phasize both in situ or "proximal" orebodies and several mechanically transported orebodies. Physical and chemical characteristics of the latter are thoroughly examined in three papers; together, these descriptions establish a standard for comparison that should be used by anyone studying transported ore. Walker and Barbour outline the morphological features of the six principal transported orebodies and conclude that transportation by mass flow allowed the ore masses to travel coherently for distances of at least 2.4 kilometers from their sources. Calhoun and Hutchinson report that they attempted to use sedimentary structures, clast sizes, and compositions of the fragments to determine the flow direction and origin of the transported ores and found that only the last gave satisfactory results. Hutchinson suggests that the ore-forming debris flows contained considerable trapped metalliferous fluid.

Papers on the alteration and the geochemical and mineralogical attributes of the ores and associated rocks are not as extensive as those on the physical aspects of the deposits and their settings and do not substantially contribute to further understanding of the genesis of massive sulfide deposits. Although Kowalik, Rye, and Sawkins provide some useful isotopic data, their explanation of the alteration sequence is different from that of Henley and Thornley. No effort is made to reconcile this difference, and yet the interpretation of the isotopic data is dependent on understanding alteration paragenesis. In evaluating the applicability of magmatic or leaching models for the generation of an ore solution, Sawkins and Kowalik consider only the footwall basalts, and not the footwall "arkose," as a source of lead. Without a more complete understanding of the distribution and characteristics of the footwall alteration, speculation on metal sources is not justified. Most aspects of the geochemistry of deposit genesis have received incomplete treatment.

Three papers discuss the application of a broad range of exploration techniques to the discovery of the Buchans orebodies. Moss and Perkins indicate that many types of airborne and ground geophysical techniques have been tried. Only Lundberg's equipotential line survey in 1926 resulted directly in ore discovery. James and Perkins illustrate that both soil geochemistry and boulder tracing techniques define very distinctive anomalies related to the Buchans orebodies. Finally, Swanson, in reviewing the development of genetic concepts, notes that since 1926 all of the orebodies have been discovered by geological deduction, in some cases assisted by geophysical data.

In summary, the volume contains a complete descriptive record of a group of very rich massive sulfide deposits and is thus useful to students of this deposit type. The lack of alteration and geochemical studies has precluded a more complete assessment of deposit genesis, and thus the volume may be of somewhat less interest to economic geologists with only a general interest in massive sulfide genesis. Nevertheless, it is well written and edited, and the figures, and particularly the colored maps, are informative, making the Buchans volume a useful addition to one's library.

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Yeast Genetics

Molecular Genetics in Yeast. Proceedings of a symposium, Copenhagen, June 1980. D. VON WETTSTEIN, A. STENDERUP, M. KIELLAND-BRANDT, and J. FRIIS, Eds. Munksgaard, Copenhagen, 1981. 444 pp., illus. D.kr. 250. Alfred Benzon Symposium 16.

Yeast genetics has come of age. The emergence of *Saccharomyces* as one of the favored tools in the quest to decipher cellular processes was acknowledged by dedication of the 16th Alfred Benzon Symposium to yeast genetics and molecular genetics. *Molecular Genetics in Yeast* contains a set of landmark papers presented at the symposium, as well as transcripts of discussion among the participants.

The volume is divided into eight sections that reflect the organization of the symposium. The range of topics being quite diverse, it is clear that the meeting's organizers opted in favor of encyclopedic exposition rather than a particular thematic emphasis. Beginning with papers on chromosomal structure and organization, the book proceeds through a short section on cell cycles and mating, several sections on gene organization and regulation, a series of papers dealing with genetic transformation, and, finally, two short sections concerned, respectively, with recombination and medical aspects of yeast biology.

If there is any recurrent theme in this diverse series of presentations, it is the awesome experimental power generated by the fusion of classical genetic analysis with the growing arsenal of recombinant DNA techniques. The papers reflect both the unique amenability of yeast to the combined genetic and biochemical approach and the inclination of most of the authors to exploit this gratuitous advantage.

The genetics of transfer RNA structure and function receives the greatest attention (five papers). Owing to the inherent simplicity of tRNA genes and the fact that a highly sophisticated genetics has evolved around tRNA-mediated suppression in yeast, it has become possible to correlate defined nucleotide sequence alterations with perturbations of function both in vivo and in vitro. The tactic is best exemplified in a paper by Kurjan *et al.* Through the use of genetic suppression as an indicator of tRNA function, loss-of-function mutations in tRNA genes were isolated. The lesions were then identified by sequencing the mutant genes, and, finally, the biological consequences were characterized quantitatively and qualitatively by transcription in vitro. Clearly, genetic and biochemical analysis of this dazzling resolution is a foreshadowing of what can be expected in other, more complex systems. A surprising finding presented by Mao *et al.* is the considerable degree of sequence divergence seen in comparisons of tRNA genes of *Saccharomyces* with those of its distant relative, the fission yeast *Schizosaccharomyces*. Yet the tRNA's are efficiently recognized by the heterologous charging enzymes, leaving us with the sobering conclusion that sequence information in itself, even of the smallest and simplest of genes, is not tantamount to true enlightenment concerning nature's use of them.

Assignment of biological attributes to yeast transposable elements (*Ty* sequences), discovered some years earlier, emerges as another theme of the symposium. That these elements can mediate positive (Sherman *et al.*) as well as negative (Fink *et al.*) effects on transcription seems to have been simultaneously revealed by molecular genetic studies in several laboratories. The possible evolutionary and developmental roles of *Ty* elements are also discussed (Davis *et al.*).

Unfortunately, the volume contains only one paper dealing with the fascinating mating-type story of *Saccharomyces*. As a model for processes of higher cells, the yeast mating-type system has aspects potentially germane both to sexual differentiation and to the role of transposition of genetic material as a determinative factor in the course of development. Herskowitz has succeeded in reviewing the usually confusing genetics of mating type with clarity and succinctness. One

wishes, however, that there were more on this important subject.

Perhaps the most striking testimony to progress with respect to basic eukaryotic cellular functions is the demonstration by Carbon and Clarke that centromeres can be isolated as physical entities encoded in DNA and that small plasmids containing such centromeric sequences are then endowed with most of the biological properties of legitimate chromosomes.

The principal shortcoming of the book is one that is unavoidable: rapid progress renders much of what is said already significantly out of date. This volume is clearly not a source for the most recent developments. Yet it contains a balanced collection of, in most cases, well-written papers that bear witness to a minor revolution brought about by the convergence of genetic and biochemical methods in the study of this simple eukaryotic organism. The excitement of the time is captured. It is perhaps fitting that the majority of these papers have been dedicated to Herschel Roman, one of the pioneers and sustaining forces of yeast genetics, on his 65th birthday. Roman is largely responsible, through his own efforts as well as through his encouragement of others, for the preeminence of *Saccharomyces* in the genetic analysis of cellular processes in eukaryotes. This volume is an appropriate tribute.

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Virus-Receptor Interactions

Virus Receptors. In two volumes. Part 1, Bacterial Viruses. L. L. RANDALL and L. PHILIPSON, Eds. xii, 148 pp., illus. $39.50. Part 2, Animal Viruses. K. LONBERG-HOLM and L. PHILIPSON, Eds. xii, 218 pp., illus. $39.50. Chapman and Hall, London, 1980–1981 (U.S. distributor, Methuen, New York). Receptors and Recognition, Series B, vols. 7 and 8.

These two slim volumes attempt to bring together the available knowledge concerning the structure and function of receptors for both bacterial and animal viruses.

The first volume contains five chapters, one dealing with the receptors of Gram-positive bacteria and the remaining four surveying various aspects of bacteriophage receptor biology in Gram-negative bacteria. Rather than provide an exhaustive (and exhausting) catalog of known phages and their receptors, the authors have attempted to emphasize general principles and to offer interesting speculations about receptor function. For example, Maxime Schwartz, writing about the interaction of phages with receptor proteins, proposes that phages bind irreversibly only if the host cell membrane is in an energized state, thus providing a mechanism whereby phages can recognize a "healthy" cell. A. R. Archibald reviews the receptors of Gram-positive bacteria, Andrew Wright and colleagues discuss the role of the lipopolysaccharide of Gram-negative bacteria as a phage receptor, and T. Palva and D. Bamford review the lipid-containing bacteriophages. Although functional analogies between receptors for phages and viruses infecting eukaryotic cells are mentioned by Palva and Bamford, this issue does not receive the full attention it deserves. Consequently, the two volumes remain separate and will probably be purchased separately by bacteriologists and animal virologists.

The subject of animal virus receptors, reviewed in the 11 chapters of part 2, embraces a much greater variety of experimental systems. There is also considerable variation in the amount of detailed knowledge about the receptors for the major taxonomic groups of viruses. Some aspects of the subject are dealt with rather summarily, and there is some redundancy in chapters on related topics. For example, there is considerable overlap in the chapters that review receptors for picornaviruses (R. L. Crowell *et al.*) and the myxo- and paramyxoviruses (A. S. Scheid) and those devoted to the role of glycophorin as a virus receptor (A. T. H. Burness), methods for receptor isolation and characterization (K. V. Holmes), and the role of lipids in virus-cell interactions (J. Bramhall and B. Wisnieski). One also experiences a feeling of déjà vu on reading certain chapters. For example, the chapter by Scheid, on the properties of envelope glycoproteins isolated from myxo- and paramyxoviruses, though well written, is a virtual copy of his many other reviews of the last few years. On a more positive note, Burness presents some new ideas about the possible role of sialic acid as a virus receptor and the lucid chapter by Crowell and co-authors makes a useful effort to relate virus receptor function and cellular properties to the pathogenesis of disease.

Because of the diversity of the topics covered in the volume on animal viruses an introductory chapter would have been helpful. The final chapter, "Evaluation and conclusions" (L. Philipson), attempts to develop a unified view of virus receptors in prokaryotic and eukaryotic cells and to define certain avenues for future research, but it is far too brief to be of any real value.

The papers in these volumes contain few literature references later than 1979, and virtually no mention is made of how advances in recombinant DNA technology and new methods for the production of monoclonal antibodies will be exploited in the study of virus-receptor interactions. The editors can be criticized for not making a greater effort to integrate information derived from studies of prokaryotes and eukaryotes. Despite these criticisms, the volumes provide the best survey of this important topic to be published to date.

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(Continued on page 1312)