A synopsis of the thesis entitled "Heat Transfer by free & forced convection"

The work presented in this thesis was carried out as a part of a programme undertaken by the Heat section of the Physics department for investigation of heat transfer.

The thesis has been divided into five chapters. The first chapter deals with a general discussion of the theory of heat convection and the method of dimensional analysis for dealing with the problems of convection. The basic equations of Thermal convection which include the equations of fluid flow and those of heat conduction are first derived in the usual elementary way, and they are then used to obtain the following dimensionless groups viz:- Nusselt Number Nu, Grashof Number Gr, Prandtl Number Pr, Reynolds Number Re, and Stanton Number St, which play an important part in the theory of thermal convection. The chapter concludes with a discussion of the utility and importance of these dimensionless numbers.

In the second chapter an account is given of some of the experiments carried out in our laboratory for studying the transmission of heat by natural (free) convection. The flow of heat by natural convection through the following fluids was studied. Methyl alcohol, Ethyl alcohol, Benzene, Toluene, Aniline, Acetone, Olive oil, Paraffin oil, Terpentine, Carbontetrachloride etc. The relation between Nusselt Number (Nu), Grashof Number (Gr) and Prandtl Number (Pr) is then established by means of graphs with Nu as ordinate and the product Gr.Pr. as abcissa. A brief discussion of these graphs and a comparison of our results with those of other workers are given in the end.

The third chapter is devoted to the study of heat transfer by forced convection. The apparatus used for studying the convective heat transfer in an unbounded medium is described in detail and the results are exhibited for different values of air velocities. The convective constants (shape constants) are then calculated for different shapes of vessels. The relation between the heat transfer coefficient and flow velocity is determined by plotting graphs of Nusselt Number (Nu= $\frac{hl}{k}$) against the Reynolds Number (Re= $\frac{\rho l}{\mu} V$).

The whole chapter is confined to the study of forced convection under lower values of Reynolds Number Re.

The fourth chapter deals with our experiments on forced convection in the upper range of Reynolds Numbers. The modified apparatus including the wind tunnel constructed in our laboratory is first described and the relation between convective heat transfer and air velocities is exhibited by plotting the Nusselt Number (Nu= $\frac{hl}{k}$) against the Reynolds Number (Re= $\frac{\rho l}{\mu} V$). The relation between heat transfer and momentum transfer is briefly discussed and the expression for drag coefficient is obtained. The graphs of drag coefficient against Reynolds Number are then plotted.

In chapter fifth some experiments are described on the heat transfer to boiling liquids. The results obtained by Nukiyama for water boiling on an electrically heated platinum wire have been verified and, the transmission of heat through some other boiling liquids such as Terpentine, Carbontetrachloride, Naphthalene etc. has been studied. Some interesting results that have been obtained are exhibited by means of graphs of log (q/a) against log (ΔT), where q/a is the heat transfer per unit area per second and (ΔT) is the difference of temperature between the heated wire & the boiling liquid. An outline of the elementary theory of Film Boiling given by Bromley is given in the end and this theory is then compared with the experimental results obtained by us.