

CHAPTER XXX

THE SYMPATHETIC NERVOUS SYSTEM

511. **Of what the system consists.** — The spinal cord controls the contraction of the arteries, the peristalsis of the intestine, and the growth of cells. Yet the impulses which it sends out for these purposes pass through another set of nerve cells and nerves called the *sympathetic nervous system*.

The sympathetic nervous system consists of small bodies like grains of corn or smaller, called *ganglia*, from which nerves go out in all directions. There are four main pairs of ganglia in the head, and twenty-three in a row down the front of the backbone all connected by nerves. Each ganglion is a collection of nerve cells and nerve fibers bound together by connective tissue. Nerve threads connect its cells with the cells of the spinal cord and also with the muscle cells of the arteries and intestine. Through the arteries they probably affect all the cells in the body. The nerve threads are smaller than those of ordinary nerves, and seldom form bundles large enough to be seen. They usually consist of a fiber like the central fiber of an ordinary nerve thread without its fatty covering. They are thus not easily found even with the aid of a microscope.

The nerves from the ganglia run mainly along the course of the large arteries. Upon the aorta and its

main branches in the chest and abdomen, nerves and small ganglia form intricate networks, each called a *plexus*.

Just back of the stomach there is a large and important plexus called the *solar plexus*, whose nerves supply the muscles of the organs of the abdomen. A plexus within the heart controls the action of the heart.

512. **Sensory sympathetic nerves.** — The sympathetic nerves carry both sensory and motor impulses, but only faint impulses of pain and touch. Thus the circulation of the blood and digestion of food go on almost without our knowledge, but a very strong irritation may give rise to an abdominal pain, as in colic.

Sensory impulses telling of the wants of the cells and of the need of secretion or movements of the arteries or digestive organs are continually being received by the ganglia. These impulses travel slowly and require some time to produce an impression. Most of them travel only to the cells in the ganglia, and few get farther than to the cells in the spinal cord. Only very strong impressions, whose cause may injure the body, reach the brain and produce a feeling of pain, hunger, thirst, or fatigue.

513. **Motor sympathetic nerves.** — The ganglia send orders to the epithelial cells of the glands to produce their secretions, and to the muscles of the intestine and arteries either to contract or to dilate. They do this in response to information furnished by the sensory nerves. They also send out orders for the growth and nutrition of the cells of the body on receipt of news of their needs. Most orders from the ganglia are reflex.

514. **Mode of action of the ganglia.** — If cut off from connection with the cord, the ganglia send few impulses. The cord seems to furnish them with a supply of nervous energy. They seem to take a small amount of its active impulses and transform it into a large

amount of gentle impulses for the arteries and intestine. When poisons or spoiled food irritate the intestine to a dangerous degree, the sensation goes beyond the ganglia and excites the spinal cells to action. In response they send out direct orders which cause energetic and painful peristalsis to remove the food, in marked contrast with the gentle action caused by the ganglia alone.

515. Influence of the brain. — The brain has some power over the ganglia. Excitement or fear may influence the spinal cord so that it in turn modifies the impulses going through the ganglia. Sorrow seems to depress the ganglia so that the processes of digestion and assimilation are not so well performed, and the nutrition and growth of the cells of the body are diminished. But nature has arranged that after leaving the brain, mental influences shall act through two sets of nerve cells before they can directly affect the nutrition of the body. Thus man's body is protected against injury from his ever-changing moods.

516. Connection of organs with each other. — By means of the sympathetic system, a nervous influence in one organ is spread over all the rest. Because other organs seem to share in the sickness when one is deranged, the nerves controlling them are called *sympathetic* nerves. Thus, when one organ is deranged, the others act less strongly and impose less work upon the disabled part.

517. Injury to sympathetic nerves. — The sympathetic nerves are less influenced by outside impressions than any other nerves in the body, and great violence is needed to impair their action seriously. Poisons which are swallowed or produced during disease may injure them so that the ganglia almost cease to send out their orders. Then life is endangered, and strong nerve stimulants like strychnine are needed.

Aside from poisons, almost the only grave danger which may threaten the sympathetic system is a blow upon the abdomen or neck. A hard blow or great pressure just below the ribs may paralyze the solar plexus. The arteries then enlarge and hold so much blood that too little goes to the head and brain. So there is danger of sickness and of death. A blow upon the side of the neck may injure

the large ganglia which are situated there, as well as the large nerves near by, and make such a profound impression upon the heart that death may take place at once. Blows upon the neck or abdomen are always dangerous.

SUMMARY

1. The sympathetic nervous system consists of collections of nerve cells called *ganglia*, and of both sensory and motor nerves which follow the course of the arteries.
2. The cells of the spinal cord send impulses to the ganglia, and they in turn distribute them to the arteries and glands and to the organs of the chest and abdomen.
3. The ganglia send orders only in a reflex way according to impressions received from their sensory nerves.
4. The ganglia control the contraction and dilatation of the arteries, the peristalsis of the intestine, the secretion of glands, and the growth of the cells of the body.
5. The ordinary sensory impulses conducted by the sympathetic nerves produce no feeling.
6. The heart is controlled mainly by a set of small ganglia within its own walls.
7. The sympathetic system produces slow and gentle movements in contrast with the quick and active movements made by the spinal cord.
8. The brain has no direct control over the ganglia.
9. Blows upon the neck or abdomen may injure the sympathetic nerves so as to cause death.

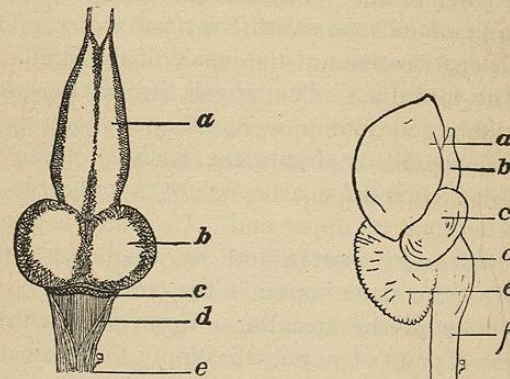
REVIEW TOPICS

1. Describe the sympathetic nervous system: its ganglia, nerves, plexus, and its connection with the spinal cord.
2. Describe the sensory impulses of the sympathetic nerves.
3. Describe its motor impulses and their relation to the arteries; to secretion of glands; to peristalsis; to the growth of cells, and to the heart.
4. Describe how the ganglia send out their impulses.
5. Describe how the spinal cord has influence over the ganglia, and how they work independently of the cord.
6. Describe how the brain can affect the ganglia.
7. Describe how the action of the ganglia may be seriously impaired by injuries.

CHAPTER XXXI

THE BRAIN

518. **General structure.** — The brain is the part of the central nervous system which can *originate* orders in distinction from the spinal cord, which acts only in response

Brain of a frog; top view ($\times 10$).

- a cerebrum.
- b optic tubercles.
- c cerebellum.
- d medulla.
- e upper end of spinal cord.

Brain of a hen; side view ($\times 2$).

- a cerebrum.
- b optic nerve.
- c optic tubercle.
- d medulla.
- e cerebellum.
- f spinal cord.

to impulses brought to it. In reptiles, toads, and frogs, it is very simple in structure, but yet contains parts corresponding to all the parts of the brain of man. In them the spinal cord swells out to form a cone-shaped body called the *medulla oblongata*. Above it there is a small flat