UNTIL about 35 years ago the unusual properties of long-chain macromolecules—such as rubber-like elasticity, high solution viscosity, abnormally low osmotic pressure—seemed so puzzling that chemists attributed very peculiar and mysterious intermolecular forces to such subsctances. When it was recognised, however, that covalent structures comprising thousands of atoms could be formed, the quantitative physicochemical sciences of macromolecular systems could be developed without recourse to these mysterious forces. Professor Paul J. Flory of Stanford University, this year's recipient of the Nobel Prize for Chemistry, stands foremost among those who have devoted themselves to the development of the physical chemistry of high polymers. His exacting efforts have provided the basic conceptual framework for much of polymer science. It is Flory's distinction to have made original and fundamental contributions to virtually every phase of the subject. He was a pioneer in establishing the basic concept that research in polymer chemistry can be carried out with the same scientific rigour as in other branches of chemistry.

Professor Flory's first contribution to polymer science consisted of theoretical and experimental investigations of the principles of condensation polymerisation. This pioneering effort in the application of statistical methods to a problem in polymer chemistry was exact and definitive and was extended to more complicated systems with multifunctional reactants. The result was the concept of an infinite network polymer and a statement of the conditions for its formation. In studies of free radical polymerisation, Flory was the first to point out, in 1937, the importance of chain transfer processes in controlling molecular weight and to show how such processes lead to branching and crosslinking.

Another area strongly influenced by Flory has been the study of the physical properties of polymers in bulk. These include major contributions to rubber elasticity theory and experiments, together with the basic understanding of the swelling of insoluble polymer networks. Professor Flory pioneered the measurement of the melt viscosity of polymers and its interpretation in terms of molecular weight, molecular weight distribution, degree of branching and temperature. His paper on the statistical thermodynamics of polymer crystallisation represents a major contribution, which clarified an area that had previously been confused. He was able to show how the crystallisation-melting phenomena involving long-chain molecules fits into the classical framework of a first-order phase transition. From this basic concept has come an understanding of crystallisation kinetics, the recognition of the importance of nucleation processes in crystallisation, morphology and the properties of semicrystalline polymers. These ideas were then applied to oriented (fibrous) systems with the development of a quantitative theory of contractility and tension development in the fibrous proteins and applications to natural systems.

Professor Flory has made major contributions to the determination of the quantitative relations beween the macroscopic thermodynamic and hydrodynamic properties of a polymer solution and the average properties and interactions of the dissolved chain. The genesis of this work was the now celebrated "lattice theory", published in 1942, which gives an explanation for the enormous deviations of the thermodynamic properties in polymer solutions from the ideal mixing law. This work was extended to encompass dilute solutions where intra and intermolecular excluded-volume effects were taken into account. When this work was coupled with an analysis of the frictional properties of dilute polymer solution a unified treatment of viscosity, sedimentation velocity and diffusion resulted. The well-known Flory theta temperature, equivalent to the Boyle Point of a real gas, emerged from this work and prescribed the conditions in which a polymer solution behaves ideally. This major development has allowed for the simple and direct determination of molecular weight and of the conformational properties of chain molecules in solution.

This description of Flory's work, the excellence of which continues to this day, shows that it is the cornerstone of every area of polymer science.

The hallmark of his work is a keen analysis of complex problems leading to essentially simple solutions. The close relationship between experiment and theory is notable in his work. Experimental findings have promoted new theoretical investigations while the predictions of theory have been tested in elegant but simply executed experiments.

L. MANDELKERN

tion to cell biology is his strict adherence to precise quantification and establishing 'balance sheets' for enzymes and other cell components derived by subcellular fractionation, a concept unfamiliar to classical cytologists before Claude's pioneering studies. His elegant use of enzyme markers has led not only to the discovery of the lysosome and the peroxisome but to engendering modern "enzyme cytology".

George Palade, a native of Rumania, was also influenced by Claude when he arrived to work at the Rockefeller Institute in the 1940s. Soon after playing his part in developing a better procedure for isolating mitochondria, Palade innovated techniques for fixation of tissues and subcellular fractions for electron microscopy which have now become standard throughout the world. This enabled him to propose a double membrane model for mitochondria, but by the mid-1950s he turned his attention to "microsomes". With K. Porter he showed that this subcellular fraction was derived from the endoplasmic reticulum, an intricate network of intracellular membranes and ribosomes. In a fruitful and long lasting collaboration with P. Siekevitz, he provided the first direct confirmation that the ribosome was the site of protein synthesis in the cell. They also showed that active ribosomes existed both as free particles and in a form, predominant in protein secreting cells, in which these are attached to membranes. (Such membranes themselves have since been recognised to be the principal site of metabolism and detoxication of drugs, hormones, carcinogens and so on in the liver.) Students of molecular biology often fail to realise that the foundations for the spectacular success with cell-free preparations from *E. coli* in understanding the process of translation of genetic information were laid down by the work on rat-liver ribosomes in the laboratories of Palade and Zamecnik.

In the 1960s Palade's group became more and more interested in secretion of proteins and, in a series of elegantly designed and executed experiments involving the pancreas, established that proteins for export from the cell are exclusively synthesised on ribosomes bound to the membranes of the endoplasmic reticulum and not on free polyribosomes. They then described the vectorial passage of the newly synthesised protein into vesicles of "smooth" (ribosome-free) endoplasmic reticular membranes followed by their entry into the Golgi apparatus which would be moving towards the periphery of the cell. Most recently, Palade has turned his attention to the biogenesis of membranes and has proposed the mosaic pattern of arrangement of membrane components.

Finally this year's Nobel Prize highlights an extraordinary success story of modern bio-medical research—the Rockefeller University.

JAMSHED R. TATA