COMMUNICATIONS TO THE EDITOR

THE RATE OF DISSOCIATION OF NITROGEN TETROXIDE

Sir:

Recently Richards and Reid [THIS JOURNAL, **54,** 3014 (1932)] reported that they had obtained a definite value of the velocity constant of the N_2O_4 dissociation, using high-frequency sound waves up to 500 k. c. This value is, of course, calculated from their velocity of sound data by the use of Einstein's theoretical equations, which they felt justified in applying to their measurements since they observed no increase in the absorption coefficient with frequency.

Their observations are not in accord with a series of experiments just completed by the author which are being submitted for publication. Sound velocity measurements at 53.8 k. c. checked with those previously reported by Kistiakowsky and Richards, although high absorption made observation difficult, but above 100 k. c. no evidence of sound transmission could be obtained with the set-up employed, although sound up to 860 k. c. was used. This increasing absorption is in accord with the theoretical predictions of D. G. C. Luck [*Phys. Rev.*, **40,** 440 (1932)], who has extended Einstein's theory to real absorbing dissociating gases. Calculations made by the author from his equations show that velocity constants computed from Einstein's original equations may be as much as 20% too low.

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RECEIVED JULY 30, 1932
PUBLISHED OCTOBER 5, 1932

QUANTUM THEORY OF THE DOUBLE BOND

Sir:

An understanding of the structure of C_2H_4 can be obtained by studying its formation from two CH_2 radicals. Electronic structures of these can be given in terms of molecular orbitals [molecular one-electron orbital wave functions, *cf.* R. S. Mulliken, *Phys. Rev.*, **40,** 55 and **41,** 49 (1932)] similar to the atomic orbitals $1s$, $2s$, $2p$ commonly used in the quantum theory in building up electron configurations to describe the structures of atoms. It can be shown that, in agreement with the chemical evidence, the energy should be a minimum if the two CH_2 come together in the same plane, a maximum if they come together with their planes at right angles. An analogous result holds for other molecules with double bonds.

These results apply to the normal state of such molecules, but for certain excited states, probably including the upper levels of the ordinary ultraviolet absorption bands, it can be shown to be probable that the energy is a maximum for the plane arrangement, a minimum for an ar-