Significant progress has been made in the recent years by discovering many novel catalysts but the origin of catalytic activity is still not well understood.

The activity particularly of metal and alloy catalysts is discussed in terms of three general concepts: (1) chemical factor (chemisorption), (2) geometrical factor and (3) electronic factor. A brief introductory account of these factors in catalysis has been given including a discussion on their merits and demerits.

A great many investigations have been made on the catalytic hydrogenation of ethylenic linkages in a variety of organic compounds. Its technical application such as in the hydrogenation of fatty oils using nickel as catalyst, is one of the major processing operations in the fat and oil industry. But a detailed understanding of the mechanism of the process has still not reached. The use of nickel catalyst is so well established that no serious attempt to find any substitute has been made. We have undertaken a study on the preparation of two nickel based alloy catalysts, e.g., nickel-copper and nickel-cobalt with a view (1) to study the role of electronic factors (continuous variation of the electronic factor effected by mixing (1) a d-metal with an s-metal, nickel and copper.
and (ii) two d-metals, nickel and cobalt) and (2) furthermore to provide basic data to evaluate the potentialities of such catalysts for hydrogenation of fatty oil in practice.

It is desired that the metal and alloy catalyst should be prepared at as low a temperature as possible to minimize sintering. The use of metal formates have several advantages over the other common salts such as sulphate, nitrate and oxalate for this purpose. The thermal reduction behaviour have therefore been studied using the technique of thermogravimetric and differential thermal analyses to determine the reduction temperatures of these salts.

It has been found that nickel formate is reduced to the metallic state at a sufficiently low temperature (~220°C) and the temperature is further reduced to below 200°C with the incorporation of copper formate or cobalt formate in it. The different steps or peaks in the T.G.A. and D.T.A. curves have been interpreted with reference to the formation of various intermediates and products. While the thermal decomposition in air of copper formate has been shown to give a mixture of Cu₂O and CuO (which finally gives CuO) and cobalt formate gives Co₃O₄, nickel formate decomposition shows an additional peak corresponding to the formation of metallic nickel which finally oxidises to NiO. The coprecipitated Ni-Cu formates and Ni-Co formates show a single reduction step in hydrogen
indicating that they form homogeneous binary alloys under the stated conditions. On the other hand, physically mixed metal formates are reduced to individual metals under the same conditions.

An X-ray powder diffraction analysis of the mixed formates and thermally decomposed samples in hydrogen and air have been made to confirm the formation of solid solution. Further the change in the lattice constants of Ni due to alloying with Cu and Co has been measured and maximum deviation from the Vegard's law has been observed around 30% Cu or Co in Ni. The former result is significant in the sense that maximum activity for hydrogenation of a fatty oil has been observed when a catalyst (Ni-Cu) of approximately the same composition was used. The oxides formed from mixed formates by thermal decomposition in air at 350°C for 4 hours showed the presence of oxides as separate phases.

The nickel-copper and nickel-cobalt alloy catalysts were prepared by reducing respective mixed formates in oil medium by the wet reduction method. Their activity was evaluated by studying the rate of hydrogenation of groundnut oil. In both the cases the activity was evaluated on total metal (viz., Ni-Cu and Ni-Co) basis. The mixed Ni-Cu catalysts are quite comparable with the pure nickel catalyst for the
hydrogenation of fatty oil both from the point of activity and selectivity. The most suitable composition lies in the range 20 to 30\% Cu in Ni. In the case of nickel-cobalt catalysts, it was observed that the catalysts containing increasing amount of cobalt are comparatively less and less active than pure nickel catalyst. At higher concentration (viz., 50\% cobalt) there is an appreciable fall in the activity. Further it was noted that the decrease in activity is not linear with changes in cobalt concentration. The activation energy for hydrogenation of groundnut oil with Ni-Cu and Ni-Co catalysts have been found to be 5.04 K.cal and 7.1 K.cal/mole respectively. These results have been compared with those from related studies reported in the literature and discussed in the light of d-band structure of the catalysts.

The nature of Ni-Cu and Ni-Co catalysts regarding their degree of selectivity in hydrogenating groundnut oil under specified and comparable conditions have been studied. The break in the plot of rate curves of hydrogenation determines the selectivity of the catalysts. It was found that this property is good for the Ni-Cu and Ni-Co alloy catalysts.