vanish. Hence the depolarization would depend on the fluctuations in density in the neighborhood of the excited atom (proportional to $\sqrt{\mathbf{p}}$).[4] Naturally for such type of depolarization the calculation of cross section would be meaningless. In addition, the existence of forces of such large range seems very doubtful.

Ellett, Olsen, and Petersen* and recently Olsen† studied the resonance radiation of mercury vapor and obtained for several gases from the field dependence of polarization values for $\alpha+\alpha'$ which are smaller than the sum of the values α and α' determined from the dependence of the polarization on the pressure of a foreign gas with no field present. Therefore, Ellett, Olsen, and Petersen introduced in their theory besides the previously generally accepted kind of non-adiabatic depolarizing collisions leading to non-coherent excited states (probability $\alpha'\mathbf{p}$) a new type of depolarizing collisions, which according to their statement depolarize adiabatically leading to no loss of coherence (probability $\alpha''\mathbf{p}$). Collisions of the latter type should not contribute to τ. From the field dependence one then should obtain only $\alpha+\alpha'$; from the depolarization *versus* pressure with no field present the quenching α and the total depolarization coefficient $\alpha'+\alpha''$. The writer would like to emphasize, that the character of the collisions of the new type ($\alpha''\mathbf{p}$) seems very obscure and that Ellett, Olsen, and Petersen apparently used some different meaning from the commonly adopted meaning of the word "coherence," since a collision occurs *ex definitione* only when the phase of the oscillator has undergone a change (owing to the interaction of the particles). Moreover their exclusion of $\alpha''\mathbf{p}$ from the formula for τ is not justified, since as shown above all depolarizing collisions with a probability proportional to pressure (short and medium range forces) must be included in that formula. On the other hand for such collisions the transitions are not adiabatical. The only way to explain the disagreement of the two sets of experimental data seems to be by introduction of the long range forces (the only kind of adiabatical depolarization) or by taking into account the formation of $^3P_1$ excited atoms from metastable $^3P_0$ states by collisions (the probability $\alpha'\mathbf{p}+\gamma(\mathbf{p})$ would be obtained from the polarization *versus* pressure dependence in the first, $\alpha'\mathbf{p}+\delta(\mathbf{p})$ in the second case).

The question arises if the deviations found by the mentioned authors are real. The discrepancy between the results of Ellett, Olsen, and Petersen in the case of hydrogen and deuterium with results previously obtained by Evans[4] and Suppe[5] (who obtained practically identical curves for both gases, both for quenching and for depolarization) shows that at least some of the investigators overestimated the limits of accuracy of their measurements. The existence and the possible sources of this discrepancy have not been discussed by Ellett, Olsen, and Petersen. In spite of this discrepancy a consideration of their data makes the writer think that in fact the deviations found by them may be real. If so, new considerations must be made, since their explanation has been shown above to be inadequate. The deviations are certainly not caused by the long range forces ($\gamma(\mathbf{p})$), since α'' was found different from zero for rare gases (which certainly cannot exert long range magnetic forces) and $\alpha''=0$ for a paramagnetic molecule O_2. But in the case of N_2, the value of α'' relatively to α' was found to be several times greater than for the rare gases, i.e., α'' has an appreciable value only when metastable $^3P_0$ mercury atoms are known to be present in the vapor. It would be, therefore, worth while to calculate for the temperature given the rate of transfer of metastable atoms into the $^3P_1$ state and to see if by introduction of such a correction term $\delta(\mathbf{p})$ instead of $\alpha''\mathbf{p}$ ($\delta(\mathbf{p})$ for small $\mathbf{p}$ is $\cong\mathbf{p}^2$, for higher $\mathbf{p}$ the increase is slower due to the slower than $\cong\mathbf{p}$ increase of the concentration of metastable atoms) a substantially better agreement between theory and experiment could be obtained.

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Cloud-Chamber Track of a Mesotron Stopped by Gas

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IN the cloud chamber arrangement previously described[1,2] the picture (Fig. 1) has been obtained which shows a mesotron track ending in argon of 1.3 atmospheres. The track, curved by a magnetic field of 1150 oersteds, shows the particle entering a lead plate of 1-cm thickness from which it emerges heavily ionizing. It undergoes 2 single scatterings of about 3° each at A and at B, and it ceases to ionize at C. The approximate mass of the particle has been determined in two ways. First, the radius of curvature of the track above the lead plate is 150 ± 50 cm. Combining this with the fact that its range is approximately 1 cm of lead we find a value of $m=100\pm50$ electron masses. Below the lead plate the radius of curvature between A and B is $\rho_1=23$ cm, and between B and C it is $\rho_2=17$ cm. The total ranges at the corresponding positions are, respectively, $R_1=12.0$ cm and $R_2=6.4$ cm, from which we find $m_1=80$, and $m_2=70$. For the computations of m the energy-momentum curves published recently by Rossi and Greisen[3] have been used.

The rather large curvatures in the second compartment can be measured with considerable accuracy, but errors are introduced by the multiple scattering which produces additional curvatures superimposed upon those caused by the magnetic field. Williams[4] has deduced the *average* radius of curvature ρ_s owing to the multiple scattering near the end of a track and finds

$$\rho_s\approx R\times1.3(m/Z)^{\frac{1}{2}},$$

where R is range of the particle, m is its mass, and Z is the atomic number of the scattering gas. As ρ_s may be either positive or negative one has to write

$$1/\rho-1/\rho_s<1/\rho_p<1/\rho+1/\rho_s,$$

where ρ_p stands for all probable values of the radius of

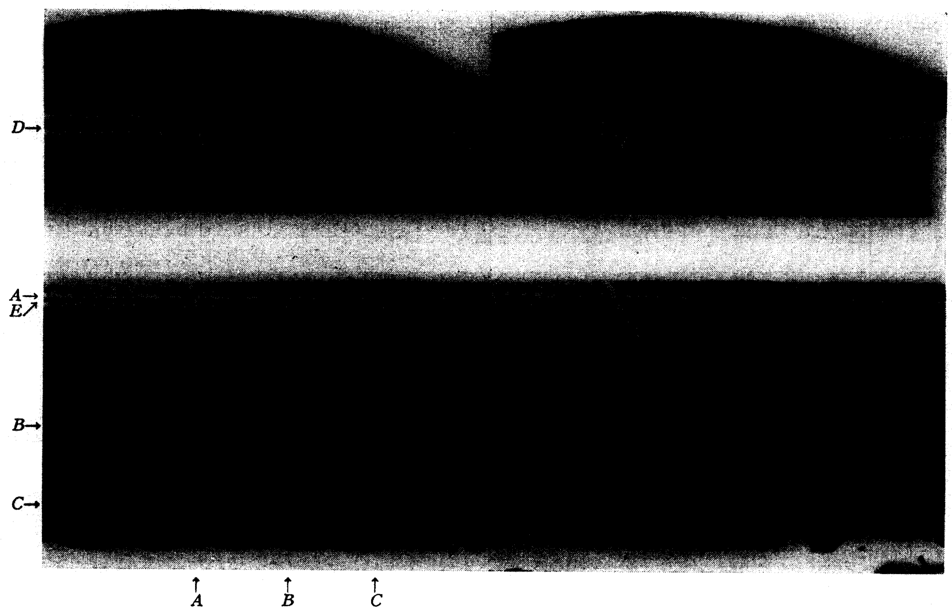

FIG. 1. Stereoscopic photographs of negatively charged mesotron stopping in the gas of the cloud chamber. Between the two compartments there is a lead plate 1 cm thick. *D* and *E* indicate scales aiding in the exact determination of geometrical positions.

curvature caused by the magnetic field alone. In our case one finds 11 cm $<\rho_{p1}<$42 cm and 6 cm $<\rho_{p2}<$39 cm. These give $m_{p1}=80$ with an uncertainty of $(+105, -55)$ and $m_{p2}=70(+150, -55)$. Averaging over m_1 and m_2, we have $m=75(+90, -40)$. This value is lower than that usually found, but this may arise from the inaccuracy introduced by the multiple scattering.

The direction of curvature is that of a negatively charged particle. It is also noted that no disintegration electron appears near *C*. The track ends at a distance of 1.4 cm in front of the background velvet. Near *B* it goes out of the directly illuminated part of the chamber and receives its light only from numerous mirrors placed around and inside the chamber, but by comparison with other pictures taken in the same arrangement a track of low density such as that of a fast electron would still be visible as close as 0.5 cm to the velvet. A mesotron at the point where it stops ionizing still has an energy of between 10^3 and 10^4 ev or a velocity of about 5×10^8 cm per sec. Since the particle appears not to disintegrate within a sphere of 0.9-cm radius around the end of the track, its lifetime after it had ceased to ionize must have been greater than 10^{-8} sec., with allowance made for a considerable increase of its path by scattering. Because of the high residual velocity of a mesotron after it stops losing energy by ionization, one cannot expect to find a disintegration electron near the end of every mesotron track. Table I shows a record of all published photographs of mesotrons stopping in the gas of a cloud chamber. Reviewing the records it appears that disintegration electrons have only been found from positive mesotrons.

TABLE I. Data on mesotrons stopped in gas of cloud chambers.

Reference	Number of electron masses	Charge	Electron track appearing near end of mesotron track	Remarks
a	220±35	+	slight indication	good, stereoscopic pictures
b	170±9	−	no	doubtful, non-ster. pict.
c	20?	+		very doubtful,
	100±30	+		stereosc. pictures
	120±30	−	no	
	55±35	−		
	170±100	+		
d	250±70	+	yes	good, stereosc. pict.
e	not determined		yes(?)	somewhat doubt-
	not determined		yes(??)	ful, stereosc. pict
This article	75(+90, −40)	−	no	stereoscopic pictures

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[c] H. Maier-Leibnitz, Zeits. f. Physik **112**, 569 (1939).
[d] E. J. Williams and G. E. Roberts, Nature **145**, 102 (1940).
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Concerning the frequency of ends of mesotron tracks occurring in the gas of a cloud chamber we should expect according to Williams[5] to find 8×10^{-7} particles per cm. With one such track found among 42,000 pictures in a cloud chamber containing 50 cm of gaseous path we actually find 5×10^{-7} track ends per cm.

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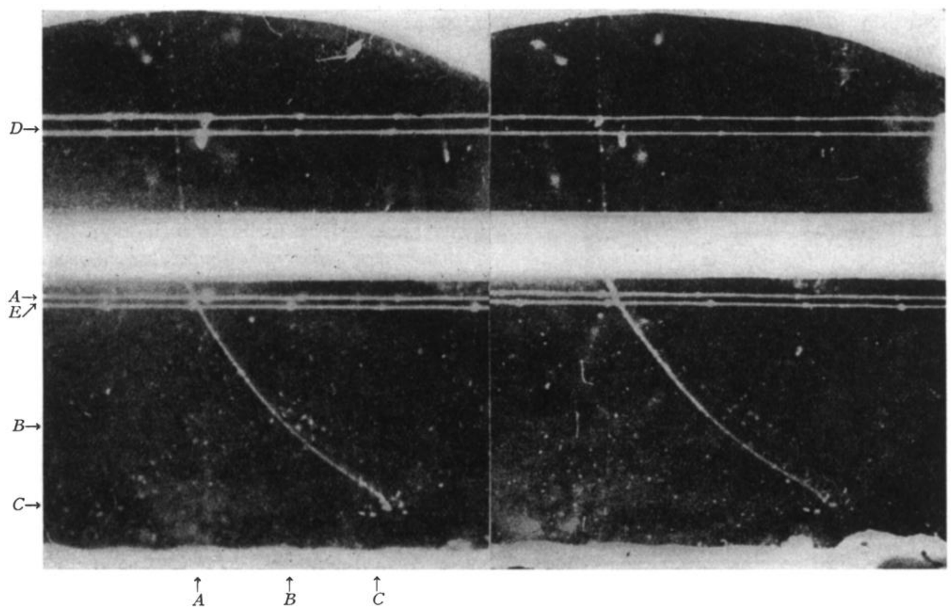

FIG. 1. Stereoscopic photographs of negatively charged mesotron stopping in the gas of the cloud chamber. Between the two compartments there is a lead plate 1 cm thick. D and E indicate scales aiding in the exact determination of geometrical positions.