in the host enzymes induced by virus infection, and sequence of mutational sites in the virus genome.

A very brilliant paper by Maaløe gives a theoretical sketch of how a cell may adjust the sizes and activities of its synthetic systems to the nutritional content of the medium. The value of this paper, especially for people, like myself, not versed in the subject, lies in the way it brings together information from different fields. A major recent contribution to biochemical genetics is the discovery by Cohen and Jacob of what we could call the principle of " two (or more) genes-one-enzyme ". For some enzymes there seems to be at least two kinds of genes: one kind determines the aminoacid sequence (or sequences) of the polypeptide (or polypeptides) which make up the enzyme: the other kind determines the formation of a specific " repressor ", apparently not protein, which checks the synthesis of the enzyme unless inactivated by specific small molecules of internal or external origin. This is what underlies the induction of certain enzymes by a specific substrate and the immediate repression of the synthesis of a whole series of enzymes in the exogenous presence of their metabolic end product. Maaløe discusses how the flow of information from the nucleus to metabolic end products and from them back to the nucleus determines the adjustments which lead to a definite growth rate and cell composition.

Other papers of the Symposium are well worth reading. Kellenberger gives an account of nuclear structure based mainly on electron microscopy. Clowes provides a useful review of fine genetic analysis by means of transduction, and Esther Lederberg gives the details of the joint biochemical and genetic analysis of galactose metabolism in *E. coli*. Harriet Ephrussi-Taylor develops some important ideas on the functions of DNA from transformation studies: unfortunately the presentation is so difficult to follow that I, for one, cannot understand more than a fraction of the paper. The same criticism applies to a probably very valuable paper by Brown on " DNA and Specific Protein Synthesis ". Catcheside's paper shows how interesting and widespread is inter-allelic complementation.

The only dissonant note in the Symposium is Danielli's paper on " Inheritance in *Amœba*, studied by nuclear transfer ". One has only to compare this paper with that of Jacob and colleagues and that of Maaløe, to see that in choosing a genetically quite unanalysed organism like *Amœba* for studying problems of nucleus-cytoplasm relations, he has chosen to bite off more than can be chewed.

G. PONTECORVO.

BIOCHEMISTRY OF HUMAN GENETICS. Ciba Foundation Symposium. Ed. by G. E. W. Wolstenholme and C. M. O'Connor. London: Churchill. 1959. Pp. 347. 50s.

The application of biochemical techniques to the study of human variation during the past decade has produced results of interest not only for medicine and anthropology but also for fundamental genetics. The main lines of development were covered in papers presented at the Ciba Foundation Symposium held in Naples in May 1959.

Hunt and Ingram reviewed their work suggesting that several abnormal human hæmoglobin types differ from the normal adult type by single amino-acid substitutions in one or the other half-molecule. Similar substitutions are often found when proteins in different animals are compared, and

it is becoming clear that this is the commonest way in which mutations affect the protein products of genes. The normal adult human hæmoglobin molecule consists of two pairs of unlike polypeptide chains, termed α and β. It appears that these are under independent genetic control and either the α or the β chain can be altered by mutation. Itano and his colleagues outlined experiments in which mixtures of hæmoglobins abnormal in respect of α and β chains were dissociated under mildly acidic conditions and recombined to give normal and doubly abnormal forms. Similar random combinations of protein subunits occur naturally and probably explain phenomena such as gene complementation in *Neurospora*.

Genetic variations in human serum proteins were described by Connell and Smithies. The several forms of transferring are analogous to the hæmoglobins, but the haptoglobins are somewhat different, in that one form of the protein polymerises and in the heterozygote gives products which appear to be qualitatively distinct from those in either homozygote. However, as Allison and Smithies have pointed out, this is probably due to co-polymerisation of the primary products of the two genes. The distribution of the plasma protein variants in some populations was outlined by Harris and colleagues, and genetic differences in human gamma globulin types, recognised serologically, described by Grubb.

Morgan and Watkins reviewed advances in the chemistry of human blood group substances made in their laboratory and Kabat's in the United States. The sugar and amino-sugar end-groups defining A, B, H and Le^a specificity have been defined. Ceppellini contributed a valuable synthesis of a difficult topic, the inheritance of the A, B and Lewis factors and their relationship to secretion.

Inherited deficiencies of enzyme activity are known to be responsible for a number of rare metabolic disorders, e.g. galactose uridyl transferase for galactosæmia, as outlined by Kalckar at the symposium. The abnormal form of plasma pseudocholinestrase in human subjects, described by Kalow, is rather more common and is of medical importance because affected individuals cannot tolerate normal doses of muscle relaxant drugs. Other deficiencies are remarkably common, including glucose-6-phosphate dehydrogenase in red blood cells of Mediterranean, African and Oriental males. This condition, and its relationship to the disease " favism ", produced in affected subjects by ingestion of broad beans, and also to hæmolysis on exposure to a variety of drugs, was discussed by Childs and Zinkham. Kalmus reviewed work on inheritance of sense organ disabilities, and Brenner contributed a general account of the part played by proteins in gene mediation.

In general, this volume is well produced and provides a convenient summary of work in the field up to early 1959. It also helps to show that despite the obvious difficulties of studying inheritance in man much valuable progress has been made. There is still a future for biochemical geneticists who recognise the proper study of mankind.

A. C. Allison.

STATISTISCHE METHODEN DER POPULATIONSGENETIK. By H. L. Le Roy. Basel: Birkhäuser. 1960. Pp. 397. sFr. 67.50. (c. 112s.).

The term " Population Genetics " has a disconcerting habit of changing its meaning slightly with each author who uses it in his title. Here the