annihilation radiation, the K- and L- photo-lines from the same radiation. The energy for the annihilation radiation obtained from the curve is $0{\cdot}515 \pm 0{\cdot}010$ Mev., in good agreement with the value, which can be computed from mc^2, namely, 0·511 Mev. No γ-ray of the previously[4] reported energy of 280 kev. has been found by us, and according to our investigation the only γ-ray which accompanies the disintegration is due to the annihilation radiation.

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[1] Siegbahn, Kai, *Ark. Mat., Ast. o. Fysik*, **30**, A, No. 20 (1944).
[2] Siegbahn, Kai, and Bohr, E., *Ark. Mat., Ast. o. Fysik*, **30**, A, No. 3 (1943).
[3] Siegbahn, Kai, and Slätis, H., *Ark. Mat., Ast. o. Fysik*, **32**, A, No. 9 (1945).
[4] Richardson, J. R., *Phys. Rev.*, **55**, 609 (1939). Lyman, E. M.., *Phys. Rev.*, **55**, 234, 1123 (1939). Watase and Itoh, *Proc. Phys.-Math. Soc. Japan*, (3), **21**, 389 (1939).
[5] Hudson, C., Herb, R., and Plain, G., *Phys. Rev.*, **57**, 587 (1940). Valley, G., *Phys. Rev.*, **56**, 838 (1939).

Temperature Effect on Ultra-sonic Velocity in Water

VERY few systematic data exist so far relating to the effect of temperature on ultrasonic velocity in liquids, especially water. Loomis and Hubbard's results[1] for the change of ultra-sonic velocity in water and other liquids with rising temperature may be cited as perhaps the only systematic investigations, because earlier experiments[2] were carried out under rather unstandard conditions and in a very low region of sonic frequencies and therefore are not reliable. Even Hubbard's data for water are reported for a very limited range of temperature, 0°–40° C., using a sonic interferometer at a frequency of 500 kc. only. The present work extends the knowledge of ultra-sonic velocity in water up to a temperature of 70° C., using the method of diffraction of light by ultra-sonics at a frequency of 5·7 mc./sec.

In this investigation the ultra-sonics were produced by a quartz crystal (diam. 22 mm., fundamental frequency 1·91 mc./sec.) which was cut and ground in this laboratory by me. The crystal was excited to its third harmonic at a frequency of 5·7 mc./sec. by applying the output from a one-valve oscillator (Hartley circuit), adjusted to the same frequency, to the two opposite faces of the crystal. For the production of ultra-sonics in water under investigation, the crystal was not directly immersed in water because of short-circuiting. The crystal was mounted in a small metallic cell containing xylol and having a small leak-tight mica window in one face to let ultra-sonics pass through it. The cell containing the quartz crystal and xylol, and thus serving as a sort of source of ultra-sonic waves, was placed along one of the walls of a rectangular plate-glass vessel containing distilled and degassed water.

The plate-glass vessel with its contents was surrounded by a water-bath the temperature of which could be controlled and kept constant within 0·1° C. by a simple thermostat and relay; the water-bath was constantly agitated by stirrers, and the whole bath was enclosed in a double-walled wooden box loosely packed with sawdust. The temperature was read directly by a sensitive thermometer dipped in the plate-glass vessel.

The bath with its outer wooden enclosure had glass windows on two opposite faces which allowed parallel monochromatic light (green line $\lambda = 5461$ A. from a mercury arc) to pass at an incidence perpendicular to the direction of ultra-sonics generated in the vessel. A long focal length lens ($f = 110$ cm.) placed on the other side focused the emergent beam on a photographic plate which recorded the diffraction pattern for various temperatures of the water. Corresponding to each temperature from about 31° C. to 70° C. at intervals of 5° C., six independent photographic exposures were taken, and a mean of these six readings was used for calculation of the velocity at that temperature. Diffraction patterns were also recorded for temperatures at 75° C. and 80° C.; but these were too diffused, due to the constant shifting of density layers, to admit of any measurement without a considerable error.

The ultra-sonic intensity was kept fairly low (so that usually only two orders of diffraction appeared) in order to avoid the heating up of the liquid which results at higher intensities and disturbs the constancy of temperature.

The ultra-sonic velocity in water at various temperatures was calculated by comparing the distances of diffraction orders with those of pure xylol (Merck's) found with the same apparatus. The ultra-sonic velocity in xylol is a good standard, as almost every worker in the ultra-sonic field has worked it out independently; and hence the velocity is known to a fair degree of accuracy at several temperatures and frequencies.

The velocity in water at the various temperatures was found to be as follows:

ULTRA-SONIC VELOCITY IN WATER (FREQ. 5·7 MC./SEC.)

No.	Temperature ° C.	Ultra-sonic vel. (author) m./sec.	Ultra-sonic vel. (Hubbard) m./sec.
1	31·5	1510	1509·0 (at 30° C.)
2	35·1	1521	1520·6 (at 35° C.)
3	40·1	1531	1530·3 (at 40° C.)
4	45·4	1538	—
5	50·5	1545	—
6	55·4	1552	—
7	60·3	1553	—
8	65·3	1555	—
9	70·3	1557	—

My thanks are due to Prof. P. K. Kichlu for his interest in the work.

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[1] Loomis and Hubbard, *Phil. Mag.*, (7), **5**, 1177 (1928).
[2] Buss, *Ann. Phys.*, **75**, 657 (1924). Dörsing, *Ann. Phys.*, **25**, 227 (1908).

Near Ultra-Violet Emission Bands of Benzene

THE ultra-violet emission spectrum in the region 3000–2475 A., obtained by Asundi and Padhye by high-frequency electrical discharge through benzene vapour[1], is probably more closely similar than the authors have realized to the fluorescence spectrum excited by Hg 2537 A. in benzene vapour at pressures which are not too low[2].

The authors point to a supposed difference of relative intensity in the various progressions labelled