Asgardia's calendar and its role in space industrialisation strategy

Currently, there is no single global standard for the calendar year. In space, none of the geocentric, terrestrial-analogue calendars used today (of which there are about 40) makes practical sense. For strategic purposes, celestial navigation and astrodynamics, they are effectively useless. In an attempt to rectify the situation, the space nation of Asgardia – the beginnings of a new strategic socio-economic formation of civilisation – has developed an astrocentric, fixed-standard, 13-month reference calendar.

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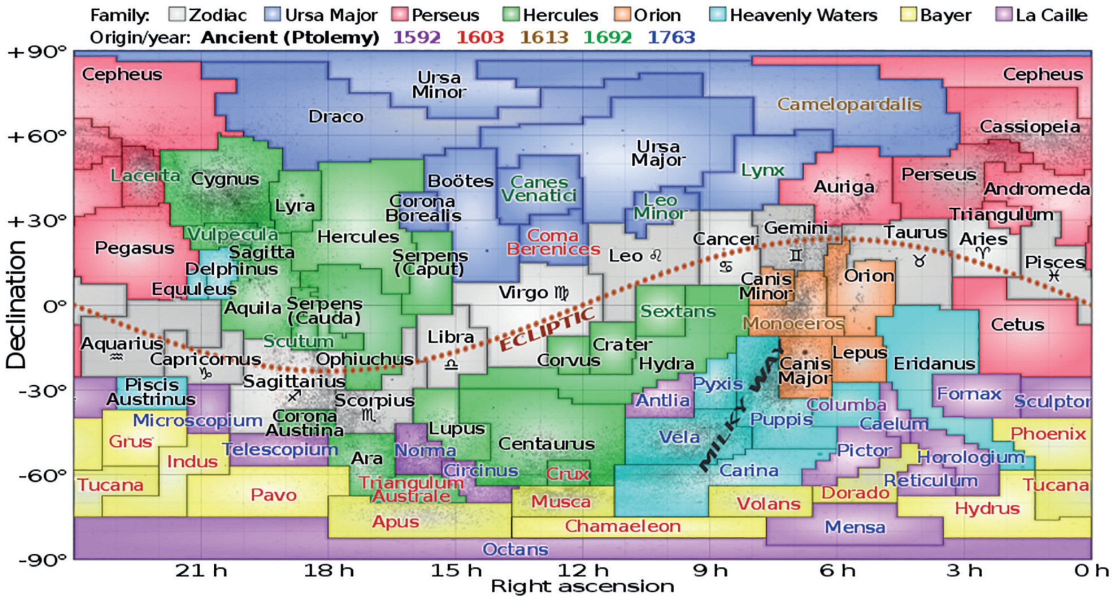
The calendar is focused on the 88 major constellations listed in the catalogue of bright stars, of which 13 zodiacal constellations are on the ecliptic. The calendar is based on atomic clocks and is designed to indicate a single time in all possible spacecraft, including the Earth as one such 'equipotential spacecraft'. This article describes the basic strategic principles of the astrocentric fixed 13-month reference zodiac calendar of the space state of Asgardia.

The issue of the reform of the geocentric analogue Gregorian calendar began to be actively discussed in the 19th century, when its logical shortcomings were revealed. However, all attempts to optimise the calendar, to reform it and, in particular, to produce the correct fixed form, have so far been unsuccessful.

The exceptional complexity of the issue and a large number of failures led scientists to conclude that the task was impossible, even theoretically. This was because the



▲ Above right: The eighty-eight constellations officially recognised by the International Astronomical Union (IAU).

astronomically certain length of the solar (tropical) year in days cannot be expressed as a multiple of seven, or even an integer, in order to make a universal calendar that is suitable for each and every year. And this is why a single, 13-month reference calendar has been proposed by the author on behalf of the space state of Asgardia. It is based on a strict digital mathematical model and is not associated with conventional, geocentric analogue models of the Earth's motion around the Sun.

The annual cycle of the star Sirius was of particular importance in Ancient Egypt. The priests of the time noticed that the star is clearly visible in the northern hemisphere at the latitude of Memphis, but for 70 days is visible only in the southern hemisphere. Its next appearance in the northern hemisphere after 70 days of absence was accurately predictable and the annual cycle was given the scientific name of the "heliacal year of the star Sirius".

This is relevant because the tropical year of the Sun - a period of time equal to the time between two successive solstices in the tropic of Cancer or Capricorn - is calculated from the heliacal year of the star Sirius [see Box 1: tropical year of the Sun calculation].

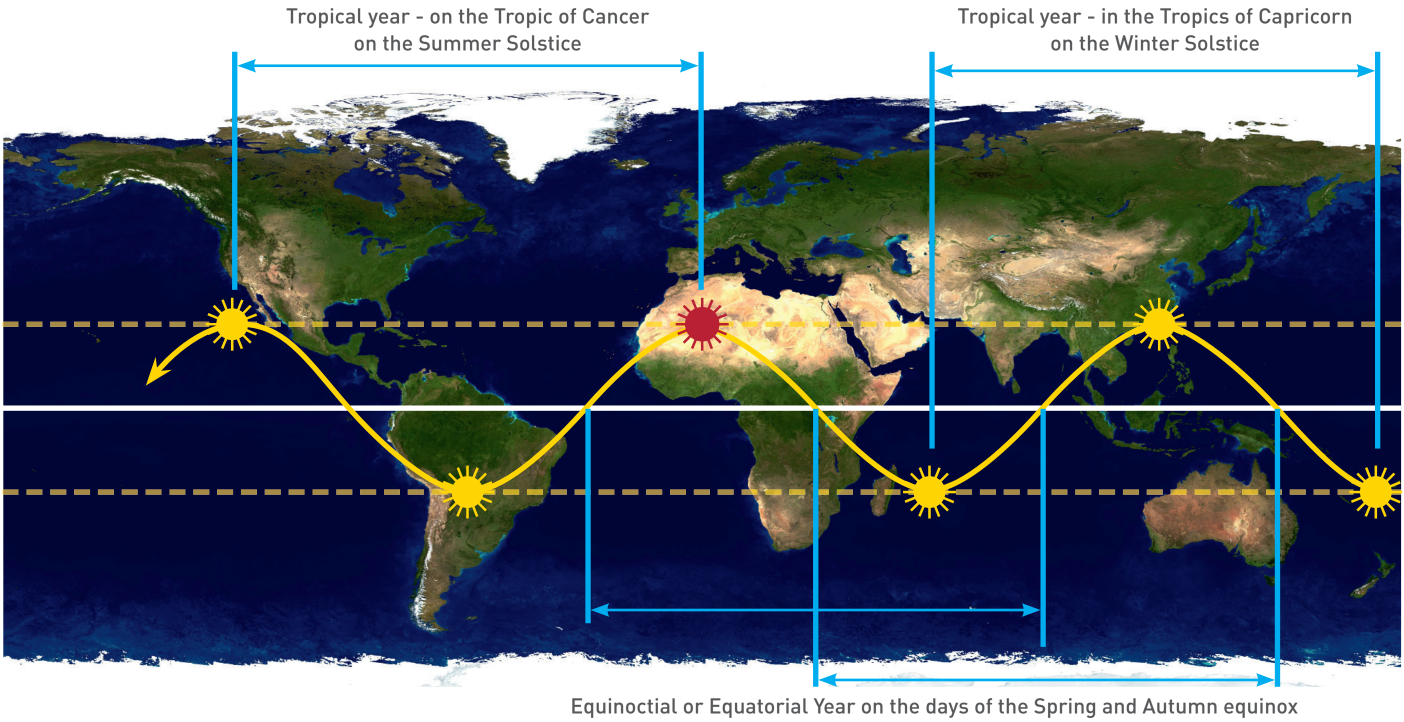
In 46BC, the heliacal calendar of the star Sirius was moved from Egypt to Rome by Gaius Julius Caesar. However, the seasonal tropical year of the Sun (365 [31/128] = 365.2421875 days) was 1/128 of a day shorter than the heliacal year of Sirius, as discovered for the first time in 325AD at the Council of Nicaea. The result was that the estimated date of the spring equinox in the calendar was moved three days, from March 24 in 46BC on March 21 in 325AD: [46 + 325]/128 = [371]/128 = 2.898 ≈3 days. This requires a 'solar' correction of [1/128] days to give 365.2421875 days: 365 [32/128] days – [1/128] days = 365 [31/128] days = 365,2421875 days.

Following the correction in the cycle of 128 years of the solar tropical year, there were 31 leap years and 97 non-leap years (31 + 97 = 128 years), instead of 32 leap years and 96 non-leap years in the basic calculation of the Julian calendar of the heliacal year of the star Sirius.

Thus, the accuracy of the calculated tropical calendar after correction is regulated by 'plug in leap years' with a frequency of 31/128 = 0.2421875 days (that is, 5 hours 48 minutes 45 seconds, or 20,925 seconds). The correction has a perfect averaged accuracy, in that the error of the calculated tropical calendar in relation to the real tropical astronomical year after the mathematical correction procedure is on average zero [see Box 2: solar calendar accuracy].

The list of all leap years (31 years, listed in Table 1) is given in the 128-year cycle (2012 + 128 = 2140), in which just three days will be attributed to the new year holidays: the 29th and the 30th day of Capricorn and the 1st day of Aquarius. For all these leap years, the same leap matrix will be used.

In space, none of the geocentric, terrestrial-analogue calendars used today (of which there are about 40) makes practical sense



▲ Determination of the duration of the solar year.

Table 2 shows all non-leap years (97 years) in the 128-year cycle (2012 + 128 = 2140). For all these 97 non-leap years, the same non-leap matrix will be used. In the non-leap year, two days will be attributed to the new year holidays: the 29th day of Capricorn and the 1st day of Aquarius. Leap year 2100 was moved to the group of non-leap years to comply with the leap calendar correction with a frequency of 31/128 = 0.2421875 days (that is, 5 hours 48 minutes 45 seconds, or 20,925 seconds).

Architecture of standard calendar

The ideal core of the standard 13-month reference calendar consists of 364 days: 52 weeks of 7 days each (Table 3). Each of the 13 months have the conventional names of the ecliptic zodiac constellations and contains exactly 28 days: (I) Aquarius; (II) Pisces; (III) Aries; (IV) Taurus; (V) Gemini; (VI) Cancer; (VII) Leo; (VIII) Virgo; (IX) Libra; (X) Scorpio; (XI) [Serpentarius, Ophiuchus or Apheuhus] (Asgard [Ásgard in Scandinavian

Table 1 - List of all 31 leap years in the calendar cycle of 128 years.

2016	2020	2024	2028	2032	2036	2040	2044	2048	2052		
2056	2060	2064	2068	2072	2076	2080	2084	2088	2092		
2096	~~2100~~	2104	2108	2112	2116	2120	2124	2128	2132	2136	2140

Table 2 - List of all 97 non-leap years in the calendar cycle of 128 years.

2013	2014	2015	2017	2018	2019	2021	2022	2023	2025	2026	2027
2029	2030	2031	2033	2034	2035	2037	2038	2039	2041	2042	2043
2045	2046	2047	2049	2050	2051	2053	2054	2055	2057	2058	2059
2061	2062	2063	2065	2066	2067	2069	2070	2071	2073	2074	2075
2077	2078	2079	2081	2082	2083	2085	2086	2087	2089	2090	2091
2093	2094	2095	2097	2098	2099	2100,01	2002	2103	2105	2106	2107
2109	2110	2111	2113	2114	2115	2117	2118	2119	2121	2122	2123
2125	2126	2127	2129	2130	2131	2133	2134	2135	2137	2138	2139

Box 1: Tropical year of the Sun calculation

The unified universal mathematical formula for calculating the duration of the space tropical year (L) for all existing calendar types is as follows:

L = (integer part) + (fractional part) = CONST + const;
L = K + (α + |±β|) = K +μ = 365 + μ = 365 + 31/128 days (Earth-specific),

where L is the total duration of the space tropical year in integers and fractions of a day; K = CONST, the basic duration of year in integer day (for Earth, K is 365 days); α — the accuracy of the calendar; |±β| — the value of the system error.

μ = α + |±β| = MCI = const. The universal Space standard [Morozov's calendar invariable - MCI, (the universal MCI for any rotating subject in space, such as a planet, satellite, star, galaxy, rotating near a certain center of mass)] is always a constant, which is calculated as a simple algebraic sum of the accuracy coefficient α and the system error |±β|. Hence, two important calendar relations are obtained: |±β| = μ (1 — α/μ); α = μ (1 — |±β|/μ).

[Morozov S.L. (Moscow) Universal mathematical model of calendar year duration for all types of the exchange calendars. Calendar constant. Economics and mathematical methods, 2015, 51 (1), 109-129.]

Accuracy of the Earth calendar: α = μ = 31/128 days, when |±β|=0 (the condition of fixing the calendar, its stabilisation and guarantee against deviations in any direction from the actual values of the tropical astronomical year).

The heliacal year of the star Sirius is 365¼ days (295¼ days + 70 days = 365¼ days = 365 [$^{32}/_{128}$] days = 365.25 days = 365 days 6 hours). The duration of the heliacal year of Sirius for many millennia is fixed and stable with an accuracy of ± 1.0-1.5 minutes.

Box 2: Solar calendar accuracy

To determine the accuracy of any solar calendar, one can use the following formula:

A = [365m + 366 n] / [m + n] – T,

where: A is the absolute value of the annual error in the average day, T [365.2421875 days] is the duration of the tropical year in the same day, m [97 days] is number of simple years in the calendar cycle, and n [31 days] is number of leap years in the same cycle.

The denominator of the fraction [m + n] = [97+31=128 days] in the formula is taken as a calendar cycle: A= (365x97) + (366x31)/128 – 365.2421875 = (35,405 + 11,346)/128 – 365.2421875 = 46,751/128 – 365.2421875 = 365.2421875 – 365.2421875 = |±0|.

mythology - heavenly city, abode of the gods] or Horus, one of the most important Egyptian gods or Ashur, the name of the main God of Assyria); (XII) Sagittarius; (XIII) Capricornus.

Each of the four quarters contains exactly 91 days. In a normal year, there are 365 days (including ED - Extra Day). In a leap year, there is an additional 366th day (EDD - Extra Day Duplicate). The name EDD has alternative names: LD (Leap Day) and BD (Bisextile Day or the same Leap Day).

After each additional 365th day in a normal year and after each additional 366th day in a leap year, the calendar matrix returns to its original state, back to the beginning of the year (Morozov`s principle of active synchronisation of the real year with the ideal year).

Therefore, each new year always begins with the 1st day of Aquarius, Sunday. We consider the calendar as a mathematical digital time counter. From Table 4, it follows that the days of the week in the traditional calendars (in the bottom row of each cell of the calendar matrix) are mobile: at the beginning of each ordinary year they are shifted one day of the week forward, and the beginning of each year, following the leap year, is shifted immediately two days of the week forward with the immutability and constancy of the numerical series relative to each other.

In all modern calendars, the opposite is true: the constant is the grid of days of the week, and the variable is the shift of numerical series relative to each other – one day in a normal year and two days in the next after leap year. In astronomical terms (but not in economic terms) this transformation is completely equivalent in relative parameters (Morozov`s principle of calendar equivalence). It is necessary to choose between either variable series of numbers at a constant grid of days of the week or constant (fixed) series of numbers at a variable grid of days of the week.

The constant rows of calendar days with a variable grid of days of the week (in the lower, current, scale of the calendar matrix) has an important advantage in economic terms over the constant grid of days of the week and variable rows of numbers adopted today in all terrestrial calendars.

Economic effect of standard calendar

In the Asgardia calendar, each new year always starts on the same date and on the same day of the week. It allows one to have the same universal

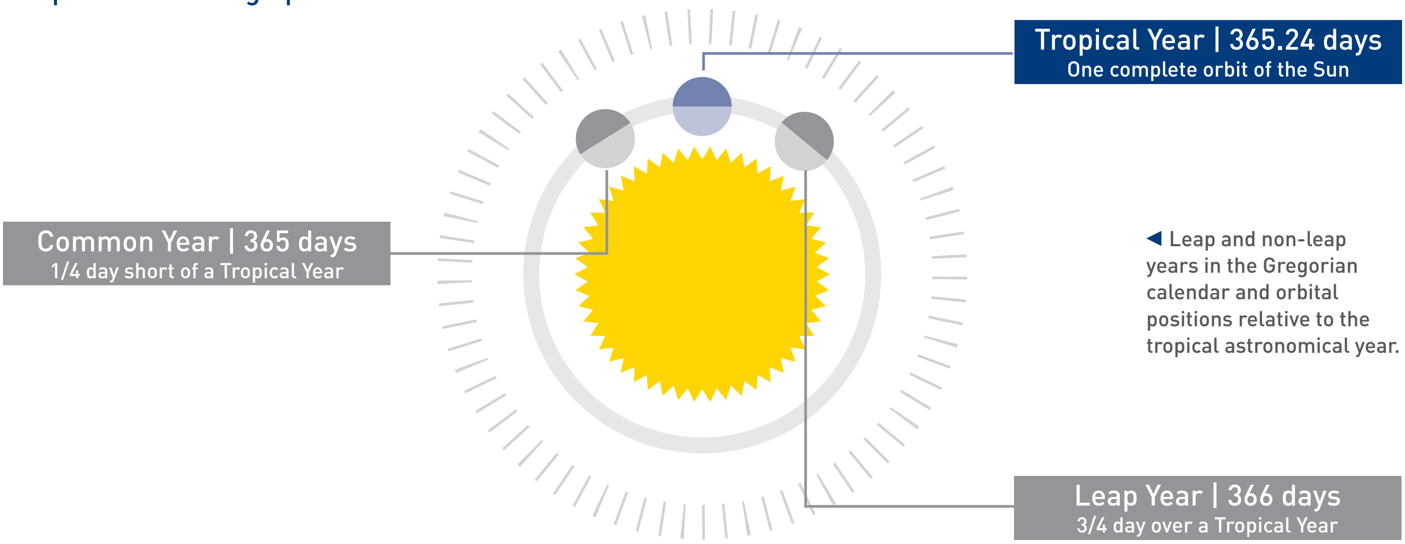
The ideal core of the standard 13-month reference calendar consists of 364 days

Table 3 - Universal standard 13-month reference calendar matrix (matrix: 13 months, 52 weeks, 7 days, 8 days off per month).

Weekday	Month												
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
	Aquarius	Pisces	Aries	Taurus	Gemini	Cancer	Leo	Virgo	Libra	Scorpio	Serpentarius*	Sagittarius	Capricornus
Sunday	1	1	1	1	1	1	1	1	1	1	1	1	1
Monday	2	2	2	2	2	2	2	2	2	2	2	2	2
Tuesday	3	3	3	3	3	3	3	3	3	3	3	3	3
Wednesday	4	4	4	4	4	4	4	4	4	4	4	4	4
Thursday	5	5	5	5	5	5	5	5	5	5	5	5	5
Friday	6	6	6	6	6	6	6	6	6	6	6	6	6
Saturday	7	7	7	7	7	7	7	7	7	7	7	7	7
Sunday	8	8	8	8	8	8	8	8	8	8	8	8	8
Monday	9	9	9	9	9	9	9	9	9	9	9	9	9
Tuesday	10	10	10	10	10	10	10	10	10	10	10	10	10
Wednesday	11	11	11	11	11	11	11	11	11	11	11	11	11
Thursday	12	12	12	12	12	12	12	12	12	12	12	12	12
Friday	13	13	13	13	13	13	13	13	13	13	13	13	13
Saturday	14	14	14	14	14	14	14	14	14	14	14	14	14
Sunday	15	15	15	15	15	15	15	15	15	15	15	15	15
Monday	16	16	16	16	16	16	16	16	16	16	16	16	16
Tuesday	17	17	17	17	17	17	17	17	17	17	17	17	17
Wednesday	18	18	18	18	18	18	18	18	18	18	18	18	18
Thursday	19	19	19	19	19	19	19	19	19	19	19	19	19
Friday	20	20	20	20	20	20	20	20	20	20	20	20	20
Saturday	21	21	21	21	21	21	21	21	21	21	21	21	21
Sunday	22	22	22	22	22	22	22	22	22	22	22	22	22
Monday	23	23	23	23	23	23	23	23	23	23	23	23	23
Tuesday	24	24	24	24	24	24	24	24	24	24	24	24	24
Wednesday	25	25	25	25	25	25	25	25	25	25	25	25	25
Thursday	26	26	26	26	26	26	26	26	26	26	26	26	26
Friday	27	27	27	27	27	27	27	27	27	27	27	27	27
Saturday	28	28	28	28	28	28	28	28	28	28	28	28	28 (364)
Sunday									Extra Day			[ED]	29 (365)
Monday									Extra Day Duplicate			[EDD]	30 (366)

* or "Ophiuchus" on Greek Latin

Leap Years: making up for lost time



◀ Leap and non-leap years in the Gregorian calendar and orbital positions relative to the tropical astronomical year.

day all over the world (the top row in each cell of the calendar matrix), which saves tens of thousands of tonnes of paper, dyes, printing and transportation costs.

With constant (fixed) rows of numbers in the calendar matrix of the permanent calendar and with a variable grid of days of the week at the bottom of the current scale of the permanent calendar, the dates of events will always remain identical: this includes holidays, dates of launch windows into space, schedules in schools and universities, parliaments, network schedules, stock and bank calculations, etc. They will remain fixed from year to year and will not require, as is the case now, any annual recalculations.

The upper universal (absolute) series of numbers of the calendar matrix in each cell never changes. This makes it possible to bring to a single mathematical denominator any specific calendar system placed in the second (lower) row of each cell of the calendar matrix (Table 4). For each cycle of 128 years, only two types of calendar are used: leap and non-leap, which differ only in the number of days related to the new year (three days in a leap year and two days in a non-leap year). In all other respects, the calendars are absolutely identical.

In the proposed calendar, the numerical axis of history is divided into uniform cycles of the same type (128 years each) and contains two rows of numbers: the upper universal and the lower Gregorian (VG). The date is recorded in two ways: universal (UM) and ordinary, according to the Gregorian calendar. For example, Aquarius 1st, 0003, Sunday (UM) / January 1st, 2019, Tuesday (VG).

Industrialisation strategy

The strategy for the industrialisation of space today naturally follows the era of capitalist and socialist industrialisation strategies on Earth, but

In the Asgardia calendar, each new year always starts on the same date and on the same day of the week

Table 4 - Aquarius month*.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1 Aquarius 0003 1 Jan 2019, Tue	2 2 Jan, Wed**	3 3 Jan, Thu	4 4 Jan, Fri	5 5Jan, Sat	6 6 Jan, Sun	7 7 Jan, Mon
8 8 Jan, Tue	9 9 Jan, Wed	10 10 Jan, Thu	11 11 Jan, Fri	12 12 Jan, Sat	13 13 Jan, Sun	14 14 Jan, Mon
15 15 Jan, Tue	16 16 Jan, Wed	17 17 Jan, Thu	18 18 Jan, Fri	19 19 Jan, Sat	20 20 Jan, Sun	21 21 Jan, Mon
22 22 Jan, Tue	23 23 Jan, Wed	24 24Jan, Thu	25 25 Jan, Fri	26 26 Jan, Sat	27 27 Jan, Sun	28 28 Jan, Mon

* The top row of numbers is a universal constant absolute date (universal matrix - UM), along with a constant absolute grid of the days of the week.
** The last row of the cell is the variable current grid of Gregorian dates and days of the week (Vatican/Gregorian - VG).

Table 5 – Per-second ratio of calendar calculations of the duration of the year in different calendars in comparison with the duration of the tropical solar year.

Calendar year	Number of days	Seconds per year	Mistake
Julian (Heliacal year of the star Sirius)	365.25 = $365^{1/4}$ = $365^{100/400}$ = $365^{32/128}$	31 557 600	+675 sec +11 min 15 sec
Gregorian average [Figure 3]	365.2425 = $365^{97/400}$	31 556 952	+27 sec
Non-Leap Gregorian	365	31 536 000	-20 925 sec -5,8125 hr
Leap Gregorian	366	31 622 400	+65 475 sec +18,1875 hr
Astronomical (Equinodent) average solar year according to Simon Newcomb by the points of the spring and autumn equinox at the equator (1900)	365.2422 ≈ $365^{132/545}$ ≈ 365.2422018	31 556 926.08 ≈ 31 556 926.23	+1,08 sec +1,23 sec
Experimental determination of the duration of the average equinoctial solar year (1900) [Figure 2]	365.24219878	31 556 925.974592	+0.974592 sec
Asgardia calendar has avereage duration equal to exp. determination of the duration of an average tropical[1] solar year. 365 days 5 hr 48 min 45 sec[2]	365.2421875 = $365^{31/128}$	31 556 925.0	±0

1. Tropical year. Astronomical Almanac Online Glossary (2015) https://en.wikipedia.org/wiki/Tropical_year (Retrieval date: 20.12.2018).https://en.wikipedia.org/wiki/Tropical_year
2. Meeus J., Savoie D. (1992). The History of the Tropical Year. Journal of the British Astronomical Association 102(1), 40–42; Secular Terms of the Classical Planetary Theories Using the Results of General Theory. Astronomy and Astrophysics 157, 59–70.

is expected to lead to the gradual replacement of terrestrial attributes currently extended to space. In particular, this will involve the replacement of the terrestrial calendar system with a space-based one.

The calendar of the space state of Asgardia is a fixed-standard, digital reference, uniform version of the 13-month global space calendar of the sixth strategic socio-economic formation of human civilisation, the first stage of which was marked by the creation of the state of Asgardia on 12 October 2016 in Paris.

The calendar itself was implemented by Igor Raufovich Ashurbeyli, Head of state of Asgardia, Decree No. 2 from 1 January 2017 and approved by the Parliament of Asgardia dated: Virgo 13, 0003 // July 28, 2019. The calendar is intended to ensure international cooperation in the strategy for the industrialisation of space. The standard 13-month reference calendar of the space state of Asgardia is a purely civil neutral calendar for the first time in the history of civilization. It does not serve any religious cults or political parties. It is designed to serve the purely economic tasks of the new space society, the new space socio-economic formation. ■

Table 6 – Compact display of a fixed standard 13-month reference Asgardia calendar in the form of a single mathematical table-matrix.

Days of the week	I -XIII month				Extra days
1st	1	8	15	22	ED 29, EDD 30
2nd	2	9	16	23	
3rd	3	10	17	24	
4th	4	11	18	25	
5th	5	12	19	26	
6th	6	13	20	27	
7th	7	14	21	28	

About the author

Sergei Lvovich Morozov studied at the Medical Institute and graduated from the University of Izhevsk in 1976. He also graduated from the Moscow Research X-ray Radiological Institute of the Ministry of Health of the Russian Federation in Moscow in 1985, from the Finance Academy under the Government of Russia in 2002, and completed doctoral studies in Central Economics and Mathematics at the Institute Russian Academy of Sciences in 2016. Morozov has been the chairman of the board of Elbimbank (1990-2000), adviser to the Secretary General of the EurAsian Economic Community (2005-2008), a senior research fellow at the National Development Institute of the Russian Academy of Sciences (2017) and a Member of the first Parliament of Asgardia (2018).

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