

long ago by Prof. Hermann Ludwig Ferdinand von Helmholtz. It was developed as a result of knowledge of physics and examination of the anatomical structure of the ear, but it is now receiving new support from physiological studies of the ear in operation by the aid of new techniques unknown to science in the days of Helmholtz.

Invention of the audiometer was important in this connection. With this modern electrical instrument, it is possible to make precise scientific tests of the hearing of persons for all the many pitches throughout the whole auditory range in much less time.

Lose High Tones

Persons of middle age or older become hard-of-hearing for high notes. Beginning at about forty years of age, tones above high C must be sounded with increasing intensity in order to be heard, and the highest notes that can be heard even when sounded loudest drop from an average frequency of something like 20,000 at 20 years to 10,000 at 60. This old age drop is not so great as it may seem from the figures, for after all it means a loss of only about one octave and that at a pitch way above the highest notes of the piano and those ordinarily used in conversation. Low tones are heard equally well by all normal groups.

This aging of the ears, corresponding to the dimming of eyesight in the aged, has been known for a long time. It was verified by exact tests made at Johns Hopkins University by Dr. C. C. Bunch, who is now at Washington University, St. Louis.

Not Equally Distributed

Microscopic studies of the snail-shaped inner ear were made by a group of Dr. Bunch's colleagues at Johns Hopkins, including Drs. S. R. Guild, S. J. Crowe, and L. M. Polvogt. These studies showed that the nerve fibers are not distributed equally throughout the whole length of the basilar membrane. The number rapidly decreases toward the base of the membrane where, it is now thought, the higher tones are received.

It may be that with age the nerve cells and fibers deteriorate, leaving parts of the membrane useless. The count of nerve fibers on the membrane varies markedly between young persons with normal hearing and hard-of-hearing aged persons. One man of 30 with normal hearing was found to have 25,245 of these nerve fibers. Another man of 63 with impaired hearing had only 4,437. Since the fibers are more widely scattered at the "high" end of the mem-

brane, total deafness would occur there first.

As the records have accumulated, it has been possible to map out the basilar membrane to show just where an injury to nerve cells or fibers will cause deafness to certain tones. This map serves also to indicate just where on the basilar membrane hearing for the different frequencies takes place. The highest tones are picked up by the outer coils of the "snail" where the nerve cells are commonly not so numerous and where the ear's discrimination between neighboring frequencies is not so keen. The lower tones are picked up in a crowded area in the center of the coil.

Similar work on animals done at Johns Hopkins and also at Harvard by Dr. Davis working with Dr. S. S. Stevens have made use of the Wever-Bray listening-in technique to determine what tones were not picked up by animals with injuries to different areas on the basilar membrane. One at a time, the areas for each corresponding tone-deafness were located and plotted on a map. This map agreed very well with that worked out on the basis of autopsies on human ears.

PHYSICS

Experimental Cornerstone of Einstein's Theory Checked

A FOUNDATION stone in the great mathematical structure that is the relativity theory of Prof. Albert Einstein has again been checked and found correct.

This, in essence, is the significance of the highly complex report presented to the National Academy of Sciences on behalf of Drs. F. L. Whipple, T. E. Sterne and D. Norman of Harvard College Observatory.

The Harvard experiment was an unsuccessful new attempt to detect in the speed of light some effect of what is known as ether-drift.

It was the failure of Michelson and Morley to discover an ether-drift that became a foundation for Einstein's relativity theory. It is a question of whether light in different directions with relation to the universe speeds along at the same pace.

The Harvard experimenters used prisms to bend light six times a day, with their spectrograph pointed in various directions. Precise measurements on lines of light showed no changes larger

Another map made by Dr. Elmer Cullers, of the University of Illinois, was made electrically by applying each of 23 frequencies throughout the auditory range to one place after another on the membrane, until the area of greatest response was located. This map, too, agrees with the others, and together they seem to provide a weight of evidence in favor of the theory that sounds of different pitch are each picked up by a different area on the basilar membrane "tuned" to that particular frequency and thence conveyed to the brain by its own "private wire."

The final chapter has not yet been written in this particular scientific mystery story. Although these experiments on animals do not conflict with what is known of human hearing, scientists know that the results cannot be considered as applying directly to man. Physiologists are still searching with microscope, audiometer, radio hook-ups and every other known device to find out the working principle for this minute, delicate, yet marvelously efficient mechanism, the human ear.

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than the very small probable error of the instrument. Incidentally, the Harvard paper did not mention ether-drift but just gave the experimental results. Scientists will interpret the results as reassuring to the most widely held ideas about the lack of an ether-drift.

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A powerful station for television broadcasting is to be installed on the Eiffel Tower in Paris.

● RADIO

January 21, 4:30 p. m., E.S.T.
REMEMBERING WHILE YOU SLEEP
—Dr. Harry M. Johnson, American University.

January 28, 4:30 p. m., E.S.T.
MIDWINTER HEALTH — Dr. R. R. Spencer, Senior Surgeon, U. S. Public Health Service.

In the Science Service series of radio discussions led by Watson Davis Director, over the Columbia Broadcasting System.