CHAPTER 6

SUMMARY AND CONCLUSION

In the present study a thermal diffusion chamber is designed and developed in order to measure C.C.N concentration at different time (diurnal variation) as well as at different supersaturation (supersaturation spectra). The results obtained are compared with those of other workers. The small temperature gradient across the height of the chamber (Section 2.4) is produced by designing one automatic temperature controller circuit. The instrument shows an excellent linearity in the controlled temperature (Fig. 3.4) in the desired temperature range. The accuracy of such control of temperature is below 0.1°C. The two surface temperature of the thermal diffusion chamber are measured accurately by an electronic oscillator circuit for the measurement of relevant supersaturation in the middle of the thermal diffusion chamber. A new procedure is suggested in which the linearization of thermistor (temperature sensor) is achieved by designing the oscillator circuit in such way that the time period of oscillation is proportional to the natural logarithm of thermistor resistance. The instrument shows very good linearity in the temperature measurement over wide range (Section 3.4) and also having an accuracy of ± 0.1°C. A detail study of transient and steady state supersaturation distribution inside the thermal diffusion cloud chamber is made before actual measurement of C.C.N. concentration at different time as well as at different supersaturation (Section 4.2). Solutions of one dimensional partial differential equations of water vapour diffusion
and heat conduction under appropriate initial and boundary conditions are used in this study. The following are the important conclusions on the basis of present study.

1. The transient supersaturations exceeding the steady state peak value will arise if the incoming air sample is saturated and colder than the top-plate temperature.

2. The transient subsaturation less than the steady state peak supersaturation value will arise if the incoming air sample is maintained at the top-plate temperature and saturated at that temperature.

3. The chamber gradually passes from a state of transient subsaturation to steady state supersaturation when the incoming air sample is maintained at either top-plate or bottom-plate temperature and the sample is associated with certain value of relative humidity.

In general supersaturation greater than that assumed for the chamber will give high counts. On the other hand transient subsaturation will only produce a delay in the activation of a portion of the cloud nuclei population and will not affect the total C.C.N count inside the thermal diffusion chamber. Thus the error in the measurement of C.C.N. can be eliminated if the sample is not introduced inside the chamber under Case I i.e. saturated air sample at the cold bottom plate temperature. In all practical cases when the sample is associated with certain relative
humidity (Case III and Case IV), there is no remarkable variation in the value of supersaturation in our chamber after 10 sec. The final steady state supersaturation is reached in our chamber in 20 second.

Our observation in the day time variation of C.C.N. concentration (Fig. 4.9 and Fig. 4.10) show that its value is maximum in the late morning around 11 hr. I.S.T. Afterwards the C.C.N. concentration decreases gradually through short time variation exist in all the curves. The trend of variation is quite similar with the result obtained by other workers \[46\]. The C.C.N. concentration increases almost linearly as supersaturation in the centre of the chamber increases. The constants (K and \(\alpha\)) of the best fitted line show some similarity with those obtained by other workers \[47\].

The recent cloud condensation nuclei counters have been developed which are based on the principle of measurement of light scattering coefficient of the cloud developed inside the chamber. The result of few important laser scatter study \[10\] in thermal diffusion chamber in relation to cloud condensation nuclei measurement is described in detail in Chapter 5. In this technique few other important measurement are also described.

(i) The radius of the droplet at a given time.

(ii) The scattering coefficient of the cloud produced inside the T.D.C.
(iii) Time required for the droplet in a T.D.C. to become essentially monodispersed.

Simultaneous measurement on the concentration of droplets inside the T.D.C. using automatic light scattering technique is also compared with those obtained by direct visual counting as reported by other workers. It is seen that the two methods of measurements agree reasonably well when the C.C.N. concentration was less than 500.

Theory of laser scatter study and mm wave attenuation are also described briefly in Section 5.6.