SHORTER CONTRIBUTIONS

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THE REDUCTION OF HUMIDITY OBSERVATIONS

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Observations of either relative humidity or of wet and dry bulb temperature have to be converted into other physical quantities before they can be used. Water vapour pressure is required for the computation of evaporation, dew points for forecasting and hydro-meteorology, mixing ratios for establishment of precipitable water, and absolute humidity for the determination of the air's electric strength. Both the British and the United States Meteorological Services use special slide rules for the reduction of humidity observations. Alternatively, there are numerous tables available for this purpose. However, most of these tables require examination of several different sheets, which is rather cumbersome. It is possible to construct a relatively simple nomogram which allows conversion of any type of humidity specification into any other. A copy of this nomogram or humidity conversion chart is shown in Fig. 3. The ordinate of the chart represents vapour pressure e on a logarithmic scale; the abscissa is the temperature T. The lines sloping upwards from left to right are lines of constant relative humidity. Those curving down from left to right are lines of equal wet bulb temperature as measured at sea level by an aspirated psychrometer with an ice covered wet bulb if T_w is less than 32^o.

The use of the chart is illustrated by the skeleton diagram, Fig. 1. Assume a dry bulb temperature $T = 70^o$ and a wet bulb temperature $T_w = 50^o$. In this case follow the 50^o line upwards to the intersection with the 100% relative humidity line and then along a constant wet bulb temperature line to its intersection with the 70^o line at the point P. The same representative point P could have been obtained immediately if the relative humidity had been measured in the first instance. At P the vapour pressure e = 5 mb.

The dew point T_D is obtained by following the e = 5 mb line

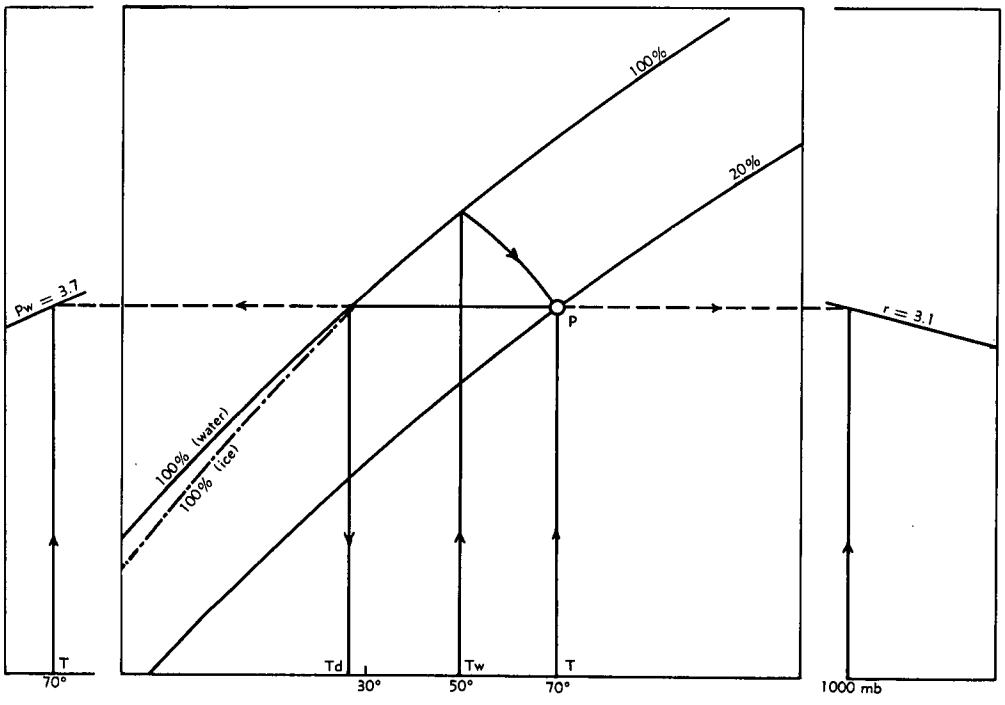

Fig. 1. Skeleton diagram illustrating use of the chart for pressures of 1000 mb (± 50 mb).

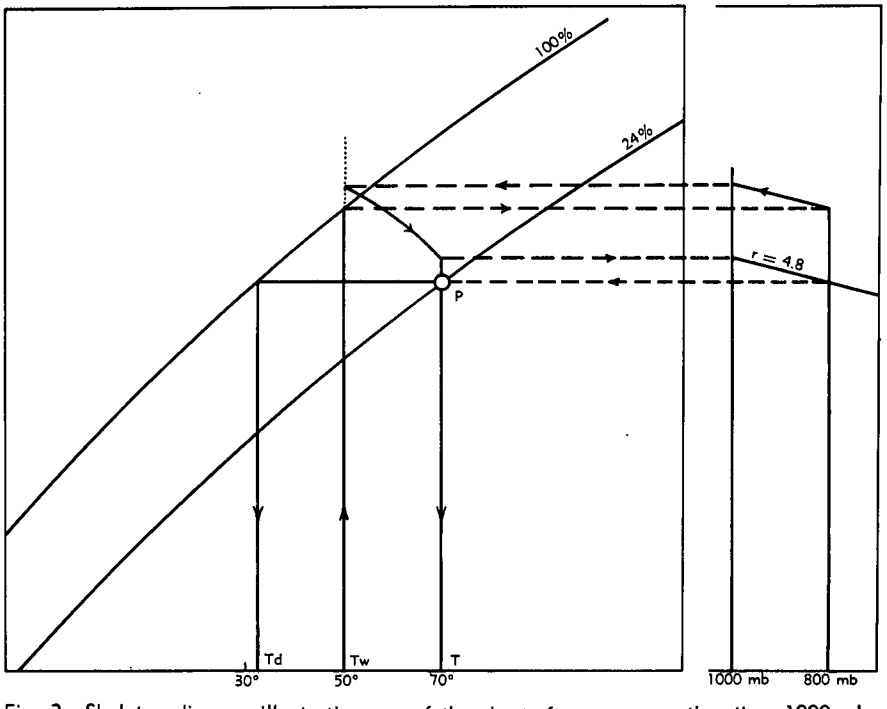

Fig. 2. Skeleton diagram illustrating use of the chart for pressures other than 1000 mb.

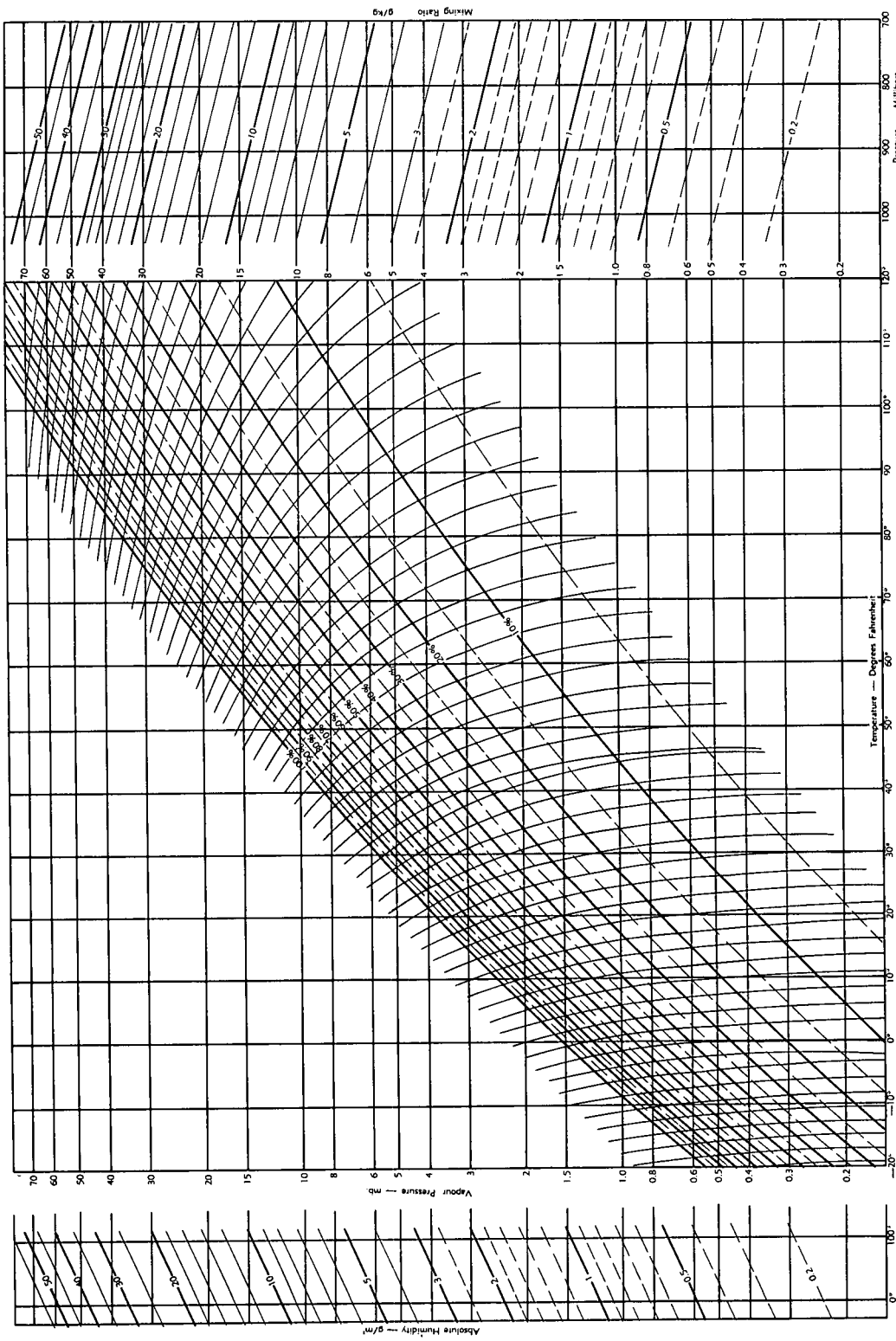

Fig. 3. Humidity Conversion Chart.
(Snowy Mountains Hydro-Electric Authority)

horizontally to its intersection with the 100% relative humidity line and by reading off the temperature at that intersection. In the present case it is 27°. The frost point T_f is obtained from the intersection of the e line with the 100% (ice line) which represents saturation over an ice surface. In the present case $T_D = 27°$ and $T_f = 28°$. Absolute humidity is obtained by going horizontally from P to the diagram on the left-hand side, and by reading off the value at the intersection with the relevant temperature line. In the present case the absolute humidity is 3.7 gram per cubic metre. The mixing ratio is obtained in a similar way on the right-hand diagram by reading off the intersection with the relevant pressure. In the example, if the pressure is 1,000 mb, the mixing ratio is 3.1 gram per kilogram.

If the pressure is other than 1,000 mb, the determination of the characteristic point P will be the same if relative humidity is the observed basic variable. If the wet bulb temperature has been observed the procedure is somewhat more involved and use of the issued tables is recommended to find the dew point in this case. From dew point and the dry bubl temperature it is again possible to obtain the characteristic point P and with it the other humidity specification on the chart. However, it is not necessary to refer to tables and a graphical procedure can be used to obtain P at any pressure level from the chart alone. The manner in which this would be done for a station with a pressure of 800 mb, corresponding approximately to Spencer's Creek, is shown in Fig. 2. In practice it is possible to neglect pressure differences of less than 50 mb for the determination of vapour pressure from wet and dry bulb observations.