Nagasaki learn that stillbirths and malformations may possibly be attributed to the effects of the bomb, they will probably lose some of their reluctance to report such matters, whereas this will not be the case in a control area.

Japan is now a defeated and occupied country, under severe postwar stress, whose people have a very different psychology from our own. A program such as that under consideration will proceed much more slowly there than it would in this country.

In order to reduce the possibility that a negative result of the investigation on Japanese material be interpreted by the medical and lay public as meaning that important genetic effects were not produced, it is essential that a comparable effort be expended in experimentation on other mammalian material, in which genetic effects of different kinds can much more readily be brought to light. In this way it should be possible to throw light upon the proportion of the total genetic effects produced by the radiation that would have been detectable by the methods used in the investigation on the human material, and the serious danger of misinterpretation of the latter results would be minimized.

Recognizing the difficulties briefly touched upon in the foregoing paragraphs, the Conference on Genetics voted unanimously to record the following expression of its attitude toward the genetic program: "Although there is every reason to infer that genetic effects can be produced and have been produced in man by atomic radiation, nevertheless the conference wishes to make it clear that it cannot guarantee significant results from this or any other study on the Japanese material. In contrast to laboratory data, this material is too much influenced by extraneous variables and too little adapted to disclosing genetic effects. In spite of these facts, the conference feels that this unique possibility for demonstrating genetic effects caused by atomic radiation should not be lost."

An Auditory Afterimage?

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FOR THOSE WHO LIKE TO EMPHASIZE THE similarities between our different sense modalities, the absence of auditory afterimages has been a persistent puzzle, a blank in the table of analogies which can be drawn between vision and audition. There is, of course, tinnitus—that annoying ringing in the ears that often follows exposure to deafening sounds. But tinnitus may last for hours, is often pathological in origin, and resembles "spots before the eyes" more than a true afterimage. Tinnitus excluded, therefore, the story of unrewarded searching (*1*) seems to justify the conclusion that auditory afterimages do not exist.

The error of such a conclusion can be demonstrated with the help of a pulse generator and a pair of earphones. The generator is used to produce a train of rectangular voltage pulses at a rate of about 100 pulses per second. [The rectangular pulses used in this experiment contain all harmonics of the fundamental pulse repetition frequency at approximately equal amplitude over the frequency range transmitted by the earphones (cutoff around 6,500 cps).] The earphones transduce the voltage pulses to acoustical pulses, and the listener is allowed to hear this buzzing sound at a high intensity for one or two minutes. When the earphones are removed, there is a striking change in the timbre of such familiar sounds as a handclap, a typewriter, the voice, etc. A peculiar metallic quality seems to be added to the sounds. Listeners have described the sounds as "jangly," "twangy," "like a rasping file," or "like two pieces of iron being rubbed together." The aftereffect of the pulses is transient, and in a few seconds the sounds regain their normal quality.

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We have had no trouble in demonstrating this aftereffect to subjects with normal hearing. It has been experienced in reverberant and anechoic rooms, with test noises produced in the room, over a loud-speaker, or in headphones. Phonographically recorded handclaps, sibilant consonants, the sound of scraping sandpaper, and typewriter noises seem to work about as well as the original sounds themselves.

Several questions immediately suggest themselves. What characteristics of the exposure stimulus are necessary to produce the effect? What kind of test stimuli can be used? What is the quality and duration of the effect?

Exposure to intense random noise—a hissing sound—is ineffective in producing the aftereffect. Random noise interrupted at regular intervals to give a train of 150 bursts of noise per second was also a failure. Nor did a combination of 11 oscillators producing frequencies not in harmonic relation elicit the aftereffect. Very loud pure tones of low frequency may evoke the phenomenon for some listeners. A square wave elicits the aftereffect but is much less impressive than the pulses. Pulses produce the phenomenon even when they are modulated in frequency from about 100 to 200 pulses per second at a rate of 20 times each second or when the low-frequency components of the spectrum are filtered out of the pulses. With a pulse repetition frequency of 140 pps the aftereffect was obtained when only those component frequencies of the pulse between 3,120 and 4,000 cps were passed, and again when only the range between 4,000 and 6,600 cps was heard. When only the first 4 harmonics of the pulse—140, 280, 420, and 560 cps—were used as the exposure stimulus, the effect was not observed, and not until the first 10 harmonics were passed was a clear aftereffect obtained. It seems that the high-frequency components of the pulse are necessary for the phenomenon to occur, but it is not clear whether these frequencies are necessary because they stimulate a certain portion of the basilar membrane or because they preserve the sharp onset of the pulses.

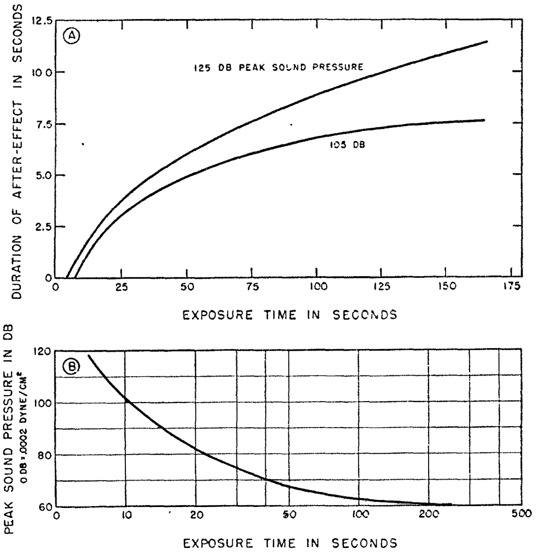

Fig. 1. A—Duration of aftereffect as a function of exposure time (parameter: peak sound pressure; pulse repetition frequency = 120). B—Peak sound pressure vs. exposure time for fixed duration of aftereffect (2 seconds) (pulse repetition frequency = 140).

The pulses used were of 120-microsecond duration, and the instantaneous sound pressure at the peak of the pulse was varied from approximately 75 to 125 db re 0.0002 dyne/cm.². For convenience in exploring the phenomenon the following procedure was adopted: The sound of two pieces of sandpaper being rubbed together at a regular rate was phonographically recorded, and the listener was exposed to the train of pulses for a fixed period of time at a given intensity and pulse repetition frequency. At the end of the exposure the experimenter switched to the phonograph channel, the listener being allowed to hear the sound of scraping sandpaper. The listener's task was then to count the number of scrapes of the sandpaper which seemed to be "metallic" in quality. By converting sandpaper rubs to a more conventional time base, the duration of the afterimage was given for the conditions of stimulation.

Durations of exposure between 5 and 240 seconds were explored, the longer exposures producing the most marked aftereffects. When the sound pressure at the peak of the pulse was held constant, the duration of the aftereffect increased as a negatively accelerated function of the exposure time. This is illustrated in Fig. 1A for two intensity levels. Fig. 1B shows the peak sound pressure necessary to elicit an aftereffect of constant duration (2 seconds). To a certain degree, exposure time can be substituted for exposure intensity. As a practical matter, an exposure of 20 or 30 seconds represents a convenient compromise between the listener's impatience and the experimenter's desire to produce a measurable effect

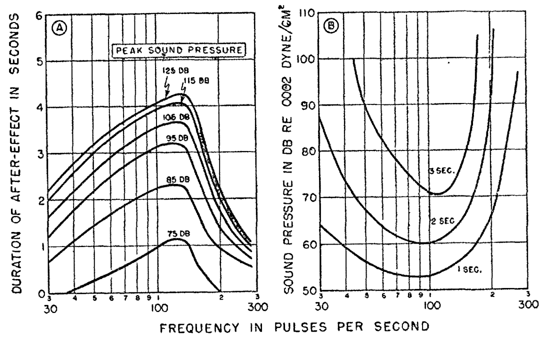

Fig. 2. A—Duration of aftereffect vs. pulse repetition frequency (parameter: peak sound pressure; exposure time = 20 seconds). B—Sound pressure vs. pulse repetition frequency (parameter: duration of aftereffect).

Only a narrow range of pulse repetition frequencies elicits the aftereffect. Frequencies between 30 and 200 pulses per second seem most effective. This is illustrated in Fig. 2A, where the duration of the aftereffect is plotted as a smoothed function of the pulse repetition frequency, with the peak pressure of the pulses as the parameter. These curves were obtained with three listeners and a constant exposure time of 20 seconds. In Fig. 2B the curves are replotted to show the intensity required to produce a given duration of the aftereffect.

A variety of test stimuli was tried, and the necessary attributes of a good stimulus seem to include familiarity to the listener, complexity in harmonic composition, and temporal discontinuity. Unfamiliar stimuli leave the listener wondering whether or not the test stimulus sounds as it should sound. Pure tones were poor so long as they were continuous; when they were interrupted, the effect was heard *following* the "click" of the interruption. Silence is silent: without a test stimulus our listeners report only a transient, impalpable, nonauditory awareness that an aftereffect persists. The dissipation of the aftereffect seems to be a function of time only and is independent of stimulation. For example, if an exposure normally produces an aftereffect lasting about 3 seconds, a 2-second silence before the presentation of the test stimulus is followed by about 1 second of the aftereffect, and after a silent delay of 4 seconds no qualitative changes are observed.

The quality of the aftereffect does not seem to change as a function of the nature of the stimulations which produce it. It is always the same—a metallic, ringing obligato to the test stimulus.

What possible mechanism could account for this phenomenon? It seems to be peripheral, for if the left ear is exposed to pulses and the right ear is tested with the scraping of sandpaper, no aftereffect is experienced. It is probably related to stimulation deafness, but in no simple manner, since exposures only to certain kinds of sounds are followed by the aftereffect. Furthermore when, a temporary hearing loss produces a qualitative change in a test stimulus, we expect the change to be less pronounced for loud test stimuli, since the temporarily deafened ear is more nearly normal in response to loud than faint sounds. The ringing auditory quality of the aftereffect is, however, most striking and persistent when the test stimulus is made more intense. The mechanism is more complex than a simple subtraction—due to hearing loss—of certain components of the test sound. Either a sharp wave-front or the presence of harmonics properly spaced along the basilar membrane is the necessary condition for producing it. In a highly mechanical system like the ear the possible mechanisms for an afterimage are somewhat limited.

Such, then, is the phenomenon observed. It is not a tinnitus, a simple hearing loss, or a pathological condition. It is a positive aftereffect of the stimulation of normal listeners. Is this not an auditory afterimage?

Reference

1. Bishop, H. G. *Amer. J. Psychol.*, 1921, **32**, 305–325.

NEWS *and Notes*

K. A. Gunnar Strand, formerly associate professor of astronomy, University of Chicago, is the new director of the Dearborn Observatory and professor of astronomy, Northwestern University. Dr. Strand, a positional astronomer who did research in navigation for the Army Air Forces during the war, succeeds **Oliver J. Lee,** who had been on the Northwestern faculty since 1928 and who retired August 31. Dr. Strand received his Ph.D. degree from the University of Copenhagen, and came to the United States as a fellow of the American Scandinavian Foundation. His first assignment here was at Sproul Observatory, Swarthmore College. His studies have included the motion of asteroids, determination of position, photographic and visual observations of double stars, and orbital motion in multiple systems. He has been retained as a special research associate at Yerkes Observatory.

Abraham White, associate professor of physiological chemistry, Yale University School of Medicine, will deliver the first Harvey Lecture of the current series at the New York Academy of Medicine, October 23. Dr. White will speak on "Influence of Endocrine Secretions on the Structure and Function of Lymphoid Tissue."

Nathan Birnbaum, Department of Chemistry, City College of New York, has returned to the Department after 5 years of military service with the Chemical Corps, U. S. Army. In addition to overseas duty in New Guinea and the Philippines, Prof. Birnbaum participated in the atomic bomb tests at Bikini as a member of the Radiological Safety Section. He is being retained by the Chemical Corps as consultant to the Research and Engineering Division.

James G. Miller, chief, Clinical Psychology Section, Neuropsychiatric Division, Veterans Administration, Washington, D. C., has been appointed chairman, Department of Psychology, University of Chicago. The appointment, which is effective January 1, 1948, carries the rank of professor of psychiatry and psychology. As a captain in the Army Medical Corps during the war, Dr. Miller served as a neuropsychiatrist, assessing personalities of OSS personnel both in this country and in the European Theater.

Charles C. Price, head, Department of Chemistry, University of Notre Dame, is now in England, where he will deliver a series of special lectures at Oxford, Cambridge, and other colleges and universities in England and Scotland. Dr. Price will also visit the Imperial Chemicals Industries at Manchester and the British Rubber Producers Association at Welwyn Garden City.

Byron Clark has assumed his duties as professor of pharmacology, Tufts College Medical School. Under his direction the laboratories for instruction and research in this field will be reorganized and enlarged.

John H. Melvin, district geologist, Corps of Engineers, Omaha, Nebraska, has been appointed state geologist of Ohio, succeeding **George W. White,** who has been appointed head, Department of Geology, University of Illinois.

Samuel Cate Prescott, of Cambridge, Massachusetts, former dean, School of Science, Massachusetts Institute of Technology, was awarded the honorary D.Sc. degree by Lehigh University at its 69th Founder's Day exercises, October 1.

A. C. Ivy, vice-president of the University of Illinois for the Chicago Professional Colleges, has been named an honorary member of the American Congress of Physical Medicine in recognition of his "studies of electrical stimulation of paralyzed muscles and resuscitation from carbon monoxide asphyxia, and for assistance to the Council of Physical Medicine of the American Medical Association."

William J. Eney, professor of civil engineering, Lehigh University, has been appointed head, and director of the curriculum, Department of Civil Engineering. He succeeds **Hale Sutherland,** who will continue as professor in the Department and will devote more of his time to professional writing.