been, it is still a useful guide to much of the literature on genetic aspects of human cancer.

IAN LECK

Mutation Research. Problems, Results and Perspectives.
By Charlotte Auerbach. (Pp. xviii + 465; Figures + Tables £10·50.) London: Chapman and Hall. 1976.

I find it very difficult to be objectively critical of the above book, since my own work on mutagenesis has been for some seven years directly, and subsequently indirectly, greatly influenced by Lotte Auerbach's ideas and outlook. In my opinion Professor Auerbach has written a unique and valuable book, in which is distilled the knowledge resulting from over three decades of work in mutagenesis. The 23 chapters provide a refreshing blend of historical perspective on early results, comparative viewpoints across the whole range of organisms studied, and critical incisiveness. Following early chapters dealing with the historical development of the subject, and the nature of mutations, *x*-ray and ultraviolet mutagenesis are dealt with in considerable detail. This is followed by several chapters on chemical mutagens, and others dealing with selected topics of continuing interest in mutagenesis such as completes and mosaics, mutagen specificities, spontaneous mutations, and instabilities. The final chapter covers the varied types of applied mutation research. As a reviewer my only regret is that the increasingly recognized importance of environmental chemical mutagens is not reflected in the mere 3-page coverage afforded in this book. One would certainly have welcomed Professor Auerbach's critical and authoritative appraisal of the various test systems currently being used to detect environmental mutagens.

It is to be hoped that this book will be available to all undergraduates taking final year genetics courses. It will be invaluable to all postgraduates and research workers involved in mutation research or testing, regardless of their particular organism or mutagen of choice. It is clearly printed and provided with numerous references to additional reading.

COLIN H. CLARKE

Haemoglobin: Structure, Function and Synthesis.
(*British Medical Bulletin*, Vol. 32, No. 3, September 1976.) Scientific Editor: D. J. Weatherall. (£3·00.) London: British Council. 1976.

Structure, Function and Synthesis of Haemoglobin is a suitable subject for the *British Medical Bulletin*. Britain has been foremost in its contribution to this field, and Dr Weatherall, the scientific editor has assembled a distinguished array of contributors of whom everyone is recognised internationally as a prominent expert.

M. F. Perutz contributes an introduction as well as a survey of the structure of haemoglobin and of the structural alterations involved in the change from oxy- to deoxyhaemoglobin. In the introduction Perutz asks what is it that makes the study of haemoglobin so absorbing. It is of course the fact that the haemoglobin is a two-way respiratory carrier, transporting oxygen from the lungs to the tissues and facilitating the return transport of CO_2. It fulfils this dual function by a reversible change of its structure so that the arterial form of haemoglobin has a high affinity for oxygen and a low one for hydrogen, chloride ions, CO_2, and organic phosphates with these relative affinities reversed in the intravenous form. Perutz quotes Monod who conferred on haemoglobin the title of an 'honorary enzyme' calling the haem its active site, oxygen its substrate, and hydrogen ions its inhibitor. Organic phosphates which preferentially combine with the deoxy structure would then be allosteric cofactors.

J. B. Kilmartin details the interaction of haemoglobin with 2, 3-diphosphoglycerate, protons, and CO_2, and J. M. Baldwin defines the Adair constants, oxygen equilibria, and co-operative interaction. Against this background J. M. White describes the unstable haemoglobins where the delicately balanced interactions between hydrophobic amino acid residues and the haem, as well as other intramolecular and subunit interactions, are disturbed. The distinctive role as a precipitating agent of the superoxide released in imbalanced oxygenation is described in what is perhaps the first fully understood molecular disease. A. J. Bellingham contributes a similar analysis of the alteration in the oxygen affinity based on changes in molecular structure. A. May and E. R. Huehns discuss the sickling process, both *in vitro* and *in vivo*. It is not yet fully understood what happens when the sickle cell haemoglobin forms monodirectional crystals, but it is becoming quite clear that insoluble helical strands of molecules are formed and that these molecules interact with each other.

There is a very thorough survey of the genetics of human haemoglobins assisted by what is now known of haemoglobin variants fusion and the products of crossing-over and deletions by A. Lang and P. A. Lorkin with some very clear illustrations.

R. Williamson describes the measurement of globin genes in animals and man. The number of human haemoglobin genes can now be expected to be in the range of 8 to 10 of which 2 are α chain genes, each a β and a δ chain gene, and the rest to be divided between the γ, ε, and ζ chain genes.

N. J. Proudfoot and G. G. Brownlee describe

what we now know of the nucleotide sequence of globin mRNA. Though up to the present still mostly done in rabbits and mice, this work has now entered the realm of human haemoglobin, and comparisons can now be made between some nucleotide sequences of human α and β globin mRNA's and the homologous regions in the rabbit. The co-ordination of synthesis of α and β chains and of haem and globin are described by Tim Hunt. J. Paul discusses haemoglobin synthesis at the level of chromatin and cell differentiation where the maturation of erythrocytes in mammals proceeds from pluripotent to committed cells destined to become morphologically identifiable red blood cells. There is also a valuable section on erythropoietin.

D. J. Weatherall and J. B. Clegg complement these chapters with an analysis of the molecular basis of the thalassaemias where the genetic systems described previously have gone astray. The clinical management of thalassaemia major is described by B. Modell and this includes intensive transfusion schemes as well as the effects of long-term chelating therapy and the prevention of thalassaemia itself by antenatal diagnosis and abortion.

M. F. Perutz mentions in his introduction that haemoglobin was the first molecule in which the transition from one form to another, fetal to adult, was described which still is one of the simplest manifestations of cell differentiation. If the mechanism of that transition could be subjected to outside control a therapy for sickle cell anaemia and thalassaemia could be developed. It is, therefore, fitting that there is also a final chapter by W. G. Wood on haemoglobin synthesis during human fetal development, where one may hope that in due course it will become possible to control the switch from fetal to adult haemoglobin with all its practical consequences.

This *Bulletin* should find its way into almost every biologist's library. Haematologists must be greatly interested in the degree to which haemoglobin has been investigated and can now be integrated with the problems of disease and therapy. Anyone associated with genetics to the slightest degree will find this issue of the *British Medical Bulletin* indispensable.

HERMANN LEHMANN

The HLA System: An Introductory Survey.
By A. Svejgaard, M. Hauge C. Jersild, P. Platz, L. P. Ryder, L. Staub Nielsen, and M. Thomsen. (Monographs in Human Genetics, Vol. 7.) (Pp. 103; Figures + Tables. SFr. 38; DM 36; approx. US $ 14·75.) Basel and New York: Karger. 1975.

This monograph from the Copenhagen Blood Bank and the Odense Clinical Genetics Unit on the HLA system is admirably clear and up to date. First the components of the system are described, the classic A, B, and C series and the MLC or D locus, the loci for the immune response genes, the loci for the complement components Bf, C2, and C4, and the loci for the Bg and Chido blood groups all close together on chromosome 6 Next the linkage disequilibrium between some of the alleles at the four HLA loci is described, the strongest being between some of those at the C and D loci. References are given to geographical variation; the A1 B8 haplotype, common in Europeans, is rare in other races. Amerindians have few of the well-known HLA antigens. Next the homologous systems in the mouse and rhesus monkey are described. Next a brief account of the biochemistry of the HLA of antigens is given. They are probably glycopeptides embedded in the cell membrane and bound to a molecule of β_2-microglobulin. The gene coding for the β_2-microglobulin is probably on chromosome 15. Next the importance of the HLA system for organ transplantation is described and the remarkable association of HLA alleles and a variety of diseases. The strongest of these still seems to be that of ankylosing spondylitis and B27, followed by Reiters syndrome and anterior uveitis with the same allele. This clearly separates this form of arthritis from other forms. The association of juvenile diabetes with B8 and B15 confirms the view that this form of diabetes is distinct from the more common form with onset usually in middle age. The authors think that the association with B27 must be direct since it has been found in three different races, and different races tend to show different gametic associations. The additive affects of B8 and B15 for juvenile diabetes, in contrast to the absence of such an effect for B13, 17, and 37 for psoriasis, suggests that in the former case the two alleles confer susceptibility by different mechanisms. The authors briefly describe the mechanisms that have been suggested for these associations. Next the authors describe the possible biochemical functions of the HLA system, for example the prevention of tumour formation and the incorporation in the cell membrane of viruses, so making these more easily recognizable by the body defences. Both mechanisms would help to account for the remarkable degree of polymorphism found at the HLA locus. The final chapter gives an outline of the laboratory methods involved in work with HLA.

This is an excellent introduction to a most intriguing development in human genetics.

C. O. CARTER

Biology of Radiation Carcinogenesis

Edited by J. M. Yuhas, R. W. Tennant, and James D. Regan. (Pp. xxiii + 341; Figures + Tables. $30·00.) New York: Raven Press. 1976.