for pastoralists who live on the edges of complex agrarian states but quite inappropriate for people in most of the 108 tribal and band societies Paige and Paige use for testing their theory. People who lack the concept of private property seldom worry about the virginity of brides or the unambiguous biological paternity of offspring, and not all men have as great a need for collecting loyal kinsmen as do property owners whose ability to enjoy a privileged life-style depends on having many kinsmen to protect their herds.

A further difficulty is that Paige and Paige posit motives only for men, although several of the rituals they analyze, such as girls' puberty ceremonies, are often put on by women. In all societies, the motives people attribute to women are related to the motives they attribute to men, but seldom are they identical.

In summary, the "political theory" of reproductive rituals presented by Paige and Paige rests on three insights that elevate their book above previous explanatory, cross-cultural studies: that ritual is a form of politics, that rituals can be explained only in terms of motives held by sponsors, not in terms of benefits accruing to such nonsponsors as youthful initiates, and that rituals are motivated by self-interest. Though Paige and Paige fail to take full advantage of their insights, their failures offer opportunities for future researchers.

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Imaging from Space

X-Ray Astronomy with the Einstein Satellite. Proceedings of a meeting, Cambridge, Mass., Jan. 1980. RICCARDO GIACCONI, Ed. Reidel, Boston, 1981 (distributor, Kluwer Boston, Hingham, Mass.). viii, 330 pp., illus. $44.50. Astrophysics and Space Science Library, vol. 87.

The successful launch of the Einstein Observatory in November 1978 put high-resolution x-ray imaging instrumentation into orbit for the first time and thus represented an enormous stride forward for x-ray astronomy. The detectors on board Einstein provided the first optical-quality images of celestial x-ray sources and, as a result of their imaging capability, were a thousand times more sensitive to point sources than anything flown previously. (This, it has been noted, is analogous to proceeding from a 6-inch telescope to the 200-inch on Mount Palomar in a single step.)

This volume consists of the proceedings of a meeting of the High Energy Astrophysics Division of the American Astronomical Society devoted to the presentation and interpretation of the results of the first year of observations by the satellite. An impressive range of topics is addressed: nondegenerate stars, supernova remnants, normal galaxies, clusters of galaxies, and quasars, among others. Such breadth seems particularly significant when one considers that as recently as a few years ago x-ray astronomy was regarded by traditional astronomers (not completely unfairly) as a rather isolated subfield with a particularly narrow range of interest—the accreting degenerate stars in binary systems.

Because of the tremendous explosion of data that Einstein provided and the relatively short time that astronomers have had to analyze it, much of the material here is necessarily presented in somewhat undigested form. This is not a major drawback, however, and most of the contributors do a creditable job in outlining the initial results and their possible implications for existing and, perhaps, future theories.

The paper that is probably the highlight of the proceedings is uncharacteristic in that it represents more of a closing of a particular chapter in x-ray astronomy than an opening. It had been suggested in the mid-'70's on the basis of some rather indirect arguments that the x-ray sources in globular clusters might be black holes of a thousand solar masses. In "X-ray sources in globular clusters," J. E. Grindlay describes his observations of eight such clusters with Einstein, in which the precise positions of the x-ray sources were measured with respect to the optical centers of the clusters. By considering these sources as "test particles" in the cluster potential wells, one could then determine their masses in a statistical sense. Grindlay found a probable mass of 2 $M_\odot$, which is consistent with the masses of the familiar x-ray binaries and rules out heavier, more exotic objects. (One can rest assured, however, that the 1000 $M_\odot$ black hole will not soon pass into obscurity; its existence—in a new context—is predicted even before the end of the volume.)

The book provides a valuable background against which the new literature in x-ray astronomy can be read; it should not be taken (nor is it intended) as a source of journal-type articles or reviews. One drawback to the collection is that a few of the contributors, faced with such a wealth of data, somewhat paradoxically overinterpret them. For example, it seems unlikely that the x-ray data on quasars really constrain the numbers of optically faint quasars as severely as is suggested here, and the issue has in fact been much debated since the meeting. Occasional excesses of this sort might have been tempered by including in the volume a few of the often probing questions that followed each paper at the conference.

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Massive Sulfide Orebodies

The Buchans Orebodies. Fifty Years of Geology and Mining. E. A. SWANSON, D. F. STRONG, and J. G. THURLOW, Eds. Geological Association of Canada, Toronto, 1981. x, 350 pp., illus., + loose maps in slipcase. $36. The Geological Association of Canada Special Paper 22.

The Buchans district, in the Central Volcanic Belt of Newfoundland, has truly exceptional orebodies of the volcanic-associated massive sulfide type, with 17.5 million tons of ore that yielded, from 1928 until the present, much more total zinc, lead, and copper than the 94 million tons of ore in the Noranda district of Quebec. The Buchans deposits are of late Ordovician age and are slightly deformed and metamorphosed and thus are ideal for intensive study of primary depositional characteristics.

The volume contains, in addition to a broad selection of papers on specific aspects of the deposits, two papers (Neary and Swanson) reviewing the history of exploration, discovery, development, mining, and research at Buchans. Although these papers are atypical for a technical review volume, they provide an excellent perspective for the research efforts presented in the remaining 13 technical papers. Throughout the history of Buchans, exploration was guided by geological deduction and not by the geophysical data more typically used in most Canadian massive sulfide camps.

Discussions of the geology of the Central Volcanic Belt (Kean, Dean, and Strong) and of the Buchans district (Thurlow) are accompanied by excellent loose colored maps. The Buchans Group is a late arc sequence, formed about 450 million years ago, according to Bell and Blenkinsop's interpretation of rubidium-strontium data.

Thurlow and Swanson, in an excellent description of the Buchans deposits, em-

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