CHAPTER 16

Astronomical estimation of the dates ciphered in the Egyptian zodiacs: a methodology

1. SEVEN PLANETS OF THE ANTIQUITY. ZODIACS AND HOROSCOPES

Nowadays we know seven planets – Jupiter, Saturn, Mars, Venus, Mercury, Uranus and Neptune. However, Uranus wasn't known to ancient astronomy since this planet is too dim for the naked eye to see. It was discovered by the English astronomer William Herschel in 1781 – already in the telescope observation epoch, that is ([85], Volume 33, page 168) – let alone Neptune.

Therefore, ancient astronomers were familiar with only five of the planets known to us today, Uranus and Neptune excluded. However, before the heliocentric theory of Copernicus became widespread, the Sun and the Moon were ranked among planets as well. Hence the "seven planets of the antiquity" that we shall be referring to.

Let us explain why the Sun and the Moon were considered planets before Copernicus. According to the old astronomical theories, all celestial bodies revolved around the Earth and not around the Sun. From the point of view of an observer from Earth, it is the latter that every celestial body revolves around, and not the Sun. The trajectories of the Sun and the Moon also look very similar to those of the planets. Thus, the pre-Copernican astronomy didn't distinguish between the Sun, the Moon and the planets in their movement across the celestial sphere.

It is possible that at dawn of astronomy people had thought all seven luminaries that one sees on the celestial sphere to move inside a real sphere of cyclopean proportions, with all the immobile stars affixed thereto in some way. After many years of observation, ancient astronomers discovered that all these luminaries follow the same imaginary itinerary as they move along the celestial sphere. They realized that this itinerary follows an extremely large circumference upon a sphere and doesn't change with the course of time (today we know that it does change, but very slowly, and cannot be noticed with the naked eye). The planetary itinerary on the celestial sphere is known as the ecliptic, or zodiacal belt in astronomy. The constellations located along it are called the zodiacal constellations.

Thus, according to the old beliefs, which were apparently shared by the authors of the Egyptian zodiacs as well, seven planets or "wandering stars" were constantly moving across the sphere of their immobile cousins. These "wanderers" are as follows: *the Sun, the Moon, Jupiter, Saturn, Mercury, Mars and Venus.*

The habit of ranking the Sun and the Moon among planets died hard. In fig. 16.1 we reproduce a

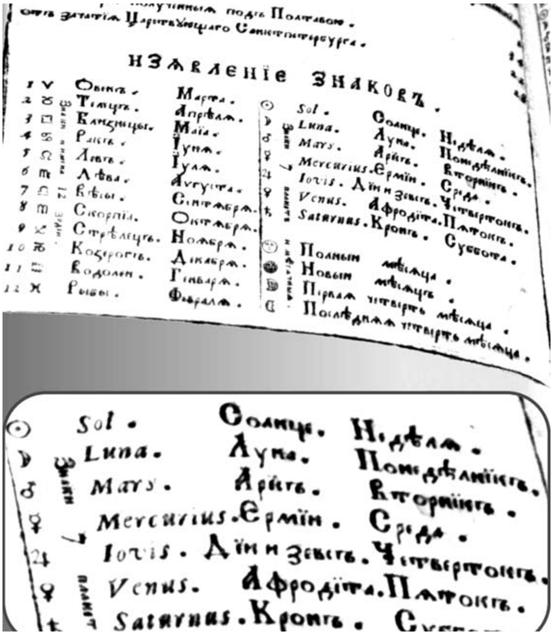

Fig. 16.1. A page from an ancient XVIII century calendar dating from the epoch of Queen Anna Ioannovna. At the bottom of the drawing we cite a close-in with a list of the seven planets, including the Sun and the Moon. Both Greek and Latin names are cited – names of the gods identified with planets, as well as days of the week related to the planets in ancient astronomy. The names of planets are as follows: Mars = Ares, Mercury = Ermis (Hermes), Jupiter – Dyis or Zeus, Venus = Aphrodite, Saturn = Kronos. Photograph of a calendar kept in the State Hermitage in St. Petersburg, taken in 2000.

page from a XVIII century calendar where the Sun and the Moon are still referred to as planets.

All the planets except for the Sun, and occasionally also the Moon, can only be seen at night – that is, when one cannot see the Sun whose light outshines all the other celestial bodies. The Sun, on the contrary, is only visible during the day. The Moon can be seen at night, and sometimes also in the daytime. Each of the seven planets is located in one of the zodiacal constellations at any one time.

The distribution of the seven planets in question across the Zodiacal constellations is called a horoscope.

Egyptian zodiacs are ancient Egytian drawings of the celestial Zodiac with Zodiacal constellations drawn thereupon symbolically. Quite often one would find planets, and thus also a horoscope, in the Egyptian zodiacs. Apart from that, a zodiac could contain auxiliary astronomical symbols as mentioned above. Most often there's just a single full horoscope in an Egyptian zodiac; however, there are some that contain several horoscopes. There are also horoscopeless zodiacs in existence.

Each planet's position in relation to the constellations of the zodiacal belt can be observed in the sky, the Sun being the sole exception. All the planets are visible at night, likewise the stars, except for the ones that have come too close to the Sun, which temporarily deprives them of nocturnal visibility. Their position on the Zodiac is nevertheless easy enough to estimate – they should be near the Sun.

The Sun's place on the zodiac cannot be observed; it is, however, possible to determine it. One can do it at dawn or immediately after dusk. For instance, one can mark the place where the sun sets in the evening and then, when it gets dark enough, also mark the zodiacal constellation that appears here. This requires the knowledge of the Sun's daily motion speed determined by the rotation of the Earth – a value that remains constant over the course of time (within the precision limits that interest us, at least). Therefore, the speed at which the Sun sets is easy enough to calculate – all it takes is a clock, no matter how roughly-made.

There is another simple method of estimating the position of the Sun among the stars with precision. It couldn't be used any day, though – only during full moon, and on the condition that the stellar longitudes on the Zodiac have already been measured by someone. Were the ancient astronomer in the possession of such a catalogue, he could estimate the position of the Sun by that of the Moon. One should bear in mind that the Sun and the Moon are on the opposite ends of the Zodiac during full moon; therefore, once we mark the position of the full moon amongst the stars, we can use the catalogue of zodiacal constellations in order to find the zodiacal point that opposes it, where the Sun shall be.

The knowledge of the Sun's position during full moons and the fact that the speed of the solar ecliptic motion remains constant throughout the entire year of the solar cycle, one can calculate the celestial position of the Sun for any day. Once again, one needs to have some sort of a timekeeping device and the knowledge of fractions; both appeared in the Middle Ages (METH3]:3, pages 94-102).

Let us emphasise that no matter how the observations are conducted, the position of the Sun among the stars can always be calculated. To reiterate – one cannot observe the Sun and the stars simultaneously, yet the position of the Sun in the Egyptian zodiacs is usually indicated with precision. Therefore, the zodiacs could simply be compiled, without the need for observing celestial objects and performing astronomical calculations.

2. THE POSSIBLE PRESENCE OF CALCULATED HOROSCOPES IN EGYPTIAN ZODIACS

And so, the ancient astronomers could estimate the zodiacal positions of every planet except for the Sun from immediate observations. The position of the Sun either had to be calculated, or could only be given very roughly. Therefore, the horoscopes from the ancient zodiacs could be compiled from actual observations.

On the other hand, nothing could prevent the ancient astronomers from calculating the horoscopes that they would subsequently write into one zodiac or another. This would require an astronomical theory of some sort in order to enable one the calculation of every planet's position and not just the Sun with any degree of precision at all – not that high, the correct indication of a planet's position as related to a constellation could easily suffer the error rate of 5-6 longitudinal degrees. Such precision requirements were well met by Ptolemy's theory, for instance, as related in the "ancient" Almagest ([704]). By the way, it is presumed that the Almagest was written in Alexandria, Egypt ([704]).

Don't forget that Scaligerian chronology dates the Almagest to the II century A.D. We have demonstrated this dating to be erroneous, as well as the fact that the Almagest was compiled between the VII and the XIV century A.D., and then complemented and edited up until the XVII century. The "ancient" editions of the Almagest that we have at our disposal today all hail to the XVII century, qv in Part 1.

Thus, according to either the New or the Scaligerian chronology, Egyptian astronomers had a theory that sufficed for calculating and not observing the horoscopes that they included in their zodiacs.

Hence the important corollary that we already mentioned above.

A horoscope one finds in an Egyptian zodiac doesn't necessarily refer to the date contemporary to this zodiac's manufacture.

For instance, if a zodiac is a drawing from the ceiling of an ancient temple, the date ciphered in its horoscope is unlikely to be that of the temple's construction – most probably, it is the date of the holy event that the temple itself was consecrated to. Therefore, there is a very real possibility that such horoscopes were calculated during the construction of the temple and reflects the builders' ideas on the dating of the even in question.

Another possibility is as follows. The "ancient" compilers of the Egyptian zodiacs (which could have lived in the XV, XVI, and in some cases even in the XVII-XVIII century A.D., according to the New Chronology) may have known an older tradition than we and owned old books which are irretrievably lost to us. For example, they may have used the truly old records of astronomical observations dating to the XI-XIII century for reference when they compiled zodiacs for the "ancient" Egyptian temples built in their epoch.

They could also have had a really old version of Ptolemy's Almagest at their disposal, one that dated to the epoch of the XI-XIV century A.D. All we have now is a XVII century European edition that is presented to us as the "unaltered original" of the "incredibly ancient" Almagest without any justification whatsoever (see CHRON3, Chapter 11).

On the other hand, a horoscope from the ceiling of an Egyptian sepulchre or the lid of an Egyptian coffin is most likely to contain a date corresponding to the time of the actual coffin's (sepulchre's) manufacture, since such zodiacs would apparently refer to the date of birth or demise of the deceased buried here. In this situation, the horoscope could be observed on the sky and instantly written into the funereal zodiac. The only thing left to calculate would be the position of the Sun. This method may have been preferential, since it involved a great deal less calculus.

It is however also possible that the sepulchres of the aristocracy could sometimes be adorned by zodiacs related to some important ancient events instead of the birth or death of the buried person. Therefore, zodiacs found in tombs and sepulchres may also have been calculated – it is obvious that the horoscope of an ancient event cannot be observed and has to be calculated. This would have to be done by specialists. Quite naturally, ancient chronologists may have informed the ancient astronomers of an incorrect dating for the horoscope, since this dating would simply reflect their ideas of the past and its chronology. These ideas could easily prove erroneous. One should hardly doubt the fact that chronological errors made then would resemble the modern ones in the respect that they would make events more ancient – not the other way round. Obviously, the older a clan, the more respect it should command. Therefore, one might expect to find horoscopes compiled for anachronistic dates in the ancient tombs.

On the other hand, one finds it highly unlikely that one should find a future date on the ceiling of a temple or the lid of a sarcophagus. Therefore, if we find a zodiac with a horoscope in an ancient temple or tomb, the event it was compiled for should predate the construction of the temple or tomb in question.

3. THE MOTION OF PLANETS ALONG THE ZODIAC

Before we begin to tell the reader just how the date of an event can be represented by a horoscope with zero or very little ambiguity, let us remind the reader of some well-known astronomical facts.

Any observer of the sky at night can notice that the celestial sphere slowly rotates as a whole. Nowadays we know this to be a result of the daily telluric rotation. Our predecessors used to think there was a huge sphere with immobile stars upon it that rotated around the Earth. This sphere was called the celestial sphere, or the sphere of the immobile stars. This concept is used in astronomy to date, although no such sphere could possibly exist in reality. However, one occasionally finds it convenient to allow for the existence of this sphere hypothetically – it facilitates astronomical discussions of the visible planetary motion and reflects the way the stars are seen from the Earth.

Indeed, in comparison to the bodies from the Solar System, the stars are far enough for us to consider them to be located at an infinite distance – or, similarly, a great distance equal for all. One can therefore imagine that all the stars are located upon the surface of a gigantic sphere with the Earth at its centre. The radius of the imaginary sphere is much greater than the distance between the Sun and the Earth, and so we may just as well consider the Sun to be its centre. The planets that rotate around the Sun, including the Earth, all have the orbits of a finite radius. The entire Solar System fits into the centre of the celestial sphere, qv in fig. 16.2.

Let us forget about the rotation of the Earth for the time being. This rotation only affects the part of the celestial sphere observable from a given point upon the surface of the Earth at any one time. One can be on the sunlit part of the Earth and see the Sun, which will be otherwise obscured by the Earth and half of the celestial sphere. However, the stars and planets on the other half of the sphere will be visible, the border between the two being the observer's local horizon, qv in fig. 16.2.

Thus, the daily rotation of the Earth only defines the visibility or invisibility of either the Sun or the planets in a given point of the telluric surface. The actual horoscope, or the way the planets are distributed across the Zodiacal constellations, does not depend on this rotation. We shall however have to account for it, albeit later, when we shall be verifying the planetary visibility conditions for individual horoscopes. For the time being, let us assume the observer sees everything. In other words, let us imagine an observer who sits in the centre of a transparent Earth and sees the Sun, the planets and the stars simultaneously.

The above viewpoint makes it easy to comprehend the planetary motion across the celestial sphere as observed from the Earth. Indeed, the position of every planet, as well as the Sun among the stars (as seen from the Earth) is defined by the direction of the ray projected from the Earth towards any of the planets. If we are to presume the ray intersects with the sphere of the immobile stars at some point, this intersection point shall give us the planet's position among the stars for a given moment in time.

Since all the planets including the Earth rotate around the Sun, the ray directed from the Earth towards any of these planets (the Sun and the Moon included) shall keep rotating, qv in fig. 16.2, since the entire segment that includes the ray shall be in motion. Thus, the sun and all the planets move in relation to the sphere of immobile stars – slowly, but at different speeds. The celestial itinerary of each planet is obviously defined by the trajectory of the point where the ray projected from the Earth crosses the imaginary celestial sphere, qv in fig. 16.2.

Let us now point out that all these rays remain in a single plane – the "orbital plane" of the Solar System. Indeed, astronomy is aware of the fact that the rotation planes of the planets are similar to each other, but don't correspond precisely. One can consider all of them to belong to approximately the same plane – the "orbital plane", that is. The intersection of this plane and the celestial sphere shall obviously be the "celestial itinerary" of the annual motion of all planets across the celestial sphere as observed from the Earth, the Sun and the Moon included.

The solar trajectory shall be the simplest. The more or less even rotation of the Earth around the sun becomes a similarly even rotation of the Sun around the Earth from the point of view of a telluric observer. This shall mean that the Sun shall travel in the same direction maintaining the same speed, making a full cycle in a year. The exact length of this time interval is known to astronomy as "the stellar year".

The trajectories of other planets are more complex and result from two kinds of rotation – the rotation of the Earth, where the segment that defines the direction of a planet begins, and the actual planet where it ends. What this results in is that planets as seen by the telluric observer occasionally stop their movement across the celestial sphere, turn back, then turn once again and continue their motion in the original direction. This is the so-called "retrograde planetary motion". It had been noticed a long time ago, and many ancient astronomers tried to explain it. One has to bear in mind that Ptolemy's "ancient" theory already described this phenomenon with high enough precision.

Here we have been referring to the annual motion of the Sun among the stars all along. As for the daily motion of the Sun – from dusk to dawn and back, it doesn't shift the Sun's position in relation to the stars and doesn't alter anything at all on the celestial sphere. In other words, it does not affect the horoscope, since the daily motion results from the

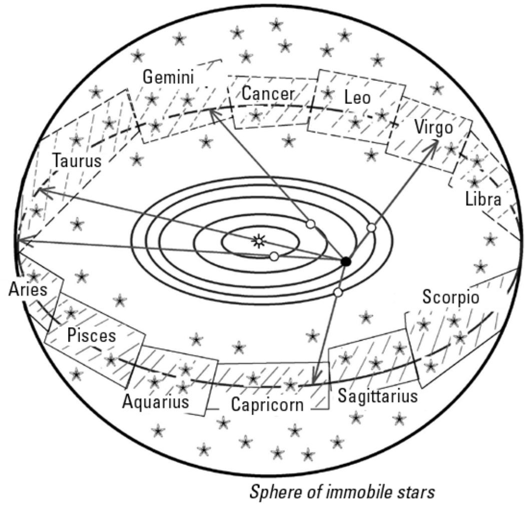

Fig. 16.2. The Solar System in the centre of the imaginary sphere whose radius is infinite – the so-called "sphere of immobile stars". The visible positions of planets in relation to the stars are determined by the intersection of rays originating on Earth with this sphere.

rotation of the Earth and bears no relation to the configuration of planets in the Solar System. Thus, neither the Sun nor the planets shift across the celestial sphere as a result of the daily telluric rotation.

4. DIVIDING THE ZODIACAL BELT INTO CONSTELLATIONS

Let us briefly reiterate what we already wrote about in CHRON3, Chapter 1. In particular, let us once again present the reader with the geometry of the celestial sphere as seen in fig. 16.3. The annual motion of the Sun, the Moon and the planets follows the same circumference on the celestial sphere known as the ecliptic. The stars located near the ecliptic form zodiacal constellations. This gives us an unbroken belt of constellations that spans the entire celestial sphere, with the ecliptic seen as its hub of sorts.

More precisely, the ecliptic is the circumference where the plane of telluric rotation around the Sun intersects with the celestial sphere whose centre can be chosen as coinciding with the centre of the Sun, which lies within the plane of the ecliptic. In fig. 16.3

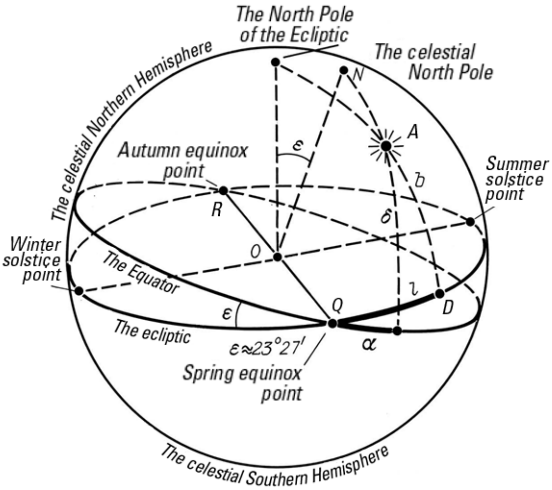

Fig. 16.3. The sphere of immobile stars, or the celestial sphere. One sees the ecliptic, the equinoctial, as well as the solstice and equinox points located thereupon. The diagram demonstrates the shifts in the celestial coordinates in an ecliptic system affixed to a certain epoch. The longitude of the point projected onto the ecliptic as counted from the spring equinox point is called the ecliptic longitude.

it is point *O*. However, we already mentioned that the distance between the Sun and the Earth, as well as the rotation of the latter, can be seen as negligible in comparison to the distance between the Solar System and the stars.

Nowadays we know that the ecliptic rotates over the course of centuries, albeit very slowly. Therefore, one has to introduce the concept of an "instant ecliptic" of a given year or epoch. For instance, the position of the ecliptic for the 1 January 2000 is called "the ecliptic of the 2000 epoch", or "ecliptic J2000" in brief.

The letter J refers to the fact that astronomy uses Julian centuries ([262] and [1222]). There is another method of astronomical timekeeping that we have used in our research – employing the *days of the Scaligerian Julian period*. Scaliger suggested to number all days, beginning with 4713 A.D. The Julian date of 1 January 1400, for instance, will equal 2232407 in this system ([393], page 316).

Apart from the ecliptic, one sees another large circumference on the celestial sphere in fig. 16.3 – the so-called equinoctial, or "the celestial equator" – the circumference where the plane of the telluric equator intersects with the celestial sphere. The equatorial circumference rotates at a great enough speed, and always changes its position on the celestial sphere.

The ecliptic and the equator intersect on the celestial sphere, the angle between them equalling approximately 23 degrees 27 minutes. The points of their intersection are marked *Q* and *R* in fig. 16.3. The Sun crosses the equinoctial in these points – twice over the course of its motion across the ecliptic. Point *Q* that marks the transition of the Sun into the Northern hemisphere, is known as the spring equinox point. Day equals night there. It opposes the autumn equinox point marked *R* in fig. 16.3. This is where the Sun enters the Southern hemisphere. Day is also equal to night here.

The winter and summer solstice points are also located on the ecliptic. Four solstice and equinox points divide the ecliptic into four equal parts, qv in fig. 16.3.

As time goes by, all four points slowly shift across the ecliptic in the direction of smaller longitudinal coordinate values. This direction is known as longitudinal precession (or simply precession) in astronomy ([262]). The rate of precession roughly equals one degree in 72 years. This shift of equinox points leads to the so-called precession of equinoxes in the Julian calendar.

Indeed, due to the duration proximity of the Julian year and the stellar year, or the time it takes the Earth to complete its cycle around the Sun, the shift of the spring equinox point across the ecliptic leads to the shift in the equinox date as given in the Julian calendar ("old style"). Namely, the Julian ("old style") date of the spring equinox keeps moving towards earlier days in March – with the approximate speed of 24 hours in 128 years, qv in fig. 14.14 above.

In order to estimate the positions of the celestial bodies one needs to know their coordinates on the celestial sphere. Astronomy has several such coordinate systems. We shall need ecliptic coordinates, specified in the following manner (see fig. 16.3).

Let us consider the celestial meridian that crosses the ecliptic pole *P* and a given point *A* on the celestial sphere whose coordinates need to be estimated. It shall cross the ecliptic plane in a certain point *D*, qv in fig. 16.3. Arc *QD* shall then refer to the ecliptic longitude of point *A*, whereas arc *AD* shall stand for its ecliptic latitude, *Q* being the spring equinox point.

Thus, the ecliptic longitudes on the celestial sphere are counted from the spring equinox point of the epoch whose ecliptic we have chosen in the present case. In other words, the ecliptic coordinate system on the celestial sphere directly relates to a certain fixed date. However, having fixed the ecliptic once, and chosen a certain coordinate system on the celestial sphere, we can specify the positions of the Sun, the Moon, the planets and any celestial body in general for any moment in time.

In our calculations for estimating the coordinates on the celestial sphere we have used the ecliptic for 1 January 2000 (J2000).

We choose the ecliptic division J1900 (1 January 1900) to represent the approximate basis for differentiation as suggested by T. N. Fomenko ([912:3], page 782). This division was performed in accordance with the star chart and the constellation boundaries specified therein ([293]). Rendered into the coordinates of the J2000 epoch, this division shall look as follows:

Zodiacal constellation	*Longitudinal interval on ecliptic J2000 in degrees*
Aries	26 - 51
Taurus	51 - 89
Gemini	89 - 118
Cancer	118 - 143
Leo	143 - 174
Virgo	174 - 215
Libra	215 - 236
Scorpio	236 - 266
Sagittarius	266 - 301
Capricorn	301 - 329
Aquarius	329 - 346
Pisces	346 - 26

It has to be said that the zodiacal boundaries on the celestial sphere are anything but clearly-specified. Therefore, any separation of the ecliptic into zodiacal constellations is approximated to some extent, and arbitrary to boot. For instance, the separation of the ecliptic into zodiacal constellations as suggested in [393], page 26 (see fig. 14.14) is slightly different from the one that we suggest above. However, simple calculations demonstrate that the difference doesn't exceed five arc degrees, which equals to the value of the solar shift over five days. What one must take into account whilst making the comparison is the fact that in fig. 14.14 the positions of the sun separate the ecliptic into days and not degrees.

Thus, both division methods are roughly coincident. We see a similar division in the mediaeval astronomical map by A. Dürer as cited above, in fig. 15.2. The differences are once again within the limits of 5 arc degrees.

We had to account for the boundary between zodiacal constellations being arbitrary. We used two methods in order to account for it.

Firstly, the program that we wrote for astronomical calculations of horoscope dates would automatically add a 5-degree "allowance interval" to the boundaries between constellations. In other words, no "border trespassing" between any pair of constellations was considered such within the limits of 5 arc degrees.

Secondly, in our interpretation and decipherment of the zodiacs and the search for preliminary astronomical solutions we would always specify wider boundaries for planetary intervals as specified in the zodiacs – namely, planets were allowed to cross the border of the adjacent constellation by half of the constellation's ecliptic length.

This would completely eliminate the possibility of losing the correct solutions due to minor discrepancies in constellation border specifications. This would naturally yield a number of extraneous solutions, which would nevertheless fail to pass the phase of secondary horoscope and planetary visibility compliance testing.

Apart from that, in the last stage of our research each of the final solutions we came up with was verified with the aid of the Turbo-Sky software so as to make sure all the planetary positions satisfy to the conditions specified by the original Egyptian zodiac. However, there wasn't a single case of poor correlation between the planetary positions as specified in the zodiac and revealed to us in the final solution. In other words, every solution that we have discovered – that is, all the solutions that withheld the test of the secondary horoscopes and planet visibility indicators, turned out to be in perfect correlation with their respective zodiacs planetary disposition-wise. Let us however reiterate that in the initial search this correlation was tested under less strict criteria.

5. "ASTRAL CALENDAR". HOW OFTEN DO INDIVIDUAL HOROSCOPES RECUR?

Let us give a more in-depth account of the astral calendar used by the ancient Egyptian astronomers and artists in order to transcribe dates in the zodiacs, and particularly its modus operandi. We already mentioned that in order to transcribe a date, an Egyptian zodiac should contain the positions of all seven planets, including the Sun and the Moon.

One might wonder whether there are enough possible ways of distributing planets across the zodiac in order to use the horoscopes for transcribing dates – possible horoscopes that could all be successfully assigned to dates, that is, with the discrepancy threshold of a day or two?

Let us perform a brief calculation. A year has 365 ¼ days, which makes a millennium equal some 365 thousand days. The historical period covered by documented history equals 5-6 thousand years, according to the consensual chronology. It is easy enough to calculate that the period in question equalled to circa two million days. Can the quantity of horoscopes available to us cover an interval this great? Could there be so few possible planetary combinations to make individual horoscopes recur every 100-200 years? Had this been the case, the dates transcribed with the aid of horoscopes would be useless for the purpose of independent chronological study, since it would then be easy to find a date to fit the horoscope in any given century.

Actually, this is the very error (among many others) made in the attempts to prove Scaligerian chronology by rough astronomical dating of Sumerian tablets ([1287] and [1017:0]) or Egyptian zodiacs ([1062], [1062:1] and [1290:1] in the interpretation that the Egyptologists suggest). See also CHRON3, Chapter 13:5.

However, let us return to the number of possible horoscopes. Fortunately, the situation is far from being as dire as one may have initially thought. The number of possible combinations for a horoscope is vast – it surpasses 3.5 million. This is quite sufficient for the purposes of independent dating.

Indeed, let us perform the following simple calculation. Bearing in mind that each of the seven planets can be in any of the 12 Zodiacal constellations at any one time, we have 12 options for every planet. However, the inner planets (Venus and Mercury) cannot lie too far away from the Sun. Thus, the maximal distance between the Sun and Venus is 48 arc degrees, and Mercury is never further away from the sun than 28 degrees ([376]). If the position of the Sun upon the zodiac is fixed, Venus can be at the distance of two zodiacal signs from the Sun maximum, whereas for Mercury this distance is never greater than a single sign. Bear in mind that a single Zodiacal sign occupies 30 arc degrees on the ecliptic in general.

Thus, we get 5 possible zodiacal signs for Venus – the same as in case with the Sun, and two neighbouring signs at either side, and 3 possible signs for Mercury, respectively, given that the solar position is fixed. Other planets can occupy varying positions on the ecliptic, independently from the position of the Sun and each other. The final result that we get is as follows:

$$12 \times 12 \times 12 \times 12 \times 12 \times 5 \times 3 =$$
$$= 3{,}732{,}480 \text{ possible horoscopes.}$$

If we aren't after particular precision and consider one zodiac to be valid for one day on the average, we shall have to divide the resulting number by the number of days in a year, which will give us the approximate horoscope recurrent interval. Any calculator shall tell us that it equals some 10,000 years. In other words, if the distribution of horoscope combinations in time were completely chaotic, each horoscope would recur once in circa 10,000 years. However, the recurrences are far from completely chaotic – thus, having once surfaced, a given horoscope recurs once or twice over the next 1,500-2,000 years, and disappears again for tens of millennia.

Such recurrence of horoscope results from the existence of pseudo-periods inherent in the planetary configuration of the Solar System. These are false periods between the recurrences of the already perturbed solar system configurations. Each recurrence of the configuration is distorted to a greater extent than its predecessor. Such pseudo-periods aren't likely to make more than two or three cycles.

One of such pseudo-periods (854 years in length) was discovered by N. A. Morozov and subsequently studied by N. S. Kellin and D. V. Denisenko ([376]). N. A. Morozov wrote the following in this respect:

"Striving to render calculations to a possible minimum, my late colleague from the Astronomical Department of the Lesgaft State Institute of Science, M. A. Vilyev, had discovered the period of 912.9 years … and after that, I calculated that an 854-year period would work even better … We see that in the present case, characterised by high precision and multimillenarian stability of similar geo-/heliocentric combinations of Saturn and Jupiter, all of these series and triads appeared to copy one another. However, Saturn's exact cycle equals 854.25 years and not 854, and so this planets is three degrees behind geocentrically, while Jupiter's cycle equals 854.05 years, which makes it lag behind by circa 1.5 degrees for each new series. On the contrary, we witness forestalling in both cases if we are to count the series in reverse … this cycle is also very interesting due to the fact that it makes new moons and similar lunar phases recur every eight days, and the position of Mars also remains rather stable … likewise, Venus and Mercury tend to linger here two or three times, being on the same side of the sun, to the East or to the West. However, tracing such calculations … much further in time (10 cycles, or 8,500 years) would be unwary" ([544], Volume 6, pages 706 and 708).

N. S. Kellin and D. V. Denisenko have conducted additional research of the nature of the pseudo-period discovered by N. A. Morozov, discovering that it sometimes works for the telluric observer even in cases when the planetary configuration in general alters significantly. They wrote the following:

"Over the course of 854 years Venus will make 1388 full cycles in its motion around the Sun and will advance by a further 70 degrees, whereas Mercury shall lag behind its former position by some 40 degrees. Although these shifts are much greater than those of Mars, Jupiter and Saturn (21, –1.5 and –3 degrees in general, respectively), Mercury and Venus as seen by the telluric observer 854 years later might end up in the same constellation as before, and on almost the same longitude to boot, owing to the fact that their orbital motion is faster than that of the Earth and they may thus become projected over the same point of the celestial sphere even if they occupy a different orbital position in relation to the Sun" ([376]).

The effect of these pseudo-periods is as follows: many of the horoscopes, seeing as how they manifested in the last 2-3 millennia, may recur two or three times over the historical period. From the viewpoint of astronomical dating, this leads to rather undesirable, yet common scenario where we are confronted with several solutions for the same horoscope manifest throughout the entire historical period.

However, there are usually few such solutions – two or three; sometimes one – or four, on the contrary. Thus, if we are to have any kind of non-trivial astronomical information at our disposal to characterise the desired date apart from the horoscope, we shall be left with just one complete solution. This is the case with every Egyptian zodiac known to us.

On the other hand, the abovementioned calculations imply that "random", or fictional horoscopes have no solutions on the historical interval of 2-3 millennia as a rule, which is a great deal less than the horoscope recurrence period.

Thus, the "astral calendar" of the Egyptian zodiacs is indeed capable of telling us the precise dates of the ancient Egyptian history.

Apparently, the very idea of using the "astral calendar" in order to transcribe the sepulchral dates would be based on its exceptional longevity. Indeed, this calendar, unlike every other system of timekeeping known to us, allows the transcription of dates without the need for referring to any contemporary events. It doesn't depend on the beginning of an emperor's reign, or the beginning of some other era or calendar cycle. It doesn't even depend on the timekeeping system and the way of writing numbers – in other words, there are no dependencies on anything that can be easily forgotten by the descendants.

The transcription of dates in such a calendar required neither words nor numbers; drawn figures would account for everything. The only knowledge one needs in order to decipher such a dating is that of zodiacal constellation symbols and planetary figures. One has to admit that this plan of the "ancient" Egyptians, based on the presumption that people shall remember these concepts due to the immutability of the celestial sphere, proved perfectly valid. We have enough knowledge of the ancient astronomy nowadays to decipher the "astral" datings. Such recollections help us with the decipherment of symbols from the Egyptian zodiacs.

Thus, nowadays we are fortunately capable of reading the old "astral" Egyptian dates, albeit not entirely without effort, and find out the exact epoch that the ancient Egypt dates to.

6. THE CALCULATION OF PAST PLANETARY POSITIONS. THE HOROS SOFTWARE. Modern planetary theory precision suffices for the dating of the Egyptian zodiacs

In order to calculate the positions of the Sun, Mercury, Saturn, Jupiter, Mars and Venus as seen from the Earth, we have used the Planetap program written in Fortran by the French astronomers from the Parisian "Longitude Bureau" (*Bureau des Longitudes)* J. L. Simon, P. Bretagnon, J. Chapront, M. Chapront-Touze, G. Francou and J. Laskar. The program is based on the algorithm of calculating the planetary ephemeredes that they published in "Astron. Astrophys.", an astronomical journal, in 1994 ([1064:0]).

The Planetap program allows to calculate coordinates, radius vectors and instant speeds for the eight primary planets of the Solar System (or, rather, the Earth-Moon barycentre), Saturn, Jupiter, Mercury, Mars, Venus, Uranus and Neptune. The heliocentric planetary coordinates in the Planetap program are calculated in relation to the ecliptic plane of the epoch J2000 (Julian day JD2451545.0, qv in [1064:0]).

Planetap software developers guarantee the precision rate of 2 arc minutes or more for the heliocentric coordinates of all eight planets on the time interval starting with 1000 A.D. ([1064:0]). The precision of their program begins to waver for dates preceding 1000 A.D., but remains sufficient for our purposes up to the first centuries of the new era. Bear in mind that we shall be perfectly satisfied with the discrepancy rate of several degrees for the planetary positions as observed from the Earth. Higher precision will simply be uncalled for in the dating of the Egyptian zodiacs.

Nevertheless, in order to evade the error growth for the epoch preceding 1000 A.D., we have cut out the top parts in the decomposition of power equation compounds of average orbital elements. The trigonometric decomposition compounds that contained no growing parts were left unaltered.

The Planetap program was used as a subroutine of Horos, the computer software developed by the authors of the present book specifically for the purpose of dating Egyptian zodiacs or other ancient zodiacs of a similar type.

The Horos program uses the heliocentric planetary coordinates calculated by Planetap in order to estimate the ecliptic coordinates of Saturn, Jupiter, Mercury, Mars and Venus as seen from the Earth. The initial reference point chosen for counting longitudes is the spring equinox of the epoch J2000.

The positions of the Moon on the Zodiac were calculated by another subroutine of the Horos program which was also written by the specialists from the Parisian "Longitude Bureau", likewise Planetap.

Namely, we have used the program for calculating the lunar ephemeredes entitled ELP2000-85 (Version 1.0), written in the same Fortran language by the astronomers J. Chapront and M. Chapront-Touze from the Parisian "Longitude Bureau" (*Bureau des Longitudes,* Paris, France – see [1405:1]). The program allows for calculating the lunar position on the celestial sphere as observed from the Earth with a high degree of precision. The precision of the program claimed by the authors for the epochs closest to ours (in the version that we used) is one arc second or higher ([1405:1]). Its precision for millenarian or multi-millenarian dates is likely to be much lower. However, let us reiterate that we don't require high precision for the astronomical datings of Egyptian zodiacs since the latter specify planetary positions with a great deal of approximations. We would therefore be satisfied with precision of several degrees, which is a great deal lower than the rate offered by ELP2000-85.

With the aid of such software as Planetap and ELP2000-85 which can calculate the past positions of all the ancient planets, we have developed a new astronomical program called Horos, specially designed for the astronomical dating of ancient zodiacs. Horos requires an approximate disposition of planets in Zodiacal constellations on the input, and calculates all possible datings applicable. If the planets are arranged on the zodiacal order in some manner specified in the source (the actual Egyptian zodiac), the program marks every date for which the planetary order satisfies to the abovementioned conditions, whether in full or partially.

The description of the Horos software and its input/output files, as well as a manual, can be found in Annexes 3 and 4. The actual application can be downloaded from one of the links specified in the bibliography.

7. THE DATING OF AN EGYPTIAN ZODIAC WITH THE AID OF ITS PRIMARY AND SECONDARY HOROSCOPES REGARDED AS A WHOLE

Let us give a step-by-step description of the procedure used for the dating of all the Egyptian zodiacs. Its primary difference from all the previously-known approaches is the fact that it is based on a new and more exhaustive interpretation of the astronomical content found in the Egyptian zodiacs.

Let us emphasise that when we mention the astronomical dating of an Egyptian zodiac, we mean the decipherment of the dates that were transcribed in these zodiacs by the ancient Egyptians, and not the actual time of their creation. Modern computing facilities allow us to reconstruct many of these dates. The manufacture date of the zodiacs themselves is an altogether different issue, and can be solved differently in each individual case. However, one can be certain enough that the date ciphered in a zodiac cannot postdate its manufacture. Zodiacs were obviously used to commemorate past events and not refer to random points in the future.

On the other hand, nothing could stop the ancient Egyptian artist from encoding some very old date in the zodiac instead of one that was contemporary to his epoch. As we mentioned above, calculating planetary positions for a given date was well within the ability of an average mediaeval astronomer, who'd had his own concept of ancient chronology as seen from his epoch – some of these concepts way well have been incorrect. Therefore, the datings we may decipher in the Egyptian zodiacs may be a result of astronomical calculations of planetary positions for some event that had already been ancient for the author of the zodiac.

And so, our procedure of astronomical dating as applied to Egyptian zodiacs is as follows.

7.1. First step. Defining the primary horoscope's planets. All possible options are considered

Step 1. We used the previously-compiled comprehensive tables of Egyptian astronomical symbols (qv in Chron3, Chapter 15:4) in order to bring out every possible option of identifying the planets in a given zodiac's primary horoscope, or decipher the zodiac's primary horoscope.

We would usually come up with several possible interpretation options. For instance, the Sun and the Moon would often be drawn with similar symbols in Egyptian zodiacs, which would result in the necessity to go through all possible identification options. Sometimes we would also find ourselves in a quandary with identifying other planets, for which we could provide no unambiguous solution at the preliminary analysis stage.

7.2. Second step. Calculating the dates for every interpretation option of the primary horoscope

Step 2. We would proceed to calculate all the dates for each interpretation option of the primary horoscope when the planetary disposition on the celestial sphere corresponded to the zodiac. This would be done with the aid of the Horos program, qv in Chron3, Chapter 16:6.

We would account for the planetary order as specified in the zodiac. As a matter of fact, it wouldn't always be defined with absolute precision – there are vague places. For instance, a planetary pair's disposition on a round zodiac would be such that no order of the respective two planets would contradict the zodiac in general. Some part of the zodiac may be destroyed, in which case the planetary order is obviously impossible to determine for the destroyed part. Therefore, we have written the Horos program in such a way so as to make it recognize all such cases.

The time interval of the calculations starts with

500 B.C. and ends with 1900 A.D. We specified the lowest boundary of the interval as 500 B.C., since, according to the consensual chronology of the ancient Egypt, the earliest zodiacs allowing for decipherment and astronomical dating (classified as "the Graeco-Babylonian type") were compiled in Egypt in the I century B.C. ([1017:1], page 40). Earlier Egyptian zodiacs are completely different, and defy decipherment so far ([1017:1], page 38). We have provided for a several extra centuries as counted backwards from the date of the first "Graeco-Babylonian" zodiacs compiled in Egypt to be on the safe side.

All the dates from the calculation interval (500 B.C. – 1900 A.D.) whose horoscopes coincide with the one contained in the zodiac (with the planetary order accounted for) would be listed as possible (preliminary) dates for respective decipherment options.

The end result was presented as a table whose every column corresponded to a single decipherment version of a given zodiac's primary horoscope. The columns contained possible (preliminary) dates calculated by the Horos program. The general amount of such dates would fluctuate from 4-5 to several dozens for some zodiacs.

It is noteworthy that we have discovered a total absence of possible dates in the first centuries of the new era for many zodiacs, which is the period most of them were compiled, according to the Egyptologists. This completely confirms N. A. Morozov's conclusion that no more or less satisfactory astronomical solutions exist for the Egyptian zodiacs in the epoch desired by the Egyptologists – the first few centuries of the new era. All the solutions from this error as suggested by various authors are so far-fetched one cannot even call them solutions ([544], Volume 6).

7.3. Third step. Solutions are tested to comply with such criteria as planetary disposition, visibility indicators and secondary horoscopes. Rejection of incomplete solutions

STEP 3. We would test each of the possible (preliminary) dates made available to us in the previous stage for compliance with the following criteria (using Turbo-Sky, A. Volynkin's astronomical application):

A) *Rigid compliance with the primary horoscope.* At this stage we would verify whether the source data (the main horoscope of an Egyptian zodiac in the present interpretation) and the real (calculated) planetary positions in Zodiacal constellations concur with each other rigidly and without any ambiguity.

The necessity for such verification arises from the fact that in our calculation of preliminary dates we would deliberately make our conditions for the intervals of possible planetary disposition on the ecliptic as lax as possible. This would be done in order to compensate for the unavoidable discrepancies and arbitrariness in the estimation of constellation boundaries.

B) *Compliance with the visibility indicators as provided for Venus and Mercury,* as well as other planets located close to the sun. See CHRON3, Chapter 15:7 for more information on visibility indicators in Egyptian zodiacs.

Planetary visibility would be checked for two observation points – the Egyptian towns of Alexandria and Luxor (located some 500 kilometres to the south of Alexandria), qv in CHRON3, Chapter 15:11, where we discuss possible observation points for the horoscopes found in the Egyptian zodiacs. In doubtful cases we would also account for possible observation points further to the north.

Planets and stars are only visible in the sky if the latter is sufficiently dark, which goes to say that the Sun should set far enough under the local horizon. However, stars and planets of varying brightness may require different celestial luminosity in order to be seen.

Let us briefly remind the reader of how the luminosity of stars and planets is measured. We shall require this below, in our discussion of the solutions applicable to individual Egyptian zodiacs.

The luminosity of stars and planets is measured by astronomers with the aid of the photometric scale of stellar luminosity. Stellar luminosity indexes are marked with the letter M. The brighter the star, the smaller the value of its photometric index. For exceptionally bright stars, the luminosity index shall be represented by a negative value; however, there are very few such stars in the sky. This concerns the brightest of stars, as well as the planets that happen to be close enough to the Sun (as observed from the Earth). Remember that the luminosity of planets depends on their position in relation to the Sun and the

Earth, since planetary light is reflected sunlight, whereas the stars shine all by themselves.

The brightest star in the sky is Sirius, or Alpha Canis Majoris. Its stellar luminosity equals M = –1.46 on the stellar luminosity scale (see [1197] and [1144]). There are about two or three other stars in the sky of comparable luminosity.

The brightest planet is Venus. Its luminosity can reach almost –5 (M = –5), and usually equals –3 (M = –3) at least. As Venus approaches the Sun, it might become very bright indeed, but then it disappears from sight altogether due to sunshine, and reappears on the other side of the Sun. This is how Venus changes visibility from morning to evening.

Other planets that approach the Sun (as observed from the Earth) attain the luminosity of 0 to –2, which is very bright on the photometric scale. Dim stars have the luminosity of +5 or +6; luminosity of +6/+7 renders a star invisible to the naked eye ([1197]).

Stars whose luminosity compares to Sirius, as well as the planets that have approached the Sun close enough, but without disappearing in its rays, are the brightest celestial objects, with Venus ruling supreme in the luminosity domain. Such stars and planets become visible when the Sun sets by 7 arc degrees under the local horizon ([393], page 16). If the Sun hasn't set this far, no planets, let alone stars, can possibly be seen – with the sole exception of the Moon, which one sometimes also see in broad daylight.

Bright celestial objects are objects whose photometric index value has the magnitude order of +1. There are few such stars in the sky – two dozens at best. The same applies to planets of average luminosity. One can see them once the Sun sets by 9-10 arc degrees.

Planets and stars of the fifth and sixth magnitude order (the ones whose luminosity index on the photometric scale equals +5/+6) are only visible in total darkness, which comes when the Sun sets under the horizon by 18 arc degrees, when the so-called astronomical twilight ends and absolute night begins ([393], page 16). This is when one can even see the dimmest of the planets.

We would therefore account for the current luminosity of planets whilst checking their visibility, with the aid of the Turbo-Sky program. In the brightness of a planet equalled M = –1 at least, it was considered visible once the Sun would set by 7 degrees or more. Luminosity value of M = +2 would render the star visible with the Sun setting by 10 degrees. Dubious or borderline cases would also be interpreted in favour of a solution. In other words, although we required precise correlation between the solution and source data, we wouldn't reject a solution for which such correlation seemed possible but not obligatory.

For instance, we would occasionally manage to estimate exact correlation between the visibility of planets on the real celestial sphere and the visibility indicators on the zodiacs partially – either for the morning or evening observation visibility of a planet, that is. Such solutions would not be rejected in the visibility indicator compliance test.

The setting of the Sun would naturally always be calculated in the direction perpendicular to the local horizon.

Let us point out that the Sun might set to a much lesser extent than the direction between the Sun and the planet at the moment when the latter intersects the local horizon (rises or sets, in other words). Indeed, the shortest arc to connect the Sun and the planet in question usually isn't perpendicular to the local horizon – therefore, using the distance between the Sun and a planet to estimate the visibility of the latter might result in a mistake. The same thing can be said about the time that passes between the rising and the setting of the Sun and the planet; its dependability insofar as the planetary visibility estimation is concerned is low, since the journey of the Sun towards the horizon might take different amounts of time for the same degree of setting, and will be largely dependent on the angle between the ecliptic and the local horizon. However, this angle differs in various parts of the Earth, and depends on the latitude of the observation point a lot.

C) *Correspondence to secondary horoscopes.*

The symbolical description of every individual horoscope present in an Egyptian zodiac would have to be in perfect correspondence with the celestial sphere of the solstice (or equinox) point for the year insisted upon by the solution in question.

Empirically, this proves to be a very strict condition which a random solution usually cannot satisfy to. One or two non-trivial secondary horoscopes suffice to eliminate all extraneous solutions (we must explain that some of the secondary horoscopes found in Egyptian zodiacs are trivial, which means they satisfy to all solutions automatically).

Another important factor at this stage is the beginning of the year used in the present zodiac. For instance, if a certain solution yields us a vernal date for the primary horoscope which we intend to test for complying with the secondary horoscope of winter solstice, our actions will depend on the beginning of the year used in the zodiac under study. If a year begins in September, for instance, we'll have to consider the winter solstice of the December that precedes the primary horoscope's vernal date. Should the year begin in January or March, it is the next December that we have to turn our attention to.

Above we already mentioned the fact that Egyptian zodiacs appear to imply September as the beginning of the year; however, one needn't exclude the possibility that some zodiac might refer to March or January as to such. Therefore, we have borne in mind the possibility of different beginnings of a year. This would be done as follows: we would initially consider the version with the year beginning in September, and consider other options in case it didn't fit. However, almost every single final solution that we came up with refers to September as the first month of the year.

8. THE "COLOURED" EGYPTIAN ZODIAC

Egyptian zodiacs leave one with the initial impression of being a complex and convoluted mixture of symbols. Its astronomical meaning is only revealed after a long and careful study.

Above we describe the basic characteristics of said meaning. Every Egyptian zodiac is usually a mixture of symbolic "layers", all referring to different things. It takes time and experience to be able to tell these layers apart, which is when one begins to understand the meaning of a zodiac.

In order to make it easier for the reader to distinguish between different symbolic layers of the Egyptian zodiacs, we shall use the so-called "coloured Egyptian zodiacs" in the present book.

Let us explain what exactly we mean by that. A coloured Egyptian zodiac is a demonstrative result of the very first stage of analysis when the symbols indicating constellations, planets, secondary horoscopes etc are already found, but it isn't yet obvious what exactly they stand for (for instance, the exact correspondence between planets and planetary figures, the precise meaning of the symbols of a secondary horoscope, and so on).

More specifically, a coloured Egyptian zodiac is a drawn copy of an Egyptian zodiac where the astronomical symbols related to different symbolic layers are highlighted by different colours. Our colour choice was perfectly arbitrary and has no ulterior meaning by itself.

1) *Red – used for Zodiacal constellations.* They specify the separation of the entire Egyptian zodiac into separate zodiacal constellations.

2) *Yellow – planetary symbols of the primary horoscope.* This symbolic layer defines the date ciphered in the zodiac, since the date we are looking for is specified as a certain disposition of planets in relation to Zodiacal constellations in the "astral calendar" that contains no numbers.

However, a coloured zodiac doesn't yet give us any understanding of a given zodiac's primary horoscope. In order to find this out, we have to specify each of the seven ancient planets as drawn on the zodiac individually, which is much more difficult that simply finding all the planetary figures of a given zodiac. Those are usually made visible enough by their usual characteristics – first and foremost, planetary rods, qv above. The actual "casting" of the planetary figures is a much finer operation, and it isn't always unambiguous.

Nevertheless, a coloured horoscope permits easy understanding of just what options we have for the primary horoscope in the present case.

3) *Blue – symbols of the secondary horoscopes.* This includes the symbols of the actual solstice and equinox points where the secondary horoscopes are concentrated, as well as the indications of planets contained therein.

4) *Brown – the ten-degree symbols.* These symbols divide each zodiacal constellation into three parts, each of which occupies some 10 degrees of the ecliptic on the average, hence the name (introduced by N. A. Morozov, qv in [544], Volume 6). Ten-degree symbols are present in the Long Zodiac of Dendera,

where they look like young women, qv in Chron3, Chapter 15:2. However, the mere presence of the ten-degree figures unfortunately does not imply that the precision rate of the horoscopes is three times higher – it remains as it was. See a discussion of this issue in Chron3, Chapter 15:2.

5) *Green – auxiliary figures for the planets of the primary horoscope, as well as additional astronomical symbols.* See examples in Chron3, Chapter 15.

6) *Symbols left uncoloured* – ones whose meaning is unknown to us, or makes little sense, as well as the symbols bearing no apparent relation to the date that we're trying to decipher.

In cases when it wasn't quite obvious just which symbolism layer a given symbol pertained to, it was divided into parts and coloured in accordance with existing possibilities. Different interpretation options that would arise in this case were added to the list of possible decipherment options, and subsequently verified by the Horos program.

Coloured drawings of zodiacs will be given in the sections on the dating of individual Egyptian zodiacs. Their appearance in the present book is as follows: illustrations in colour were replaced by black and white equivalents (C1-C12), with the following colour codes: *R* for red, *J* for yellow, *B* for blue, *G* for green and *BR* for brown.

9. UNAMBIGUOUS RECONSTRUCTION OF THE DATES TRANSCRIBED IN THE EGYPTIAN ZODIACS. FINAL (EXHAUSTIVE) SOLUTIONS

All three steps of the abovementioned dating procedure would either invalidate all preliminary solutions we would come up with for Egyptian zodiacs, or leave us with just one solution. Cases with more solutions were extremely rare, and all pertain to uninformative or largely destroyed zodiacs.

The resulting solution is the one we call final, or exhaustive for a given zodiac.

If the primary horoscope of an Egyptian zodiac was deciphered correctly in the preliminary analysis stage (step 1) – as one of the versions, at least, it would, as a rule, leave us with a single final solution satisfying to everything drawn in the zodiac.

In cases where we ended up with no correct decipherment of the primary horoscope in any version, given that said zodiac contained a single non-trivial secondary horoscope at least, we would come up with no final solutions whatsoever. This would be the case when we found new methods or symbols used in the zodiac under study, which would bring us to step 1 and new efforts to decipher the zodiac in question.

The important thing is that the procedure of decipherment and dating of the Egyptian zodiacs as suggested by the authors permits the unambiguous reconstruction of the dates ciphered therein with the aid of the ancient "astral calendar" in most cases.

As we shall witness below, all these dates turn out mediaeval.

10. THE "CONSTELLATION SCALE" OF A ZODIAC

The very construction of the Egyptian zodiacs doesn't provide for specifying planetary positions with high precision. All Egyptian horoscopes are but approximated descriptions of how the planets were positioned in relation to the constellation figures.

However, in order to conduct astronomical calculations, we have to specify the possible planetary disposition intervals in degrees of ecliptic longitude. This is a difficult enough task from the sight of the Egyptian zodiacs, since they contain nothing that resembles a degree scale. Therefore, if we want to specify planetary positions in degrees, we shall have to conduct some simple yet rather arduous calculations.

In order to avoid this, we have written the Horos program in such a way that the planetary positions it gets on the input wouldn't be specified in degrees of longitude, but rather the way they are read from an Egyptian zodiac, which only allows us to make such statements as "this planetary figure is drawn in Virgo, or the half of Libra adjacent to Virgo", or "this planet is in Aries or, more likely, its border, since one-third of the figure trespasses into the neighbouring constellation" etc.

Remember that when we intend to decipher a zodiac, we always make the criteria defining the borders of possible planetary disposition as lax as possible in the initial stage so as to avoid losing the correct solution inadvertently. The extraneous solutions that we come up with are subsequently rejected in the

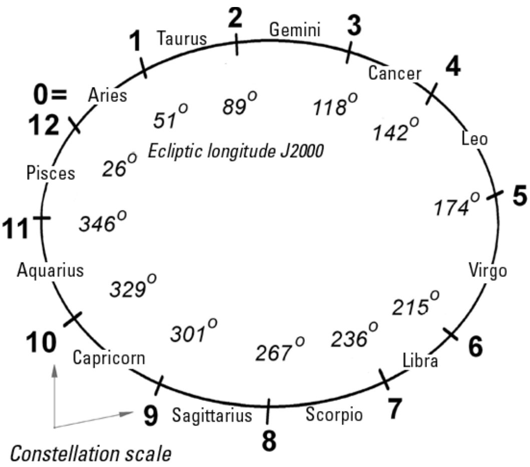

Fig. 16.4. The cyclic "constellation scale" for ecliptic J2000. Point 1.5 on this scale refers to the middle of the Taurus constellation, for instance – or, rather, the point with a longitude of 70 degrees on ecliptic J2000. Point 13.5 has the same value on this scale, since the latter is cyclic with a step value of 12. This is the scale we shall use for reading horoscopes off Egyptian zodiacs and feeding them as input data to the Horos program, which will calculate all possible datings of said horoscopes.

course of the secondary horoscope compliance test, and the resulting solution is once again tested to be in rigid correspondence with the specifications of the Egyptian zodiac.

However, this often leaves us with such intervals as "half of Aquarius, Capricorn, or half of Sagittarius" etc.

Therefore, we shall act as follows.

1) We'll separate the ecliptic J2000 (the one that we use in our research) into 12 uneven parts. Each of them will correspond to a single zodiacal constellation. The precise boundaries resulting from this separation rendered into degrees of ecliptic longitude J2000 can be seen in fig. 16.4, and also above, in section 16.4.

2) We shall proceed to mark the boundaries between zodiacal constellations with numbers (0 to 12, qv in fig. 16.4). We come up with an uneven scale of 0-12 for the ecliptic J2000. Let us make this scale cyclic specifying 12 = 0 in order to reflect the fact that the ecliptic is a circumference for which 12 equals 0.

The resulting scale allocates a single grade for every zodiacal constellation – however, the lengths of said grades are uneven and correspond to the length of the ecliptic segments covered by zodiacal constellations.

This is our "uneven constellation scale". It looks like this:

<0> Aries <1> Taurus <2> Gemini <3> Cancer <4>
Leo <5> Virgo <6> Libra <7> Scorpio <8>
Sagitt. <9> Capric. <10> Aqua. <11> Pisces <12=0>

Now we are capable of using this "constellation scale" in order to specify points upon the ecliptic – for instance, 1.5 will refer to the middle of Taurus, or, more precisely, a point with the longitude of 70 degrees on the ecliptic J2000. Point 13.5 will mean the exact same thing, since the scale has a cyclic nature with a step of 12, and 13.5 – 12 = 1.5 etc.

We can specify the position of a planet on this uneven scale (half of Aquarius, Capricorn or half of Sagittarius) as the interval (8.5 – 10.5), where 8.5 stands for the middle of Sagittarius and 10.5 – for the middle of Aquarius, qv in fig. 16.4. Bear in mind that the right border value of this interval can be smaller than its left die to the cyclic nature of the scale. For instance, the interval (11.5 – 0.33) has meaning and means "middle of Pisces to the boundary of the first third of Aries".

This is the scale we shall use for specifying the boundaries of possible disposition options for every planet found in an Egyptian zodiac; this is how their coordinates should be specified for the Horos program.

11. POINTS OF APPROXIMATE PLANETARY DISPOSITION IN AN EGYPTIAN ZODIAC ("BEST POINTS") AND ACCOUNTING FOR PLANETARY ORDER

Apart from longitudinal boundaries, we shall also estimate the approximate position of a planet in the sky – that is, its position on the celestial sphere that corresponds optimally to the specifications of the respective planetary figure from an Egyptian zodiac. The related point on ecliptic J2000 shall be known as the "best point", or the point of a given planet's approximate disposition.

It is obvious that the choice of such points can be subjective to a great extent; therefore, the exact position of "best points" does not affect the rejection of solution options.

However, the mutual disposition of "best points" does affect it; their order has to rigidly concur with the order of planetary figures in an Egyptian horoscope for the decipherment version of the primary horoscope under study. For each of the calculated solutions, the planetary order on the ecliptic is compare to the "best point" order by the Horos program. The solutions that have no exact equivalents are rejected.

If the mutual disposition of two or more planetary figures in a zodiac isn't specified, all the planets as a whole have to correspond to the same "best point", in which case the Horos program will consider any order correct. However, its disposition as compared to other planets shall still be verified in accordance with the "best points" specified for this set as well as other planets.

Let us point out that the mutual planetary order is rather vague in some Egyptian zodiacs – especially those of the round type where the figures aren't presented in a line but rather scattered all across the field of the drawing.

In some cases there is nothing at all we can say about the position of a given planet on the ecliptic – for instance, when we failed to identify it as any of the figures of the Egyptian zodiac under study. In this case the disposition borders of this planet on the constellation scale must be specified as the interval 0-12. The "best point" for this planet will be equal to any number greater than 100. For the Horos program this will mean the planet is "free", that is, nothing limits its position.

If the approximate disposition point isn't specified, the Horos program notifies the user accordingly.

12. AVERAGE DISTANCE BETWEEN BEST POINTS AS THE APPROXIMATE QUALITY CRITERION OF AN ASTRONOMICAL SOLUTION

"Best points" were also used for calculating the value of the "average best point deviation". Due to the fact that there's a substantial degree of vagueness involved in the choice of the "best points" themselves, this value may serve but as an approximated indicator of how the solution concurs with the specifications of the source zodiac. However, this indicator proved quite useful.

The average deviation from best points is calculated in degrees. It results from averaging absolute values of the discrepancy between the calculated positions of the seven planets and the corresponding "best points" read off the actual Egyptian zodiac under study.

If one manages to locate all planetary figures in a zodiac successfully, the "best points" of such a zodiac should be defined with the precision of circa 15 degrees, or about one half of a Zodiacal constellation, since this is the best possible precision of planetary positions as specified in the Egyptian zodiacs. Therefore, the deviation or discrepancy rate of the "best points" is minute at 15-20 degrees, which is a high degree of precision in our case. It is satisfactory at 20-30 degrees. Larger values can only enter the final solution if some of the source data were incomplete (due to the destruction of a part of the zodiac, for instance).

Should the "best point" of a given planet remain unspecified, which means it has a greater value than 100, it can be deemed equal to the calculated position of this planet in the calculation of the average deviation. However, this could make the value of the latter much lower for the solution in questions, especially in case of there being several unidentified (vacant) planets in the source data.

This would prove awkward in the comparison of various solutions to different quantities of such vacant planets.

We have therefore used the following algorithm in order to compensate for the abovementioned effect. Namely:

1) All planets were considered as a sequence in the calculation of the average deviation.

2) Unidentified (vacant) planet would be assigned temporary "best points" until the end of the abovementioned process. It would be chosen from the averaged calculated positions of neighbouring planets for which such "best points" were already specified – either at the very beginning, or during one of the previous stages of the process.

13. AN EXAMPLE OF THE INPUT DATA FORMAT USED BY THE HOROS PROGRAM

Let us provide an example of the input file syntax (INPUT.TXT) as used by the Horos program. These data were obtained from one of the decipherment versions of the primary horoscope as read from the Long Zodiac of Dendera. The boundaries of planetary disposition and the "best points" as applicable to them were specified in the "constellation scale".

No calculus whatsoever was required for the compilation of these data into a table – they were read from the Egyptian zodiac immediately. All the calculations necessary for converting the data into the ecliptic longitude degrees from the "constellation scale" are performed by the software itself.

A SPECIMEN INPUT.TXT FILE

INPUT DATA FOR HOROSCOPE DATE CALCULATION SOFTWARE **HOROS**

SUN	MOON	SATURN	JUPITER	MARS	VENUS	MERCURY
#FROM#						
11.0	6.0	9.0	11.0	10.0	.0	.0
#TO#						
1.0	8.0	11.0	1.0	12.0	2.0	2.0
#BEST POINTS#						
11.5	7.5	9.5	12.0	11.0	.5	1.0

The file INPUT.TXT can contain any commentary – however, the configuration lines marked "# … #", immediately preceding each line of data, must remain intact, with no other lines beginning with the symbol "#" anywhere else in the text of the file. Furthermore, the order of the data lines cannot be altered.

14. VERIFICATION TABLE FOR THE ASTRONOMICAL SOLUTION

For each solution obtained as a result of astronomical calculations with the use of the Horos program we would compile a table of just how well this solution corresponds to the indications specified in the Egyptian zodiac but unaccounted for in the preliminary solution search (step 2 of our method, qv in CHRON3, Chapter 16:7).

Let us remind the reader what exactly we tested in the solution:

Visibility indicators of Venus, Mercury and other planets that end up near the Sun in the primary horoscope, qv in CHRON3, Chapter 15:7.

Correspondence to the four secondary horoscopes – of autumn equinox, winter solstice, spring equinox and summer solstice, qv in CHRON3, Chapter 15:5, CHRON3, Chapter 15:6 and CHRON3, Chapter 15:8.

Correspondence to the auxiliary astronomical symbols and scenes of the Egyptian zodiac in question, qv in CHRON3, Chapter 15:9.

We have used a verification table for this purpose, which was compiled for every preliminary solution. It would contain six or more columns with the following content:

1) Visibility of Venus in the primary horoscope.
2) Visibility of Mercury in the primary horoscope.
3) Secondary horoscope of autumn equinox.
4) Secondary horoscope of winter solstice.
5) Secondary horoscope of spring equinox.
6) Secondary horoscope of summer solstice.
7) The Passover full moon in Libra. This column only applies to the zodiacs that have a circle in Libra (or, possibly, other symbols referring to the Passover full moon).

There would be more columns for some of the Egyptian zodiacs, depending on the amount of auxiliary astronomical symbols and scenes found therein.

Each column would contain a brief description of the corresponding part of the celestial sphere that would be modelled in this solution. If the model corresponded to the source zodiac completely, we would put a "+" sign in the table cell corresponding to this column.

If we failed to estimate complete concurrence, we would use the "–" sign. Ambiguous cases also employ the "+/–" indication.

An exhaustive or complete solution would be one for which the verification table consisted of nothing but plus signs. Such solutions were declared final, with all others rejected.

Let us point out that it is everything but obvious a priory that one can find such complete, or exhaustive solutions for all the Egyptian zodiacs known to us. Our demands for precision from the part of the ancient Egyptian astronomers and artists could have proven too high, or we simply could have misinterpreted the symbolism of the Egyptian zodiacs. It is obvious that in either case the probability of coming up with ideal exhaustive solutions for all zodiacs at once, as is the case with our research, would simply equal zero.

On the contrary, if our conditions for the ideal (exhaustive) solutions proved too lax, we would have several ideal solutions for different zodiacs.

Neither of the above is the case. On the contrary, our calculations demonstrated the following:

For almost every Egyptian zodiac that we studied, just one of the preliminary solutions is ideal. This is why we claim our method to yield unambiguous datings for Egyptian zodiacs in almost every case (apart from the zodiacs too poor in content, or too greatly damaged).

We would usually come up with several near-ideal solutions (all pluses and one or two minuses). However, in almost every case there is just one solution with all pluses.

Below, in the sections dedicated to the dating of actual Egyptian zodiacs, we shall cite the verification tables of their complete solutions. We were using the following abbreviations:

1) S. D. – the distance between the set sun and the horizon in arc minutes. For instance, S. D. = 10 refers to the Sun that had set by ten degrees.

The setting distance of the Sun is calculated for the moment the planet in question rises or sets, if we are referring to its morning or evening visibility. Just how far the Sun sets by that point determines the observer's ability to see this planet in the sky. If nothing else is specified, it is presumed that the setting of the Sun is calculated for the observation point in Cairo, Egypt.

Bear in mind that a planet of regular luminosity is only seen in the sky when the distance between the set Sun and the local horizon equals or exceeds ten degrees. Very high luminosity of a celestial body (–3.5 and higher) makes the planet visible with the Sun set by 7-8 degrees, qv in CHRON3, Chapter 16:7, Step 3-B.

2) M. – the luminosity of the planet specified according to the photometric scale. M = –3.2 means that the planet in question had the luminosity of minus 3.2 at the time. We already mentioned that planetary luminosity may fluctuate greatly.

Bear in mind that the luminosity of a planet as specified on the photometric scale may be a negative number – the smaller the value, the brighter the planet. Venus, the brightest planet, can attain the luminosity level of circa M = –4, although it usually fluctuates between –3 and –3.7. Luminosity of 0 to 1 is characteristic for bright stars as well as planets; planets of this visibility can only be seen together with bright stars when the Sun sets by 8-9 degrees; lower luminosity of a planet only makes it visible with the Sun set by 10 degrees and more, 18 degrees equalling to total darkness which makes the dimmest stars and planets visible. See more about it in CHRON3, Chapter 16:7.3.

3) A fractional value from 0 to 12 in parentheses – calculated position of a planet on the "constellation scale", qv in CHRON3, Chapter 16:10. For instance, 2.5 refers to the middle of Gemini, or a point with the coordinates of 70 degrees on the ecliptic J2000, whereas 0.2 would stand for a point in Aries with the longitude of 31 degrees on the ecliptic J2000, qv in CHRON3, Chapter 16:10.

4) The columns that deal with planetary visibility also occasionally specify the distance between the planet and the sun in arc degrees. This distance is specified by the capital Greek letter delta (Δ).

In the free part of the verification table we draw a grid that contains as many cells as there were columns in the verification table, each of the cells containing a plus, a minus or a plus/minus sign, depending on how well the solution satisfies to the source zodiac. If the solution proves exhaustive, there should be a plus in every cell.

Apart from this, we also specify the average distance between the calculated positions of the main horoscope's planets and their "best points" near the "grid" (by "best points" we understand positions of optimal correspondence to the specifications of the Egyptian zodiac, qv in CHRON3, Chapter 16:11).