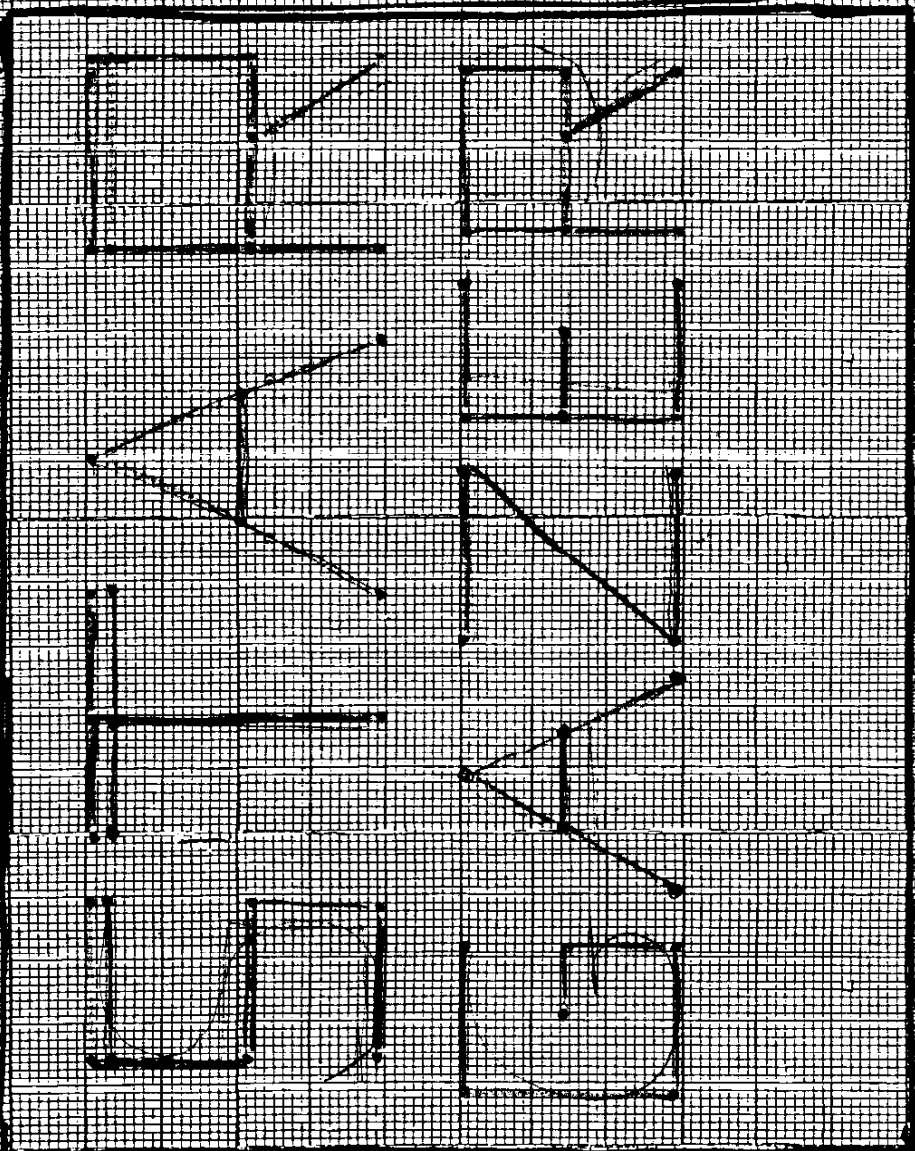


8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24



2 3 4 5 6 7 8 9 10 11 12 13

INSTRUCTIONS

INSTRUCTIONS

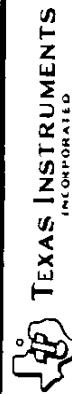
A series of horizontal lines for writing answers.

AUDIO/TONES:

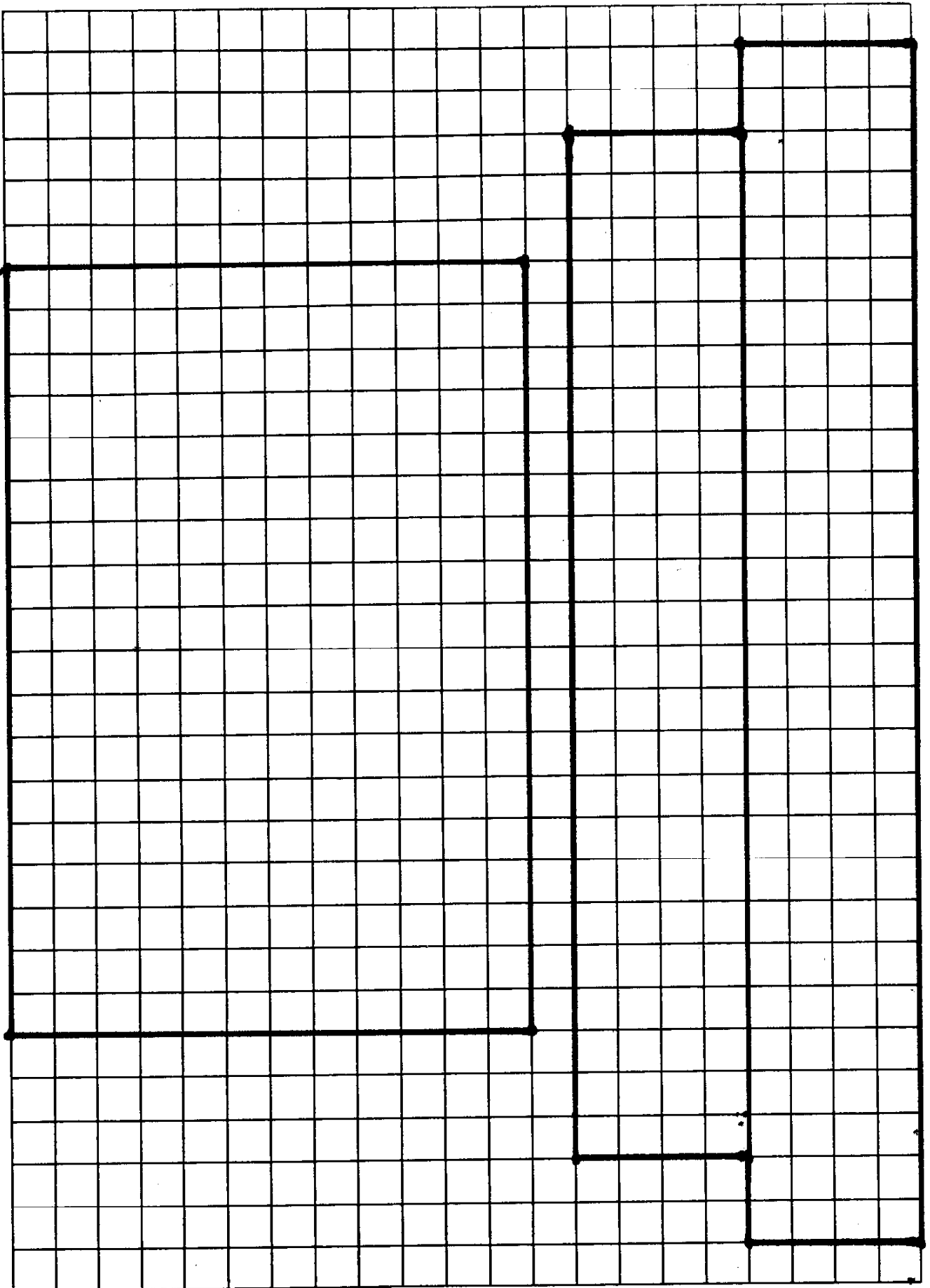
AUDIO/TONES:

HOME COMPUTER "GROM" DEVELOPMENT

DATE:



TEXAS INSTRUMENTS
INCORPORATED



↓ CHECK YOUR SCORE

COM/SCI MATCH	00	0
SCI/COM MATCH	00	0
COMMON GUESSES	00	5
SCIENTIFIC GUESSES	00	0

INSTRUCTIONS

INSTRUCTIONS

AUDIO/TONES:

AUDIO/TONES:



TEXAS INSTRUMENTS
INCORPORATED

HOME COMPUTER "GROM" DEVELOPMENT

DATE:

MOVE THE GLOVE TO YOUR CHOICE, 30
 THEN PRESS FIRE BUTTON 24

20
 11
 17
 18
 16
 15
 19
 16
 16
 14

G A Z E R
 K A Z E R
 I) MEET THE STARS
 2) COM SCI MATCH
 3) SCI/COM MATCH
 4) COMMON GUESS
 5) SCIENTIFIC GUESS
 6) TO BE DEFINED
 PRESS THE NUMBER
 OF YOUR CHOICE

INSTRUCTIONS:

INSTRUCTIONS:

AUDIO/TONES:

AUDIO/TONES:

LITTLE DIPPER

Ursa Minor

①

DOTS : 38, 89 50, 97 61, 111 68, 133 78, 132 82, 157
69, 155 >FF

LINES : 41, 90, 48, 95 / 52, 99, 60, 108 / 62, 113, 67, 130
71, 132, 76, 131 / 79, 134, 81, 155 / 79, 156, 72, 155
69, 135, 70, 152 >FF

The Lion

LEO

DOTS : 64, 79 52, 96 62, 99 67, 140 55, 136 50, 126
43, 127 36, 138 40, 144 >FF

LINES : 62, 81, 54, 93 / 55, 96, 60, 98 / 65, 81, 63, 96
63, 101, 67, 137 / 65, 139, 58, 137 / 55, 133, 52, 128
48, 125, 46, 126 / 42, 129, 38, 135 / 37, 140, 38, 141, >FF

The Crab CANCER

DOTS : 74, 111 103, 127 70, 136 45, 164 >FF

LINES : 74, 113, 70, 133 73, 135, 101, 127 68, 138, 47, 161 >FF

The Twins

GEMINI

DOTS : 87, 87 86, 104 61, 103 49, 99 29, 111 29, 127
67, 129 85, 135 90, 141 >FF

LINES : 87, 89, 87, 101 / 84, 104, 64, 103 / 59, 102, 52, 99
47, 100, 32, 111 / 29, 113, 29, 124 / 32, 126, 45, 129
70, 129, 83, 134 / 88, 137, 89, 138 / >FF

HERCULES

DOTS : 36, 90 48, 117 57, 150 56, 81 59, 110 77, 122 98, 152 >FF

LINES : 38, 92, 47, 114 / 49, 119, 57, 147 / 51, 114, 57, 111
57, 83, 60, 107 / 62, 111, 75, 119 / 79, 124, 96, 149 >FF

CASSIOPEIA

(2)

DOTS : 42, 102 58, 107 61, 123 79, 132 71, 155 >FF
LINES : 45, 102, 56, 105 / 58, 109, 61, 120 / 64, 124, 77, 130
79, 134, 72, 152 >FF

LIBRA

DOTS : 43, 102 61, 93 85, 149 49, 139 >FF
LINES : 43, 104, 49, 136 / 52, 139, 83, 148 / 63, 95, 85, 146
57, 94, 46, 100 >FF

VIRGO

DOTS : 39, 134 53, 138 61, 147 85, 123 65, 107 >FF
LINES : 42, 134, 51, 136 56, 140, 60, 144 64, 144, 83, 125
84, 120, 68, 109 >FF

CAPRICORNUS

DOTS : 39, 137 45, 141 87, 142 87, 104 76, 77 64, 112 >FF
LINES : 42, 138, 43, 139 / 48, 141, 85, 141 / 88, 139, 88, 106
87, 101, 78, 79 / 76, 79, 65, 109 / 62, 113, 41, 134 >FF

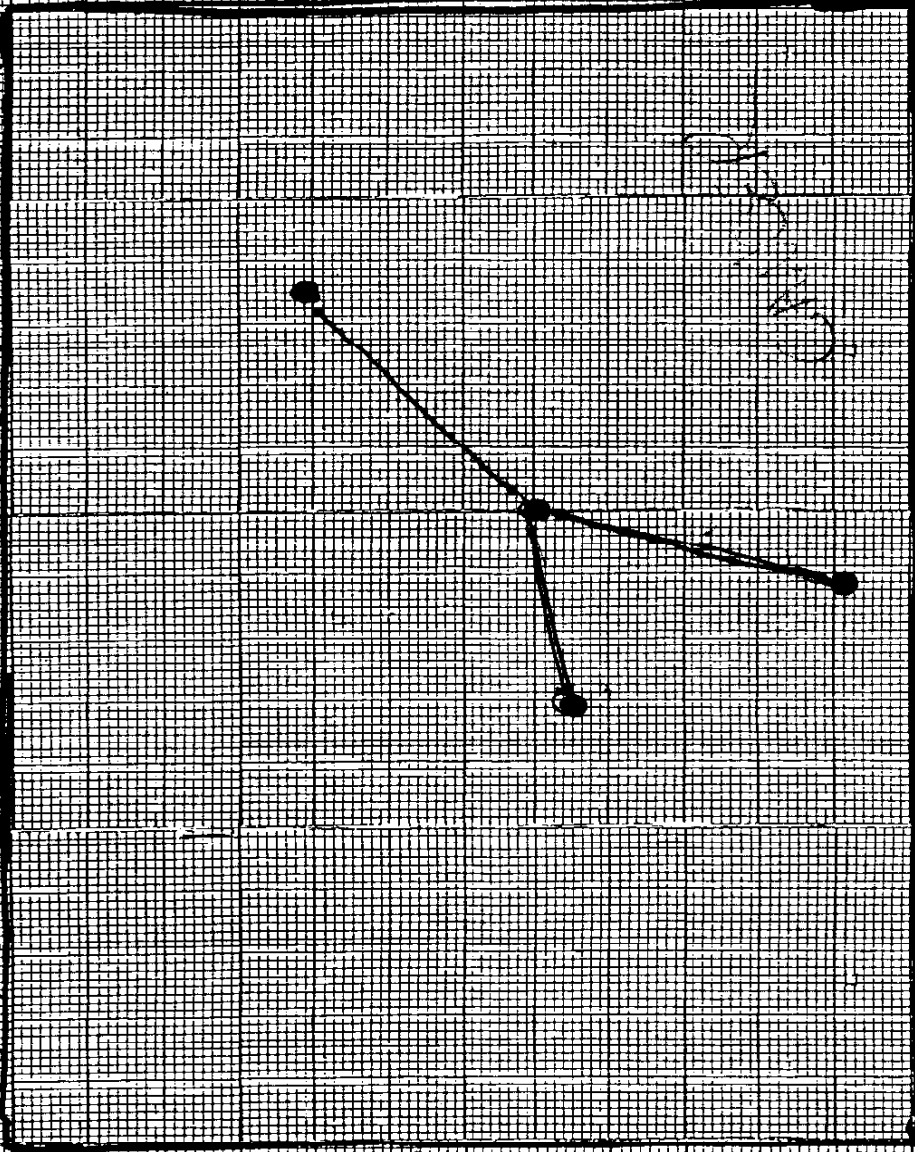
CEPHEUS

DOTS : 31, 77 61, 94 81, 119 81, 129 56, 145 41, 122 >FF
LINES : 34, 77, 60, 91 / 64, 95, 80, 116 / 82, 121, 82, 126
79, 131, 59, 144 / 55, 142, 43, 124 / 41, 119, 31, 79
60, 96, 44, 120 >FF

SAGITTARIUS

DOTS : 58, 96, 66, 106 54, 115 52, 108 45, 131 58, 144
73, 147 57, 162 >FF
LINES : 57, 98, 54, 105 61, 98, 65, 103 64, 108, 57, 113
53, 110, 53, 112 47, 134, 56, 142 52, 117, 46, 128
59, 146, 58, 159 61, 144, 71, 146 >FF

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deral agency dedicated to cancer research and control. The largest voluntary organization engaged in this work is the American Cancer Society.

Many of the anticancer efforts in the United States are carried out as part of a National Cancer Program established by Congress in 1971. This program awards federal funds to private and public organizations engaged in cancer research and control. The program also provides for the coordination of research and control activities at the national level. The National Cancer Institute manages the program.

As part of the National Cancer Program, the federal government has created about 20 Comprehensive Cancer Centers throughout the United States. The centers are intended primarily to promote and coordinate cancer research and control at the local level. Also as part of the cancer program, about 60 Specialized Centers for cancer research have been established at hospitals, medical schools, and other institutions throughout the country.

FRANK J. RAUSCHER, JR., and
NORMA GOLUMBIC

Related Articles in WORLD BOOK include:

Biopsy	Fibiger, Johannes A. G.	Radioactivity (In Medicine)
Cancer Society, American	Hodgkin's Disease	Radium
Cell	Leukemia	Rous, F. Peyton
Cobalt Bomb	Malignancy	Smoking
Disease (table)	Radiation	Tumor
Epithelioma		

Outline

- I. How Cancer Develops
- II. Kinds of Cancer
 - A. Classification by Body Site
 - B. Classification by Body Tissue
- III. Causes of Cancer
 - A. Carcinogens
 - B. Inherited Tendencies
- IV. Cancer Detection and Diagnosis
 - A. Cancer's Seven Warning Signals
 - B. Preliminary Diagnosis
 - C. Final Diagnosis
- V. Cancer Treatment
 - A. Surgery
 - B. Radiation Therapy
 - C. Drug Therapy
 - D. Combination Therapy
- VI. Basic Cancer Research
- VII. Cancer Organizations and Programs

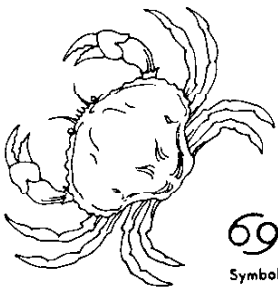
Questions

- What are the three main methods of treating cancer?
- What kind of cancer causes the most deaths among American men? Among American women?
- How is cell reproduction involved in the development of cancer?
- What are cancer's seven warning signals?
- How do scientists determine whether a particular substance can cause cancer?
- Why is cancer extremely difficult to treat unless it is detected early?
- What are *carcinomas*? *Sarcomas*?
- Why may many people be immune to cancer?
- What steps has the U.S. government taken to coordinate the nation's anticancer efforts?
- What causes most cases of lung cancer in the United States?

Reading and Study Guide

See *Cancer in the Research Guide/INDEX*, Volume 22, for a *Reading and Study Guide*.

Cancer—The Crab



69

Symbol

Birth dates: June 21–July 22.

Group: Water.

Characteristics: Artistic, emotional, home-loving, instinctive, patriotic, shy.

Signs of the Zodiac

Aries
Mar. 21–Apr. 19

Taurus
Apr. 20–May 20

Gemini
May 21–June 20

Cancer
June 21–July 22

Leo
July 23–Aug. 22

Virgo
Aug. 23–Sept. 22

Libra
Sept. 23–Oct. 22

Scorpio
Oct. 23–Nov. 21

Sagittarius
Nov. 22–Dec. 21

Capricorn
Dec. 22–Jan. 19

Aquarius
Jan. 20–Feb. 18

Pisces
Feb. 19–Mar. 20

WORLD BOOK Illustration by Robert Keys

CANCER is the fourth sign of the zodiac. Cancer, a water sign, is symbolized by a crab. Astrologers believe that the moon, which they consider a planet, rules Cancer.

Astrologers regard people born under the sign of Cancer, from June 21 to July 22, as intuitive and artistic. Cancerians also love home and family life. They are emotional, and their moods change quickly. They rely more on their feelings than on reason.

Cancerians can be hard to get along with. They often try to seem shy, but they are hiding feelings that are easily hurt. Their sensitivity makes them successful in business because they are aware of public needs. Cancerians can be selfish. They often prefer to dwell on their own dreams and memories instead of facing reality.

CHRISTOPHER MCINTOSH

See also **ASTROLOGY**; **HOROSCOPE**; **ZODIAC**.

CANCER, TROPIC OF. See **TROPIC OF CANCER**.

CANCER INSTITUTE, NATIONAL. See **CANCER (Cancer Organizations and Programs)**.

CANCER SOCIETY, AMERICAN, is a voluntary health organization. It supports research through grants to individuals and institutions. It also supports a program of service for cancer patients and their families. It directs educational programs for the public, doctors, and others who have an interest in curing the disease.

The society is governed by a national board of 114 volunteer directors. Half the volunteers are laypeople and half are physicians and scientists. Most society funds are raised in an annual drive during April, which was designated as Cancer Control Month by Congress in 1938. The society was founded in 1913. Headquarters are at 777 Third Avenue, New York, N.Y. 10017.

Critically reviewed by the AMERICAN CANCER SOCIETY, INC.

CANDELA, *kan DEE lah*, is the unit of measurement of *luminous intensity*, the amount of light produced in a certain direction by a glowing object. The more luminous intensity a light has, the brighter the light appears. Luminous intensity is sometimes called *candlepower*.

The candela is one of the seven base units in the metric system. Its symbol is *cd*. One candela is the amount of light that shines out through a hole in one side of a ceramic container after it has been heated to

1772° C under a pressure of 101,325 newtons per meter. The container is called a *blackbody*; the hole measures $\frac{1}{100,000}$ of a square meter. The radiating surface consists of platinum until the metal begins to melt. The container is slowly cooled until the platinum begins to solidify. At a temperature of 1772° C, the platinum inside begins to solidify at a temperature of 1772° C. At such a temperature, the platinum inside glows with intense light. This light shines through the hole in the container.

The candela is used to calculate other units of measurement. These units include *lumen* and *candle*. The unit of measurement for lumen was once the *candle*, the amount of light from a certain kind of candle. But scientists found it difficult to standardize. In 1948, the International Commission on Illumination adopted the candela as slightly less than 1 candle.

See also **FOOT-CANDLE**; **LIGHT (The Light)**; diagram: **Basic Units of Light**

CANDIDE. See **VOLTAIRE**.

CANDIRU. See **CATFISH**.

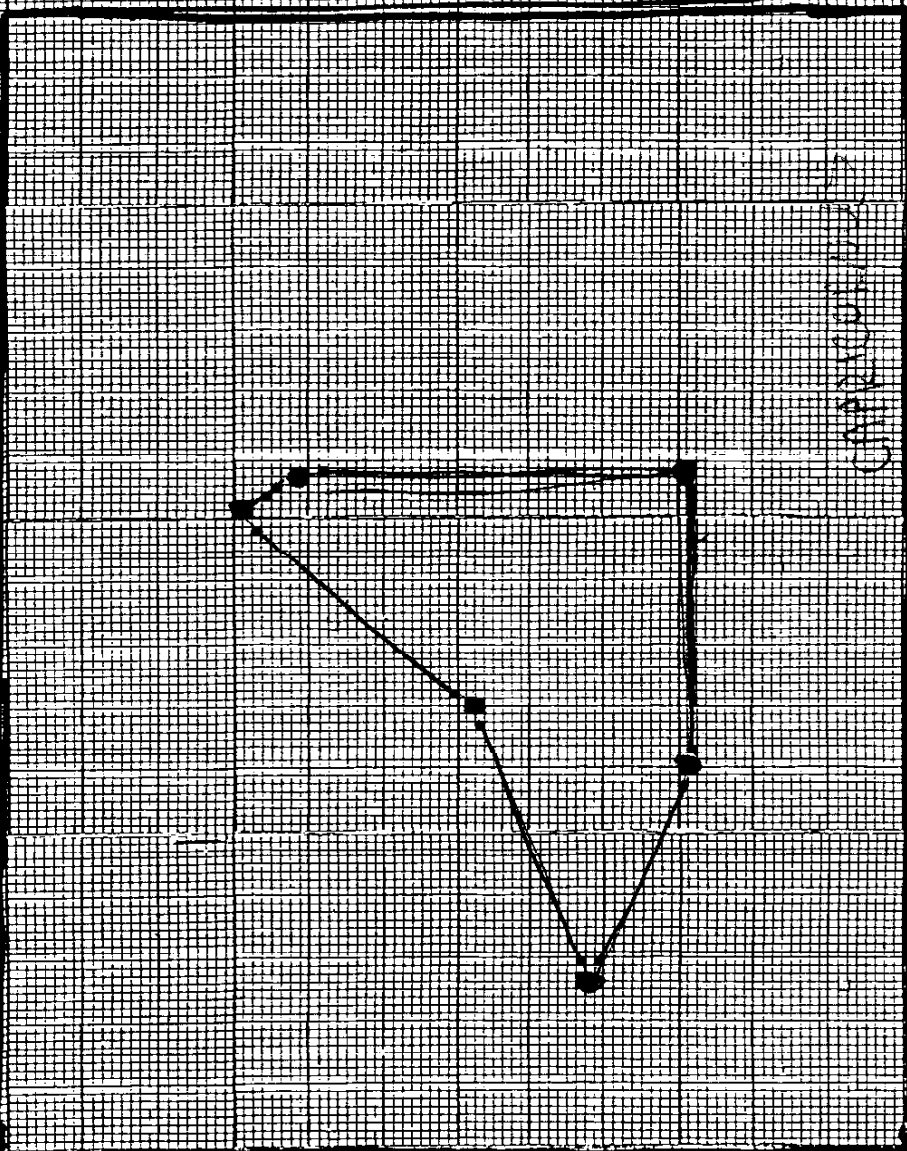
CANDLE was the chief source of artificial light for at least 2,000 years. The candle is a lighting device that is simple, portable, and can be stored indefinitely. Candles made of fats wrapped in tusk were used before the time of Christ. Later, tallow was placed in a candle mold. The wax was melted and poured into the mold. The finished candle was then dipped in tallow, which is obtained from tallow, mineral wax. They are formed by dipping many times into the melted material, or by forcing the candle material into molds, or by forcing the candle material into molds and then threading the wick down the center. Candles are made of woven cord.

Candles often play a part in religious ceremonies. Christians burn candles at Christmas.



Candlemaking by Hand is still an art. It makes candles by dipping the wicks into hot wax.

15 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25



15 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

CAPREOLINIUS



Mike Salisbury, Black Star
Truman Capote

are set in the South. Many of their characters are eccentric, some sinister and others comic. The atmosphere is filled with grotesque, supernatural elements, and the style is vivid and fanciful. *A Tree of Night and Other Stories* (1949) makes even greater use of weird, supernatural elements. *Breakfast at Tiffany's* (1958) traces the decline of Holly Golightly, a New York City playgirl.

Capote also wrote *The Muses Are Heard* (1956), an account of his experiences with the cast of *Porgy and Bess* touring Russia. He adapted his story *House of Flowers* into a musical produced in 1954. EUGENE K. GARBER

CAPP, AL (1909-), an American cartoonist, created the comic strip *L'il Abner* in 1934. Capp centered the comic strip on the humorous adventures of L'il Abner Yokum, a hillbilly from "Dogpatch U.S.A." Other major characters included his wife Daisy Mae and his parents Mammy and Pappy Yokum. Capp often used *L'il Abner* to satirize famous persons and events of the day. He created the character of Fearless Fosdick in *L'il Abner* as a satire on another comic strip character, detective Dick Tracy.



Al Capp

Capp was born in New Haven, Conn. His real name is Alfred Gerald Caplin. He attended two art schools before joining the Associated Press as a cartoonist in 1932. He helped create the comic strip *Abbie*

an' Slats in 1937 and created another strip, *Long Sam*, in 1954.

See also SATIRE.

CAPPER-VOLSTEAD ACT OF 1922. See COOPERATIVE (History).

CAPRA, FRANK (1897-), is an American motion-picture director. He became noted for his comedies dealing with the individual's fight against corruption in society. These comedies include *Mr. Deeds Goes to Town* (1936), *You Can't Take It with You* (1938), *Mr. Smith Goes to Washington* (1939), and *State of the Union* (1948). Capra won Academy Awards for his direction of *Mr. Deeds Goes to Town*, *You Can't Take It with You*, and *It Happened One Night* (1934). He also directed *Lost Horizon* (1937), *Meet John Doe* (1941), and *Arsenic and Old Lace* (1942). During World War II, he produced the *Why We Fight* series for the United States Army.

Capra was born in Palermo, Sicily, and moved to the United States at the age of six. He studied chemical engineering in California before entering the motion-picture industry in 1923. Capra directed comedian Harry Langdon's best silent films, including *Tramp*, *Tramp*, *Tramp* (1926). Capra's autobiography, *The Name Above the Title*, was published in 1971. HARVEY R. DENBEROFF

CAPRI, KAH pree (pop. 12,144), is an Italian island the Bay of Naples. Its climate and scenery attract the sands of visitors. The famous Blue Grotto is a wave-cave that is filled with a sapphire-blue coloring when the sun shines through its waters. For the location Capri, see ITALY (physical map).

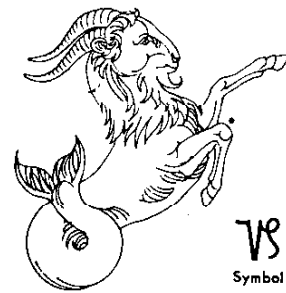
The island covers about 4 square miles (10 square kilometers). Mount Solaro (1,932 feet, or 589 meters) the highest point. The capital, which is also named Capri, lies in the eastern part of the island. The town Anacapri, in the western portion, is 738 feet (225 meters) above sea level. It stands on a plateau. Products the island include red and white wine, olive oil, and fruits. In Greek mythology, Capri was the home of the lovely maidens called the Sirens, whose music enchanted Ulysses and his sailors. The Roman emperors Augustus and Tiberius built splendid palaces on Capri.

DENJAMIN WEBB WHEELER

CAPRICORN is the 10th sign of the zodiac. Its symbol is a goat. Astrologers believe that the planet Saturn rules Capricorn. They consider Saturn to have a strong influence. Capricorn is an earth sign.

According to astrologers, people born under the sign of Capricorn, from December 22 to January 19, take life seriously and do not have much of a sense of humor. They overcome hardship well and enjoy the challenge.

Capricorn—The Goat



♄
Symbol

Birth dates: Dec. 22–Jan. 19.

Group: Earth.

Characteristics: Ambitious, cautious, dignified, patient, persistent, practical.

Signs of the Zodiac

Aries
Mar. 21–Apr. 19
Taurus
Apr. 20–May 20
Gemini
May 21–June 20
Cancer
June 21–July 22
Leo
July 23–Aug. 22
Virgo
Aug. 23–Sept. 22
Libra
Sept. 23–Oct. 22
Scorpio
Oct. 23–Nov. 21
Sagittarius
Nov. 22–Dec. 21
Capricorn
Dec. 22–Jan. 19
Aquarius
Jan. 20–Feb. 18
Pisces
Feb. 19–Mar. 20

WORLD BOOK Illustration by Robert Key

of difficult problems. Capricorns do not rush into friendships, but they remain loyal after their confidence has been gained.

Capricorns behave with dignity and do not like to hurry. Their stubbornness often leads them to insist that their opinions are right. They can sometimes be too stern.

CHRISTOPHER MCINTOSH

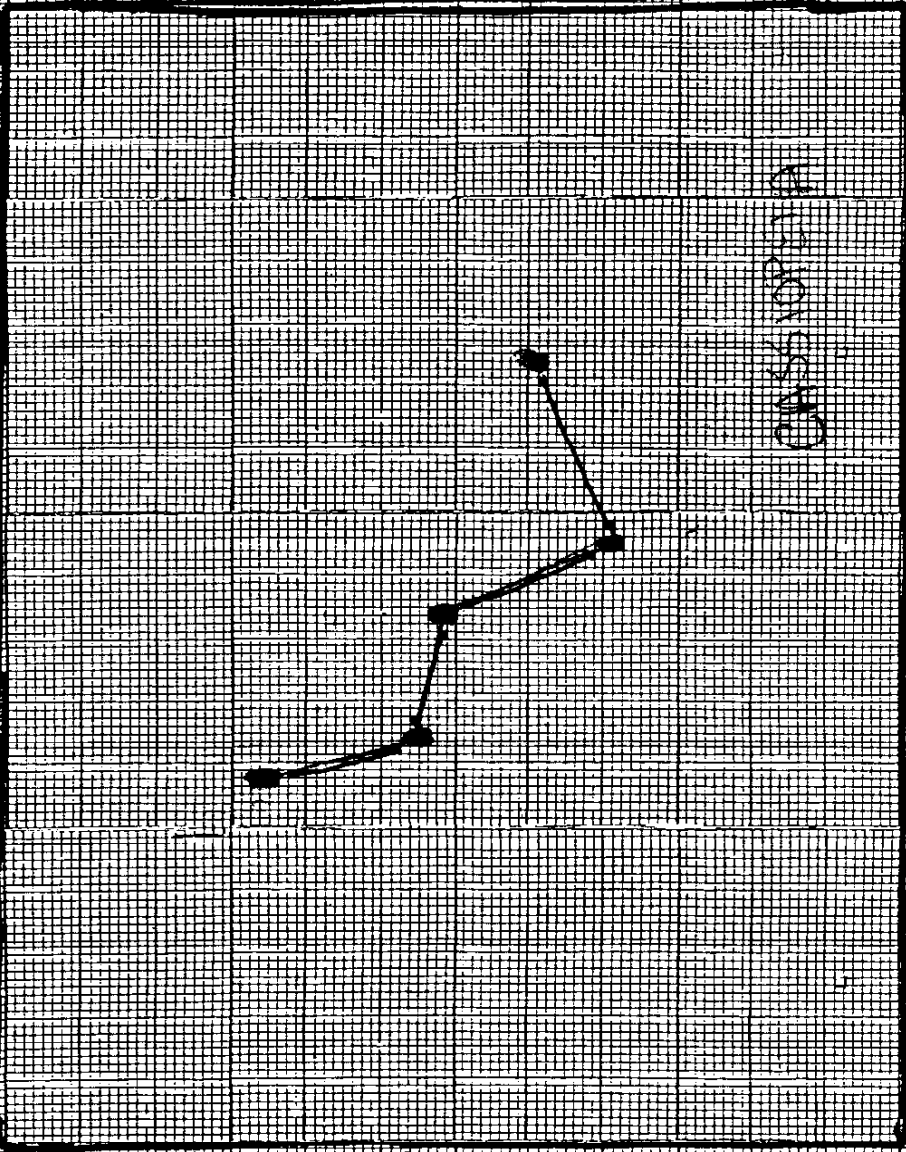
See also ASTROLOGY; HOROSCOPE; ZODIAC (diagram: The Signs of the Zodiac).

CAPRICORN, TROPIC OF. See TROPIC OF CAPRICORN.

CAPRICORNUS. See ASTRONOMY (Skies of the Seasons).

CAPS AND GOWNS are the official and traditional costumes for students in many nations. In most cases,

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CLASS VOTING

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0

CASSETTE. See TAPE RECORDER; TELEVISION.

CASSIA, KASH uh, is any one of a group of plants that includes many trees, shrubs, and herbs. They grow in tropical and warm temperate climates. Some botanists place over 400 different species in this group.

Cassias from Africa and from India supply the *senna* (dried leaves) used as a laxative. Several kinds of cassia grow wild in the United States. These include wild senna and partridge peas. *Cassia bark* is the bark of a plant of the laurel family. It tastes like cinnamon.

Scientific Classification. True cassias belong to the pea family, *Leguminosae*. The African cassia is genus *Cassia*, species *C. acutifolia*. The Indian cassia is *C. angustifolia*. The wild senna is *C. marilandica*. The partridge pea is *C. fasciculata*. HAROLD NORMAN MOLDENKE

See also CINNAMON; PARTRIDGE PEA.

CASSIN, RENÉ. See NOBEL PRIZES (table [1968]).

CASSINI, JEAN DOMENIQUE. See SATURN (Rings).

CASSINO, kuh SEE noh (pop. 21,105), is an Italian town about 75 miles (121 kilometers) southeast of Rome. For location, see ITALY (political map). The famous Benedictine monastery of Monte Cassino has been the home of Benedictine monks since A.D. 529. Fierce fighting took place in Cassino during World War II, when German troops made a stronghold of the city and resisted Allied attempts to seize it. SHEPARD B. CLOUGH

See also MONTE CASSINO.



Cassiopeia Is Called "The Lady In Her Chair."

CASSIOPEIA, KAS ee uh PEE uh, is an easily seen constellation of the Northern Hemisphere. It is located on the side of the North Star opposite the Big Dipper, and about the same distance away. Five of the brightest stars in Cassiopeia form a sprawling, irregular letter W. In Greek mythology, Cassiopeia was the mother of Andromeda and the wife of Cepheus. Because of her mother's vanity, Andromeda was chained to a rock in the sea. I. M. LEVITT

CASSITERITE, kuh SIHT uh ryt (chemical formula, SnO_2), is the only important mineral ore of tin. It is sometimes called *tinestone*. Cassiterite usually has a slight metallic luster, with a brown or black color. It usually occurs in veins associated with quartz, and is either in or near granite rocks. Malaysia provides

CASSOWARY

about one-third of the world's tinstone supply. Bolivia, Communist China, Russia, and Thailand are also major sources. See also TIN.

WALTER J. MOORE

CASSIUS LONGINUS, KASH ih uhs lahn JY nuhs, GAIUS (? -42 B.C.), was a Roman general who, with Marcus Junius Brutus, led the conspiracy against Julius Caesar. During the civil war between Caesar and Pompey, Cassius commanded a fleet for Pompey. Caesar won the war, pardoned Cassius, and made him *praetor* (administrator of the courts) in 44 B.C. But Cassius helped murder Caesar later in 44 B.C. Cassius and his brother-in-law Brutus fled east and raised a large army. Mark Antony and Octavian defeated them at Philippi. Cassius committed suicide when his camp was taken. See also CAESAR, GAIUS JULIUS. CHESTER G. STARR

CASSOWARY, KAS uh WEHR ee, is a large, shy bird that lives in the thick forests of Australia, New Guinea, and nearby islands. Cassowaries cannot fly. All three species of cassowaries have a massive body, long legs, and a featherless neck and head. A bony helmet, used for butting through undergrowth, covers the head.

The largest species, the one-wattled cassowary of New Guinea, stands about 5 feet (1.5 meters) tall and weighs about 120 pounds (54 kilograms). Its wings and tail are small and almost hidden. Brownish-black, bristlelike feathers cover the body. Each foot has three toes armed with sharp claws. These claws are deadly weapons in a fight.

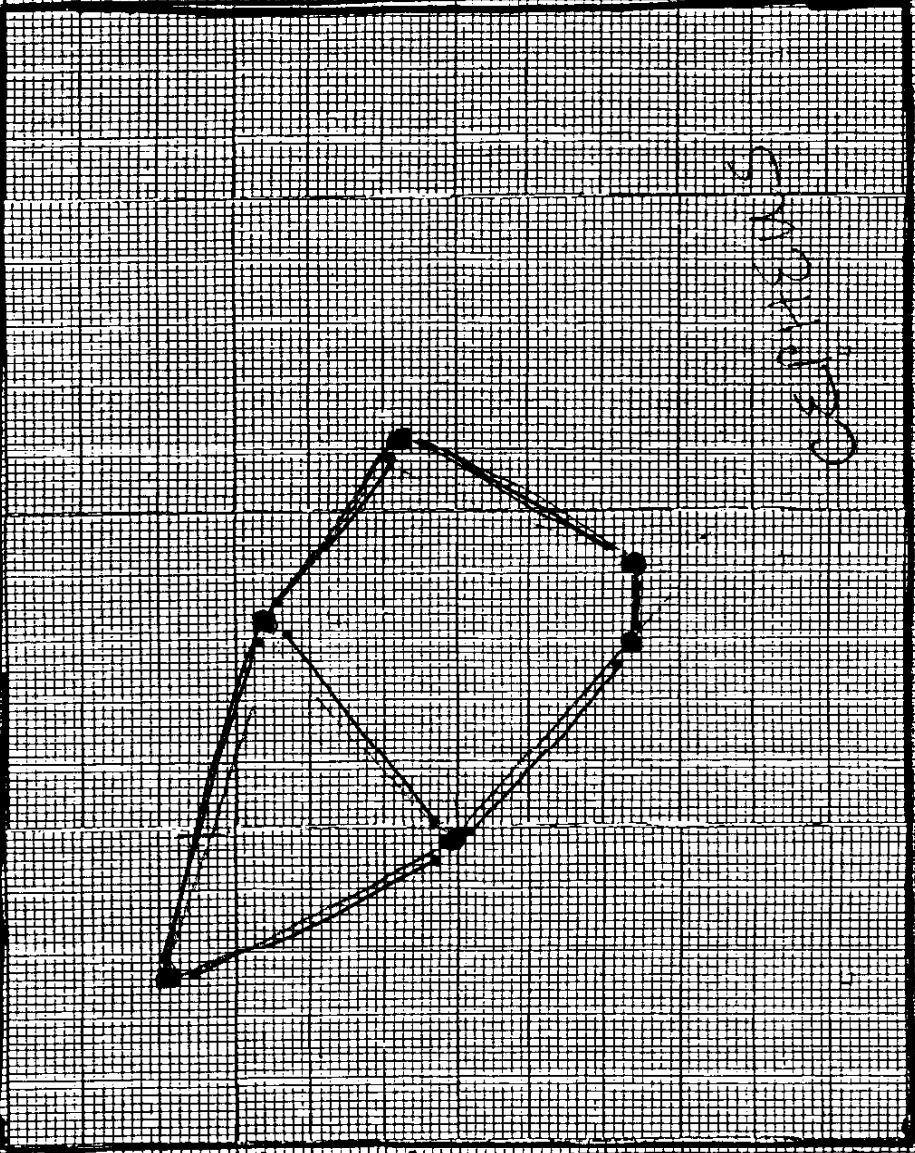
Scientific Classification. Cassowaries make up the cassowary family, *Casuariidae*. The one-wattled cassowary is classified as genus *Casuarius*, species *C. unappendiculatus*. R. A. PAYNTER, JR.

See also BIRD (Interesting Facts About Birds [Most Dangerous]); EMU.

The Cassowary can sprint at nearly 40 miles (64 kilometers) per hour and leap 6 feet (1.8 meters) or more in the air.



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15 2
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31 4
39 5
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55 7
63 8
71 9
79 10
87 11
95 12
103 13

You can use the following formula to calculate the centripetal force, F , necessary to make an object travel in a circular path:

$$F = \frac{mv^2}{r}$$

Multiply the object's mass, m , by the square of its velocity (the velocity multiplied by itself), v^2 , and divide this product by the radius of the circle in which the object moves, r . In the metric system, the centripetal force is given in newtons when the object's mass is in kilograms, the velocity in meters per second, and the radius in meters.

See also INERTIA; MOTION (Newton's Laws of Motion).

CENTROSPHERE. *SEHN troh spher*, or **BARYSPHERE**, *BAR ih spher*, is the inner core of the earth. Its diameter is about 1,630 miles (2,623 kilometers). Scientists believe that it is composed mainly of iron and nickel. See also SEISMOLOGY.

CENTURION was a captain in the Roman army who commanded a *century* (a force numbering approximately 100 men). See also LEGION.

CENTURY ordinarily means 100 years. The word is from the Latin *centuria*, meaning a hundred. The years 1 through 100 after the birth of Christ are called the first century; from 101 through 200 was the second century. The present century is the 20th century.

CENTURY CITY. See LOS ANGELES (West Los Angeles; picture: Century City).

CENTURY OF PROGRESS EXPOSITION marked the *centennial* (100th anniversary) of Chicago. The fair opened in 1933 on a strip of reclaimed land about 6 miles (10 kilometers) long and 600 feet (180 meters) wide along Lake Michigan. More than a fifth of the area was devoted to lagoons. The exhibits of science and industry were regarded as the best ever assembled in the United States up to that time. Appealing to non-scientific minds, they emphasized the union of science and industry and its remarkable developments.

In 1933, the United States was in the midst of a severe depression. Unlike most previous major expositions, the Century of Progress was an outstanding financial success. It was held over for the next summer, and not only paid off its underwriters, but yielded a surplus. Its construction and operation, together with the many people it brought to the city, proved strong business stimulants. The fair enabled many Chicago businessmen to avoid bankruptcy.

HERBERT J. DOTTEY

See also FORT DEARBORN (picture).

CENTURY OF REVOLUTION. See REVOLUTION, CENTURY OF.



Josef Muench

Century Plant stems reach their full height—20 to 30 feet (6 to 9 meters)—in one season.

CERAMIC ENGINEERING

CENTURY PLANT, or **AGAVE**, *uh GAY ver*, is the name of a group of desert plants belonging to the agave family. The name came from the mistaken idea that the American century plant blooms only once in 100 years. Some kinds of century plants flower every year. Other kinds bloom less often. But none blooms so rarely as once in 100 years.

The American century plant has thick, fleshy leaves with sharp-spined edges. The white or greenish flowers grow in an open cluster on the upper portion of the stalk. The leaves die after the plant has bloomed. The roots remain alive and produce a new plant. The American century plant is also known as the *American aloe*.

The people of Mexico use the sap of certain agaves to make beverages, such as *pulque* and *mescal*. The long, tough fibers of agaves may be formed into thread, cord, and ropes. The green leaves are used as fodder.

Scientific Classification. Agaves belong to the agave family, *Agavaceae*. The American century plant is genus *Agave*, species *A. americana*.

EDMUND C. TARDER

See also HENEQUEN; MAGUEY; SISAL.

CEPHALOPOD. See MOLLUSK (Octopuses and Squids); OCTOPUS.

CEPHALOTHORAX. See ARACHNID.

CEPHEUS, SEE fyooos, is a constellation of stars located between the North Star and Cygnus. In Greek mythology, Cepheus was a king. He was the husband of Cassiopeia and the father of Andromeda. One star in the constellation Cepheus, *Delta Cephei*, ranks as the first-known and brightest of the class of regularly pulsating stars known as the *Cepheid variables*.

I. M. LEVITT

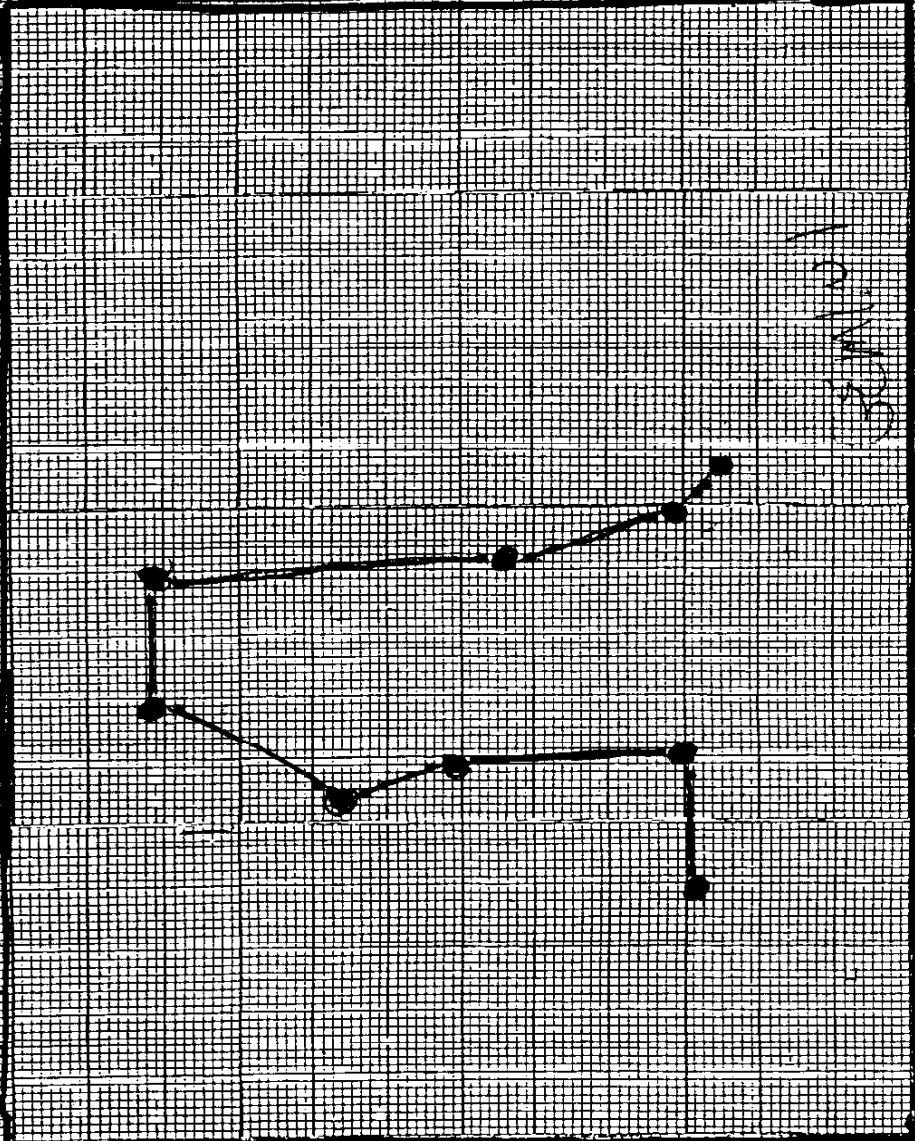


The Constellation Cepheus

CERAM. See INDONESIA (The Moluccas; table: Chief Islands).

CERAMIC ENGINEERING. See ENGINEERING (table: Specialized Engineering Fields).

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GEM STATE

In recent years, synthetic gems of good quality have been produced in the laboratory. Rubies and sapphires have been made by melting aluminum oxide in a flame from oxygen and hydrogen gases. They constitute the bulk of synthetic stones on the market. Other artificially produced gems include star sapphires, rubies, emeralds, spinels, rutiles, and one stone that does not exist in nature, fabulite.

FREDERICK H. POUGH

Related Articles in WORLD BOOK include:

Agate	Corundum	Onyx
Alexandrite	Diamond	Opal
Amber	Diopside	Pearl
Amethyst	Emerald	Peridot
Aquamarine	Garnet	Ruby
Beryl	Intaglio	Sapphire
Birthstone	Jade	Sardonyx
Cameo	Jasper	Tanzanite
Carat	Jet	Topaz
Carbuncle	Jewelry	Tourmaline
Carnelian	Lapidary	Turquoise
Cat's-eye	Lapis Lazuli	
Chalcedony	Mineral	
Coral	Moonstone	

GEM STATE. See IDAHO.

GEMARA. See HEBREW LANGUAGE AND LITERATURE; TALMUD.

GEMINI, JEHM *uh ny*, is the third sign of the zodiac. It is symbolized by twins. Astrologers believe that Gemini is ruled by the planet Mercury, which is named for the ancient Roman messenger of the gods. Gemini is an air sign.


Astrologers regard people born under the sign of Gemini, from May 21 to June 20, as clever, curious, and expressive. Geminis also are witty in conversation. They have a two-sided personality. They often change moods quickly, and they can see both sides of an argument. Because of this trait, Geminis sometimes have trouble making decisions.

Geminis are restless and try many activities. They have special talents for communication and language, and so are excellent journalists, politicians, salespeople, and teachers.

CHRISTOPHER MCINTOSH

See also ASTROLOGY; HOROSCOPE; ZODIAC.

WORLD BOOK Illustration by Robert Keys

<p>Gemini—The Twins</p>  <p style="text-align: center;">II Symbol</p> <p>Birth dates: May 21–June 20. Group: Air. Characteristics: Curious, lively, moody, restless, talkative, witty.</p>	<p>Signs of the Zodiac</p> <p>Aries Mar. 21–Apr. 19</p> <p>Taurus Apr. 20–May 20</p> <p>Gemini May 21–June 20</p> <p>Cancer June 21–July 22</p> <p>Leo July 23–Aug. 22</p> <p>Virgo Aug. 23–Sept. 22</p> <p>Libra Sept. 23–Oct. 22</p> <p>Scorpio Oct. 23–Nov. 21</p> <p>Sagittarius Nov. 22–Dec. 21</p> <p>Capricorn Dec. 22–Jan. 19</p> <p>Aquarius Jan. 20–Feb. 18</p> <p>Pisces Feb. 19–Mar. 20</p>
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GEMINI PROGRAM. See ASTRONAUT; SPACE TRAVEL (Manned Spacecraft; table: Manned Space Flight).

GEMSBOK, or **GEMSBUCK**, is a large antelope related to the roan and sable antelopes. It lives in southern Africa. Related species (kinds) live farther north in Ghana, Sudan, Somaliland, and southwestern Ethiopia. The gemsbok stands about 4 feet (1.2 meters) high at the shoulder. Its nearly straight, sharp horns also grow about 4 feet. These horns, which extend backward, are ribbed at their lower ends.

The gemsbok is yellowish-brown on top and black beneath, with black markings on the head, sides, and back. It is not a swift runner because of its heavy body. The gemsbok lives in bands of up to 20 animals and likes to roam on dry, grassy plains and areas of open vegetation.

Scientific Classification. The gemsbok belongs to the bovid family, *Bovidae*. It is classified as genus *Oryx*, species *O. gazella*.

VICTOR H. CARR

See also ANTELOPE (with picture).

GENDARME, zhahn DAHRM, is a French police officer. The title is given to French military police, who perform civil duties much like those of the state police in America. In wartime, the military police are called to active duty with the French armed forces. The first gendarmes were the elite armored cavalrymen who served as bodyguards to French kings for 450 years before the French Revolution.

THOMAS E. HARRIS

GENDER. In English, living things are classed as male or female, and things without life as neuter, or sexless. In the same way, words are said to belong to the masculine, the feminine, or the neuter gender. Neuter and gender are derived from Latin words meaning neither and middle. The word *animal* may represent either a male or female creature. Such words are said to be of common gender. These four classifications cover all nouns and pronouns and explain all the English genders.

English is the only important language in which gender is largely determined by the sex of the object which the word stands. Some other languages use a different system. In an entirely different way, a French feminine *hand* (*la main*) opens the feminine *door* (*la porte*). In German, a neuter *girl* (*Mädchen*) gazes at a masculine *moon* (*Mond*) in a *neuter night* (*Nacht*). Several other modern European languages have this same system of gender, and so do Early English, or Anglo-Saxon. Latin has a similar system of gender.

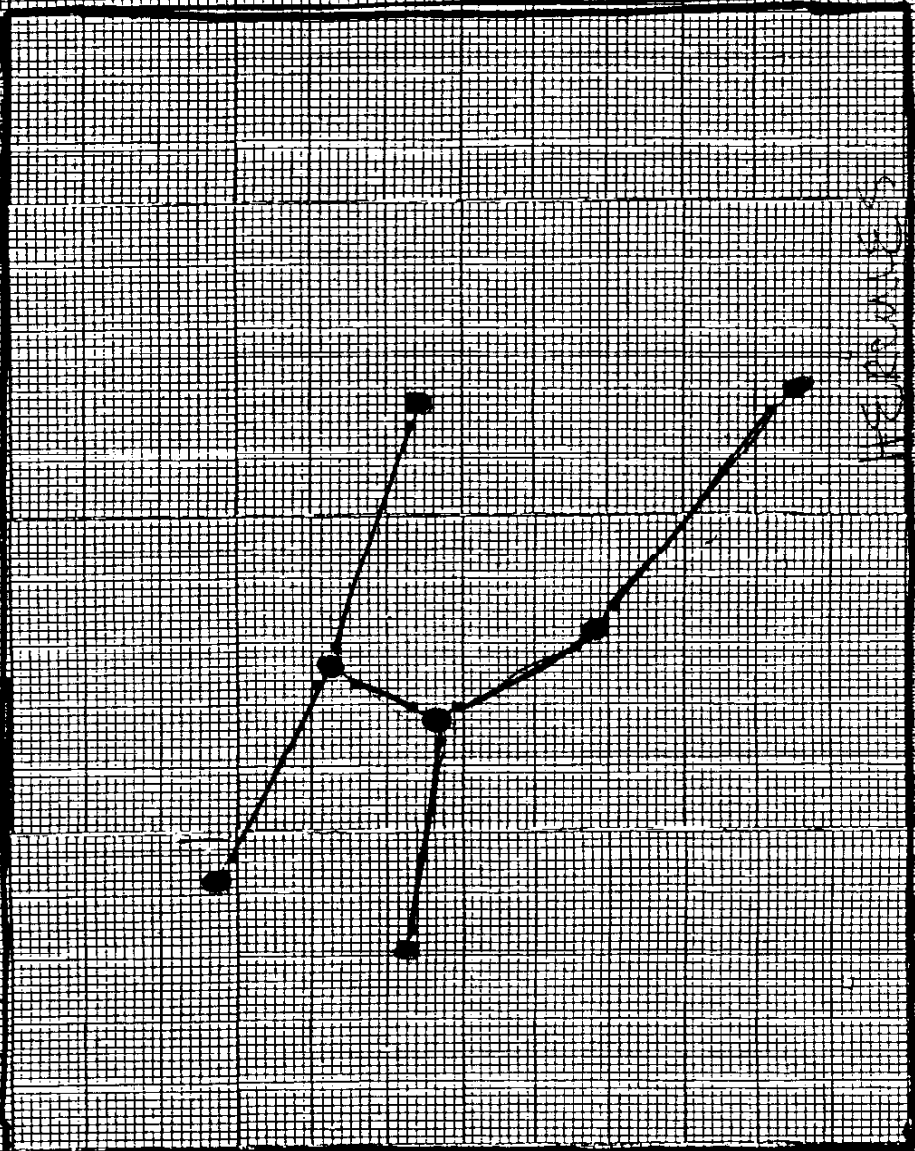
Personal Pronouns are the only pronouns that have different forms to show gender. These forms are in the third person singular—*he, his, him, she, her, hers, it*. The gender of others may be assumed for a particular use if one knows that *I, me, my, mine, you* stand for male or female. *It* and *its* are usually neuter, but not always. A young child may be represented by *it* or *its*, as "The infant cried for *its* food."

Nouns show the difference between the masculine and feminine gender in three ways.

Some nouns have different forms for the masculine and the feminine. Examples are *man, woman; boy, girl; lad, lass; husband, wife; cock, hen; stallion, mare; gander, goose; buck, doe; beau, belle; wizard, witch*.

Many masculine nouns may be made feminine by adding the suffixes *ess, ine, ina, trix, ne, a* or *ette*. Sometimes a letter in the masculine is changed or omitted.

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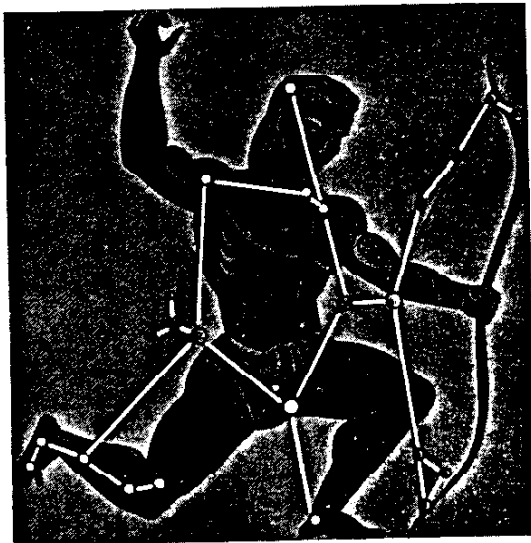
Apples of the Hesperides to Eurystheus. For his 12th labor; Hercules had to show Cerberus, the watchdog of the Lower World, to Eurystheus. He succeeded in seizing the monster and carrying it to Eurystheus. Then Hercules returned it to the Lower World. The last three labors were ways of winning immortality, because Geryon and Cerberus represent Death, and the apples were the fruit of the Tree of Life. See AMAZON; ATLAS; CERBERUS; HESPERIDES; PILLARS OF HERCULES.

Hercules' Death. At the end of his life, Hercules won immortality. He was traveling with Deianira, his wife, and he allowed a centaur named Nessus to carry her across a flooded stream. Nessus was rude to her, and Hercules shot him with a poisoned arrow. As Nessus died, he told Deianira to save his blood to use as a love charm. When Hercules later fell in love with Iole, a woman he had captured, Deianira dipped a robe in the blood and sent it to him. When he put it on, the poison ate away his flesh. In agony, he begged his friends to place him on a funeral pyre and light it. After his body had been burned up, he was taken up into Olympus and welcomed as one of the gods.

O. M. PEARL

See also ALCESTIS; HEBE.

HERCULES is a constellation of the Northern Hemisphere between Corona Borealis and Lyra. It is best seen high overhead in summer. The red star marking the head of Hercules lies toward the south. It is a giant, hundreds of times larger than the sun. In the northwest side of

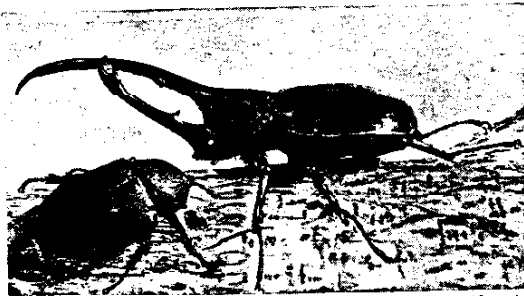


Hercules Was a Hero in Greek Mythology.

Hercules, a cluster numbering more than 100,000 stars appears. It is so far away that light requires more than 30,000 years to reach the earth. Even under good conditions, the cluster is barely visible to the naked eye. In 1934, a star in Hercules suddenly began to grow brighter. It increased until it looked brighter than the North Star. Such a star is called a *nova*. Novas have appeared in other constellations during this century, but all have now faded and telescopes are needed to see them (see NOVA).

I. M. LEVITT

HERCULES, PILLARS OF. See PILLARS OF HERCULES.



Nature Magazine

The Male and Female Hercules Beetles of the West Indies are quite different in appearance. The male has a shiny coat and curved horns which are longer than its body. The female is smaller, has no horns, and its coat is dull and rough.

HERCULES BEETLE is a remarkably large and strong beetle that lives in the West Indies. The male beetle grows 5 to 6 inches (13 to 15 centimeters) long. The insect's long horns project from the head and front underpart of the body. The horns are curved to meet each other and look like pincers. The rhinoceros beetle of southern and western United States is related to the Hercules beetle. It is similar in appearance but smaller.

Scientific Classification. The Hercules beetle belongs to the family *Scarabaeidae*. It is genus *Dynastes*, species *D. hercules*, and it belongs to the order *Coleoptera*. H. H. ROSS
See also BEETLE.

HERD. See ANIMAL (Flocks, Herds, and Schools).

HERDER, JOHANN GOTTFRIED VON (1744-1803), was one of the most original and versatile German writers, critics, and philosophers. His deep influence on the humanities can be felt today. He inspired Goethe and the other writers of the *Sturm und Drang* (Storm and Stress) movement with new ideas in poetry, art, language, religion, and history.

Herder continued Gotthold Lessing's work in trying to free German writers from imitating French classicism, based on the ancient Greeks. He argued that Shakespeare, Ossian, the Hebrew poets, and folk songs equaled the works of the Greeks.

His admirable translations of Shakespeare and the songs of many nations formed models for translations by the German romanticists who followed him. His *Ideas to a Philosophy of History* (1784-1791), in four volumes, contributed important theories on the development of human civilization. He explained the cultural evolution of human beings as part of the evolution of nature, rather than being a manifestation of man's rational free will.

Herder was born in Mohrungen, East Prussia, the son of a poor schoolteacher. He worked to finance his education. At the University of Königsberg, he studied theology and philosophy. Immanuel Kant was one of his teachers there. After four successful years as a teacher and preacher in Riga, Russia, Herder traveled through Europe. In Strasbourg, he met Goethe, and they became friends. Through Goethe's influence, Herder was appointed general superintendent of churches and court preacher at Weimar in 1776. GOTTFRIED F. MERKEL

See also GERMAN LITERATURE (The Storm and Stress Movement).

HERD'S-GRASS. See TIMOTHY (grass).

LEO

LEO is the name of 13 popes of the Roman Catholic Church. Five of the popes were *canonized* (made saints) in the church. Leo XIII was an especially important pope. Their reigns were:

Leo I, Saint (440-461)	Leo VIII (963-965)
Leo II, Saint (682-683)	Leo IX, Saint (1049-1054)
Leo III, Saint (795-816)	Leo X (1513-1521)
Leo IV, Saint (847-855)	Leo XI (1605)
Leo V (903)	Leo XII (1823-1829)
Leo VI (928)	Leo XIII (1878-1903)
Leo VII (936-939)	

Saint Leo I (? -461), one of two popes commonly given the title *The Great*, brought the qualities of energy, perseverance, and human understanding to the papal office. Conscious of his rights as pope, he successfully enforced his authority in both the West and the East. In the western provinces, Leo regulated discipline and attacked heresy. He persuaded Attila the Hun to spare Italy in 452. Three years later, Leo persuaded the Vandal leader Genseric (Gaiseric) not to subject Rome to fire and slaughter (see **ATTILA**; **GENSERIC**).

Leo's greatest triumph was over the Eastern bishops. When he sent a formal statement of the church's teaching to settle authoritatively an Eastern theological dispute, the Eastern bishops accepted it with the famous statement: "Peter has spoken through Leo."

Saint Leo III (? -816) crowned Charlemagne Emperor of the Romans in 800. This appointment cemented a close relationship between the church and the state. Charlemagne guaranteed the pope's temporal authority in the Papal States, and the pope gave his blessing to Charlemagne's imperial rule (see **CHARLEMAGNE**).

Leo X (1475-1521) helped Rome become the center of the artistic and literary world. He was an ardent scholar and patron of the arts. Through his efforts, scholars obtained high positions in the papal court.

Leo encouraged the preaching of indulgences in Germany to raise money for the rebuilding of Saint Peter's Church. The preaching of indulgences helped cause Martin Luther's break from the Roman Catholic Church and the beginning of the Reformation. Up to the time of his death in 1521, Leo never took the movement started by Luther seriously (see **LUTHER**, **MARTIN**).

Leo was born in Florence, Italy, the son of Lorenzo the Magnificent of the Medici family (see **MEDICI**).

Leo XIII (1810-1903) enjoyed one of the longest reigns in papal history. He is best known for his *encyclicals* (papal letters to bishops) on social and religious subjects. His most famous encyclical, *Rerum Novarum*, is often called "the Magna Carta of labor" because it upheld the rights of the working classes.

Leo, a brilliant diplomat, helped make the Roman Catholic Church acceptable to the non-Catholic world. His diplomatic successes included mediating a dispute between Spain and Germany over the Caroline Islands and directing French Catholics to support loyally their republican government.

Born Gioacchino Vincenzo Raffaello Luigi Pecci, in Carpineto, he studied in Viterbo and in Rome. He was ordained a priest in 1837, and served for over 20 years as archbishop of Perugia. He became a cardinal in 1853.

THOMAS P. NEILL and FULTON J. SHEEN

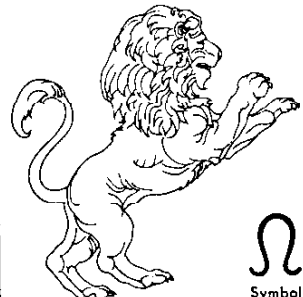
See also **POPE** (picture: Leo XIII).

LEO, a constellation. See **ASTRONOMY** (Finding Constellations).

LEO is the fifth sign of the zodiac. It is symbolized by a lion. Astrologers believe that Leo is ruled by the sun. Leo is a fire sign.

Astrologers regard people born under the sign of Leo, from July 23 to August 22, as energetic, generous, and strong-willed. Both the lion and the sun are traditionally linked with kings, and Leos have kingly characteristics. They are good leaders and enjoy being

Leo—The Lion



Symbol

Birth dates: July 23–August 22.
Group: Fire.
Characteristics: Cheerful, colorful, generous, kind, powerful, proud.

Signs of the Zodiac

Aries
Mar. 21–Apr. 19

Taurus
Apr. 20–May 20

Gemini
May 21–June 20

Cancer
June 21–July 22

Leo
July 23–Aug. 22

Virgo
Aug. 23–Sept. 22

Libra
Sept. 23–Oct. 22

Scorpio
Oct. 23–Nov. 21

Sagittarius
Nov. 22–Dec. 21

Capricorn
Dec. 22–Jan. 19

Aquarius
Jan. 20–Feb. 18

Pisces
Feb. 19–Mar. 20

WORLD BOOK illustration by Robert Keys

the center of attention and importance. However, Leos can sometimes be too proud.

Leos like colorful, showy things. They are attracted to occupations in such fields as the jewelry business and the theater.

CHRISTOPHER MCINTOSH

See also **ASTROLOGY**; **HOROSCOPE**; **ZODIAC**.

LEÓN (pop. 70,046) is the chief intellectual center and an important farm produce market in Nicaragua. It lies in a farming district in western Nicaragua, about 50 miles (80 kilometers) northwest of Managua. For location, see **NICARAGUA** (color map).

León is the home of the National University of Nicaragua, as well as a national institute and two religious colleges. The city's many fine buildings include the largest cathedral in Central America.

Spanish explorers founded León in 1525 on the shores of Lake Managua. It was moved to its present location in 1610 after the old town was destroyed by an earthquake. León served as the provincial capital of Nicaragua for many years, and then as the capital of the republic until 1855.

ROLLIN S. ATWOOD

LEÓN, LUIS. See **SPANISH LITERATURE** (The Golden Age [Poetry]).

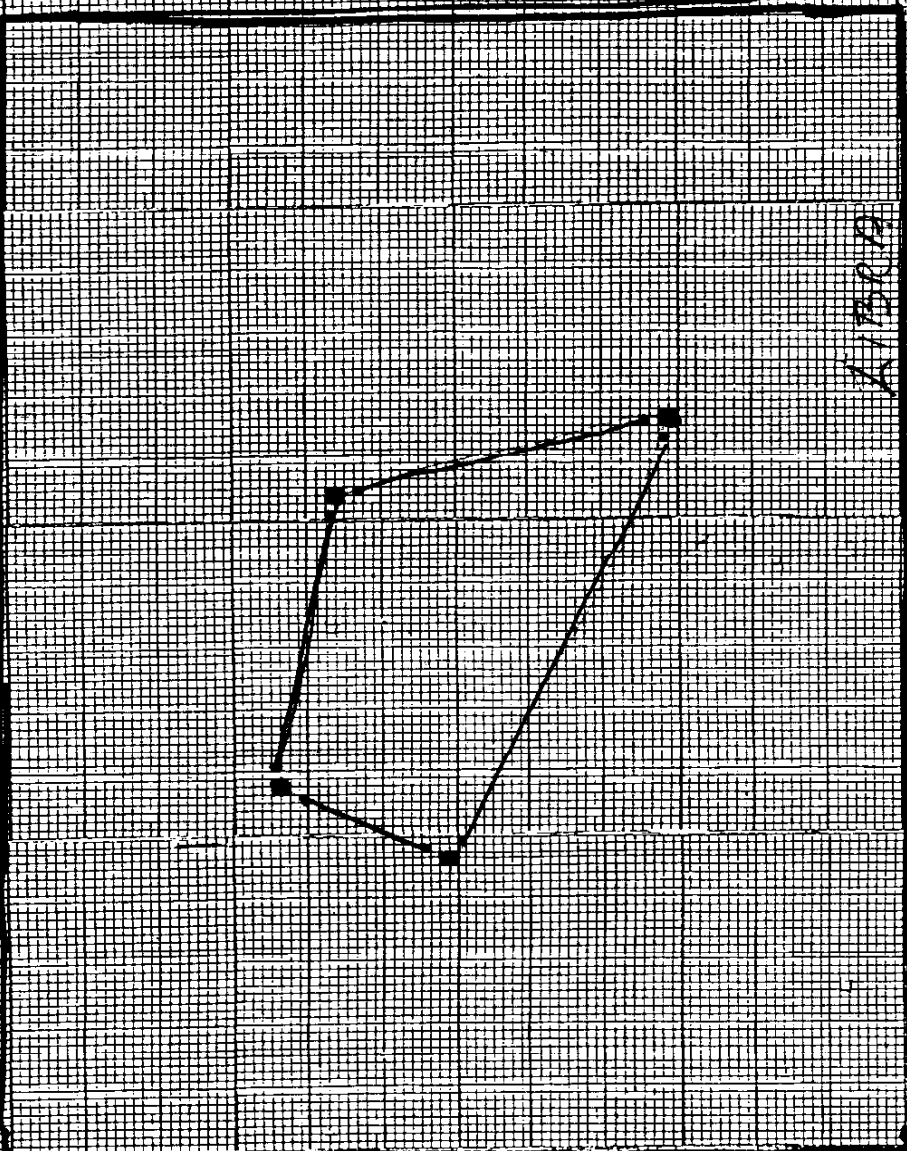
LEÓN, PONCE DE. See **PONCE DE LEÓN, JUAN**.

LEONARD, BENNY. See **BOXING** (table: Lightweights; picture).

LEONARDO DA VINCI. See **DA VINCI, LEONARDO**.

LEONCAVALLO, lay ohn kah VAHL loh, **RUGGIERO** (1858-1919), was an Italian opera composer. He is best known for his two-act *Pagliacci* (1892). This opera is a violent tragedy about a group of traveling players in Italy. It is an example of a melodramatic form of real-

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The Liberty Cap has long been a symbol of freedom.

LIBERTY CAP is a famous symbol of freedom. In modern times it has appeared on certain American coins and on the seals of several Central and South American republics.

The modern liberty cap is copied from the cone-shaped Phrygian headdress which was given to a freed slave in ancient Rome. At the start of the French Revolution, the *bonnet rouge* (red cap) was adopted by the "patriots," as the opponents of monarchy were called. **ROBERT B. HOLTMAN**

LIBERTY, EQUALITY, FRATERNITY is the English translation of the French national motto *Liberté, Égalité, Fraternité*. The motto was first used by the leaders of the French Revolution.

LIBERTY HALL. See **KENTUCKY** (Places to Visit).

LIBERTY ISLAND is an island in Upper New York Bay on which the Statue of Liberty stands. The island, which lies southwest of Manhattan Island, covers 12 acres (5 hectares).

Before Liberty Island was officially renamed in 1956, it was called *Bedloe's Island*. It belongs to the U.S. government. The Statue of Liberty, given by France in 1884, was received in 1885 and dedicated in 1886. Fort Wood is the base on which the statue stands. The fort, built in the shape of an 11-point star, was completed in 1811 and named for an officer killed in the War of 1812. The area was a military post until 1937. Then the land was added to the Statue of Liberty National Monument. An American Museum of Immigration was dedicated there in 1972. **WILLIAM E. YOUNG**

See also **LIBERTY, STATUE OF**.

LIBERTY LEAGUE, OF AMERICAN LIBERTY LEAGUE, was an organization that tried to rally public opinion against President Franklin D. Roosevelt's New Deal. Conservative Democrats who disapproved of Roosevelt's New Deal measures founded the group. Prominent members included John W. Davis and Alfred E. Smith, the Democratic presidential candidates in 1924 and 1928. In 1934, they combined with wealthy business executives, who provided most of the league's funds. The league published pamphlets and sponsored radio programs, arguing that the New Deal was destroying personal liberty. However, the league failed to gain support in the 1934 and 1936 elections, and soon disappeared. **DAVID A. SHANNON**

LIBERTY LOAN. See **SAVINGS BOND**.

LIBERTY PARTY was the first political party in the United States to give most of its attention to the slavery question. The politician James G. Birney (1792-1857) and the poet John Greenleaf Whittier were the leading supporters of the group. From July, 1844, to March, 1845, Whittier edited the *Middlesex Standard*, a paper published in Lowell, Mass., by the Liberty Party. He was also chiefly responsible for editing the *Essex Transcript*, another of the Liberty Party's publications.

The Liberty Party nominated Birney for President in 1840, but he made a poor showing in the election.

LIBRARIAN

Birney also headed the Liberty Party ticket in 1844 and polled 62,000 votes.

In 1848, the party met in Buffalo, N.Y., with other groups to form the Free Soil Party. **DONALD R. MCCOY**

See also **ABOLITIONIST; FREE SOIL PARTY**.

LIBIDO, *lih BY doh*, is a psychoanalytic term referring primarily to instincts or urges that are satisfied pleasurably. Sigmund Freud was the first to use this term (see **FREUD, SIGMUND**).

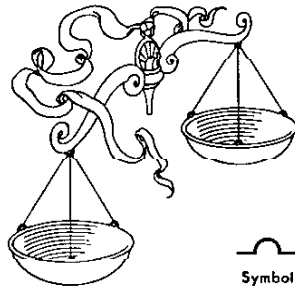
Some psychoanalysts believe that the libido develops through certain stages. In the *oral* phase, the infant derives pleasure from such activities as sucking and biting. In the *anal* phase, the child obtains satisfaction and interest in bowel control. The *genital* phase includes early adolescence, with its problems of adjusting the sexual drives to fit the patterns of society.

Many psychiatrists believe that the libidinal development is a more continuous process, however, and that the phases are less distinct. **GEORGE A. ULETT**

See also **PSYCHOANALYSIS** with its Related Articles.

LIBRA is the seventh sign of the zodiac. It is symbolized by a pair of weighing scales. Astrologers believe that Libra is ruled by the planet Venus, which is named for the ancient Roman goddess of love and beauty. Libra is an air sign.

Libra—The Scales



Symbol

Birth dates: Sept. 23—Oct. 22.

Group: Air.

Characteristics: Companionable, diplomatic, friendly, intelligent, pleasant, thoughtful.

Signs of the Zodiac

Aries
Mar. 21—Apr. 19
Taurus
Apr. 20—May 20
Gemini
May 21—June 20
Cancer
June 21—July 22
Leo
July 23—Aug. 22
Virgo
Aug. 23—Sept. 22
Libra
Sept. 23—Oct. 22
Scorpio
Oct. 23—Nov. 21
Sagittarius
Nov. 22—Dec. 21
Capricorn
Dec. 22—Jan. 19
Aquarius
Jan. 20—Feb. 18
Pisces
Feb. 19—Mar. 20

WORLD BOOK Illustration by Robert Keys

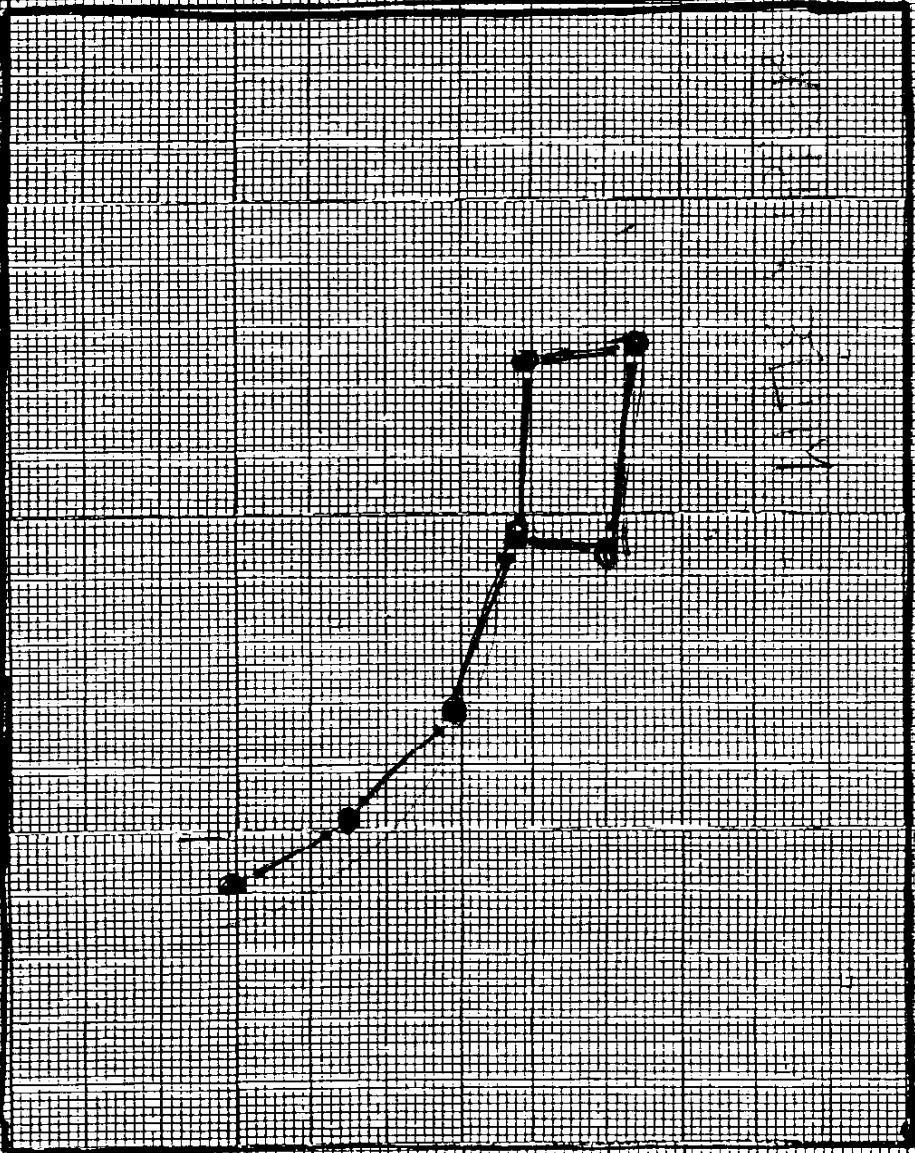
Astrologers consider people born under the sign of Libra, from September 23 to October 22, to have the characteristics of scales. Libras like balance and harmony in all things and dislike conflict, disagreement, and sudden changes. They are warm, friendly, and sociable. They also are intelligent and thoughtful and are good at patching up quarrels between other people. Libras often have trouble making up their minds because they are quick to listen to different viewpoints and reach a compromise.

Libras have a love of pleasing surroundings and an eye for beauty. They have a pleasant smile that comes naturally and frequently. **CHRISTOPHER MCINTOSH**

See also **ASTROLOGY; HOROSCOPE; ZODIAC**.

LIBRARIAN. See **LIBRARY; PUBLISHING** (Careers).

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BIENNIAL, by *EIN* *cc uhl*, is a plant that requires two years to reach its full development. In the first season such plants put forth leaves and roots. During the winter, they remain dormant. The next spring or summer they bear flowers and seed, then die. Thus their life span is two years, or two growing seasons. Familiar examples of biennials are the turnip, beet, and carrot, which accumulate food in their roots the first season. If left in the ground for a second year, the plants produce shoots that use up this reserve of root food. WILLIAM C. BEAVER

See also **ANNUAL**; **GARDENING** (Cultivating an Outdoor Garden); **PERENNIAL**.

BIENVENU. See **HELICOPTER** (Early Experiments). **BIENVILLE**, *BYAN VEEL*, or *bih EN vill*, **SIEUR DE** (1680-1768), **JEAN BAPTISTE LE MOYNE**, a French-Canadian explorer, was prominent in settling the province of Louisiana. He served as governor of the province four times. He founded the city of New Orleans in 1718 (see **NEW ORLEANS** [History]). He also founded Mobile Ala., in 1702 and helped found Biloxi, Miss., in 1717.

Bienville was born at Ville-Marie (now Montreal), Quebec. As a boy, he went with his brother Iberville on early explorations of the Mississippi River (see **IBERVILLE**, **SIEUR D'**). Bienville was appointed governor of Louisiana in 1706, at the age of 26. His office was taken away from him in 1713, but he continued to work for the province. He served as acting governor in 1716 and 1717. He became governor again in 1718. He was dismissed again six years later, but was named governor a fourth time in 1733.

BIERCE, **AMBROSE GWINETT** (1842-1914?), was an American short-story writer and journalist. Perhaps the best of his stories are collected in *Tales of Soldiers and Civilians* (1891) and *Can Such Things Be?* (1893). His cynical concentration on death in shocking forms in these stories shows his realistic observations as a Civil War soldier. Many of his stories have horrifying surprise endings. An example is "An Occurrence at Oak Creek Bridge," which describes what a man thinks at the moment of hanging.

Bierce became the Washington, D.C., correspondent for the Hearst newspapers in 1897. *Fantastic Fables* (1899) shows his cynical political and economic attitudes. He wrote *The Cynic's Word Book* (1906), later issued as *The Devil's Dictionary* (1911). It contains humorously sarcastic definitions. He published *Collected Works* between 1909 and 1912.

Bierce was born in Chester, Ohio. He disappeared in Mexico in 1913, and the circumstances of his death are not known.

BIERSTADT, **BEER** stat, **ALBERT** (1830-1902), was one of the greatest American romantic landscape painters. He first viewed the scenic grandeur of the American West in 1858, while traveling with a surveying expedition. He made on-the-spot sketches which he later developed into large panoramas of western mountains. These paintings are impressive, despite their simple subdued color. Bierstadt received as high as \$350 for his work, but his reputation declined after his death. Today, his paintings, especially those on a smaller more controlled scale, are popular because of a renewed interest in the romantic movement of the 1800's. Bierstadt was born in Solingen, Germany, and was brought to New Bedford, Mass., as a baby. He studied painting in Germany from 1853 to 1857. FREDERICK A. B...

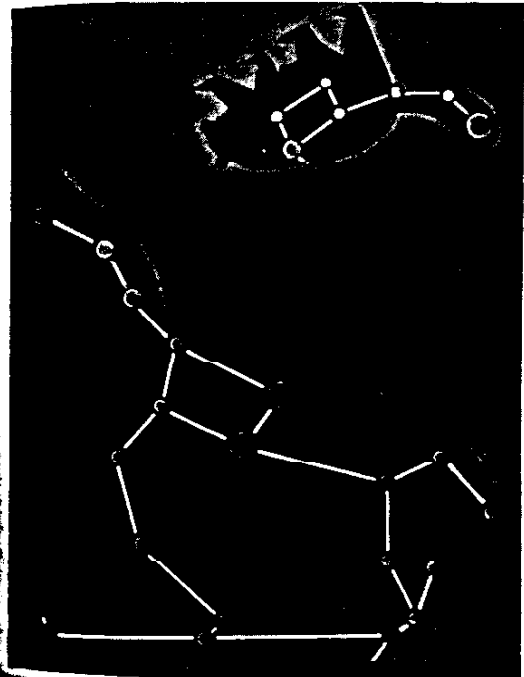
BIFOCAL. See **GLASSES**. **BIG AND LITTLE DIPPERS** are the names of two groups of stars seen in the northern sky. Both groups of stars form the outlines of long-handled cups.

The **Big Dipper** consists of seven stars. The two stars in the front of the cup point to the North Star (see **NORTH STAR**). These *pointers* are the star Dubhe and the star Merak. The Big Dipper forms part of a larger constellation, Ursa Major or the Great Bear. The cup of the dipper marks the hindquarters of the bear. The handle outlines the tail. Other stars form the head and legs. The star Mizar lies at the crook of the handle. It has a companion star, Alcor. Mizar is a double star (see **DOUBLE STAR**). Alcor has been used for hundreds of years as a test for eyesight. The stars of the dipper lie between 70 and 80 light-years from the earth.

The **Little Dipper** is fainter and smaller than the Big Dipper. But the Little Dipper has long been important as an indicator of north, because the North Star is in the end of the handle. In the days of the Phoenicians, it was called Cynosura. It forms almost the entire constellation Ursa Minor, or the Little Bear.

In Greek mythology, Ursa Major is the nymph Callisto and Ursa Minor is her son Arcas. According to one myth, Zeus loved Callisto and this angered his wife Hera. When Hera tried to kill her, Zeus changed Callisto into a bear. Arcas did not know the bear was his mother, and tried to kill it. So Zeus changed Arcas into a bear, and put them both into the sky to save them from harm. Writers in the 1600's said that the tails of the bears were stretched because Zeus pulled them into the sky.

Position of the Dippers. On winter evenings, the Little Dipper is to the left of the Big Dipper and has



Big and Little Dippers Are in Ursa Major and Minor.

its handle pointed up. The Big Dipper is down. On summer evenings, the Little Dipper is up. By early morning, the position of the stars changes because of the rotation of the earth.

See also **CONSTELLATION**.

BIG BEN is the great bell in the Houses of Parliament in London. It weighs 13 short tons (12 metric tons). It is 9 feet in diameter and 7½ feet (2.3 meters) high. It boomed out in 1859. On New Year's Eve 1925 it was first heard on radio, and on New Year's Eve 1936 it and the floodlighted clock became visible. It was installed during the reign of Queen Victoria. Sir Benjamin Hall served as Clock Commissioner. He was called Big Ben, and it is named the bell for him.

The clock connected to Big Ben is famous for its accuracy. The clock's mechanism weighs 25 tons (4.5 metric tons). Until 1925 it was hand-wound. Since then, an electric motor has driven the clock's four faces. Each face is lighted by two crescent lamps.

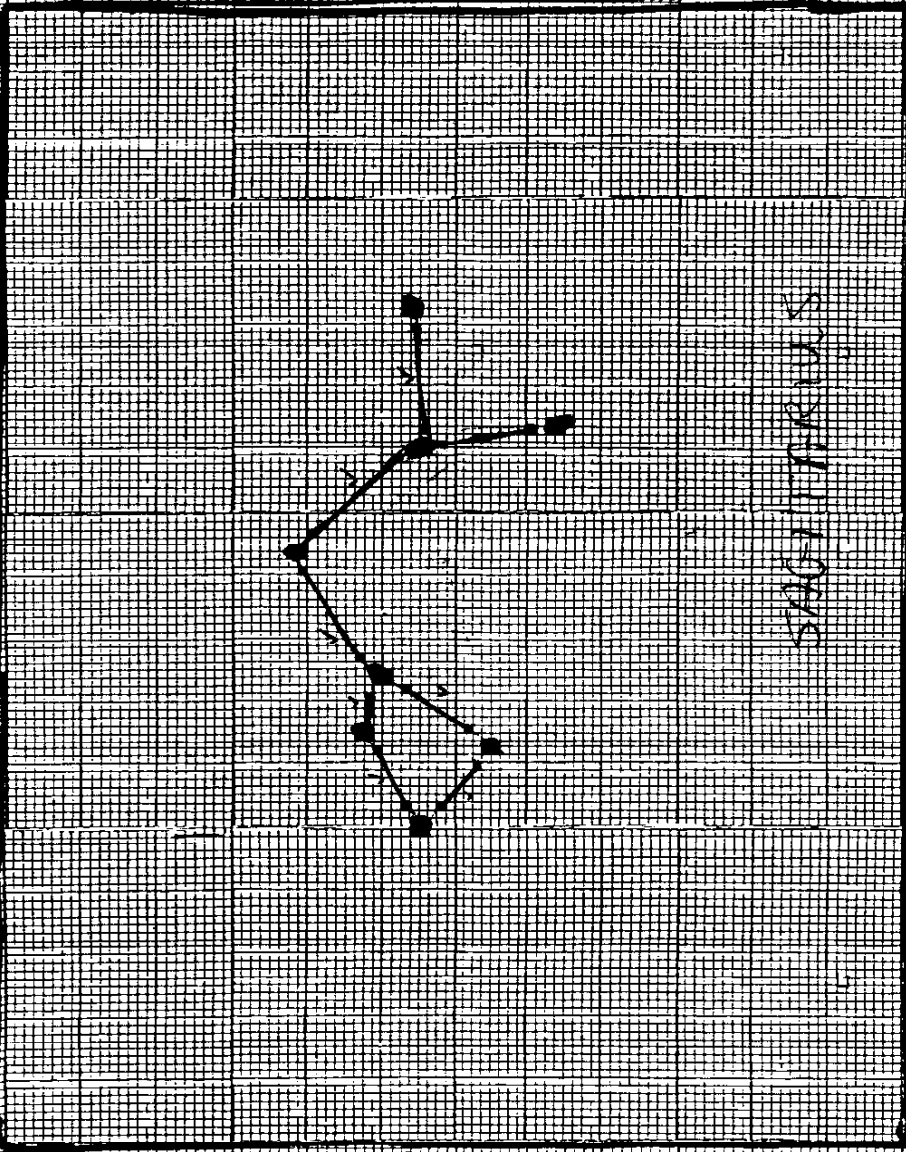
BIG BEND NATIONAL PARK is a natural area of Texas. It is one of the oldest geological processes are so clearly shown that almost any person can understand them. The park was created by voluntary donation. In the park, were created by volcanic activity. Age of Dinosaurs and by the late Permian period. Boquillas, Mariscal, and Santa Elena geological history for the past 100 million years. One-fifth of the earth's known history is in Big Bend. Relics of four faces are found in the park.

Relics of an ancient cave dweller are found in the park. The later Comanche Indians have lived in the park. Archaeological expeditions to the park have found the life of desert land surround the Chisos Mountains. The life in the park includes the antelope and the cholla cactus.



Big Bend National Park lies in western Texas. The walls of Santa Elena Canyon are visible in the background.


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SAGITTARIUS

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23 24 25 26 27 28 29 30 31 32 33 34 35

SAGITTARIUS

<p>Sagittarius—The Archer</p>  <p style="text-align: right;">Symbol</p> <p>Birth dates: Nov. 22–Dec. 21. Group: Fire. Characteristics: Cheerful, enthusiastic, generous, outgoing, relaxed, warm.</p>	<p>Signs of the Zodiac</p> <p>Aries Mar. 21–Apr. 19 Taurus Apr. 20–May 20 Gemini May 21–June 20 Cancer June 21–July 22 Leo July 23–Aug. 22 Virgo Aug. 23–Sept. 22 Libra Sept. 23–Oct. 22 Scorpio Oct. 23–Nov. 21 Sagittarius Nov. 22–Dec. 21 Capricorn Dec. 22–Jan. 19 Aquarius Jan. 20–Feb. 18 Pisces Feb. 19–Mar. 20</p>
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WORLD BOOK Illustration by Robert Keys

SAGITTARIUS, *saj uh TAIR ee uhs*, is the ninth sign of the zodiac. Its symbol is an archer. Astrologers believe that Sagittarius is ruled by the planet Jupiter, which they consider a wise and friendly planet. Sagittarius is a fire sign.

Astrologers consider people born under the sign of Sagittarius, from November 22 to December 21, to have the characteristics of Jupiter. Sagittarians are warm, outgoing, and relaxed, and they like to be surrounded by friends. Sagittarians also are generous and spend money impulsively. Jupiter makes them thoughtful, fond of exploring ideas, and capable of far-sighted decisions. They are cheerful and enthusiastic. In addition, Sagittarians are restless and like change and travel. They are independent and have difficulty accepting discipline.

CHRISTOPHER MCINTOSH
See also **ASTROLOGY**; **HOROSCOPE**; **ZODIAC**.

SAGO, *SAY goh*, is a starch found in the spongy center, or pith, of various tropical palm trees. A type of flour, called *sago flour*, is made from sago. The largest supply of sago comes from the East Indies. Large quantities of sago are sent to Europe and North America for cooking purposes. Sago flour is used mostly in making puddings and as a thickening for soups. The flour is nourishing and easy to digest. Sago is one of the principal foods of East Indian people.

The fruit of the palm trees from which sago is produced is not allowed to ripen fully. The full ripening completes the life cycle of the tree and exhausts the starch center. It leaves the trunk a hollow shell and causes the tree to die. The palms are cut down when they are about 15 years old, just before they are ready to flower. The stems, which grow 30 feet (9 meters) high, are split up. The starch pith is taken from the stems and ground to a powder. A single palm yields about 800 pounds (360 kilograms) of starch. The powder is kneaded in water over a cloth or sieve. It passes into a trough where it settles. After a few washings, the flour is ready to be used in cooking. Sago is further refined and prepared for export.

LEONE RUTLEDGE CARROLL

See also **ARROWROOT**; **CORNSTARCH**; **TAPIOCA**.

SAGUARO, *suh GWAH roh* or *suh WAH roh*, is the largest cactus of the United States. This huge plant often called the *giant cactus*, may stand more than 50 feet (15 meters) tall and weigh as much as 10 short tons (9 metric tons). It grows only in the foothills and desert of southern Arizona, southeastern California, and northwestern Mexico. It is the state flower of Arizona.

The saguaro has a columnlike trunk that measures from 1 to 2½ feet (30 to 76 centimeters) in diameter. The plant also has a few large, upturned branches. Grooves and ribs (ridges) run lengthwise along both the trunk and branches. Little rain falls in the region where the saguaro grows. The plant soaks up and stores large amounts of water after the rare showers that do occur. The grooves and ribs of the saguaro expand and contract, much like an accordion, depending on the amount of stored water.

Padlike structures called *areoles* grow along the ribs. Each areole has from 15 to 25 long spines. The branches of the saguaro grow from certain areoles on the trunk. During May and June, the areoles near the tip of the trunk and branches produce waxy, greenish-white flowers. These funnel-shaped flowers measure 3 or 4 inches (7.6 to 10 centimeters) long and bloom at night.

Bats, birds, and insects gather nectar from saguaro blossoms and, during the process, spread pollen from flower to flower. The pollinated flowers may then produce purplish-red, egg-shaped fruit. The mature fruit splits open, exposing watermelon-red pulp filled with black seeds. Many desert creatures eat the ripe fruit. The Indians of the region also eat the raw fruit or use it to make preserves and syrups.

Scientific Classification. The saguaro belongs to the cactus family, *Cactaceae*. Many botanists classify it as genus *Cereus*, species *C. giganteus*. Others classify it as *Carnegiea gigantea*.

DONALD J. PINEAV

See also **ARIZONA** (pictures: The State Flower, Giant Saguaro Cactus); **CACTUS**; **TREE** (picture).

SAGUARO NATIONAL MONUMENT is in southern Arizona near Tucson. It is named for the saguaro cactus, which may grow 50 feet (15 meters) high and weigh 10 short tons (9 metric tons). The monument was established in 1933. Its wildlife includes the coyote, black bear, and elf owl. For area, see **NATIONAL PARK SYSTEM** (table: **NATIONAL MONUMENTS**). See also **ARIZONA** (picture: **Giant Saguaro Cactus**).

SAGUENAY RIVER, *SAG uh MAY*, is an important waterway in the Canadian province of Quebec. The river begins at the eastern end of Lac Saint-Jean in Quebec. It flows eastward for about 100 miles (160 kilometers), and empties into the St. Lawrence River about 120 miles (193 kilometers) northeast of the city of Quebec. (see **QUEBEC** [physical map]).

The Saguenay River is not navigable for its first 35 miles (56 kilometers). It drops more than 300 feet (91 meters) in this stretch, which extends from Lac Saint-Jean to Chicoutimi. However, this upper branch of the Saguenay has been harnessed for a power output of more than 1 million kilowatts.

The Lower Saguenay begins just below Chicoutimi, where the river forms a small inlet called Ha Ha Bay. The chief harbors on Ha Ha Bay are Port Alfred for industrial traffic, and Bagotville for passenger ships. The Lower Saguenay is navigable for the 65 miles (105 kilometers) from Chicoutimi to the St. Lawrence River. It

Graduates of the institute have played an active part in every U.S. war since the school was founded in 1839. Alumni have also entered almost every civilian field. From 1851 to 1861, Stonewall Jackson was a professor of artillery tactics and natural philosophy at the institute (see JACKSON, STONEWALL). General George C. Marshall graduated from the institute in 1901. The George C. Marshall Research Library on the campus contains the general's papers and souvenirs, as well as military and historical exhibits. General George S. Patton, Jr., and Admiral Richard E. Byrd also attended the institute. For enrollment, see UNIVERSITIES AND COLLEGES (table).

Critically reviewed by the VIRGINIA MILITARY INSTITUTE

VIRGINIA PLAN. See RANDOLPH (Edmund); CONSTITUTION OF THE UNITED STATES (The Compromises).

VIRGINIA RAIL. See RAIL (with picture).

VIRGINIA RESOLUTIONS. See KENTUCKY AND VIRGINIA RESOLUTIONS.

VIRGINIUM is a name formerly given to chemical element number 87. The element is now known as francium. See FRANCIUM.

VIRGINIUS MASSACRE was an event in 1873 that almost involved the United States in a war with Spain. During a Cuban revolt against Spain, the Spanish gunboat *Tornado* captured a merchant ship called the *Virginus* on the high seas off Jamaica. A U.S. citizen, Captain John Fry, commanded the *Virginus*, and flew the American flag. The Spanish authorities executed Fry, 36 of the crew members, and 16 passengers. The Spanish claimed that the vessel was aiding the rebels.

The affair caused great excitement in the United States. But Spain agreed to surrender the ship and survivors, and denied any hostile intent. Later, authorities discovered that the *Virginus* was owned by Cubans, was illegally registered, and had no right to fly the American flag. The vessel was wrecked and left off Cape Fear on its way to the United States.

JOHN DONALD HICKS

VIRGIN'S-BOWER. See CLEMATIS.

VIRGO is the sixth sign of the zodiac. Virgo, an earth sign, is symbolized by a virgin. Astrologers believe Virgo is ruled by the planet Mercury, which was named for the messenger of the ancient Roman gods.

According to astrologers, people born under the sign of Virgo, from August 23 to September 22, are intelligent, practical, and sensible. They like order and tidiness in all things. Virgoans are good at concentrating on details and tend to find fault with things that other people consider unimportant. They have to be careful that their criticism does not hurt the feelings of others.

Virgoans rely on reason rather than emotion, and they may seem unsympathetic and too proud. They are not natural leaders but tend to work in the background, where they often become powerful. Virgoans succeed at jobs that require them to be orderly and pay attention to details. They are also successful at skilled crafts. Virgoans have an interest in health, which leads many into the medical professions.

CHRISTOPHER MCINTOSH

See also ASTROLOGY; HOROSCOPE; ZODIAC.

VIROLOGY. See BIOLOGY (table); MICROBIOLOGY.

VIRTANEN, ARTTURI. See NOBEL PRIZES (table: Nobel Prizes for Chemistry—1945).

VIRTUAL IMAGE. See LENS.

VIRUS is a microscopic organism that lives in a cell of another living thing. Viruses are the smallest and

VIRUS

simplest form of life and are a major cause of disease. Some viruses infect human beings with such diseases as measles, influenza, and the common cold. Others infect animals or plants, and still others attack bacteria. Viruses produce disease in an organism by damaging some of its cells. However, viruses sometimes live in cells without harming them.

Viruses are so primitive that many scientists consider them to be both living and nonliving things. By itself, a virus is a lifeless particle that cannot reproduce. But inside a living cell, a virus becomes an active organism that can multiply hundreds of times.


Viruses are shaped like rods or spheres and range in size from about 0.01 to 0.3 micron. A micron is $\frac{1}{100,000}$ inch or 0.001 millimeter. Most viruses can be seen only with an electron microscope, which magnifies them by thousands of times. The largest virus is about $\frac{1}{10}$ as big as a bacterium of average size.

The study of viruses began in 1898, when a Dutch botanist named Martinus Beijerinck realized that something smaller than bacteria could cause disease. He named this particle a *virus*, a Latin word meaning *poison*. In 1935, Wendell M. Stanley, an American biochemist, showed that viruses contain protein and can be crystallized. This research and many other studies eventually led to the development, during the 1950's, of vaccines for measles, poliomyelitis, and other diseases. *Virologists* (scientists who study viruses) demonstrated in the early 1900's that viruses can cause cancer in animals. During the 1960's and 1970's, experiments with cancer viruses became an important part of biological research.

The Structure of a Virus. Viruses, unlike other organisms, are not made up of cells. Therefore, they lack some of the substances needed to live on their own. To obtain these substances, a virus must enter a cell of another living thing. It then can use the cell's materials to live and reproduce.

A virus has two basic parts, a core of a nucleic acid and an outer coat of protein. The core consists of either

WORLD BOOK Illustration by Robert Keys

<p>Virgo—The Virgin</p>  <p>Birth dates: Aug. 23—Sept. 22. Group: Earth. Characteristics: Careful, efficient, modest, orderly, practical, tidy.</p>	<p>Signs of the Zodiac</p> <p>Aries Mar. 21—Apr. 19 Taurus Apr. 20—May 20 Gemini May 21—June 20 Cancer June 21—July 22 Leo July 23—Aug. 22 Virgo Aug. 23—Sept. 22 Libra Sept. 23—Oct. 22 Scorpio Oct. 23—Nov. 21 Sagittarius Nov. 22—Dec. 21 Capricorn Dec. 22—Jan. 19 Aquarius Jan. 20—Feb. 18 Pisces Feb. 19—Mar. 20</p>
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