HEALTH BULLETIN for TEACHERS

Suggested List of Topics
1941 — 1942

Theme: The Health of the Nation

September — Out of Old Fields, New Corn.

October — Sanitary Engineering and the Environment.

November — A Good Deal for Mother and Child.

December — The School Health Service and the School Child.

January — The Teacher and Health Education.

February — The Parents and the Correction of Physical Defects.

March — The Family and the Community.

April — The Health of the Worker.

May — Facing Reality.

June — The Year's Progress in Medicine and Public Health.

M E M O R A N D U M

March 18, 1941

DR. LANZA

We shall appreciate having your comments and criticisms on the attached manuscript, which has been prepared for the March HEALTH BULLETIN FOR TEACHERS.

E. B. W.
School Health Bureau

March 17, 1941

DR. ARMSTRONG

We shall appreciate having your comments and criticisms on the attached manuscript which has been prepared for the March HEALTH BULLETIN FOR TEACHERS.

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HEALTH BULLETIN FOR TEACHERS

Special Sensibilities

Sight, hearing, taste, touch, and smell - the familiar "five senses" - were first classified as special sensibilities in the early part of the 18th century. At that time all the other less distinct sensations were lumped together as general sensibilities. Now touch is no longer called a "special" sense. It belongs among the sensations designated as somatic or body sensibilities which make us aware of pressure, pain, heat, and cold. The other senses, vision, hearing, taste, and smell, are called "special" for convenience to distinguish them from the more ancient (in point of admission to consciousness) somatic sensibilities.

The Anatomy of Sense Perception. The mechanism of sense perception consists of a vast system of sensory nerve endings or "receptors" connected by devious but well-defined nerve paths with definite sensory areas in the cerebral cortex where the different types of sensation are translated into conscious impressions. The simplest sort of diagram upon which an illustration of the sensory mechanism might be roughed in is that of a circle. On the periphery we should place dots representing the sensory nerve endings, and from them we should draw radii representing the nerve fibers. Somewhere along each radius we should place other dots to stand for the neurons or nerve cells through which the impulse from a receptor is relayed to the center of the circle, or cerebral cortex. Actually this simple wheellike diagram would resemble a far more highly complicated web than any spider could ever spin if we attempted to show the devious routes, the cross roads, the relay stations by which the impulses finally reach the particular central areas where they "make sense."

The Cause of a Sensation. The primary cause of a sensation of any kind is the reaction of a sensory receptor to a stimulus to which it is sensitive. The sensation lasts just as long as the sensory end organ reacts to the stimulus. The reaction may outlast the application of the stimulus just as a rocking chair may continue to rock after it has once been set in motion. This is true especially of the sensation of pain. On the other hand, reaction may cease while the stimulus is still being applied. This is true especially of the sensation of touch. The nerve fibers involved get used to or adapt themselves to the constant stimulus of mechanical pressure so that only single impulses or at most a few are discharged.

The Intensity of a Sensation. The strength or weakness of a sensation apparently is connected with the number of impulses arriving at the central nerve-cell junctions (synapses). Just as the congestion in a railway freight yard increases with an increase in the number of tracks over which cars are shunted into it, so the greater the number of nerve fibers engaged in shunting impulses into a sensory area of the brain, the more intense a sensation will be. The intensity of a sensation depends also on the speed with which impulses follow one another along individual nerve fibers. In the conduction of impulses nerves obey the all or nothing law. Either they do not transmit impulses at all, or they transmit them as fast as they possibly can.

The Kind and Quality of a Sensation. The starting point of an impulse and its destination are what determine the kind and quality of a sensation, not the impulse itself. ~~For example,~~ the impulses carried by sensory nerve fibers leading from light-wave receptors do not differ materially from the impulses carried by nerve fibers leading from sound-wave receptors. In the one case you see, in the other you hear, because sensory nerve fibers leading from the retina of the eye end in the visual center of the cerebral cortex and those from the inner ear in the auditory center.

Although all impulses in themselves are more or less alike - no one knows exactly what they are like. The passage along a nerve fiber of an excitation process started by the stimulation of a receptor, and associated with a series of electrical and chemical changes along the route, is the nearest we can come to defining a nerve impulse.

Each sensory receptor is the station of departure for the passage of an impulse to the terminal station in the brain with which it is connected. Only one kind of stimulus can initiate the passage of an impulse from that particular station. Just as a ticket for Boston would not get a passenger past the gate to board a train for Miami, so the stimulus of light waves would not get a message started on the way to the auditory center. However, it does sometimes happen that a receptor is excited by an unusual stimulus. When that happens the sensation aroused is similar to the sensation aroused by the usual stimulus. Thus the usual stimulus of a receptor on the retina is light waves, but an unusual stimulus, like a blow between the eyes, also gives rise to the sensation of light. One sees stars! As someone has said, if impulses arising in the retina were directed to the auditory center and impulses from the inner ear to the visual center, we should hear the lightning and see the thunder.

Somatic Sensibilities. The so-called somatic, or body, sensations may be divided into paleo-sensibilities and neo-sensibilities. Paleo-sensibilities which are the first sensations admitted to consciousness, are those of extreme degrees of pressure, pain, heat, and cold. They are all unpleasant and all vitally important in self-preservation. A hearty smack, as likely as not, made many of us draw our first breaths in protest. The discomforts of coldness, heat, hunger, and wetness evoked the cries which brought us needed attention. Then by degrees, neo-sensibilities became superimposed on the

older ones to supply us with critical information regarding the outside world. These newer sensibilities include tactile sensations, those evoked by light contact with receptors in the skin, and kinesthetic sensations, those from receptors in the voluntary muscles, tendons, joints, and bone coverings. Tactile sensations give us the sense of touch and its refinements. Kinesthetic sensations furnish us with information concerning the movements and position of the limbs, trunk, and head and enable us to estimate resistance to muscular contraction when we lift or move objects. The two together make it possible for us to judge the forms, shapes, consistencies, and weights of objects in the outside world.

The sensation of pain is served by naked nerve endings in the skin, cornea of the eye, and serous surfaces inside the body, such as the peritoneum and the pleura. Pain nerve endings are not selective, as other receptors are. They respond to any type of stimulus whether mechanical, chemical, or thermal provided it is intense enough. The sensation of pain therefore gives warning of the injurious nature of a stimulus rather than information as to any more specific quality.

Disturbances of somatic sensations result from any abnormal change produced by mechanical or chemical agents along the course of nerve tracts from receptors to sensory areas in the brain. Regardless of where a mechanical or chemical agent acts along a nerve the disagreeable sensations aroused are generally referred to the part containing

the receptors from which the particular nerve fibers arise. This explains why a person whose leg has been amputated refers the pain in the stump to the missing limb. The pressure of the dressings or newly formed tissue on the nerve fibers may be compared to the tapping of a telephone wire between stations, and the message received by the operator (i.e., in the body a sensory area in the brain) is interpreted as coming from the station which in the body is the regular receptor. Sometimes the disagreeable sensations also are referred to the course of the peripheral nerves, as in neuralgia. The subjective sensation of pain may be constant or intermittent and dull or sharp and lancelike depending on the nature of the stimulus, the rate of recurrence of local excitations, the adaptation of the nerve fibers concerned, and so on.

The Sense of Sight. When we see we have many sensations. Not only do we know that it is light, but also we recognize different intensities of illumination. By virtue of this ability we avoid obstacles and recognize moving objects. We can distinguish colors, outlines, and fine details in the things we look at and appreciate depth, volume, and perspective. The sensory receptors which mediate all these sensations, are located in the retina of the eye. There are two kinds - rods and cones - named after their shapes. At the point where the optic nerve which conducts impulses from the retina to the brain, enters the retina, rods and cones are absent. Hence this is a "blind spot," a point on the retina where light waves produce no visual sensations.

Rods and cones are arranged on the retina in a definite pattern. Beginning with a small area near the center of the retina, only cones packed closely together are present. Then in a widening circle the cones diminish progressively in number while the rods increase proportionately until finally, at the outer rim, only rods remain. Distinct and accurate vision and the recognition of color are localized near the center of the retina while the ability to see in a dim light is almost

entirely lacking. On the other hand low light intensities and movements at any illumination are best detected at the outer rim of the retina, while color perception and perception of detail are lacking. Thus it is inferred that the functions of the cone apparatus are sharpness of vision and recognition of details and colors, while the rod apparatus, which is very sensitive to light, is used for twilight vision.

A rose-red light-sensitive pigment found in the rods is essential for normal vision in dim light. This pigment is called visual purple. Since illumination of the eye causes bleaching of the visual purple, this substance must be regenerated when the eyes are in the dark. Vitamin A is in some way intimately associated with the bleaching -regeneration cycle of visual purple. Thus people who do not get enough vitamin A may have night blindness, that is, inability to see in dim lights.

Tiny upside-down images of objects in the outside world are projected on the retina by a series of refractive surfaces forming the lens system of the eye. Disturbances of vision most frequently occur through structural defects or muscular weaknesses which make it impossible for the lens system to focus images properly on the retina. In most instances such disturbances can be corrected by wearing suitable glasses.

The Sense of Hearing. When we hear we do not just hear a sound - we recognize even small differences in the pitch, loudness or intensity, and quality of the sound. We know whether it is disagreeable (noisy) or pleasant (musical), we know usually what makes it - a strange voice or a familiar one; a piano or a violin; a gun shot or something dropped with a bang on the floor. The organ of hearing, which mediates the sensations of sound, is called the organ of Corti and is located in the lymph-filled inner ear or cochlea. The interior of this bony "snailshell" which is about as big as a pea, is subdivided by walls of membrane into three spiral undersea galleries, or chambers. Along the floor of one of these galleries (the scala media)

lies the organ of Corti. This organ contains sensory sound receptors and hair cells. It is the stimulation of the hair cells by the tiny variations in pressure of the fluid surrounding them that excites the sound receptors to send impulses to the brain via the auditory nerve.

All the other apparatus of the ear is concerned solely with sound wave conduction. Over a system of delicate membranes and tiny bones impinging on one another the series of waves set up in air by vibrating bodies in the outside world travel to the cochlea where they are transformed into "water" waves of the same frequency, amplitude, and form. Their frequency determines the pitch; their amplitude, the loudness; and their form, the quality of the sound heard.

Impairment of hearing occurs most frequently as a result of conditions which affect the conduction of sound to the inner ear. Destruction or functional disturbance of the organ of Corti or injury to the auditory nerve is rare. Frequent or chronic head colds are the chief cause of the loss of hearing due to interference with sound conduction.

The Sense of Taste. We have four primary taste sensations, sweet, bitter, sour, and salty. Each kind is mediated by the sensory receptors or taste buds on the tongue which are sensitive to it. Taste buds are chemically stimulated, but it is not known exactly what centers in the brain are reached by the impulses started off as a result of the stimulation.

The great variety of different taste sensations actually experienced is due to a mixture of primary sensations (much as a mixture of primary colors will produce different shades and tones), to the stimulation at the same time of touch and temperature nerve endings on the tongue, and to confusion with sensations of smell. Many flavors are really odors and disappear when the nose is "stuffed up" as a result of a cold. A substance that causes first a sweet taste and then a bitter stimulates in sequence the sweet receptors toward the front of the tongue and the bitter

receptors toward the back. Personal variati ns in the sense of taste occur, and taste blindness for one or more of the primary sensations is common and hereditary.

The Sense of Smell. The organs of smell, called the olfactory bulbs, are located in the roof of the nose. They are composed of a collection of spindle-shaped receptors which are stimulated by the pressure of vapor molecules given off by volatile substances. It is possible to distinguish many different odors, but they are hard to classify except as being pleasant, unpleasant, or neutral. Since sensations of smell may be tied up intimately with other sense impressions from the outside world, it is no wonder that their ultimate destination in the brain is the most obscure of all the cerebral sensory areas.

Past associations have a great deal to do with psychological reactions to odors of different kinds. Thus an odor may be very disagreeable to one person and pleasant or neutral to another. The senses of taste and smell together determine whether or not a food is appetising. Forming pleasant associations with the taste and smell of food in childhood play a leading role in creating a liking for the right kinds of food.

REFERENCES

Carl J. Wiggers. Physiology in Health and Disease. Lea & Febiger, Philadelphia. 1939. Chapter XI - Somatic Sensibilities and Their Disturbances; Chapter XII - Special Sensibilities.