by vacuum distillation. The fraction distilling at 195–201° at 29 mm. was collected in 90% yield, resulting in a white, wax-like solid upon cooling. Recrystallization from isopropyl alcohol gave 89.9 g. (86%) of N,N-dicyclohexylformamide, m. p. 62.5–63.5°. *Anal.* Calcd. for $C_{13}H_{23}NO$: N, 6.69. Found: N, 6.58.

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COMMUNICATIONS TO THE EDITOR

THE SPONTANEOUS IGNITION OF ALUMINUM BOROHYDRIDE VAPOR IN OXYGEN[1]

Sir:

We would like to report some preliminary observations on the ignition of aluminum borohydride vapor $(Al(BH_4)_3)$ in oxygen. This volatile compound (b. p. 44.5°) was first prepared by Schlesinger and associates, and was found by them to ignite spontaneously when exposed to laboratory air.[2] We have somewhat extended their observations on the inflammability of the vapor.

Experiments were carried out in clean spherical Pyrex bulbs (6.6 cm. diameter) attached to a system of storage bulbs, mercury manometer and pump. The vapor was first introduced into the bulb to the desired pressure and a predetermined amount of oxygen was then run in quickly. The mixture was usually observed for a period of a kilosecond (1000 seconds—about seventeen minutes), but it was generally found that there was either no change at all, or else immediate explosion.

With *dry* oxygen, no explosions occurred on filling at 20°, over a range of 1 to 300 mm. (14 mole % $Al(BH_4)_3$), though on subsequent evacuation ignition almost always followed. This might indicate an upper pressure limit but we have no evidence of this in the pressure range studied.

Explosion was observed at higher temperatures. Thus at 110° the lower pressure limit was 25–30 mm. for mixtures of 5–50 mole % $Al(BH_4)_3$.

With *moist* oxygen, explosion occurred at 20°. When the oxygen was saturated at this temperature (2.3 mole % H_2O) explosions were observed from 5–90 mole % $Al(BH_4)_3$, the minimum total pressures running from 25–75 mm. A few experiments with half-saturated oxygen indicated that minimum pressures were roughly doubled, as if a minimum partial pressure of water vapor (about 0.5 mm., but depending somewhat on composition) was required for explosion.

Since Schlesinger has reported that aluminum borohydride is subject to rapid hydrolysis, it would appear that this reaction is a prerequisite to explosion at room temperature. In the absence of water vapor, decomposition at a higher temperature may serve the same purpose.

Further work on the ignition and also the decomposition of aluminum borohydride is in progress.

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(2) H. I. Schlesinger, R. T. Sanderson and A. B. Burg, THIS JOURNAL, **62**, 3421 (1940).

THE DESCRIPTION OF BEHAVIOR BY PHYSICAL PROPERTIES

Sir:

Dr. Telang's recent note and letter[1] in which he recalls Ferguson and Kennedy's[2] revised parachor $P_r = MC^{1/p}$ where $1/p$ is an exponent whose magnitude differs for different substances, raises the whole problem of the description of behavior when physical properties lose their invariance. P_r is no longer a "property" of the atom, molecule or radical but corresponds to those entities which, in rheology, have been called "quasi-properties."[3,4] Comparisons between substances can be made only in terms of both the intensity factor C and the exponent $1/p$; neither has meaning apart from the other.

The analogy between this treatment and Nutting's equation or Bach's power law[5] relating stress and strain, is exceedingly close.

Will a similar type of quasi-property be needed for the accurate formulation of rheochors[6] and thermochors?[7]

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(1) M. S. Telang, THIS JOURNAL, **71**, 1883, 1898 (1949).
(2) A. Ferguson and S. J. Kennedy, *Trans. Faraday Soc.*, **32**, 1474 (1936).
(3) G. W. Scott Blair, B. C. Veinoglou and J. E. Caffyn, *Proc. Roy. Soc.*, **189A**, 69 (1947).
(4) G. W. Scott Blair and J. E. Caffyn, *Phil. Mag.*, **40**, 80 (1949).
(5) C. Z. Bach, *Ver. dtsch. Ingen.*, **32**, 192 (1888).
(6) J. N. Friend, *Nature*, **150**, 432 (1942), etc.
(7) H. G. de Carvalho, *ibid.*, **160**, 370 (1947).