first self-sustaining chain reaction, the first xerographic copy, the first waveguide demonstration, first transistor (but only a replica!), first integrated circuit, first microprocessor. ... Indeed, from the *Album* emanates the occasional whiff of the Guinness record book — not only the first but the oldest, the deepest and the most distant.

The editor is to be commended for including two final chapters under the guise of "The science of science" (Part VIII) — the first on scientific collaboration and social organization, the second on scientific popularization through science museums and international exhibitions. Pictures of the scientific enterprise represent observational data, historical record and communication; and it would have been easy enough to dish up the first two whilst forgetting that the third is also on the menu. One particularly telling photograph pictures an editor of *Physical review* between the handful of issues representing output for 1931 and the stacks of massive bound tomes covering 1985.

Except perhaps for the images returned by interplanetary probes, the book does not suffer unduly from being printed in black and white. Many of these photographs are cunningly selected so that colour is not of the essence (the north pole of Mars, Saturn's rings) but the Great Red Spot of Jupiter jibs at monochromaticity.

"In many ways," writes Owen Gingerich in the introduction, "the *Album* is like a Victorian scrapbook, ... erratic and opportunistic, with splendid mementoes and curious omissions". The fact that astronomy figures so prominently in the scrapbook is not the fault of too partial an editor; it is, as he says, "a naturally pictorial subject", for the distant realms it conjures, of course, but also for its impressive instrumentation. In visual terms, the junction transistor and Chadwick's neutron apparatus cannot hold a candle to the observer's cage at prime focus of the 200-inch Hale telescope at Palomar (especially when occupied by Edwin Hubble!).

Each chapter is introduced by some twelve paragraphs setting the conceptual and historical scene for the ensuing illustrations. To judge the *Album of science* by its sketchy prose content would be unjust. It is first and foremost a picture album and as such succeeds in providing a wealth of stimulating material, testimony to much well-thumbed literature and many well-plumbed archives.

H.M. Treasury, London JON DARIUS

A BABYLONIAN ASTRONOMICAL HANDBOOK

MUL.APIN: An Astronomical Compendium in Cuneiform. Hermann Hunger and David Pingree (Archiv für Orientforschung, Beiheft 24; Verlag Ferdinand Berger and Söhne, Horn, Austria, 1989). Pp. 164 + 28 plates. Ö.S.495 (paperback).

Recent years have brought a spate of critical editions and translations of Mesopotamian astronomical texts, including the first instalments of two major projects: the great omen collection Enūma Anu Enlil (by E. Reiner and D. Pingree) and the astronomical Diaries from Babylon (by A. Sachs and H.

Hunger). This edition of the astronomical handbook MUL.APIN is by contrast a self-contained volume of modest scale; but its importance for the early history of astronomy is nonetheless considerable. MUL.APIN has long been recognized as the principal document relating to astronomical practice (exclusive of omens) before the seventh century B.C. Until now, however, the text itself has been practically inaccessible to non-cuneiformists, except through the medium of van der Waerden's useful extended discussion in his *Die Anfänge der Astronomie* (Groningen, 1966).

When complete, MUL.APIN comprised two tablets (Hunger and Pingree discount the possibility of a lost third tablet); from the forty known exemplars we can recover substantially the whole first tablet and most of the second. The variants among the copies are minor. Tablet I consists of six lists of fixed stars and constellations, most of which have by now been identified securely. The first list is the well known catalogue of stars grouped into 'paths' of the gods Enlil, Anu, and Ea. The 'paths' are now understood to refer to portions of the eastern horizon within which the stars rise, rather than celestial bands bounded by declination circles; nevertheless several circumpolar stars (as well as the five planets) were interpolated in this list. List II gives rough dates of heliacal rising of stars, and also solstices and equinoxes, according to an ideal calendar of twelve 30-day months; from this list were derived the intervals of days between risings comprising List IV. Simultaneously rising and setting constellations make up List III, while Lists V and VI give respectively, the *ziqpu* stars (stars that pass close to the zenith, coordinated with simultaneously rising constellations) and the constellations in the moon's path.

The contents of Tablet II are less homogeneous, but the dominant theme is calendaric, with two intercalation schemes and a shadow table. The intercalation schemes do not presume a regular cycle of intercalary months, but specify various tests to determine when the epact has accumulated to approximately 30 days. For example, the first test in the second scheme is the date in month I when the moon passes the Pleiades; this should occur on day 1 in an 'ideal' year, whereas an intercalation is called for when the conjunction occurs on day 3. For the solstices and equinoxes one is told the measure of water in a water-clock needed for the duration of daytime and nighttime, and the times corresponding to shadow lengths of a gnomon. Underlying these schemes are simple arithmetical functions (zigzag functions and reciprocal tables), pointing distantly forward to the mathematical astronomy of the Seleucid period.

The planets receive a much slighter treatment. Tablet II prescribes intervals of days for the periods of visibility and invisibility of the planets; these allow for variations (in some instances diverging by wide margins from the range that actually occurs), but no pattern or scheme is said to determine which values apply in any given instance. Stationary points and acronychal risings receive no mention. The almost complete absence of lunar theory should warn us against rashly assuming that MUL.APIN represents the entire spectrum of astronomical knowledge of its time, but such planetary theory as there is manifestly belongs to a more primitive stage than the observational experience underlying the Seleucid mathematical schemes.

MUL.APIN is known in both Neo-Assyrian and Neo-Babylonian exemplars, the oldest dated copy being from 687 B.C. Establishing the time and place of its composition, however, is no simple matter. The text is obviously a composite incorporating sometimes contradictory sources; and none of the astronomical data is susceptible of precise dating. Hunger and Pingree argue that the stellar catalogues would be appropriate for roughly the beginning of the first millennium B.C. at a latitude near 36° (e.g. Nineveh), on the basis both of astronomical accuracy and of the general progress of Mesopotamian stellar astronomy as indicated by the other known documents.

The presentation of this volume is clear, concise, and accurate (I am not competent to judge the philosophical aspect). Hunger's English translation is given together with the transcription of the text line-by-line in so-called 'score' format; it is quite literal, but this should present no difficulties for the reader. A "philological commentary" is devoted primarily to textual matters, although some of the notes discuss the interpretation of dubious passages and should therefore be consulted by all readers. As well as discussing historical questions (including analogues in Greek and Indian astronomy), Pingree's "astronomical commentary" usefully extracts and reorganizes the contents of the several sections of MUL.APIN, and is a considerable aid to understanding the text; the reader is assumed to be acquainted with the conventions and terminology of Babylonian astronomy, e.g. as presented in Neugebauer's *History of ancient mathematical astronomy*. Barring the discovery of substantial new fragments of the text, this edition will surely serve the needs of all who are concerned with early Mesopotamian astronomy.

University of Toronto ALEXANDER JONES

JHA, xxii (1991)

COMMISSION 41 AT THE BUENOS AIRES GENERAL ASSEMBLY OF THE IAU

The 21st General Assembly of the IAU was held in Buenos Aires from 23 July to 3 August 1991, and the scientific programme of the IAU/IUHPS Commission 41 (History of Astronomy) was spread over four sessions. The general theme was "The preservation and conservation of astronomical archives and instruments", and the papers and discussion of this theme led to a resolution that was endorsed by the General Assembly at its closing session:

> That the Union supports an initiative taken by Commissions 41 and 5 [on Documentation and Astronomical Data] (1) to establish a register of the whereabouts of all extant astronomical archives of historical interest; (2) to impress on observatories and other institutions their responsibility for the preservation, conservation, and where possible cataloguing of such archives; (3) to search for an institution that will allocate space and funds for maintaining such a register and publishing it.