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The Gupta Era.

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(*Communicated by Prof. M. N. Saha.*)

In the present paper it is proposed to determine the beginning of the era of the Gupta emperors of northern India. Dr. Fleet in his great book *Inscriptionum Indicarum*, Vol III, has published a collection of the Gupta inscriptions. In order to verify the dates in those inscriptions he had the assistance of the late Mr. S. B. Dikṣita of Poona, and his calculations led Dr. Fleet to conclude that the Gupta era began from 319–321 A.D.[1] This indefinite statement or inference is not satisfactory. Mr. Dikṣita was also not able to prove that the Gupta and Valabhī eras were but one and the same era.[2] Of recent years some have even ventured to prove that the Gupta era is to be identified with the Saṁvat or Mālava era. Hence it has become necessary to try to arrive at a definite conclusion on this point, *viz.*, as to the true beginning of the Gupta era.

The tradition about this era is recorded by Alberuni, which is equivalent to this:—from the Śaka year deduct 241, the result is the year of the Gupta kings and that the Gupta and the Valabhī eras are one and the same era.[3] Now the Śaka era and the Saṁvat or Mālava era are generally taken to begin from the light half of lunar *Caitra*. As has been stated already, it is extremely controversial to assume if this was so at the times when these eras were started.

From the earliest Vedic times and also from the *Vedāṁga* period, we have the most unmistakable evidences to show that the calendar year, as distinguished from the sacrificial year was started either from the winter solstice day or from the day following it. The so-called *Caitra-śuklādi* reckoning started the year from the vernal equinox day or from the day following it. So far as we can see from a study of the history of Indian astronomy, we are led to conclude that this sort of beginning the year was started by Āryabhaṭa I, from 499 A.D. The great fame of Āryabhaṭa I as an astronomer led all the astronomers and public men of later times to follow him in this respect. We start with

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[1] Fleet—*Corpus Inscriptionum Indicarum*, Vol. III (Gupta Inscriptions) page 127.

[2] S. B. Dikṣita, भारतीय ज्योतिःशास्त्र, page 375 (1st edn.).

[3] Sachau's Alberuni, Vol. II, page 7—'The epoch of the era of the Guptas falls, like that of the Valabha era, 241 years later than the Śakakāla.'

the hypothesis that the Gupta era was originally started from the winter solstice day and that initially the year of the era more correctly corresponded with the Christian year than with the *Caitra-śuklādi* Śaka year.

Now the year 241 of the Śaka era is equivalent to 319-20 A.D. We assume that the Gupta era started from the winter solstice day preceding January 1, 319 A.D. The elapsed years of the Gupta era till 1940 A.D. becomes 1,621 years and $1,621 = 160 \times 10 + 19 + 2$. Hence the starting year of the era was similar to 1938 A.D. Now the mean precession rate from 319 to 1938 A.D. = 50″·0847 per year. Hence the total shifting of the solstices becomes till 1938 A.D. = 22° 31′ 27″·54. Thus what was 270° of the longitude of the sun should now become 292° 31′ nearly—a longitude which the sun now has about the 13th of January. On looking up some of the recent calendars we find that

(*a*) In the year 1922 there was a full-moon on January 13.

(*b*) In the year 1937 there was a new-moon on January 12.

We apply the elapsed years 1,619 (sidereal) backward to January 12, 1937 A.D and arrive at the date:—

December 20, 317 A.D., on which at G.M.N. or Ujjayinī, mean time, 5-4 P.M.,

Mean Sun	= 269° 5′ 11″.26
,, Moon	= 272° 39′ 40″.40
Lunar Perigee	= 39° 50′ 37″·25
A. Node	= 257° 44′ 29″·88
Sun's Apogee	= 74° 7′ 25″·16
,, eccentricity	= 0·0173808.
Hence $2e$	= 119′·5016
$\frac{5}{4}e^2$	= 1′·2981
Appt. Sun	= 269° 37′
,, Moon	= 268° 52′ nearly.

The moon overtook the sun in about $1\frac{1}{2}$ hours and the sun reached the summer solstice in about 9 hours. Hence December 20, 317 A.D., was a new-moon day and also the day of winter solstice according to the ordinary mode of Indian reckoning. As this day was similar to January 12, 1937 A.D., *viz* lunar *Agrahāyaṇa* ended, it appears that the Gupta era was started from about the 21st December 318 A.D., and this was the 12th day of lunar *Pauṣa*. It must be remembered in this connection that the distinguishing character of the lunar *Agrahāyaṇa* with which the year ended at the end of a correct luni-solar cycle, was that the last quarter of the moon was very nearly conjoined with *Citrā* (*Spica* or *α Virginis*).[1] In our opinion this character of the month was used

[1] *Cf.* the long. of the moon on January 4, 1937 A.D., at L.Q. with that of *α Virginis*.

for the intercalation of a lunar month at the end of a correct luni-solar cycle. We now proceed to examine the dates given in the Gupta Inscriptions as collected together by Dr. Fleet in his great book on the subject.

(i) गते पञ्चषष्ट्यधिके (१६५) वर्षाणाम् भूपतौ च बुधगुप्ते आषाढ-मास-शुक्लद्वादश्यां सुरगुरोर्दिवसे [1] ।

The inscription says that the 12th *tithi* of the light half of lunar *Āṣāḍha* of the Gupta year 165, fell on a Thursday. We examine this both by the modern and the *Siddhāntic* methods.

(*a*) By the modern method.

The year 165 of the Gupta Kings is similar to the year 1924 A.D., and the date corresponded with July 13, Sunday, of 1924 A.D. The elapsed years till this date=1,440 sidereal years= 525,969 days. We increase the number of days by 1 and divide it by 7: the remainder is 4, which shows that the inscription statement of Thursday agrees with the Sunday of July 13, 1924 A.D.

We next apply 525,969 days backward to July 13, 1924, and arrive at the date June 21, 484 A.D., the date of the inscription.

This date was 14·15 Julian centuries and 181·25 days before January 1, 1900 A.D.

Hence on June 21, 484 A.D., at G.M.N.:		
Mean Sun	= 91° 12′ 50″·64	
,, Moon	= 235° 7′ 53″·42	Hence :—
L. Perigee	= 335° 23′ 2″·80	$2e$ = 119′·0564
A. Node	= 277° 14′ 51″·51	$\frac{5}{4}e^2$ = 1′·290.
Sun's Apogee	= 76° 14′ 32″	
,, Eccentricity	= 0·0173175	

From these we readily find the same mean places at the preceding Ujjayinī mean midnight.

Hence on June 20, 484 A.D. at Ujjayinī mean midnight :

Mean Sun	= 90° 30′ 47″·38	Appt. Sun = 90° 2′
,, Moon	= 225° 45′ 41″·78	,, Moon= 219° 47′
Lunar Perigee	= 335° 18′ 17″·61	nearly.
A. Node	= 277° 17′ 7″·08	

Thus at the Ujjayinī mean midnight of the day before (Wednesday), the 11th *tithi* was current, and next day, Thursday, had at sunrise the 12th *tithi* of the lunar month of *Āṣāḍha*.

[1] Fleet's Gupta Inscriptions, page 80, Êran Inscription.

(*b*) According to the method of the *Khaṇḍakhādyaka* of Brahmagupta, the *Kali ahargaṇa* on this Wednesday at the Ujjayinī mean midnight was =1309545.

Hence:— Mean Sun = 91° 3′ 4″
„ Moon = 226° 23′ 17″
Lunar Perigee = 335° 42′ 56″
A. Node = 277° 35′ 17″

The above two sets of the mean elements for the same instant are in fair agreement. Hence the date of the inscription is Thursday, June 21, 484 A.D., and the Zero Year of the Gupta era is thus 319 A.D. We are here in agreement with Dīkṣita's finding.

(ii) The Second Instance of Gupta-Inscription-date.

श्रीविश्वनाथ प्रतिवद्ध नौजनानां बोधक रसुल मह्मद संवत् ६६२ तथा श्रीन्टपविक्रमसंवत् १३२० तथा श्रीमद् वलभी संवत् ९४५ आषाढ़ वदि १३ रवौ अद्य इह[1]।

Here the Hizri year 662 shows that the Vikrama Saṁvat is expressed in elapsed years as 1320; and as it is now reckoned it should be 1321. The Valabhī Saṁvat 945 is the same as the Gupta Saṁvat 945, in which the thirteenth *tithi* of the dark half of *Jyaiṣṭha* fell on a Sunday.

Now the mean *Khaṇḍakhādyaka ahargaṇa*=218,878
from which we deduct 30
218,848,

which we accept as the correct *ahargaṇa*, and is exactly divisible by 7, and which was true for Saturday of *Āṣāḍha Vadi* 12 of the Gupta era 945. The English date for this Saturday was May 25, 1264 A.D. On the next day (Sunday) the date was May 26, 1264 A.D. the date of the inscription.

From the above apparent *ahargaṇa* for May 25, 1264 A.D., which was a Saturday, at the Ujjayinī mean midnight we have—

Mean Sun = 1ˢ 27° 42′ 48″
„ Moon = 0ˢ 27° 31′ 40″
L. Apogee = 6ˢ 20° 29′ 1″ (with Lalla's correction)
A. Node = 9ˢ 29° 53′ 4″ („ „ „)

Hence:—Appt. Sun = 1ˢ 28° 21′ 57″
„ Moon = 0ˢ 28° 8′ 44″
Moon—Sun = 10ˢ 29° 46′ 47″
= 27 *tithis*+5° 46′ 47″.

[1] Fleet's Gupta Inscriptions, page 84, Veraval Inscription.

Thus at the midnight (U.M.T.) of the Saturday ended, about 11 hrs. of the 13th *tithi* of the dark half of *Jyaiṣṭha* were over and 13 hrs. nearly of it remained. Thus the current *tithi* of the next morning of Sunday was also the 13th of the dark half of *Jyaiṣṭha*, which is called *Āṣāḍha Vadi* 13.

In the present case the Valabhī or Gupta year 945 = 1264 A.D. Hence also the Gupta era began from 319 A.D. and we are in agreement with Dīkṣita.

(iii) The Third Instance of Gupta-Inscription-date.

९२७ वर्षे फाल्गुन सुदि २ सोम[1] ।

It is here stated that in the Gupta or Valabhī year 927, the 2nd *tithi* of the light half of *Phālguna*, fell on a Monday. The English date becomes 1246 A.D. February 19. Śaka Year was 1,167 years +11 months +2 *tithis*, the Gupta year being taken to have been reckoned from the light half of lunar *Pauṣa*.

The true *Khaṇḍakhādyaka ahargaṇa* becomes = 212,179 at Ujjayinī Mean Midnight of Monday, when

Mean Sun	=	10^s	24°	43′ 44″
,, Moon	=	11^s	24°	26′ 37″
L. Apogee	=	6^s	3°	20′ 53″
A. Node	=	2^s	1°	59′ 40″.

Hence on the same date at 6 A.M. Ujjayinī M.T.:

Mean Sun	=	10^s	23°	59′ 23″
Sun's Apogee	=	2^s	17°	0′ 0″
Mean Moon	=	11^s	14°	33′ 41″
L. Apogee	=	6^s	3°	15′ 52″.

Thus:—

Appt. Sun	=		325°	59′ 2″
,, Moon	=		342°	56′ 51″
Moon—Sun	=		16°	57′ 25″
	=	1 *tithi*	+4°	57′ 25″.

On this Monday, the *tithi* was the second of the light half of lunar *Phālguna*, while the sun's longitude shows that the Bengali date was the 24th of solar *Phālguna*. We are here in agreement with Dīkṣita.

In this case also calculation by the modern methods is unnecessary as the time was later than that of Brahmagupta. It should be noted that the old year-reckoning from the light half of *Pauṣa* has continued in spite of Aryabhata I's rule of reckoning it from the light half of *Caitra*. Here also 927 of the Gupta era = 1246 A.D.

∴ Zero year of the Gupta era = 319 A.D.

[1] Fleet's Gupta Inscriptions, page 90, Veraval Inscription.

(iv) The Fourth Instance of Gupta-Inscription-date.

३३० गुप्तसंवत् द्विमार्गशीर्षसु सुदि २ सोम [1]।

This states that the Gupta year 330 had at its end the second *Agrahāyaṇa*. Here of the Gupta year 330, up to *Agrahāyaṇa*, the time by the *Caitra-śuklādi* Śaka era would be 570 years +9 months.

According to the *Khaṇḍakhādyaka* of Bramhagupta the total *Kali-solar days* up to 570 of Śaka elapsed +9 months = 1,349,910, in which we get $1,383\frac{1}{3}\frac{2}{6}$ intercalary months, *i.e.* 1,383 exact intercalary months by the mean rate, which tends to show that there was a second lunar *Agrahāyaṇa* at this time. But this explanation appears unsatisfactory. If we follow the method of the *siddhāntas*, there can be no intercalary month in the solar month of *Agrahāyaṇa*, of which the length as found by Warren is less than that of a lunar month.[2] We have also examined it carefully and found that in the present case this could not happen. We have then to examine it another way.

On December 20 of the year 317 A.D. there was a new-moon with which the lunar *Agrahāyaṇa* ended and the sun turned north. The character of this lunar *Agrahāyaṇa* was that the last quarter was conjoined with *Citrā* or α *Virginis*. The Gupta era was started one year later than this date, from the 20th December, 318 A.D. The year 330 of the Gupta era was thus the year which ended about December 20 of 648 A.D. and the number of years elapsed was $331 = 160 \times 2 + 11$.

Thus 331 years was a fairly complete luni-solar cycle, and comprised 120,898 days. Again 577,825 days before January 1, 1900 A.D., was the date December 20, 317 A.D. Hence applying 120,898 days forward to this date, we arrive at the date December 21, 648 A.D. But the new-moon happened one day earlier, *i.e.* on the 20th December 648 A.D. with which the lunar *Agrahāyaṇa* ended this year.

Now on the day of the last quarter of this month or the *aṣṭakā* which fell on the 13th December 648 A.D., the moon was conjoined with *Citrā* or α *Virginis*, in the latter part of the night. On this day at G.M.N. we had—

Mean Sun	= 264° 57′ 0″·47	Hence :—	
,, Moon	= 180° 14′ 22″·10	Apparent Sun	= 265° 8′
L. Perigee	= 188° 32′ 34″·17	,, Moon	= 179° 10′
Sun's Apogee	= 79° 46′ 40″·79	Long. of α *Virginis*	= 185° nearly.
$2e = 118'·7$, $\frac{5}{4}e^2 = 1'·298$			

[1] Fleet's Gupta Inscriptions, page 92, The Kaira (22° 45′ N, 72° 45′ E) Grant.

[2] Length of solar *Agrahāyaṇa* = 29 da. 30 n. 24 v. 2^{m} 33^{iv} (Burgess *S. Sidhānta*, XIV, 3.)

Length of lunar month = 29 da. 31 n. 50 v. 6^{m} 53^{iv} according to the *Khaṇḍakhādyaka*.

From these calculations it follows that the last lunar month of the year was the second *Agrahāyaṇa* as this month completed the luni-solar cycle of 331 years.

The date of the inscription being the second (third ?) day of the second *Agrahāyaṇa*, was Monday, the 24th of November, 648 A.D., with this second *Agrahāyaṇa* which ended on the 20th December 648 A.D. the year 330 of the Gupta era ended. It must be admitted that the inscription as it has been read or as it was executed was slightly defective. In this case also Aryabhaṭa I's *Caitra-śuklādi* reokoning is not followed.

Here 330 of the Gupta era = 649 A.D.
Or Zero year ,, ,, = 319 A.D.

(v) Morvi Copper Plate Inscription.

पञ्चाग्नीत्यायुतेऽतीते समानां शुतपञ्चके ।
गौप्ते ददावदो नृपः सोपरागेऽर्कमण्डले ॥
संवत् ५८५ फाल्गुन सुदि ५ ।

This inscription says that on the day of the 5th *tithi* of the light half of lunar *Phālguna* of the Gupta year 585, the King of the place, Morvi (22° 49′ N and 70° 53′ E) made a gift at the time of a solar eclipse, which happened some time before this date, on which the deed of gift, *viz.*, the copper plate in question, was executed.

To find the date of this copper plate had been a pitfall to Dr. Fleet, who mistook that the solar eclipse in question, happened on the 7th May, 905 A.D. Now the year 585 of the Guptas should be 904 A.D. and the date of execution of the plate should be February 20, 904 A.D. We looked for the solar eclipse two lunations 5 days before and 8 lunations 5 days before this date. Although there happened the two solar eclipses at these times, they were not visible in India.

We find, however, that here the Gupta year is reckoned not from the light half of *Pauṣa*, but from the light half of *Caitra* according to Āryabhaṭa I's rule. Here the year 585 of the Gupta era = 826 of the *Caitra-śuklādi* Śaka era = 904-905 A.D., or the zero year of the Gupta era was 319-20 A.D. The date of the inscription corresponds to March 3, 1941 A.D., and the elapsed years till this date = 1,036 years = 12,814 lunations = 378,405 days. The date of the copper plate works out to have been February 12, 905 A.D. The eclipse referred to in the inscription happened on November 10, 904 A.D.,[1] on which at G.M.N. or 4-44 P.M. Morvi time,

[1] Finally accepted by Fleet—Indian Antiquary, Nov. 1891, page 382. S. B. Dīkṣit did actually find it.

Mean Sun	= 234°	22′	29″·34
Sun's Apogee	= 83°	9′	18″·32
Mean Moon	= 231°	7′	21″·80
D. Node	= 246°	7′	31″·10
L. Perigee	= 162°	10′	10″·68

The new-moon happened at mean noon, Morvi time, the magnitude of the eclipse as visible at the place was about ·075. The beginning of the eclipse took place at 11-35 A.M. Morvi time. The end came about 12-45 noon, Morvi mean time. Duration was about 1 hr. 10 min.[1]

Secondly, if we use the *Khaṇḍakhādyaka* constants, the *ahargaṇa* becomes for 826 of Śaka era + 8 lunations = 87,528. Hence the mean places with Lalla's corrections thereto, at G.M.N. of the same day become:—

Mean Sun	= 228°	18′	5″
,, Moon	= 224°	27′	36″
D. Node	= 239°	44′	56″
L. Perigee	= 155°	59′	47″.

It appears that this eclipse could be predicted by the method of the *Khaṇḍakhādyaka*. The gift made by this copper plate was probably a reward to the calculator of the eclipse.

(vi) The Sixth Instance of Gupta-Inscription-date.

षट्पञ्चाशोत्तरेऽब्दशते (१५६) गुप्तनृपराज्यभुक्तौ महावैशाख-संवत्सरे कार्त्तिकमास-शुक्लपक्षद्वतीयायां [2]।

In the year 156 of the Guptas, which was the Jovial year styled the *Mahāvaiśākha* year, the inscription records the date as the day of the 3rd *tithi* of the light half of *Kārtika*.

Now 156 of the Gupta era = 475 A.D.
Julian days on January 1, 475 A.D. = 1,894,552 and
,, ,, ,, ,, 1900 A.D. = 2,415,021, the difference is 520,469 da. which comprise 14·24 Julian centuries+353 days or 14·25 Julian centuries—12·25 days. We increase 520,469 da. by 12·25 da. and arrive at the date December 20, 474 A.D., on which at G.M.T. 6 hrs. or 11-4 A.M. Ujjayinī M.T.,

Mean Jupiter	= 170°	54′	6″·57
Mean Sun	= 269°	47′	11″·66

[1] The above circumstances of the eclipse have been calculated by my collaborator, Mr. N. C. Lahiri, M.A.
[2] Fleet's Gupta Inscriptions, page 104, the Khôh Grant I.

Hence we calculate that mean Jupiter and mean sun became nearly equal 289 days later, *i.e.* on the 5th October, 475 A.D. at 6 A.M. G.M.T.

Mean Jupiter = 194° 55′ 34″·42
Mean Sun = 194° 38′ 19″·15.

It is thus seen that the mean places would become almost equal in 6 hrs. more. For the above mean places, however, the equations of apsis for Jupiter and Sun were respectively —2° 6′ 4″·08 and —1° 45′ 2″·70. Hence their apparent places become as follows:—

Appt. Jupiter = 192° 49′ 30″·34
,, Sun = 192° 53′ 16″·45.

Thus they were very nearly in conjuction at 6 hrs. G.M.T. on the 5th October, 475 A.D.

According to Brahmagupta, Jupiter rises on the east on getting at the anomaly of conjunction of 14°. This takes place in 15·5 days. Hence the date for the heliacal rising of Jupiter becomes the 20th October, 475 A.D. at G.M.T. 18 hrs. when,

Appt. Sun = 208° 45′
and ,, Jupiter = 196° 20′ nearly.

Thus Jupiter was heliacally visible about October 20, 475 A.D.

The actual date of the inscription was October 18, 475 A.D.[1]

Here on the day of the heliacal visibility, the sun was in the *nakṣatra Viśākhā* but Jupiter was 3° 40′ behind the first point of the *nakṣatra*-division, the vernal equinox of the year being taken as the first point of the Hindu sphere. According to the rule of naming Jupiter's years as given in the modern *Sūrya-siddhānta* xiv, 16-17, it was sun's *nakṣatra*, on new-moon prior to October 18, 475 A.D., the date of the inscription, which took place on October 15-16 of the year, gave the name of the year. The sun was in the *nakṣatra Viśākhā* and the year begun was consequently the *Mahāvaiśākha* year of Jupiter.

This inscription also shows that the Gupta era began from 319 A.D.

(vii) The Seventh Instance of Gupta-Inscription-date.

चिषष्ट्युत्तरेऽब्दशते (१६३) गुप्तनृपराज्यभुक्तौ मद्दा-आश्वयुज-संवत्सरे चैत्रमास-शुक्लपक्ष-द्वितीयायाम्[2]।

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[1] *Kali ahargaṇa* on the day of the 3rd *tithi* of *kārtika* light half in the Gupta year 156 was 1,306,377, and Julian days = 1,894,843.

[2] Fleet's Gupta Inscriptions, page 110, the Khôh Grant II.

The inscription records the date as the year 163 of the Gupta kings, the Jovial year called *Mahā-Āśvayuja*, the day of the 2nd *tithi* of the light half of *Caitra*.

The year 163 of the Gupta era or 482 A.D. was similar to the year 1941 A.D. and the date to March 30, 1941. In 1,459 sidereal years (1,941—482 = 1,459) there are 532,909 days, which are applied backward to the 30th March, 1941 A.D., and we arrive at the tentative date of the inscription as March 8, 482 A.D. On this date at G.M.N., we had—

Mean Jupiter = 29° 58′ 8″·24
,, Sun = 347° 12′ 47″·11.

Here, Jupiter's heliacal setting is yet to come in about 30 days. Hence on April 7, 482 A.D.—

Mean Jupiter = 32° 27′ 46″·22
,, Sun = 16° 46′ 57″·02 at G.M.N.

Thus the heliacal setting of Jupiter took place in two days more according to Bramhagupta's rule on the 9th April, 482 A.D. and the new-moon happened on the 5th April, 482 A.D. when the sun was on the *nakṣatra Bharaṇī*. Hence the year to come got its name *Āśvayuja* year. But the tentative date of the inscription was obtained as March 8, 482 A.D., which was 28 days before the new-moon, on about the 5th April, 482 A.D. This needs elucidation.

Here by coming down by 30 days we arrive at the lunar month of *Vaiśākha* as it is reckoned now. But in the year 482 A.D., *i.e.* 17 years before the year 499 A.D. when the Hindu scientific *siddhāntas* came into being, the calendar formation rule was different. In our gauge year 1941 A.D. the moon of the last quarter got conjoined with *Citrā* or *α Virginis* on the 20th January before sunrise. Hence as pointed out before in this gauge year 1941 A.D. also, the lunar *Agrahāyaṇa* of the early Gupta period ended on the 27th January, 1941. Thus the lunar month that is now called *Pauṣa* in 1941 A.D. was called *Agrahāyaṇa* in 482 A.D. Hence the lunar *Caitra* of 482 A.D. is now the lunar *Vaiśākha* of 1941.

The date of the inscription is thus correctly obtained as THE 7TH APRIL, 482 A.D.; the Jovial year begun was a *Mahā-Āśvayuja* year. This instance also shows that the zero year of the Gupta era was approximately the same as the Christian year 319 A.D.

(viii) The Eighth Instance of Gupta-Inscription-date.

एकनवत्युत्तरेऽब्दशते (१९१) गुप्तनृपराज्यभुक्तौ श्रीमति प्रवर्धमान-महाचैत्रसंवत्सरे माघमास-बहुलपक्षद्वतीयायाम्[1]।

[1] Fleet's Gupta Inscriptions, page 114, the Mājhgavāṁ Grant.

This inscription records the date as the year 191 of the Gupta emperors, the Jovial year of *Mahācaitra*, the day of the third *tithi* of the dark half of lunar *Māgha*.

We first work out the date on the hypothesis that the Gupta year was in this case also reckoned from the light half of lunar *Pauṣa*. The Gupta year 191, on this hypothesis would be similar to the Christian year 1931 and the date of the inscription would correspond with March 6, 1931. Now this Gupta year 191 = 510 A.D. would be later than the time of Āryabhaṭa I, *viz.* 499 A.D., by 11 years.

The elapsed years (sidereal) are 1,421, which comprise 17,576 lunations = 519,029 days. These days are applied backward to the date, March 6, 1931 A.D., and we arrive at the date, February 12, 510 A.D.

On this date, February 12, 510 A.D., at G.M.N., we had—

Mean Jupiter = 158° 8′ 3″·87
,, Sun = 323° 46′ 13″·72.

We find easily that the sun and Jupiter had reached equality in mean longitude in 183·5 days before, when at G.M.T. 0 hr.

Mean Sun = 142° 54′ 14″·50
,, Jupiter = 142° 52′ 48″·57.

If these were the longitudes as corrected by the equations of apsis, then the heliacal visibility would come according to the rule of Bramhagupta about 15·5 days later. The mean longitudes 15·5 days later become—

For Sun = 158° 10′ 54″·21
,, Jupiter = 144° 10′ 7″·25.

These longitudes corrected by the equations of apsis become—

For Sun = 156° 3′ 27″
,, Jupiter = 146° 16′ 41″.

Hence the true heliacal visibility would come in 4 days more. We have here (1) gone up by 183·5 days and (2) come down by 15·5 days. On the whole we have gone up by 168 days or 5 lunations and 21 *tithis*. Thus on the day of the heliacal visibility of Jupiter, which came in four days more, we would have to go up by 164 days = 5 lunations+17 *tithis*. This interval we have to apply backward to the 18th *tithi* of *Māgha* and we arrive at the 1st day of *Bhādrapada*. The date of the heliacal visibility would thus be September 1, 509 A.D., and at G.M.N. the sun's true longitude would be 160° 9′ nearly, which shows that the sun would reach the *Hastā* division. On the preceding day of the new-moon, the sun would be in the *nakṣatra U.Phalgunī* and the Jovial year begun would be styled *Phālguna* or the *Mahāphālguna*

year. This result does not agree with the statement of the inscription.

It now appears that after the year 499 A.D. or Āryabhaṭa I's time, the reckoning of the years of the Gupta era was changed from the light half of *Pauṣa* to the light half of *Caitra*, according to Āryabhaṭa I's rule:

युगवर्षमासदिवसाः समं प्रवृत्तास्ते चैत्रशुक्लादेः ।

Kālakriyā, .

'The *Yuga*, year, month and the first day of the year started simultaneously from the beginning of the light half of *Caitra*.'

After the year 499 A.D. all the Indian eras slowly changed their year-reckoning from the winter solstice day to the next vernal equinox day, *i.e.* the year beginning was shifted forward by 3 lunations. Hence in finding in our own time a year similar to the Gupta year of times later than 499 A.D., we have sometimes to compare it to the present-day Śaka year and not to the Christian year.

Hence the year 191 of the Gupta era = the year 432 of the Śaka era. In our times the Śaka year 1853 is similar to the Gupta year 191 and the date of the inscription corresponds to February 24, 1932 A.D. The number of sidereal years elapsed up to this date=1,421 = 519,029 days, which applied backward lead to the date of the inscription as FEBRUARY 2, 511 A.D.

The date of the heliacal rising arrived at before was September 1, 509 A.D. The next heliacal rising would take place 399 days or 13·5 lunations later. The date for it works out to have been October 5, 510 A.D., and the sun had the longitude of 194° 24′ 51″ at G.M.N. At the preceding new-moon, which followed the previous heliacal setting of Jupiter, the sun had the longitude of about 179° and was in the *nakṣatra Citrā* or the Jovial year begun was *Caitra* or the *Mahā-Caitra* year, as it is styled in the inscription.

In the present case the year 191 of the Gupta emperors = 432 of the Śaka emperors = 510-11 A.D. Thus the year 0 of the Gupta emperors = 241 of the Śaka emperors = 319-320 A.D.

(ix) The Ninth Gupta-Inscription-date.

नवोत्तरेऽब्दशतद्वये गुप्तनृपराज्यभुक्तौ श्रीमति प्रवर्धमानविजय-राज्य-महा-आश्वयुजसंवत्सरे चैत्रशुक्लपक्षत्रयोदश्याम् ।

The year and date as given in this inscription is 209 of the Gupta era, the day of the 13th *tithi* of the light half of *Caitra*. Following the *Caitra-śukla* reckoning, the corresponding date in our time is the 11th April, 1930. We have to apply 1,402 sidereal years, or more correctly, 17,341 lunations = 512,090 days backward to this date of April 11, 1930. We thus arrive at the date of the inscription, MARCH 19, 528 A.D.

On this date at G.M.N,. we had—

Mean Jupiter	= 347° 37′ 23″·90
,, Sun	= 358° 53′ 52″·27
Jupiter's Perihelion	= 350° 51′ 21″·61
Sun's Apogee	= 77° 42′ 56″
,, Eccentricity	= 0·017301
Jupiter's Eccentricity	= 0·046175.

Hence :—
Jupiter as corrected by the equation of apsis = 347° 19′
Appt. Sun = 358° 5′

It appears that the heliacal rising of Jupiter would happen 3 days later and the preceding new-moon happened 13 days before, *i.e.* on the 6th March, 528 A.D.

For on that date at G.M.N., we had—

Mean Sun	= 346° 5′ 3″·98
,, Moon	= 343° 5′ 27″·90
Lunar Perigee	= 313° 57′ 36″·84
Sun's Apogee	= 77° 42′ 56″

Hence :—
Appt. Sun = 349° 4′
Appt. Moon = 345° 43′ nearly.

The new-moon happened at about 8 hours later. The sun was in the *nakṣatra Revatī*, and the Jovial year begun was *Āśvayuja* or the *Mahā-Āśvayuja* year as the inscription says.

Here the year 209 of the Gupta era = 528 A.D. = year 440 of Śaka era.

The Zero year of the Gupta era = 319 A.D. = year 241 of Śaka era.

(x) The Tenth Instance of Gupta-Inscription-date—The Nepal Inscription.

संवत् ३८६ ज्यैष्ठमास-शुक्लपक्ष-प्रतिपदि रोहिणीनक्षत्रयुक्ते मुहूर्त्ते प्रशस्तेऽभिजिति [1] ।

Here the date is stated to have been 386 of the (Gupta) era, the day of the 1st *tithi* of lunar *Jyaiṣṭha*; the moon was in the *nakṣatra*-division *Rohiṇī* and the 8th part (*muhūrta*) of the day.

The equivalent years are 627 of Śaka era = 705 A.D.; we readily see that the corresponding day in our own time was May 20, 1939. We arrive at the date, April 30, 705 A.D.

Now on April 30, 705 A.D., at G.M.T. 0 hr.	On April 29, 705 A.D., at G.M.T. 0 hr.
Mean Sun = 40° 54′ 10″·97	Mean Sun = 39° 55′ 2″·64
,, Moon = 62° 0′ 9″·07	,, Moon = 48° 49′ 34″·04
L. Perigee = 322° 39′ 15″·02.	L. Perigee = 322° 32′ 33″·97

Thus on April 29, 705 A.D., at G.M.T. 0 hr.
Apparent Sun = 41° 12′
,, Moon = 53° 50′.

[1] Fleet's Gupta Inscriptions, page 95.

Hence on this day, at the stated hour, the 1st *tithi* was over; we have to deduct about 3° 3′ from these longitudes to allow for the shifting of the equinoxes from 499 A.D. The date of the inscription is thus April 28, 705 A.D.

According to the *Khaṇḍakhādyaka* calculations, the *ahargaṇa* at the midnight (mean) of Ujjayinī of April 28, 705 A.D. = 14,647. In order to have the mean places at the G.M.T. 0 hr. of 29th April, we have to take the *ahargaṇa* = 14,647 days+5 hrs. and 4 mins.

The mean places are:—

Mean Sun	= 36° 52′ 12″	Hence:—	
,, Moon	= 45° 43′ 58″	Apparent Sun	= 38° 16′ 23″
L. Perigee	= 318° 56′ 2″	,, Moon	= 50° 44′ 30″
Sun's Apogee	=77° 0′ 0″		

Note.—To the *Khaṇḍakhādyaka* mean places, we have applied Lalla's corrections which are well known in Hindu Astronomy.

Hence on the 29th April at G.M.T. 0 hr. or 5-4 A.M. of Ujjayinī mean time, the 1st *tithi* was over, the sun was in the *nakṣatra Kṛttikā* and the moon in the *nakṣatra*-division *Rohiṇī*, which extends from 40° to 53° 20′ of the Hindu longitudes. The date of the inscription was the previous day, THE 28TH APRIL, 705 A.D., as has been shown before.

Now Gupta year 386 = Śaka year 627 = 705 A.D.
∴ Gupta year Zero = Śaka year 241 = 319 A.D.

(xi) The Eleventh Example of Gupta-Inscription-date.

संवत्सर १०० ९० ९ (१९९) महामार्गवर्षे कार्त्तिक १०[1]।

The date of the inscription is the Gupta year 199, the *Mahāmārga* Jovial year; the day of the 10th *tithi* of lunar *Kārtika* which corresponds to November 21 of 1939 A.D. of our times. The elapsed sidereal year to this date = 1,421 = 17,576 lunations =519,029 days.

Hence the date of the Inscription was OCTOBER 29, 518 A.D.[2] On this date at G.M.N.—

Mean Jupiter	= 62° 34′ 9″·59
,, Sun	= 219° 6′ 50″·17
,, Moon	= 332° 22′ 20″·47.

Now 173·5 days before October 29, 518 A.D., the mean longitudes were for—

Jupiter	= 48° 8′ 46″·95
Sun	= 48° 6′ 14″·86

[1] *Epigraphica Indica*, Vol. VIII, pp. 284 *et seq.*

[2] Kielhorn's approximate date was 518 A.D., October 15 or September 15—*idem*—page 290.

and these are practically equal. Hence according to Brahmagupta's rule Jupiter should rise heliacally 15·5 days later, *i.e.* 158 days before October 29, 518 A.D., *i.e.* on May 24, 518 A.D., when the mean sun had at G.M.N. the longitude of 63° 23′ 54″ and the mean moon, at the same hour, the longitude of 50° 40′ 6″. Thus the new-moon came on the day following, the sun having a small positive equation. The new-moon-sun was in the *nakṣatra* division *Mṛgaśiras* (53° 20′ to 66° 40′ of longitude) and the Jovial year begun was *Mārga* or the *Mahā-Mārga* year as the inscription says.

Thus the Gupta year 199 =518 A.D.
∴ Gupta year Zero= 319 A.D.

Conclusion

We have here proved from 11 concrete statements found in the inscriptions which have used either the Gupta or the Valabhī era that—

(1) The Gupta and Valabhī eras were but one and the same era.

(2) It was most probable that the era in question had been originally started by the Gupta emperors and was given a new name by the Valabhī princes who were vassals of the Gupta emperors.[1]

(3) The date from which the Gupta era was started was from December 20, 318 A.D., when began the zero year of the era from the day of the winter solstice.

(4) That the Gupta era agrees with the Christian era from 319 A.D. till about 499 A.D., the date of Āryabhaṭa I, up to which the year reckoning began from the light half of *Pauṣa*.

(5) From some year which was different for different localities, after 499 A.D., the beginning of the year was shifted forward from the light half of *Pauṣa* to the light half of *Caitra*, conformably with Āryabhaṭa I's *dictum* of beginning the year from the vernal equinox day, so that the 'year of confusion' was of 15 or 16 lunations. This is evident from the inscriptions dealt with as Nos. v, viii, x and xi. This change has been noticed in the inscriptions of those localities where Āryabhaṭa I's reputation as the foremost Indian astronomer had been unquestionably accepted. In such cases the Gupta years correspond more conformably to the *Caitra-śuklādi* Śaka years and that the zero year of the Gupta emperors is taken as the Śaka year 241 (*Caitra-śuklādi*) which is the same as the Christian year 319-320 A.D.

To sum up: the zero year of the Gupta era was originally the same as the year 319 A.D. and in times later than 499 A.D.,

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[1] Fleet's Gupta Inscriptions, Plate No. 18, the Mandasor stone inscription of Kumar Gupta and Bandhu Varman will be discussed in a separate paper on the Saṁvat era.

this zero year was in some cases taken equivalent to 319-320 A.D. Further the Gupta and Valabhi eras were the same era. It is hoped that further speculations as to this era would be considered inadmissible.

One point more that we want to lay stress on, is that in verifying the Jovial years as stated in the Gupta Inscriptions, we have followed the *Sūryasiddhānta* rules given in Chapter XIV, 16-17. Dīkṣita, however, appears to have followed the *Bṛhatsaṁhitā* rules and was led to conflicting results as to the zero year of the Gupta-Valabhi era as varying from 240–242 of the Śaka years of *Caitra-śuklādi* reckoning. We have shown in this paper that the Gupta Inscriptions using the Jovial years have consistently followed the *Sūryasiddhānta* rules. This work even in its present form has preserved some of the rules which were followed before the time of Āryabhaṭa I.