The *Cairo Calendar* as a Stellar Almanac

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Abstract

The *Cairo Calendar* is a Nineteenth Dynasty Egyptian almanac that lists religious feasts, mythological incidents, favorable or adverse days, forecasts, and warnings. The 365 passages that make up Book II of the *Cairo Calendar* include 46 references to the *pr* of deities and mythological beings. This term is most often translated "going forth." The dates for three *Cairo Calendar* passages announcing the *pr* of the goddess Neith are dates of astronomical events involving the bright star Canopus (alpha Carinae), and the passages make sense when read as astronomical observations. The *Calendar* lists two or more *pr* for 11 other deities or mythological figures, and based on this information the celestial objects can be identified. In closing, the article briefly discusses the possibility that the *Cairo Calendar* reflects an indigenous tradition of celestial divination.

Watching Stars in Ancient Egypt

The earliest evidence of stellar observation in ancient Egypt is prehistoric: Wendorf and Malville (2001:499–501) describe astronomically aligned megaliths at Nabta Playa in Upper Egypt, a Neolithic site. The earliest calendar used in Egypt was synchronized to the heliacal rise of Sirius, an event used to predict the annual flooding of the Nile (Parker 1950:31–32).

In dynastic Egypt the *ỉmy-wnwt,* Hour Watchers, observed the sky nightly in order to fix the timing of religious services. An inscription found on a sighting instrument owned by the *ỉmy-wnwt* Hor explains that the device is for "attending to the guiding [or introduction] of festivals and giving all people their hours" (Clagett 1995:II:Fig.III.20a; DeYoung 2000:503; Wells 1996:37). The *ỉmy-wnwt* probably belong to the class of skywatchers Krupp (1997:209–243) has described for several early civilizations: an elite who defined calendars, advised farmers and kings, and generally framed social order in terms of celestial order.

Egyptian surveyors used the stars in construction. Trimble (1964:183–187) asserted that the "air shafts" of the Great Pyramid of Giza are oriented to the culmination of Thuban (alpha Draconis) and the transit of Alnilam, one of the belt stars of Orion. Haack (1984:S120–S123) identified precession-related error in the orientation of several pyramids. DeYoung (2000:491) notes claims for the astronomical orientation of the Temple of Hathor at Dendera, the peristyle hall of the Mut temple of Karnak, and the Abydos temple of Seti I.

"The Stretching of the Cord," a foundation-laying ceremony, offers insight into the practical and symbolic nature of such alignments. An early reference to this ceremony is found on the Palermo Stone. There an inscription notes, "The Year of the Stretching of the Cord at the Great Door of the Castle [called] 'Seat

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of the Gods' by the Priests of Seshat" during the reign of Den in the First Dynasty (Clagett 1989:I:73). Depictions of this ceremony, at the Temple of Hathor at Dendera and at the Temple of Horus at Edfu, show the pharaoh assisted by Seshat, goddess of temple records, as he drives a stake. An inscription at the Temple of Hathor outlines the procedure: "Looking to the sky at the course of the rising stars, recognizing the *ak* of the Bull's Thigh constellation, I establish the corners of the temple of Her Majesty" (Krupp 1983:26).

Beyond furnishing measures of time and orientation, the stars play a role in Egyptian religious thought. The Old Kingdom *Pyramid Texts,* "the oldest *corpus* of Egyptian religious and funerary literature now extant" (Faulkner 1969:v), describes the ascent and divinization of the pharaoh as a star among the imperishable stars (Krauss 1997:86–130).

Despite this evidence for the cultural role of the stars, our understanding of ancient Egyptian astronomy has significant gaps. It is known that the Egyptians identified particular deities with the Sun, the Moon, the planets, the star Sirius, and the constellations Orion and Ursa Major; moreover, we know the names the ancient Egyptians gave to these objects (Neugebauer and Parker 1960:III). Yet beyond this—and despite much conjecture based on what one writer dubbed "the almost embarrassing abundance of constellation pictures produced in the course of more than two millennia" (Davis 1985:S102)—there is no consensus regarding the identity of stars and constellations known in ancient Egypt (DeYoung 2000:506).

In their monumental *Egyptian Astronomical Texts,* Neugebauer and Parker (1960) reconstructed a table of decanal hour-stars, a "star clock" based on heliacal risings of stars every 10 days, using inscriptions from Middle Kingdom coffin lids, and traced the replacement of rising decans by a system of stellar transits during the New Kingdom. Nevertheless, Neugebauer and Parker rejected the possibility of identifying the stars mentioned in these inscriptions, stressing the inaccuracy of Egyptian methods as well as the funerary character of the texts: "It cannot be too strongly emphasized that all attempts to deal with these texts as if they were reliable astronomical observations in order to deduce from them identifications of Egyptian constellations are doomed to failure" (II:15).

Other recognized astronomical papyri, such as the *Papyrus Carlsberg I,* are copies of, and commentaries upon, inscriptions found elsewhere in a funereal context (Neugebauer and Parker 1960:I:37–38).

This article concerns a nonfunerary papyrus containing significant astronomical material unrecognized by its translators and by later investigators.

Reading an Ancient Almanac

In 1943, the Egyptian Museum of Cairo purchased a papyrus from an antiquities dealer at the recommendation of Dr. Jaroslav Cerny (Bakir 1966:1). A. E. Bakir published the papyrus in 1966 as the *Cairo Calendar, No. 86637*. Subsequently, in 1994, Christian Leitz published a study of Book II of the *Calendar* and the closely related *Papyrus Sallier IV*. A passage in the *Cairo Calendar* dates the document to the reign of Ramses II in the Nineteenth Dynasty; Bakir (1966:5–6) accepts this dating based on internal textual evidence.

Bakir (1966:1) felt that nothing in the papyrus definitively established its place of origin but conjectured that it came from Deir El Medina. This site has been a rich source of papyri and ostraca (Lesko 1994:131–133). Based on the prominence given to the gods and myths of Heliopolis in the *Calendar*, Leitz (1994:8) concluded that the text was originally composed at the Temple of Re in Heliopolis.

The papyrus is divided into three sections. Book I is an incomplete text titled *ḥꜣ t-ꜥ m pryw(t) n nṯr nb nṯrt nbt,* "An introduction to the manifestation-feasts of every god and every goddess" (Bakir 1966:2,11). Book II, the largest part of the document, is titled *ḥꜣt-ꜥm ḥꜣt nḥḥ ph.wy ḏt,* "An introduction to the beginning of infinity and the end of eternity" (1966:3, 13). This part consists of 365 passages, one for each day of the 360-day Egyptian year plus five epagomenal days. The passages seem to concern religious feasts, mythological incidents, favorable or adverse days, forecasts, and warnings. There is a further, unlabeled "month" of 30 days appended to this section. Book III is titled *ḥbyt nt mdw nṯr rḥ nfr r ꜥḥꜣ,* "List of feasts of divine words distinguishing favorable days from adverse ones" (1966:4, 57).

Reading Bakir's translation of the *Calendar,* I counted in Book II no less than 42 instances of the phrase "going forth of" followed by the name of an Egyptian deity or mythological figure. I also found four passages involving deities or mythological figures "coming forth" or "coming," and these proved to be a translation of the same term, *pr*. This made a total of 46 instances of *pr*. The term *pr* does not appear in Book I or in Book III. Nor is it found in the "extra" month at the end of Book II. Bakir explains this "going forth" in the context of religious ritual, as "manifestation-feasts": "On such occasions, it is understood that statues of the gods in whose names these feasts were set up, were carried in procession to go forth, to pay visits to other gods in their neighborhood or in other localities" (1966:61). Leitz (1994:484) gives no explanation of the term, though he suspects that the document as a whole contains astrological or astronomical material of a systematic nature.

The entry for the fifth day of the third month of the season *Proyet* (III *prt* 5) caught my attention: "Neith goes forth from Sais when they see (her) beauty in the night for four and a half (hours)" (Bakir 1966:35).[1] The timing of the "beauty in the night" suggests a celestial object rather than a ritual procession. Indeed, "going forth," *pr,* can refer to the rising of a star. Neugebauer and Parker (1960:III:214) cite this specialized meaning for *pr* in a passage by the Egyptian astronomer Harkhebi. The festival *pr Spdt* has long been recognized as a reference to the heliacal rising of Sirius (Parker 1950:34).

This article explores some consequences of reading instances of *pr* in the *Cairo Calendar* as astronomical events.

Tools, Assumptions, and Conventions

To investigate the "beauty in the night" on III *prt* 5, I relied on astronomical software for the Macintosh: Red Shift 3.0 (Piranha Interactive Publishing, Tempe, Arizona). Red Shift 3.0 handles precession, uses the Julian calendar prior to October 4, 1582 C.E., and provides convenient tabular and graphical reports on the hours of a star's visibility. Dearborn (1996:3) reported that in an informal comparison of the accuracy of three astronomical programs for desktop computers, an earlier version of Red Shift was used to test a conjecture about a solar eclipse in 484 C.E., with good results.

To simulate the ancient Egyptian sky in Red Shift requires a date and a position for the observer. Accepting Leitz's argument for the origin of the *Calendar,* I set the observer's position to Heliopolis at 30°08' N, 31°18' E (Baines and Málek 1980:235).

The next issue that must be addressed is chronological: translation between the dates of the *Cairo Calendar* and the Julian year. The ancient Egyptians used at least two calendars: initially a luni-stellar calendar synchronized to the heliacal rising of Sirius, requiring occasional intercalation, and later a civil calendar of 365 days independent of astronomical observation (Parker 1950:30–34; Wells 1996:34). In this article I make the simplifying assumption that the *Cairo Calendar* is not a civil calendar. Rather, it is a Sirius calendar whose first day is *pr Spdt,* the heliacal rising of Sirius. Rejecting this simplification does not cause great difficulty: "The first year of Ramses II (ca. 1300 B.C.) was only a few years away from the time when the rising of Sothis had fallen on the first day of the civil year (ca. 1313 B.C.) so that the civil calendar and the natural year were in harmony" (Parker 1950:39). Leitz (1994:485–497) adopts 1312 B.C.E. as the year in which the heliacal rising of Sothis opened the year and provides a table ("Konkordanz der verschiedenen Kalender") for converting dates of the *Calendar* into Julian dates. Accordingly, I set Red Shift for the year 1312 B.C.E. All translations of Egyptian calendar dates in this article are Julian dates taken from the "Konkordanz," which assigns the first day of the *Calendar,* 1 *ꜣḫt* 1, to July 19.

Observations of a Virtual Sky

The Egyptian date III *prt* 5 is January 19. I set Red Shift to this date and watched a simulation of sunset seen from Heliopolis in 1312 B.C.E. Shortly after full darkness, Canopus, the next-brightest star after Sirius, rose in the far southeast. Red Shift calculated the rise of Canopus at 1902 local time and the setting at 0021 local time, for a total of 5.3 hours above the horizon. Is this consistent with the "four and a half (hours)" reported in the *Cairo Calendar*?

Neugebauer and Parker (1960:I:116) document the Egyptian division of the night into 12 decanal hours

starting around 2000 B.C.E. Given the continuing use of a 12-hour division of the night in Nineteenth-Dynasty astronomical inscriptions (1960:I:82) and in religious texts such as the *Amduat* and the *Book of Gates* (Hornung 1999:26), it is likely that the *Cairo Calendar* measure of "four and a half (hours)" is also based on a night of 12 hours.

"Four and a half (hours)" represents 0.37 of a 12-hour duration. Let us assume the 12 hours of the night began at sunset and ended at sunrise.[2] For January 19, 1312 B.C.E., Red Shift calculated sunrise at 0641 local time and sunset at 1658 local time, a day length of roughly 10.3 hours. This implies a night of 13.7 hours. Taking 0.37 of the modern measure yields 5 hours. This intriguing result must be weighed against the risks of treating III *prt* 5 as an exact observation. How would Egyptians of the Nineteenth Dynasty have measured their "hours"? They could use a water clock or the transit of decanal stars to time such an observation (Neugebauer and Parker 1960:I:116–121). Given variable terrain and seeing conditions at the horizon, an observer will report a later rise and an earlier setting than the computed value. It seems likely that those who saw the "beauty in the night for four and a half (hours)" on this date saw Canopus.

There are two other references to Neith "going forth" in the Cairo *Calendar*. Do these references strengthen or weaken the case for a link between Canopus and Neith? On II *ꜣḫt* 21, the *Cairo Calendar* notes "the going forth of the Upper Egyptian Neith in the presence of the Majesty of (Atum Re Har)akti" (Bakir 1966:21). This date corresponds to September 7. Red Shift discloses that this is a plausible date for the heliacal rising of Canopus.[3] Canopus rises at 0325 local time, during astronomical twilight, and is over 4º above the horizon by sunrise. Atum, Re, and Harakti are Sun gods (Hornung 1982:274–275, 281). The text may be interpreted in straightforward astronomical terms: on this day, in the south (Upper Egypt), Canopus is seen rising at dawn.

On II *šmw* 26, the *Cairo Calendar* notes "the going forth of Neith. She treads on this day in the flood (in order to) look for the things of Sobek" (Bakir 1966:44). That day corresponds to May 10. On this date, Canopus rises and sets during the hours of daylight; at no time is it visible. Red Shift reveals that the last visible setting of Canopus during evening twilight—the start of its period of invisibility—took place in the last week of April. In what sense has Neith "gone forth"?

The Realm of Sobek

On May 10, at the end of evening twilight, Red Shift shows the Milky Way low and adjacent to the southern horizon, extending from due east to due west. Anyone who had previously observed the position of Canopus relative to the Milky Way would realize that the star was in the unseen region below the horizon.

Older Egyptian texts provide a clue regarding the "flood" of II *šmw* 26. They also link the Egyptian god Sobek to this region. The *Pyramid Texts* mention the *Mḫt-wrt*, a "Great Flood" that is in the heavens (Faulkner 1969:65, 99, 185). In Utterance 317 of the *Pyramid Texts*, "The king becomes the crocodile-god Sobk," Faulkner (1969:99) comments on the use of *idb* to designate first the edge of the floodwaters and then the edge of the horizon region, and cites Sethes' belief that the "Inundation" is in the sky. The *Pyramid Texts* also mention the *Mr nḫꜣ*, the "Winding Waterway." Davis (1985:S102) identifies this waterway as the Milky Way. In the later *Coffin Texts*, the god Sobek is described as "Lord of the Winding Waterway" (Faulkner 1973:203).

These passages suggest an interpretation for II *šmw* 26 consistent with what is seen on the night of May 10. Neith/Canopus was regarded as having descended into the celestial waterway flooding the southern horizon. The term *pr*, earlier used to designate the rising of a star, is used here in connection with its setting.

Re-reading the *Calendar*

In Book II of the *Cairo Calendar*, three passages in which the Egyptian goddess Neith "goes forth" are interpretable as references to Canopus, the second-brightest star in the Egyptian sky: III *prt* 5 measures the star's period of visibility, II *ꜣḫt* 21 notes its heliacal rising, and II *šmw* 26 explains its disappearance.

Encouraged by this result, I turned to analysis of other *pr* events. Beyond Neith, I counted 11 cases in which the *pr* of a god or mythological figure was mentioned on two or more dates. In each case, I

checked for the heliacal rising of a prominent star. For a possible match, I checked the other date(s) for an event—a culmination or a setting—involving that same star. This resulted in nine plausible matches.

If *pr* has an astronomical meaning, might some of the other language in the *Calendar* be astronomical jargon? To approach that question, it is necessary to seek independent textual evidence regarding stellar events observed by the Hour Watchers. The most helpful source for this purpose is the *Papyrus Carlsberg I*. This papyrus consists of commentary on inscriptions in the cenotaph of Seti I and in the tomb of Ramses IV. The inscriptions depict "Nut, the goddess of the sky, supported by Shu, the air, surrounded by texts which deal in mythological terms with the movements of the sun and the stars" (Neugebauer and Parker 1960:I:37). Neugebauer and Parker summarize the observation of a decan, *Pḥwy ḏ3t:*

> The star of the "first" (*tpt*) hour is the decan which has completed its ten days as first hour star and is seen in the meridian at the beginning of the night, that is, sometime after sunset. . . . It takes 90 days "in the west" after finishing as first hour star before a decan becomes enclosed (*šn*) by the Duat. At that time the decan is setting right after sunset and thus begins its period of invisibility, which is assumed to be 70 days. Reappearance from the Duat is called "birth" (*ms*). From then on the decan is visible for a longer period each night, but it takes 80 days "in the east" before the decan really does "work," i.e., indicate an hour by its culmination . . . we now have 120 days left for the "working" of a decan. At first its culmination indicates the 12th hour, ten days later the 11th, and so on until it stops working after 120 days having indicated at last the first hour [1960:I:41].

This reveals that the Ramesside *imy-wnwt* paid special attention to risings, culminations at the first and twelfth hours of the night (evening and morning twilight), and settings. Both Neugebauer and Parker (1960:I:97) and Leitz (1994:183–186) seem to infer from this that stars used for timekeeping must be invisible for 70 days. Given what we find elsewhere in Egyptian technical writing—in the mathematical papyri, where the scribe presents a general method by presenting a specific instance of its application (Clagett 1999:III:94; Gillings 1972:233)—it is more likely that the phases, not the precise number of days, are significant.

If the *Calendar* is a stellar almanac, we should expect to find evidence of these phases in the document. Once the star associated with one or more *pr* passages in the *Calendar* is tentatively identified, we can calculate dates for other phases in the presumed observation of that star and check corresponding passages in the *Calendar*. Do those passages mention the deity named in the *pr* passage(s)? Of all passages mentioning a given deity, how many appear to be connected with stellar events?

Anubis

On II *3ḫt* 4 (August 21), the *Calendar* notes "the day of the going forth of Anubis for the inspection of this *wʿbt* for the protection of the body of the god" (Bakir 1966:19). In 1312 B.C.E., this marks the heliacal rising of Denebola (beta Leonis). This is supported by III *prt* 6 (January 20): "Jubilation of Osiris in Busiris; going forth of Anubis, (his) adorers (or, adoration) following him; he has received everybody in the hall" (1966:35). This day marks the acronychal rising of Denebola—the rising of the star at dusk.

The *Calendar* makes three other references to Anubis. Of these three, two may be Denebola events. On IV *prt* 2 (February 15), Denebola culminates at midnight. For this date we read: "The Majesty of Geb proceeds to the throne of Busiris to see Anubis, who commands the council on the requirements (of the day)" (1966:37). The "Feast of Anubis who is on his mountain" (1966:49) on IV *šmw* 22 (July 5) occurs shortly before the acronychal setting of Denebola.

The Confederates of Seth

On II *prt* 3 (December 18), "It is the day of the going forth of Seth together with his confederates to the eastern horizon. . . ." (Bakir 1966:33). The stars of Sagittarius are rising heliacally on this date.

For IV *prt* 17 (March 3), Bakir (1966:39) gives "going forth of Seth, son of Nuit, to disturb the great

ones who check him in his town of *Sw*." Here Bakir takes *sw* to be Asyut. Leitz (1994:319) asserts that the phrase *m sw f* is rather to be translated as "in seiner Zeit," that is, "in his hour," but expresses uncertainty about the meaning of this phrase. The meaning becomes clear when Red Shift shows that on this day, at dawn twilight, the stars of Sagittarius culminate.

On I *ꜣḫt* 25 (August 12), it is the day of "the repelling of the confederates of Seth" (Bakir 1966:17). This is not a *pr* event. However, this date is one decade after transit of the constellation of Sagittarius at *dusk*. In the terminology of *Papyrus Carlsberg I*, the stars have "stopped working."

Seth and his confederates are also mentioned in III *ꜣḫt* 13 (September 29). They attempt to storm the embalming hall and mutilate the body of Osiris, but they are transformed into cattle in the West and the gods kill them (Leitz 1994:120). The stars of Sagittarius are setting at dusk on this day, marking their "death" and the start of their period of invisibility.

Most Egyptian inscriptions and papyri link the god Seth with the constellation Ursa Major. The Egyptians called it the Foreleg (*ḫpš*) or the adze (*mśḥtyw*); the *Papyrus Jumilhac* explains that it is the Foreleg of Seth, hewn from his body by Horus and thrown into the northern sky where spirits (*ḫꜣtyw*) guard it (Te Velde 1977:86). To prevent the *ḫpš* from ever again threatening Osiris, Isis chained the asterism to a mooring post in the sky (Piankoff 1942:24). If the god Seth is exclusively associated with Ursa Major, a constellation that does not rise or set in the Heliopolis sky, the *Calendar* cannot include any *pr* events for Seth except dates of upper or lower culmination.

The *Calendar* states that Seth's "confederates" perish in the West. Yet the *Pyramid Texts* assert that Seth does not die; he "escapes his day of death" (Faulkner 1969:224, 226). If the stars of Sagittarius are the "confederates" of Seth, this explains III *ꜣḫt* 13: the "confederates" perish as that constellation begins its period of invisibility. At the same moment, the constellation Ursa Major is at its lowest point in the sky. Seth is defeated, but he nonetheless escapes his day of death.

Leitz (1994:28) notes elsewhere in the *Calendar* a reference to a feast timed using the inferior culmination of Dubhe (alpha Ursa Majoris) at midnight. It is therefore significant that the inferior culmination of Dubhe at dusk takes place on I *ꜣḫt* 25 (August 12), the day on which the confederates of Seth are "repelled." Although Seth is associated with Ursa Major, in the *Calendar* this god "goes forth" with the stars of Sagittarius who are the "confederates of Seth."

Min

On II *prt* 26 (January 10), the *Calendar* notes "going forth of Min from Coptos on this day" (Bakir 1966:35); and on IV *prt* 7 (February 20), "(the going forth) of Min into the tent" (1966:38). Bakir (1966:106) further notes that Min is at Akhmim on IV *šmw* 5 (June 18) and that the feast of Min is on IV *šmw* 28 (July 11).

The star that fits these dates is Rigel Kentaurus (alpha Centauri), the next-brightest star in the Egyptian sky after Sirius and Canopus. The transit of Rigel Kentaurus marks the beginning of dawn twilight on II *prt* 26 (January 10). On IV *prt* 7 (February 20), Rigel Kentaurus sets during dawn twilight. Further, the star transits at the start of dusk on *šmw* 5 (June 18) and sets during dusk on IV *šmw* 28 (July 11), the beginning of its period of invisibility.

Thoth

On III *ꜣḫt* 26, the *Calendar* notes the "going forth of Thoth in order to judge in the presence of Re" (Bakir 1966:25). This date (October 12) marks the heliacal rising of Alphekka (alpha Coronae Borealis).

The other two *pr* events for Thoth are separated by a couple of days but seem to reference the same event. For III *prt* 10 (January 24), the *Calendar* states, "It is the day of the coming of Thoth" (1966:36). Again on III *prt* 13 (January 27), we find "coming of Thoth (with his spirits) on this day" (1966:36). On III *prt* 10, Alphekka culminates at dawn. Coronae Borealis as a whole transits during dawn twilight over the course of III *prt* 10–13.

Bakir identifies seven other references to Thoth in the *Calendar*. One of these, IV *Axt* 26 (November 11), marks the setting of Alphekka at dusk, though the star reappears later the same night. Between its dawn rising on October 12 and its dusk setting on November 11, Alphekka can be seen setting in the west in the

evening and rising in the east at dawn on the same night. Two Thoth-related passages fall in this period. On IV *ꜣḫt* 1 (October 17), Bakir (1966:26) has "the Majesty of Thoth" issuing an order, while Leitz (1994:148) notes, "Aufbruch der Majestät des Thoth"—that is, the departure of the Majesty of Thoth. A few days later, on IV *ꜣḫt* 9 (October 25), "It is the day of the action performed by Thoth" (Bakir 1966:27). Thoth is a Moon god (Bleeker 1973:114). It is not clear why Thoth is here associated with Alphekka. Possibly the form of the Coronae Borealis suggested a lunar crescent.

Isis

The passages for Isis appear to reference two *different* stars. On III *ꜣḫt* 8 (September 24), the *Calendar* notes, "Isis goes forth—her heart being pleased on this day, the heritage being established unto her son, Horus" (Bakir 1966:23). This day marks the heliacal rise of Spica (alpha Virginis). Yet a few days later on III *ꜣḫt* 24 (October 10), "Isis goes forth, her heart being happy and Nepthys in jubilation when they see Onnophris. . . ." (1966:25), which coincides with the dawn culmination of Sirius.

There are three other references to Isis in the *Calendar*. Two match Sirius events. Sirius sets at dawn on I *prt* 14 (November 29). The *Calendar* reports that on this day Isis is weeping for Osiris. Subsequently, on II *prt* 16 (December 31), we read that Isis is awakened by Re; on this date Sirius is seen rising at dusk.

Ḥedj-Ḥotep

On I *ꜣḫt* 10 (July 28), the *Calendar* reports, "It is the day of the going forth of Ḥedj-Hotpe while all the gods and goddesses are in festivity" (Bakir 1966:14). This day marks the heliacal rise of Algieba (gamma Leonis). On IV *ꜣḫt* 14 (October 30), "The Ḥedj-ḥotpe and the Tayet come forth from the temple of Benben on this day" (Bakir 1966:28). The dawn transit of Algieba takes place on this day.

Bastet

For I *prt* 20 (December 5), "It is the day of the going forth of Bastet who protects the two lands and cares (?) for him who comes in darkness" (Bakir 1966:32). For III *ꜣḫt* 20 (October 6), the *Calendar* reports, "The going forth of Bastet, mistress of 'Ankh-towe, in front of Re, she being angry" (1966:25).

If we look for a bright star based on the belief that one of the two dates is a heliacal rising, the star that appears to fit these constraints is Sargas (theta Scorpii): December 2 is the date of the heliacal rise of Sargas, and October 4 marks the beginning of its period of invisibility.

However, the reference to "him who comes in darkness" suggests a better match. On December 5, Orion rises after sunset. The god Osiris is strongly associated with the constellation Orion. If Orion/Osiris is "him who comes in darkness," his caretaker must be a nearby bright star. The star that seems to most closely match the set of *Calendar* passages is Procyon, which rises at dusk on December 5. The dawn transit of Procyon takes place on October 6.

There are four other references to Bastet in the *Calendar*. On I *prt* 21 (December 6), the *Calendar* announces the "guidance of the two lands by Bastet," and on I *prt* 29 (December 14), Thoth commands that the two lands be guided by Bastet and Sekhmet. Red Shift discloses that Procyon culminates at midnight on December 14. During I *prt* 21–29, Procyon is visible throughout the night from dusk until dawn. The other two references to Bastet on II *ꜣḫt* 10 and 1 *prt* 1 do not appear to be Procyon events.

If Bastet is indeed associated with Procyon, we might expect to find two other Bastet-related events in the *Calendar*: the heliacal rising of Procyon around I *ꜣḫt* 5 (July 23) and Procyon's period of invisibility beginning around III *šmw* 6 (May 23). No reference to Bastet is found for I *ꜣḫt* 5 or nearby dates. However, the passage for III *šmw* 5 concerns the departure of an unnamed goddess "to the place wherefrom she came" (Bakir 1966:45).

Shu

The *Calendar* notes that I *prt* 16 (December 1) is the "going forth of Shu . . . in order to count the crew of the mesektet-boat" (Bakir 1966:31–32). This is a good fit for the heliacal rising of Vega (alpha Lyrae). "The going forth of Shu with the intention to bring back the Wedjat-Eye" takes place on II *šmw* 30 (May 14). This date roughly marks the acronychal rising of Vega.

Flame

On I *ꜣḫt* 11 (July 29), "It is the day of the going forth of the great flame raging in the inaccessible shrine . . . who are in the following of his Majesty" (Bakir 1966:14). The helical rise of Regulus takes place on this day. On 1 *prt* 10 (November 25), "It is the day of the coming forth of flame (together with Horus from the marshes) on this day" (1966:31). There are repeated references to a great fire or a flame on I *prt* 1, I *prt* 3, I *prt* 5, I *prt* 7, and I *prt* 11. During this period the transit of Regulus marks the twelfth hour, the last hour of darkness.

On III *prt* 10 (January 24), the "great flame" is guided "into her house of the desert of eternity, (along) the way which she has found among them" (1996:108). Indeed, we note that Regulus sets in the west during dawn twilight on January 24. Given all this, one expects to see an entry for the "first hour," the dusk transit of Regulus around March 28. Sadly, this date, I *šmw* 13, is among the dates that are illegible in the original papyrus, and so we are deprived of decisive proof.

Nun

The *Calendar* mentions the going forth of Nun on three dates, two of which are closely adjacent. On I *prt* 15 (November 30), "It is the day of the going forth of Nun through the cave to the place (where the gods are) . . . (in) darkness" (Bakir 1966:31). The *Calendar* adds on I *prt* 17 (December 2): "It is the day of the going forth of Nun to the place where the gods are. Those who are above and below come into existence; the land being (still) in darkness" (1966:32). That cave is mentioned six months later in IV *šmw* 15 (June 28): "Do not go out on any road on this day . . . going forth of Re on it to propitiate Nun . . . in his cavern (in front of) his followers and the Ennead" (1966:48).

Finally, on II *ꜣḫt* 19 (September 5), the *Calendar* announces the "going forth of Nun to set up the noble one in his place in order to give compensation to the gods who are in the presence of the noble one" (1966:21). Nun is a personification of the primordial waters of the abyss (Hornung 1982:280; Lesko 1991:95). Bakir interprets the "land being (still) in darkness" in I *prt* 15–17 in terms of Egyptian creation myth, wherein the waters of Nun precede all things, including light. Let us take the scribe at his word: Something is happening in full darkness. What was seen in the sky between the end of evening twilight and the beginning of morning twilight?

At the end of evening twilight on I *prt* 15–17, an observer in Heliopolis would see the Milky Way arc directly overhead, due east to due west. With the passing of the hours of the night, the arc would appear to pivot and descend. The region of the sky south of the Milky Way's arc appears to set below the southwestern horizon. This darkness beneath a bright arch might have suggested the mouth of a cave. The constellation prominently visible within that region is Orion.

On I *prt* 17, just before the beginning of morning twilight, the Milky Way rings the horizon. Shortly thereafter, the Sun rises—at the point where the ecliptic crosses the Milky Way. Six months later, on IV *šmw* 15, the Sun rises at the other point where its path crosses the Milky Way. The positioning of gods on boats in Figures 1 and 2 also suggests these points of intersection.

As mentioned earlier, the Egyptians viewed the Milky Way as a celestial waterway. I conclude that here Nun is being identified with the Milky Way, which appeared to divide the sky into two regions (Davis 1985:S102), and that these passages concern the intersection of the Sun's path with the path of the Milky Way.

What was the Milky Way doing on September 5? Who is the noble one, and what compensation is suggested here? Starting at dusk on September 4, an observer in Heliopolis would perceive the Milky Way arched directly overhead, with stars of Sagittarius visible at its southwestern end. Over the course of the entire night, the Milky Way remains at the zenith, dividing the sky. At dawn on September 5, the constellation of Orion culminates. I have already shown that the stars of Sagittarius seem to be associated with the confederates of the god Seth and that Osiris is identified with our constellation Orion. The "noble one" is presumably Osiris/Orion, the victim of murder by Seth and his confederates. On II *ꜣḫt* 19, the stars of Orion/Osiris are "elevated" while the stars of the enemy of Orion/Osiris descend and disappear into the west.

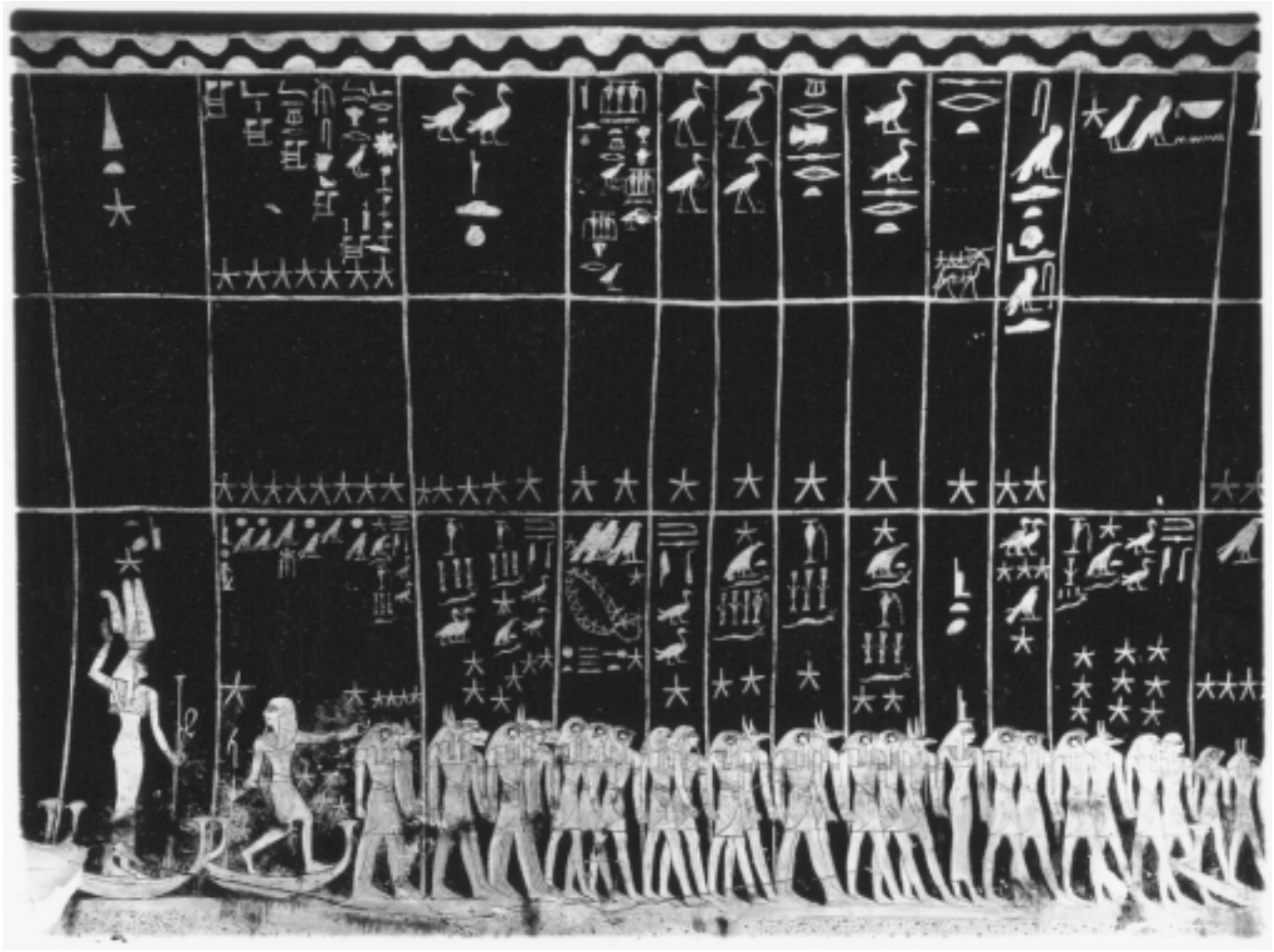

FIGURE 1. Decans and constellations of ancient Egypt. The top register gives names of the decans; the bottom register shows constellation figures and asterisms above a procession of gods. Note the figures of Isis/Sothis and Osiris/Orion standing on boats, as well as the clusters illustrated in adjacent decanal hours. From the astronomical ceiling in the tomb of Pharaoh Seti I (reproduced with the permission of the Metropolitan Museum of Art, New York).

Majesty of Re

On II *ꜣḫt* 15 (September 1), the *Calendar* warns the reader not to go out at night, for the "Majesty of Re" goes forth "at nightfall with his followers" (Bakir 1966:20), and if the reader sees this, the reader will immediately die.

On IV *prt* 19 (March 4), six months later, the "Majesty of Re" again goes forth, and the reader is told this is a most favorable day, that anything seen will be good on this day—although the preceding day is unlucky on account of the imminent "going-forth" (1966:39). Re is a Sun god, but going forth "at nightfall with his followers" suggests that these dates concern something about the Sun and its "followers" visible at night.

In 1312 B.C.E., the solstice points were in our constellations Cancer and Capricornus. These constellations lie adjacent to the Milky Way. On II *ꜣḫt* 15, the south solstice point (in Capricornus) is culminating at the beginning of full darkness. On this night the path of the Sun and his "followers" between fall equinox and vernal equinox is visible at the beginning

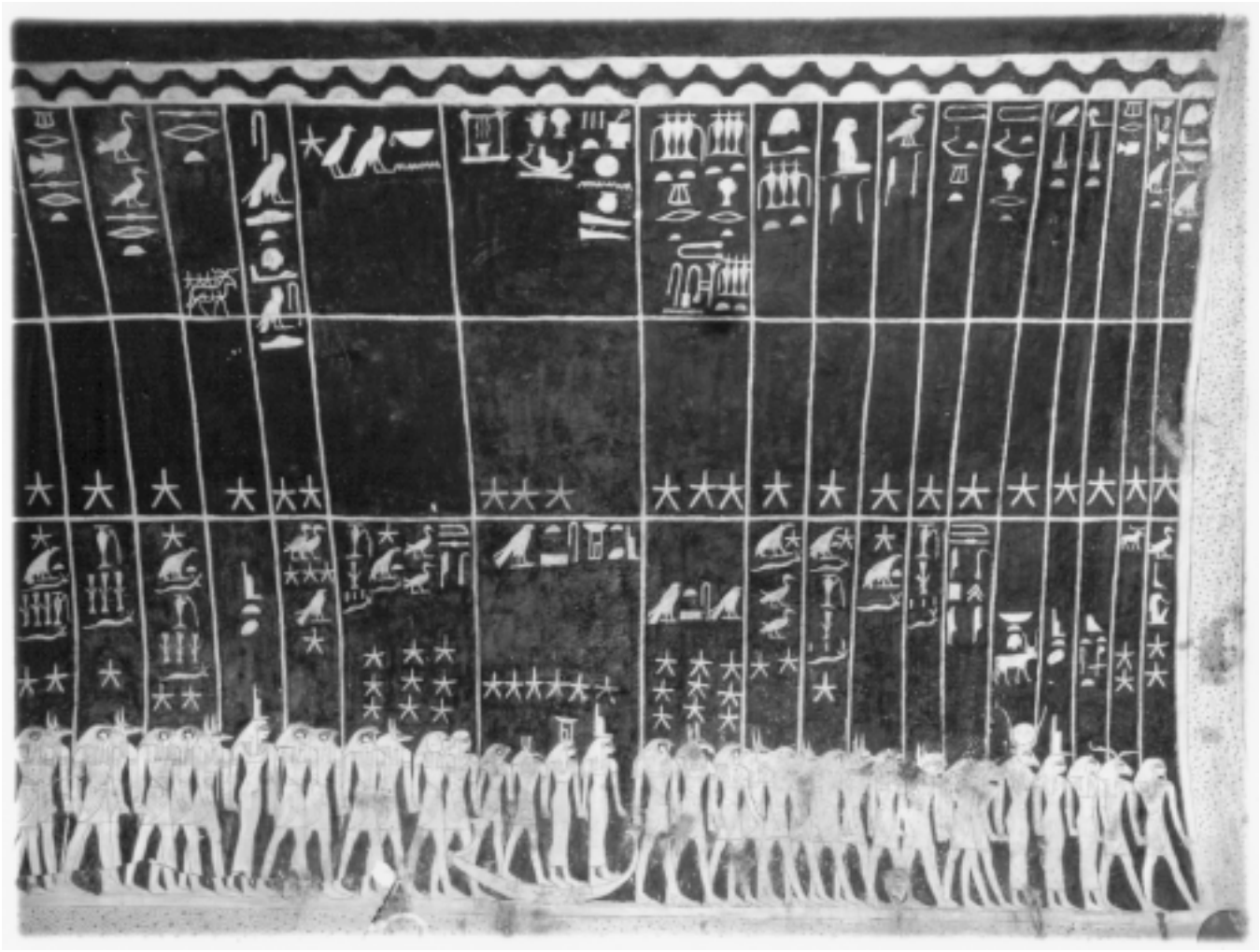

FIGURE 2. Decans and constellations of ancient Egypt. Note the boat constellation flanked by many stars. From the astronomical ceiling in the tomb of Pharaoh Seti I (reproduced with the permission of the Metropolitan Museum of Art, New York).

of full darkness. Similarly, on IV *prt* 19, the north solstice point (in Cancer) is culminating (and very near the zenith) at the beginning of full darkness. On this night the ecliptic constellations between vernal equinox and fall equinox are visible. Accordingly the passages for II *ꜣḫt* 15 and IV *prt* 19 may be taken as statements about the Sun and the ecliptic constellations (as well as a corresponding division of the year into lucky and unlucky halves). Table 1 summarizes the dates, mythological figures or deities, and astronomical events discussed so far.

Tentative Identifications

For the remaining *pr* events, I checked dates for the rising of bright stars. The results are summarized in Table 2. Although these results are considerably more tentative than those of Table 1, a few merit discussion.

Sekhmet

Sekhmet "goes forth" on 1 *ꜣḫt* 25 (August 12). The heliacal rise of Zosma (delta Leonis) takes place on this day. The *Calendar* contains seven other references to Sekhmet, four of which may be Zosma

events. The date 1 *prt* 5 (November 20) coincides with the dawn transit of Zosma; I *prt* 9 (November 24) and 1 *prt* 12 (November 27) refer to Sekhmet's actions on 1 *prt* 5. In I *prt* 5, Sekhmet "places the flame in front of the great ones" (Bakir 1966:108). This flame is most likely Regulus, the star of the previous "hour." The dusk transit of Zosma marks "the day of the executioners of Sekhmet" on III *šmw* 25 (June 8).

Hathor

The passage for I *ꜣḫt* 2 (July 22) notes the "going forth" of Hathor. The heliacal rise of Phaet (alpha Columbae) takes place on this day. The one other reference to Hathor in the *Calendar* is III *ꜣḫt* 1 (September 17). On this day the *Calendar* notes a "Feast of the mistress of heaven, Hathor in heaven" (Bakir 1966:22), and Phaet culminates during morning twilight.

Ma't

After noting the coming forth of Seth, II *prt* 3 (December 18) adds "the navigation of Ma't to the place (where the gods are)" (Bakir 1966:33). As the passages for Nun suggest that "the place where the gods are" lies at or beyond the western horizon, I looked for the setting of a prominent star. December 18 marks the setting of Fomalhaut (alpha Piscis Austrini) and the beginning of its period of invisibility. This may be another instance of framing opposition in both mythic and astronomical terms: on II *prt* 3, Ma't, goddess of justice and order (Hornung 1982:279), sets in the west when the confederates of Seth, the murderer of Osiris and god of confusion (Te Velde 1977:81–98), appear in the east.

On III *šmw* 18 (June 1), the day of the dawn transit of Fomalhaut, we read of "the going forth of Ma't and Re . . . secret on this day" (Bakir 1966:106). On III *ꜣḫt* 22 (October 8), Fomalhaut transits at the end of evening twilight, and for this date we find "raising Ma't in order to see Re, when she is summoned by the gods in the presence of Re" (1966:106). Fomalhaut's heliacal rising marks the "going forth of Khepri, who hears the words of his followers" on IV *prt* 16 (February 27).

Table 1. Deities with Two or More *pr* in the *Cairo Calendar*

Passage	Date	Deity	Object[a]
I *ꜣḫt* 10	7/28	Hedj-Hotpe	Algieba
I *ꜣḫt* 11	7/29	Flame	Regulus
II *ꜣḫt* 4	8/21	Anubis	Denebola
II *ꜣḫt* 15	9/1	Majesty of Re	Ecliptic
II *ꜣḫt* 19	9/5	Nun	Milky Way[b]
II *ꜣḫt* 21	9/7	Neith	Canopus
III *ꜣḫt* 8	9/24	Isis	Spica
III *ꜣḫt* 20	10/6	Bastet	Procyon[c]
III *ꜣḫt* 24	10/10	Isis	Sirius[c]
III *ꜣḫt* 26	10/12	Thoth	Alphekka
IV *ꜣḫt* 14	10/30	Hedj-Hotpe	Algieba[c]
I *prt* 10	11/25	Flame	Regulus[d]
I *prt* 15	11/30	Nun	Milky Way[b]
I *prt* 16	12/1	Shu	Vega
I *prt* 17	12/2	Nun	Milky Way[b]
I *prt* 20	12/5	Bastet	Procyon[e]
II *prt* 3	12/18	Seth	Sagittarius
II *prt* 26	1/10	Min	Rigel Kentaurus[c]
III *prt* 5	1/19	Neith	Canopus[f]
III *prt* 6	1/20	Anubis	Denebola[e]
III *prt* 10	1/24	Thoth	Alphekka[c]
III *prt* 13	1/27	Thoth	Coronae Borealis[c]
IV *prt* 7	2/20	Min	Rigel Kentaurus[g]
IV *prt* 17	3/3	Seth	Sagittarius[c]
IV *prt* 19	3/4	Majesty of Re	Ecliptic[b]
II *šmw* 26	5/10	Neith	Canopus[d]
II *šmw* 30	5/14	Shu	Vega[e]
IV *šmw* 15	6/28	Re and Nun	Milky Way[b]

[a]Unless indicated otherwise, all events are heliacal risings for the star or asterism.

[b]See text for discussion.

[c]Transit at dawn.

[d]Setting at dusk (beginning of period of invisibility).

[e]Rising at dusk.

[f]Measure of duration of visibility.

[g]Setting at dawn.

Table 2. Other *pr* in the *Cairo Calendar*

Passage	Date	Deity	Object[a]
I *ꜣḫt* 4	7/22	Hathor	Phaet
I *ꜣḫt* 8	7/26	Re goes forth	—
I *ꜣḫt* 19	8/6	[illegible]	—
I *ꜣḫt* 25	8/12	Sekhmet	Zosma
III *ꜣḫt* 29	10/15	Three noble ladies	Crux
IV *ꜣḫt* 5	10/21	Khentet-'abet	—
IV *ꜣḫt* 13	10/29	White one of heaven	Canopus[b]
IV *ꜣḫt* 21	11/6	Great ones	—
I *prt* 19	12/4	The gods	Orion and Sirius[b]
II *prt* 3	12/18	Ma't	Fomalhaut[c]
II *prt* 10	12/25	Wedjat-eye	—
II *prt* 11	12/26	Sobek	Deneb
II *prt* 15	12/30	The gods	—
II *prt* 18	1/2	Seven executioners	—
IV *prt* 6	2/19	The stars	Scorpius[d]
IV *prt* 16	3/1	Khepri	Fomalhaut
II *šmw* 18	5/2	Khenty	Capella
III *šmw* 18	6/1	Ma't and Re	Fomalhaut[e]

[a]Unless indicated otherwise, all events are heliacal risings for the star or asterism.

[b]Setting at dawn.

[c]Setting at dusk (beginning of period of invisibility).

[d]See text for discussion.

[e]Transit at dawn.

"White One of Heaven"

For IV *ꜣḫt* 13 (October 29), the *Calendar* reports "the going forth of the white one (or the Majesty) of heaven, their (for 'her') heart being pleased in the presence of Re" (Bakir 1966:28). Elsewhere, the "white one of heaven" is mentioned in a fragmentary entry for 1 *šmw* 10 (March 25): "Proceeding of the white one of heaven upstream to seek at the front among (those who rebelled against their) master in the Delta" (1966:41).

I chose to treat this "proceeding" as an astronomical event. Having done this, I found the "white one of heaven" was Canopus: October 29 marks the dawn setting of the star, while it transits at evening twilight on March 25. If this identification is correct, there are five dates in the *Cairo Calendar* associated with the observation of Canopus.

Sobek

A festival of Neith is celebrated on II *prt* 11 (December 26), but it is marked by "the going forth of Sobek," the crocodile-god mentioned earlier (Bakir 1966:34). It is tempting to identify this with the heliacal rise of Deneb (alpha Cygni). In the *Calendar* there is one other explicit reference to Sobek, on II *ꜣḫt* 22 (September 8) (1966:26). On this day Deneb sets at the beginning of dawn twilight.

Another possibility deserves mention: Locher (1985:S152) proposed identifications for the northern constellations of ancient Egypt. Among these northern constellations is the figure of a hippopotamus with a crocodile standing on its back (see Fig. 3). Locher's proposed crocodile is a band of stars on the edge of the Milky Way, with nose at Alfrick (beta Cephei), an eye at Alderamin (alpha Cephei), and tail stretching past iota Cygni and kappa Cygni. These stars rise, along with Deneb, in the northeast at dawn twilight on December 26.

The Three Noble Ladies

On III *ꜣḫt* 29 (October 15), the *Calendar* reports the "going forth of the three noble ladies who are in the Tanenet sanctuary in the presence of Ptah, beautiful of face, while giving praise to Re, him who belongs to the throne of the truth of the temples of the goddesses"

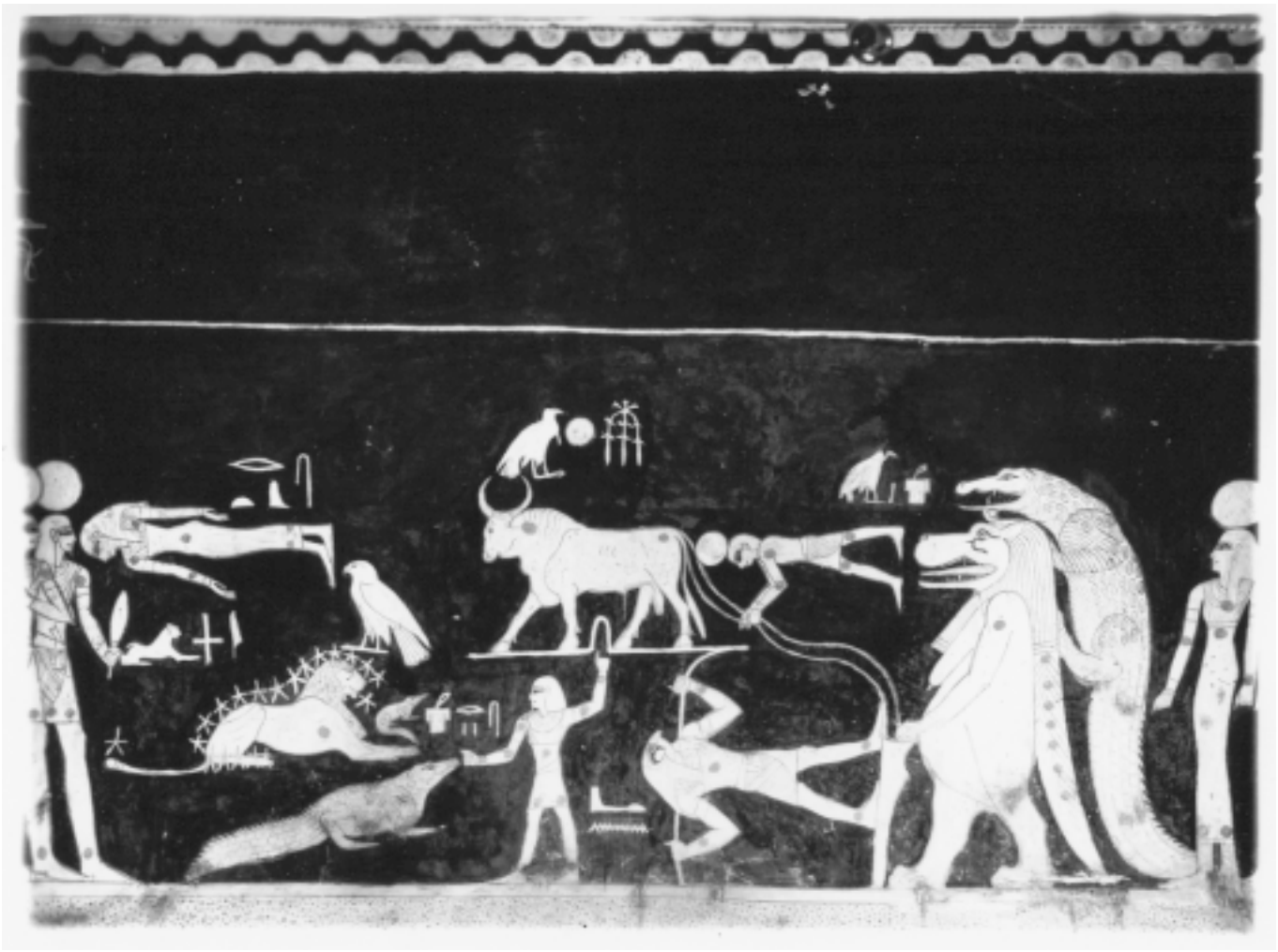

FIGURE 3. The circumpolar constellations. From the astronomical ceiling in the tomb of Pharaoh Seti I (reproduced with the permission of the Metropolitan Museum of Art, New York).

(Bakir 1966:26). Did the Egyptians view the four stars of the constellation Crux as the god Ptah and the three noble ladies? It would seem so: Acrux transits at the beginning of morning twilight on II *prt* 1 (December 16), "the festival of (lifting) the heaven of Re by Ptah" (1966:105).

The Stars

"Going forth of the stars, bitterly and openly" takes place on IV *prt* 6 (February 19). Bakir (1966:38) and Leitz (1994:307) compare this passage to that of III *ꜣḫt* 13 and conclude that the stars must be the Sethian decan *ḥry-ỉb wiꜣ*.

Locher (1981:S74) points out that *ḥry-ỉb wiꜣ* is the middle decan of a large boat constellation whose prow contains a red star; based on its position in the star clocks and astronomical ceilings presented by Neugebauer and Parker, he concludes that the boat spans Scorpius and Sagittarius and that the red star is Antares. Davis (1985:S104) also places the constellation of the boat in this general region of the sky (see Fig. 2). In view of this, it is interesting that IV *prt* 5 mentions "the red one" (Bakir 1966:38). The bitter stars of IV *prt* 6 may include the sting of the Scorpion, Shaula (lambda Scorpii), which transits at the beginning of dawn twilight on this day.

The Gods

The date I *prt* 19 (December 1) marks "the going forth of the gods to Abydos" (Bakir 1966:32). The necropolis of Abydos was the center of the cult of Osiris (Baines and Málek 1980:114; Erman 1971: 23; Lesko 1991:94). Red Shift discloses that on this date in 1312 B.C.E., an observer would have seen the constellation of Orion and the star Sirius set during dawn twilight. Possibly the descent of these stars in the West was thought to suggest a funeral procession (see the previous remarks on Isis and I *prt* 14).

Astral Determinism in the Cairo Calendar

I have presented stars, asterisms, and constellations associated with at least 28, and perhaps as many as 39, of the 46 *pr* in Book II of the *Cairo Calendar*. The *ỉmy-wnwt* undoubtedly used such an almanac for the timing of festivals and other activities. However, there is another side to the *Calendar*—an astrological or hemerological side.

Each day in Book II of the *Calendar* is divided into three parts, each marked as favorable or unfavorable. There follows a description of an event that, as shown, may be celestial. Many passages end with advice or a prediction.

The structure of the Book II entries somewhat resembles that of the omen texts of Mesopotamia. Chadwick (1984:92–93) describes the characteristic form of the omen texts: each includes a *protasis,* recounting a celestial observation, followed by the *apodosis,* a prediction based on the content of the *protasis*. However, there is a striking difference. Mesopotamian celestial divination concerns matters of state: "the welfare of the nation, the economy, war and peace, crops, plagues" (1984:92–93). Campion (2000:519) presents a typical omen from the middle of the second millennium B.C.E.: "In month XI, 15th day, Venus in the west disappeared, 3 days in the sky it stayed away, and in month XI, 18th day, Venus in the east became visible: springs will open, Adad his rain, Ea his floods will bring, king to king messages of reconciliation will send."

The prognostications of the *Cairo Calendar* target a different audience:

"Anyone born on this day will die in a state of drunkenness" (Bakir 1966: 19).

"Do not go out of your house on any road on this day" (1966:37).

"Pay attention to the incense on the fire" (1966:38).
"If you see anything, it will be good on this day" (1966:43).

Did the author of the *Calendar,* and those who consulted it, see a causal relationship between the *pr* and such predictions?

Kàkosy (1982:163–165, 191) asserts that an Egyptian "proto-astrology" arose in the second half of the New Kingdom, was enriched by foreign elements during the Third Intermediate Period, and ultimately became part of the Hellenistic synthesis responsible for classical astrology. In establishing the timing of this development, he alludes to the lack of material or textual evidence for astral determinism during Old and Middle Kingdom periods: "[I]n spite of the role of Sothis as bringer of the inundation, astral influence appears almost invariably in funerary context up to the middle of the 2nd millennium. . . . one gets the impression that flood remained the sole earthly phenomena that was supposed to start under an astral influence" (1982:187).

That impression needs to be considered in a broader context: the general absence of nonfunerary astronomical texts from Old and Middle Kingdom Egypt. If there are no texts on the stars written for the living, there will be no descriptions of "astral influence" on earthly phenomena. The *Calendar* seems to be a document of this kind. Moreover, it is the *only* one, together with the fragmentary *Papyrus Sallier IV*, which appears to be a copy of the same work. Is the *Cairo Calendar* truly a New Kingdom innovation? Considering that some *pr* passages in the *Calendar* are illuminated by astral passages from the Old Kingdom *Pyramid Texts* and the Middle Kingdom *Coffin Texts*, it is fair to ask whether the practice of associating lucky and unlucky days with the stars began in the New Kingdom.

Based on just two passages that mention stellar decans, Kàkosy (1982:188) cites the *Calendar* as one

of two examples of New Kingdom belief in "astral influence on particular days." With the discovery of the astral character of the *pr* passages, one can build a stronger case for such a belief. It may even be possible to reconstruct this "proto-astrology" and trace its relationship to Babylonian and Hellenistic developments.

In summary, the *Cairo Calendar* is, at least in part, a stellar almanac. It documents risings, transits, and settings for a number of bright stars and asterisms and includes descriptions of astronomical events. This information was used by the *imy-wnwt*, the "Hour Watchers" responsible for the timing of festivals and religious observances. The *Calendar*'s use of mythological and astral elements from much older funerary texts, plus comparison of the form and content of its passages to Mesopotamian omen texts, suggests that a form of astral divination was practiced in New Kingdom Egypt. Pharaohs expected to join the stars in the afterlife, but the *Calendar* shows that ordinary Egyptians turned to the stars for guidance in the conduct of life on earth.

Notes

1. Egyptian calendar dates have the form "month season day." The month is given as Roman numerals between I and IV, and the day is given as an Arabic number. The season is given by name. Bakir (1966) uses popular English renderings for the names of the Egyptian seasons: Akhet, Proyet, and Shomsu. Leitz (1994) uses the transliteration favored in Egyptological literature: *ꜣḫt*, *prt*, and *šmw*. In this article the latter are used.

2. Based on examination of Middle Kingdom star clocks, Neugebauer and Parker (1960:I:100–102) deny that the 12 decanal hours extended from sunrise to sunset. They assert that the 12 decanal hours span only the period of true darkness; the 12 hours of night were preceded, and followed by, three decans during twilight. However, in the course of tracing the evolution of the 24-hour day, they cite an Eighteenth-Dynasty shadow clock whose calibration marks indicate a 12-fold division of day (Davis 1985) and infer a corresponding division of the period between sunset and sunrise (Neugebauer and Parker 1960:I:121).

3. The actual date for the heliacal rise of a star is a function of several variables, including terrain, sky brightness, stellar magnitude, and position relative to the Sun. In the course of quantifying these factors, Schaefer (1987:S25) observed that "the moment of heliacal rising for bright stars . . . is when the Sun is relatively near the horizon and the star is well above the horizon." Even for a bright star, poor observing conditions can delay observation of heliacal rising (Schaefer 1987:S29). September 6 is a conservative date for the heliacal rising of Canopus.

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