tribution (see the table). It is seen from the table, in particular, that molecules moving toward the sun have shorter lifetimes than those moving away from the sun. This suggests a high optical thickness of the coma with respect to the radiation causing the decay of the molecules. The theoretical isophots of the coma were found to agree well with the observed ones. A comparison for the hydrogen atmosphere of Comet Bennett (with allowance for the charge exchange of solar-wind protons) made it possible to estimate the solar wind flux outside the plane of the ecliptic (heliocentric latitude 37.5° at a distance of 0.6 a.u.). It was found equal to $6 \times 10^8\ cm^{-2}\text{-}sec^{-1}$. The theory had also predicted that pulling of individual isophots toward the sun was possible at the high hydrodynamic outflow velocity that may arise in dust-poor comets. This was indeed observed for Comets Encke and Ikeya-Seki.

Conditions near the nucleus are such that many cometary gases, such as C_2, should be in a strongly supersaturated state and should condense into dust particles. An investigation of the condensation kinetics indicates that the dust particles reach dimensions of $10^{-5}-10^{-4}$ cm. Such particles are observed in the atmospheres of comets and in meteor streams. This makes it possible to explain the entire dust component of comets by condensation, without resorting to the hypothesis that the dust particles are already present in the nucleus in their final form.

When it is remembered that the surface of the nucleus may consist of two (or more) zones with widely differing heats of evaporation, it becomes possible to explain the appearance and grouping of synchrones in type II tails. If such a nucleus rotates, the quantity of matter evaporated is modulated with the period of the rotation. For example, this yielded a period of rotation of ~ 0.6 day for Comet 1910 I.

Cometary dust particles acquire a charge as a result of the photoeffect and collisions with electrons and protons. This results in formation of a plasma in which the dust particles act as heavy ions. The propagation velocity of perturbations, e.g., Alfven waves, in a dust plasma differs from the velocity of the waves in an electron-proton plasma.

The orientation of the dust particles must be taken into consideration in analyzing data on the scattering and polarization of light in dust tails. Orientation under the action of the directional luminous flux from the sun is possible. It is especially effective if the dust particles have optical activity and the probabilities of absorption of right-hand and left-hand quanta are different. However, it is evident that orientation under the influence of solar-wind-proton impacts is most effective.

An oriented dust medium is anisotropic and, in many cases, gyrotropic. There are many common features in the scattering of light (see, for example, Astrophys. J. **160**, L101 (1970)) by cometary dust particles and by dust particles of the interstellar medium and those of nebulae. The cometary dust medium might be a convenient model for study of the galactic dust. For example, interest attaches to observations of stars (and especially of the polarization of their radiation) through the densest parts of the coma.

The materials of the paper are being published in the collected transactions of the 45th IAU Symposium (Leningrad, 1970). Earlier papers by the author were also used: Astron. Zh. **44**, 434 (1967) [Sov. Astron.-AJ **11**, 345 (1967)]; Dokl. Akad. Nauk SSSR **179**, 1070 (1968) [Sov. Phys.-Doklady **13**, 281 (1968)]; Transactions of the 39th IAU Symposium (Crimea, 1969); Transactions of the Sixth Winter School on Space Physics (Apatity, 1969), as were papers written jointly with Yu. N. Gnedin and G. G. Novikov: Planet. and Space Sci. **19**, 143 (1971); Astron. Zh. **47**, 870 (1970); **43**, 181 (1966) [Sov. Astron.-AJ **14**, 700 (1971); **10**, 143 (1966)]; Icarus **5**, 64 (1966).

Values of the parameters characterizing the region near the nucleus and the corresponding theoretical isophots

Comet	v, cm/sec	T, °K	b, cm/sec²	τ, sec⁻¹
1955 g, 0.93 a.u., C_2	10^5	$1.7\cdot10^3$	0.395	$1.35\cdot10^5$
1956 h, 0.64 a.u., C_2	$9.6\cdot10^4$	$1.6\cdot10^3$	0.844	$\tau_0=3\cdot10^6$ $\tau_1=3.4\cdot10^5$
1959 k, 1.055 a.u., C_2	$8.1\cdot10^4$	$1.1\cdot10^3$	0.308	$1.48\cdot10^5$
1951 I, 1.2 a.u., CN	$1.2\cdot10^5$	$2.5\cdot10^3$	0.365	2.10^5
1956 h, 0.64 a.u., CN	$1.36\cdot10^5$	$3.15\cdot10^3$	1.28	$\tau_0'=1.8\cdot10^5$ $\tau_1'=1.26\cdot10^5$

A. F. Aleksandrov and A. A. Rukhadze. Heavy-current Electric-discharge Light Sources.

With the increasing demand witnessed in recent years for high-powered ultraviolet sources for laser pumping, interest has grown in the heavy-current self-compressed discharges (the pinch effect)[6]. Investigations of such discharges with the purpose of obtaining controlled thermonuclear fusion have shown that owing to the development of force instabilities such as constrictions and bends, such discharges break down during a time $\tau_c \approx R/v_s$, where v_s is the speed of sound and R is the radius of curvature of the discharge surface. Under thermonuclear conditions, τ_c is no more than a few microseconds, while in radiating discharges with a heavy-element plasma temperature $T_0 \approx 2-5$ eV and a density $N \approx 10^{18}-10^{20}\ cm^{-3}$, we have $\tau_c \approx R/v_s = 30-100\ \mu sec$, which is of the same order or even greater than the time necessary to pump lasers. The basic requirements made of the radiating discharges—near-black-body plasma radiation, uniformity of temperature, and optimum efficiency of transformation of the energy invested in the discharge into radiant energy—place limits on the total discharge current[1]:

$$I_{min} \leqslant I_n \leqslant I_{max}. \quad (1)$$

For the z pinch in a plasma with multiply ionized atoms (silver, tungsten, lead, aluminum, etc.), $I_{min} \approx 10^5$ A and $I_{max} \approx 4.3 \times 10^5$ A. At currents $I_n < I_{min}$, the discharge becomes optically transparent and subject to a dangerous and rapidly developing ($\tau_n < \tau_c$) overheating instability, and when $I_n > I_{max}$, the radiator's efficiency drops off sharply as a result of plasma-temperature nonuniformity. Experiments with electrical explosion of short metallic wires in a vacuum, carried out on apparatus with a comparatively high rate of current buildup ($I_n \lesssim 400$ kA, $T = 25$ μsec), confirmed the presence of a magnetic-confinement stage and of threshold currents I_{min} and I_{max}, in full quantitative agreement with the theory. In the interval (1), the radiation of the discharge is closely similar to that of a black body with temperature determined in accordance with the theory by the expression[2]

$$T_0 = \frac{3.6 \cdot 10^{13} I_n^2}{N_n (1+Z)}, \qquad (2)$$

where Z is the average charge of the ions and N_n is the total number of ions per unit length of the discharge. The percentage transformation of the energy invested in the discharge into ultraviolet radiation in the region from 2200 up to 2700 Å was $\eta \approx 4-5\%$ under optimum conditions (at $I_n \approx I_{min}$). The stability of this discharge was verified on long wires (longer than 25 cm); it was found that stability is determined by the time for development of large-scale force instabilities and does not exceed r_0/v_s, where r_0 is the radius of the discharge. When $I_n < I_{min}$, the discharge becomes optically transparent, and it radiates a complex line spectrum in the case of explosions of wires made from various elements. Under these conditions, the discharge in lithium vapor[3], which exhibits good radiative selectivity, shows quite high ($\eta \approx 4\%$) radiative characteristics. However, the emission in this discharge experiences local nonregular variations that are apparently due to the development of overheat instability.

In addition to the vacuum discharges, heavy-current discharges in air at atmospheric pressure were investigated. During the expanding stage, the discharge is of quiet nature, with no instabilities, and its dynamics is described quite well by the self-similar theory[4]. During the confined stage, the discharge acquires the nature of a vacuum discharge and is subject to constriction instability. At this stage, the behavior of the basic equilibrium characteristics of the discharge is well described by numerical experiments[5]. The emission of the discharge in the atmosphere is also close to black-body, and the efficiency of conversion of the energy invested in the discharge into radiant energy is the same as in the case of a vacuum discharge (4–5%).

When wires 75 cm long were exploded in the experiments, an absolute ultraviolet (2200–2700 Å) radiation yield of 9 kJ was attained for a time on the order of 60 μsec.

Thus, direct heavy-current discharges exhibit approximately the same efficiency of conversion into radiation in the ultraviolet as ordinary xenon lamps, but are substantially brighter, a fact that makes it possible to obtain an absolute radiation yield one order of magnitude higher at similar geometrical dimensions. Attempts to increase further the absolute radiation yield and the duration of the stable state of the discharge should be oriented to the design of coaxial discharges with back current (inverse pinches). Estimates indicate that it would be possible to increase the absolute radiation yield by one to two orders of magnitude by comparison with linear pinches if this approach were taken.

[1] A. F. Aleksandrov, A. A. Rukhadze, and S. A. Triger, Trudy IX Mezhdunarodnoĭ konferentsii po yavleniyam v ionizovannykh gazakh [Transactions of the Ninth International Conference on Phenomena in Ionized Gases], Bucharest, 1969.

[2] L. A. Artsimovich, Upravlyaemye termoyadernye reaktsii [Controlled Thermonuclear Reactions], Fizmatgiz, 1961.

[3] A. D. Klementov, G. V. Mikhaĭlov, F. A. Nikolaev, V. B. Rozanov, and Yu. P. Sviridenko, Teplofiz. Vys. Temp. 8, 736 (1970).

[4] N. G. Basov, B. P. Borovich, V. S. Zuev, V. B. Rozanov, and Yu. Yu. Stoĭlov, Zh. Tech. Fiz. 40, 805, 516 (1970) [Sov. Phys.-Tech. Phys. 15, 624, 399 (1970)].

[5] A. F. Aleksandrov, V. V. Zosimov, S. P. Kurdyumov, Yu. P. Popov, A. A. Rukhadze, and I. B. Timofeev, Zh. Eksp. Teor. Fiz. 61, 1841 (1971) [Sov. Phys.-JETP **34**, No. 5 (1972)].

[6] M. R. Bedilov, V. N. Likhachev, G. V. Mikhaĭlov, and M. S. Rabinovich, ibid. 48, 94 (1965) [**21**, 64 (1965)].

V. N. Andreev, A. G. Aronov, and F. A. Chudnovskiĭ. The Phase Transformation in V_2O_3 in an Electric Field.

A sharp change in resistivity is observed in a number of transition-metal oxides, e.g., V_2O_3, VO_2, Fe_3O_4, Ti_2O_3, and others, at a certain (critical) temperature (for V_2O_3, $T_c = 150°K$, and for VO_2, $T_c = 360°K$). In VO_2, for example, the resistivity changes by a factor of 10^5, while the sharpest resistivity change occurs in V_2O_3 and amounts to a factor of 10^7-10^8. Below the critical temperature, conductivity is of semiconductor (activational) nature, and above it it is metallic (decreases weakly with temperature). The presence of temperature hysteresis, volume change, and heat release offer evidence that the semiconductor-metal transition is a first-order phase transition. It was shown in[1] that when an isostatic pressure is applied, and when V_2O_3 is doped with Cr and Ti atoms, which are substitutional in the vanadium lattice, there are changes in both the transition temperature and the nature of the transition (Fig. 1b). For example, with a 10% Cr content and rising temperature, the phase transition from the antiferromagnetic semiconductive phase to the metallic phase is absent, but there is a phase transition from the antiferromagnetic semiconductive phase to the nonmagnetic semiconductive phase.

A number of authors have also undertaken to shift the transition temperature with an electric field[2]

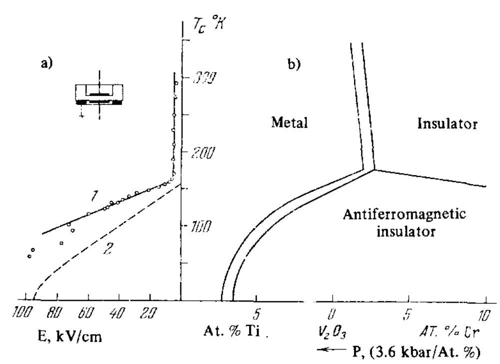

FIG. 1. a) Transition temperature T_c as a function of electric-field intensity E(1–$V_{1.8}Cr_{0.2}O_3$–polycrystal; 2–V_2O_3–single crystal; top–shape of specimen with guard ring on which $T_c(E)$ curve was recorded). b) Phase-transition temperature as a function of the degree of doping with Cr and Ti and of the isostatic pressure p [1].