

spheres, and a temperature of  $-140^{\circ}$ , obtained by means of sulphurous and carbonic acids.

"Signed, RAOUL PICTET."

Roscoe and Schorlemmer in their account of these observations, say:

"It is difficult, on reading the descriptions of these experiments, to know which to admire most, the ingenious and well-adapted arrangement of the apparatus employed by Pictet, or the singular simplicity of that used by Cailletet. The latter gentleman is one of the greatest of French ironmasters, whilst the former is largely engaged as a manufacturer of ice-making machinery, and the experience and practical knowledge gained by each in his own profession have materially assisted to bring about one of the most interesting results in the annals of scientific discovery."

The final liquefaction of hydrogen by Dewar was another such event. After repeated attempts to liquefy this gas in different laboratories, the end was accomplished and a laconic telegram from Dewar in May, 1898, announced to the scientists at Leiden "Hydrogen liquefied." Now, liquid hydrogen is a common sight in cryogenic laboratories.

If we try the method of Hampson and Linde, employing the Joule-Kelvin effect of expanding through a small orifice, we find that hydrogen is heated instead of being cooled. This was the difficulty Dewar had to overcome. He found that if hydrogen is first cooled in liquid air, then the expansion from high pressure produces a lowering of temperature as in the case of air and then the regenerative process may be employed and the hydrogen liquefied at  $-253^{\circ}$ . At this appallingly low temperature air is a solid. A vessel containing liquid hydrogen may have frost collect on it, but this will be air frost, i.e. air that is frozen. If the hydrogen be evaporated at low pressure by a vacuum pump the temperature falls to  $-257^{\circ}$  when the hydrogen freezes solid. By continued evaporation the temperature may be reduced further, to  $-259^{\circ}$ .

Is this the end? Fortunately, there is one more gas, helium, of such peculiar properties that it is still gaseous at these low temperatures. And if cooled to  $-258^{\circ}$ , it may then be