‡For mesons (n = 0), which are bosons in ordinary space (but not for hyperons with n = 1), the number of possible multiplets can be doubled, corresponding to the two possibilities for ordinary spin of the boson, 1 or 0 (Ref. 9).

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ON THE THEORY OF THE STABILITY OF LIQUID JETS IN AN ELECTRIC FIELD

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We shall consider the behavior of a cylindrical jet (of radius R_0) of a liquid dielectric in an electric field. (All that follows is also applicable to a magnetic liquid in a magnetic field). The behavior of an incompressible viscous fluid, in the absence of body forces, is described by the hydrodynamic equations

$$\operatorname{div}\mathbf{v} = 0, \quad \frac{\partial \mathbf{v}}{\partial t} + \mathbf{v}\cdot\nabla\mathbf{v} = -\frac{1}{\rho}\operatorname{grad} p + \nu\nabla^2\mathbf{v}. \quad (1)$$

To these must be added the electrostatic equation

$$\operatorname{div}(\varepsilon\mathbf{E}) = 0. \quad (2)$$

Let the jet be subjected to a perturbation which is symmetrical about the axis. Then, introducing the flow function Ψ and making use of Eq. (1), we obtain

$$(\nu L - \partial/\partial t) L\Psi = (v_x \partial/\partial x + v_r \partial/\partial r - 2v_r/r) L\Psi \quad (3)$$

and the following conditions for force equilibrium at the surface $r = R_0$:

$$p_{rx} = p_{xr} = 0, \qquad p_{rr} = -(N + T_{rr}), \quad (4)$$

where

$$L = \partial^2/\partial r^2 - r^{-1}\partial/\partial r + \partial^2/\partial x^2,$$
$$p_{rx} = \nu\rho(\partial v_r/\partial x + \partial v_x/\partial r), \qquad p_{rr} = -p + 2\nu\rho\,\partial v_r/\partial r,$$

T_{rr} is the normal component of the stress tensor in the electric field, and N represents the effect of the surface forces.

Consider a perturbation of the type

$$q = q_0 + q(r)\exp[i(kx + \omega t)], \quad (5)$$

where q_0 is the equilibrium value and $q(r)$ is to be determined. Solving Eqs. (1) to (3) for such a perturbation, assuming that the amplitudes are small (linearized theory) and using the boundary conditions (4), we obtain the following dispersion equation for the perturbation frequency in the presence of a longitudinal field E_0:

$$(\omega - 2ik^2\nu)^2 \frac{I_0(z)}{kI_1(z)} + 2i\frac{\nu}{R_0}(\omega - 2ik^2\nu)$$
$$+ \frac{4k^2\nu^2}{R_0 I_1(nR_0)}[nR_0 I_0(nR_0) - I_1(nR_0)]$$
$$- \frac{\sigma}{\rho R_0^2}(z^2 - 1) - \frac{(\varepsilon-1)^2 E_0^2 k}{4\pi\rho}\,\frac{I_0(z)K_0(z)}{\varepsilon I_1(z)K_0(z) + K_1(z)I_0(z)} = 0,$$
$$z = kR_0, \quad n^2 = k^2 + i\omega/\nu, \quad (6)$$

where I_0, I_1, K_0, and K_1 are the Bessel functions of the first and second kind for imaginary argument, and σ is the surface tension.

The solution of (6) leads to the following conclusions. (1) The viscosity has a stabilizing effect (as Rayleigh has already shown). (2) A jet is always dynamically stable for $kR_0 > 1$. (3) For $kR_0 < 1$ a jet of incompressible non-viscous liquid dielectric is stable under the conditions

$$E_0^2 > \frac{4\pi\sigma}{(\varepsilon-1)^2 R_0^2 k}\,\frac{\varepsilon I_1(z)K_0(z) + K_1(z)I_0(z)}{I_0(z)K_0(z)}. \quad (7)$$

For a water jet with $\epsilon = 81$, $\sigma = 74$ dynes/cm, and $R_0 = 2$ cm, (7) gives $E_0 > 597$ v/cm for $kR_0 = 0.2$; and $E_0 > 729$ v/cm for $kR_0 = 0.1$.

Investigation shows that a transverse electric field has no effect on the dynamic stability of jets.

I wish to thank Prof. A. A. Vlasov sincerely for his interest in the accomplishment of this work.

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LIBERATION OF GAS UPON CLEAVAGE OF CRYSTALLINE QUARTZ

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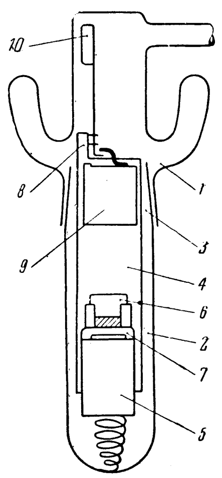
PREVIOUSLY reported experiments[1] disclosed electron emission upon cleavage of certain crystals in a vacuum of 10^{-4} to 10^{5} mm Hg.

To study and to explain further the nature of the emission, it was necessary to use higher vacuum, which in turn called for development of a new procedure. To attain high vacuum in the simplest possible manner, it was decided to make the equipment completely of glass, like the instruments used for the study of the kinetics of chemical reactions



(see diagram). The upper portion of the instrument consisted of a trap 1 for the lubricant vapor with a ground neck. The lower portion of the instrument consists of a sealed tube 2 which was inserted into ground section 3. Placed inside the instrument was a setup for cleaving solid specimens to incandescence, consisting of stainless steel tube 4 with windows, and of a brass cylinder with spring 5. Attached to this cylinder were guides for a knife 6 and a holder for x-ray film 7. Located in the upper portion of the tube was a trigger 8 for falling weight 9.

The instrument was sealed to a vacuum mercury pump and evacuated to a pressure of approximately 10^{-7} mm Hg (the vacuum was measured with an ionization manometer). After evacuating the instrument, lever 10 of the trigger was rotated with an electromagnet, and the weight fell and fractured a plate approximately 4 mm. The photographic film was exposed to the electrons emitted from the gap formed upon cleavage of the plate.

It was observed in the preliminary experiments that upon cleavage of glass and diffused quartz there is no noticeable change in the vacuum, and no electron emission was observed (like in the previous experiments).

Cleavage of crystalline quartz (like in the previous experiments) caused electron emission, and the pressure rose to 10^{-4} to 10^{-5} mm Hg (measured with an ionization manometer). The area of the fresh surface obtained upon cleavage of crystalline quartz was approximately 1 cm^2. The capacity of the vacuum system was about 1300 cubic cm. Liberation of gas was observed also upon splitting of mica and stripping of high-polymer films from glass.

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ON ELECTRON CAPTURE IN BETATRONS

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LOGUNOV and Semenov[1] have pointed out the existence of statistical capture of electrons into betatron orbits and have estimated the efficiency of this mechanism. This calls for the following two essential remarks.

1. This mechanism can work only at not too large densities of the injected electrons. In par-