PHYSIOLOGY

Auditory Nerve Cannot Carry Highest Audible Frequencies

Scientists Detect Frequencies Up to 2800 Cycles in Nerve But Cannot Explain How Higher Pitches Reach Brain

HOW CAN you tell the highest note of the violin from the deepest boom of the bass tuba? The puzzle of how to account for the ability of the human auditory mechanism to perceive various pitches was the subject of researches reported to the meeting of the National Academy of Sciences in Cambridge by Drs. H. Davis, A. Forbes, and A. J. Derbyshire, all of Harvard Medical School.

Although their findings have thrown considerable light on the problem they have also served to complicate it, because they serve to demonstrate that one of the familiar theories of hearing may apply to the hearing of low tones, but not of the highest pitches of stringed instruments and shrill squeaks.

This theory of hearing assumes that the high pitch is perceived as different from the low pitch because the frequency of the sound waves is transmitted to the higher nervous centers as a corresponding frequency of the nerve impulses in the auditory nerve. Other nerves in the body are not able to respond to impulses following each other as rapidly as the succeeding waves of a high pitched sound. But this theory has also assumed that the auditory nerve might have a much briefer recovery period than other nerves.

"Listen in" on Cat Nerves

The Harvard researchers picked up the action currents from the auditory nerves of an anesthetized cat by a sort of "listening in" arrangement and measured them on a cathode ray oscillograph. They found that when the sound reaching the ear was of a frequency of 700 or lower—that is, below the upper limit of the cello or alto singing voice—the frequency of the action currents of the auditory nerve was exactly the same.

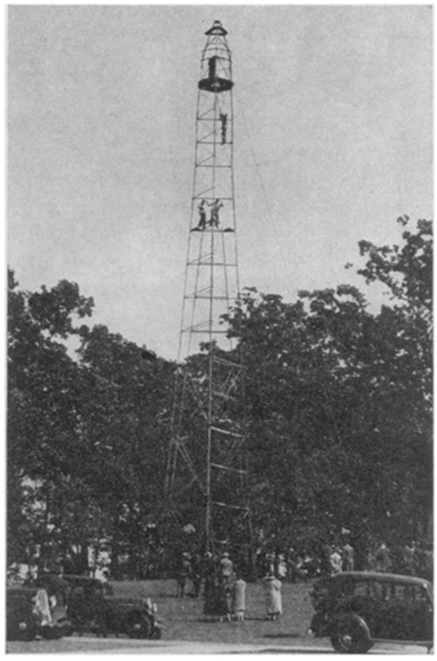
Between 700 and 900, a sharp change occurs in the amplitude of the waves picked up. It drops to approximately half the size of those produced by equally loud sounds of lower frequencies. This is interpreted by the investigators as meaning that the nerve fibers have reached their speed limit and now respond to only one of each two successive waves. Since only half the fibers respond to any one wave, the size of the response is only half as great as when all were working.

At a frequency of 1700—somewhere among the high notes of the flute and violin and above the limit of the clarinet—another drop occurs indicating a breaking up of the nerve fibers into three groups each responding to every third wave.

Not Unique

At a frequency of 2800, however, the responses become completely irregular.

"The auditory nerve is in no way unique in respect to its ability to transmit high frequencies of impulses," the investigators concluded. "Furthermore, even by virtue of rotation of activity, the frequency of stimulation is not represented centrally above 2800 per second. Therefore, pitch discrimination for high tones must depend upon some selective activity in the cochlea and not involve the frequency of nerve impulses. For tones of low pitch, however, a frequency theory is still possible."



FULL HEIGHT

Science News Letter, November 25, 1933

ENGINEERING

Steel Towers Go Up and Down To Speed Survey of Country

See Front Cover

WORK ON control surveys of the United States is being rapidly pushed forward under funds recently provided by the Public Works Administration to The U. S. Coast and Geodetic Survey. Although the immediate purpose is to provide employment to a great number of men, the present program fits into the plan to cover the country with a close network of triangulation stations so that no point will be more than 12½ miles from a station. Boundaries of private properties and political units may then be much more certain and much costly litigation may be avoided.

Press representatives in Washington were recently allowed a peep behind the scenes when they were invited to witness the erection of one of the triangulation towers on the campus of the University of Maryland. The tower, which is shown, in the process of erection, on the cover of this issue of SCIENCE NEWS LETTER, although approximately 100 feet high, was put up in only about three hours. It is a double structure, the outer portion, supporting the observer's platform and the light, being without contact with the inner tower on which the surveying instrument is placed, so as to prevent any jarring of the instrument.

The sections of the tower, which was designed in 1927 by Jasper S. Bilby of the U. S. Coast and Geodetic Survey,

look like giant counterparts of a child's erector set. And they are handled almost as easily by the skilled workmen. As you may see at the top of the photograph, the workman holds the 13-foot piece of steel in one hand while he fastens the bolt in place with the other, although the steel weighs about 132 pounds. As the tower increases in height, the motor of the truck is used to hoist the sections up to the workmen.

When completed, the tower is exactly plumb and sturdy enough not to be swayed in the slightest by the winds.

Before this modern tower was designed, it was necessary to take great care in building a thoroughly braced wooden structure for the purpose. At least two days were required to build the old type of tower, and then the material had to be discarded when the triangulations were completed. One of the great advantages of the Bilby tower is that it can be easily dismantled and re-erected repeatedly on new locations.

Science News Letter, November 25, 1933

MEDICINE

Nerves Give Two-Way Transport to Paralysis Virus

Dr. Flexner Reports Path of Invasion of Poliomyelitis Probably Followed by Viruses of Other Diseases

EXPOSED endings of the nerves of smell, in the delicate membranes lining the nose, are the gateway by which the virus of poliomyelitis (infantile paralysis) may enter the system. The nerve trunks to the brain, nerve connections in it, and nerves returning to the body surface are the paths the invasion follows. So long as it stays with nerve tissue, the disease virus is to a large degree isolated from the blood and lymph, so that protective substances formed in the body or introduced into it cannot reach it effectually, and it is free to continue its malignant work.

This, in brief summary, is the story of poliomyelitis invasion, as studied by Dr. Simon Flexner, director of the Rockefeller Institute for Medical Research, New York City, and reported before the National Academy of Sciences meeting in Cambridge, Mass. Dr. Flexner made his studies exclusively on rhesus monkeys, in which he produced the disease by introducing into their noses a suspension in salt solution of the spinal cord of a paralyzed monkey. But he extended the significance of his findings, stating:

"While this communication relates specifically to poliomyelitis, it applies in principle to still other infectious and inflammatory diseases of the brain and spinal cord."

Dr. Flexner then sketched the details of the progress of the infection:

"The virus gives rise to no detectable pathological changes in the nasal mucous membrane. It possesses an affinity for the olfactory nerve cells—the organ of smell—which lie exposed in this membrane. The hairlike processes (dendrites) of these cells project into a layer of mucus which the virus enters to come in contact with the cells. The dendrites take up the virus and pass it on, by way of the axon or nerve fiber, to the olfactory lobe of the brain, whence it passes on still further, by nerve connections, to more distant parts of the brain and spinal cord. As the virus travels it becomes affixed to the motor nerve cells which control voluntary motion, injures them, and thus induces muscular paralysis. Other cellular changes, secondary and reactive in nature, are also induced in the nervous organs.

Carried by Olfactory Nerves

"Hence the olfactory nerves carry the virus from the periphery (nasal membrane) to the brain, and they also carry it in the reverse direction from the center (brain) to the periphery. This two-way transport has been shown for the first time in connection with the virus of poliomyelitis.

"The olfactory nervous structures are to a considerable extent isolated from the blood and lymph, which carry the protective, immune substances effective against impending infections," Dr. Flexner continued. "They afford, therefore, potentially a ready means of penetration of the virus into the central nervous system. It is only after the virus has reached the brain that the cellular reactions in the system, detectable by microscopic and chemical examination of the cerebrospinal fluid, make possible the escape of these protective substances. This phenomenon is more strongly marked among children than among monkeys, which probably accounts for the occurrence of many cases of mild poliomyelitis among children and few among the experimentally infected monkeys.

"The influence of the isolation of the olfactory nerves is observed in monkeys artificially immunized to the virus. These monkeys may be protected against the paralyzing effects of the virus injected into the brain, and yet respond with paralysis to virus instilled into the nose.

"Although this report deals only with experimental poliomyelitis, evidence exists showing that other viruses having a strong affinity for the central nervous organs utilize the exposed olfactory nervous structures in the nasal membrane in order to reach the nervous system. The origin of certain epidemic, nervous diseases of the higher animals is becoming explicable in this way."

Science News Letter, November 25, 1933

PSYCHIATRY

Physiological "Clumsiness" Feature of Mental Disease

THE PERSON suffering from the type of mental disease known to psychiatrists as schizophrenia has characteristic physiological as well as mental symptoms, Dr. R. G. Hoskins, of the Memorial Foundation for Neuro-Endocrine Research of Harvard Medical School, reported.

The equilibrium of body fluids, blood gases, and oxygen consumption rates usually maintained by normal persons is upset in the schizophrenic patient. The basal metabolic rates of the patients vary in consecutive tests without apparent cause. The rate of using up oxygen not only varies abnormally, but the average rate is low as compared with normal individuals. Blood pressure, pulse rate, and red blood cell count are also low. The waste fluid output averages twice the normal amount, and the amount varies three times as much as for the normal person.

"The schizophrenic is characterized by physiologic 'clumsiness' as he is by lack of social adaptability," Dr. Hoskins said.

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