Changes of energy postulated above may take place along with changes of rotational or vibrational energy of the molecules in which case, the principal lines will be broadened and appear as bands.

It is improbable that the picture postulated above corresponds to facts in the case of liquids of low viscosity or liquids heated to high temperatures. We should naturally expect in such cases the disappearance of the continuous spectrum or its becoming very faint.

The magnitude of a is probably of the order of the size of a molecule, i.e., 10^{-8} cm. It may be three or four times the size of a molecule. In other words, a may be approximately equal to the size of the diameter of the average spherical volume associated with a molecule by Wheeler[2] in his papers on the theory of liquids.

S. V. CHANDRASHEKHAR AIYA

Khar, Bombay,
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Ionization of Mercury Vapor by Positive Sodium Ions

In 1930, Kirschstein[1] reported observing the excitation of mercury vapor by sodium ions having as little energy as 35 volts. The observations were made photographically on the 2537 line by means of a quartz spectroscope. If this excitation really occurred, then ionization of mercury by sodium ions could also be anticipated and probably at sodium ion energies of less than 100 volts.

A balanced space-charge method of detecting positive ions has been used recently by one of the writers to study ionization of gases by positive alkali ions.[2] With minor modifications, this apparatus was suitable for examination of the effects of sodium ions on mercury. Preliminary results indicate that ionization of the mercury sets in when the sodium ions reach an energy of 88 volts. This value of 88 volts is probably accurate to about ± 4 volts. It confirms qualitatively the observation of Kirschstein. It is also in agreement with the conclusions on relative ionization potentials drawn in reference 2 and by others.[3] The conclusion in reference 2 was that when the ionization energy of the positive sodium ions was corrected for conservation of momentum, the potential for ionization of Ne by Na^+ should be less than that for any other substance ionized by Na^+. The corrected ionization energy for Ne was 61 volts; for Hg it turns out to be 79 volts.

The efficiency of ionization of Hg by Na^+ is qualitatively of the same order of magnitude as that of Ne by Na^+. The ionization of other gases (A, Kr, Xe, He, H_2, N_2, CO_2) by Na^+ if it occurred at all was so weak as to be undetectable by the balanced space-charge method. The fact that ionization by alkali ions was only observed in the noble gases led to the belief that only these gases with their completed outer electron shells could be ionized at all by alkali ions. The new results on mercury indicate that the outer electron shell may not be as important in determining the efficiency of ionization as the atomic or molecular nature of the gas. No molecular gas has been observed to be ionized by the writers. Mercury is the first atomic gas beside the noble gases to have been tried.

Caesium ions have been tried in this tube on the mercury vapor. The results seem to indicate an ionization inset at 59 volts. Further experiments with this apparatus are in progress.

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R. N. VARNEY
W. C. COLE

Physics Department,
University of California,
Berkeley, California,
July 1, 1936.

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