there is no state of the molecule ion the energy of which is greater than that corresponding to the dissociation. Again, there may be such a state, but it may be metastable, one which upon collision will not undergo dissociation. Considering, then, that this value may be somewhat greater than that strictly required in the change alone, a maximum value can be calculated for the heat of dissociation of oxygen; and a minimum value can be determined, since no atom ions occur at 16 v.

These calculations can be made in the familiar way from the following simple thermochemical considerations. The reactions in question can be represented by the following equations.

$$O_2 = O + O^+ + E^- \quad (1)$$
$$O = O^+ + E^- \quad (2)$$

Subtracting (2) from (1) there results

$$O_2 = 2O \quad (3)$$

The heat of ionization corresponding to Equation 2 can be found from the ionization potential of the atom, which has been determined spectroscopically by Hopfield[4] to be 13.56 v. This corresponds to a heat of ionization of 312,600 cal. per mole. The heat of dissociation and simultaneous ionization of one atom corresponding to Equation 1 is not greater than the energy corresponding to 19.5 v. which is 450,000 cal. per mole, and not less than that corresponding to 16.0 v. which is 369,000 cal. per mole, for the reasons given above. The difference in the first case is 137,400 cal. and in the second 56,400 cal. Therefore, the heat of dissociation of molecular oxygen into atomic oxygen is not less than 56,400 cal. per mole and not greater than 137,400 cal. per mole. While these limits are wide, it is believed that they are narrower than could be given heretofore.

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Germanium. XI. Germanium Glasses. Preliminary Note.—The positions of silicon and germanium in Mendeléeff's Periodic Table make it evident that close analogies between the compounds of the two elements are to be expected. The compounds of germanium which have thus far been isolated and studied, in particular the hydrides, the halides, germanium tetra-ethyl and germanium chloroform, bear out this view,

[4] Hopfield, *Nature*, **112**, 437 (1923).

although in some cases germanium shows a closer resemblance to tin, the element below it in Group IV, than to silicon.

It therefore seemed reasonable to suppose that glasses similar to the silicate glasses, but in which the silicon dioxide is replaced by germanium dioxide, could be prepared. This has been found to be the case, and thus far four different germanium glasses, a very dense flint, a flint, a borate crown and a barium crown have been made and superficially studied. To render it possible to compare these glasses definitely with similar silicate glasses, identical mixtures were used in the preparation of the corresponding samples except that the silica in the one was replaced by an equimolecular quantity of germanium dioxide in the other.

Table I gives the composition of the "mix" in parts by weight and the refractive index of the resulting glass for each of the four kinds mentioned above, with the corresponding silicate glass in the adjacent column.

TABLE I

COMPARISON OF GERMANIUM AND SILICATE GLASSES

	Very dense flint		Flint		Borate crown		Barium crown	
	Si No. 1	Ge No. 2	Si No. 3	Ge No. 4	Si No. 5	Ge No. 6	Si No. 7	Ge No. 8
Refractive index n_D	1.967	2.068	1.644	1.794	1.5172	1.619	1.5726	1.670
SiO_2	18.0	..	41.3	..	67.850	...	48.323	..
GeO_2	..	31.2	..	71.61	..	117.652	..	83.80
K_2O	..	..	6.8	6.8	8.580	8.580	8.326	8.326
Na_2O	..	..	..	..	8.333	8.333	..	..
BaO	..	..	..	..	3.163	3.163	30.039	30.039
B_2O_3	..	..	..	..	11.869	11.869	3.163	3.163
ZnO	..	..	..	..	..	..	9.665	9.665
PbO	82.0	82.0	51.6	51.6	..	..	..	..
As_2O_3	0.1	0.1	0.3	0.3	0.204	0.204	0.483	0.483

The two germanium flint glasses, Nos. 2 and 4, had a yellowish tinge which was due to the high percentage of lead which they contained. The corresponding silicate glasses showed the same color. The other two germanium glasses were very transparent, free from color and apparently quite stable. Germanium glasses homogeneous in character and free from air bubbles can be prepared much more easily than the corresponding silicate glasses because they melt at considerably lower temperatures than the latter.

As is shown in the table, the replacement of silicon by germanium in the several glasses raises the refractive index in each case.

It is proposed to make a detailed study of germanium glasses in this Laboratory, and to determine the optical, physical and chemical properties of various types.

The preparation of fused, transparent germanium dioxide is also being investigated, and it has already been found to be possible to obtain this in clear, transparent form quite similar in appearance to fused quartz.

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Filling Mercury Manometers.—The method of filling mercury manometers described by Swan[1] is similar to one which has been found very convenient in this Laboratory. In the latter method, the mercury is distilled into the manometer in a high vacuum. The apparatus is shown in Fig. 1. The bulb A contains the mercury. B is a by-pass for the escape of any gas liberated during the distillation after mercury has sealed off the bottom of the manometer. The vacuum pump is connected at C. After the manometer is filled, the constriction at D is sealed off, air is admitted and a cut made at E.

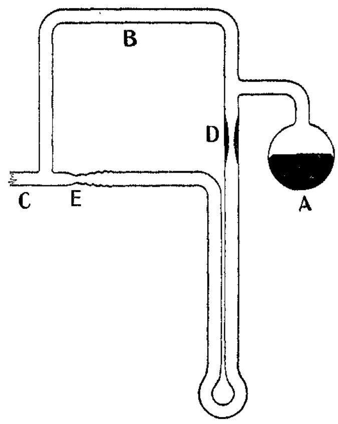

Fig. 1.

The distillation makes it easy to obtain clean mercury surfaces and does away with the necessity of boiling out small tubes. If care is taken to see that all air held by the mercury and the tubes is driven off before the outlet through the manometer is closed by mercury, the by-pass may be found to be unnecessary.

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[1] Swan, THIS JOURNAL, 47, 1341 (1925).