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By Harry Jivenmukta

PTOLEMY 100-180

1

Claudius Ptolemaeus was an ancient astronomer, mathematician and geographer who lived in Alexandria during the second century. Nothing is known of his early life except that he was an Egyptian rather than Greek. Ptolemy is famous for the book he wrote in thirteen volumes called the 'Almagest'. This book was to have a profound effect on scientific thinking for more than ten centuries, or a millennium.

Each of the thirteen volumes deals with different aspects of the solar system as it was known at that time. In the first volume, Ptolemy maintains a geocentric system with the Earth being the centre of the known universe. This idea became firmly entrenched until astronomers such as Brahe, Copernicus and Galileo began to discover how erroneous it was.

Ptolemy argued that, since all bodies fell towards the centre of the cosmos, the Earth must be fixed there or anything falling would not be seen to fall towards the centre of the Earth. It was the revoking of this idea by Copernicus that left the way open for Isaac Newton to discover the force of gravity.

In mathematics, Ptolemy prepared a calendar from his own calculations. It was these calculations which caused the errors which Clement VII wanted to be corrected by Copernicus. Ptolemy's contribution to science should never be belittled. His achievements were amazing considering the instruments available during his lifetime. Without the survival of his works and knowledge, scientists of the later Middle Ages would have made far less progress than they did.

Activity.

1. Find out and remember the meaning of the following terms:

Azimuth, Elevation, Horizon, Zenith, Zodiac, Ecliptic.

2. List the constellations of the zodiac and their meanings. Check that you know your own sign.

3. Make a chart to show the phases of the moon. What is meant by a Gibbous Moon?

4. What are:

Comets, Asteroids, Meteors and Tektites?

DA VINCI 1452-1519

2

Leonardo da Vinci was the son of a notary, a person able to write up legal documents. His mother was a peasant girl who married someone else after Leonardo's birth. Leonardo was born near Florence, in Italy. He was taught with other boys on his father's estate. He didn't like school and was poor in mathematics, geometry and Latin which he was expected to learn. Instead, he excelled at drawing.

When Leonardo was fifteen he was apprenticed to an artist, Verrocchio, in Venice. Here he learned anatomy, and the technical aspects of drawing and painting. He was accepted into the painter's guild when he was twenty. In 1477, Leonardo set up his own studio/workshop in Florence. Among the early work he completed, were drawings for weaponry and mechanical pumps. Five years later, Leonardo entered the service of the Duke of Milan as a designer, painter and sculptor. Although interested more in mechanics and science, Leonardo he still found time to complete several major works of art including the painting of the 'Last Supper'.

Leonardo made hundreds, even thousands of drawings of possible inventions and mechanical devices. He planned a dam for the Isonzo Valley and went to work for Cesare Borgia, the notorious son of Pope Alexander VI, as an architect and military engineer.

In 1503, Leonardo returned to Florence where he studied anatomy and physiology in an effort to determine whether manned flight could be possible. It was during this period that he painted the 'Mona Lisa'.

In 1513, Leonardo travelled to Rome. he was given quarters and a studio in the Belvedere, in the Vatican. He worked day and often long into the night producing drawings and illustrations for inventions and producing art works for the Pope. But he was cut off from the hustle and bustle of the busy city and very lonely. After three years he moved to France and lived in a house close to the palace of Francis I. He continued working until he died at sixty-seven years old.

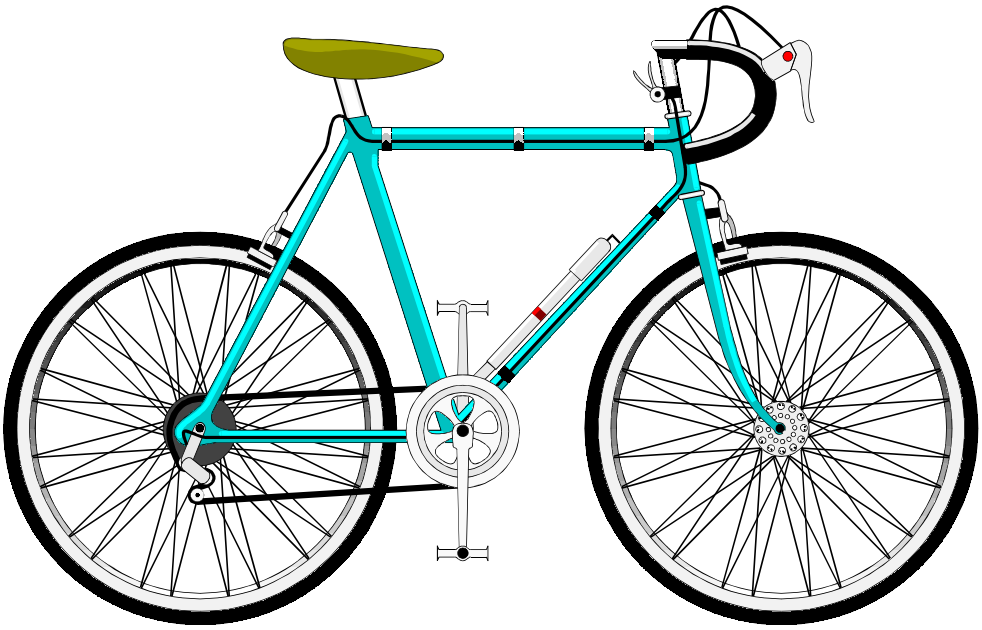
Activity: Emulation.

1. With drinking straws, or fine wire make a model of a dodecahedron.

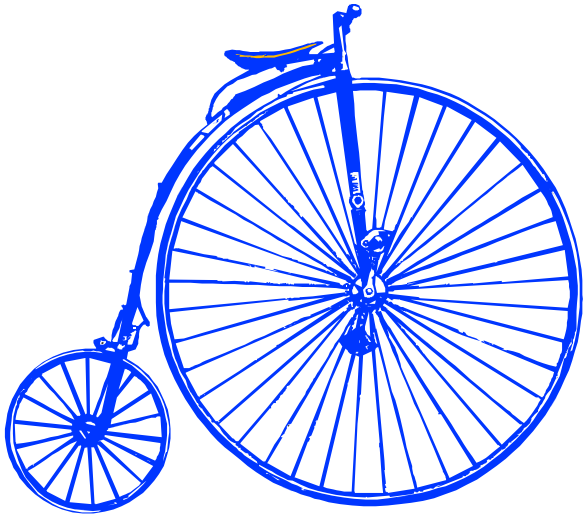
2. Use the library to find a copy of Leonardo's sketch of a bicycle. Compare this with the drawing on the next page. List the differences that you find.

3. Have a paper aeroplane contest to see who can make the most efficient plane which flies the farthest. compare your efforts with the sketches of aeroplanes by da Vinci. How close to modern aircraft are da Vinci's ideas?

4. Read the books: 'Leonardo the Inventor' and 'Leonardo the Scientist' both published by McGraw Hill Book Co.



Label the parts of the bicycle and compare these to the details which da Vinci thought of. How similar were da Vinci's ideas to the bicycle of today? How have bicycles developed in the last 100 years or so?



COPERNICUS 1473-1543

4

Nicolaus Copernicus was born in Torun, in eastern Poland. His father was a wealthy merchant and burgher, or councillor, of the town. The type of schooling Nicolaus experienced is not known. The first we hear of him is that he went to the University of Kracow when he was eighteen. He studied astronomy and mathematics.

Three, or maybe five years later he returned to Torun, where his uncle, the Bishop of Ermeland, persuaded him to take a position in the canonry of the Church. Members of the canonry are responsible for the day-to-day running of a cathedral, and its finances. Working as a member of the canonry gave him enough money to live and some spare time to continue his studies and observations.

In 1497, Nicolaus made his first scientific observation when he recorded the eclipse of the star, Aldebaran, by the moon. Within three years he had published many papers on his observations, given lectures and received visits from scientists and astronomers from all parts of Europe. He even travelled to Rome to give lectures on mathematics and astronomy.

In 1514, the Lateran Council in Rome sought his advice on the long-overdue reform of the calendar. Early measurements with inadequate knowledge and poor instruments had resulted in many errors.

Copernicus tried to use the measurements made by Ptolemy (circa AD 140) but they were useless. He tried to prove this by writing papers on his observations on the movement of the Earth, moon, planets and stars. He passed these papers around among his friends and associates, but they soon spread to a much wider audience. Opposition to him and his theories was both loud and angry. Nicolaus had challenged the theories of the ancient Greeks and the beliefs of the Church. The idea that the Earth was not at the centre of the world, or that it was complete and unchanging from its inception by God was so entrenched that anyone challenging it was considered a heretic - a terrible crime in those days! This radical change in thinking is often called the ‘Copernican Revolution’. It also paved the way for Newton’s theory of gravity, because it revoked the belief of Aristotle that “all things fell naturally towards the centre of the Cosmos”.

In 1533, the Pope, Clement VII, sent for Copernicus to come to Rome to explain his theories. He listened to Nicolaus for many days and eventually accepted his theories, but many still couldn’t grasp them. Martin Luther opposed him so strongly that he was forced to publish away from Luther’s jurisdiction. Nicolaus continued his observations and recording until he died. On his deathbed, it is said that he asked for all his papers to be brought to him to see one last time.

Activity: Shadow clock. Making a shadow clock will allow you to see the movement that so intrigued Copernicus when he was young.

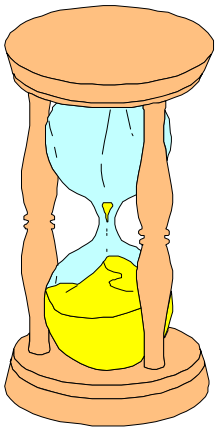
1. Set up a shadow clock with a large pole set at right angles to a flat surface.

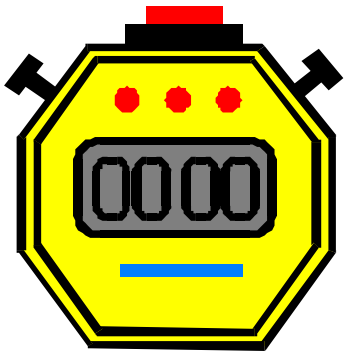
2. Mark the shadow, length and direction, every half hour throughout a sunny day.

3. Account for any changes you observe.

4. Try this during the different seasons of the year with a set number of weeks, or days, between each experiment. Account for any changes you observe.

5. How has the telling of time developed since the time of Copernicus?





BRAHE 1546-1601

6

Tycho Brahe was the son of a wealthy politician. He was born in the Castle of Halsinborg, in Denmark while his father was the Governor. Tycho was not brought up by his parents. When he was still very young, his wealthy uncle, who had no children of his own, abducted him and took him to live in Tostrup Castle. It didn't matter how often his parents argued, or pleaded for Tycho's return, his uncle refused to release him. Tycho was clever! He went to university in Copenhagen to study law when he was just thirteen.

During the following year, Tycho saw an eclipse of the sun. In those days, few understood what was happening. People were scared, others predicted the end of the world, the Church sold many pardons for people's sins, but Tycho was fascinated and wanted to know much more. He gave up the study of law and began attending lectures on mathematics and astronomy. He discovered a book on mathematics called the 'Almagest' written by Ptolemy in Egypt circa, AD140. He read it carefully and began to check some of the measurements which he found to be wrong.

Still studying, this time in Leipzig, Tycho made the first recorded observations of the overlapping of the planets Saturn and Jupiter. He carefully noted the time and day that this happened and then checked his account with that of Copernicus. They did not match. This discrepancy persuaded Tycho that more accurate tables of known astronomical data were vitally necessary and that he would set about the massive task of producing them.

He travelled throughout Europe making as accurate measurements as were possible at that time and with the rudimentary instruments at his disposal. Then the most momentous event occurred, he discovered a new star! This was earth shattering for it completely opposed the theory of Aristotle that the "whole world was governed by a harmony that was perfect and unchanging". It also added to the problems of the Church, which still maintained that the Earth was the centre of the universe; it was made by God and therefore unchanging! The Church and all those who preferred the ancient theories opposed him. Life became very difficult. Eventually in 1576, King Frederick II of Germany, gave him money to build an observatory on an island and enough to support him as he worked. Many scholars from the countries in Europe visited him. One of his assistants was Johannes Kepler.

Then Frederick died and his son, Gustav, would have none of him. Tycho was forced to leave. He ended his days, tired and despondent, in Prague.

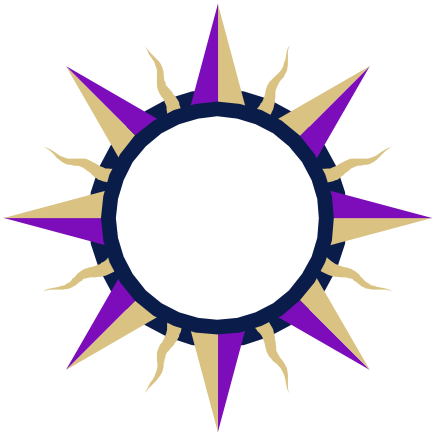
Activities: Stars.

1. How many stars do you know by name or group name?

2. How many stars, that you know, can you find at night? To which constellations do they belong?

3. During the clear nights of late autumn, or early winter, choose three bright stars and plot their positions in the sky every half hour for four to five hours.

4. Find out more about your stars from star maps, (Try your library).



KEPLER 1571-1630

8

Johannes Kepler was born in Germany. His father, a soldier, was often absent from home so Johannes was brought up by his mother, the daughter of an innkeeper. He was an unhealthy little boy and never grew tall and strong. He was however, very clever; so clever that he was brought to the notice of the Duke of Wurtenburg who paid for him to have a proper education.

Johannes went to university at sixteen where he studied astronomy and mathematics. When he had his degree, he stayed on to study theology. He failed to finish theology and became a mathematics teacher at the High school in Graz.

Teaching didn't prevent Johannes from his astronomical observations. After just a year in Graz, he wrote a treatise on celestial harmony in which he tried to establish a relationship between mathematics and the orbits of planets. He sent a copy of it to Tycho Brahe, who impressed with his insight, still believed his calculations to be wrong. In spite of this Brahe invited Kepler to come and assist him in his laboratory and observatory.

Five years later, Kepler took over Tycho's work and laboratory when Tycho died. In 1604, Johannes was scanning the heavens one evening when he observed two amazing sights for the first time. He saw the planets, Mars, Saturn and Jupiter in line with each other, and while watching this, he saw a supernova explosion. He recorded all his observations and published them.

They caused an uproar among every other astronomer and scientist, as well as the Church. It was impossible for two such momentous events to occur in an unchanging universe. Taking little notice of all the fuss, Johannes kept working. He worked on the refraction of light through the atmosphere and endeavoured to measure the deflections accurately. This led him to maintain that Mars moved elliptically and not in a circle. This was another challenge to the authorities who had believed in the 'Wheel of Heaven' for many centuries.

In 1620, Kepler received some terrible news; his mother was being tried for witchcraft! If she was found guilty, she would be tortured and then tied to a stake and burned. Johannes hurried home to plead on her behalf. Luckily he succeeded and she was released. If this wasn't enough, when Johannes tried to return to his work, the uprising of the peasants in the Peasant's Revolt halted him and he was forced to flee. For two years he managed to exist without any pay, and away from his work, but not being strong, he became very ill and died.

Activity: Research. Did you know that new stars and planets are still being discovered.

1 Find out as much as you can on the latest developments in our knowledge of the solar system.

2 For more solar system research, refer to the section on Kepler on the next page.

Activity.

Try some research of your own. You will need reference books on astronomy.

1 Find out about the Sun:

How big is it?

What is it made of?

What are sunspots?

How hot is it?

2 Find out about the moon:

How big is it?

What is it made of?

How far is it from the Sun?

How far is it from the Earth?

How long does it take to orbit the Earth?

3 Select two planets of your choice. Write up a detailed report on each and include illustrations.

FLAMSTEED 1646-1719

10

John Flamsteed was born in Denby, in Derbyshire. He was a sickly boy who struggled to remain at school until he was sixteen, by which time he was too unwell to continue and found it better to study at home. He studied astronomy on his own for eight years and until his health had improved enough for him to go to university.

He went to Cambridge University in 1670 and achieved his degree in 1674. In the following year he was ordained a clergyman and later was given the living of Burstow in Surrey. In spite of his clerical duties, John found the time to continue with his astronomical exploration and studies. During the same year he wrote a scientific paper for the Royal Society which resulted in the founding of the Greenwich Observatory.

In 1677 he was elected as a member of the Royal Society (for science). He was also appointed as the first Astronomer Royal and began to undertake his duties in the recently completed observatory. Unfortunately, although it was a splendid building, it was extremely poorly equipped. John had to purchase all the instruments he needed.

He gained a small inheritance from his father who died in 1688, and with this he was able to buy a mural arc for measuring the altitudes of stars as they passed the meridian. He used his church stipend and was still forced to augment his earnings by tutoring private pupils to purchase other instruments. It was at this time that he began working on his famous star catalogue, called the 'Historia Coelestis', in which he listed and charted three thousand stars!

Much of Isaac Newton's work was based on Flamsteed's observations and even today, some stars are still known by their original Flamsteed number, (e.g. 61 Cygni). During his later years he was surrounded by problems. Many still refuted his observations and measurements of the movements of stars as being impossible, but these same measurements were needed urgently by Newton and Halley, putting John under immense pressure. He tried to hold up publication until he felt that all his intended material was completed to his own satisfaction, but scientists demanded their immediate publication, leaving John with a struggle to explain himself clearly.

The scientists prevailed and with Prince George of Denmark bearing the cost, Halley had four hundred copies published of incomplete data. John was furious and he managed to have three hundred of the copies destroyed (1712). Although, exhausted with the pressure of trying to complete his work in a hurry, John continued for another five years. He died in 1719 at the age of seventy-three.

Activity: Constellations.

1. What is a constellation? List three constellations that you know. Draw a sketch of each of your constellations.

2. Using your three constellations and a star chart, measure and plot their position at 2030 hours on the same night of the week for four to six weeks. Your plotting will be clearer if you use different colours for each constellation.

3. Account for what occurs.

HALLEY 1656-1742

Edmund Halley was born in Shoreditch, in London. He attended St. Paul's School and then went on to study at Queen's College in London. Edmund was amazed at the comprehensiveness of Flamsteed's catalogue of the stars in the northern hemisphere and he vowed to complete a similar project for the southern hemisphere.

With money from his father, support from Charles II and a letter of introduction to the East India Company, he set sail for St. Helena, before he had completed his degree. Bad weather stopped him from finishing what he intended but he did manage to catalogue 341 stars plus their celestial measurements. He also observed the passage of the planet Mercury, across the sun and made many of his measurements by using a pendulum.

On his return he was elected a member of the Royal Society and King Charles II persuaded Oxford University to grant him an honorary M.A. degree. He also worked with Isaac Newton in trying to solve the puzzle of planetary motion. Halley with Robert Hooke, had calculated that a force of some kind kept the planets in orbit in a particular way, but they were unable to go further. Halley then visited Newton, who claimed that he had already solved the problem. He said that the orbits were ellipses, but that he had mislaid his notes proving his theory! Robert Hooke claimed that he had already put forward this theory, and so began the terrible arguments between the two of them with Edmund siding with Newton.

Halley was also given the task of seeing that Newton's great book, the 'Principia' was edited and published. Halley had a wide-ranging ability. He drew a world map showing the wind directions over the oceans, and he even commanded a war-sloop, 'Paramount Pink' on the first official sea-voyage for scientific purposes. Edmund was well into middle-age before he started his studies on comets and their parabolic orbits. In his 'Synopsis of Astronomy of Comets', Edmund described the orbits of twenty-four known comets including the one named after him.

In 1720, Edmund succeeded Flamsteed as Astronomer Royal. He worked at Greenwich on the transit of the moon until he died aged eighty-six.

MORSE 1791-1872

12

Samuel Finley Breese Morse was born in Charlestown, Massachusetts, USA. His father was a clergyman and a keen amateur geographer. Samuel went to school at Phillips Academy in Andover, USA. and then to Yale College. He didn't do very well because the only subjects he enjoyed were science, especially the lectures on electricity, and painting miniatures. He graduated in 1810 and obtained a job as a clerk in a publishers office in Boston. He didn't take to this so after one year he left to study painting in England.

During the war of 1812, he was very patriotic and outspoken. He also spent most of his time painting famous historical events on huge canvasses. After three more years he returned to America and earned his living by painting portraits of wealthy people. But only for a short time. He soon returned to Europe to continue studying art.

It was during his second return to America in 1832 that he began to ponder on the possible uses of the newly invented electromagnet. He wondered if it would make a telegraph machine. Others had contemplated such a machine, but it was Samuel who thought out how it could possibly be made to work. He still earned his living through painting and teaching art, but he also found time to work on his new machine.

Five years later, he gave up teaching and painting and began to devote all his time to perfecting his new machine. After one year, in 1838, he had developed a system of dots and dashes which he thought he could convert into electrical impulses. His system is known to the world as The Morse Code.

The first telegraph line was built between Baltimore and Washington, and the first message to be sent was "What God hath wrought!" Samuel Morse died in New York in 1872, a much revered man who in his later years gave a great deal of his earnings to charity.

Activity: Using Morse Code.

1. Construct an electrical circuit which operates a light bulb (torch), or a tapping machine.

2. With a friend, or partner, send simple messages to each other using Morse Code.

3. Time each other in sending messages containing 26-30 letters. How fast can you get and still be able to read the message?

4. With one of you at either end of the football field, try using the flag method of sending Morse Code.

5. Why do you think the letters: E, S, O and T are given such easy codes to remember?

A .-	N -.
B -...	O ---
C -.-.	P .--.
D -..	Q --.-
E .	R .-.
F ..-.	S ...
G --.	T -
H	U ..-
I ..	V ...-
J .---	W .--
K -.-	X -..-
L .-..	Y -.--
M --	Z --..

1 .---- 2 ..--- 3 ...-- 4 ....- 5 .....

6 -.... 7 --... 8 ---.. 9 ----. 0 -----

You can use flags to pass messages in Morse Code. A small figure of 8 above the head denotes a dot and an extended figure of eight down one side denotes a dash.

SCHLIEMANN 1822-1890

14

Heinrich Schliemann was born in Germany. He was the son of a poor pastor. When he was seven years old his father gave him a history book in which was a picture of the ancient city of Troy burning. Part of his education included learning about Ancient Greece and reading the poems of Homer. After seeing the picture, the poems of Homer took on reality and Heinrich became determined to find this lost city of legend.

At fourteen, his parents could no longer afford to keep Heinrich at school, so they apprenticed him to a grocer. He stayed for several years but found the work too hard and he became very ill. In order to try and regain his health, and believing that sea air would help, Heinrich signed on as a cabin boy on a ship sailing to Venezuela from the German port of Hamburg. Unfortunately, before the sea life had had any beneficial results, he was ship-wrecked! He was saved from a watery grave and quickly decided that the sea was not for him.

Instead he became an office boy in an overseas trading company in Amsterdam. In spite of all his difficulties Heinrich remained energetic and optimistic. Whilst in Holland, he discovered that he had a flair for languages. Determined to succeed he set about learning as many languages as he could. It was said that he learned eight languages fluently and could manage fairly well in another five! During the Crimean War (1853-56) he made a fortune dealing as a military contractor. He moved to America and became an American citizen sometime during the 1850s.

It wasn't until 1868 that Heinrich was finally able to visit Greece. He took most of his fortune with him and started travelling around, seeking the Homeric sites of the ancient world. In 1874, he claimed that he had found the ancient city of Troy. He had certainly found some very old artefacts, but most of the world's archaeologists were sceptical and didn't believe it was really Troy. He had found it but it had been slightly dug and unidentified by others in the past, so it wasn't completely his own discovery.

Then he went to Mycenae where he dug up a set of very well provisioned tombs. He maintained that these were the graves and artefacts of King Agamemnon and his consort, Clytemnestra.

He continued digging wherever he found a likely sight and unearthed many valuable artefacts. Unfortunately, with no field or other training, and being strictly an amateur, it is said that he probably destroyed more material than he found. Several years later Heinrich developed ear trouble and sought advice from doctors in America and Europe. On Christmas Day, 1890, he was walking quietly and in great pain in Naples, in Italy, when he collapsed. He died the following day.

Activity: Archaeology.

1. Visit a historical site or ruin in your locality.

2. Find out the following:

Age of building or site,

Who built it,

Probable reason for building,

How it was built,

Who used it and how was it used,

What happened to it,

How and when was it restored, and by whom?

3. Write up your information, illustrate it and present it to an audience.

EDISON 1847-1931

Thomas Alva Edison was the youngest of four children. He was born in Milan, Ohio USA, to very poor parents. His father rarely had a steady job. When he was tiny, Thomas caught scarlet fever which, with no antibiotics, was a very dangerous disease. He recovered but the disease had affected his hearing and he was very deaf. When he was seven, the family moved to Michigan and Thomas went to the local school. Within a few months, Thomas had been expelled for being 'retarded'. Thomas' mother, who had once been a teacher, took on the task of educating him.

Thomas was a bright and curious little boy, but he was often frustrated and angry when he couldn't hear people properly. Sometimes he was so angry that he misbehaved badly; then his father would remonstrate with him, which Thomas couldn't hear, and when he didn't answer he beat him. On one occasion, Thomas' father was so angry with him that he dragged him to the centre of the town and whipped him publicly. His mother tried to help him. Realising how frustrated he was, she began to interest him in science. She bought him some science books and a few simple instruments. Then together, they fixed up part of the cellar for him to use as a laboratory. Thomas loved it and spent every available minute working in there. He liked to try and copy the experiments that he read about in his books. He was so successful that he made himself an electric telegraph set that would work. A fine accomplishment in those days for a young boy with little equipment.

Thomas needed money to buy more advanced equipment. His parents couldn't help, so at twelve years old Thomas set up in business for himself. He bought newspapers and sweets and then re-sold them to passengers on the trains. After he had sold his stock, he would persuade the guards to let him work in an empty part of the baggage car.

He became an expert in using the telegraph system and became a telegraph operator. After a year, he had saved enough for more instruments and he decided to give up his job as a telegraph operator and devote all his time to his experiments.

Edison became an inventor. He used his talents to fix things and to find ways of making things work better. He could see a problem, and then he would work on ways of solving it. He was much sought after and became very famous. Among his thousand or so patents for improvements and inventions were the electric light bulb, the phonograph and a machine for projecting motion pictures. He died, still active and working, in his eighties in 1931.

Activity: Electric Light Bulb.

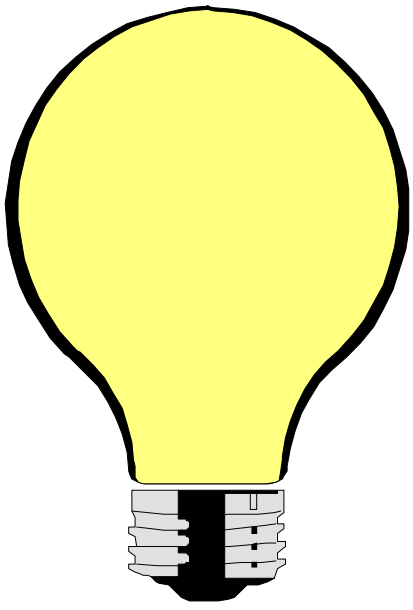
1. You will need an ordinary, clear electric light bulb.

2. Get an ordinary light bulb and describe what you see. Make a diagram of a light bulb. Which parts carry the current and turns it into light? Compare a light bulb which no longer works with one which does work. Are all light bulbs the same? Compare a camera flash bulb with normal light bulbs. What are the differences?

3. How many different types of electric light bulb are in use in your house or school?

4. Find out what is meant by wattage and voltage.

5. Have a display of different types of light bulb, or collect



BOAS 1858-1942

Franz Boas was born in Minden, in Germany. His father was a Jewish merchant. Both his parents were 'free-thinkers' who believed in the principles of revolution to overthrow autocratic regimes.

From a very early age, Franz was captivated by the world around him. He enjoyed such subjects as geography, natural sciences and astronomy while still at school. He wasn't strong and was more often found buried in a book than playing vigorous games outside.

At secondary school, he discovered 'culture' and was thrilled by the idea that the world was filled with different cultures and peoples. At university, he continued with this interest by studying geography and physics.

After leaving university, he had to undertake military service for a year. This was to be most useful to him in the future as it taught him resourcefulness. In 1883, he set out on his first expedition to study the geography and peoples of Baffin Island. Then he undertook another expedition to study the Indians of Vancouver Island. On his return, he stopped in New York, fascinated by America he decided to stay.

In order to earn a living, he began a teaching career which was so successful, that he achieved the position of professor of anthropology at Columbia University in 1899. Here he studied as he worked. He investigated the languages, art and culture of the Native American tribes. This branch of science is called anthropology. Franz led the world in the discipline of anthropology and his work and writings influenced all future studies in this field. He maintained that, in anthropology, it was not enough to study particular aspects of a group of peoples in isolation, but that it was necessary to study them as a complete whole before any conclusions could be reached.

He died in New York, well-respected as the founder of culture based, scientific anthropology at the age of eighty-four.

Activity: Cultural anthropology.

1. Choose any particular culture that interests you, e.g. Inuit, Lapps, Native Americans, Australian Aborigines, or any other except your own.

2. Write a project on your chosen culture, (use the guide on the next page).

3. Present your project to the rest of the class.

Activity. Guide for anthropological study.

1 Draw a map of the area in which your chosen people live.

2 How do they find shelter? Consider traditional housing, building materials, and methods.

3 Finding food: staple foodstuffs, production of food, eating habits and methods of cooking.

4 Clothing: everyday wear, traditional and ceremonial clothing, production of clothing.

5 Ceremony and ritual: traditional ceremonies; e.g. birth, marriage, death.

6 Travel: normal forms of transport, purpose of travel.

7 Skills: normal and traditional, uses of skills.

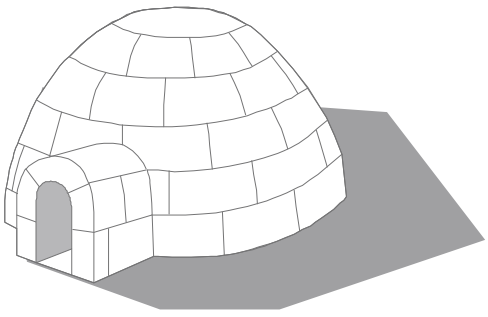
8 Economy: economic activity, money, trade, etc.

9 Childbirth and rearing: attitudes and ritual, education, preparation for adulthood, etc.

10 Arts and crafts.

11 Beliefs: religious.

12 Conclusion: influence of western civilisation etc., changes in way of life, the future.



BINGHAM 1875-1956

20

Hiram Bingham was born in Honolulu, the capital of Hawaii. His father was a well-known missionary who was keen on mountaineering. His father taught him everything he knew.

Hiram had a normal schooling and set about becoming a history teacher. He wanted to specialise in the history of Central and South America, and in the Maya, Aztecs and Incas who fascinated him. In order to increase his knowledge, Hiram set out on a journey to South America taking the same route as that taken by Simon Bolivar in 1819. He travelled from Venezuela to Colombia absorbing sights and knowledge as he went.

Two years later, in 1908, he set out again. This time he followed the old trade route of the Spanish through the Andes going from Buenos Aires, in Argentina, to Lima, the capital of Peru. When he returned, he obtained a position in the history faculty of Yale University.

In 1911, he led a university archaeological team to South America to find the ancient city of Vilcabamba. It was going to be difficult, because even the Spanish, when they conquered the country in the 16th century, failed to find it.

They searched for months, suffered hardships and had many life-threatening experiences and accidents. It was only the courage and perseverance of Hiram that kept the expedition going. They came across several ancient Inca settlements before they believed that they had finally found the city of Vilcabamba. On arrival, they found stone walls that were well-preserved and a structure that was almost identical to a temple, dedicated to the sun god near Cuzco. They also found another Inca site, Vitcos. Then they returned to America by the shortest possible route.

Later, in the following year, Hiram led another expedition to excavate the ruins of Vilcabamba. After a successful dig, he and his associates returned to Yale University where they wrote up their findings and published all the information they had from the dig. In 1922, Hiram gave up history and archaeology and entered politics. He became governor of Connecticut, and then a senator. He served for some years before leaving and devoting himself to his business interests. President Truman invited him to serve with McCarthy in the investigations into un-American behaviour and loyalty. Hiram died in Washington, in 1956 at the age of eighty-one.

Activity: Museums and artefacts.

1. Museums are full of material that has been excavated by archeologists. Visit your local museum.

2. Choose one particular section. Do a complete survey of your chosen section; artefact, where found, when, by whom, its use and date. Sketch, or illustrate your work.

3. Find out about any excavations, or archaeologists working in your locality.

SIKORSKY 1889-1972

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Igor Sikorsky, sometimes known as Ivan, was born in Kiev in Russia. Igor's father was a physician as was his mother. His mother, although qualified, never practised medicine. Her chief interest was in the life and work of Leonardo da Vinci. It is certain that she interested her son in some of da Vinci's achievements.

Igor started making model aeroplanes before he was twelve, and soon after his birthday he succeeded in making a rudimentary helicopter using elastic-band power.

After leaving school, Igor decided that he wanted to become a sailor, so he entered the Russian Naval Academy in St. Petersburg, but after three years his burgeoning interest in engineering made him give up this idea and go to study engineering instead. In this he was fairly successful, passing his exams and completing the programme, but he felt that all the theory he had learned was not much use when it came to solving practical problems.

He decided to build and work in his own laboratory. He was a practical man who wanted to find solutions to the many problems he found. In 1908, he met the Wright Brothers and others interested in flying and aeronautical machines. In the discussions they had, Igor remembered da Vinci; like him, he maintained that the only way to fly was to go straight up vertically. For years he worked at solving the problem. He built many prototypes and had just as many failures.

The Russian Revolution and the aftermath of World War I, disrupted his work so badly that he could see no future for himself in Russia. In 1919, he sailed to New York and was accepted as an immigrant. To begin with he was very poor and hadn't enough money to buy the tools and materials he needed. He worked as a teacher and augmented his pay with some part-time lecturing. Then, when he had gained his citizenship papers, he with some other ex-patriot Russians set up a company to develop Igor's dream of a vertical take-off flying machine.

On September 14th. 1939, the first helicopter climbed into the air - Igor had succeeded. From then on, development surged ahead. Igor was given many awards and quickly became famous. He retired in 1957 but continued with consultancy work until his death at the age of

Activity: Paper Flying.

1. Obtain a book giving directions for making different types of paper aeroplanes.

2. Make a variety of different models.

3. Have a flight competition to see which type flies the furthest. Indoors is best and from a standing start.

4. Invite a hang-glider pilot, and/or an experienced glider pilot to your class to talk about their experiences.

5. Find out all you can about learning to fly in your own area. You need to know such things as cost, how long it will take to learn, equipment, amount of theory and weather requirements for lessons.

HUBBLE 1889-1953

22

Edwin Powell Hubble was born in Montana in the USA He attended normal primary and secondary schools and had an uneventful childhood. It was at the University of Chicago that he discovered his interest in astronomy. He studied mathematics and astronomy and whiled away his spare time gaining a reputation as a fine amateur boxer! When he graduated he was awarded a Rhodes Scholarship to study law at Oxford University.

After graduating he returned to America and set up as a lawyer in Kentucky. He was soon so bored that he gave up his practice and returned to the University of Chicago to study astronomy again, and work in the Yerkes Observatory in Wisconsin. He served in World War I and then returned to his favourite activity of observing the heavens.

He went to work at the Mount Wilson observatory and was so involved in his work that he began to make several significant discoveries. He published his observations and theories in 1924 and made many astronomers re-think some of their own theories.

His main work was in classifying other galaxies than our own Milky Way. He found out that these other galaxies were receding from the Milky Way and that the farther away they were the faster they receded. Therefore, he stated that the universe was not static, but still expanding. Although some of his calculations were wrong, Hubble's idea of a constantly expanding universe has since proved to be correct. Hubble, considered to be the father of extragalactic astronomy, worked until he died in 1953 at the age of sixty-four.

Activity: Research - Knowledge.

1. What is the difference between a reflecting and refracting telescope?
2. What are the two types of eclipse that occur?
3. How can you tell the difference between a star and a planet as they traverse the sky?
4. Find out the length of the different 'years' of three planets. (Time to orbit the sun).
5. If you have access to a telescope, choose a clear autumn evening when it's not too cold, make yourself comfortable and spend an hour or two observing the heavens. Break off periodically to note down all your observations and anything that happens.

Mary Douglas Leakey was born in London. Her father was an artist and her grandfather was an anthropologist and archaeologist. Mary inherited her father's skill and put it to good use drawing all the artefacts she discovered. Mary had a normal schooling and then took up archaeology as a profession. She met Dr. Louis Leakey, another archaeologist who was back on leave from Africa in 1935.

Dr. Leakey needed a good illustrator, and he persuaded Mary to return to Africa with him. They were married on Christmas Eve, 1936. They spent most of the rest of their lives in Africa, excavating sites in an attempt to find evidence of the existence of the earliest form of man. They had many exciting finds which they published and earned enough to allow them to continue searching.

In 1959, Mary made a significant find when she spotted a piece of bone with two fossilised teeth half buried in a rocky slope. Very carefully, she released it from the ground and then went on to find four hundred more pieces of a skeleton. It was a long and slow process, each piece had to be removed with such care that only dental picks and artists soft brushes could be used. The skeleton was of an early hominid, or man, and was dated as being one and three quarter thousand years old. It was named Zinjanthropus, meaning East Africa Man.

In 1960, the National Geographic Society gave them enough money to proceed with several more excavations. They found more bones,but these were smaller than those of 'Zinj' and they named them, 'Homo Habilis' or skilful man. 'Homo' had a more upright stance than 'Zinj' plus a larger cranial cavity which presupposes a larger brain and thus more like modern man.

After Louis' death in 1960, Mary continued to live in their primitive house which consisted of three huts each of which had one side open to the elements. When not excavating, Mary spent many hours painstakingly restoring the many bone fragments that she had collected into some semblance of their original state.

In 1974, the National Geographic Society, again provided her with funds. She returned to the Laetoli region where her team made a very lucky discovery. Some of the team were fooling about pelting elephant dung at each other, when one of them looked down and saw some unusual indentations in the volcanic surface. They had discovered the marks left by hominids walking upright! They used the potassium-argon method to date them and found them to be about 3.7 million years old! They were photographed and carefully preserved using latex plaster casts. Since then more than twenty other sets of fossilised bones have been found in the same strata of rock, proving that man has existed for at least 3.7/8 million years. Mary Leakey has been presented with many awards for her work, and as she grows older she is now more likely to be found in the Museum in Nairobi than out on a dig.

Activity: Research - Archaeology.

1. Find out how different artefacts can be dated accurately.

2. What is dendrochronology and how is it used?

3. What is a proton magnetometer used for?

4. What is a soil resistivity meter? What is it used for?

5. In how many ways could a camera be used in archaeology?

6. If possible, visit some archaeologists on a dig. Ask them questions.