to the left, obliquely outwards and downwards, and, curving inwards again, reaches a point about one inch internal to the left mammary line of the 6th rib. The lower margin of the *right* lung passes to the right, behind the costal cartilages of the 6th rib, and is at the level of the 6th rib in the mammary line, the 8th rib in the mid-axillary line, and the 10th rib in the scapular line. It reaches the spinal column on a level with the 11th dorsal vertebra.

The inferior margin of the *left* lung takes a similar course, but extends about a finger’s breadth lower than on the right side. The apex rises on each side to a point about 1½ to 2 inches above the clavicle, that of the left lung being slightly lower than that of the right. The external margin of each apex lies behind the clavicle, just to the outer side of its centre (Diagram 36).
The **Heart** is situated in the lower part of the mediastinum, and lies obliquely in the chest. The base is directed upwards, backwards, and to the right, while the apex is directed downwards, forwards, and towards the left. The base corresponds anteriorly to a line drawn across the sternum, on a level with the upper border of the 3rd costal cartilages, and it extends about half an inch external to each sternal margin.

![Diagram](image)

**Diagram 37.—Relation of Heart to the Anterior Chest Wall.**

(From Sawyer's 'Physical Signs.')

The right border of the heart (formed by the right auricle) corresponds to a line of the upper margin of the 3rd right costal cartilage, about half an inch to the right of the sternum, to the 6th right chondro-sternal junction. The left border (formed by the left ventricle) corresponds to a curved line, extending from the upper margin of the 3rd left costal cartilage to the apex. The apex lies behind the 5th left intercostal space, just internal to the mammary line; but the
apex-beat is felt during life in the 5th left intercostal space, one inch internal to the mammary line.

The heart lies behind the lower two-thirds of the sternum, the cartilages of the 3rd, 4th, and 5th right ribs, near the sternum, and behind the cartilages of the 3rd, 4th, 5th, and 6th left ribs, extending to the left from 3 to 3½ inches beyond the middle line (Diagram 37).

**Regions of the Abdomen.**—The surface of the abdomen is divided by two vertical lines, passing through Poupart’s ligament on each side, and two horizontal lines—(1) the infracostal, which stretches between the lowest points of the 10th costal cartilages; and (2) the bi-iliac, which is drawn between the highest points of each iliac crest. The abdomen is therefore divided up into nine regions:

<table>
<thead>
<tr>
<th>RIGHT.</th>
<th>MEDIAN.</th>
<th>LEFT.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypochondriac</td>
<td>Epigastric</td>
<td>Hypochondriac</td>
</tr>
<tr>
<td>Lumbar.</td>
<td>Umbilical.</td>
<td>Lumbar.</td>
</tr>
<tr>
<td>Iliac.</td>
<td>Hypogastric.</td>
<td>Iliac.</td>
</tr>
</tbody>
</table>

The umbilicus is situated normally opposite the disc between the 3rd and 4th lumbar vertebrae, and about 2 inches above the bi-iliac line.

The **Liver** lies mostly under cover of the ribs, except a portion of the left lobe, which is in contact with the anterior abdominal wall in the epigastric region. Its highest point is the 4th intercostal space, in the right mammary line. The lower border passes obliquely downwards from the left costal margin at the level of the 8th costal cartilage, crossing the middle line halfway between the infrasternal notch and the umbilicus to the 10th right costal cartilage. The right lung overlaps the right lobe of the liver in front, reaching down to the 6th rib in the mammary line.

The fundus of the **Gall-Bladder** lies opposite the 9th right costal cartilage, just to the outer side of the linea semilunaris (on outer border of rectus abdominis muscle). A line drawn
from the right nipple to the umbilicus just passes to its inner side.

The Spleen lies obliquely under the 9th, 10th, and 11th ribs of the left side, and its long axis corresponds to that of the 10th rib. Between it and these ribs are the diaphragm and a small portion of the left lung. The upper end of the spleen is about 1½ inches from the middle line behind, on a level with the 9th dorsal spine. The lower end is that part which lies most anteriorly. Its highest and lowest parts are on a level respectively with the 9th dorsal and 1st lumbar spines (Quain).

The Stomach is situated behind the left hypochondriac and the left half of the epigastric region.

The cardiac orifice lies behind the 7th left costal cartilage, about 1 inch from the sternum.

The pyloric orifice lies one inch to the right of the middle line, about midway between the base of the ensiform cartilage and the umbilicus; it is not, however, a fixed point. The fundus rises to the lower border of the 5th left rib, just internal to the mammary line. The greater curvature in health is about the level of the junction of the middle and lower thirds of a line drawn from the base of the ensiform cartilage to the umbilicus, and should not lie below the umbilicus. When empty, the stomach lies almost entirely under cover of the left lobe of the liver (Diagram 38).

The Intestines.—The duodenum commences at the pylorus and terminates in the jejunum, on the left side of the 2nd lumbar vertebra, and the ileum terminates in the right iliac fossa. The coils of the small intestine lie below the transverse colon, and are covered almost completely by the great omentum. The caecum lies half in the right iliac region and half in the hypogastric region, and the ileo-caecal valve corresponds to the point where a line drawn between the umbilicus and the right anterior superior iliac spine crosses the outer edge of the rectus abdominis muscle. The base of the vermiform appendix is situated rather more than 1 inch below this. The hepatic flexure of the colon lies under the right lobe of the liver, behind the 9th and 10th costal cartilages; the splenic flexure behind the stomach in the left
hypochondriac region. The ascending colon is chiefly in the right iliac and lumbar regions, but its left border in the umbilical region. The transverse colon, though varying considerably, is usually in the upper half of the umbilical region. The descending colon lies in the left hypochondriac and lumbar regions.

The **Kidneys** are situated at the back part of the abdominal cavity, their upper ends being nearer the spinal column than the lower. A horizontal line through the umbilicus is below the lower edge of each kidney. Posteriorly about one-third of the left kidney and not more than one-sixth of the right kidney lie above the last rib. The upper end of the left kidney is on a level with the spine of the nth dorsal vertebra, and its lower end about 2 inches above the iliac crest. The right kidney is from ¼ to ½ inch lower. The hilum of each kidney is placed about 2 inches from the middle line on a level with the spine of the 1st lumbar vertebra.

![Diagram 38.—Relation of Some of the Abdominal Viscera, as Seen from the Front.](image)

(From Sawyer's 'Physical Signs.')
The **Pancreas** crosses the vertebral column opposite the disc between the 1st and 2nd lumbar vertebrae, which corresponds to a point midway between the base of the ensiform cartilage and the umbilicus. It lies obliquely across the back part of the abdomen, the head being a little lower than the tail; about one-third of the length of the pancreas is to the right of the middle line.

The **Abdominal Aorta** can be fairly accurately marked out by a line drawn from the **median** on a level with the 7th costal cartilage, to a point half an inch below and to the left of the umbilicus, where the bifurcation of the aorta takes place (Diagram 39).
CHAPTER XIX

HINTS TO MASSEUSES

Before bringing this little work to a close, I venture to add a few words of advice to students of massage, the outcome of my own personal experience during many years of happy and varied work, both in manipulations and instruction. Many will perhaps close this text-book with a feeling of disappointment that more space has not been devoted to descriptions of movements; but, as I said in my original preface, my object has been to supply a general fundamental knowledge, without encroaching on the province of the teacher of practical work.

There is a tendency to imagine that massage can be picked up by reading a book on the subject; and being personally thoroughly opposed to the system of getting a smattering of knowledge, harmful in every way, I have purposely refrained from giving any encouragement to this idea.

Every teacher has his or her own routine system of foundation movements, and when this knowledge has been acquired by personal instruction, others can easily be added.

I would impress on everyone taking up this study to be most careful in the choice of a teacher, as massage badly taught or imperfectly apprehended is useless—nay, worse, productive of irreparable harm, and all have not the gift of imparting the knowledge they possess themselves in full measure.

If a course of instruction is taken at a well-recognized institution, the probabilities are that the teachers will have acquired their position by virtue, not only of personal attainments, but also of powers to instruct others.
Too great care cannot be exercised in the individual application of treatment to the patient, with reference not only to the physical condition and strength, but also to the psychological attitude. Never be induced to continue your treatment if you have real cause for believing that it or your personality is in any way prejudicial. As we learn more of psychology we shall understand better why one nurse or masseuse is so successful where another has failed, and how powers of mentality can be acquired or developed. It is incontestable that many of our most brilliant results are obtained by a combination of suggestion (perhaps often unconsciously applied) and skilful manipulation.

To maintain health there should be a proper adjustment of mind, environment, and structure; consequently each and all should receive definite attention by those who have the care of the sick.

One thing I am assured of—that is, the absolute necessity for a masseuse, as well as a nurse, to keep her mind in as well-balanced a condition as possible, and during her treatment to concentrate her attention (as fully as circumstances permit) on the patient and her needs, not necessarily speaking much, but having her mind full of healthfulness and hope as regards the ultimate issue of her work. She follows up mentally, as it were, the results she is trying to achieve manually.

In nervous cases she can materially aid the physician by continuing the impressions he is striving to make on an impaired, exhausted mind, in re-educating and restoring the harmonious rhythm. Also, she must use all her powers of observation, reporting anything and everything to him that may help towards a full diagnosis and effective treatment, such knowledge being kept for his ears alone. However busy she is, her aim must be to convince her patient that, for the period, she alone is the object of her thoughts and work. Whenever possible, it is well not to fill up her time so fully that she is unable to spare the five minutes’ extra attention, which will perhaps give the finishing touch to otherwise incomplete work.

Equally important is the need for keeping up her own
physical health, allowing sufficient time for sleep, food, fresh
air, and recreation. It is impossible for anyone, however
strong, to continue satisfactory work without these essentials
of our present existence; better refuse cases than neglect
these points. Of course we all have our periods of pressure,
but our reserve force should be equal to these emergencies,
and we should know the length of our tether, and not
exceed it, making up arrears at suitable opportunities. Such
symptoms as insomnia, intense nervous irritability, sense of
complete exhaustion, or of difficulty in resting or throwing
off the strain of work and responsibility when opportunity
comes, and even abnormal activity, are all danger-signals we
cannot afford to ignore, or we shall soon swell the ranks of the
broken-down workers, who find ‘ no place for the sole of
their foot.’ To continue work under these conditions, unless
the circumstances are very exceptional, is suicidal to the
worker and unjust to the employer, because it is impossible to
give a fair equivalent.

Finally, I would say, never be contented with your own
attainments, but be always on the look-out for those who
know more than yourself, and try to acquire that knowledge
fairly and honestly. In many subjects great developments are
taking place, so keep in touch not only with massage, but
with all collateral subjects—physiology, psychology, physical
education, sociology.

**EXERCISES.**

**Daily Exercises for General Health, suitable for the Use**
**of those engaged in Massage Work.¹**

These exercises should be done in the order in which they
are given. They are carefully arranged to bring into play
every part of the body in turn:

1. Raise arms to shoulder height, breathing in while you
count four; hold breath while you count four; lower arms
and breathe out evenly while you count eight.

¹ The above exercises have been compiled by a teacher of Physical
Training, who has had long experience both in England and in the
United States.
The counting should gradually become slower as you are able to take a longer breath. *Never strain*, or make any effort to take a longer breath than you can take with perfect ease. The breath will become naturally longer as your chest becomes permanently expanded.

Breathing should always be rhythmical—*i.e.*, the breath should be held (lightly and easily) for the same length of time as it took to draw it in, and the exhalation should take just twice as long as the inhalation.

Repeat about twelve times.

2. Holding the arms close to the body, rotate them so that the palms are turned outwards, at the same time drawing the shoulders down as far as possible and carrying the head slightly backward.

Repeat twelve times.

(This exercise corrects round shoulders and improves the carriage of the head.)

3. Bending the wrists backwards stretch with the palms as far as possible. This may be done in any direction—sideways, forward, or over the head.

(This will be found to be a great relief if feeling nervous and ‘fidgety.’)

4. Hands on hips; raise heels, bend knees slightly outward, holding the body upright and steady; stretch knees again and let heels sink.

Repeat twelve times.

(This exercise will make you light on your feet.)

5. Hold the arms out sideways at shoulder height. Work them round backwards in small circles, gradually increasing the size of the circle and the speed until you are swinging them in as big a circle as you can, and as quickly as possible.

(This exercise loosens the shoulder-joint, corrects round shoulders, and improves the circulation.)

6. Lie on back with hands at back of neck. Raise legs slowly up with knees straight until they are at right angles with body. Let them drop again *very slowly*.

The benefit of the exercise is in doing it slowly. Do not repeat more than six times, and do not hold the breath while doing it.

(This exercise is most valuable in constipation.)
7. Feet together, toes as well as heels. Hands at back of neck with elbows pressed back.
   Turn body as far round as possible to right and left slowly. Breathe regularly; inhale while turning to right and left; exhale while turning forward.
   (Improves circulation through the abdomen, and decreases the size of the waist.)
8. Walk round the room very slowly on the toes.
   (Improves carriage.)
9. Repeat No. 1.

The following exercises, put together by the author, will be also found beneficial both for personal and for patients’ use:

**Exercise in Correct Poise.**

Patient lies in supine position, forehead resting on hands, then goes through following exercises:
1. (a) Head, raising backward, four times.
   (b) Leg, raising each leg and foot separately, four times.
   (c) Leg, raising both together, four times.
   (d) Head and leg, raising each, two to four times.
   (e) Head and leg, raising both, two to four times.
2. Repeat above exercises with arms in rest position, lying prone.
3. Patient lies prone with heels drawn up to body.
   (a) Hips, raising till trunk and thighs are in line from shoulders to knees, two to eight times.
   (b) Knees, separating as widely as possible, four to eight times.
   (c) Hips raising and knees separating; separate knees well, raise the hips, hold a few seconds, then bring knees together while lowering the hips.

**To Obtain Correct Standing Position.**

Stand against the wall having the hips, heels, shoulders, and back of head in contact with it, the arms straight and down to sides. Flex the head backward till top of head
touches wall, allowing shoulders to move forward, extremities as before. After bending head backward as far as possible, which pushes shoulders forward, raise the head, keeping the shoulders in the same position, and draw the chin well in. The test is whether the person can immediately rise upon the toes without swaying the body forward, the weight being on the ball of the foot. A line drawn in front of the ear should fall over the point of the shoulder and strike the foot at the root of the toes.

**General Exercises.**

The following exercises are of general utility, especially for general debility, which may be learnt under supervision, and then performed alone by the patient:

Reach as high as possible with each hand alternately, rising on tiptoe each time after taking a deep breath and retaining it.

Hands behind head, hips firm, bend at waist, and sway upper body in circles.

Knees rigid, bend forward, touching floor with fingers or knuckles; straighten body, raising arms above head, bending far backward.

Flex arms well; bend as far as possible to right and left.

Right hand to temple, left on hip (turned backwards), slightly bend right knee and straighten left leg; then bend forward to the right. Reverse.

Weight resting on right leg, bend far forward, raising left leg. Reverse.

Bring the shoulders as far forward and downward as possible, then backward and downward. Raise shoulders as high as possible, then put them backwards and forwards alternately.

Link the fingers in front and press them firmly downwards, keeping the chin in, and drawing the shoulders down and back till the back muscles feel the strain. Repeat several times, straightening the whole trunk and keeping the knees flat.

Link hands at the back, and proceed as before.
For reducing Stomach and Hip Girth.

Bend forward as far as possible, pressing hands on abdomen. Walk about room, raising the thighs as close to the abdomen as possible (species of high-stepping) wearing light clothing, and no constriction.

For strengthening Internal Organs.

Raise end of couch or bed two feet, place strap or rope over upper part, inside which place feet:

(a) Rise from lying on back to sitting position, with hands on sides.

(b) Raise head and shoulders only.

(c) From the prone position raise head and chest as far as possible.

(d) Raise and twist the body to right and left.

Lying on back, raise legs and thighs at right angles to trunk, alternately first, then together, afterwards circumduct them as fully as possible.

Lying low down in bed with knees flexed against the wall, raise each foot alternately and touch the wall, each step being higher than the last, till the limit is reached.

Breathe deeply, forcing the sides against the hands placed on the ribs during inspiration, and take care to expel the air gradually and as fully as possible.

Place hands on abdomen, breathe deeply, and expel air fully, pressing the abdomen inwards.

Place hands behind head, and expand the waist-line during inspiration.

Lying on the bed, stretch the arms out level with shoulders, and cross in front of chest.

DONT’S.

Don’t take a case without medical permission, at least, if not supervision. Fatal results have sometimes followed massage of unsuitable cases.

Don’t discuss the doctor’s methods with the patient, and don’t mention the names of other patients in conversation.
Don’t talk scandal to your patients, and, on the other hand, avoid shop talk.
Don’t speak as if you were the one competent masseuse to be had.
Don’t undertake more cases than you have energy and vitality for, or both you and the patients will suffer.
Don’t accept any stimulants at a patient’s house.
Don’t abuse any confidence reposed in you, or publish abroad private matters that come to your knowledge.
Don’t continue your attendances a day longer than is necessary, or if you see that massage is not proving beneficial.
Don’t forget that you have come on business, and don’t give the impression that massage is an act of condescension on your part.
Don’t neglect to study your patient’s individuality, and if you can in any way rest her mind as well as her body, do so.
Don’t give the servants more trouble than you can help, whilst maintaining your position with dignity.
Don’t allow a patient to experience the discomfort of feeling your breath.
Don’t wear rings or bracelets.
Don’t sweep the patient’s skin with your sleeve or any part of your dress.
CHAPTER XX

TABLES, ETC.

SPINAL NERVES.

There are 31 pairs of nerves—8 cervical, 12 dorsal, 5 lumbar, 5 sacral, 1 coccygeal—the 1st cervical issuing above the 1st vertebra, and giving off posteriorly the suboccipital nerve.

The nerve emerging from the intervertebral foramen is mixed, having both motor and sensory fibres, and divides, the posterior divisions being small, and supplying the muscles and skin of the back. The anterior supply the neck, front and sides of the trunk, and extremities; they unite to form plexuses, from which the most important nerve trunks originate, and each is connected with the sympathetic.

Cervical Nerves (8).

1. The Cervical Plexus, formed from the anterior divisions of the first 4 cervical nerves. It rests on the levator anguli scapulæ and scalenus medius, and is covered by the sterno-mastoid. The following are its chief branches:

   Occipitalis Minor: To back of side of head.
   Auricularis Magnus: To skin over parotid gland, pinna, concha, and mastoid.
   Superficialis Colli: To skin of neck.
   Supraclavicular: To skin of suprasternal, clavicular, and acromial regions.
   Communicating Branches: To 10th, 11th, and 12th cranial nerves and to sympathetic.
Muscular: To recti, sterno-mastoid, trapezius, levator anguli scapulae, and scalenus muscles.

Phrenic (Internal Respiratory of Bell): To diaphragm; filaments to pericardium and pleura, communicating with solar and phrenic plexuses.

2. **Brachial**: Plexus formed from anterior division of 4 lower cervical and 1st dorsal—5th, 6th, and 7th, unite in the trunk external to scalenus medius; 8th cervical and 1st dorsal, unite in another trunk behind it. Below the clavicle they bifurcate—2 adjacent, uniting behind axillary artery, form *posterior* cord, and the remaining 2 form *outer* (exterior to artery) and *inner* cords.

   Above the clavicle are—

Muscular: To longus colli, scaleni rhomboidei, subclavius muscles.

Posterior or long Thoracic (External Respiratory of Bell): to the Serratus magnus.

Suprascapular: Supra- and infraspinatus muscles and shoulder-joint.

Below the clavicle are:

Anterior Thoracic: Pectoral muscles.

Subscapular: Subscapularis, teres major, latissimus dorsi muscles.

Circumflex: Muscles and skin of shoulder and joint.

Musculo-cutaneous: Forearm externally.

Internal Cutaneous: Arm and forearm.

Nerve of Wrisberg: Back of arm. Sometimes connected with intercosto-humeral.

Median: Passing between 2 heads of pronator radii teres, supplies pronators, flexors, first 2 lumbricales, skin of thumb, fingers, radial side of palm.

Ulnar: Passes between 2 heads of flexor carpi ulnaris to inner condyle of humerus, supplies elbow and wrist joints, some muscles, palmar and dorsal skin of little finger, and outer half of ring-finger.

Musculo-spiral: Accompanies superior profunda artery and vein in spiral groove of humerus, and divides into—

Radial to skin of thumb and adjacent sides of 2½ fingers.

Posterior Interosseous: Supplies all muscles of radial side
and back of arm (except 3), ligaments and articulations of wrist.

**Dorsal Nerves (12).**

Anterior divisions are intercostal nerves distributed to walls of thorax and abdomen: 6 upper to chest alone, 6 lower to chest and abdomen, the last having a cutaneous filament to the buttock. One branch of the 1st dorsal goes to the brachial plexus.

Intercosto-humeral (from 2nd dorsal) joins nerve of Wrisberg, and supplies skin of upper half of inside and back of arm.

**Lumbar Nerves (5).**

Anterior divisions pass outwards behind the psoas magnus. Four upper nerves (with branch from 12th dorsal) form lumbar plexus, 5th (with a branch of 4th) forms lumbo-sacral cord, which, joining with 3 upper sacral nerves and part of 4th, forms sacral plexus.

**Lumbar Plexus** gives off—
- Ilio-hypogastric: Skin of gluteal and hypogastric regions.
- Ilio-inguinal: Skin of upper and inner thigh.
- Genito-crural: Skin of anterior superior part of thigh.
- Obturator: Through obturator foramen to obturator and adductor muscles of thigh, and to hip and knee joints.

Anterior Crural: Iliacus and pectineus, nearly all muscles of front of thigh, hip and knee joints, skin of front and inner side of thigh.

It descends through the psoas muscle, beneath Poupart’s ligament to thigh, dividing into anterior and posterior divisions. It gives off following branches:
- Muscular: Iliacus, pectineus, and sartorius.
- Arterial: Femoral artery.
- Long Saphenous: Skin of patella, front and inner side of leg.

**Sacral (5), Coccygeal (1).**

These nerves descend vertically in spinal canal as cauda equina.

Anterior divisions communicate with sacral ganglia of sympathetic.
Sacral Plexus formed by 3 upper and part of 4th sacral nerves and the lumbo-sacral cord lies on pyriformis muscles, is covered by pelvic fascia, and gives off 2 great nerve cords. Both pass out through great sacro-sciatic notch, upper being prolonged into great sciatic nerve, lower becoming pudic nerve. It has the following branches:

Superior Gluteal: Gluteus medius and minimus, and tensor fasciae femoris.

Inferior Gluteal: Gluteus maximus.

Small Sciatic: Skin of perineum and back part of thigh and leg.

Pudic: Perineum, anus, and genitalia.

Great Sciatic (largest nerve in the body) gives off—

Articular: To hip-joint.

Muscular: Flexors of leg and adductor magnus, and divides into—

External and internal popliteal.

External popliteal, or peroneal, descends along outer side of popliteal space, winds round neck of fibula, then dividing into—

Anterior Tibial: Extensor muscles of leg, ankle-joint, skin of adjacent sides of great and 2nd toes.

Musculo-cutaneous: Peroneal muscles, skin of ankles, skin of dorsum and sides of all toes, except outer side of little toe and adjoining sides of great and 2nd toes.

Internal popliteal descends along back of lower thigh and middle of popliteal space to lower part of popliteus muscle, when it becomes posterior tibial nerve. Its branches are—

Articular: To knee-joint.

Muscular: Gastrocnemius, plantaris, soleus, and popliteus anterior.

Exterior or short saphenous, formed by communicans tibialis and communicans peronei (of external popliteal); descends to outer malleolus; supplies skin of outer side of foot and little toe.

Posterior Tibial (from internal popliteal) descends along back of leg to inner malleolus. Branches are—

Muscular to soleus, tibialis posticus, flexor longus digitorum, flexor longus hallucis muscles.
ARTICULATIONS

Internal Calcanean: Skin of heel and inner side of sole.  
Articular: Ankle-joint.

Internal Plantar: Inner plantar muscles, sole, plantar skin of inner 3½ toes.

External Plantar: External plantar, and plantar skin of outer 1½ toes.

ARTICULATIONS.

Atlanto-axial: Gliding between articular processes, double pivot between atlas and odontoid of axis; 6 ligaments—2 anterior, 1 posterior, 2 capsular, 1 transverse or cruciform.

Occipito-atlantal: Double condyloid, 6 ligaments—antero-, postero-, 2 lateral, 2 capsular.

Occipito-axial: 4 ligaments—occipito-axial, lateral, 2 lateral occipito-odontoid (check), middle odontoid (suspensory.)

Temporo-mandibular: 4 ligaments—external lateral, in ternal lateral, stylo-mandibular, capsular.

Costo-vertebral: 3 ligaments—antero- or stellate, interarticular, capsular.

Chondro-sternal: 4 ligaments—antero-, postero-, capsular, interarticular.

Vertebral: Anterior and posterior ligaments, ligamenta subflava (connect laminae of adjacent vertebrae), capsular, supra- and interspinous, intertransverse, intervertebral discs.

Sacro-vertebral: Lumbo-sacral, ilio-lumbar.

Sacro-iliac: Anterior, posterior, and oblique.

Sacro-ischiatic: Great sacro-sciatic from posterior inferior spine of ilium, and posterior surfaces and margins of sacrum and coccyx to inner margin of tuberosity and ascending ramus of ischium; latter called falciiform ligament.

Lesser Sacro-sciatic: Posterior margins of sacrum and coccyx to spine of ischium.

Symphysis Pubis: Anterior, posterior, superior, and sub-pubic.

Sterno-clavicular: Anterior, posterior, interclavicular, rhomboid, capsular.

Acromo-clavicular: Superior, inferior, coraco-clavicular (trapezoid, conoid).
Scapula Ligaments proper: Coraco-acromial and transverse (from coracoid to suprascapular notch).

Shoulder-joint: Ball-and-socket, formed by humeral head and glenoid cavity of scapula. Its synovial membrane is reflected on biceps, subscapularis, and infraspinatus tendons. Its arterial supply is anterior and posterior circumflex and suprascapular, nerve supply circumflex and suprascapular. Its 3 ligaments are—Capsular: From margin of glenoid cavity to anatomical neck of humerus. Coraco-humeral: Closely united with capsular, extending from coracoid to great tuberosity of humerus. Glenoid: Fibro-cartilaginous ring, continuous with long tendon of bicep’s above and attached round margin of glenoid cavity, deepening articular surface.

Elbow-joint: Hinge, formed by lower end of humerus, with greater sigmoid cavity of ulna and head of radius. Its synovial membrane is reflected over the ligaments, and dips down between surfaces of radio-ulnar articular. Arterial supply from anastomotica magna; nerve supply from ulnar, musculo-cutaneous and median. Its 4 ligaments: anterior, from internal condyle and anterior surface of humerus to orbicular lip of radius and coronoid process of ulna; posterior, from posterior surface of humerus to olecranon; external lateral, from external condyle of humerus to orbicular ligament of radius; internal lateral, from internal condyle of humerus to coronoid and olecranon of ulna.

Radio-ulnar articulations: 3.
Superior Radio-ulnar: Pivot, formed by radial head and lesser sigmoid cavity, has only orbicular ligament surrounding the radial neck, attached to lesser sigmoid cavity and external lateral ligament of elbow-joint.

Middle Radio-ulnar: Formed by shafts of radius and ulna, connected by oblique ligament from tubercle at base of coronoid of ulna to shaft of radius. Interoosseous membrane, obliquely downwards from interosseous ridge of radius to ulna.

Inferior Radio-ulnar: Pivot, formed by ulnar head and sigmoid cavity of radius towards synovial membrane; ligaments—anterior, posterior, interarticular.
ARTICULATIONS


Carpal articulations between each bone and between the two rows of bones, and the metacarpal also articulate by dorsal, palmar, and interosseous ligaments, and the phalanges have anterior and 2 lateral ligaments.


Ilio-femoral or Y ligament: From the anterior inferior spine of ilium to anterior intertrochanteric line.

Ligamentum Teres: From depression on femoral head to cotyloid notch of acetabulum and transverse ligament.

Cotyloid, fibro-cartilaginous band surrounding margin of acetabulum, deepening cavity.

Transverse, part of cotyloid ligament crossing notch, making it a foramen.


External ligaments are 6:

Anterior or Ligamentum Patellae: Central portion of common tendon of quadriceps extensor muscles, continued from patella to tubercle of tibia.

Ligamentum Winslowii: From intercondyloid notch
of femur to head of tibia, connected with semimembranosus muscle.

Internal Lateral: From internal condyle of femur to inner tuberosity of tibia and internal semilunar cartilage.

2 External Lateral: From external condyle of femur to head of fibula—1 long anteriorly, 1 short posteriorly.

Capsular: Thin, strong membrane, inseparably connected with above ligaments.

Internal ligaments, 8:

Anterior Crucial: From front of spine of tibia to outer condyle of femur (inner side).

Posterior Crucial: From back of spine of tibia and popliteal notch to inner condyle (outer side).

Semilunar Fibro-cartilages: External and internal, between articular surfaces, attached in front and behind spine of tibia.

Transverse: Connecting slip between semilunar fibro-cartilages.

Coronary: Short bands connecting fibro-cartilages with head of tibia.

Ligamentum Mucosum: Triangular fold of synovial membrane at lower border of patella.

Ligamenta Alaria: 2 fringe-like folds on sides of above attached to semilunar cartilages.

Bursae: 3 in front, 4 on outer, 5 on inner sides. That between patella and skin is affected in ‘housemaid’s knee.’

Tibio-fibular: (1) Superior, has Capsular surrounding joint, anterior and posterior: Connecting head of fibula with outer tuberosity of tibia.

(2) Middle: Shafts connected by interosseous membrane.

(3) Inferior: Contiguous rough surfaces at lower ends of tibia and fibula, connected by interosseous ligaments. Inferior continuous with above. Anterior and posterior inferior: From external malleolus to front and back of tibia. Transverse: Posteriorly between malleoli.

tibial and peroneal. Nerve Supply: From anterior and posterior tibial.

Anterior Ligament: Connecting tibia and astragalus anteriorly. Posterior Ligament: Connecting tibia and astragalus posteriorly. Internal Lateral or Deltoid: From internal malleolus to 3 adjacent tarsal bones. External Lateral: From external malleolus to astragalus and os calcis.


Tarso-metatarsal have dorsal, plantar, and interosseous ligaments, and 6 synovial membranes.

Phalanges have 1 plantar and 2 lateral ligaments.
# The Muscles

The following are the most important muscles. Those marked with an asterisk (*) are particularly important, and should be learnt first. See diagrams at the end of this list.

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Origin</th>
<th>Insertion</th>
<th>Action</th>
<th>Nerve Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Occipito Frontalis.* (back of head)</td>
<td>Superior curved line of occipital bone and mastoid portion of temporal.</td>
<td>Eyebrows.</td>
<td>Raises eyebrows; moves whole scalp.</td>
<td>Facial.</td>
</tr>
<tr>
<td>3. Masseter.* (chew)</td>
<td>Malar process of superior maxilla and zygomatic arch.</td>
<td>Angle and lower half of ramus of jaw.</td>
<td>&quot; &quot; &quot;</td>
<td>&quot; &quot;</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>Muscle</th>
<th>Origin</th>
<th>Insertion</th>
<th>Action</th>
<th>Nerve Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. Risorius. (laugh)</td>
<td>Fascia over masseter.</td>
<td>&quot; &quot;</td>
<td>Draws back corners of mouth, as in laughing.</td>
<td>&quot;</td>
</tr>
<tr>
<td>16. Trapezius.* (sided shape)</td>
<td>Superior curved line of acciput, ligamentum nuchae, spinous processes of 7th cervical and all dorsal vertebrae.</td>
<td>Posterior border of clavicle, acromion process, and spine of scapula.</td>
<td>Draws head back or to side; elevates shoulder, as in supporting weights, etc.</td>
<td>Spinal accessory, cervical plexus.</td>
</tr>
<tr>
<td>MUSCLE</td>
<td>ORIGIN</td>
<td>INSERTION</td>
<td>ACTION</td>
<td>NERVE SUPPLY</td>
</tr>
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<td>------------------------</td>
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</tr>
<tr>
<td>17. Latissimus Dorsi.</td>
<td>Spinosus processes of six lower dorsal, all lumbar and sacral vertebrae, external lip of crest of ilium, three or four lower ribs.</td>
<td>Bicipital groove of humerus, inner margin.</td>
<td>Draws humerus back and down, and rotates it inwards; assists in climbing.</td>
<td>Subscapular.</td>
</tr>
<tr>
<td>(long and round)</td>
<td></td>
<td></td>
<td>(The last three muscles afford protection to shoulder-joint.)</td>
<td>&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MUSCLE</th>
<th>ORIGIN</th>
<th>INSERTION</th>
<th>ACTION</th>
<th>NERVE SUPPLY</th>
</tr>
</thead>
<tbody>
<tr>
<td>25. Rhomboideus Major.</td>
<td>Spinous processes of four or five upper dorsal vertebrae.</td>
<td>Border and spine of scapula.</td>
<td>Carries inferior angle of scapula back and upwards, as in shrugging the shoulders.</td>
<td>5th cervical.*</td>
</tr>
<tr>
<td>26. Erector Spinae.*</td>
<td>Crest of ilium, sacrum, spinous processes of lumbar and three lower dorsal vertebrae.</td>
<td>Opposite last rib; divides into sacro lumbaris and longissimus dorsi.</td>
<td>Keeps spine erect, bends it laterally, and rotates.</td>
<td>5th cervical.*</td>
</tr>
<tr>
<td>30. Serratus Magnus.*</td>
<td>Eight upper ribs by nine digitations (two from second rib).</td>
<td>Inner margin of posterior border of scapula.</td>
<td>External inspiratory muscle; draws shoulder forwards and downwards.</td>
<td>Posterior thoracic.</td>
</tr>
<tr>
<td>MUSCLE</td>
<td>ORIGIN</td>
<td>INSERTION</td>
<td>ACTION</td>
<td>NERVE SUPPLY</td>
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</tr>
<tr>
<td>31. Deltoïd.*</td>
<td>Clavicle, acromion process,</td>
<td>Prominence on middle of shaft of</td>
<td>Raises arm from side; draws forwards and</td>
<td>Circumflex.</td>
</tr>
<tr>
<td>(shoulder)</td>
<td>lower border of spine of</td>
<td>humerus (outside).</td>
<td>backwards.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>process.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32. Triceps.*</td>
<td>(1) Below glenoid cavity.</td>
<td>Olecranon process and shaft of ulna.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3 heads)</td>
<td>(2) Posterior outer surface</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>of the shaft of humerus.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(3) Posterior inner surface</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>of shaft of humerus.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3 heads)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(long)</td>
<td>(2) Upper margin of</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>glenoid cavity.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(arm)</td>
<td>humerus.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(crown's beak)</td>
<td></td>
<td>of humerus.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>37. Pronator Radii Teres.*</td>
<td>(1) Above internal</td>
<td>Ridge on middle of outer surface of shaft</td>
<td>Rotates radius on ulna, and so pronates</td>
<td>Median.</td>
</tr>
<tr>
<td>(spokes of wheel)</td>
<td>condyle of humerus.</td>
<td>of radius.</td>
<td>hand; assists in flexing forearm.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2) Coronoid process of</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ulna.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38. Pronator Quadatus.*</td>
<td>Lower part of shaft of</td>
<td>Lower part of shaft of radius.</td>
<td>Rotates radius on ulna, and so pronates</td>
<td>Anterior interosseous.</td>
</tr>
<tr>
<td></td>
<td>ulna.</td>
<td></td>
<td>hand.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MUSCLE</th>
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<th>INSERTION</th>
<th>ACTION</th>
<th>NERVE SUPPLY</th>
</tr>
</thead>
<tbody>
<tr>
<td>(wrist)</td>
<td>humerus.</td>
<td>metacarpal bone of little finger.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40. Flexor Carpi Radialis.*</td>
<td>(2) Inner margin of</td>
<td>Base of metacarpal bone of index-finger.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>olecranon.</td>
<td></td>
<td></td>
<td>Median.</td>
</tr>
<tr>
<td>41. Palmaris Longus.*</td>
<td>Internal condyle of</td>
<td>Annular ligament, expanding and ending</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>humerus.</td>
<td>in palmar fascia.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>42. Flexor Sublimis Digit orum.*</td>
<td>(1) Internal condyle of</td>
<td>Lateral margins of second phalanges.</td>
<td>Flexes fingers.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>humerus.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2) Coronoid process of</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ulna.</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(3) Oblique line of radius.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Base of last phalanx of thumb.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>44. Flexor Longus Pollicis.*</td>
<td>„ „, radius.</td>
<td>Base of styloïd process of radius.</td>
<td></td>
<td>Anterior interosseous.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Supinates foræ m.</td>
<td></td>
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</tr>
<tr>
<td>45. Supinator Longus.*</td>
<td>External condyloid ridge of</td>
<td>Tuberosity and oblique line of radius.</td>
<td></td>
<td>Musculo-spiral.</td>
</tr>
<tr>
<td></td>
<td>humerus.</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>humerus and ridge of ulna.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>47. Extensor Carpi Radialis Longior.*</td>
<td>External condyloid ridge of</td>
<td></td>
<td></td>
<td>Musculo-spiral.</td>
</tr>
<tr>
<td></td>
<td>humerus.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>MUSCLES</td>
<td>ORIGIN.</td>
<td>INSERTION.</td>
<td>ACTION.</td>
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<td>---------------------------------------------</td>
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<tr>
<td>56. Pectoralis Minor.</td>
<td>3rd, 4th, and 5th ribs.</td>
<td>Coracoid process.</td>
<td>Depresses shoulder; draws scapula downwards and inwards.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>MUSCLE.</th>
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<th>NERVE SUPPLY.</th>
</tr>
</thead>
<tbody>
<tr>
<td>59. Diaphragm.* (partition)</td>
<td>Internal circumference of thorax, cartilages, ribs, lumbar vertebrae, etc.</td>
<td>Central or cordiform tendon.</td>
<td>Muscle of inspiration, expiration, expulsion.</td>
<td>Phrenic and phrenic plexus.</td>
</tr>
<tr>
<td>60. Rectus Abdominis.*</td>
<td>Crest of pubis and fellow of opposite side.</td>
<td>Cartilages of 5th, 6th, and 7th ribs.</td>
<td>Depresses thorax; flexes vertebral column and pelvis.</td>
<td>Intercostal, ilio-hypogastric, and ilio-inguinal.</td>
</tr>
<tr>
<td>61. Obliquus Externus.*</td>
<td>Eight lower ribs.</td>
<td>Crest of ilium; os pubis; forms Poupart's ligament and linea alba; extends from ensiform cartilage to symphysis pubis.</td>
<td>Flexes pelvis on thorax; compresses viscera; assists in expiration; turns and bends trunk.</td>
<td>Intercostal, ilio-hypogastric, and ilio-inguinal.</td>
</tr>
<tr>
<td><strong>MUSCLE</strong></td>
<td><strong>ORIGIN.</strong></td>
<td><strong>INSERTION.</strong></td>
<td><strong>ACTION.</strong></td>
<td><strong>NERVE SUPPLY.</strong></td>
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</tr>
<tr>
<td>64. Quadratus Lumborum.</td>
<td>(1) Crest of ilium. (2) Transverse processes of three to five lower lumbar vertebrae.</td>
<td>Last rib.</td>
<td>Draws down and fixes last rib; flexes thorax laterally.</td>
<td>Last dorsal; 1st lumbar.</td>
</tr>
<tr>
<td>70. Psors Magnus.* (buttock)</td>
<td>Transverse processes and bodies of last dorsal and all lumbar vertebrae.</td>
<td>Lesser trochanter.</td>
<td>&quot; &quot;</td>
<td>Anterior lumbar.</td>
</tr>
<tr>
<td>71. Iliacus. (thigh)</td>
<td>Iliac fossa and crest of ilium.</td>
<td>&quot; &quot;</td>
<td>Flexes and rotates femur; flexes trunk and pelvis on thigh.</td>
<td>Anterior crural.</td>
</tr>
<tr>
<td>72. Sartorius.* (thigh)</td>
<td>Anterior superior spine of ilium and notch below.</td>
<td>Inner upper part of shaft of tibia.</td>
<td>Flexes leg on thigh and thigh on pelvis; crosses legs.</td>
<td>Anterior crural.</td>
</tr>
<tr>
<td>73. Tensor Vaginis Femoris.*</td>
<td>Anterior superior spine and crest of ilium.</td>
<td>Fascia lata on outer side of thigh.</td>
<td>Renders tense the fascia lata.</td>
<td>Superior gluteal.</td>
</tr>
<tr>
<td>76. Adductor Magnus.</td>
<td>Tuberosity and ascending ramus of ischium and descending ramus of pubis.</td>
<td>Linea aspera from trochanter to adductor tubercle.</td>
<td>Adducts and flexes thigh.</td>
<td>Oburator and great sciatic.</td>
</tr>
<tr>
<td>78. Crureus.* (leg)</td>
<td>Front of shaft of femur.</td>
<td>&quot; &quot;</td>
<td>&quot; &quot;</td>
<td>&quot; &quot;</td>
</tr>
<tr>
<td>79. Vastus Internus.*</td>
<td>Inner lip of linea aspera.</td>
<td>&quot; &quot;</td>
<td>&quot; &quot;</td>
<td>&quot; &quot;</td>
</tr>
<tr>
<td>80. Vastus Externus.</td>
<td>Greater trochanter and outer lip of linea aspera.</td>
<td>&quot; &quot;</td>
<td>&quot; &quot;</td>
<td>&quot; &quot;</td>
</tr>
<tr>
<td>MUSCLE.</td>
<td>ORIGIN.</td>
<td>INSERTION.</td>
<td>ACTION.</td>
<td>NERVE SUPPLY.</td>
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</tr>
<tr>
<td>84. Semitendinosus.*</td>
<td>Tuberosity of ischium.</td>
<td>Posterior surface of shaft of tibia. By tendo Achillis into os calcis.</td>
<td>Flexes leg; rotates leg inwards.</td>
<td>&quot; &quot;</td>
</tr>
<tr>
<td>85. Semimembranosus.* (2 latter, with Gracilis, form inner ham-strings)</td>
<td>&quot; &quot;</td>
<td>&quot; &quot;</td>
<td>Flexes leg; rotates leg inwards.</td>
<td>&quot; &quot;</td>
</tr>
<tr>
<td>87 Gastrocnemius.* (belly) (leg)</td>
<td>(1) External condyle of femur. (2) Internal condyle of femur.</td>
<td>By tendo Achillis into os calcis.</td>
<td>Extends foot, raises ankle; flexes femur on tibia, etc.</td>
<td>Internal popliteal and posterior tibial.</td>
</tr>
<tr>
<td>89. Peroneus Longus. (tibio)</td>
<td>Head and shaft of fibula.</td>
<td>Metatarsal bone of little toe.</td>
<td>Extends foot.</td>
<td>&quot; &quot;</td>
</tr>
<tr>
<td>90. Peroneus Brevis.</td>
<td>Shaft of fibula.</td>
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</tbody>
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</tr>
</thead>
<tbody>
<tr>
<td>93. Extensor Proprius Hallucis.</td>
<td>Shaft of fibula.</td>
<td>Inner cuneiform and 1st metatarsal bones.</td>
<td>Extends great toe</td>
<td>&quot; &quot;</td>
</tr>
<tr>
<td>94. Tibialis Anticus.*</td>
<td>Shaft of tibia, outer surface.</td>
<td>Metatarsal bone of little toe.</td>
<td>Flexes foot.</td>
<td>&quot; &quot;</td>
</tr>
<tr>
<td>95. Peroneus Tertius.</td>
<td>Lower part of fibula.</td>
<td>Last phalanges of four lesser toes.</td>
<td>&quot; &quot;</td>
<td>&quot; &quot;</td>
</tr>
<tr>
<td>97. Flexor Longus Hallucis.</td>
<td>Shaft of fibula.</td>
<td></td>
<td>Flexes great toe.</td>
<td>&quot; &quot;</td>
</tr>
</tbody>
</table>
Diagram 40.—Muscles of the Neck and Face.
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Diagram 45.—Anterior View of Right Forearm, Deep Muscles.
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Diagram 50.—Muscles of Right Thigh, Posterior Surface.
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Diagram 56.—Anterior Surface of Right Leg and Foot.
# TABLE OF NERVE CENTRES

*C, D, L, S, refer to the Cervical, Dorsal, Lumbar, and Sacral Vertebra.*

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<tr>
<th>Names of Parts.</th>
<th>Conditions.</th>
<th>Centres for Treatment.</th>
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<td>Arteries</td>
<td>Stimulation or inhibition of circulation.</td>
<td>1-6 C.</td>
</tr>
<tr>
<td>Arms</td>
<td>Paralysis.</td>
<td>5, 6, 7 C; 1 D.</td>
</tr>
<tr>
<td>Bladder</td>
<td>For over-distension.</td>
<td>11, 12 D; 1 L.</td>
</tr>
<tr>
<td></td>
<td>For enuresis.</td>
<td>11, 12 D.</td>
</tr>
<tr>
<td></td>
<td>For micturition.</td>
<td>2 L.</td>
</tr>
<tr>
<td>Brain</td>
<td>To influence sphincter.</td>
<td>3 S.</td>
</tr>
<tr>
<td>Carotid artery</td>
<td>Control of blood-supply.</td>
<td>1-6 C.</td>
</tr>
<tr>
<td></td>
<td>Abdominal circulation.</td>
<td>7 C-3 L.</td>
</tr>
<tr>
<td>Cardiac plexus</td>
<td>Pelvic circulation.</td>
<td>9 D-5 L.</td>
</tr>
<tr>
<td>Diaphragm</td>
<td>To induce sleep.</td>
<td>Carotid plexus (compression).</td>
</tr>
<tr>
<td>Eye</td>
<td>Recti of eyeball (regulation).</td>
<td>Between 5 and 6 C and 2 D.</td>
</tr>
<tr>
<td>Oesophagus</td>
<td>Vaso-constrictors of eye.</td>
<td>3, 4, 5 C. Phrenic plexus and nerves (inhibit).</td>
</tr>
<tr>
<td>Fallopian tubes</td>
<td>Vaso-motors.</td>
<td>Between 2 and 3 D.</td>
</tr>
<tr>
<td>Gall-bladder and liver</td>
<td>—</td>
<td>2 and 3 C.</td>
</tr>
<tr>
<td>Heart</td>
<td>Feverishness.</td>
<td>1 and 2 D.</td>
</tr>
<tr>
<td>Head</td>
<td>In chills.</td>
<td>4 and 5 D.</td>
</tr>
<tr>
<td>Intestines</td>
<td>Diseases of head, eyes, ears, throat.</td>
<td>12 D; 2-5 L.</td>
</tr>
<tr>
<td>Vermiform appendix</td>
<td>Vaso-dilators of face and mouth.</td>
<td>6-10 D.</td>
</tr>
<tr>
<td>Intestines</td>
<td>Vaso-constrictors.</td>
<td>1-6 C.</td>
</tr>
<tr>
<td>Rectum</td>
<td>To induce peristalsis.</td>
<td>1-6 C; 8-12 D.</td>
</tr>
<tr>
<td>Kidneys</td>
<td>Diarrhoea.</td>
<td>1-6 C (stimulate).</td>
</tr>
<tr>
<td>Lungs</td>
<td>—</td>
<td>2-5 D.</td>
</tr>
<tr>
<td>Liver</td>
<td>—</td>
<td>6-12 D (slightly stimulate).</td>
</tr>
<tr>
<td>Legs</td>
<td>Dysentery.</td>
<td>1-4 L.</td>
</tr>
<tr>
<td>Larynx</td>
<td>Defaecation.</td>
<td>2-5 S.</td>
</tr>
<tr>
<td>Nose</td>
<td>—</td>
<td>9-12 D; 1 and 2 L.</td>
</tr>
<tr>
<td>Ovaries</td>
<td>For torpidity.</td>
<td>2-7 D.</td>
</tr>
<tr>
<td>Spleen</td>
<td>For stimulation.</td>
<td>6-7 C.</td>
</tr>
<tr>
<td>Sphincter ani</td>
<td>Paralysis.</td>
<td>6-12 D.</td>
</tr>
<tr>
<td>Stomach</td>
<td>—</td>
<td>1-6 C; 1-12 D.</td>
</tr>
<tr>
<td>Splanchnic, great</td>
<td>Control of external sphincter.</td>
<td>1-3 C.</td>
</tr>
<tr>
<td>&quot; small</td>
<td>Cardiac end.</td>
<td>1-6 C.</td>
</tr>
<tr>
<td>&quot; smallest</td>
<td>Pyloric end.</td>
<td>9-11 D.</td>
</tr>
<tr>
<td></td>
<td>—</td>
<td>8-12 D.</td>
</tr>
<tr>
<td></td>
<td>—</td>
<td>4 and 5, 8 and 9 D.</td>
</tr>
<tr>
<td></td>
<td>—</td>
<td>6-10 D.</td>
</tr>
<tr>
<td></td>
<td>—</td>
<td>10, 11 D.</td>
</tr>
<tr>
<td></td>
<td>—</td>
<td>12 D.</td>
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Note that above are centres for paths of least resistance, but many others are used, through which all the organs can be affected.

**TABLE OF NERVES (DE WATTEVILLE).**

The following tabulated statement of the more important spinal nerves, showing the muscles supplied by each, is taken from a paper by Dr. de Watteville, and will be found useful:

<table>
<thead>
<tr>
<th>Names of Parts</th>
<th>Conditions</th>
<th>Centres for Treatment</th>
</tr>
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<tbody>
<tr>
<td>Uterus</td>
<td>Amenorrhea, Dysmenorrhea, To induce labour, To check labour, To relieve morning sickness.</td>
<td>2-5 L (stimulate), 2-5 L (inhibit), 2-3 L (stimulate), 7-8, 11-12 D ; 4-5 L, 4-5 D (stimulate).</td>
</tr>
<tr>
<td>Vaso-motors for body generally</td>
<td>—</td>
<td>For head 1-6 C; upper extremities 3-7 D; lower extremities L and S.</td>
</tr>
<tr>
<td>Vaso-dilators</td>
<td>—</td>
<td>2-5 D. Chiefly in vagus.</td>
</tr>
<tr>
<td>Vena cava, inferior</td>
<td>—</td>
<td>5 L.</td>
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4th Cervical: Deltoid, rhomboids, spinati, biceps, brachialis anticus, supinator longus, extensors of hand.

5th Cervical: Deltoid (clavicular portion), biceps, brachialis anticus, serratus magnus, supinator longus, extensors of hand.

6th Cervical: Latissimus dorsi, pectoralis major, serratus magnus, pronators, triceps.

7th Cervical: Teres minor, latissimus dorsi, subscapularis, pectoralis minor, flexors of hand, triceps.

8th Cervical: Flexors of wrist and fingers, muscles of hand, extensors of wrist and fingers, triceps.

1st Dorsal: Muscles of hand (thenar, hypothenar, interossei).

3rd Lumbar: Ilio-psoas, sartorius, adductors, extensor cruris.

4th Lumbar: Extensor femoris et cruris, peroneus longus, adductors.

5th Lumbar: Flexors and extensors of toes, tibial, crural, and peroneal muscles, extensors and rotators of thigh, ham-strings.

1st Sacral: Calf, ham-strings, long flexor of great toe, intrinsic muscles of foot.

2nd Sacral: Intrinsic muscles of foot.
SOME IMPORTANT LIGAMENTS.

Greater or Posterior Sacro-Sciatic, situated at the lower and back part of the pelvis.

Lesser or Anterior Sacro-Sciatic, attached to the spine of ischium and lateral margin of sacrum and coccyx.

Poupart’s extends between the anterior superior spine of ilium and spine of os pubis.

Broad or lateral ligaments pass from each side of the uterus to the lateral pelvic walls, forming a septum across the pelvis, dividing the cavity into two portions—the anterior, which contains the bladder, urethra, and vagina; and the posterior, containing the rectum.

Patellae, attached above to the apex of the patella; below, to tuberosity of tibia.

Crucial: two interosseous, in interior of knee-joint, between the femur and tibia; so called because they cross each other.

Orbicular, connecting the radius and ulna.

Annular, anterior and posterior, arching over carpus.

,, anterior, internal, and external of the ankle.

Capsular of hip, knee, shoulder, thumb, and vertebra (connecting the articular processes).

Ligamenta Subflava, connecting the laminae of the spinal column, from axis to sacrum.

Teres and Cotyloid, at the hip-joint.

Nuchae, placed in the line of union between the trapezii muscles, extending from external occipital protuberance to spinous process of 7th cervical vertebra.

Supraspinous, connecting the spinous processes.

Coraco-Acromial, between coracoid and acromion processes.
VARIOUS NAMES OF PROTUBERANCES ETC., TO BE SPECIALLY NOTICED.

Condyles:
(a) 1 on each side of the foramen magnum, on occipital bone, for articulation with atlas (first of cervical vertebrae).
(b) 1 on each inferior maxillary bone.
(c) 1 external, 1 internal, on lower extremity of humerus.
(d) 1 external, 1 internal, on lower extremity of femur.

Styloid Processes:
(a) 1 on lower extremity of radius.
(b) 1 on lower extremity of ulna.
(c) 1 on inner side of petrous portion of temporal bone.
(d) 1 on outer side of head of fibula.

Tuberosities:
(a) Maxillary tuberosity, on the lower part of the zygomatic surface of the superior maxillary bone.
(b) Tuberosity of the palate bone or pterygoid process.
(c) Tuberosity or tubercle of the rib at the vertebral extremity.
(d) Greater and lesser tuberosities, on head of humerus, separated by the bicipital groove.
(e) Bicipital tuberosity, on the upper extremity of radius.
(f) Tuberosity of ischium (on which we rest when sitting).
(g) Outer and inner tuberosities, on lower extremity of femur (above the condyles).
(h) External and internal tuberosities, on the head of tibia.
(i) Inner and outer tuberosities, on os calcis.

Processes:
1 Spinous, on each vertebra.
2 Transverse, on each vertebra.
4 Articular, on each vertebra.
Odontoid, on 2nd cervical, or axis.
Mastoid, on temporal bone.
Internal and external, on frontal bone.
Pterygoid, 1 on each side of sphenoid bone. (Also on each palate bone.)
Alveolar, on superior maxillary bone.
**VARIOUS NAMES OF PROTUBERANCES, ETC.**

_Malar_, on superior maxillary bone.
_Nasal_, on superior maxillary bone.
_Palatine_, on superior maxillary bone.
_Frontal_, on malar bone.
_Orbital_, on malar bone.
_Maxillary_, on malar bone.
_Zygomatic_, on malar bone.
_Orbital_, on palate bone.
_Sphenoidal_, on palate bone.
_Coronoid_, on inferior maxillary bone. (Also on ulna.)
_Mental_, on inferior maxillary bone.
_Condyloid_, on inferior maxillary bone.
_Acrromion_, on scapula.
_Coracoid_, on scapula.
_Olecranon_, on ulna.
_Styloid_, on ulna.

„ on radius.

_Spinous_, anterior, superior

„ „ inferior on ilium.

„ „ posterior, superior

„ „ inferior
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