

REVIEW TOPICS

1. Tell why alcohol affects the brain and give the three stages of its effects.
2. Describe the stage of stimulation.
3. Trace the career of a man as he becomes more and more under the influence of drink, giving the effects of alcohol upon the moral feelings; upon the judgment; upon the motor region and cerebellum; upon the sensory region; and upon the medulla.
4. Describe the permanent effects which long-continued drinking produces in the brain.
5. Show how the bad company kept by drinkers affects their minds.
6. Describe delirium tremens.
7. Show that the taste for alcohol and the effects of its use may be transmitted to children.
8. Show that the alcohol habit is a disease, and give its treatment.
9. Tell how tobacco affects the brain.
10. Tell how drug habits, as opium using, affect the brain.
11. Tell how ether and chloroform produce insensibility, and how the state resembles drunkenness.

CHAPTER XXXIV

TASTE, SMELL, AND HEARING

588. Touch. — Touch is a special sense. Its sensations are aroused without the need of any special organ. So the discussion of sensory nerves is really a discussion of the special sense of touch. (See p. 269.)

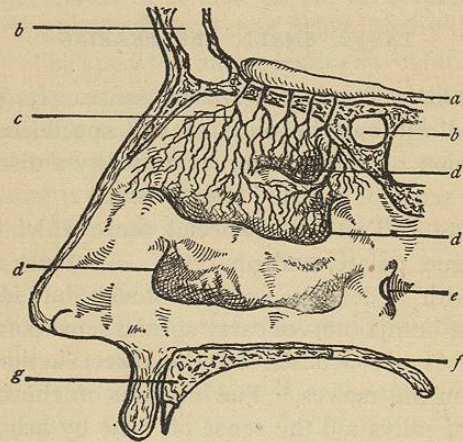
589. Taste. — Taste is a special sense which is located in the tongue, palate, and pharynx. All these parts are endowed with a delicate sense of touch, but in addition two pairs of cranial nerves carry special sensations of taste. The impulses are aroused by the direct action of substances upon the nerves. The motions of chewing and a good flow of saliva aid the sense of taste by bringing food in contact with the nerves, while a dry substance, or one which will not dissolve in water, can have no taste. All tastes are some combination of sweet, sour, bitter, and salt tastes. Sweetness and sourness are recognized mainly by the front part of the tongue, and bitterness and saltness by the back parts and pharynx.

Taste is greatly influenced by the sense of smell. The real taste of coffee is greatly changed by the odor which reaches the back part of the nose as it is swallowed.

590. Use of taste. — Taste enables a man to detect spoiled or unwholesome food. The sense is capable of great education. The prices of different grades of tea are determined by expert tea tasters, who devote their whole time to tasting different samples. Alcohol and tobacco

irritate the nerves in the mouth and so blunt the taste for good food. For this reason a drinker does not enjoy plain food, but requires spices to excite his taste.

591. The nose. — Impressions of smell originate within the nose. Each nostril leads to a wedge-shaped cavity,



The outer wall of the nose.

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| <i>a</i> the nerve of smell at the base of the brain. | <i>d</i> curved curtains of bone. |
| <i>b</i> air spaces in the skull bones. | <i>e</i> opening of the Eustachian tube. |
| <i>c</i> branches of the nerve of smell. | <i>f</i> soft palate. |
| | <i>g</i> upper jawbone. |

which opens into the pharynx. The inner wall of each cavity is smooth, and is formed by the thin bone that separates the two nostrils. Each outer wall is formed by three very thin bones which hang down like narrow curtains. They nearly cover cavities, called *sinuses*, which are situated in the neighboring bones. One sinus occupies the interior of the upper jawbone, and is called the *antrum*. The part of the skull behind the eyebrows is honeycombed with small cavities, called the *frontal sinuses*.

592. Olfactory nerves. — From the under surface of the brain, about twenty nerves extend through perforations in the upper part of the nose and spread out over the upper one third of the surface of the nasal cavities. An odorous gas entering the nose comes in contact with the ends of these nerves and excites the sense of smell. An odor is found only in substances which can be turned to a vapor.

The olfactory nerves are so delicate that they can perceive the presence of gases which cannot be detected in any other way. Some substances excite the sense of smell when they are in such small quantities that they are given off for years without causing a perceptible lessening of the weight of the substance.

When too much mucus covers the nerve endings, or when the surface of epithelium is dry, no gas can reach the nerves, and then the sense of smell is diminished. A cold in the head can produce either condition.

593. Use of smell. — Smell is a warning against foul air and decaying matter. The gases themselves are in too small quantities to do harm, yet they are a sign that other substances are present which can harm the body. Air which has no odor is almost surely fit to be breathed. Meat which has a pleasant odor is almost certainly fresh.

Tobacco smoke and snuff are irritating to the delicate nerves of smell, and partly deprive its users of nature's most useful protection against foul air.

594. The inner ear. — Sound is produced by certain air waves which are received by nerves in the ear. There they excite impulses which the brain interprets as sound. In the hard bone, which rises from the bottom of the skull by each ear, is a tortuous cavity, called the *labyrinth* or *internal ear*. The center of the labyrinth is about one eighth of an inch in diameter, and is called the *vestibule*. From the vestibule there extends a small spiral

tunnel, called the *cochlea*, which is like the inside of a snail's shell, and also three other tunnels called the *semicircular canals*, from their shape.

The labyrinth is filled with a clear liquid, and is lined with epithelial cells, among which the nerves of hearing end. Upon the surface of the epithelium are cilia, among which are fine hard particles called the *ear sand*. The air waves produce waves in the liquid which beat against the

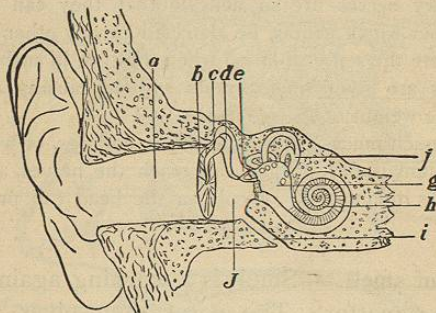


Diagram of the ear.

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|----------------------------------|----------------------------------|
| <i>a</i> outer air passage. | <i>f</i> semicircular canals. |
| <i>b</i> membrana tympani. | <i>g</i> vestibule of inner ear. |
| <i>c</i> malleus or hammer bone. | <i>h</i> cochlea. |
| <i>d</i> incus or anvil bone. | <i>i</i> Eustachian tube. |
| <i>e</i> stapes or stirrup bone. | <i>j</i> tympanum or middle ear. |

cilia and produce the sense of sound. Waves in the fluid surrounding the nerves must occur at least sixteen times a second in order to produce a sound. When they occur more than thirty-eight thousand times a second, they are too rapid for the nerves to take account of their motion, and so no sound at all will be heard.

The *semicircular canals* do not seem to be essential to hearing, but when they are diseased a person is unable to balance himself so as to walk or even to stand. The movements of the fluid in the canal seem to produce nervous impressions which, in the cerebellum, excite such reflex actions as are necessary to balance the body in an upright position.

595. The middle ear. — To make hearing distinct, a special mechanism is provided for transmitting the air vibrations to the inner ear through two outer cavities.

A small aperture connects the inner ear with a middle cavity called the *middle ear*, or *tympanum*. The middle ear is half an inch long and a quarter of an inch broad. It is lined with mucous membrane and is filled with air. Its outer end is closed like a drum, by a thin leaf called the *drum membrane* or *membrana tympani*, while a similar membrane closes the aperture to the inner ear. The cavity of the middle ear is greatly increased by its extending backward into a bony projection called the *mastoid process*, which can be felt just behind the outer ear. It connects with the pharynx by means of a tube which is about the size of a knitting needle and is called the *Eustachian tube*. The act of swallowing opens the tube.

596. Bones of the middle ear. — The essential part of the middle ear is a chain of small bones called the *malleus*, *incus*, and *stapes*, which extend across its cavity from one membrane to the other.

Air waves, striking the ear drum, throw it into vibrations, which the chain of bones transmits to the inner ear. The tympanum and its extension into the mastoid cells act like the sounding box of a violin to increase the vibrations.

597. Deafness. — The Eustachian tube permits air to pass in and out of the middle ear so as to keep the air pressure within the same as it is outside. When it is closed, the air pressure outside may change, and thus the drum membrane will be pressed upon and prevented from vibrating freely. This results in partial deafness. Enlarged tonsils and adenoid vegetations are liable to cause a stoppage of the tube and to produce deafness, and for this reason they should always be removed. When the tube is stopped, there is a feeling of fullness in the ear, and roaring or singing noises will be heard.

Deafness due to a stoppage of the Eustachian tube is the most common form. It often can be relieved by opening the tube by swallowing. By blowing the nose hard with the nose and mouth closed and at the same time puffing out the cheeks and swallowing, one can almost always force air through the tube into the ear and thus relieve the deafness. This should be done several times a day.

Sometimes an inflammation extends from the pharynx up the Eustachian tube and sets up an inflammation in the middle ear like that in the throat. Mucus and matter then collect in the middle ear and press upon the ear drum, causing a severe earache. If the tube does not open, the membrane may burst and allow the matter to run out of the ear.

598. *A running ear* should be kept clean by cleansing it with warm boiled water as often as the matter collects. Sometimes in running ears, the disease eats away the bones and produces inflammation of the brain. For this reason running ears are always dangerous.

Some drugs may produce a ringing in the ears and partial deafness. Quinine, which is taken for malaria, and salicylic acid, which is taken for rheumatism, may cause it, but the effects pass off within a few hours.

Boxing the ears suddenly compresses air against the drum membrane, producing pain and sometimes even bursting the membrane. Loud reports, as of cannon, cause such extensive and painful vibrations of the membrane that deafness may result.

599. Early in life a child may become deaf, and yet no one may be aware of the trouble. Then the child is apparently inattentive and does not answer when spoken to. At school the teacher may ascribe his lack of attention to carelessness or ill temper. In consequence, the child receives unjust punishment. The hearing of every dull and inattentive child should be examined.

600. The outer ear.—Outside of the drum membrane is a passage to the air about an inch in length and one quarter of an inch in diameter, formed partly of bone and partly of flesh. Around its opening is a shell-shaped fold of flesh which, together with the passage, is called the *outer ear*. Connected with it are rudimentary muscles

which are so well developed in some persons that they can move their ears as a horse does.

601. Ear wax.—The epithelium of the outer half of the passage secretes a kind of bitter and sticky wax which keeps insects and dust from reaching the drum membrane. The epithelium grows outward towards the surface like the nails, and carries the wax with it, thus preventing its accumulation. Often in picking the ears the wax is pushed against the drum membrane so that it cannot vibrate. Next to throat trouble this is the most common cause of deafness. The accumulated wax can be softened and removed by gently syringing with warm water. Wax can best be removed with the loop of the smallest-sized hair pin, taking care not to insert it far enough to touch the drum membrane.

602. Illusions of hearing.—Too dense or too rare air in the middle ear, too much blood circulating in the inner ear, the use of certain drugs, as quinine, blows upon the head or wax in the ear, are all causes which may excite the nerves of hearing. Then the impression goes to the brain as though a real sound had excited the nerves.

The cells of the brain itself may interpret a sensation wrongly; thus an insane person may think that the sound of his own pulse beating in his ears is the echo of the blows of demons within his head.

Sometimes persons recall memories of sounds so vividly that they seem to be real. This occurs naturally in dreams, but it may occur in an insane person at any time.

603. The ear in lower animals.—In four-footed animals and in birds the ear is the same as in man. In turtles and frogs there is no outer ear, but the drumhead lies just under the skin, forming a visible circle behind the eyes, while the middle ear contains a single bone. In the snake

there is no external or middle ear, although a bone extends from the inner ear to a kind of drum membrane just under the skin. In the fish there is no external or middle ear, and the labyrinth has no cochlea, but the vibrations are transmitted only through the skull. In the lobster there is a small cavity filled with liquid, in which are the endings of the nerves of hearing. The vibrations producing sound are transmitted to the bag through the sides of its head. Thus all animals which have ears at all, possess what in man is the internal ear.

SUMMARY

1. The sense of taste is excited by substances which become dissolved in the saliva and excite special nerves in the tongue and pharynx.
2. The sense of taste enables one to distinguish good food from bad.
3. The sense of smell is excited by minute amounts of gas, which excite special nerves in the upper part of the nose.
4. Smell guards us against foul air and decayed substances.
5. Sound is produced by vibrations of the air.
6. The inner ear consists of winding canals filled with liquid into which special nerves project. Vibrations of the air excite the nerves and produce the sense of sound.
7. The middle ear consists of a bony cavity across which three small bones convey the vibrations of the air to the inner ear.
8. Deafness is often caused by the Eustachian tube being stopped.

9. Inflammation of the throat may extend into the middle ear and produce an earache.
10. Enlarged tonsils and adenoid vegetations are the two principal causes of earache and deafness.
11. Running ears should be kept clean.
12. In all animals having a hearing apparatus, the essential and often the only part is the inner ear.

DEMONSTRATIONS

130. Examine the tongue of one of the pupils. Notice that its surface contains three kinds of projections. There is a V-shaped row of large, flat, and smooth projections upon its back part. There are red pinhead-sized projections scattered over the whole front surface. There are also fine projections like velvet spread over the whole surface. In all these projections the nerves of taste seem to end. Examine also a cat's tongue, and note the stiff hairs upon its surface.

131. Test the power of taste in different parts of the tongue. Place a bit of a sweet or of a sour substance in the back of the mouth, and notice the slight taste, while it is easily tasted in the front part. Now place some salt or bitter substance upon the front of the tongue. Notice that it has little taste until it spreads to the back part.

132. Saw lengthwise through a calf's head so as to open the nose. Notice the smooth inner surfaces of the nostrils, and their furrowed outer surfaces produced by the folded bones. Notice that the nostrils open into the pharynx. (See demonstration 35.)

133. Have a butcher remove the bone containing the middle and internal ear from a calf's skull. Carefully cut away the shell of bone over the middle ear. One can judge of its position by measuring down the outer air passage. Notice the size and shape of the middle ear. Notice the ear drum, and the three little bones which stretch from it entirely across the cavity. Notice also that the last bone fits into the small opening leading into the inner ear.

134. The inner ear will be more difficult to show, for it is small and complicated, and is situated deep in a very hard bone. Cut away the bone a little farther in, when the cochlea may be opened, and possibly a semicircular canal will be recognized. The spiral tube of the cochlea is barely $\frac{1}{8}$ of an inch in diameter, while the semicircular canals are as small as a sewing needle, but yet form loops about $\frac{3}{8}$ of an inch across.

REVIEW TOPICS

1. Describe the process of tasting, and tell how smell influences the sense of taste.
2. Give the use of the sense of taste.
3. Describe the endings of the nerves of smell in the nose, and tell how the sensation of smell is produced.
4. Give the use of the sense of smell.
5. Describe the inner ear: its cochlea, semicircular canals, and nerves of hearing, and tell how they act.
6. Describe the middle ear: its bones, the two membranes which close it, and its Eustachian tube.
7. Show how a stoppage of the Eustachian tube may lead to deafness; to running ears.
8. Show how throat trouble may cause ear disease.
9. Tell how to care for running ears.
10. Show why boxing the ears is dangerous.
11. Describe the outer ear: its air passage and wax.
12. Show how the ears may seem to hear sounds which do not exist.
13. Describe the ear in a frog; in a snake; in a fish; in a lobster.

CHAPTER XXXV

THE EYE

604. Light. — Straight lines of light called *rays* pass off from objects in all directions. Each ray is supposed to be a vibrating line in a thin substance called ether, which fills all space.

The vibrations of ether take place many millions of times each second. In sound the air vibrates only a few hundred times. Light travels nearly 185,000 miles each second, while sound travels about 1000 feet in the same time. Light waves are from $\frac{1}{100000}$ to $\frac{1}{10000}$ inch in length, but each sound wave reaches several feet. The length of a wave of light determines its color. Red waves are about twice as long as violet waves. A mixture of all colors produces white light, while black is due to the absence of light. Colors which, like red and green, form white light, are called *complementary colors*.

In passing through glass or other clear substances, rays of light may be bent from their courses. By a properly shaped glass called a *lens*, rays may be spread apart or may be brought together in a point called

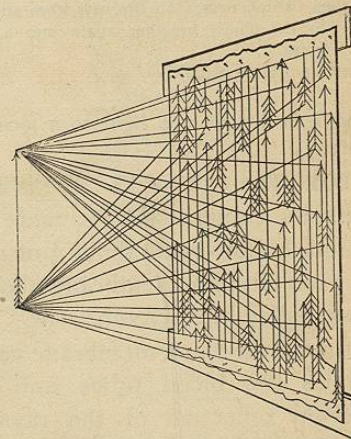


Diagram of light passing from an object.

It passes in every direction, and, falling upon a screen, produces a confused multitude of images, which form only a mass of light, but no one clear image.