

sorption lines at $z \approx 1.95$ in objects with larger values of emission red shift, the lack of expected Lyman- α absorption, and the lack of any evidence of association with distant galaxies. These observations, and others, are not easily compatible with cosmological distance and would tend, as the authors point out, to favor a more local explanation of QSO's.

After presenting the complete experimental picture, the Burbidges discuss the various cosmological models of Schmidt, Woltjer, Colgate, Barnothy, and others, the more local models of Hoyle and Fowler, Arp, and the Burbidges, and the very local model of Terrell. They discuss the very real difficulties for cosmological models, such as the problem of preventing overwhelming Compton loss of energy by relativistic electrons in a radiation field necessarily as intense as inside a laser, which have been largely ignored by those who would be highly disappointed if QSO's should turn out not to be at cosmological distance.

As the authors point out, "The local hypothesis has bothered those who may have believed consciously, or subconsciously, that if the quasi-stellar objects are local they are not such great discoveries as if they are cosmological . . . But if they are comparatively nearby they are exceedingly interesting in the problems that they pose." The Burbidges originally favored cosmological distance but were eventually persuaded by the evidence that a more local explanation, such as ejection by our own or nearby galaxies, was probably necessary. They now think that most of the red shift may be due to gravitational effects, at moderate distances, which might account for the puzzling predominance of the absorption red shift $z = 1.95$.

The Burbidges also discuss the objections to various local models, such as the belief that there is a continuous transition of properties from radio galaxies to cosmological QSO's (Heeschen's diagram), and the feeling that ejection of local QSO's from galaxies requires excessive amounts of energy. One puzzling lapse occurs in their discussion of Terrell's local model, in which they state that the lack of observable proper motion puts the QSO's at distances of at least a few megaparsecs (that is, ≈ 10 million light-years), with correspondingly large energy and mass requirements. They have evidently forgotten that, with origin at the center of our galaxy, little of the relativistic

recession speed would now appear as a transverse component, so that the distances could easily be less than a million light-years. (*Note added in proof:* T. A. Matthews has recently reported that QSO 3C 287 cannot be at more than this distance, because of rapid changes in the size of an associated jet.)

One cosmological model too recent for inclusion in this book is that of Cannon and Penston, McCrea, and (independently) Gamow, who have suggested occultations by transversely moving dark bodies or absorbing clouds as a mechanism for producing rapid fluctuations. However, as Geoffrey Burbidge has pointed out since the writing of this book [*Nature* **214**, 1213 (1967)], this model would actually worsen the problems associated with cosmological models, since the dimensions of such light sources would have to be a matter of only light-minutes, much less than the relativistic upper limit imposed by the fluctuations alone.

Although the Burbidges make no secret of their present leaning toward a local model of QSO's, they have attempted to treat all the possible explanations fairly. They state that "none of the arguments is watertight, and much of the observational evidence is highly incomplete." In this book they have made an admirable effort to present the whole picture of our present knowledge of quasi-stellar objects.

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Prehistory: Africa Depicted

Atlas of African Prehistory. Compiled by J. DESMOND CLARK. Maps by EVE KEMNITZER. University of Chicago Press, Chicago, 1967. Twelve maps and 38 overlays, boxed, with explanatory booklet (64 pp., illus.). \$32.

The publication of this atlas marks the completion of a ten-year project. The compiler, assisted by an advisory committee of six and drawing on information received from some 60 collaborators, has produced a unique work—the first atlas dealing with the prehistory of a whole continent.

The atlas consists of 12 base maps and 38 overlays printed on loose sheets of clear plastic; a white background is provided against which these can be viewed without the use of a lightbox.

The first group (11 base maps, 26 overlays) is drawn to a scale of 1:20,000,000 (sheet size 45 cm by 40 cm); a second group (one base map, 12 overlays) is drawn to a scale of 1:38,000,000 (sheet size, 23 cm by 22 cm).

The base maps of Group I provide a wide choice of ecological conditions which may have affected the biological and cultural evolution of man on the African continent. These include topography, geology, soils, rainfall, and vegetation, as well as an intriguing series of hypothetical situations in which vegetation zones are projected for conditions with 50 percent and 150 percent of present rainfall (temperature held constant), and with rainfall at the present or at 150 percent of the present level (temperatures 5°C lower). The overlays from Group I provide further environmental information (drainage, diseases, faunal distributions), locations of fossil-man sites, and a full inventory of lithic sites from the Oldowan through the Neolithic. A very large number of combinations is possible; by selecting, for example, map 9 (hypothetical vegetation zones, 150 percent of present rainfall, temperatures as today), and combining it with overlays 1 (drainage) and 23 (Neolithic industries of North Africa), the user can approximate conditions in the Sahara during the Neolithic Wet Phase. As a precautionary measure, the explanatory booklet provides a sketch map to show the relative intensity of prehistoric research in different parts of Africa.

The map and overlays of Group II provide outlines of present-day discontinuous distributions of seven mammals (for example, the white rhinoceros and the diadem monkey) and five bird species (for example, *Alcippe abyssinicus* and *Neocossyphus rufus*).

Notes on the atlas appear in the explanatory booklet, which also includes chronological charts of the lithic industries; lists of African fauna for different time levels of the Pleistocene; and map coordinates for lithic sites, indexed by country and industry.

This atlas is a magnificent publishing venture in which the compiler and his collaborators can take pride. Its success whets an Africanist's appetite for similar compilations of ethnographic, linguistic, and protohistoric data. Publication was generously subsidized by the Wenner-Gren Foundation; the atlas is probably worth twice its price.

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