Over a range of several different temperatures marked differences in varieties could be noted.

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THE USE OF SOLID CARBON DIOXIDE IN MAKING FREEZING-POINT DETERMINATIONS WITH PLANT JUICES

DUNN[1] has recently employed "Dry Ice" as a refrigerant in subjecting tissues of apple stems to freezing temperatures.

The ease with which this material can be handled and the ease with which low temperatures can be obtained and maintained caused the writer to test out its use as a refrigerant in determining the freezing-point depression of plant juices.

Although others may possibly have employed Dry Ice for this purpose, it seems to the writer that knowledge of this method should receive more publicity. Because of the ease of manipulation and the cleanliness and rapidity of the method, it seems as though its use would be of value to workers in the plant sciences.

In this method an ether bath surrounds the air jacket of the usual Beckman freezing-point apparatus. The temperature of the bath is regulated by adding to it pieces of Dry Ice (solid CO_2) until the desired temperature is reached. When the pieces of Dry Ice drop into the ether they sink, causing at the same time violent bubbling of the liquid, while the temperature of the bath becomes lower. The bubbling causes the temperature of the bath to become uniform throughout, dispensing thus with stirring.

The air-jacket may be filled with ether or alcohol if desired. The ether bath should be in a cylindrical container, tall enough to accommodate the air-jacket and its contents and the auxiliary thermometer. The container may be of metal, enamelware or glass, and should have a capacity preferably of two to two and one half liters, and tall enough to accommodate the freezing tube.

The desired temperature of the bath may be maintained during an experiment by adding small pieces of solid CO_2 whenever there is a tendency for the temperature of the bath to rise. The apparatus should be placed in sawdust or some other insulating material.

The advantages of using ether for a bath lie in the following points: (1) Ordinary ether is cheap. (2) The freezing-point of ether is very low. (3) Ether is volatile, leaving the apparatus clean after its use. (4) In other liquids that are volatile and do not adhere to the parts of the apparatus in contact with them, difficulty is obtained in lowering the temperature of the bath if water is present. For this reason alcohol has been discarded as a bath. In alcohol the pieces of CO_2 become coated with ice which retards or stops the volatilization of the CO_2.

It is apparent that this method excels as cooling is produced by drawing air through the ether bath causing rapid evaporation therein because of the more rapid lowering of the temperature.

The advantages of this method over methods where a salt-ice mixture is used are the following: (1) The temperature of the cooling mixture is more easily controlled. (2) The material is cleaner and easier to handle. (3) The ether in the bath may be used over and over again. (4) The temperature of the ether bath can be lowered more rapidly and accurately.

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[1] Stuart Dunn, "The Use of 'Dry-Ice' or Solid Carbon Dioxide as a Laboratory Refrigerant," SCIENCE, March 29, 1929.

SPECIAL ARTICLES

SERIES IN THE ARC SPECTRUM OF BROMINE[1]

RECENTLY we have photographed the spectrum of bromine as emitted by a Geissler tube, from the ultra-violet to beyond 9300A in the near infra-red. The type of spectrum obtained depends both on the pressure of the gas within the tube and the character of the exciting discharge. When the gas at low pressure is activated by an uncondensed discharge from a high-voltage transformer the spectrum observed is predominantly that of the neutral atom, the arc spectrum.

With the new wave-length data and the wave-lengths observed by Turner[2] in the Schumann region, we have succeeded in working out the structure of the arc spectrum, Br I. The theoretical structure of the spectrum is similar to that of Cl I which we described in our note to SCIENCE for October 12, 1928. Turner's lines represent the combination of the lowest term $s^2p^4 \cdot 4p$ ^2P with the higher ^2P and ^4P terms coming from the electron configuration $s^2p^4 \cdot 5s$. These terms, in turn, combine with still higher terms coming from $s^2p^4 \cdot 5p$ and $s^2p^4 \cdot 6p$ to give the prominent arc lines observed in the infra-red and in the green and blue.

For the lines observed by Turner, we give the following classification.

The lines from the $5p$ and $6p$ electrons are in Rydberg sequence. We therefore use them in calculating

[1] Publication approved by the director of the Bureau of Standards, of the U. S. Department of Commerce.

[2] *Physical Review*, 27: 400. 1926.