conditions stated, is about 2°K, and then only if the parallel capacity C_1 of the resonant circuit can be made precisely 0.02μf and the associated network components are designed to give a resonance at 1600 c/s.

It may be possible to reduce the measurable T_a below 2°K. A tube might be designed around Eqs. (1), (2), and (3) which would have better properties for this application than the D-96475; furthermore, if this tube could be inserted in the low temperature bath along with the resonant circuit (R, X in Fig. 1), C_2 might be lowered to 6$\mu\mu$f; perhaps also the background could be measured or balanced out to better than one percent. A scrutiny of these possibilities leads, however, to the conclusion that the ultimate attainable temperature will almost certainly be greater than 0.1°K. It must be noted, however, that these calculations depend on the assumption that the noise arising in the portion of the circuit at temperature T_b can be accurately determined or balanced out. If this is not possible, the minimum temperature measurable by this method may be very much higher.

* Bulletin of the American Physical Society **21**, 6 (1946).
[1] A. W. Lawson and E. A. Long, Phys. Rev. **70**, 220 (1946).
[2] This conclusion was arrived at independently by J. B. Brown and D. K. C. MacDonald, Phys. Rev. **70**, 976 (1946).
[3] F. B. Llewellyn, Proc. I.R.E. **18**, 243 (1930).
[4] D. O. North, RCA Review **4**, 441 (1946).
[5] F. E. Terman, *Radio Engineers' Handbook*, first edition, p. 316.

On Bringing the Beam out of a Betatron

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COURANT and Bethe[1] have given a brief discussion of their theoretical considerations on bringing the electron beam out of a betatron. I should like to mention that in the autumn of 1944 I made similar considerations and came to the same conclusion that the deflection electrodes for bringing out the beam should be located quite near the point where Br is a maximum. If the simplifying assumption is made that Br follows a parabolic law, for instance $\mathrm{Br}=(\mathrm{Br})_{\max}(1-\alpha\rho^2)$, with ρ indicating the distance from the point r_m where Br is a maximum, while the magnetic guiding field must vary (relative to the induction field) with the time constant T (for example, as $B_{\Delta t}=B_0(1-\Delta t/T)$, then as a first approximation the following differential equation for the electron orbits is obtained.

$$\frac{\partial^2\rho}{\partial t^2}=\frac{V^2}{r_m}\left(\alpha\rho^2+\frac{\Delta t}{T}\right)$$

where V is the tangential velocity of the electrons at the radius r_m.

This corresponds to the so-called Painlevé differential equation $y''=y^2+x$, which cannot be solved by known functions. Figure 1 shows a solution of this differential equation, the initial conditions being so selected that the electrons do not execute any superposed oscillations. It will be seen that the curve for y' (which also corresponds to the separation of the single orbits) rises very steeply when the radius r_m is exceeded (about proportionality to $y^{\frac{1}{2}}$). In order therefore that the divergence of the emerging

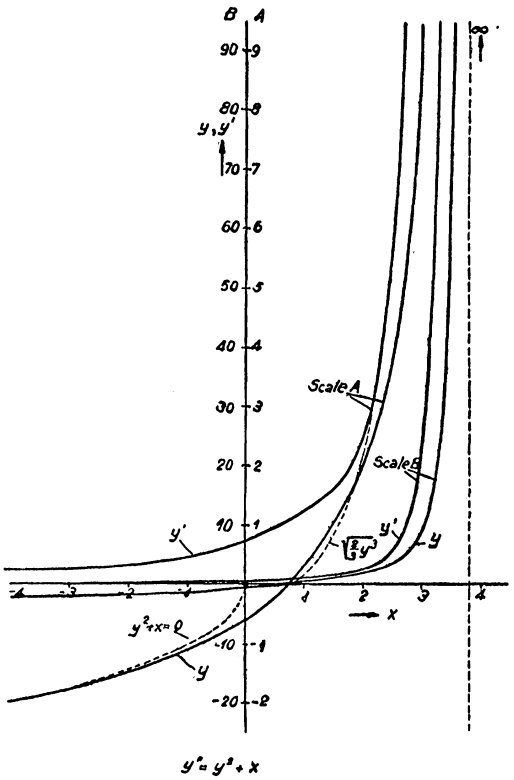

FIG. 1. Graphical form of the solution of the equation $y''=y^2+x$.

electrodes should not become too large, the deflecting electrodes must not be located too far outside the circle r_m. On the other hand, in order that too many electrons do not fall on the edge of the deflecting plate, this latter must not be placed too far inwards.

These two conditions result in an optimum position for the deflecting plates which, in conjunction with a particular construction of the deflecting field (preliminary deflection by means of a special very thin deflecting electrode), has formed the subject matter of a patent application filed by me in December, 1944. In this patent application also the refocusing of the emerging beam by means of an auxiliary magnetic field has been provided.

[1] E. D. Courant and H. Bethe, Phys. Rev. **70**, 798 (1946).

On the Dissociation Energy of CO

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THREE proposed interpretations of the band spectrum of CO lead to $D(\mathrm{CO})=6.92$ ev,[1] 9.14 ev,[2] and 11.11 ev,[3] respectively. Electron collision experiments in CO give the unique value, $D(\mathrm{CO})=9.6$ ev.[4] Clearly a reconciliation of these conflicting positions is demanded.

$D(\mathrm{CO})=9.6$ ev from electron impact rests upon the appearance potentials of four ionization and dissociation