Panorama of Egypt, from the frontispiece to the first edition of the *Déscription de l'Égypte*

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THE LEGACY OF EGYPT

SECOND EDITION

EDITED BY

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OXFORD
AT THE CLARENDON PRESS
1971

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THE CALENDARS AND CHRONOLOGY

ACCORDING to ancient tradition, when in 45 B.C. Julius Caesar decided to reform the unwieldly lunar-based calendar of Rome, he took advice from an Alexandrian astronomer, Sosigenes, who applied his calendarial experience to the problem. The result, with Augustus' correction a few years later, became the Julian calendar, used by all Christendom until the time of Pope Gregory, when it was further reformed into our present calendar. Though the length of the year as 365¼ days had been common knowledge for some centuries before Sosigenes, the Egyptians were surely the earliest people to have arrived at that figure and, as well, to have devised a calendar divorced from the awkward lunar month. These remain two of the most significant of all their legacies to us, and how they arrived at them may well serve as an introduction to the catalogue of their accomplishments.

Primitive man was, of course, far from the realization that the year had a constant length. In his gradually developing sense of time he would first be aware only of the alternation of day and night, with the passage of the sun across the sky in the one and the passage of the stars in the other. The waxing and waning of the second great celestial body, the moon, would lead him to the longer time measure of the lunar month, and when he had learned to count he would be able to reckon that from one disappearance of the crescent moon to the next—or from one new crescent to the next, or from one full moon to the next—would be around twenty-nine or thirty days.[1] Finally, the rhythm of the seasons,

[1] Quite unlike the majority of ancient peoples the Egyptians began their lunar month when the *old* crescent of the moon could no longer be

especially when primitive man abandoned food-gathering and turned to food-producing, would become of paramount interest and would come to be reckoned in terms of lunar months.

In Egypt primitive man, settled in the valley of the river Nile or wandering near it, had in the river itself a giant seasonal clock which swelled with its annual flood, overran its banks, and then gradually withdrew to its bed, getting lower and lower until the next flood began the cycle over again. As an agriculturalist and food-producer, he would adjust to this rhythm, building his home on high ground, waiting for the several lunar months while the river grew and the flood lay over the land, tilling the soil and planting seed when the land was exposed again, cultivating and watering his field as the river sank lower and lower through several more lunar months, and finally harvesting and waiting again through the months of low water for the flood to recur. Gradually he would thus come to associate some four lunar months with the season of flood, four with the season of planting and growth, and four with the season of harvest and low water.

How long this process of calendar approximation went on and when finally it was systematized we have no idea, but we do know that the first calendar-maker in Egypt took the broad concepts outlined above and by adding one very important observation formulated a calendar, which we can detect in the written records, at least by protodynastic times and probably earlier. The new element was derived from observation of the behaviour of the brightest star in the sky, the dog-star Sirius. Like all except the circumpolar stars, Sirius would apparently change its place in the sky at night as the earth moved around the sun and so shifted the point of observation. Eventually earth, sun, and star would be so nearly in a line that the light of the star would be swallowed

seen just before dawn, i.e. with cresent invisibility as opposed to new crescent visibility. As a consequence, their days ran from dawn to dawn instead of from sunset to sunset. See R. A. Parker, *The Calendars of Ancient Egypt*, Chicago, 1950, pp. 9 ff.

up in the sun's brightness and the star be invisible for a period later recognized by the Egyptians as of seventy days. At the end of this period there would be a night when, just before dawn, the star would again become visible, if but momentarily, in the eastern horizon, an astronomical event known as its heliacal rising. The Egyptians saw Sirius as a goddess, Sopdet (Sothis), and, as it happened, the heliacal rising of the goddess would usually occur just about the time when the period of low water was coming to an end. As a result, the rising of Sothis came to be regarded as the herald of the inundation, and it provided a most satisfactory peg on which to hang a true calendar.

As we may formulate it, the calendar year consisted of three seasons, each of four lunar months. The months had names, taken from important festivals occurring in them, and the seasons were called *akhet*, 'flood' or 'inundation', *peret*, 'emergence', and *shomu*, 'low water' or 'harvest'. The great feast of the rising of Sothis, called *wep renpet*, 'opener of the year', by the Egyptians, gave its name to the fourth month of the third season, i.e. the last month of the year. Unlike the other month festivals, which were in each case assigned to various days of the lunar month such as the first day, first quarter-day, full-moon day, etc., the rising of Sothis was a stellar event with no relation whatever to the moon, and it was necessary therefore to arrange a calendar which would keep this event properly within the month which it named. Experience led to a very simple rule. Since twelve lunar months total on the average 354 days—some eleven days shorter than the natural year—whenever the rising of Sothis took place in the last eleven days of the month *wep renpet*, the following month was not taken as the first of the year, but as an intercalary or extra month, and the next year became a 'great' year of thirteen months, some 384 days, which would keep the rising of Sothis safely in its month.

To make this more clear, let us assume that one year Sothis rose heliacally on the sixteenth of the month *wep renpet*: the next year it would fall on the twenty-seventh, eleven days later. Were nothing done, the next year it could be another eleven days later, and out of its month entirely. But an intercalary month of twenty-nine or thirty days would save it and place the next rising of Sothis early in *wep renpet*, on perhaps the seventh or eighth day.

Such then was Egypt's first calendar on record—a normal year of three seasons, each of four lunar months, with an extra month every three, or more rarely two, years, and kept in place in the natural year by being tied to the heliacal rising of Sirius/Sothis, and so a luni-stellar calendar. For the predynastic and proto-dynastic Egyptian such a year would have been completely adequate, and the small oscillation about the rising of Sothis inherent in it would have been of no concern.

In time, however, Egypt became a well-organized kingdom, and such a fluctuating calendar, with now twelve months and now thirteen, and all beginning by observation, must have become an administrative handicap. To be sure, other peoples in the ancient Near East used lunar months and lunar years throughout their history and made do, despite the awkwardness. It was the genius of the Egyptians to be the first to break the bonds imposed by the lunar month and to devise a more workable calendar. What they did was to create a schematic or averaged lunar year, and there are two ways in which this might have been done. The less likely would have been to keep a record of the total days in each year, whether of twelve or thirteen months, and average them: after eleven years this would have given a figure of 365·09 days, after twenty-two years of 365·04, and after twenty-five of 364·96,[1] inevitably the figure of 365 would have been selected.

An easier way, and perhaps the more probable one, would have been to count the days between successive heliacal risings of Sothis, since that star was the peg upon which the present calendar

[1] For the above figures see Parker, *Calendars*, p. 53. The Egyptians themselves would have used unit fractions.

was hung. With allowance for errors in observation and poor observational conditions, a few years would be all that was necessary to decide on 365 as the correct number of days. The new calendar year, which we may call the 'civil' year, consisted, like its predecessor, of three seasons of four months each. The great advance was, however, to fix all the months at thirty days each; the extra five days were called the 'days upon the year' (by the Greeks, the 'epagomenal' days) and were in essence an intercalary period, similar to the thirteenth lunar month. The resulting achievement was the calendar which has been aptly termed 'the only intelligent calendar which ever existed in human history'.[1]

It should be remarked that the new thirty-day months were divided into 'weeks' of ten days each. While the lunar month divides naturally into quarters, these are uneven—for the Egyptians they were of seven, eight, seven, and seven or eight days each to the lunar month.[2] Since such irregularity was precisely what they were trying to avoid, as evidenced by the rounding-off of all the months to thirty days, for the new months they abandoned quarters and instead settled on thirds. This had a most far-reaching and quite unforseen effect, in that the ten-day week led directly to another of our legacies from Egypt—the division of the day into twenty-four hours. Precisely how this came about will be discussed elsewhere.[3]

Though the length of the civil year was probably determined by Sothis, it is important to note that it was never tied to its rising as was the lunar year. Presumably after it was installed—

[1] O. Neugebauer, *The Exact Sciences in Antiquity*, Providence, 1957, p. 81. Its lack of intercalation made it an ideal instrument for astronomical calculations. This was recognized by Hellenistic astronomers and by their successors through the Middle Ages to Copernicus, whose lunar and planetary tables still used the Egyptian civil calendar.

[2] The days of the lunar month were named. The seventh day was called 'part day' as was also the twenty-third. The fifteenth day was 'half-month day' (see Parker, *Calendars*, p. 11).

[3] See below, p. 52.

and we can place this between about 2937 and 2821 B.C.—,[1] though running concurrently with the lunar year, it was restricted to administrative and economic purposes, while the original lunar year continued to determine the dates of temple service and religious festivals, just as our own liturgical year is fixed. The two years, civil and religious, will have complemented one another excellently, and because of the vacillation of the lunar year it will for a long time have remained unnoticed that the civil year was not remaining in place with it but, because there was never a leap-year with a sixth extra day, was slowly moving forward in the natural year at the rate of one day every four years. Eventually it cannot have escaped attention that no month of the civil year ever coincided even for a day with its lunar counterpart and that the dual character of the year was being nullified. Instead of adjusting the situation by adding a number of days to a particular civil year, so forcing it back into agreement with the lunar year, and then keeping it in place by a sixth extra day every four years (since by now, through Sothic risings, the year was surely known to have $365\frac{1}{4}$ days), a rather astounding solution was imposed. The civil year, having proved its worth to officialdom for a century or more, was left untouched to continue its creeping progress through the natural year, but since it was after all an artificial creation, a schematic year, it was given a lunar counterpart to provide the same sort of dual year that existed at first. This second lunar year was not tied to Sothis but rather to the civil year, so that its months would coincide generally with their civil counterparts. From this time (perhaps about 2500 B.C.) Egypt had three years, one civil and two lunar, all of which continued in use to the very end of pagan Egypt. The civil year and its lunar counterpart moved forward through the seasons, while

[1] On the reasonable assumption that the first day of both civil and lunar years coincided, with the latter being as close as twelve days to the heliacal rising of Sirius or as far away as forty-one days. In about 2773 B.C. the first day of the civil year came to coincide with the rising.

the original lunar calendar, since it remained in place, continued to provide an agricultural and festival year.[1]

In the last centuries B.C., the second lunar year, while still preserving its lunar character, divorced itself from observation for determining the beginning of its months, and adopted instead a twenty-five-year-cycle scheme based on the civil year.[2] Henceforth, lunar months began on predetermined dates which repeated themselves every twenty-five years. At its inception (about 357 B.C.) the cycle scheme, though relatively simple, had a rather high degree of agreement with observation.[3] Over the centuries, however, since twenty-five civil years have 9,125 days, and 309 lunar months (sixteen years of twelve months and nine years of thirteen months) have only 9,124·95231 days, this good agreement began to lessen, and by the time of the Carlsberg demotic papyrus itself (A.D. 144) it had disappeared and reflected instead a situation in which new-crescent visibility would seem to have been the underlying basis of the cycle. Nevertheless, just as earlier with the civil year, no adjustment or correction was made.

It is, of course, the civil year of 365 days which is so well known to students of Egyptian history, and it must again be emphasized that we have no evidence of any adjustment of or tampering with

[1] It needs to be emphasized, in view of the vast amount of sheer speculation and undemonstrable hypotheses about Egyptian calendation, that these three are the only calendars for which there is any solid evidence. Particularly attractive to earlier chronologers has been the idea of a fixed or Sothic year, one whose first day always coincided with the rising of Sothis by having a leap-year of 366 days every four years. There is no evidence for such a year, and the postulated need for it (so that natural feasts such as that of the harvest might be celebrated at their proper times) was fully met by the original lunar calendar.

[2] Discovered in Carlsberg demotic papyrus No. 9 by O. Neugebauer and A. Volten and published by them in *Quellen und Studien zur Geschichte der Mathematik*, Abt. B, Bd. 4, Berlin, 1938, pp. 383–406. See also Parker, *Calendars*, pp. 13 ff.

[3] Calculated dates for two years of lunar months, twenty-five in all, show agreement with derived cycle dates in eighteen cases, an accuracy of 72 per cent (Parker, *Calendars*, p. 25).

this year from the time of its installation in the early third millennium B.C. until 238 B.C., when Ptolemy III made an unsuccessful effort to keep it in place by the device of a sixth epagomenal day every four years.

It is upon this unchanging civil year that Egyptian chronology has been built, for any event which can be fixed precisely in the astronomical year will, as we have remarked, fall on the same day of the Egyptian civil year for four years, on the day after for the next four years, and so on until the civil year has made a complete circuit through the seasons in some 1,460 years (365×4). This is the period that because of the prominence of the heliacal rising of Sirius/Sothis in Egyptian chronology has been called the 'Sothic cycle'. Now Censorinus informs us that in A.D. 139 the first day of the civil year and the heliacal rising of Sirius coincided, and we might then expect a similar coincidence 1,460 years earlier in 1322 B.C., and again in 2782 B.C. In point of fact, since the star Sirius is itself moving, the coincidences must be calculated by astronomical tables and are set as more probable in 1317 and 2773 B.C. respectively. Earlier historians, knowing that the civil calendar was in use before 2773 B.C. and assuming that it must have been established in a year when the heliacal rising of Sirius fell on its first day (since later texts name the first day of the civil year *wep renpet*, 'opener of the year', which is also, as we have noted, a name for the rising of Sothis), thought it necessary to place the establishment of the civil year another cycle earlier, and 4241 B.C. became, e.g. for Breasted, 'the earliest fixed date in the history of the world'.[1] We have seen above, however, that the civil year was not tied to Sothis at its installation but developed from the lunar calendar, and we are thus no longer forced back to the fifth millennium but may set the first civil year in the century or so before 2773 B.C. There are a few texts scattered throughout Egyptian history which give dates for a heliacal rising of

[1] J. H. Breasted, *A History of Egypt*, 2nd ed., London, 1909 and following, p. 14.

Sothis in terms of the civil year, and their prime importance for dating purposes will readily be appreciated, but before we examine them some general remarks on Egyptian chronology may be appropriate.

Following the pattern set by Manetho, an Egyptian historian and priest who lived under the first Ptolemies, the rulers of Egypt are divided into dynasties, thirty-one in all, beginning with Menes, who, as first king of the First Dynasty, unified the Two Lands (the upper valley of the Nile and its lower delta), and continuing down to the conquest of Alexander the Great. The dynasties, which broadly speaking consist of related kings (a change of ruling house was the principle of Manetho's division), are now for historical purposes grouped into periods—the Old, Middle, and New Kingdoms, the intermediate periods, and the various distinct phases of Egypt's later history (for which, see the summary ble at the end of the chapter). The situation of the kingdoms d periods, the dynasties and their kings, in time is the first task of the historian, and here only written records are of use, though these are all too frequently lacking or of dubious value.

After the earliest dynasties, when a year was named after an important event occurring in it or by a numbered repetition of a biennial cattle count, the kings numbered the years of their individual reigns, though not all according to the same system,[1] Had we contemporary records of every king it would indeed be a simple matter to work by dead reckoning, but in only a few dynasties can this be done, and other indications are required to assign them to specific years B.C. King lists have in fact been preserved which help to establish the sequence of dynasties and kings but provide no other information. Manetho gives lengths

[1] The regnal years of the kings of the Twelfth Dynasty, for example, agreed with the civil year, and every New Year's Day began a new regnal year. In the Eighteenth Dynasty, however, regnal years began with the king's accession, and so usually contained part of one civil year and part of the following one. See A. H. Gardiner, 'Regnal Years and Civil lendar in Pharaonic Egypt', *JEA* xxxi (1945), 11–28.

of reigns and dynastic totals, but what we now have is not his own work but extracts from it by later historians, and in many cases either he or they have made demonstrable errors. Of much greater value are two more contemporary sources, the fragments of a tablet (or tablets) from the Fifth Dynasty, the largest known as the Palermo Stone, which recorded the reigns of previous kings, each year in a separate field, and a papyrus known as the Turin Canon which listed the kings of Egypt from the earliest dynasties down to the end of the Hyksos period, that is just prior to the New Kingdom, and gave the length of reign for each. Were these documents complete, most of our problems would disappear, but unhappily they are both fragmentary. Much useful information can, nevertheless, be gained from them when combined with other data.

In the fluid state of Egyptian chronology as it may appear from the foregoing remarks, the few records of the heliacal rising of Sothis stand out as strong anchors. The first and most important of them predicts, some days before the event, a heliacal rising on the sixteenth day of the fourth month of the second season in the seventh year of King Senwosret III of the Twelfth Dynasty. It is easily possible to calculate that this must have been in the neighbourhood of 1870 B.C.,[1] and certain lunar dates for the same king in his third and twenty-ninth years enable us to fix the exact year as 1872 B.C. Since we are well informed on the Twelfth Dynasty, and on the Eleventh also, it is possible to date the beginning of the former to 1991 B.C. and of the latter to 2134 B.C. From contemporary sources historians are moreover convinced that the Tenth Dynasty and the Eleventh were concurrent and that the Ninth was of but short duration and also partially contemporary with the Eleventh.

[1] A full Sothic cycle earlier can be ruled out because of synchronisms with Western Asiatic history. The possible years are set by Edgerton (*Journ. Near Eastern Studies*, i (1942), 307–14) from 1875 to 1865 B.C. because of the range of the *arcus visionis* (the height of the star above the sun) from 9·5° to 8·4° and also the possibility that the sighting was finally made at either Heliopolis (lat. 30·1°) or el-Lāhūn (lat. 29·2°).

It is here that the Turin Canon supplies a most useful figure, a total of 955 years and some days for the first eight dynasties. Since this figure is supported by reconstructions of the royal annals of the First and Second Dynasties and by other indications, there is small reason to question its accuracy, and if we add it to 2134 B.C., the date for the Eleventh Dynasty, we arrive at 3089 B.C. To this we must further add whatever length we wish to give to the Ninth Dynasty when it ruled alone, so that, as a round figure, 3110 B.C. may be taken to mark the beginning of Egypt's dynastic history.

With the Twelfth Dynasty firmly fixed in time, the dynasties which follow, some of which were contemporary with others, are more easily placed, with possible errors of a number of years but no longer of centuries. Moreover, other Sothic dates help to achieve accuracy. An important one is given as the ninth day of the third month of the third season, in the ninth year of Amenhotpe I, the second king of the Eighteenth Dynasty. If the star was sighted at Heliopolis the possible years for this would be 1544 to 1537 B.C.; if it was sighted at Thebes they would be 1526 to 1519 B.C.[1] In any circumstances the reign of Amenhotpe I is thus fixed within a twenty-six-year range, and other considerations will surely narrow the choice.

Enough has been said to show how the chronologer, with the help of all his source material—Sothic dates, lunar dates, genealogies of long-lived officials who served successive kings, king lists, historical records, business documents, temple calendars, records of the lives of sacred animals, synchronisms with other peoples, and other miscellaneous data—is able to build a fairly

[1] This is a possibility which, though pointed out by Edgerton, *American Journ. of Semitic Lang. and Lit.* liii (1937), 193, was not generally taken into account by chronologers until the appearance in 1964 of Hornung's study (see bibliography). It should be recalled that the Ebers medical papyrus, which has the Sothic date as a calendar notation on it, was actually found at Thebes, which was surely the working capital of the country under Amenhotpe I.