be to "load" the liquid with solid particles to provide nucleation sites and induce rapid boiling in the bulk should a pressure decay occur. Apart from the obvious practical difficulties, however, recent experiments by Buivid and Sussman (*6*) appear to show that this idea is not viable. They showed that the experimental superheat-limit temperature for liquids was not greatly affected even when the liquids were loaded with suspended hydrophobic or hydrophilic particles. Another concept worth further study would be the use of "gelled" liquids—liquids modified to resemble gels by use of very small quantities of frozen water or methyl alcohol. The solid phase is composed of very fine particles (< 1 μm) dispersed homogeneously throughout the liquid (*7*). In this case, the spacing between nucleation sites might be sufficiently small to allow effective nucleation in the event of a pressure drop. Finally, safety valves and rupture disks might be redesigned to prevent very rapid pressure decays even in the event of overpressurization.

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Noradrenaline and Seizures

Tabakoff *et al.* (*1*) presented evidence on the role of brain noradrenaline (NA) in the development of tolerance to barbiturates: animals that suffered a 50 percent depletion of brain NA through intraventricular injection of 50 μg of 6-hydroxydopamine (6-OHDA) failed to develop tolerance to long-term barbiturate treatment, as measured by sleep time and hypothermia after a subsequent challenge dose of barbiturate, or by potentiation of seizures induced by pentylenetetrazol (Metrazol). Tabakoff *et al.* (*1*) also compared the susceptibility of control and 6-OHDA-treated animals to Metrazol-induced seizures even in the absence of chronic barbiturate treatment and found no effect of the 6-OHDA.

We have recently obtained evidence that brain NA is indeed involved in Metrazol-induced seizures and that a marked alteration in these seizures occurs if NA is depleted (*2*). Animals that received 4 μg of 6-OHDA injected into the fibers of the dorsal noradrenergic bundle, a procedure that depleted forebrain NA to less than 5 percent of control values, showed a marked potentiation in the duration, number, and type of seizure elicited by subcutaneous administration of 70 mg of Metrazol per kilogram of body weight (Table 1). Thus, the seizures lasted longer, occurred more frequently, and were tonic rather than clonic. These data support our earlier report that depletion of both NA and dopamine (DA) in varying proportions also potentiates Metrazol-induced seizures (*3*). They also support data indicating that catecholamines are significantly involved in seizures induced by other means (*4*). An alteration in brain NA may therefore be important in the pathogenesis of human conditions such as epilepsy. We suggest that the failure of Tabakoff *et al.* (*1*) to observe a potentiation of Metrazol-induced seizures in rats treated with 6-OHDA reflects the modest (no more than 50 percent) depletion achieved by their manipulation. In other catecholaminergic systems, such a small loss would be without behavioral effect (*5*), and the effectiveness of this loss in altering the development of tolerance to barbiturates testifies to the pervasive role of brain NA in this phenomenon.

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Mason and Corcoran have presented evidence that a profound depletion of brain norepinephrine (NE) results in a potentiation of pentylenetetrazol-induced seizures. They suggest that the lack of such effects in our studies (*1*) was due to a less extensive destruction of brain NE neurons. We totally agree with their assessment and would like to reiterate certain points that appeared in (*1*) as well as in our previous publications on this subject (*2, 3*). Adrenergic receptor supersensitivity develops during the 2-week interval between injection of 6-hydroxydopamine (6-OHDA) and the testing of the animals in our studies and we have stated: "the development of recep-

Table 1. Seizure response to subcutaneous injection of Metrazol (70 mg/kg) in NA-depleted rats (4 μg of 6-OHDA was injected into the fibers of the dorsal NA bundle); N.S., not significant.

Group	Duration of first seizure (sec)	Number of rats		Noradrenaline content of tissue*				Dopamine content of striatum
		With multiple seizures	With tonic seizures	Hippocampus-cortex	Hypothalamus	Cerebellum	Spinal cord	
Control (N = 7)	32.9 ± 3.0	0/7	0/7	246 ± 6	2,230 ± 77	219 ± 12	255 ± 6	13,170 ± 570
6-OHDA (N = 9)	113.2 ± 11.7	5/9	5/9	6 ± 1	590 ± 87	271 ± 8	307 ± 12	11,570 ± 1,190
P	.01	.05	.05	.001	.001	N.S.	N.S.	N.S.

*Percentages for the 6-OHDA-treated rats were, for NA: hippocampus-cortex, 2; hypothalamus, 26; cerebellum, 124; and spinal cord, 120; and for DA: 88.

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tor hypersensitivity after destruction of certain noradrenergic terminals, and only partial depletion of NE in brain in our studies, may have combined to suppress differences in withdrawal symptoms between animals pretreated with 6-OHDA and those receiving control CSF [cerebrospinal fluid]" (2). Animals injected intraventricularly with 6-OHDA (50 μg) 48 hours before receiving pentylenetetrazol did exhibit a greater incidence of seizures compared to the appropriate control mice (2). Referring to the statement by Mason and Corcoran that barbiturate tolerance was measured in our studies (1) by quantitating the pentylenetetrazol-induced seizures, we point out that the pentylenetetrazol-induced seizures were used as a measure of central nervous system excitability and the presence of physical dependence on barbiturates in the barbiturate-withdrawn mice. We have previously stressed that tolerance to and physical dependence on sedative hypnotics are not identified phenomena (2, 3), and here again we speak against synonymous use of the terms drug "tolerance" and "dependence."

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Carbon's High-Temperature Behavior

Whittaker (1) presented evidence for the occurrence of stable "carbyne" forms of graphite—forms that contain a triple bond—at temperatures above 2600 K. He also suggested that the Swing's bands of C_3 are not seen from carbon vapor at these high temperatures because of the presence of excited states of C_3 at low energy. These excited states would have to be forbidden to transitions from the ground state and must be such as to deplete the population of the ground state and decrease the intensity of the Swing's bands. A set of $^3\Pi$ states is suggested as a possibility (2). Considerable controversy has surrounded the spectroscopic and thermodynamic properties of C_3 in the past (3, 4), and it is important to consider the possibility that previous ideas concerning C_3 may not be complete.

Whittaker's suggestion appears to be untenable. The Swing's bands do not decrease in intensity as the temperature increases. Painstaking experiments have shown that the Swing's bands form a pseudocontinuum at high temperatures and that the intensity of the continuum increases with temperature as does the C_3 concentration (5). Spectral observations at still higher temperatures can be used to draw conclusions about the population of the ground state only if the intensity of the continuum is taken into account. If new states of C_3 became populated at high temperatures, new features might be expected in the vibrational spectrum even though the new states were forbidden in the electronic spectrum. The infrared spectrum at about 3100 K has been examined, and it too is consistent with ground state C_3 (6).

The approximate energies of excitation of the excited states of C_3 have been calculated (7). The $^1\Pi_u$ state was calculated to be at 3.03 eV, in excellent agreement with the energy of the Swing's band. The $^3\Pi_u$ state was calculated to be at 2.04 eV, in agreement with weak bands found in the spectrum at 2.10 eV (8). These energies yield a population of less than 0.2 percent for the triplet states at 3000 K and about 1 percent at 4000 K. This population is much too small to make the spectra due to the ground state disappear.

It is possible that the $^3\Pi_u$ state is populated by a nonequilibrium mechanism. However, at these temperatures the saturation vapor pressure of C_3 is substantial [$> 10^{-4}$ atm at 3000 K and rapidly increasing as a function of temperature (3)] and collisions will rapidly establish equilibrium.

I conclude that the observations of the gas phase spectra cited by Whittaker provide no evidence for new forms of C_3.

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The published spectrum by Phillips and Brewer (1) shows the 405.0-nm band of C_3 at ~ 3000 K, but the spectrum taken at 3200 K by Brewer and Engelke (2) does not show this band. None of our spectra taken over the temperature range of 3500 to 4200 K show the 405.0-nm band, and a similar result was reported by Null and Lozier (3) and Howe (4). The remarks I made about the disappearance of C_3 emission were based on the behavior of the 405.0-nm band. A reexamination of our plates reveals a weak continuum starting at ~ 465.0 nm and extending at least to 360.0 nm, with a maximum at ~ 393.0 nm and a very weak band at 590.2 nm. These could correspond to the pseudocontinuum and the $^3\Pi$-$^1\Sigma$ transition of C_3. In this case, I must agree with Strauss that the behavior of C_3 emission provides no evidence for new states of C_3.

Apparently no new states are necessary to account for the triple-bonded carbon forms. A recent theoretical study of C_n molecules by Kertesz *et al.* (5) shows that models with alternating short and long bonds are energetically more stable than equidistant ones. This means that alternate bonds of all C_n molecules have some triple-bond character regardless of whether n is odd or even. In view of this, the remarks I made in my report about C_n molecules where n is even are not correct.

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