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FURTHER EXPERIMENTS IN MICROBAROMETRY

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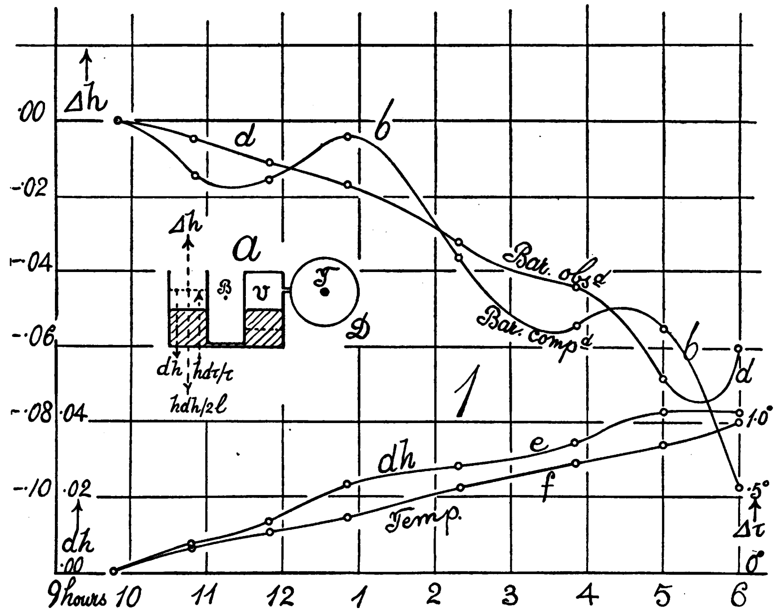
1. *Disc of Air.*—The experiments of my last paper,* in which the expansion of the closed disk-like air volume above one pool of the U-gage is measured while the other is open to the atmosphere, were successively modified to advantage as follows: In the first place a horizontal hole 7 cm. long and 0.6 cm. in diameter was drilled into the iron body of the gage symmetrically between the two pools as indicated at B, figure 1, insert a. This received a thermometer reading to 0.01°C. Thus it was possible to obtain all the terms on the right of the equation $\Delta h = dh + h\ (dh/2l + d\tau/\tau)$ with apparent precision (dh the observed change of level, l the normal depth of the disc of air, h the mean barometer height and τ absolute temperature). Nevertheless, the results for Δh computed in this way were at times too large, at other times too small by a few tenths of a millimeter, showing that there was too much lag in the penetration of temperature, even when the temperature variations did not exceed 0.1°C. per hour. The actual results need not be given here.

2. *Auxiliary Volume.*—The obvious cure for this consists in enlarging the volume v by connecting it with a Dewar flask (D, Fig. 1, insert a) of relatively large capacity, containing a sensitive thermometer at its center T. In this way not only is the τ found for the main body of air, but the importance of the term $hdh/2l$ is virtually eliminated. With a flask of 450 cm.^{3} capacity, if this volume is reduced to a cylinder of the diameter 9.4 cm. of the gage, the disc volume of the gage and the reduced volume of connections added, the term becomes $hdh/16$ instead of $hdh/3$. For so thin a medium as air and slow procedure, the Dewar flask is of little advantage, and any glass vessel will do equally well. Thus, on comparing the temperature change $\Delta\tau$ of thermometer on the barometer with that in the Dewar flask, the relations in successive runs on different days were

	JULY 12	JULY 13	JULY 14	JULY 19
Time	9 hours	7 hours	7 hours	8 hours
Barometer	$\Delta\tau = 0.8$	0.5	0.8	0.5°C.
Dewar	$\Delta\tau = 1.0$	0.2	0.7	0.8°C.

Values of $\Delta\tau$ should never exceed this, implying a room of fairly constant temperature.

Data. —As the Dewar flask is here joined on the right (Fig. 1, *a*, *D*), to the closed volume *v*, and as the micrometer reading increases when this surface of the gauge is depressed, furthermore, as $d\tau/\tau$ is always positive, dh, $hdh/2l$, $hd\tau/\tau$ are additive, while Δh is positive if dh is negative. Again, since dh is positive when Δh is negative, dh and $hdh/2l$ will have opposite signs to $hd\tau/\tau$ and the difference is to be taken. Δh of course indicates the barometric change on the left or open side of the gauge. These relations are suggested in figure 1, *a*.



In the graphs, figure 1, the abcissas give the hours at which observations were made. Curve *d* summarizes the observed (to 0.01 cm.) barometer height reduced to 20°C. Curve *b* is the change of barometer, Δh, computed from the interferometer observations. For this purpose curve *e* gives the values of $dh = 0.71\, dr_0$ (r_0 read off to 0.0001 cm. at the micrometer) and curve *f* the changes of temperature (read to 0.01 °C.) in the Dewar flask.

Figure 1 is a good example of the more complete series, made between 9 A.M. and 6 P.M. The total change of temperature ($d\tau$) of the Dewar flask is here fully 1 °C. (curve *f*). The micrometer displacement *dh* has increased over 0.04 cm. But the curves *b* and *d* are an attempt at coincidence, remembering that the data *d* (reduced to 20°C.) can be read but to 0.01 cm. This curve is really a ribbon of a breadth of about 0.0025 either side of the middle and the curve b is liable to be a trustworthy result within a few 0.001 cm.

These experiments were carefully made after a variety of other similar preliminary work. They did not come out as well as was expected, but they are a great improvement on the preceding set without flask. Obviously a thermocouple will have to be used for temperature measurement. If the trustworthiness of such a curve as figure 1b can be slightly increased, the vessel should make an available laboratory for treating small pressure increments, Δh in chemical reactions, for instance. In fact, if both shanks of the U-gauge are closed and provided with identical auxiliary flasks, the equation becomes $\Delta h = dh + h(dh/l + (d\tau' - d\tau)/\tau)$, in which temperature changes are active differentially.

* These PROCEEDINGS, **14,** 1928, pp. 641–45.

REFLECTION OF SOFT X-RAYS

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A. H. Compton[1] has called attention to the fact that since the index of refraction in the hard x-ray region is less than one, total reflection should occur. This prediction has been verified by him and others, and good agreement found with the Drude-Lorentz theory by which

$$\mu = 1 - \frac{e^2 n}{2\pi m} \sum \frac{n_c}{\nu^2 - \nu_c^2}$$

where n is the total number of atoms per cc., n_c the number of electrons per atom having the critical frequency ν_c, and the other symbols have their usual significance. It was the purpose of the experiments described here to investigate reflection in the region of long wave-length x-radiation. The problem is complicated experimentally and theoretically by the high absorption, the non-monochromatic nature of the ordinary source of radiation, and the lack of exact information concerning the critical frequencies in the region. Holweck[2] found a small amount of reflection from a bronze mirror at angles 11° and 16°. One[3] of us showed by a photographic method that this type of radiation is specularly reflected from glass, copper and nickel over quite a range of angles, but this method did not lend itself to a quantitative measure of intensities.

The apparatus consisted of an x-ray tube with nickel target connected