# Our Universe

SUBMITTED BY

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Department of Mathematics

Sri Avinashilingam Home Science College For Women

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# C O N T E N T S

# A C K N O W L E D G E M E N T

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# I N T R O D U C T I O N

Astronomy, the "Science of the Stars", is concerned with the physical universe. This science deals with planets and their satellites including the earth and moon, with comets and meteors, with the sun, the stars are clusters of stars, with the interstellar gas and dust, with the system of the Milky Way and the other galaxies that lie beyond the Milky Way.

The splendour of the starlit sky has always fascinated man and will continue to do so. But his joy will increase immensely if he acquires some scientific knowledge about the heavenly bodies?

Space researeh has progressed at an astounding pace during the last two deeades and the new knowledge gained about the cosmos has helped mankind to see its problem in a new light.

Today, space technology is effectively employed in communication, meteorology, resources survey and many other areas. In fact, the scope of space applications has become so wide that laymen often find it difficult to comprehend.

Cosmology has at last reached the position foreshadowed many years ago by William Blake:

To see a world in a grain of sand,
And a heaven in a wild flower,
Hold infinity in the palm of your hand,
And eternity in an hour.

Recently, astronomy has acquired a new scientific interest through establishing its position as an integral part of the general body of science. The various sciences can no longer be treated as distinct; scientific discovery advances along a continuous front which extends un broken from Comets, meteors, with photograph electrons of fraction of a millionth of a millionth of an inch in diameter to nebulae whose diameters are measured in hundreds of thousands of millions of millions of miles. A gain of astronomical knowledge may add to our knowledge of physics and chemistry.

In this dissertation an attempt has been made to present some elementary information about the structure of the universe and its inhabitans, the galaxies, the nebulae, the stars and the planets, comets, meteors with photographs.

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## SECTION - I

### ANCIENT ASTRONOMY

Astronomy, rightly called the "Queen of all Sciences" has been a subject that has attracted the attention of mankind from prehistoric times and it is not easy to fix the date when the solar and lunar motions among the stars and the motions of the planets first attracted the attention of the inhabitants of the Earth.

According to Sir William Jones, the Hindus, the Romans, the Greeks, the Egyptains and Chinese all had a common home in Central Asia and spoke the same language. The had common ideas of cosmos even before settling in different parts of the world.

The cycle of 60 years is another important point in which the eastern countries arerelated. This combination of a period of 5 years from the the vedas and the period of 12 years, of the biggest planet Jupiter. This Jupiter's cycle is followed in South India.

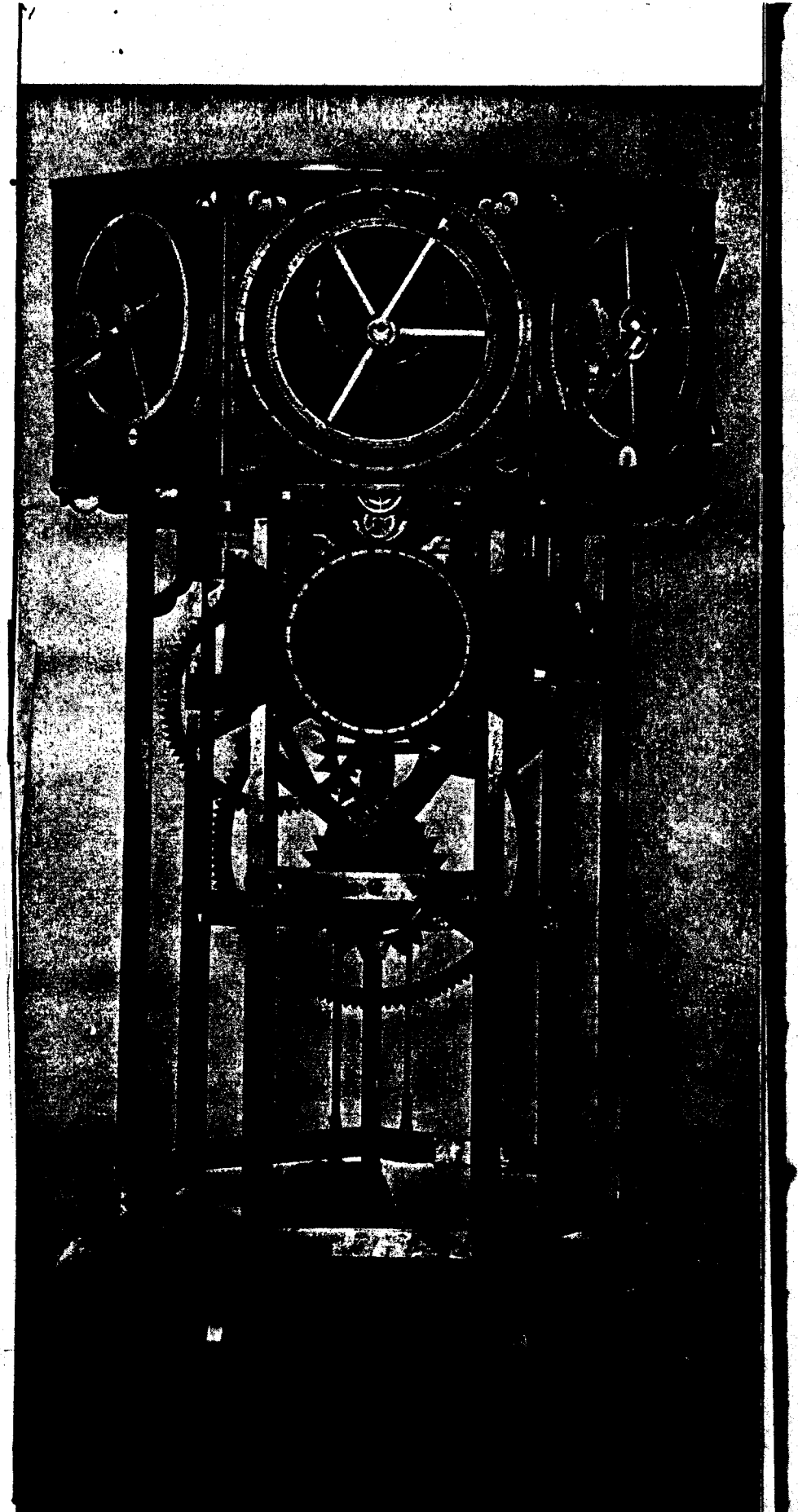
Just as the Hindus of the ancient time the Greek also were of the opinion that the earth was flat and it was centre at the Universe. The ancient Greek astronomy founded on these basis. Pythagoras (570 - 504 BC) regarded the universe as a sphere rotating about an axis passing through the centre of earth which remained at rest.

## THE INDIAN SATELLITES

MODERN ASTRONOMY:

Dr.Vikram Sara Bai of the Indian Space Research Organisation (ISRO) did the pioneer work in the field of space Exploration in India. The Indian satellite Aryabhata was launched on April 19, 1975 at 13.00 hours I.S.T. by a Soviet Intercosmos rocket from a cosmodrome is U.S.S.R. some where near the Baikanur area in Central Asia.

The main data collecting earth stations are at Sriharikota, an island off coastal Andhra at a distance of 100 K.M. north of Madras, at Bears Lake near Masoow and the French tracking station in Kourou in French Guiana.



DE DONDI'S CLOCK

The satellite is tracked at Sriharikota with an Australian and built Yagi Antenna. The satallite is fitted with very sophisticated instruments. There are about 1800 solar cells. They supply 60 to 65 watts of powers. The satellite consumes about 45 watts power.

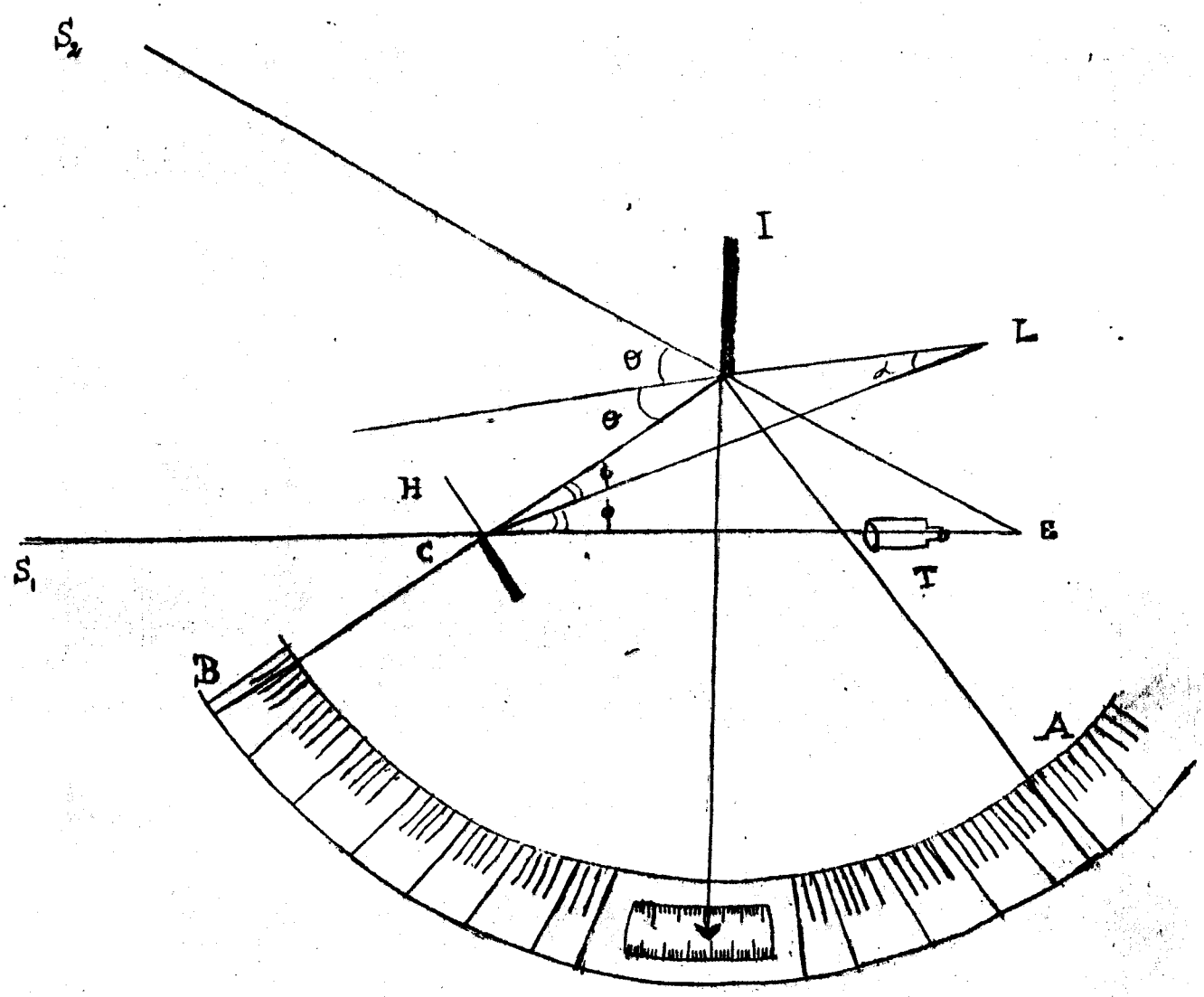
Though Aryabhatta and Bhaskara were fabricated in India, the rockets that flung them into space were Soviet and the launching operations took place from Soviet launching pads.

An Indian satellite called Rohini Satellite 1 (RS-1) was launched by an indigenous four stage rocket SLV-3 at $8^h\ 3^m\ 4^s$ Ist on 18th July 1980 from the launching pad at Sriharikota.

## ASTRONOMICAL INSTRUMENTS

DE DONDI'S CLOCK: 50 inches high, is seen here in a replica made for the Smithsonian Institution in Washington. The upper dials trace, from the left, movements of Mars, the sun and Venus; the lower dial is a 24 - hour clock. De Dondi spent 16 years on the original.

# THE SEXTANT



Sidereal Clock: The sidereal clock or the astronomical clock is a high precision clock indicating the sidereal time at a given station at any instant.

Sun dial: The sun dial is a simple instrument used by ancient Hindus and Greeks to reckon the apparent solar time.

The Zenith Sector: This is a simple instrument used to measure the meridian Zenith distance of a body.

The Heliometer: Dolland's heliometer is used to measure the angular distance between two bodies and the angular diameters of the sun and moon.

The Sextant: Hadley's Sextant is a small instrument used to measure the angular distance between two objects, the altitude of a star or the angular diameter of the sun and moon.

Principle: The ray of light from the star $S_2$ falls on the index mirror I and gets reflected in the direction OB and is incident on the silvered portion of the horizon glass. If then gets reflected in the direction CT so that the image of $S_2$ is been with $S_1$ in the direction TC produced.

## SECTION - II

John Kepler: (1571 - 1630) was perhaps the greatest of all German Astronomers. He joined Tycho Brahe in 1600 and succeeded him as the Imperial Mathematician. He studied for himself all the careful observations of Tycho for nearly two decades before he formulated his famous three laws of planetary motion.

i) Every planet describes an elliptic orbit around the sun, the sun being situated at a focus.

ii) The motion every where in the orbit of a planet is such that the radius vector joining the sun and the planet describes equal areas in equal intervales of time.

iii) The squares of periodic times of planets are proportional to the cubes of their mean distances from the sun.

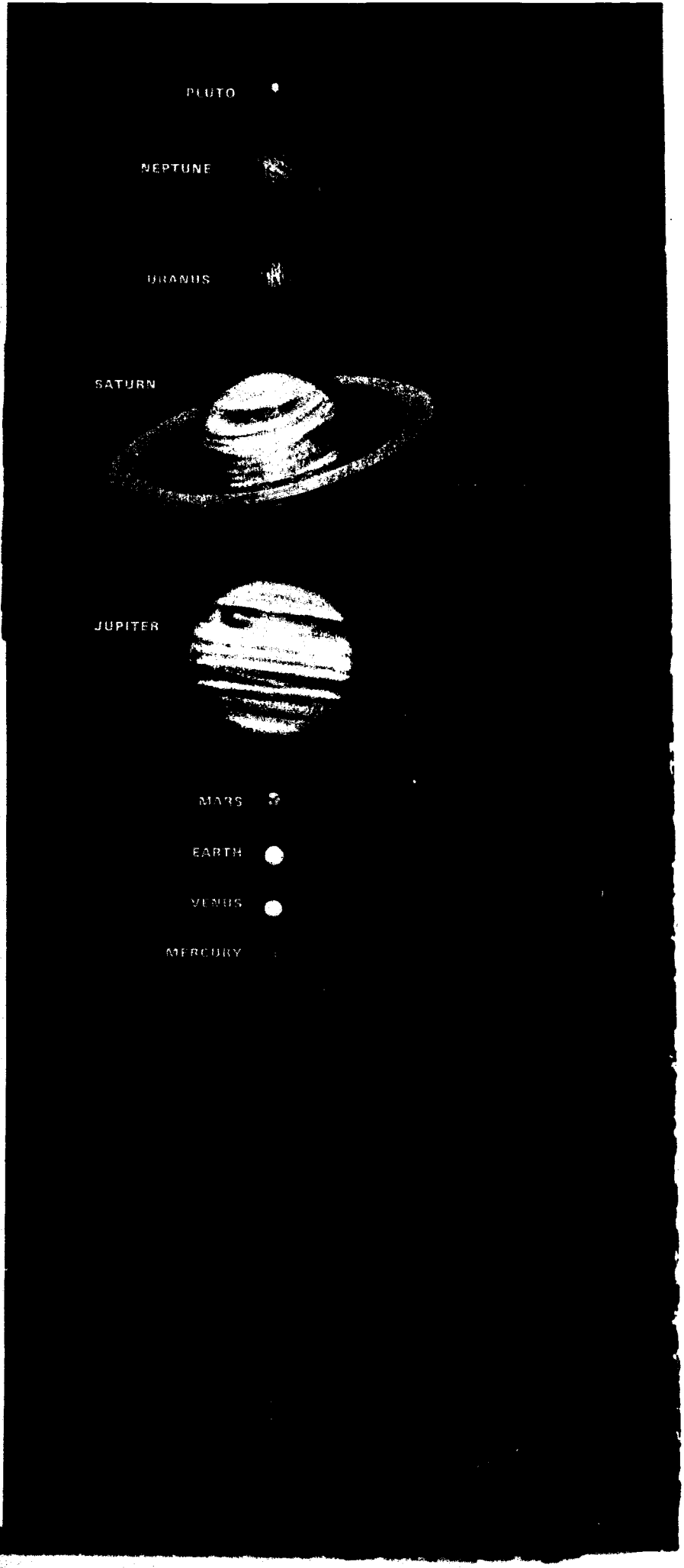
Galileo: (1564 - 1642) The great Italian Astronomer was a contemporary of kepler. He verified and proved by dropping two bodies of much different weight from the learning tower of Pisa, that all bodies fall through the same distance in the same time.

Sir Isaac Newton: (1642 - 1727 AD) was the Chief architect of Modern Astronomy and the Pioneer of Dynamics and Calculus.

Newton's theory of universal gravitational is "every particle of matter in the universe attracts every other particle with the force that varies directly as the product of their masses and inversely as the square of the distance between them"

Halley: (1656 - 1742 A.D.) was the first to discover a periodic comet. He proved that comets also move in elliptic orbits round the sun.

# PLANETS


PLUTO
NEPTUNE
URANUS
SATURN
JUPITER
MARS
EARTH
VENUS
MERCURY

## SECTION - XXX

## SOLAR SYSTEM

"All five planets came into being " - Manu Smiriti

### THE SUN:

"The Sun divides the day and night on the Earth" - Manu Smiriti

The Sun, the central figure of the solar system is an enormous ball of hot glowing gas and it shines by its own light. It is white in colour with intensity of about 50,000 candle power per square centimetre of sun's surface. Its diameter is about 865,000 miles. The sun is about one lakh times as large as the earth and its mass is about 330,000 times the mass of the earth. The mean distance of the sun from the earth is about 93 million miles.

Scientists have divided the atmosphere of the sun into 3 layers. Inner most of all is the photosphere. Outside of this, again, is the chromosphere. Then, out side of all, that extends many millions of miles into space, is the corona.

### MERCURY:

Nearest of all to the sun and smallest of the nine planets is Mercury. Its diameter is 3,100 miles. The mass of Mercury is only 1/20 part of the Earth's mass. Mercury is only 36 million miles from the sun, compared with 93 million from the Earth. It is closed, planet to the sun. It moves faster in its orbit, too,

and takes only 88 days to make a revolution around the sun. Its orbit is less circular than the orbit of any other planet except pluto and is more inclined.

Mercury is might but hard to see. We glimpse it only in the west after sunset or in the east before dawn. Mercury would probably look very much like the Moon.

VENUS:

Venus can very easily he seen as extremely brilliant object, also just after sun set or just before dawn. The diameter of venus is only 300 miles, less than is that of the Earth. Its mass are only about 80 percent of Earth's. Venus's year is 225 of our days. Venus is 67,200,000 miles from the sun. It is never seen for longer than four hours after sunset nor the same length of time before sunrise.

EARTH:

We live on the Earth, one of the nine planets that go around the sun. The Earth is third in distance from the sun and fifth in size. It has a moderately dense atmosphere, and usually about half its surface is covered with clouds. About 3 quaters of the Earth's surface is covered by oceans. This is unique for no other planet with a large amount of

oxygen in its atmosphere. Both features make the Earth the only planet on which we could live without special breathing apparatus and water supply. The Earth's diameter at the poles is 7,900 miles, while at the equator it is 7,926 miles. The Earth's mass is about 6,000 million, million, million tons. The force of gravity gives objects weight and pulls them towards the centre of the Earth. Become of the flattering at the poles than at the equator. The Earth turn on its own axis from west to east. This the Sun, Moon Planets, and stars seem to rise in the east and set in the west. The most prominent heavenly body is the Sun. When the sun is above the horizon, we call the time day, the time when the sun is below the horizon is what we call night.

The Earth's revolution around the sun seems slower, since it takes a whole year. The path that the Earth follows around the Sun is called its orbit.

MARS:

The fourth planet away from the Sun is Mars. The average distance of Mars from the Sun is about one and a half times that of the Earth 141,500,000 miles. Mar's year, however, is nearly twice as long as ours although its day is only a little more than half that of the Earth. Mars has two moons. The names of the moons are Deimos and Phobous. Mars is fairly 100| planet.

ASTEROIDS:

The planets are not only cold, solid bodies that travel in orbits around the Sun. There are also many smaller bodies called astereids. The orbits of astereids are not around as those planets, and not as close to the same plane. Most of them completely between the orbits of Mars and Jupiter, where there would otherwise be a gap in the solar system.

Astereids are much smaller than planets. The largest of them, ceras, pallas, Vesta and Juno, are from 100 to 440 miles in diameter, but the fainter astroids are much smaller. All are bare rock, with no atmospheres. The large astreids are round, but many of the smaller oves are irregular in shape and sail through space, turning end over end.

JUPITER:

The fifth planet away from the Sun is the first of the giant planets. Jupiter is larger than all of the other planets put together and its mass is more than twice the combined mass of all the rest. Jupiter gets around the Sun in 11-86 of our years, travelling at the rate of about 8 miles a second to make the trip schedule. Jupiter's orbit is sufficiently elliptical so that there is a difference

of nearly 40 million miles between its maximum and minimum distance from the Sun. Jupiter has twelve moons, but only four of there are large enough to be seen by any means except the great telescopes. The two largest are each very nearly the size of Mercury and third is about as large as our own Moon. They were discovered by Galileo in 1610 and are called the Galilean satellites.

SATURN:

Beyond Jupiter lies the next giant planet and the sixth out from the Sun. That is, saturn, second only in size to Jupiter. It is 72,000 miles in diameter, but, for all its size, it is only ninety five times as heavy as the Earth. Saturn moves at the fairly leisurely pace of 6 miles per second to complete its journey around the Sun in about 29½ years. Saturn generates plenty of centrifugal force by rotating at the rate of one complete turn 10¼ hours. Saturn has nine other moons apart from the ring system and all these extra moons are outside the rings.

Saturn is enclosed by a system of three concentric circular rings lying roughly in the place of its equator. These rings which are less than 75 miles thick look solid but when examined with a spectroscope this was found to be illusion. They are

composed of thousands of meteorites, moons, of iron and stone of all size moving in circular formation round the planets.

The sun shines on the swarm of these little balls and make them bright. During half the period of its revolution one side of the ring is visible to us and during the other half the other side is visible.

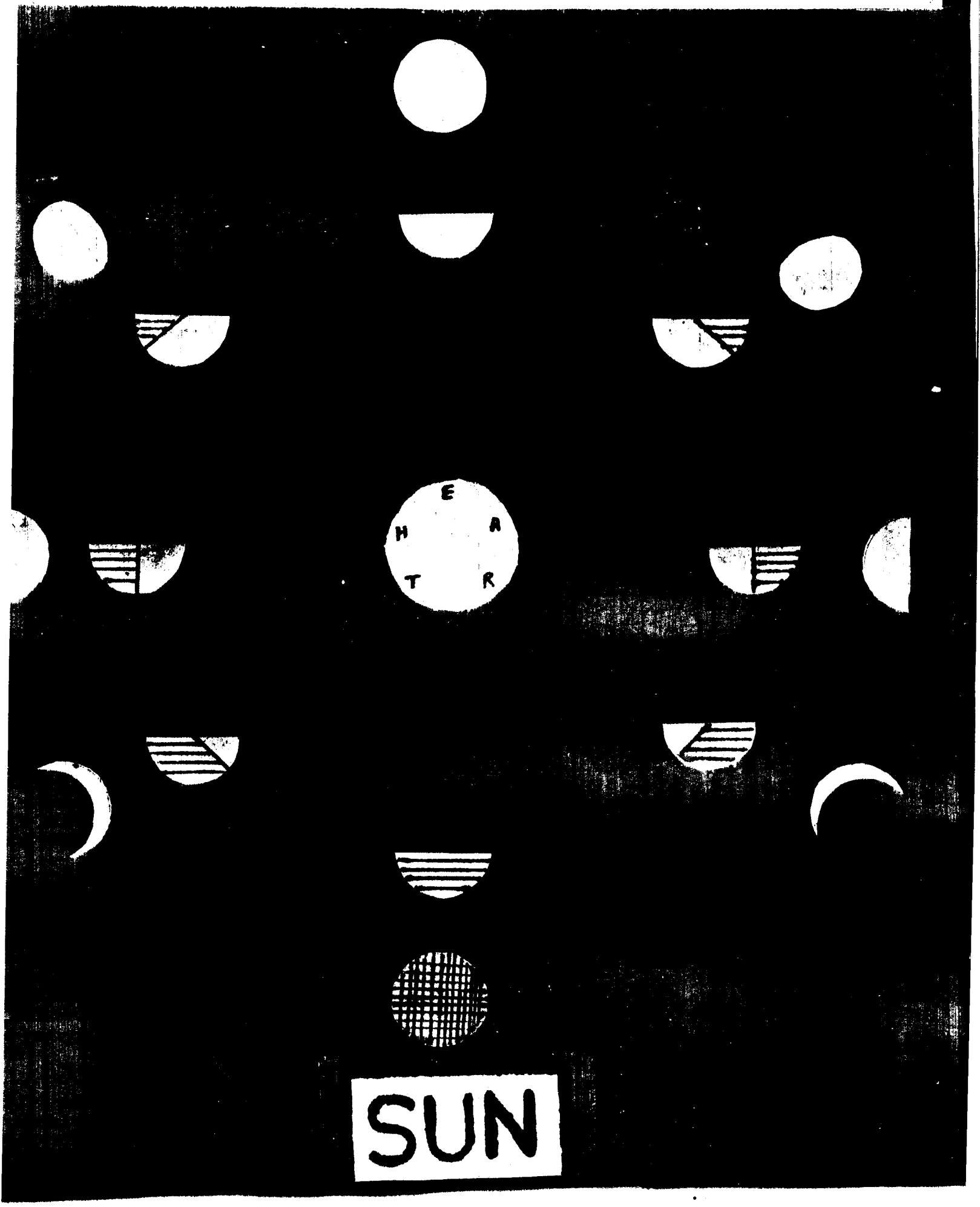
URANUS:

The seventh planet away from the Sun is Uranus. Uranus is a pale green object. Its diameter is 30,900 miles, and although its size is forty-seven times that of the Earth. The mars is only about fifteen times that of the Earth. Uranus has a short period rotation on its own axis, too in which it also resembles the other giant planets. Its day is just under 11 hours. It has five moons whose diameters range from about 400 miles to 1,000 miles.

NEPTUNE:

Neptune is the eighth planet in distance from the Sun. Its averge miles is or 30 times the Earth's distance. The planet takes 165 years to circle this large orbit. Neptune is the third largest

# PHASES OF THE MOON



planet, although it is only slightly more massive, than Uranus, which it resembles in many ways. Neptune's diameter is 28,000 miles, or nearly four times the diameter of the Earth. Being so far from the Sun, Neptune is very cold. Neptune has two satellites.

PLUTO:

Pluto is probably about the size of the Earth and about 0.8 density. It has no moons. No gases or water vapor has yet been discovered upon it, and since it is more than 3½ billion miles from the sun its temprature there in the awful depths of space must be close to absolute zero. It makes its way around the Sun in nearly 248 of our years.

MOON PHASES:

Every month the Moon goes through all its phases as it moves around the earth. At new moon it is invisible, then it is successively cresent, half-moon, gibbous, and full; then it is gibbous, half-moon, cresent, and new again.

As the phases change, the moon rises and sets nearly an hour later each day. A few days after new moon, we first glimpse the cresent moon in the west just after sunset, and it sets very quicklyl

# TOTAL ECLIPSE

By the time it reaches first quarter, the Moon sets at mid night. At full moon it rises and is in the sky all night, setting at dawn. The last quarter Moon rises at mid night, while the cresent of the old Moon can be seen in the east for only, a little while before dawn.

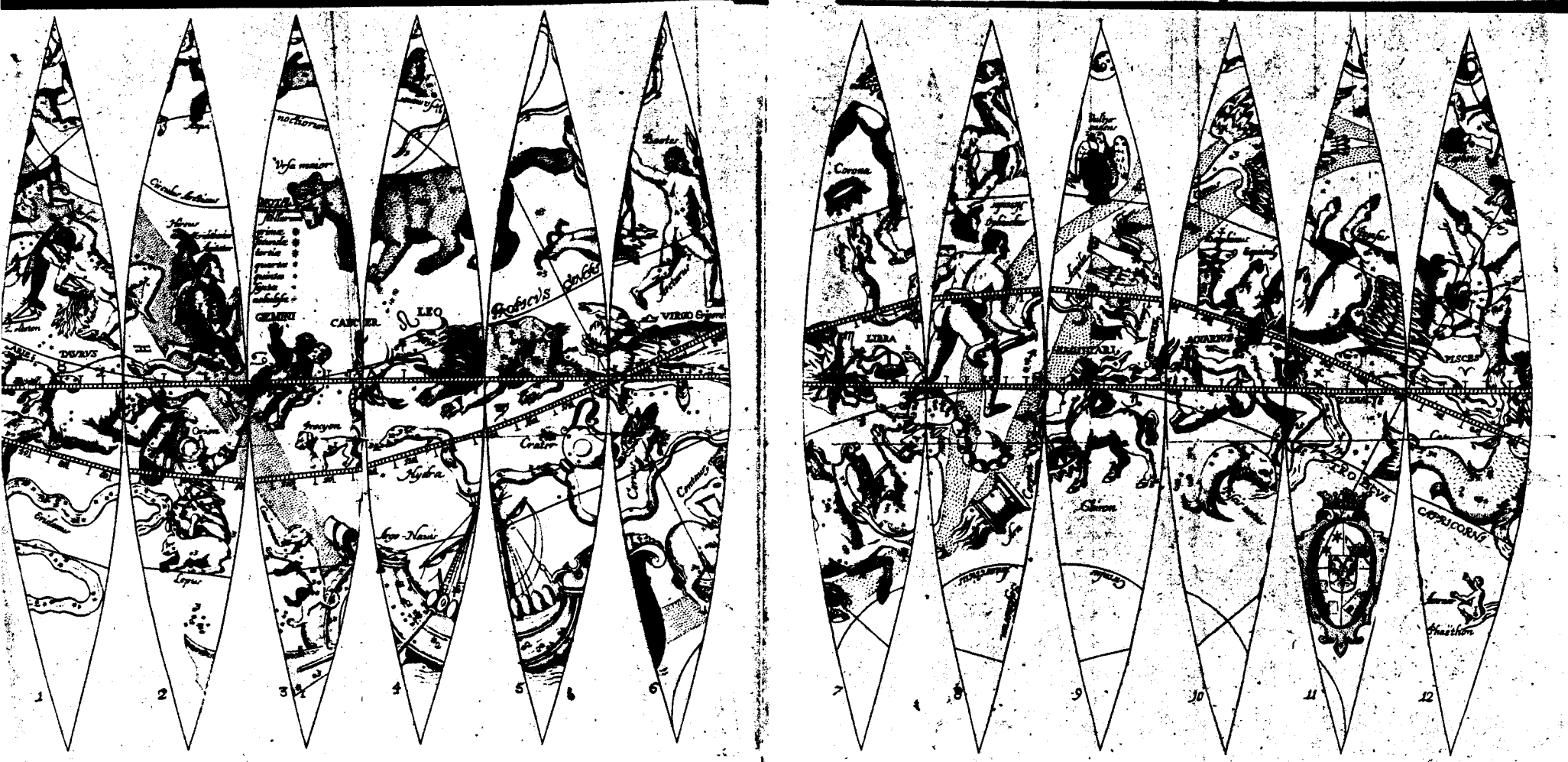
ECLIPSES:

Eclipses are two kinds, lunar and solar.

A lunar eclipse is caused by the moon's entering into the shawdow cone cast by the earth and thereby getting its disc either partially or totally obscured. Lunar eclipses occur only on full moon days that is when the moon is in oppesition with the sun.

A solar eclipse is caused by the moon's inter position between the sun and the earth, the moon hiding either a portion or the whole of the sun's disc as seen from the earth. Solar eclipses occur only on new moon days, ie when moon is in conjunction with the sun.

All the places in the hemisphere of the earth turned towards the sun experience the lunar eclipse when it occurs. But for a solar eclipse to be visible at a place it must within the spherical cap where the direct common tangents to the sun and moon meet




# ZODIACAL CONSTELLIONS

the earth. Therefore at a place the occurence of a lunar eclipse is more frequent than the occurence of a solar eclipse.

As the lunar orbit is at an angle 5° 8' to the ecliptic plane, on certain full moon and new moon days the moon may pass on without even touching the cone formed by the direct common targents of the sun and earth. Therefore all full moons and new moons do not give eclipse.

The linear diameter of the moon is 2160 miles and that of the section of the shadow is 5866 miles. That is the diameter of the section of the shadow where the moon enters is about three times the diameter of the moon. Therefore an annular eclipse of the moon is impossible.

ZODIACAL CONSTELLATIONS:

The zone of the celestial sphere extending to a width of about 8° on either side of the ecliptic is called the Zodiac. This is divided into 12 equal parts each of length 30°, called the signs of the zodiac. Each sign contains a constellation and it is named after the imaginary figure it resembles.

# HALLEY'S COMET

## SECTION - IV

HALLEY'S COMET:

This famous comet, the first known periodic comet, is named in honour of Edmund Halley, who predicted its return. Halley calculated as a parabola, the orbit of the bright comet of 1682 and noted its close resemblance to the orbits that he had similarly calculated for earlier comets of 1531 and 1607 from records of their places in the sky. Concluding that they were appearences of the same comet, which must therefore be moving in an ellipse, Halley predicted that it would return again in 1758. The comet was sighted that year according to prediction, it returned again in 1835 and 1910. Halley's comet is the only conspicuous comet having a period less than 100 years. The revolution is retrograde.

Twenty-eight observed returns of this comet have been recorded, as far back as 240 B.C. It was Halley's comet that appeared in 1066, at the time of the Norman conquest of England. The period has varied nearly 5 years meanwhile, because of disturbing effects of planets; the average interval between perihelion passages is 77 years. The comet has now passed its aphelion beyond the orbit of Neptune. It returned to perihelion in 1986. We had the fortune to see the comet recently with our naked eyes on April 16th

# METEOR

*The infall of a meteorite created this great crater in the desert of Arizona, USA. It is about 4200 feet wide and 600 feet deep. Whether a large mass of the original material remains intact is controversial.*

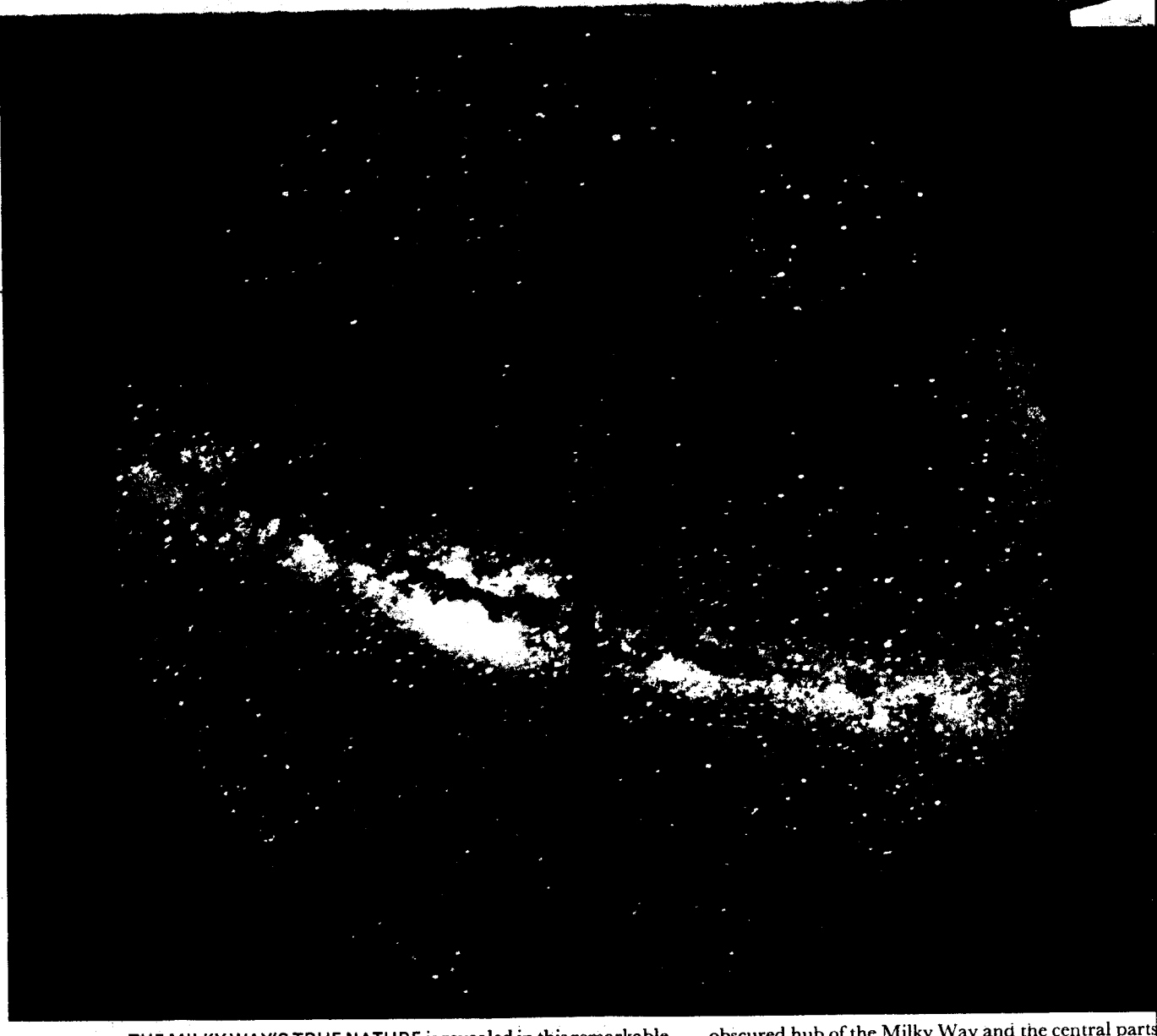
Every man gets an opportunity to see once in his life's span.

METEORS:

If you watch on a clear, dark night, we will some times see a point of light shoot across the sky, as if a star had left its place. Such a body is often called a shooting star or a falling star, but it is not a star at all. Astronomers call there bodies meterors. The stars are far away, but meteors are often very close to us.

Some meteors come at random, and we can generally see one of these every 5 or 10 minutes. Others travel in groups and occur in greater nos called showers. Meteors of a showers occur at a particular time of a year. Ordinary meteors burn up completely in their first flash. Occasionally a larger body enters the Earth's atmosphere, shining brightly and lighting up the whole country side for a few moments. Such an unusually bright meteor is called a fire ball. The very largest meteoric bodies manage to reach the Earth's surface without burning up completely, and they are then called meteorities.

A meteorite strikes the Earth with great force, and the large ones make big craters. Many larger craters identified in various parts of the world measure many miles across.



**THE MILKY WAY'S TRUE NATURE** is revealed in this remarkable photograph taken in the Southern Hemisphere with red-sensitive emulsion. Since red light penetrates gas, the normally obscured hub of the Milky Way and the central parts of the disc around it show up as those of a typical galaxy in c The three dark bars are braces supporting the fi

MILKY WAY:

The sun and other stars around us from only a tiny part of the large star system called the Milky way. This band of stars around the sky is actually an edge view of the galaxy in which we live. Most stars of the Milky way, including the sun, are scattered through a large flat disc which is composed of gas, dust and stars. Not all the stars of the Milky way belong to the disc or the spiral arms; some are thinly spread through a large region called the halo.

The different parts of the Milky way are inhabited by stars of different types. The youngers stars live in the spiral arms, for gas and dust. As these stars become older they diffuse out of the spiral arms and spread through the whole disc, which consists of middle aged and old stars. In the halo are old stars only, for there are no dust clouds.

GALAXY:

The stars are all around us. The/ system of stars that we live in does have a limited size, even though it is very large. Such a system is called a galaxy, and our own galaxy is called the Milky way. The Milky way is a type of galaxy called a spiral.

IN THE WHIRLPOOL GALAXY, AS DRAWN IN 1850 BY LORD ROSSE THROUGH HIS 72-INCH TELESCOPE, SPIRAL SHAPE WAS FIRST DETECTED

HORSEHEAD NEBULA, A CLOUD OF COOL DUST, REARS ITSELF AGAINST A BACKDROP OF HOT GAS GLOWING WITH ENERGY FROM NEARBY STARS

Another type of galaxy is called eelliptical. Elliptical galaxies have very little interstellar material and contain only old stars. All galaxies are in motion. Many rotate about their own axis, and the stars move back and forth. But each galaxy is also moving along as the whole usually at a speed of 50 to 100 miles a second.

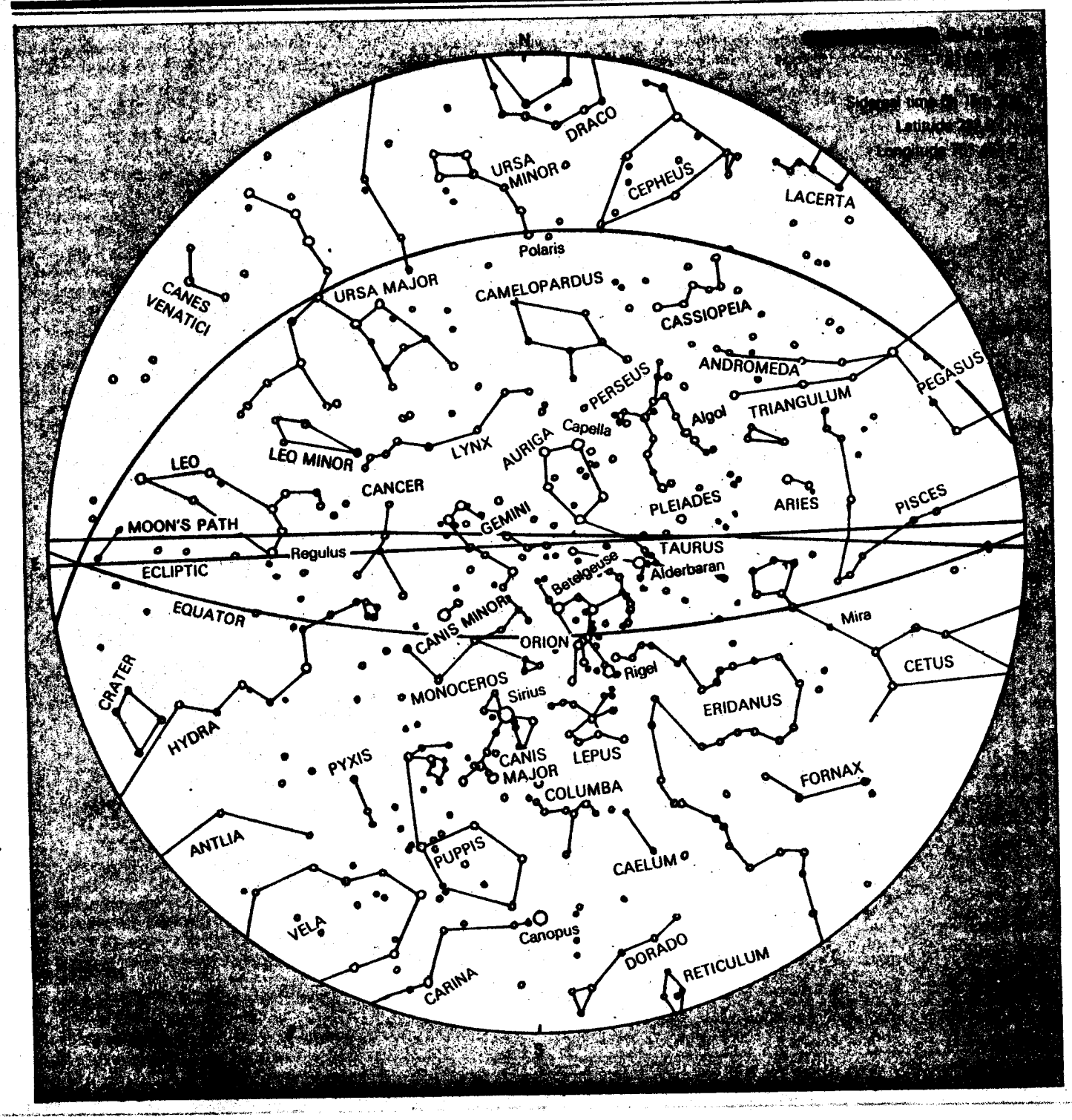
NEBULAE:

Even in the most powerful telescope, a star looks no bigger than sharp point of light. But here are there among the stars we find hazy bright patches. The astronomers who first observed these called the nebulae. The true nabulae are part of our own Milky way. Some are irregular in shape and are called diffuse nebulae. We sometimes find dark spot in the Milky way, where there are many fewer stars than in surroundings regions called dark nebulae, these are caused by dense clouds of dust hide the light of the stars beyond.

# NIGHT SKY

1985 YEARBOOK

# FEBRUARY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TAURUS
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Betelgeuse
EQUATOR
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ORION
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CRATER
MONOCEROS
Sirius
ERIDANUS
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PYXIS
CANIS MAJOR
LEPUS
FORNAX
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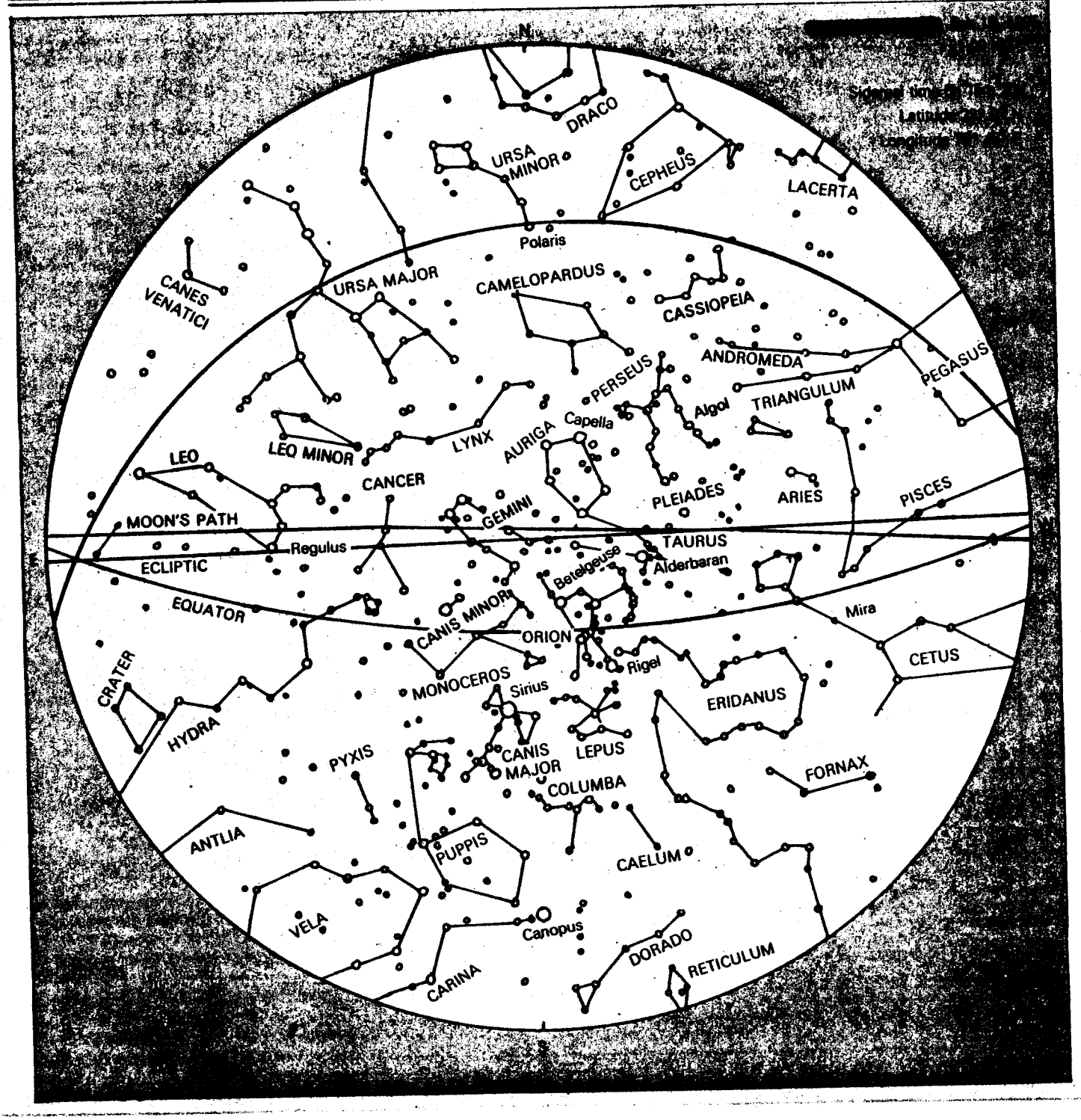
VELA
Canopus
DORADO
RETICULUM
CARINA

# NIGHT SKY

# JANUARY

# FEBRUARY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VELA
Canopus
DORADO
CARINA
RETICULUM

# NIGHT SKY

**STARS:**

"Twinkle Twinkle little star,
How I wonder what you are,
Up above the world so sky,
Like a diamond in the sky."

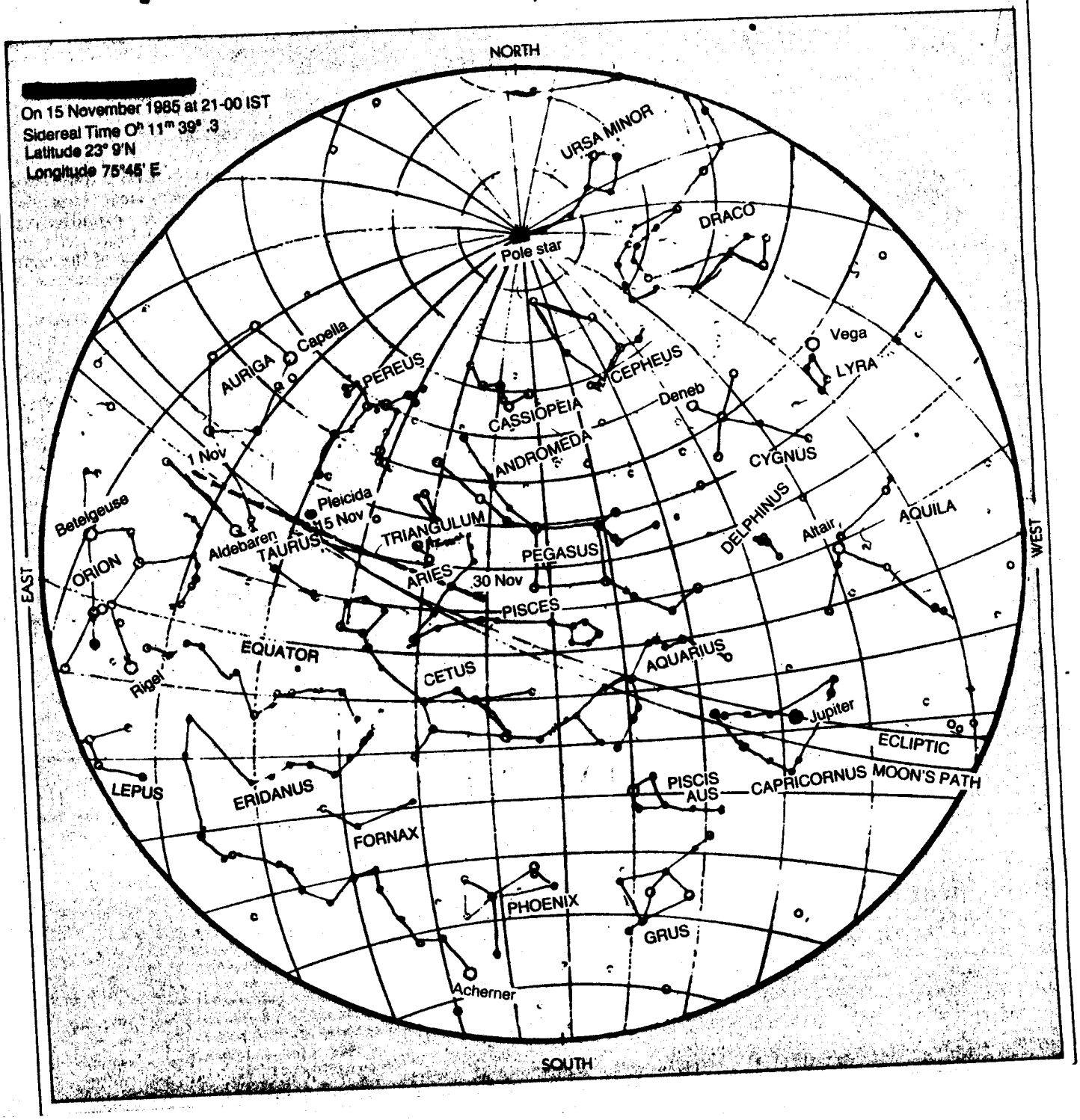
"As spheres of light" - Brahma Sutra

January 1985 - February 1985

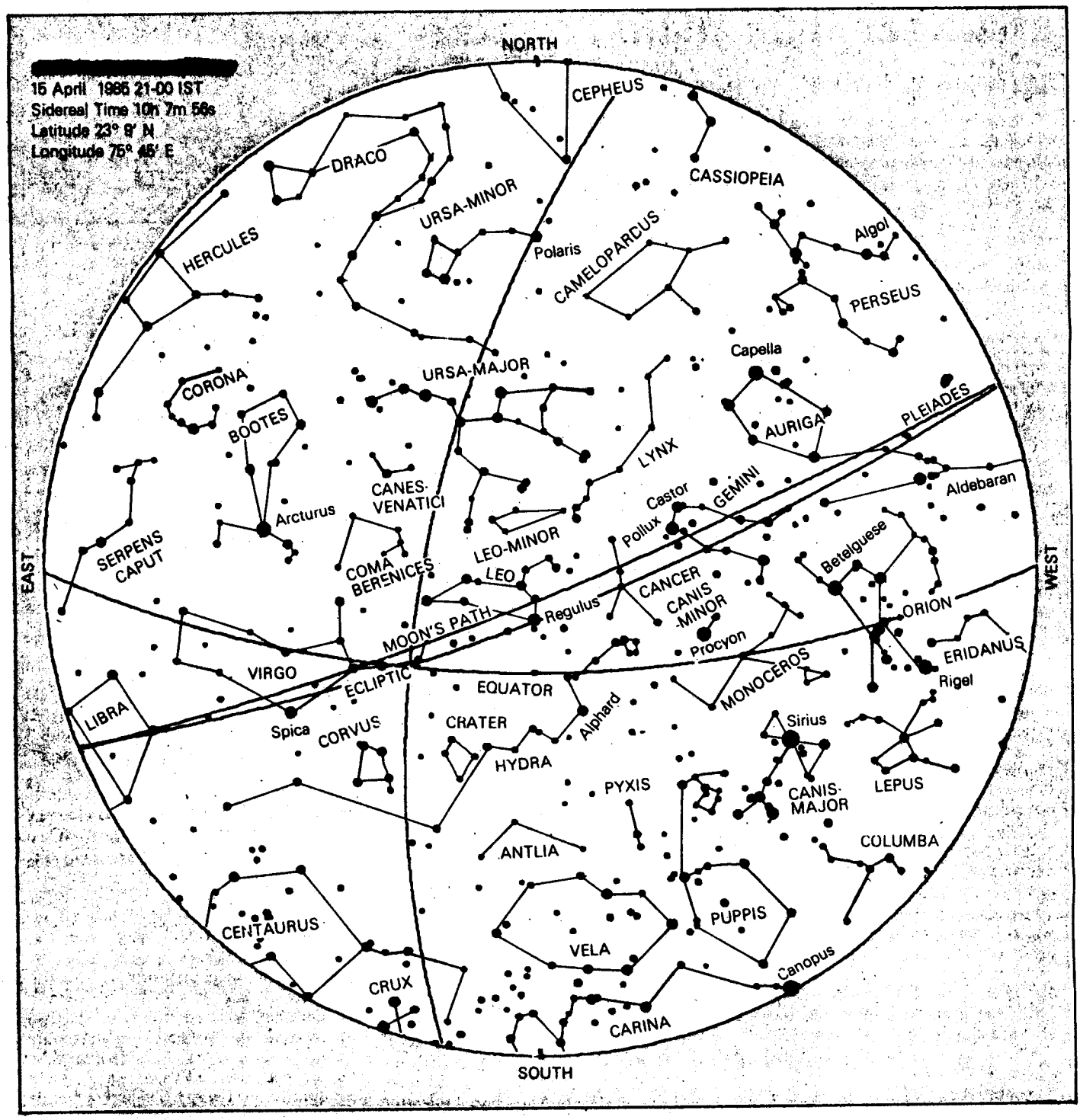
The major constellations Orion, Taurus, Gemini, Auriga, Perseus, Cassiopeia, Andromeda and Canis Major. The names of the prominent stars are shown in small letters, and those of the constellations in block capitals.

Mercury will be seen in the Morning Sky for the first three weeks on January and then it will remain lost in the morning dusk. Venus, on the other hand, will appear as the most brilliant object in the evening sky and should be visible for at least three hours after the sunset. It will become the brightest by the end of February. Mars will also be seen in the evening sky, not very far from Venus. It will gradually approach Venus from the above, stay for a while very close to Venus and finally Venus will take over the lead fly off from the evening sky at a faster pace,

# The sky in November-December 1985



# The sky in March-April 1985

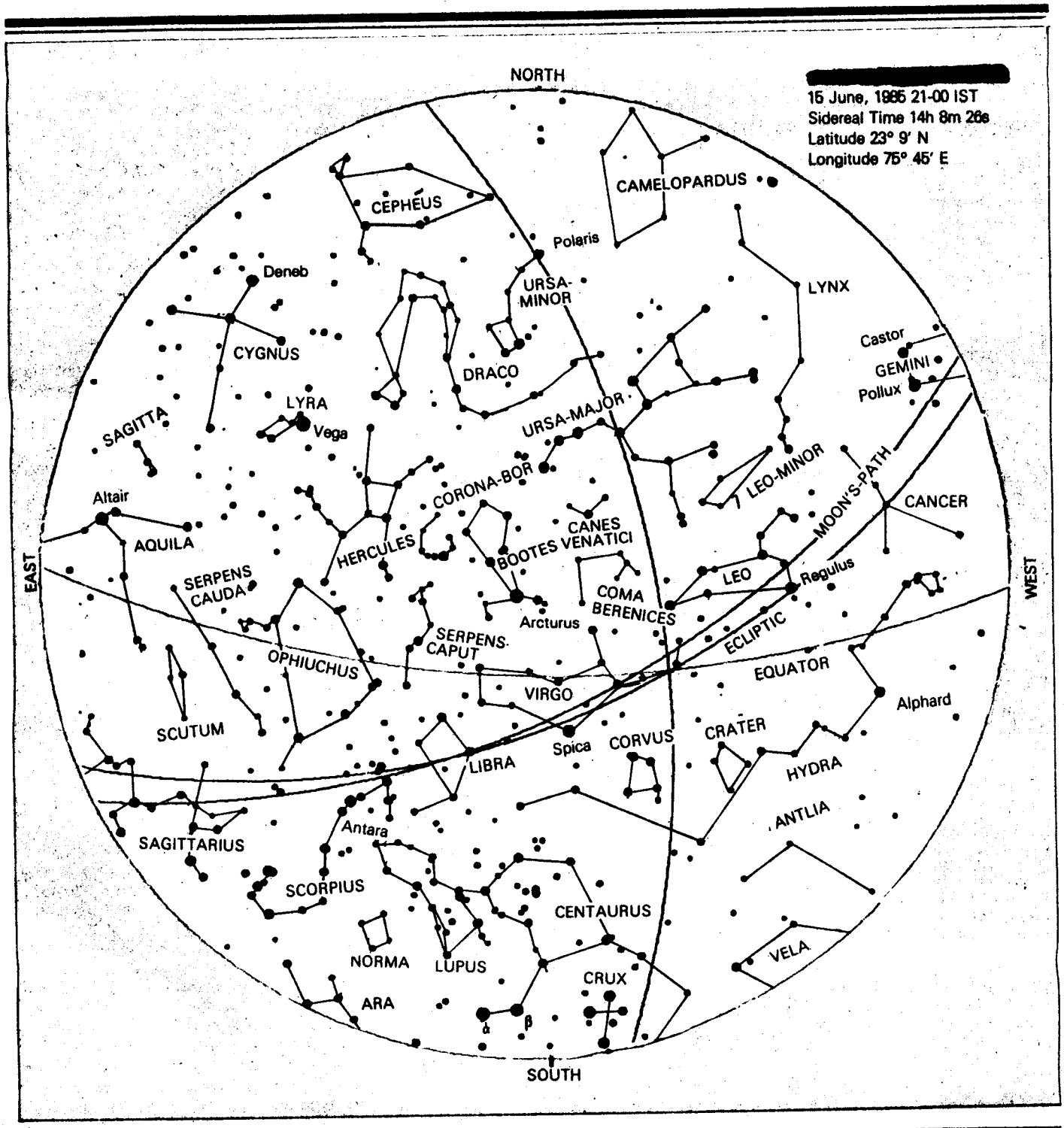


Nevertheless, the venus and Mars pair will be an interesting object to watch with the unaided eye.

Jupiter will not be seen at all during January, as it is going to conjoin the sun on January '14. It will then appear in the morning sky, and rise earlier and earlier every day. Saturn will rise approximately five hours before Jupiter rises in the east. Jupiter will stay in Sagittarius, and Saturn in Libra. The quadrantids meteor shower with about one meteor every minute may be witnessed at about 5 a.m. on 4 January, streaming out from a point about 40 degrees high in the north east.

MARCH - APRIL 1982:

The major constellations of the season are Orion, Canis major, Taurus, Auriga, Gemini, Leo, Ursa major, Puppis, Vela and Carkina. The longest constellation Hydra will rise in the southeast, and a little smaller, Draco, in the northeast, whereas Eridanus will disappear in the south west. Less conspicuous constellations such as camelopardus, lynx, Antlia, Pyxis and Mono ceras could be identified with some effort of course. The Milky Way will be seen to run from the south to the north-west.


NORTH
15 June, 1985 21-00 IST
Sidereal Time 14h 8m 26s
Latitude 23° 9' N
Longitude 75° 45' E
CEPHEUS
CAMELOPARDUS
Polaris
Deneb
URSA-MINOR
LYNX
CYGNUS
DRACO
Castor
GEMINI
Pollux
LYRA
Vega
SAGITTA
URSA-MAJOR
LEO-MINOR
MOON'S-PATH
CANCER
Altair
CORONA-BOR
AQUILA
HERCULES
CANES VENATICI
BOOTES
SERPENS CAUDA
LEO
Regulus
COMA BERENICES
Arcturus
ECLIPTIC
SERPENS CAPUT
OPHIUCHUS
EQUATOR
VIRGO
Alphard
SCUTUM
Spica
CORVUS
CRATER
LIBRA
HYDRA
ANTLIA
Antara
SAGITTARIUS
SCORPIUS
CENTAURUS
VELA
NORMA
LUPUS
CRUX
ARA
SOUTH
EAST
WEST

Mercury and Venus are to be found together in the evening sky during the later weeks of March and in the morning sky after the first week of April. The transition is very quick. In fact, Venus will disappear all of a sudden from the evening sky on or around 2nd April and reappear in the morning twilight on 9th April. Those who have not seen Mercury before many try this time. When both are in the evening sky, Mercury in the beginning will be seen some what below Venus, then Venus will over take Mercury. But in the morning sky venus will be placed well above Mercury. Mars will continue in the evening sky, slowly drifting towards the sun. Saturn will rise well before the mid night, and Jupiter well past. Jupiter will move from Sagittarius to capricornus and the retrograde saturn will continue to stay in Libra.

MAY - JUNE:

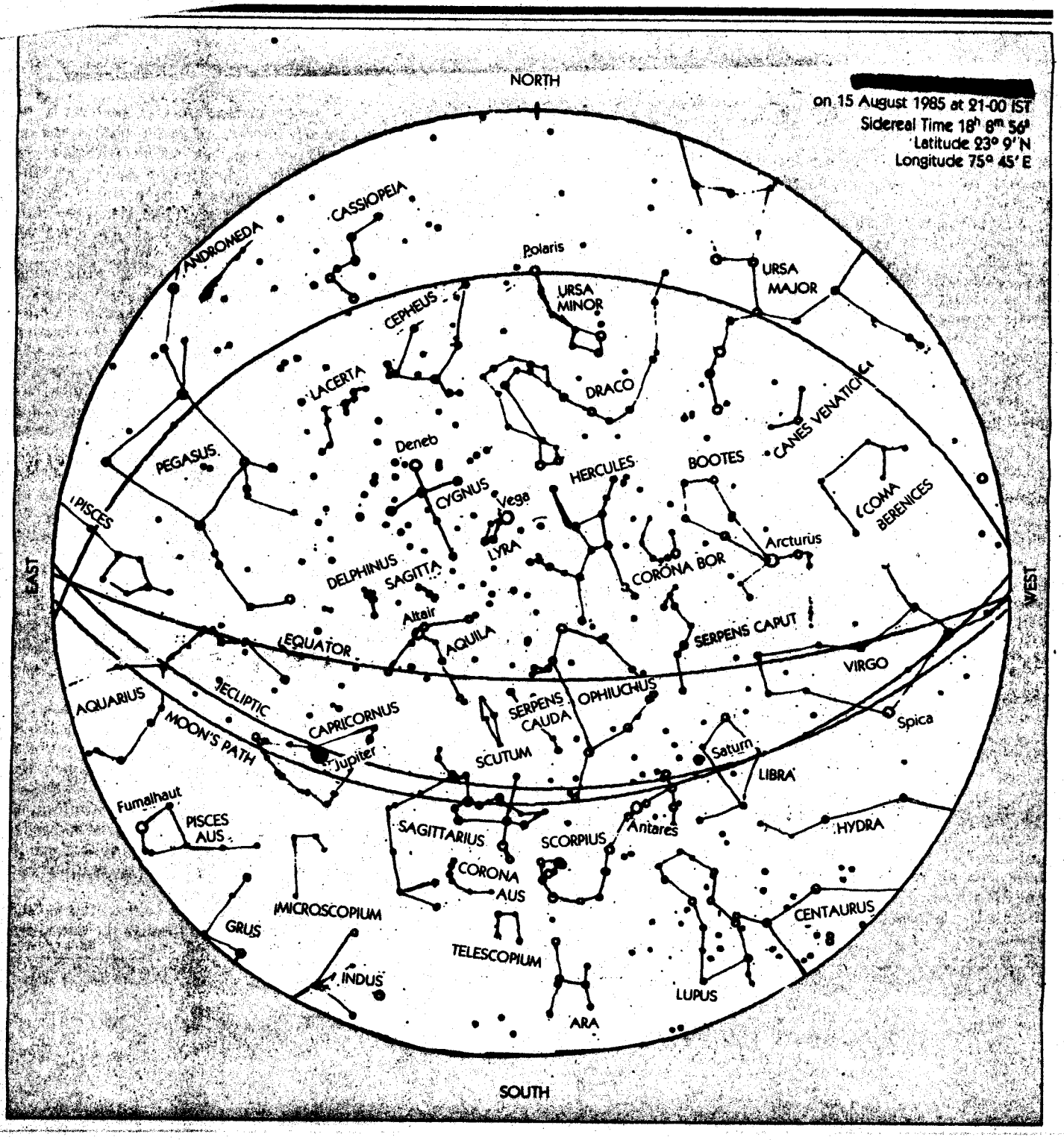
New constellations appear in the east, while the familiar ones set in the west. Among the new ones during this season, Bootes, Coma borealis, Hercules, Lyra, Cygnus, Ophiuchus, Serpens caput, Serpens cauda, Aquila, Virgo, Libra, Scorpinus, Sagittarius, crux, Centaurus and Lupus are quite prominent and easily identifiable. Down in the southern sky do not miss the stars closest to us, the sun apart. The

constellation Crux is popularly known as the Southern cross, and Cygnus the Northern cross. When the star configurations are like the one given in the first chart, the Milky Way disappears from the sky as it then lies on the horizon and the north pole of the Galaxy right near the Zenith. The centre of our Galaxy lies in the direction of the constellation sagittarius.

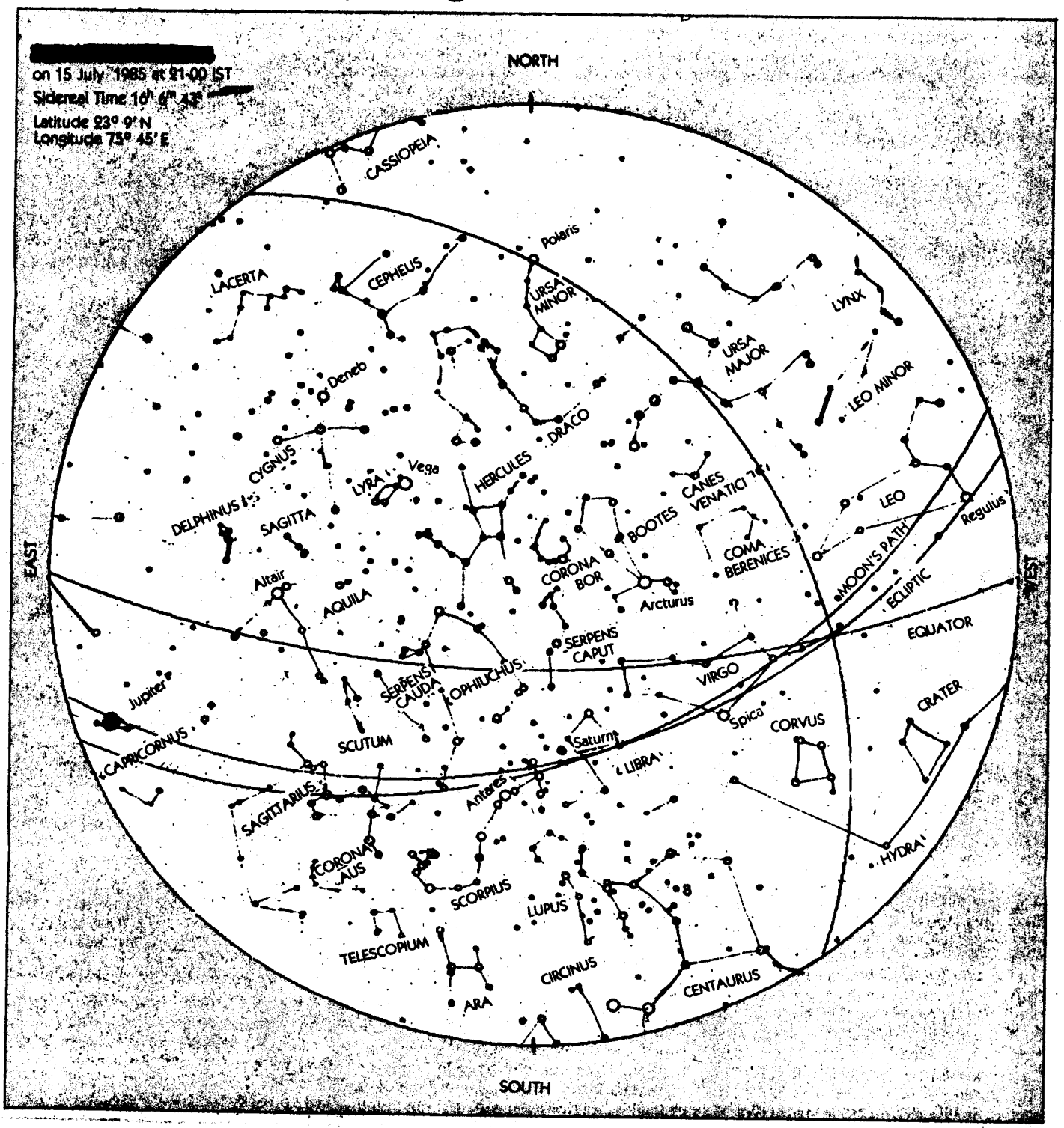
Mercury transits from the morning to the evening sky. Venus becomes exquisitely brilliant in the morning sky. If one wishes to follow venus in board day light with the naked eye, this is the best time to do so. Through a small telescope Venus will now appear as a little cresent Moon growing fatter day by day but shrinking in dia meter. Mars, if it can be traced, will be seen very low in the west. Saturn will easily be found in Libra and Jupiter still in Capricornus, becoming brighter and brighter everyday. Jupiter becomes retrograde in the first week of June.

JULY - AUGUST

It is during the monsoon months that some of the bright constellations, such as centaurus, scorpius, Sagittarius, Aquila, Lyra and Cygnus are visible in the evening sky. The densest part of the Milky Way also runs through them. You could try to identify


NORTH
on 15 August 1985 at 21-00 IST
Sidereal Time 18h 8m 56s
Latitude 23° 9' N
Longitude 75° 45' E
CASSIOPEIA
ANDROMEDA
Polaris
URSA MAJOR
URSA MINOR
CEPHEUS
LACERTA
DRACO
CANES VENATICI
Deneb
PEGASUS
HERCULES
BOOTES
CYGNUS
Vega
COMA BERENICES
PISCES
LYRA
Arcturus
DELPHINUS
SAGITTA
CORONA BOR
Altair
AQUILA
SERPENS CAPUT
EAST
WEST
EQUATOR
VIRGO
ECLIPTIC
AQUARIUS
SERPENS CAUDA
OPHIUCHUS
CAPRICORNUS
MOON'S PATH
Jupiter
SCUTUM
Saturn
Spica
LIBRA
Fumalhaut
PISCES AUS
SAGITTARIUS
SCORPIUS
Antares
HYDRA
CORONA AUS
MICROSCOPIUM
CENTAURUS
GRUS
TELESCOPIUM
INDUS
LUPUS
ARA
SOUTH

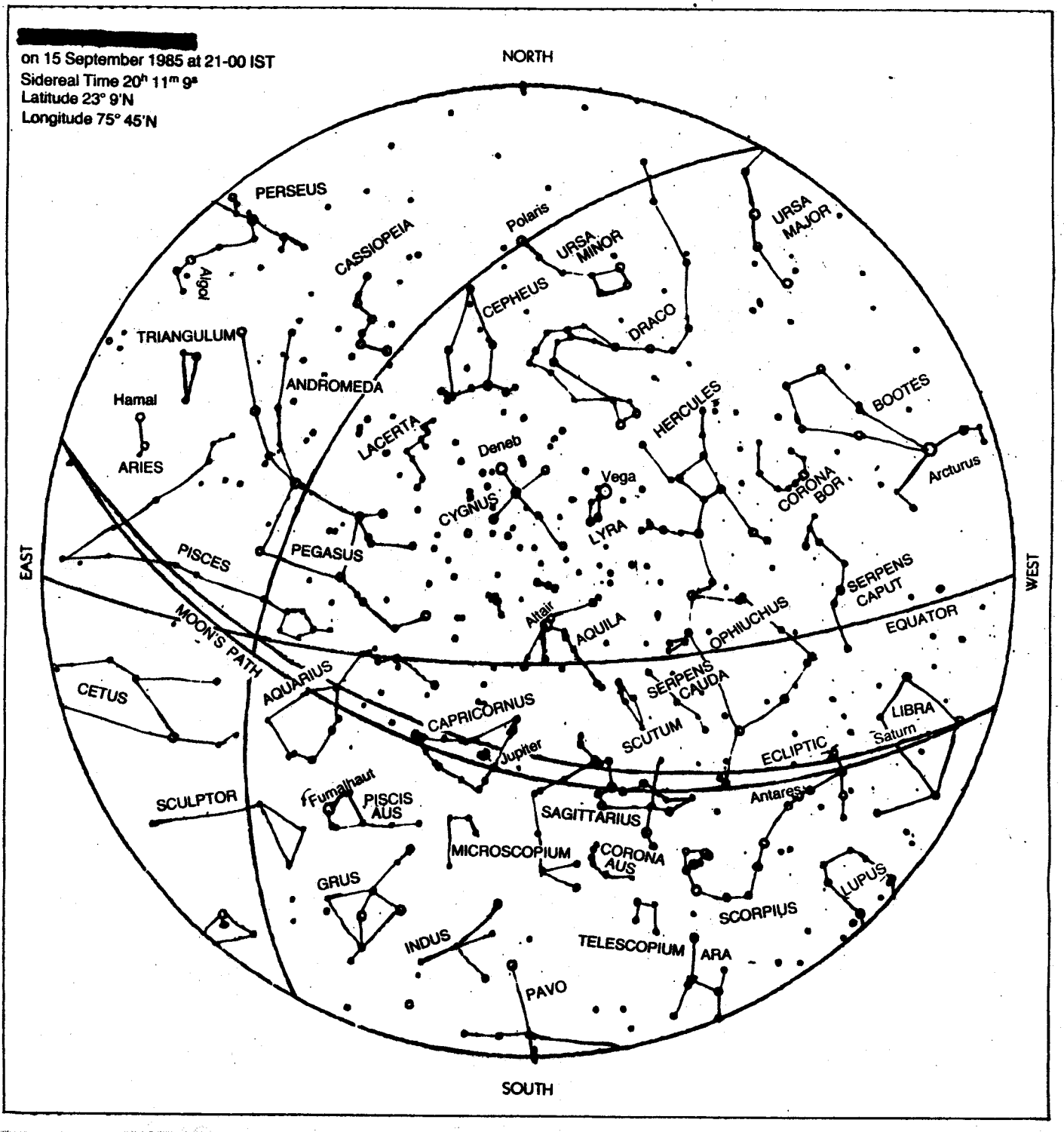
# The sky in July-August 1985

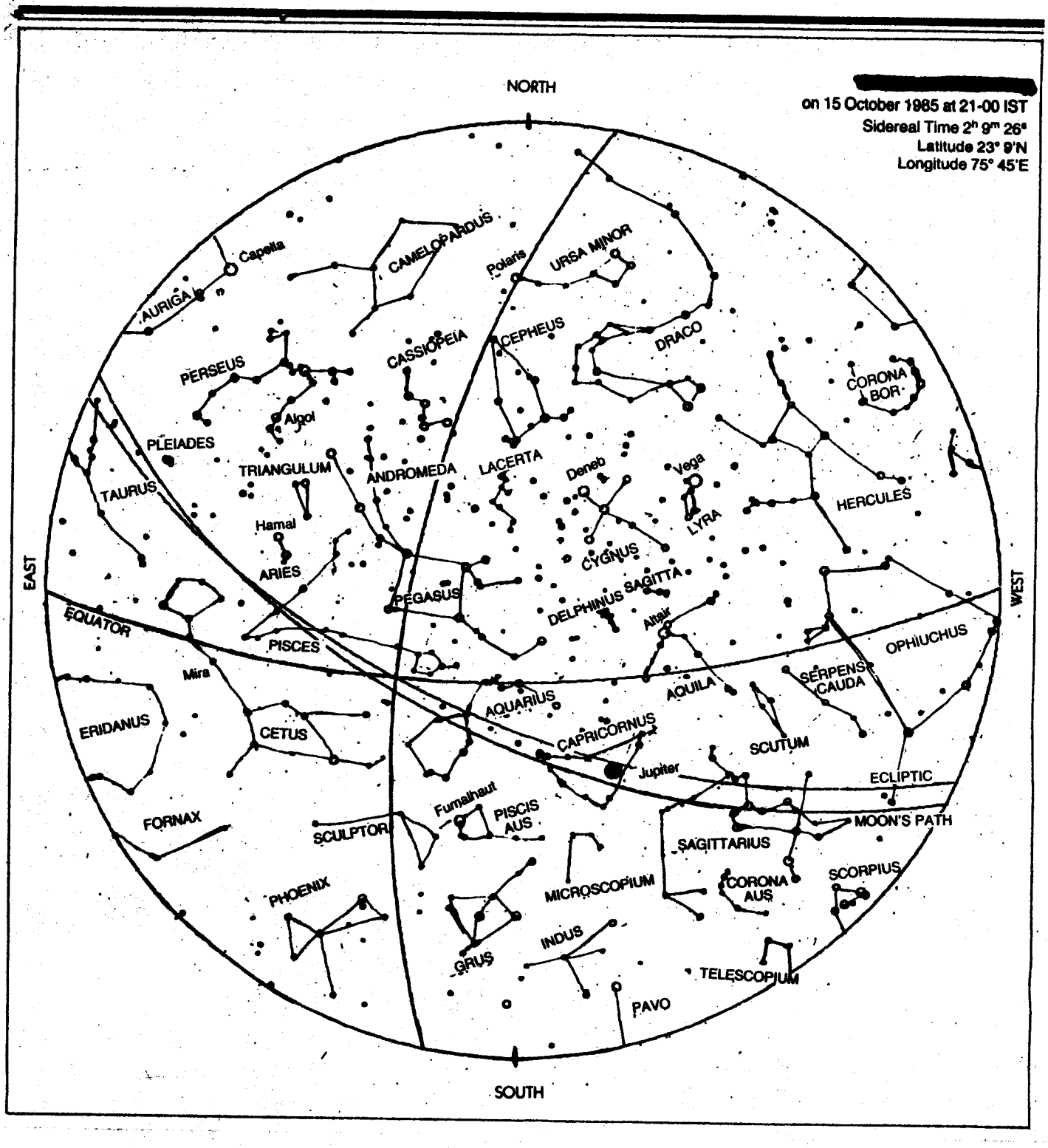


some of the difficult constellations such as Telescopium, Microscopium, Scutum, Sagitta and Lacerta, all shown in the adjacent charts. They are however, two Coronae in the sky - the northern one is called Corona Borealis and the southern one Corona Australis. Similarly there are two serpens - serpens caput and serpens Cauda, two Pisces the northern one is simply Pisces, the southern one Pisces Australis (the word "Australis" refers to south and "Borealis" to the north). There is a confusing counter part of Pulada , the heavenly seven sisters, called Delphinus, (in sanskrit literature ; Dhanistha, the 23rd asterism) and is placed between Pegarus and Aquila. Some of the zodiacal constellations that closely follow the line of ecliptic may be identified with the help of the charts which presently include Leo, Virgo, Libra, Scorpius, Capricornus, Aquarius and a part of Pisces.

Mercury will be seen in the evening sky during the second and the third week of July about an hour after the local sunset, and then after about a month it reappears in the morning sky for about a couple of weeks. Venus continues in the morning sky; its height brightness and angular size are all declining steadily. Mars conjoins the sun on 18th July and will thereafter remain lost in the morning dusk for another couple of months. The retrograde Jupiter will be found in

# The sky in September-October 1985

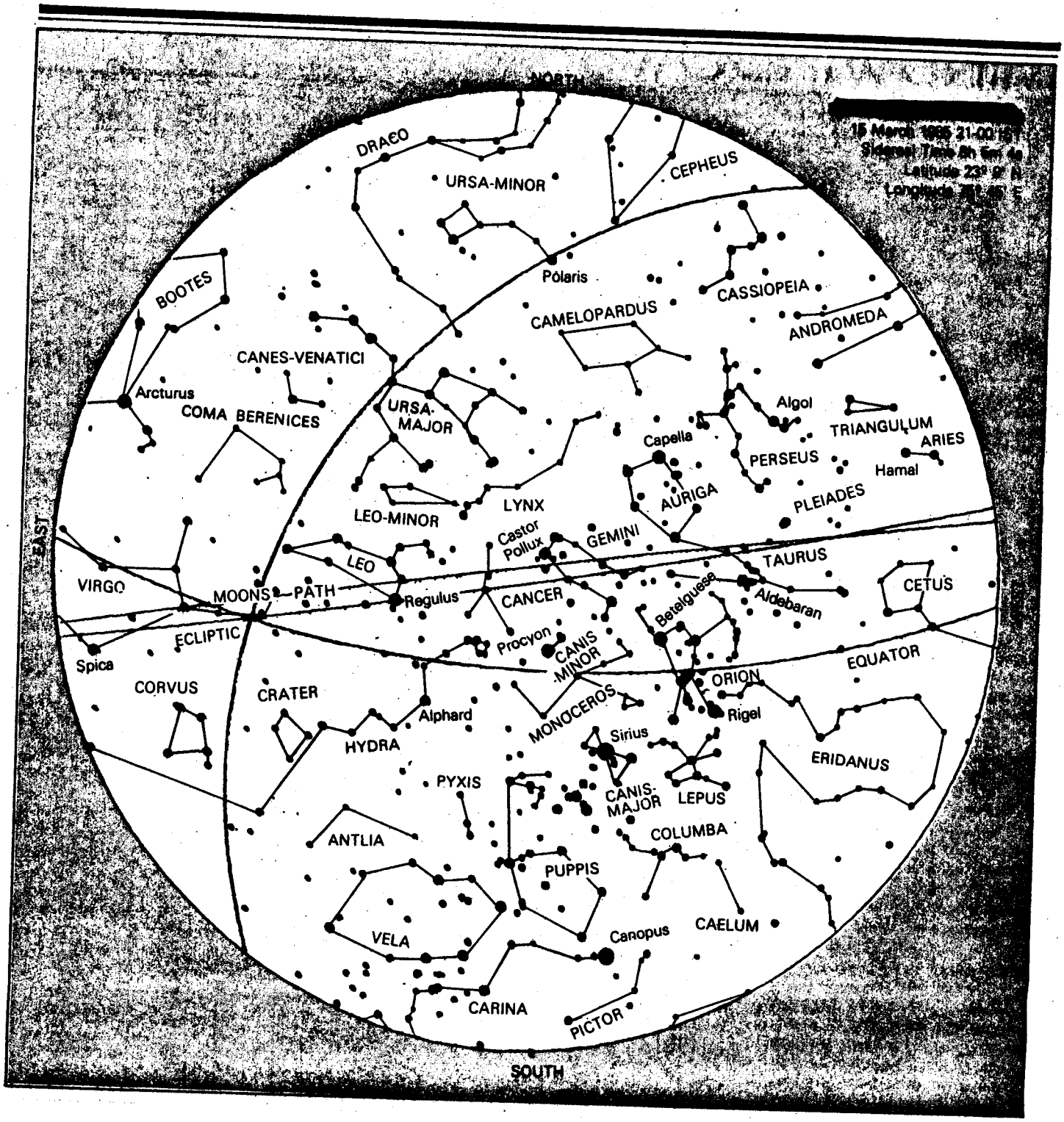


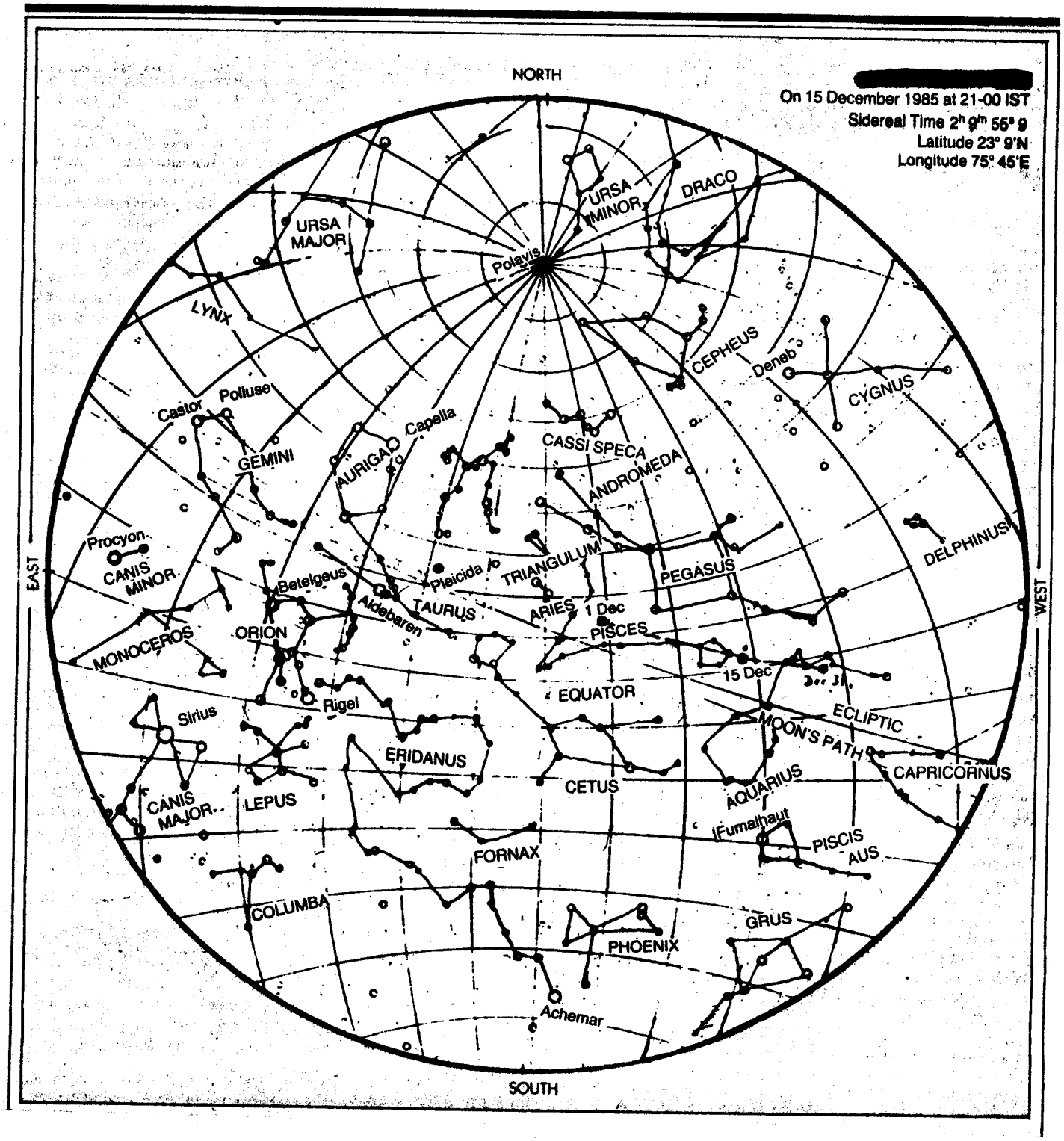

NORTH
on 15 October 1985 at 21-00 IST
Sidereal Time 2h 9m 26s
Latitude 23° 9'N
Longitude 75° 45'E
EAST
WEST
SOUTH
EQUATOR
ECLIPTIC
MOON'S PATH
Capella
AURIGA
CAMELOPARDUS
Polaris
URSA MINOR
CASSIOPEIA
CEPHEUS
DRACO
PERSEUS
Algol
CORONA BOR.
PLEIADES
TRIANGULUM
ANDROMEDA
LACERTA
Deneb
Vega
LYRA
HERCULES
TAURUS
Hamal
ARIES
CYGNUS
PEGASUS
DELPHINUS
SAGITTA
Altair
PISCES
OPHIUCHUS
Mira
AQUILA
SERPENS CAUDA
ERIDANUS
AQUARIUS
CETUS
CAPRICORNUS
SCUTUM
Jupiter
FORNAX
Fumalhaut
PISCIS AUS
SCULPTOR
SAGITTARIUS
PHOENIX
MICROSCOPIUM
CORONA AUS
SCORPIUS
INDUS
GRUS
TELESCOPIUM
PAVO

Capricornus, slowly approaching the "Opposition" with the Sun, which is due on 4th August. Around that time, it will appear dazzlingly bright, about ten times brighter than Vega, for about a month and shall remain visible for the whole night. Saturn, however, has already passed the "Opposition" in the middle of May and will shortly resume its direct motion on 26 July. It will readily be visible in the south by the evening, looking somewhat brighter than the nearby Antares or Spica. Then there will be the famous Perseid meteor shower around 12th August originating in the constellation Perseus, but its ostentation will be curbed by the presence of a full Moon this year.

SEPTEMBER - OCTOBER:

In the north - east region of the sky, there will appear in the evening five famous constellations named after characters from Greek mythology - the fettered Andromeda, her parents Cepheus and Cassiopiia, her rescuer Perseus and the horse Pegasus. Some new but less conscicuous constellations, such as Indus, Grus, Phoenix, Sculptor, Fornax, Cetus, Aquarius and Pisces appear in the South east.


NORTH
EAST
SOUTH
DRACO
URSA-MINOR
CEPHEUS
Polaris
BOOTES
CASSIOPEIA
CAMELOPARDUS
ANDROMEDA
CANES-VENATICI
Arcturus
COMA BERENICES
URSA-MAJOR
Algol
TRIANGULUM
ARIES
Capella
PERSEUS
Hamal
LYNX
AURIGA
PLEIADES
LEO-MINOR
Castor
Pollux
GEMINI
LEO
TAURUS
VIRGO
MOONS PATH
Regulus
CANCER
Betelgeuse
Aldebaran
CETUS
ECLIPTIC
Procyon
CANIS MINOR
EQUATOR
Spica
ORION
CORVUS
CRATER
Alphard
MONOCEROS
Rigel
HYDRA
Sirius
ERIDANUS
PYXIS
CANIS MAJOR
LEPUS
ANTLIA
COLUMBA
PUPPIS
VELA
Canopus
CAELUM
CARINA
PICTOR


NORTH
[redacted]
On 15 December 1985 at 21-00 IST
Sidereal Time 2h 9m 55s 9
Latitude 23° 9'N
Longitude 75° 45'E
URSA MAJOR
URSA MINOR
DRACO
Polaris
LYNX
CEPHEUS
Deneb
CYGNUS
Castor
Pollux
GEMINI
Capella
AURIGA
CASSI SPECA
ANDROMEDA
Procyon
CANIS MINOR
DELPHINUS
Betelgeus
Pleicida
TRIANGULUM
PEGASUS
EAST
WEST
TAURUS
ARIES
1 Dec
Aldebaren
ORION
PISCES
MONOCEROS
15 Dec
EQUATOR
ECLIPTIC
Rigel
Sirius
MOON'S PATH
CAPRICORNUS
ERIDANUS
CETUS
AQUARIUS
CANIS MAJOR
LEPUS
Fumalhaut
PISCIS AUS
FORNAX
COLUMBA
GRUS
PHOENIX
Achernar
SOUTH

sky in the fourth week of September, Venus still continues in the morning sky, but by the end of October, it will appear fairly dull and low at sun rise. Mars begins to appear in the morning sky in the house of Leo. During the first two weeks of September, Mars will be seen to slowly pass by regulus at a very close range. (Mars will be the fainter between the two). Saturn still continues in Libra but will be losing height as well as brightness at sunset every evening. Jupiter will be found in Capricornus, shining brightly in the south by the evening.

NOVEMBER - DECEMBER:

The prominent new constellations that appear successively on the east are Taurus, Auriga, Eridanus, Orion, Gemini, Lepus, Caris Major and Canis Minor.

Halley's comet is now in Taurus and is heading fast towards Aquarius. It is gradually coming into the range of ordinary binoculars. The coma of comet Halley may be spotted very close to a fourth magnitude star in Taurus called Kappa Tauri, on the evening of 11 November. Again on the evening of 19 November, the coma will pass over a fifth magnitude star in Aries, called Zeta Arietis. Both the events can be viewed with the help of a small three inch telescope or a pair of good binoculars (10x50, for example).

September is the best time for observing "Zodiacal light" shortly before the dawn. The zodiacal light is supposed to be a strip of faint glow rising from the east and extending right up to the zenith and is caused by the diffuse scattering of sunlight by dust particles that are mostly concentrated in the plane of zodiacus - and hence the name zodiacal light.

The full moon in September is called the harvest moon as the Moon rises very early night following the full Moon, and therefore the farmers could continue their work in the field Moo even after the sunset with the anticipation that the Moon will rise very soon. This effect is more pronounced at higher latitudes in the north. This year, the full Moon is on 28th October and will appear about five percent smaller than usual as the Moon will then stay very closed to the aphelion of its orbit round the Earth. It is also the time when the Moon crosses the ascending node of its orbit (Rahu), thus causing a total eclipse of the Moon the same night. This totality will be visible in India. The sun will reach the autumnal equinox on September 23rd.

Mercury will remain mostly lost in the dusk, although it shifts from the morning to the evening

During the first two weeks of December someone should be the first person to see the comet Halley in its present apperision with the unaided eye. By then the comet should cast a tail about four degrees in length (roughly about eight times the angular size of the full moon), and will move to Pisces.

Mercury can best be seen with the naked eye in the evening of the first two weeks of December but in the morning sky. On 9 November, Mercury may be spotted only about two degrees north of Antares, the brightest star to be visible a little about the south - west horizon after the local sunset. Again on the mornings of 4-6 December, Mercury, Venus and Saturn will form a tiny celestial triangle, rise in the south-east about an hour before the local sunrise, but remain ordinarily invisible to the unaided eye because of the advancing dawn. However, in the early hours of 17 December, Mercury and Saturn will be seen together in the morning sky. Mercury being positioned about half-a-degree north of Saturn.

Mars will now move to Virgo, to be seen only about three degrees north of spica on 2 December. Jupiter will still continue in Capricornus and Saturn is yet to move from Libra to its neighouring sign, Scorpius.

One of the most spectacular meteor showers, the Geminids, will as usual occur on the night of 13-14 December. The radiant of the emerging shower (approximately one meteor every minute) will be very close to the star Caster in Gemini (see the second star chart for the location of Caster). So please wait until Gemini's well up in the north - east on that night and please note that this year moon light won't interfere to spoil the grandeur of the event.

## CONCLUSION

Astronimical studies have led to outstanding advances in other branches of knowledge. Mathematics, for example, and astronomy have always gone hand in hand. In the earlier days, geometry and trigonometry were very largely used in describing the grouping of the stars, in studying the paths of the planets and in solving problems about the rising and setting of the sun and other heavenly bodies. In 1665, in an attempt to understand the motion of the planets, Sir Isaac Newton invented the theory of fluxions, the forerunner of modern differential calculus, and in 1666, he enunciated his universal law of gravitation. Astronomy has also inspired great advances in various branches of modern physics and chemistry, for example, spectroscopy, properties of matter under extreme conditions of temprature and pressure, the theory of relativity, quantum mechanics, and atomic energy. In the applied sciences, and atomic energy. In the applied sciences, too, work of astronomers had led to remarkable advances in such fields as photography, the development of sensitive instruments to measure minute quantities of energy, photo electric devices and so on. Sir John Herschel (1792-1871) introduced the technique of taking photographs on glass plates using sodium thiosulphate as a fixing agent. Similarly the need to photograph the feeble

light from the distant stars and development of extra sensitive photographic plates. The development of modern balloon and rocket techniques to explore the space round the earth, and finally space vehicles, got considerable impetus from the intense desire to know about universe.

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