where A and B are constants. From Eq. (8) we would expect that experimental values of Q_{Tr} would lie on a straight line if plotted in the form $Q_{Tr}^{\frac{1}{2}}$ vs. $\ell n\, E$, where E is the relative energy. Such a plot is given in Fig. 1. The measured values were not available for Refs. 16 and 17, so only the average curves are shown. However, some idea of the probable scatter from the average curves can be obtained from the Nichols-Witteborn data.[15] A number of measurements of Q_{Tr} were carried out before the discovery of the Ishii-Nakayma effect in McLeod gauges and are too high by unknown amounts. Of these earlier values only those of Refs. 13 and 14 are included here.

It is evident that there is considerable disagreement among the experimental measurements, and that it would be difficult to choose the best values. We can, however, bring in additional information from a very accurate determination of the reduced mobility of argon ions in argon.[18-21] The mobility is related to the average ion-atom cross section by

$$K = \frac{3e}{16n} \left(\frac{2\pi}{\mu k T} \right)^{\frac{1}{2}} \frac{f_D}{\overline{Q}^{(1,1)}} \qquad (9)$$

where e is the electron charge, n is the total number density ($=2.69 \times 10^{19}$ cm^{-3} for the reduced mobility), μ is the reduced mass and f_D is a factor to account for higher approximations in the Chapman-Enskog method. The previous calculations for argon showed that f_D could be taken as unity with negligible loss in accuracy.

If $Q^{(\ell)}$ is given by Eq. (8), then an analytical form for $\overline{Q}^{(\ell,s)}$ may be obtained.[1] The constants A and B may then be adjusted so that the value $K = 1.535$ cm^2/V-sec is reproduced at 296°K and the curve for Q_{Tr} passes through the beam data of Fig. 1. Which part of the beam data the curve is to pass through is, of course, somewhat arbitrary; since the only corrected data at high energies are those of Ref. 16, it was decided to use this point at 100eV to help determine A and B. As can be seen from Fig. 1, the curve so determined passes in addition through about the center of the measurements in the 3-10 eV range of relative energies.

At the relative energies important for the $\bar{Q}^{(1,1)}$ integral at 296°K, it is possible that the polarization forces between the ion and atom can result in a diffusion cross section $Q^{(1)}$ higher than that given by Eq. (7). This polarization correction was computed with the method of Dalgarno,[12] and found to be $4\mathring{A}^2$ at 296°K, resulting in an average charge-transfer cross section of $152.8\mathring{A}^2$. It is worth noting that an attempt was made to use Dalgarno's method to connect the beam measurements with the known value of mobility. Although this was found to be possible, the curve of Q_{Tr} vs. E. dropped off more rapidly above 10eV than the beam measurements indicate. It was therefore thought preferable to use the simpler connecting formula of Eq. (9). The constants so determined were A=31.80 and A=1.725 for Q_{Tr} in $\mathring{A}^2$ and g in cm/sec. Values of $\bar{Q}^{(1,1)}$ are given in Table II as a function of temperature.

In order to compute the electron transport coefficients, we need only the momentum-transfer cross section for electron-atom or ion collisions. In the previous computations of argon properties, the Frost-Phelps[22] values for $Q^{(1)}$ were preferred. Since that time Golden[23] has derived values of $Q^{(1)}$ from his measurements of the total electron-atom cross section with the aid of the modified effective-range formula. He obtained a Ramsauer minimum considerably deeper than that of Frost and Phelps and claims that it is not possible to find such behavior with the analysis used by these authors. Additional evidence for his claim is lacking to date. In view of this and the fact that the Frost-Phelps values are consistent with transport behavior in actual gases, it was decided to use them again for the present work. Values of one of the average cross sections are given in Table II.

The problem of the correct cross section between charged particles has been considered by several authors. If the parameter Λ, which is taken here as

$$\Lambda = \frac{2d}{b_\circ} \tag{10}$$

where d is the Debye length and $b_\circ = z_1 z_2 e^2/2kT$ the average closest impact parameter, is quite large (more precisely $\ln\Lambda >> 1$), then the cross sections derived