COMMUNICATIONS TO THE EDITOR

AN EQUATION OF STATE FOR SATURATED FLUIDS

Sir:

During a search for an equation of state for saturated fluids a simple relationship between pressure, temperature and specific volumes was found which seemingly is of general validity. In fact out of 59 substances tested only one, acetic acid, showed anomalous behavior. In this case the admittance of association, that is, double molecules, will explain the discrepancies. The test substances have molecular weights from 2 to 260, critical pressures from 2.3 to 218 atm., critical temperatures from −268 to +448° and critical densities from 0.03 to 1.15 g./cc.

Upon separating the roots of a more general, three constant, quadratic equation the following expression was arrived at:

$$P = \frac{CT}{v_g + v_e + 2B}$$

where $C = R/M$ and $B = (CT_c/2P_c) - v_c$.

The symbols denote: p, the saturation pressure in atm.; T, the saturation temperature in °K. (ice point 273.16°K.); v_g and v_e the specific volume of saturated vapor and saturated liquid, respectively, in l. per gram; R, the gas constant (0.08206 for l., atm., g.-moles) and M, the molecular weight in grams (based on atomic weights of 1942). Subscripts c, indicate critical values.

The pressures calculated by the equation from corresponding v_g, v_e and T values are given for water from melting point to critical point. The critical data and constants for water are: T_c = 374.11°C., p_c = 218.167 atm., v_c = 3.1975 cc./g., C = 0.0045548 and B = 0.0035593.

TABLE I

T, °C.	p, atm. calcd.	p, atm. lit.[1]	T, °C.	p, atm. calcd.	p, atm. lit.[1]
0	0.0060307	0.0060273	200	15.910	15.332
20	.023089	.023042	220	23.800	22.897
40	.073126	.072748	240	34.356	33.044
60	.19742	.19656	260	48.049	46.322
80	.47070	.46740	280	65.290	63.343
100	1.0109	1.0000	300	86.583	84.776
120	1.9901	1.9595	320	112.34	111.40
140	3.6419	3.5669	340	143.09	144.14
160	6.2638	6.1032	360	180.59	184.26
180	10.216	9.896	374.11	(218.167)	218.167

Evidently the equation does not compare with the high accuracy afforded by several vapor pressure equations; however, the wide range of application, the great simplicity and the ease of calculation will render it useful for checking and supplementing experimental data. The agreement is considerably better for many of the substances tested and especially for the simpler gases such as helium, hydrogen, neon, nitrogen.

A complete report will be published later.

(1) Fales and Shapiro, THIS JOURNAL, **58**, 2418 (1936); "Int. Crit. Tables," Vol. III, 1928.

COMMONWEALTH COLOR AND CHEMICAL CO.
BROOKLYN, N. Y. J. E. HAGGENMACHER

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ELECTRON MICROSCOPE OBSERVATIONS OF CLAM MUSCLE FIBRILS

Sir:

Submicroscopic fibrils have been obtained from the adductor muscles of marine and fresh-water clams (Mya, Venus, Anodonta). In the dark-field microscope they appear as long, slender, needle-like fibrils. This fibrous protein has the solubility properties of myosin; it dissolves in 0.6 M potassium chloride to form a solution showing high viscosity and stream birefringence. Dilution with water produces a flocculent precipitate which can be redissolved in potassium chloride and which is apparently devoid of fibrils.

Electron micrographs show the fibrils to be very long and evenly contoured, having widths usually between 200 and 1000 Å., though sometimes less. In fibrils treated with osmic acid the density along the axis is not uniform but shows a periodic variation, producing a cross-striated appearance (Fig. 1). From measurements of 100 fibrils a distribution curve of "spacings" of this fiber axis repeat pattern was constructed. All the values lay between 290 and 470 Å., a surprisingly small range in view of the mechanical lability usually associated with muscle fibers. The most frequently occurring spacings were between 330 and 390 Å., the average value of all spacings being 360 Å.

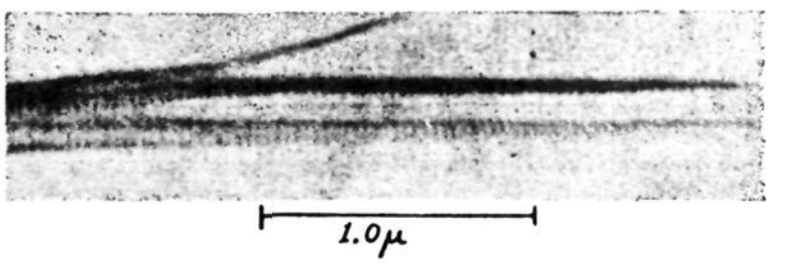

Fig. 1.—Electron micrograph of clam muscle fibrils, magnification × 27,000.

Subsequently Dr. R. S. Bear examined these muscles with X-rays and obtained diffraction evidence that the fiber-axis period in the intact dried muscle is 720 Å. It is improbable that this apparent difference is due to alterations produced in isolating the fibrils and preparing them for elec-