9 DISCOVERY and NIGHT SKY

SYNOPSIS

DISCOVERY – History of Astronomy
A thumbnail history - from the ancients of Babylon and China to the Egyptians who created today's calendar and the Greek, Eratosthenes, who worked out that the Earth is round. In the 16th century Copernicus reasoned that the planets orbit the Sun and, early the following century, Galileo first used a telescope on the sky. Isaac Newton improved it - and described the effects of gravity. Last century, Edwin Hubble revealed an ever-expanding Universe – into which today we peer ever deeper.

NIGHT SKY – Navigating the Constellations
Discovering the stars and the 88 constellations of the night sky. A beginner's guide to using vivid and easily recognizable patterns - like Orion, the Hunter, and Ursa Major, the Great Bear – as signposts in the heavens. How to find Polaris, the north pole star, and the southern celestial pole, where there is no marker star. Why the position of stars changes a little night by night and a lot season by season. Why different places see different skies.

BACKGROUND

Astronomy began in the Middle East with the Babylonians who charted the rising and setting of the Sun. They grouped stars into constellations and observed that planets moved differently to stars. Planets made loops on annual movements through a band of constellations the Babylonians named the Zodiac. To this day 12 of the original 13 constellations of the Zodiac survive in popular astrology.

The ancient Chinese astronomers were meticulous observers. They made star maps that featured the Milky Way. They recorded comets, eclipses of the Sun, sunspots and the aurora borealis. About 3000 BC, at the time of the pyramids, the Egyptians created our calendar of 365 days. They were experts at celestial cycles. They knew the rising of the "Dog Star" Sirius heralded the flooding of the Nile.

The Greeks worked out that reflected sunlight lit the Moon. Eratosthenes deduced that Earth was round. By comparing the noon elevation of the Sun at locations far apart, he calculated the approximate circumference of the planet. But another Greek, Aristotle, thought heavenly bodies were carried round Earth in crystal spheres. His error persisted for 17 centuries.

This mistaken notion was actively promoted by another Greek, Ptolemy, who was troubled by the backward loops of planets in their motions across the sky. He explained them with epicycles - the planets dancing circles on their orbits of Earth. Such was Ptolemy's reputation, the mistake long survived the decline of Greece. Astronomy had entered the Dark Ages

Enlightenment came in the 16th century with the Pole Nicolaus Copernicus. He

theorised that planets orbit the Sun. A little later, through careful observations by the Dane Tycho Brahe, came a real understanding of planetary orbits. Using these observations, the German Johannes Kepler established three laws - that planets orbit in ellipses rather than circles, that planets move faster when nearer the Sun, and that different orbital periods – as when Earth's orbit overtakes that of Mars - are why planets appear to make loops in the sky against the background stars.

In 1608, the Italian Galileo Galilei turned a telescope on the sky. He discerned moons around Jupiter, the phases of Venus and craters on the Moon - and angered the church with his Sun-centred views.

Towards the end of the 17th century, the English genius Isaac Newton split sunlight into the colours of the rainbow – a spectrum. He developed the reflecting telescope and, most importantly, worked out gravity – a force of attraction between all bodies. It explained Kepler's laws. Modern astronomy was born.

In 1781 William Herschel discovered Uranus and mapped the Milky Way. He realised he was sketching a sideways view of our galactic disk. Not until the mid-19th century did the Irish aristocratic Lord Rosse record a galaxy other than our own. Astro-photography began. So did spectroscopy where the light of cosmic objects can be analysed to reveal their chemical composition.

With the 20th century came Edwin Hubble and his discovery from the spectra of galaxies that they were all rushing away from each other. The Universe was expanding. Optical astronomy advanced by leaps and bounds – not least with the Hubble Space Telescope and the advent of CCD imaging. Simultaneously radio astronomy added to our cosmic comprehension, not to mention observations in infra-red, ultra-violet and X-rays. Today, a new generation of optical ground-based telescopes promise to out-perform orbiting Hubble.

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The spin of Planet Earth causes the nightly motion of the stars. And where we are on Earth governs which stars we see. Just a little, night by night, stars shift position. Over a season it is a lot. From the same point on Earth, the winter sky is quite different to the summer sky.

To put order into the heavens, the ancients joined the stars with imaginary lines to create patterns. They called these patterns constellations, groups of stars that suggested figures. To each figure was attached a legend. It was a natural if unscientific way of navigating the night sky – and it still works today.

The Greeks named more than half the constellations – the patterns visible through the seasons from the mid latitudes of the northern hemisphere. Those of the southern hemisphere, out of sight to the Greeks, have more recent names. Altogether there are 88 constellations.

The most glorious and distinctive is Orion. Luckily it is visible from everywhere on Earth. In Greek mythology, Orion was a hunter. But he was killed by a scorpion that

stung his heel. So, in deference, only as the stars of Orion set do those of his slayer rise – as depicted in the constellation of Scorpius at the other side of the night sky.

By recognizing constellations, we learn their main stars and find pointers to other stars and constellations. For instance, in the northern sky, as viewed from the northern hemisphere, is the pattern of the Big Dipper, part of Ursa Major, the constellation of the Great Bear. Two stars in the bowl of the Big Dipper (or Plough as it is sometimes known) are Merak and Dubhe. They are called the Pointers because they show the way to the pole star, Polaris.

Polaris is the only star that is virtually stationary – for it lies directly over our north pole. The rest of the sky appears to move day by day and season by season because of the spin of Earth and its annual orbit of the Sun. It is the same with the south celestial pole – except there is no marker star. The pole can only be found by stringing a line from the constellation of Crux, the Southern Cross, to the bright star Achernar.

Polaris is useful. The father north you go, the higher Polaris appears in the sky. The farther south, the lower is Polaris. From the tropics, it nears the horizon. Intriguingly, Polaris will not always be the pole star – because Earth wobbles on its axis. The cycle, called precession, takes 26-thousand years. Once, the star Thuban marked the north celestial pole. Today it is Polaris. In four thousand years time it will be Alderamin.

Anywhere on Earth, away from city lights, stargazing has endless fascination – especially for the informed observer.

Weblinks for DISCOVERY – History of Astronomy

http://cassfos02.ucsd.edu/public/tutorial/History.html - From the University of California, San Diego, Gene Smith's useful astronomy tutorial. Weblinks to other sites devoted to the history of astronomy.

http://encyclopedia.kids.net.au/page/hi/History_of_astronomy - From the Australian kids.net site, an introduction to the history of astronomy, suitable for young people.

http://www.astro.uni-bonn.de/~pbrosche/astoria.html - From Commission 41 of the International Astronomical Union, Wolfgang Dick's history of astronomy website at the University of Bonn in Germany. Contains hundreds of weblinks to other sites dealing with every aspect of the history of astronomy.

http://www.le.ac.uk/has/c41/ - From Commission 41 of the International Astronomical Union, a new website (currently under development) on the history of astronomy. It is planned to link this site as soon as possible to a major new set of resources relating to astronomical heritage that, among other things, will replace the history of astronomy resource developed a few years ago by Wolfgang Dick at the University of Bonn.

http://en.wikipedia.org/wiki/History_of_astronomy - From Wikipedia, the free encyclopedia, a detailed overview of the history of astronomy.

http://www.answers.com/topic/history-of-astronomy - A comprehensive review of the history of astronomy from another online encyclopedia.

http://www.windows.ucar.edu/tour/link=/the_universe/uts/ast_history.html&edu=mid – From the University Corporation for Atmospheric Research's "Windows to the Universe" website, a guide to "Astronomy throughout History" with information available at beginner, intermediate and advanced levels.

http://www.physlink.com/Education/History.cfm - From Physics and Astronomy online, a good set of weblinks to many aspects of the histories of physics, astronomy and mathematics.

http://en.wikipedia.org/wiki/Greek_astronomy - From Wikipedia, the free encyclopedia, a guide to Greek astronomy.

http://en.wikipedia.org/wiki/Islamic_astronomy - From Wikipedia, the free encyclopedia, a handy guide to Islamic astronomy.

http://curious.astro.cornell.edu/history.php - From the "Curious about Astronomy?" pages at Cornell University, a collection of links and previously asked questions about the history of astronomy.

Weblinks for NIGHT SKY – Navigating the Constellations

http://www.dustbunny.com/afk/constellations/ - From the "Astronomy for Kids" website, a summary of constellations and asterisms (i.e. clusters of stars).

http://www.kidsastronomy.com/astroskymap/ - A simple guide for young people to learn the night sky, with real-time skymaps that can be printed out.

http://spaceplace.nasa.gov/en/kids/st6starfinder/st6starfinder.shtml - From NASA's SpacePlace, a really useful guide to making a star finder and learning the night sky.

http://www.astro.uiuc.edu/~kaler/sow/const.html - From Jim Kaler's "Stars" pages, an excellent introduction to the 88 constellations of the night sky, with the English and Latin names, official abbreviations and names of the brightest stars.

http://www.astro.wisc.edu/~dolan/constellations/constellation_list.html - Chris Dolan's alphabetical listing of the 88 constellations, with links to tables of data about every constellation - plus maps showing the principal stars.

http://www.astronomyforbeginners.com/astronomy/celestialsphere.php - From the "Astronomy for Beginners" website an introduction to the celestial sphere including the celestial poles, visibility of the stars from different latitudes and celestial coordinates.

http://en.wikipedia.org/wiki/Celestial_pole - From Wikipedia, the free encyclopedia, an introduction to the celestial poles, with helpful tips on how to find the South Celestial Pole, which has no bright naked-eye star nearby at present.

http://en.wikipedia.org/wiki/Precession_of_the_equinoxes - From Wikipedia, the free encyclopedia, an interesting explanation of why the pole star changes as a consequence of the precession of the equinoxes. Maps show the changes over time.

http://www.icoproject.org/star.html - From the website of the Islamic Crescents' Observation Project, a list of Arabic star names and their meanings, many of which have survived in modern scientific astronomical atlases.

http://www.cascaeducation.ca/files/genastro_observing.html - From "Canadian Astronomy Guide", some tips and hints on observing the night sky and on planning an evening observing session.