small compared with resonance damping due to conduction in the flame, given by the following formula[2]:

$$\sigma = \frac{0{\cdot}00169\ R(t^{1/2} - 1)}{r^2 Q},$$

where σ(mho-cm.) is the conductivity of the flame of radius r cm. in a cavity of radius R cm., and with a Q factor of Q in the absence of flame; t is the ratio of the power transmitted by the cavity in the absence of flame to that in its presence. On the basis of the theory developed by Margenau[3,1], it can be shown that σ is proportional to the electron concentration, the factor of proportionality being sensibly constant under the present conditions and having a value of $1{\cdot}3 \times 10^{20}$. Whereas the direct attenuation method of Belcher and Sugden was only capable of measuring electron concentration to about 5×10^9 per c.c., the present method is capable of extending this down to about 10^8 electrons per c.c., that is, a pressure of 2×10^{-9} atmosphere at flame temperatures in the region of 2,000° K.

The flames studied contained about 20–30 per cent of acetylene and gave temperatures ranging from 2,240° to 2,180° K., both by Kurlbaum's method[4] and the sodium line reversal method[5], the cooler and more luminous flames being the acetylene-rich ones. According to a theorem of statistical thermodynamics[6] the number of electrons per c.c. in equilibrium with a solid is given by:

$$n = \frac{2(2\pi m_e\ kT)^{3/2}}{h^3} \cdot \exp(-\chi/kT),$$

where m_e is the electron mass and χ the thermal work-function of the metal. If the solid is not infinite in extent, however, and consists of N spherical particles per c.c. of mean radius $\bar{r}$, the exponential term will be modified to:

$$-[\chi + f(r)]/kT,$$

where $f(r) = (300\ ne)/(N\bar{r})$ electron volts. Preliminary observations by electron microscopy of the particles have shown $\bar{r}$ to be about 200 A., and theoretical calculation of the amount of carbon indicated 10^{11}–10^{12} particles per c.c., which should make $f(r)$ negligible compared with χ, which is 4·34 electron volts according to Reimann[7].

The results obtained with this apparatus show an electron concentration very near the theoretical value for flames very rich in acetylene, but falling off as the flame becomes hotter and richer in air to values of about one-quarter of theoretical. This is a greater divergence than corresponds with the estimated $f(r)$; but the methods of measurement of N and $\bar{r}$ require further development, and may allow of an explanation of this. The detailed results will be described elsewhere.

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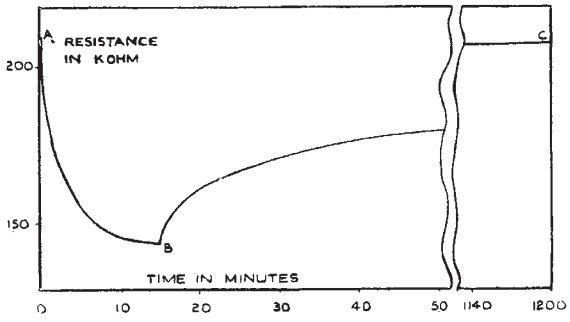
A Photo-conductive Effect in Tellurium Film

In the course of measurements of the electrical resistance of thin films of tellurium on glass plates, it became clear that the resistivity of a film decreased on exposure to sunlight.

A tellurium film was placed in a dark box for a few days in order to make sure that it was settled in the dark state. Leads through the sides of the box permitted the measurement of the resistance of the film. The lid of the box was then removed so that direct sunlight could fall on the film. It was found that the resistance decreased rapidly at first and then slowly until a steady state was reached after about 15–60 min. exposure to light. The steady-state resistance value depended upon the light intensity but was about two-thirds of the resistance in the dark. On closing the box it was found that the film recovered its resistance value after about a day in darkness.

Measurements were made on a number of films prepared at different times, and in each case the effect was much the same. A typical resistance–time curve is shown in the accompanying graph. It was observed that the speeds of response of the various specimens were quite different even for samples which had been adjacent in the evaporating chamber.



AB, exposed to sunlight; *BC*, recovery in darkness

The speeds of response and recovery were compared by measuring the time taken for the resistance to reach the geometric mean of the initial and steady values. The recovery measurements were the more reliable as it was easier to maintain steady conditions in the dark box than when facing the summer sky. The response times as defined above varied between 2 and 14 min., and the recovery times between 20 and 100 min. There was no simple correlation between the response and recovery times. It will be noticed that the time-scale for this effect is very much greater than for those utilized in the normal photocells, which have response times of a small fraction of a second. It is thought that this effect might be used in photocells required to be insensitive to rapid fluctuations in illumination.

The tellurium films were formed on 3-in. by ½-in. glass slides. Platinum end contacts were deposited on the glass from a solution and fired at 700° C. The tellurium was deposited upon the slide by vacuum evaporation. The film thickness was of the order of 3×10^{-6} cm.

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