furans but is hindered by the presence of certain substituents. Crystalline solids were obtained from 2-bromofuran (m. p. 116°), 3-bromofuran (m. p. 131.5–132°), furfuryl methyl ether (m. p. 97°), furfural diacetate (m. p. 126.5–127°), furfurylacetone (m. p. 86–87°) and several others. We have not succeeded in obtaining addition products from compounds containing a carbethoxyl, cyano, nitro or ethylenic group attached directly to the ring.

A study of the effect of hydrolytic agents upon the addition products (substituted 3,6-endoxo-Δ^4-tetrahydrophthalic anhydrides) has shown that they can be converted directly into the corresponding phthalic acids (or anhydrides).[3] Since the orientation of the substituents in the resulting phthalic acids (or anhydrides) is known, this transformation constitutes an absolute method for establishing the position of substituents in the furan ring. Thus, the substituted 3,6-endoxo-Δ^4-tetrahydrophthalic anhydrides from 2-methylfuran, 2- and 3-bromofuran on heating with hydrogen bromide in glacial acetic acid gave, respectively, 3-methylphthalic anhydride (m. p. 111–113°), 3-bromophthalic anhydride (m. p. 134–135°), and 4-bromophthalic anhydride (m. p. 108–110°). We are now engaged in extending the observations reported here.

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[3] Diels and Alder [*Ann.*, **490**, 243 (1931)] have shown that the addition product from furan and maleic acid can be converted into phthalic acid by a series of five reactions, involving four intermediate products.

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VAPOR PRESSURE AND HEAT OF VAPORIZATION OF GRAPHITE

Sir:

A large amount of experimental work has been carried out in the past decade to determine the vapor pressure and heat of vaporization of graphite and very discordant values are given in the literature. We have recently investigated this problem, determining vapor pressure from the rate of loss in weight of carbon rings heated by high frequency induction in a vacuum [reported to April, 1932, Meeting, American Philosophical Society]. The interpretation of the results is complicated by the fact that carbon vapor exists in both monatomic and diatomic forms, the relative amounts being determined by the total pressure and the temperature. Vaughan and Kistiakowsky [*Phys. Rev.*, **40**, 457 (1932)] have independently made calculations, using the equations of quantum statistical mechanics, which support this conclusion.

It is possible to reconcile our results in the temperature range 2350–2800°K. with those of Kohn and Gückel [*Z. Physik*, **27**, 305 (1924)] on the vapor pressure of carbon in the arc.

They have taken the value of 4200°K. as the temperature of the positive crater at 1 atmosphere pressure. This value is due to Benedict [*Ann. Physik*, **49**, 144 (1916)]. The method used by her has been adversely criticized by others and a careful search of the literature shows that this temperature may be 200° too high.

The following values are the heats of reaction for the two processes involved:

$$C_{\text{solid}} \longrightarrow C_{\text{monatomic vapor}} \qquad \Delta H = 177 \text{ k. cals.} \tag{1}$$

$$C_2 \longrightarrow 2C \qquad \Delta H = 150 \text{ k. cals.} \tag{2}$$

The rate of loss in weight in g./sq. cm./sec. as a function of temperature is given by the formula

$$\log m = -\frac{177{,}000}{4.58T} + 2 \log T + \left(\frac{F^\circ - E_0^\circ}{4.58T}\right)_{\text{graphite}} + 3.174 \tag{3}$$

This equation applies only to the carbon evaporating to form monatomic vapor. In the temperature range 2300–2800°K. this is 92–96% of the total carbon evaporating. The vapor pressure can be calculated from the rate of loss in weight by the equation

$$\log p = \log m + 1/2 \log T - 2.187 \tag{4}$$

where p is expressed in atmospheres. The equation for the variation of the equilibrium constant of reaction (2) as a function of temperature is

$$\log \frac{(P_c)^2}{(P_{c2})} = -\frac{150{,}000}{4.58T} + 3/2 \log T + \log (1 - e^{-2340/T}) + 1.462 \tag{5}$$

When this equation is applied to the results of Kohn and Gückel the following values are calculated for the partial pressures of monatomic carbon vapor

T, °K.	Total pressure	P_c (atm.)	P_c (extrap.)
4200	1	0.21	0.17
4705	5	1.23	1.50

The fourth column gives the values extrapolated by equations (3) and (4) from the results in the temperature range 2350–2800°K. In making the extrapolation it was assumed that the latent heat of fusion of graphite was 8000 cal.

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A SIMPLE TEST FOR STREAMING IN THE POROUS DIAPHRAGM DIFFUSION CELL

Sir:

The diffusion cell of Northrop and Anson [*J. Gen. Physiol.*, **12**, 543 1929)] as further standardized by McBain and Liu [THIS JOURNAL, **53**, 59 (1931); see also M. E. Laing McBain, THIS JOURNAL, in press (1933)]