we might reasonably expect a discrepancy of as much as 2 percent, the g-sums are even closer than the individual values.

Average g-values and g-sums for the $2p^53d$ and $2p^54d$ configurations are listed in Table III. The parameters for the $2p^53d$ configuration have been obtained by Sampson[8] and for the $2p^54d$ by Shortley;[9] the latter neglected interaction between the upper and lower levels of the configuration. The agreement for the $2p^53d$ configuration is almost perfect; for the $2p^54d$ configuration almost as good.

The $2p^5md$ configurations are involved in transitions which yield complicated patterns that are difficult to interpret due to incipient Paschen-Back effect. This type of interaction takes place between $d_6(j=0)$ and d_5, between d_4 and d_4', between d_1' and d_1'', and among the levels s_1'', s_1''', and s_1''''. The g-values of these levels as given in Table III have been determined by first calculating the Paschen-Back pattern to be expected from the calculated g-value for the level in combination with Back's value for the lower level, and then adjusting the assumed g-value to fit the measured pattern.

[8] Sampson, Phys. Rev. **52**, 1157 (1937).
[9] Shortley, Phys. Rev. **44**, 666 (1933).

TABLE IV. *Some g-values for the $2p^55d$ configuration.*

LEVEL	J	$g_{\text{OBS.}}$	LEVEL	Σg	2.983
$5s_1'$	1	0.809	$5s_1''$	2	1.251
$5d_2$	1	0.791	$5d_3$	2	1.298
$5d_5$	1	1.383	$5d_4$	3	1.093

Table IV gives a few additional g-values. Since complete configurations were not observed, it was not thought worth while to calculate the g-values from known parameters, which in any case do not seem to be accurate enough to yield good agreement for the positions of the levels.

The conclusions that may be drawn from the foregoing results are fairly obvious. Wherever it is possible to determine parameters for a configuration that will yield calculated positions for the levels in agreement with the observed positions, then related parameters, like the g-values, will also be in good agreement. Thus, the parameters determined for the $2p^53p$ configuration[9] give very poor agreement with observed levels, and the calculated g-values are correspondingly poor, while for the $2p^53d$ configuration[8] the largest discrepancy in position is 0.9 cm^{-1} and the agreement in g-values is practically perfect. The same sort of situation should hold with respect to intensities.

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Application of Clay's New Value of the Jaffé-Zanstra Coefficient for Air to High Pressure Ion Current Measurements

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Clay has found the coefficient $1.24(10)^{-4}$, employed by Zanstra in his treatment of high pressure ionization data for air by Jaffé's columnar theory, should actually be applied to nitrogen, and the coefficient 10^{-5} substituted in the case of air. We have used the new coefficient in a repetition of the analysis of our experimental data. The straight lines predicted by the theory are obtained in the collecting field range, 1769–4520 volts/cm, in most cases, and the curvatures of the Jaffé-Zanstra curves are lessened in the remaining cases. The curves obtained by plotting the theoretical "saturation" current values against the specific gravity of the air do not display the definite breaks indicated before.

IN a recent paper[1] which will hereafter be referred to as paper 1, we presented the results of the application of the equation

$$1/i=1/I+(q/I)f(x) \tag{A}$$

formulated by Zanstra[2] from the Jaffé theory, to

[1] J. W. Broxon and G. T. Merideth, Phys. Rev. **54**, 9 (1938).
[2] H. Zanstra, Physica **2**, 817 (1935).

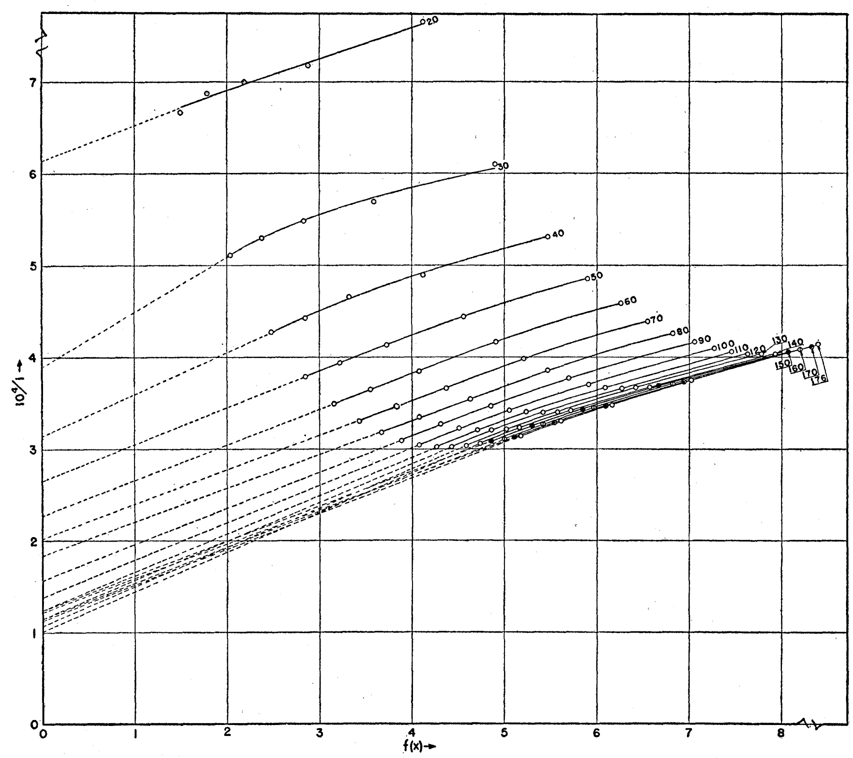

FIG. 1A. Jaffé-Zanstra function curves corresponding to our measurements with central-source. Air at 28°C. Central source of gamma-radiation. Numbers at upper ends of curves represent specific gravity relative to air at N. T. P.

our high pressure ion current measurements[3] in air. The terminology was discussed in detail in paper 1. In particular, Zanstra found upon examination of ion current measurements by Erikson,[4] that for air $x=1.24(10)^{-4}(E/p)^2$, where E is the collecting field intensity in volts/cm, p is the pressure in atmospheres, and x is the argument of the function presented for a wide range in graphical form by Zanstra. This relation was tested by Clay[5] and Clay and van Tijn[6] with their measurements of ion currents in air, and equation (A) was thereby verified.

In order to provide for comparison of data corresponding to other than room temperatures, we substituted for p the specific gravity of the air, σ, relative to air at N.T.P., but used the same coefficient. On this basis we found the reciprocals of our measured currents plotted against $f(x)$ did not yield quite straight lines at very high field intensities, as predicted, but curves slightly concave toward the $f(x)$ axis. These curves are shown in Figs. 1 and 2 of paper 1.

Immediately upon receipt of paper 1, Professor Clay wrote us they had found recently that air compressed by themselves did not yield straight Jaffé-Zanstra curves such as they had obtained formerly with air supplied by a commercial concern. Upon investigation they found that nitrogen yielded straight curves with use of the coefficient $1.24(10)^{-4}$ specified above, whereas for increasing fractions of oxygen, decreasing values of the coefficient were required to provide straight curves, until with 12 percent to 29 percent oxygen, the coefficient value 10^{-5} must be employed. (Professor Clay informs us these findings have appeared in the August 1 issue of *Physica* which we have not yet received.) It appears, then, that their earlier measurements were actually made with nitrogen rather than air. The situation relative to Professor Erikson's data is not clear.

[3] J. W. Broxon and G. T. Merideth, Phys. Rev. **54**, 1 (1938).
[4] H. A. Erikson, Phys. Rev. **27**, 473 (1908).
[5] J. Clay, Physica **2**, 811 (1935).
[6] J. Clay and M. A. van Tijn, Physica **2**, 825 (1935).

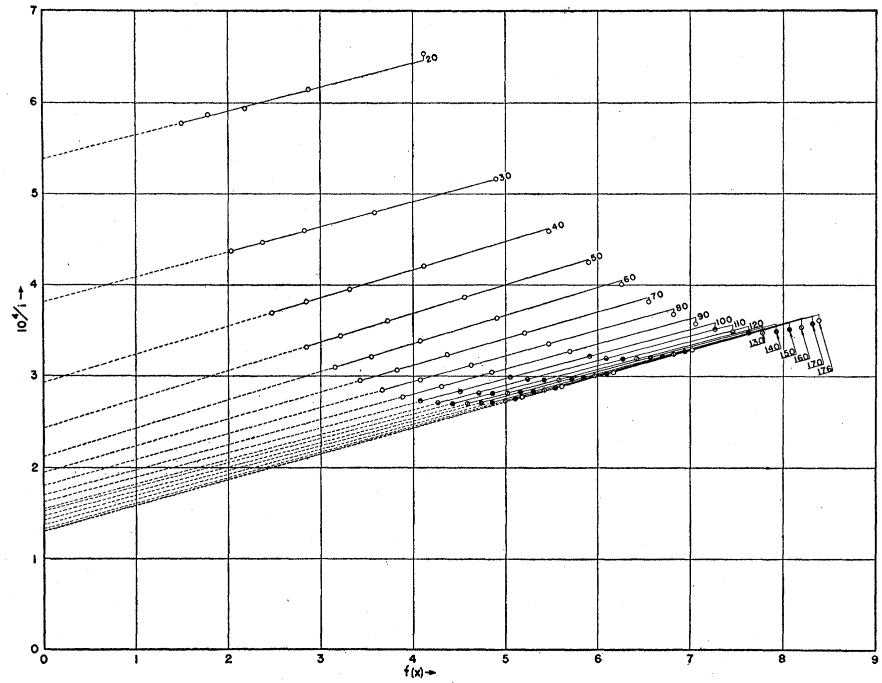

FIG. 2A. Jaffé-Zanstra function curves corresponding to our measurements with ring-source. Air at 27°C. Ring-source of gamma-radiation beneath chamber. Numbers at upper ends of curves represent specific gravity relative to air at N. T. P.

In view of this situation Professor Clay suggested that we repeat the analysis of our data, using the value 10^{-5} instead of $1.24(10)^{-4}$. This we have done. The results are presented in Figs. 1A and 2A corresponding to Figs. 1 and 2, respectively, of paper 1. The curvatures are definitely reduced by the use of the new coefficient. In Fig. 1A, corresponding to the central source of gamma-radiation the points corresponding to the four highest field intensities, 1769, 2727, 3617 and 4520 volts/cm, may be regarded as lying on a straight line for the range of specific gravities, 50 to 80. At both lower and higher densities, however, there seems even in this high range of field intensities to be a lessened curvature in the same sense as before. In Fig. 2A, corresponding to the ring-source of gamma-radiation the points corresponding to the designated four highest field intensities lie remarkably close to straight lines for all densities. In view of this situation only straight lines determined by the four highest intensity values were drawn. Vertical lines connect these to the points corresponding to the fifth field intensity, 888 volts/cm.

As in paper 1, "saturation" currents were determined by extrapolations formed by drawing tangents to the curves at the termini corresponding to highest field intensity. In the case of the straight lines of Fig. 2A, "least-squares" calculations were employed as an aid in the determination of the intercepts in view of the long extrapolations, although this may not appear justified on account of the arbitrariness of construction of the original current curves drawn from the experimental data.[3] The "saturation" currents obtained from the reciprocals of the intercept values are plotted against the specific gravity in Figs. 3A and 4A which correspond, respectively, to Figs. 3 and 4 of paper 1. Again, the curves representing experimental currents at the highest field intensities are included for comparison.

For both gamma-radiation sources, considerably higher "saturation" current values are yielded by the new than by the old coefficient. The new "saturation" current curves resemble the earlier ones in that if extrapolated at their low density ends they would appear to intercept the current-axis above the origin, and they both

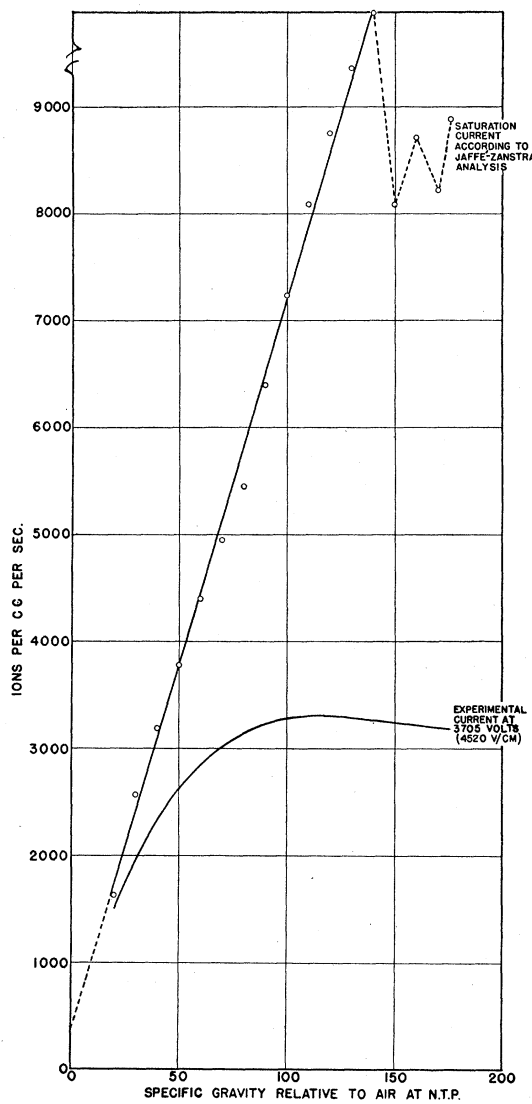

FIG. 3A. "Saturation" current curve corresponding to our observations with central-source, together with experimental curve obtained with strongest collecting field.

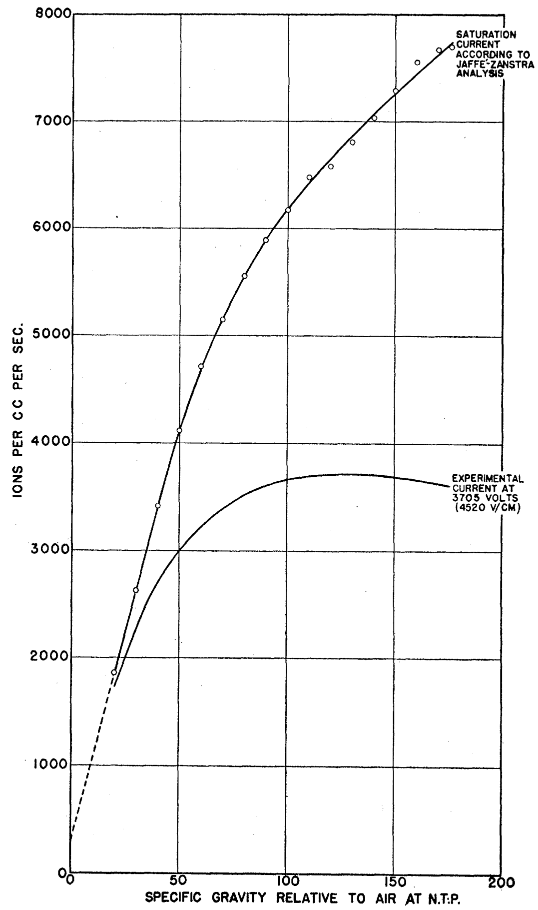

FIG. 4A. "Saturation" current curve corresponding to our observations with ring-source, together with experimental curve obtained with strongest collecting field.

lie above the highest experimental current curves. However, the straight line segments with definite breaks do not appear to be indicated. In the case of the central-source, Fig. 3A, a straight line appears best to represent the relation between "saturation" current and density for all densities to $\sigma=140$ (or 156 atmospheres). Above this the variation is rather irregular as at the higher densities in paper 1. This may be related to the large extrapolations. The ring-source values, Fig. 4A, appear to indicate a smooth curve throughout the density range. In this connection it should be noted that a smooth curve might well be substituted for the broken line curve of Fig. 4 of paper 1.

The "saturation" currents corresponding to negative and positive ion currents (see Fig. 6 of paper 1) have been determined with the use of the new coefficient. At 120 atmospheres the "saturation" currents may be regarded as practically identical for both signs, but at the other two pressures there seems no better agreement than before.