CORRESPONDENCE

Fluothane-Ether Mixtures

To the Editor.—We submit certain additional data pertinent to the recent paper: Hall, Norris and Downs (Physical Chemistry of Halothane-Ether Mixtures, ANESTHESIOLOGY 21: 522, 1960). These data were obtained during a study of the vaporization characteristics of mixtures of "Fluothane®" and diethyl ether. The vaporization and other physicochemical measurements confirm the existence of an azeotrope of composition corresponding to 2 moles of Fluothane and 1 mole of ether, as follows:

(1) Mixtures of Fluothane and ether in the proportions of 2 moles to 1 were vaporized completely from a fully charged Ohio "Vernitrol" vaporizer at temperatures of the order of 25 C. by streams of oxygen at flow rates up to 1,000 ml. per minute yielding controllable concentrations of azeotrope vapor of constant Fluothane-ether composition during the entire vaporization periods.

(2) Thermal data derived from the observed temperature rise on successive additions of ether to Fluothane in an insulated system (table 1, fig. 1) indicate a critical region close to the composition corresponding to 0.5 mole ether/Fluothane ratio. The "break" is best exhibited in the ΔH versus ether added relation (fig. 2), which represents the heat liberated after each (equal) successive addition of ether to well beyond the azeotrope composition.

The second curve of figure 2 represents the total heat evolved at various ether/Fluothane ratios and indicates that when the mixture acquires the azeotropic composition, approximately 80 per cent of the maximum heat which is produced in the system (after excess ether has been added) will have been liberated at this point. This is consistent with the variations (±17 per cent) observed by Hall, Norris and Downs in their determination of the heat of formation of the azeotrope under conditions of stoichiometry, excess ether, and excess Fluothane.

The heat of formation of the azeotrope from

TABLE 1

THERMAL DATA DERIVED FROM OBSERVED TEMPERATURE RISE ON SUCCESSIVE ADDITIONS OF DIETHYL ETHER TO FLUOTHANE

(Ether at 20.7 C. added in 10 ml. increments to 100 ml. Fluothane in a Dewar flask)

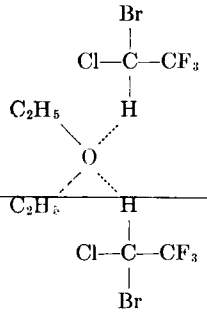
Ether Added (ml.)	Mole Ratio Ether/ Fluothane	Temperature of Mixture (° C.)	Specific Heat at Temperature of Mixture*		Heat Evolved upon Each Addition of Ether† Calories	Total Heat Evolved (Accumulative) Calories
			Fluothane	Ether		
0	0	20.72	0.352	0.540	—	—
10.0	0.1015	25.00	0.415	0.544	446	446
20.0	0.203	28.22	0.463	0.545	397	843
30.0	0.3045	30.77	0.502	0.546	361	1,204
40.0	0.406	32.70	0.530	0.547	309	1,513
50.0	0.5075	33.68	0.545	0.548	191	1,704
60.0	0.609	34.19	0.550	0.548	127	1,831
70.0	0.7105	34.44	0.553	0.548	90	1,921
80.0	0.812	34.51	0.555	0.549	65	1,986
90.0	0.9135	34.50	0.556	0.549	52	2,038
100.0	1.015	34.36	0.555	0.549	34	2,072

* Data for Fluothane derived from graphical plot of data reported by Hall, Norris and Downs, ANESTHESIOLOGY 21: 523 1960; data for ether from similar plot of data reported for several temperatures in Handbook of Chemistry (Lange).

† Calculated from the observed temperature rise, the average specific heat of Fluothane and ether for the temperature range involved, and the heat capacity of the Dewar calorimeter vessel (30 calories per degree C.).

our data would correspond to 1,180 or 1,480 calories per mole of azeotrope, depending on whether the reaction was stipulated as involving stoichiometric quantities of the Fluothane and ether or a large excess of ether, respectively. The former of these values compares very favorably with that of Hall, Norris and Downs (1,200 calories per mole).

Finally, in response to the question raised in the aforementioned article concerning the nature of the bonding in the Fluothane-ether azeotrope, we would suggest that azeotrope formation in this system may be attributable to a hydrogen bonded structure of the form:



since the oxygen atom of diethyl ether has considerable basic character (electron donor) and the hydrogen atom of the Fluothane molecule possesses enhanced acidity due to the inductive effect (high electronegativity) of the halogens, particularly the fluorine atoms.

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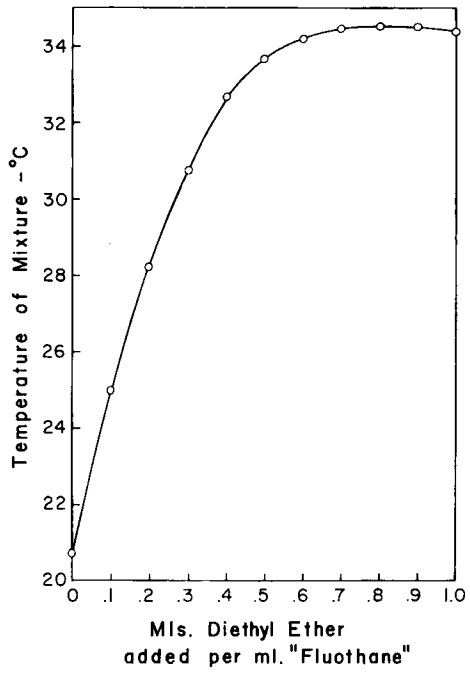

Fig. 1. Temperature rise on successive additions of diethyl ether to Fluothane.

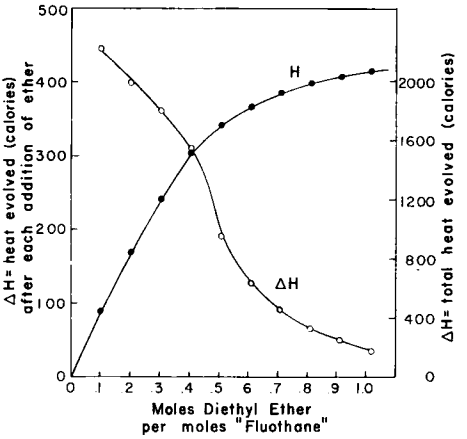

Fig. 2. Thermal data for system—Fluothane-diethyl ether: heat evolved on successive additions of diethyl ether to Fluothane.

Correction

To the Editor.—In my article "Concentrations of Halothane, Ether, and Cyclopropane in Inspired Atmospheres During Closed Circuit Anesthesia" (Anesthesiology 22: 459 May-June 1961), there was an error on page 463 in the paragraph just preceding the summary of the paper. This paragraph should have read: "In the cases of halothane and ether, the concentrations in blood would probably be quite dissimilar for the two drugs due to the greater solubility of *ether* in blood. It is known that ether is considerably more soluble than halothane in blood and one would expect relative blood tensions of halothane to develop at a considerably faster rate than those of ether."

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