of special interest as it shows the results obtained by flotation of the same ore on water at different temperatures. The decided improvement in the grade of concentrates by using warm water may be attributed to the decreased surface tension of the liquid allowing some particles of gangue to sink more readily. The recovery with warm water is, however, remarkable and can be accounted for only by some factor, such as a difference in the rate of feed, that would make the tests not strictly comparable. A summary of the data obtained by Wood is given in a table which is presented below:

Results of Concentration Tests of Molybdenite Ores by Wood Flotation Process.

1	Through 40-mesh.	2.08	41.38	99.00	Colorado ore. Retreatment would materially increase the grade of concentrates with little loss.
2	Through 20-mesh.	2.00	61.55	92.27	Alaskan ore.
3	....	1.87	45.31(a) 56.70(b)	79.08(a) 89.17(b)	Canadian ore with a quartz and mcia gangue. (a) was obtained with water at 56° F. and (b) with water at 110° F.
4	Through 20-mesh.	6.66	63.50	96.34	Foreign ore.
	Through 30-mesh.	6.73	67.42	86.26	
	Through 40-mesh.	6.66	65.50	86.48	
	Through 40-mesh.	8.95	74.60	94.19	
.5	Through 40-mesh.	8.65	30.00(a) 81.45(b)	79.00(a) 26.30(b)	Alaskan ore containing pyrrhotite and magnetite, and low in silica. (a) was obtained with raw ore, and (b) with slightly roasted ore.

In order to obtain data as to concentration of a molybdenite ore containing copper sulphides by this process a small-scale test was made of a sample of ore from the Whale claim, in Copper Canyon, near Copperville, Ariz. The ore consisted of a clean white quartz containing about 7 per cent. of molybdenite and 2 per cent. of copper, present largely as chalcopyrite.

After the ore has been dried and then crushed in a ball mill to pass a 40-mesh screen, it was concentrated on a laboratory-size flotation machine of the Wood type. The concentrator was so arranged that the floating film of concentrates picked up by the take-off belt was discharged to a second flotation surface from which it was allowed to run into a concentrate tank. The material that sank in the second flotation tank was considered middlings. The ore and water feeds to the machine were adjusted with the idea of causing as much chalcopyrite as possible to sink. The results of the test are given in the accompanying table.

Weight, grams	4,000.00	538.00	107.00	*3,355.00
Per cent. Molybdenite ..	†7.10+	47.44	6.74	.65
Per cent. Cu	†1.93+	5.26	5.90	1.27
Weight Molybdenite, grams	284.25	255.23	7.21	21.81
Weight Cu, grams.......	77.22	28.30	6.31	42.61
Extraction Molybdenite, per cent.	.....	89.79	2.54	.....
Extraction Cu, per cent...	.....	36.65	8.17	.....

The great difference between the percentage of recovery of molybdenite and of chalcopyrite is of particular interest. As compared with the feed, the concentrates contained approximately seven times the percentage of MoS_2 and less than three times the percentage of copper, and the recovery in the concentrates was 89.79 per cent. of the molybdenite, as compared with only 36.65 per cent. of the copper. Inasmuch as the crushed ore had stood only a short time before treatment, so that the particles of chalcopyrite had little opportunity to oxidize, which would cause them to be more readily wetted, the author considers the widely different results obtained in the concentration of the two minerals to be remarkable.

Oil-Flotation Processes.

Many of the principal processes of concentration by oil flotation are described in detail by Hoover and in numerous articles that have recently appeared in the mining press. Published data giving the results obtained by the application of these processes to molybdenite ores are extremely meager, and are practically confined to the results of treatment by the Elmore vacuum flotation system. As the Bureau of Mines at present has no equipment at its disposal for conducting tests of the various flotation processes, the concentration of molybdenite by these methods must, of necessity, be discussed here in only a general way.

Broadly speaking, oil flotation probably offers the best method of treating molybdenite ores in general, and those particular processes that have been successfully applied in concentrating ores of the other metallic sulphides would, without doubt, meet with equal success in the treatment of molybdenite. The above statement does not mean that all molybdenite ores can be successfully concentrated by oil flotation, for the physical characteristics and mineralogical composition of an ore are as important factors in determining the success of any oil-flotation process as of electrostatic or water-flotation methods. The ores best suited for treatment by oil flotation are those in which the molybdenite is flaky. From ores in which the mineral is so fine as to be almost amorphous and the gangue contains a considerable proportion of soft material, such as kaolinized feldspar, it is almost impossible to obtain a good grade of concentrates because of the flotation of some of the finer particles of gangue. Of course, if molybdenite is associated with other metallic sulphides, such as chalcopyrite, pyrite, or pyrrhotite, these are concentrated too, and must either be removed from the ore, by a preliminary treatment, or from the concentrate if a high-grade product is desired. Methods that may be employed for this purpose are discussed later. Ores containing magnetite, hematite, garnet, hornblende, or similar gangue minerals that are good conductors of electricity, and therefore are not adapted for concentration by electrostatic methods, are especially suited for treatment by flotation.

Laboratory experiments indicate that in general the particles of molybdenite that can be floated are much coarser than those of other metallic sulphides, and if finer crushing is not necessary for the liberation of the molybdenite from the gangue, material as coarse as 20-mesh may be successfully concentrated. On the other hand, there is every reason to believe that a good recovery and a fair grade of concentrates can be obtained from the treatment of molybdenite through 200 mesh because galena and sphalerite of similar fineness have been successfully treated by oil flotation. In general, therefore, oil-flotation processes are applicable to a wider range of sizes than are electrostatic or water-flotation methods, and many of them have the added advantage of large capacities from small units. For example, Hoover estimates that in one type of apparatus used in the minerals-separation process a unit consisting of six mixing boxes each only 16 inches wide and 36 inches deep will have a daily capacity of 50 to 60 tons of ore,* presumably Broken Hill lead-zinc tailings, and a 5-ft. Elmore machine will ordinarily treat from 25 to 45 tons of crude ore in 24 hours.** Capacities equal to and perhaps even greater than these

* Hoover, T. J., Concentration ores by flotation, 1912, p. 120.
** Hoover, T. J., op. cit., p. 101.