

VOLUME


11

I—Izmir
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Compton's Encyclopedia

and Fact-Index



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1991 EDITION COMPTON'S ENCYCLOPEDIA

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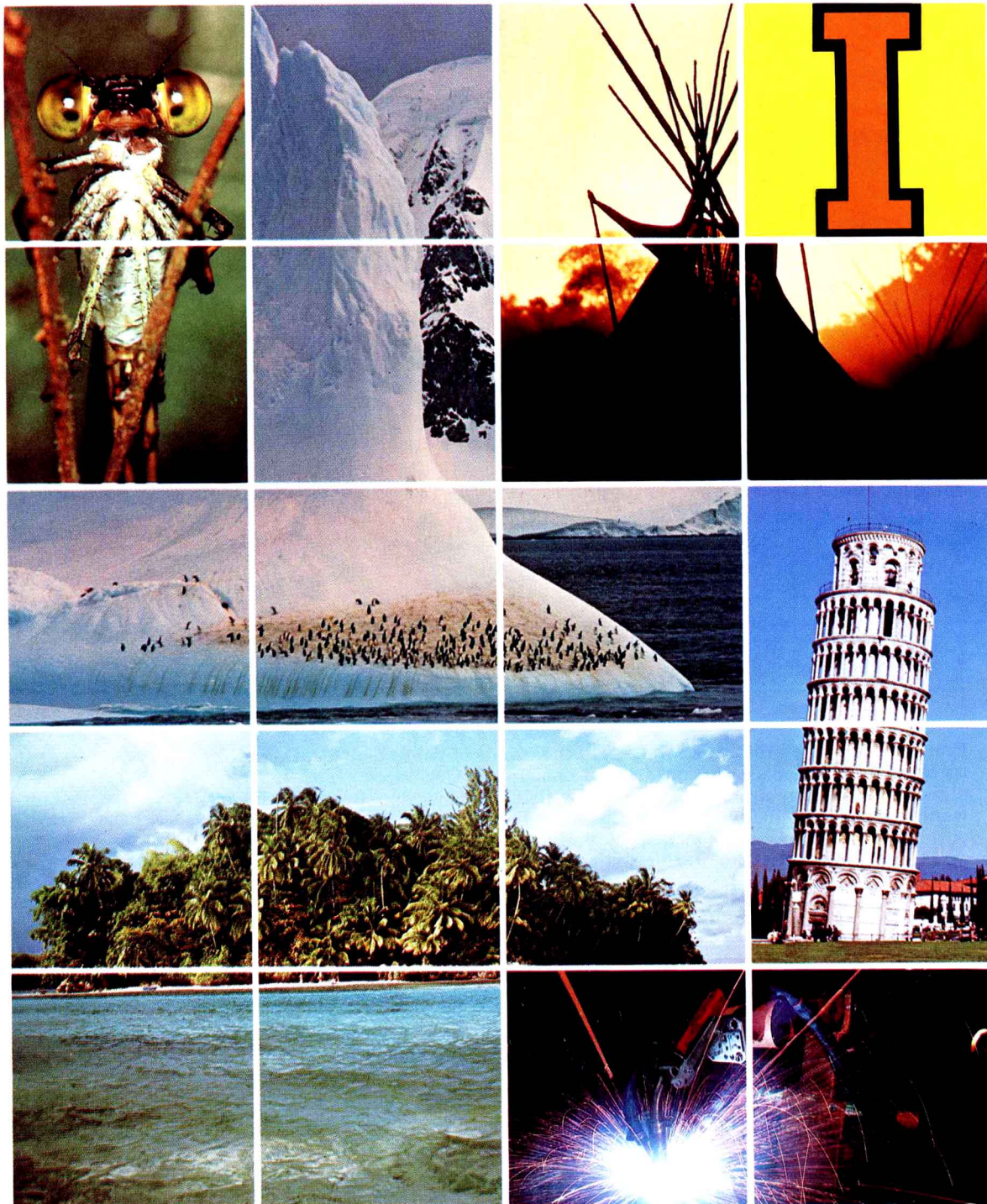
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BY COMPTON'S LEARNING COMPANY, DIVISION OF ENCYCLOPÆDIA BRITANNICA, INC.

Library of Congress Catalog Card Number: 89-81651
International Standard Book Number: 0-85229-530-8
Printed in U.S.A.



THE UNIVERSITY OF CHICAGO
COMPTON'S ENCYCLOPEDIA IS PUBLISHED WITH THE EDITORIAL ADVICE
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PHOTOS: Row 1: (far left) Donald Perry; (center left) © Robert W. Hernandez — Photo Researchers; (right) Nicholas deVore III — Bruce Coleman Inc. Row 3: (right) Art Resource. Row 4: (left) Eastern Air Lines, Inc. Row 5: (right) Bill Pierce — Rainbow.

EXPLORING VOLUME 11

Courtesy of the Philadelphia Museum of Art



Why are household furnishings studied by historians of both art and material culture? 243.

Peter Menzel—Stock, Boston



Why is irrigation necessary in some areas with adequate annual rainfall? 353.

United Air Lines Mainliner



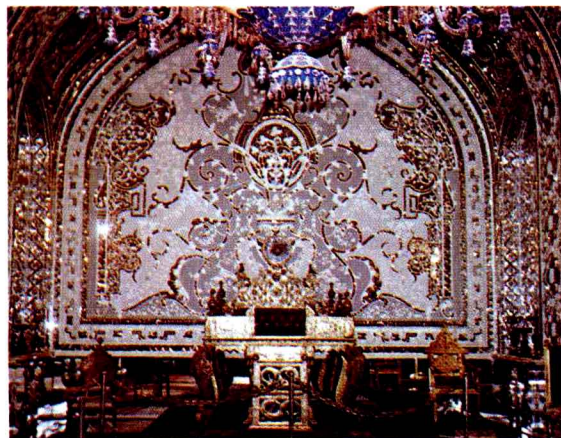
How long ago was the ice-cream soda introduced? 12.

Iceland Tourist Bureau



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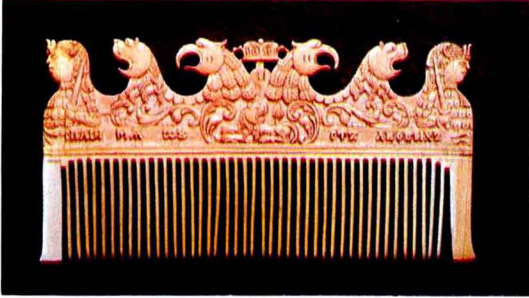
Tom Putnam

Which countries share spectacular horseshoe-shaped falls that divide into some 275 separate waterfalls? 32.

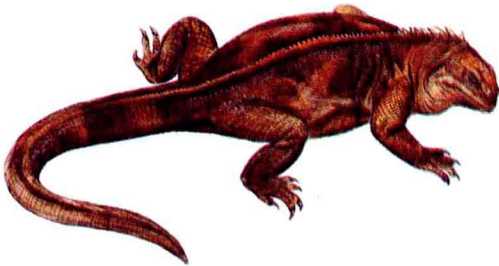


Ed Drews—Photo Researchers

Courtesy of the Walters Art Gallery, Baltimore



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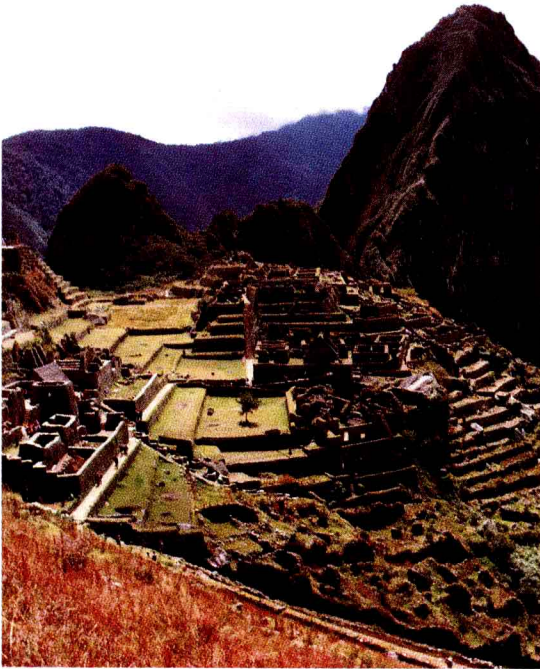


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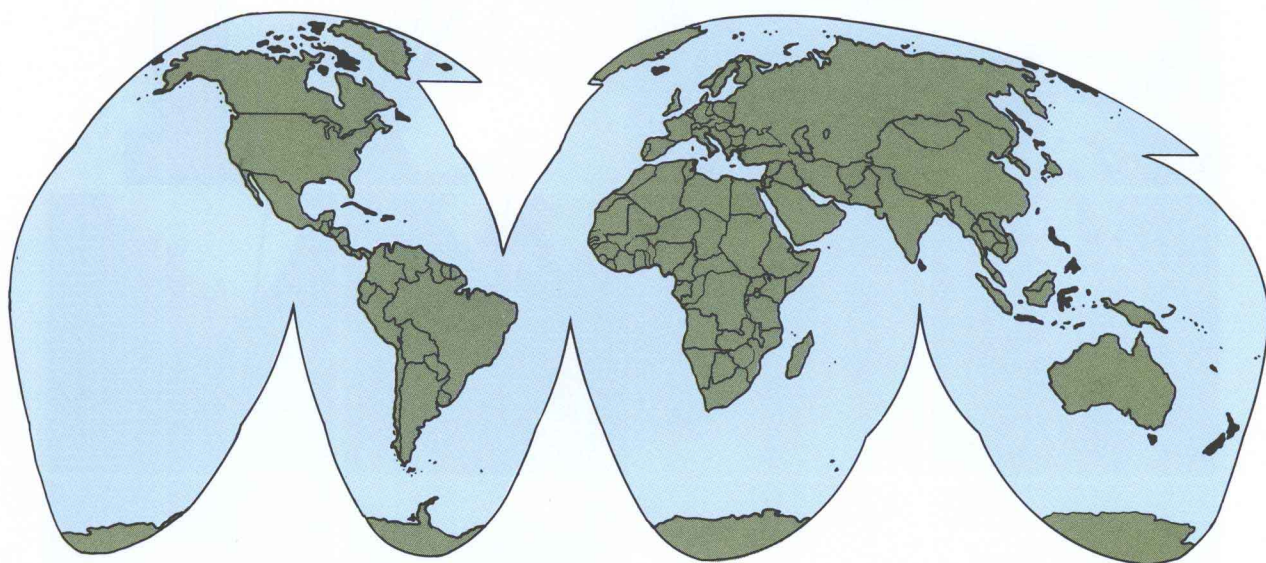
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HERE AND THERE IN VOLUME 11

From the A-1 satellite to the zygote cell, thousands of subjects are gathered together in Compton's Encyclopedia and Fact-Index. Organized alphabetically, they are drawn from every field of knowledge. Readers who want to explore their favorite fields in this volume can use this subject-area outline. While it may serve as a study guide, a specialized learning experience, or simply a key for browsing, it is not a complete table of contents.

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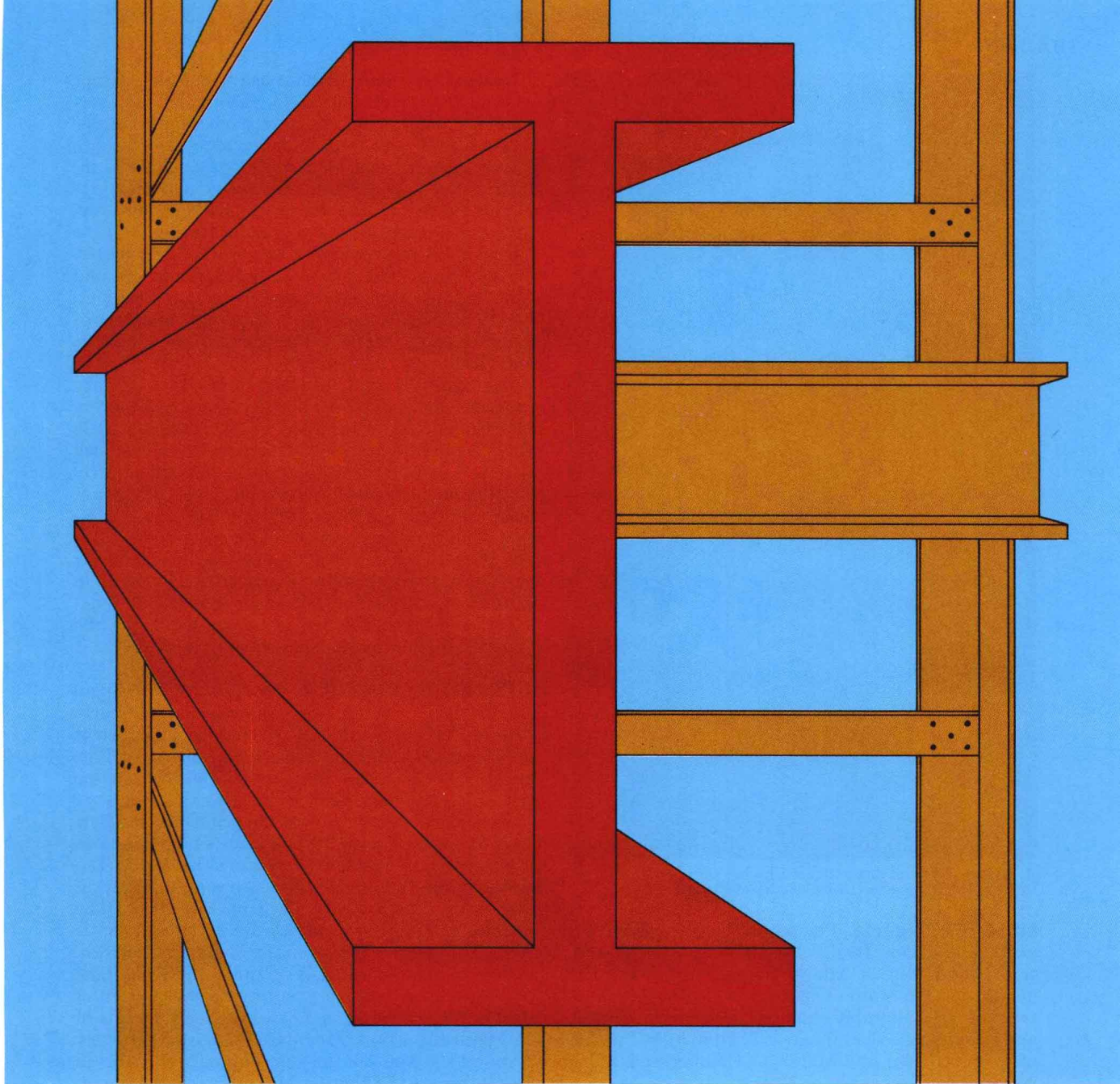
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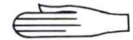
The letter I

probably started as a picture sign of a hand, as in Egyptian hieroglyphic writing (1) and in a very early Semitic writing used about 1500 B.C. on the Sinai Peninsula (2). About 1000 B.C., in Byblos and other Phoenician and Canaanite centers, the sign was given a linear form (3), the source of all later forms. In the Semitic languages the sign was called *yodh* or *yadh*, meaning "hand." It stood for the consonantal sound "y" (as in the English word "yes").

The Greeks renamed the sign *iota* and gave it the vocalic value of the English "i." They also simplified it into a single stroke (4).

The Romans took this sign over into Latin. From Latin the capital letter came into English unchanged.

The English small handwritten or printed "i" is the same sign as the capital except for a bottom curve and for a dot. The dot was added in medieval times to distinguish the letter from similar ones, such as a hastily written small "c."



1



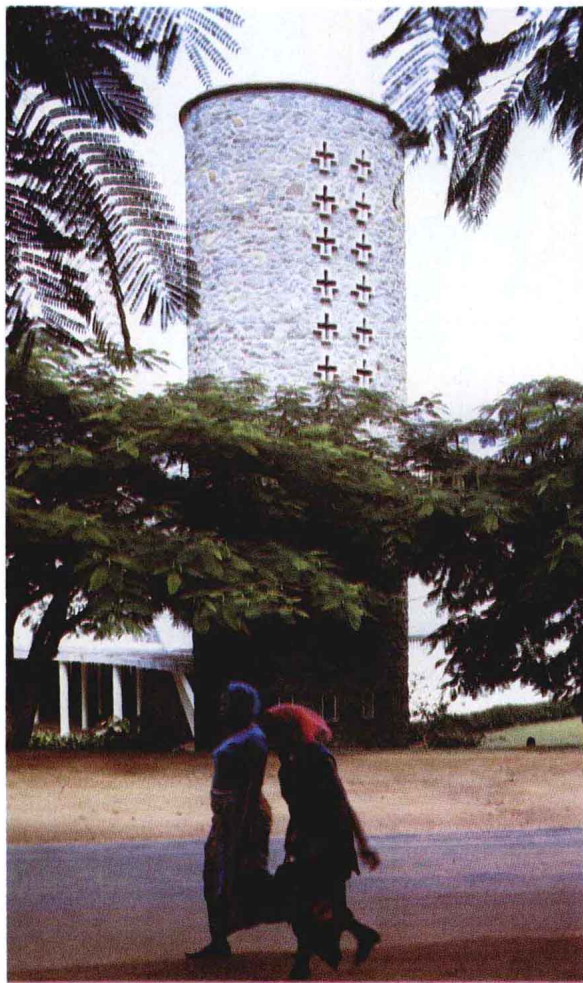
2



3



4



A modern chapel of distinctive design has been built on the campus of the University of Ibadan.

IBADAN, Nigeria. The second largest city of Nigeria after Lagos, Ibadan lies 100 miles (160 kilometers) inland from the Atlantic coast of Africa. It is the capital of Oyo state. The original town grew as a trade center, favorably situated between a rain forest and a savannah. The climate is hot and humid with a wet season from mid-March to October and a dry period from November to March.

Yoruba peoples—notably the Oyo, Ife, Ilesha, Egbe, and Ijebu groups—constitute about 90 percent of Ibadan's population. Most of the remainder of the people are immigrants from other parts of Nigeria. The population is about 60 percent Muslim and 40 percent Christian.

Old Ibadan at the approximate center of the city contains the Parliament and Secretariat buildings, the Central Bank, and various Nigerian federal ministries, including those of the army and police. Nearby is the modern central business district. Densely populated low-income housing spreads out from the central area, and planned suburbs have been developed on the outskirts of the city.

Ibadan is virtually without heavy industry. Crops such as cocoa, yams, cassava, rice, millet, and sorghum are sold in market squares and vending stalls. Crafts include weaving, spinning, *adire* (tie-dyeing), pottery making, and blacksmithing. Among the industries are corn milling, soft drink and cigarette manufacturing, leather working, wood and steel furniture making, brick making, and printing.

Ibadan is well served by roads, rail, and air routes. The city has several cinemas, daily newspapers, and radio and television broadcasting stations. The University of Ibadan, founded in 1962, has institutes of science research, child health care, African studies, and education.

The original Yoruba settlers of the 18th century are believed to have been outcasts from neighboring villages. The city's recorded history began in 1829 when victorious armies of intertribal wars camped there and formed the nucleus of the modern city. By 1851 Ibadan had established a dual system of government, combining military and civilian administration. The British colonial government assumed control of the city in 1893. Commercial development increased after the railway arrived from Lagos in 1901. In the 1920s and 1930s roads were built to connect the city with the rest of the country. (See also Nigeria.) Population (1980 estimate), 2,500,000.

IBERIAN PENINSULA. Occupied by both Spain and Portugal, the Iberian Peninsula lies in southwestern Europe. Its name is derived from its ancient inhabitants, whom the Greeks called Iberians. This name probably comes from the Ebro (Iberus), the peninsula's second longest river after the Tagus.

In the northeastern part of the peninsula, the Pyrenees Mountains, with the peninsula's highest peaks, form an effective land barrier from the rest of Europe. At Gibraltar, in the south, the peninsula is separated from North Africa by a narrow strait. The western and northern coasts are on the Atlantic Ocean; the eastern coast is on the Mediterranean Sea.

Most of the peninsula is occupied by Spain. The Meseta, a large plateau at an average elevation of 2,000 feet (610 meters), is the main physical feature of the Spanish portion. Mountains almost completely surround the Meseta: the Cantabrian Mountains in the northwest, the Iberian Mountains to the northeast, the Sierra Morena in the south, and low mountains on the border with Portugal in the west. Spreading between the Iberian and Pyrenees mountains is the Ebro River valley, which drains into the Mediterranean Sea. South of the Meseta region, the Guadalquivir drains the Andalusian region into the Atlantic Ocean.

Portugal occupies about 15 percent of the Iberian Peninsula. It is largely a lowland region, consisting of broad river valleys, plains, and low plateaus. The chief mountain ranges extend north of the Tagus River, which flows through central Portugal to the Atlantic Ocean. Portugal's highest point is about 6,500 feet (2,000 meters).

IBERVILLE, Pierre (1661–1706). In colonial days a daring French Canadian spent his life trying to win America for France. He was Pierre Le Moyne, sieur d'Iberville. His skill as a colonizer strengthened France's claim to all the "Louisiana country."

He was born in Montreal, Que., on July 16, 1661. He had ten brothers and three sisters. His father, Sieur Charles Le Moyne, taught his sons frontier skills. At 14 Pierre was commissioned in the royal navy. After some years of service he returned to Canada, eager to help drive the British from America.

Iberville was 25 when an undeclared war against the British fur trade began. He quickly joined a band of French Canadian adventurers under Sieur de Troyes. After a trek of 900 miles (1,450 kilometers), they raided James Bay, and Iberville helped capture three forts of the Hudson's Bay Company. In 1689 war was officially declared (see King William's War). Iberville led three more daring attacks against British posts in the Far North. He also directed the destruction of Schenectady in New York and seized Saint John's, Newfoundland.

Iberville's greatest military exploit took place on Hudson Bay in 1697. His small fighting ship, the *Pelican*, met three British warships. He sank one and captured two. Then the *Pelican* was wrecked in a storm. But Iberville with his half-frozen crew captured the British stronghold, Fort Nelson.

After the war Iberville was commissioned to locate the mouth of the Mississippi and to establish a colony. In 1699, after exploring the lower stream, he set up a colony at what is now Ocean Springs, Miss., near Biloxi. This became France's foothold in the "Louisiana country." A year later he built a post near the site of present-day New Orleans.

When war began again in 1702, Iberville commanded the French West Indian fleet. He captured the islands of Nevis and Saint Christopher in 1706. A few months later he died of an attack of yellow fever in Havana, Cuba.

IBEX see GOAT.

IBIS AND SPOONBILL. Like a storm of great snowflakes, the white ibises circle over a Florida swamp, settle on the water lettuce and violet hyacinths, and then flash suddenly upward again. Occasionally in the midst of this great white swirl a few of the rare rose-pink roseate spoonbills may be seen.

Ibises and spoonbills are closely related tropical wading birds. They live in colonies along bays and saltwater lagoons of southern seacoasts and on interior marshes, where they feed on shellfish, frogs, and small fish. Both birds stalk about the swamp with an air of haughty dignity. Like the cranes, they fly with neck and long legs outstretched. The spoonbill's flight is an easy, uninterrupted flapping. The ibis alternates the wing strokes with short glides.

The spoonbill gets its name from its large, flat, spoon-shaped bill. When it feeds it submerges its bill and, with it open to scoop in whatever may come its way, swings the entire head and body from side to side as it moves forward like a man cutting grain with a scythe. The roseate spoonbill is found in Florida and on the Gulf coast. This bird is almost three feet (one meter) long. The wings and under parts are a delicate rose-pink, tipped with rich crimson. The plumes at the base of the neck are crimson; the upper neck and back are white. The nest is a bulky platform of sticks in small trees. The three to five eggs are white, blotched with olive-brown.

The ibis has a long, slender, downward-curving bill with which it probes in the mud for food. It makes its nest of rushes and weed stalks, attaching it to reeds and low bushes. About 30 species of ibis are distributed over the warm parts of the Earth. Four species occur in North America. The most abundant is the white ibis. As many as 35,000 individuals have been counted in a single Florida rookery. The adult bird is about 2 feet (.6 meter) long. Its plumage is pure white, with glossy black wing tips. The face, bill, and legs are red. Immature birds are a dull grayish brown with white head and neck and white underparts. The sexes look alike. The birds nest across the southern United States from Florida to California. They have

Colorful roseate spoonbill (*Ajaia ajaja*) and two sacred ibises (*Threskiornis aethiopicus*)

(Right) Ben Goldstein—Root Resources/EB Inc.; (far right) M. P. Kahl



also been found as far north as the marshes of Long Island, southern Illinois, and Great Salt Lake.

Much less common are the eastern glossy ibis and the white-faced glossy ibis of the Western states. They are dark-colored birds of a rich purple-green, with dusky bill and legs. The scarlet ibis of tropical South America has sometimes been seen in the Gulf states. The sacred ibis of Egypt lives in the Nile Valley. It was revered by the ancient Egyptians, who embalmed it at its death.

The North American ibises are sometimes called curlews. However, the true curlews, although their bills are similar, are short-legged waders. The so-called wood ibis is a stork (*see* Stork).

Ibises and spoonbills form the family Threskiornithidae. The scientific name of the white ibis is *Eudocimus albus*; eastern glossy ibis, *Plegadis falcinellus*; white-faced glossy ibis, *Plegadis chihi*; scarlet ibis, *Guara rubra*; sacred ibis, *Threskiornis aethiopicus*; roseate spoonbill, *Ajaia ajaja*.

IBN BATTUTAH (1304–68?). The best-known medieval Arab traveler, Ibn Battutah, was the author of one of the most famous travel books in history, the ‘Rihlah’ (Travels). He was born at Tangier, Morocco, on Feb. 24, 1304. At the age of 21 he began his extensive travels, covering some 75,000 miles (120,700 kilometers); he was known as “the traveler of Islam.”

The first part of his journey brought him to Egypt, and it was during this trip that he became enthusiastic about traveling, vowing to visit as many parts of the world as possible. He established as a rule for himself “never to travel any road a second time.” Ibn Battutah traveled for its own sake, for the reward of learning about new countries and new peoples. As he became increasingly famous, he made a living from his travels. Numerous sultans, rulers, and high dignitaries were generous toward him, enabling him to secure an income and to continue his wanderings.

The ‘Rihlah’ contains Ibn Battutah’s accounts of his visits to, among other places, Egypt, Syria, Arabia, Iraq, southern Iran, Azerbaijan, Yemen, Aden, Africa’s eastern coast, southern Arabia, Oman, Hormuz, Anatolia, the Crimea, the northern Caucasus, Constantinople, Central Asia, Afghanistan, India, the Maldives, Ceylon, Bengal, Assam, Sumatra, China, Tunisia, Sardinia, Algiers, Spain, the western Sudan, and Mali.

Ibn Battutah died in 1368 or 1369 in a town in Morocco, where he held the office of *qadi* (judge). He was buried in his native Tangier.

IBN GABIROL (1021?–58?). A medieval Hebrew poet and philosopher, Ibn Gabirol wrote during the Spanish period. His Hebrew verse consists of both sacred and secular poems.

Solomon ben Yehuda ibn Gabirol was born about 1021 in Málaga, Spain. After a lonely childhood as a dependent orphan, he showed early promise as a poet and was soon recognized as a master of Hebrew. His secular poems reveal an intellectual mind that was

sensitive to change. His sacred poems, which are meditative and devotional, humbly reflect the glory of God and the longings for redemption of suffering Jews. Many of the latter poems became part of the Hebrew liturgy, or worship, of the time. Among these is a mystical confessional called ‘Keter Malkhut’ (Crown of the Kingdom), which expresses the grandeur of God as well as the insignificance of human struggling to master passion and desire. His secular poems include love odes, dirges, and praise of his friends.

Ibn Gabirol was also interested in philosophy. His major philosophical works were written in Arabic. Their translated titles are ‘The Improvement of the Moral Qualities’ and ‘Fount of Life’. The latter had great influence on medieval scholars and was long believed to be written by a Christian. It was not until the 19th century that the scholar Salomon Munk proved the work to have been written by Ibn Gabirol. The Hebrew poet died about 1058 in Valencia.

IBN KHALDUN (1332–1406). In the more than 1,000 years between the times of the philosopher Aristotle in ancient Greece and the writer Machiavelli in Renaissance Italy, the most preeminent social scientist in the West was a Muslim Arab scholar named Ibn Khaldun. He was a historian, philosopher of history, and sociologist, much of whose life was devoted to public service and teaching.

Ibn Khaldun was born in Tunis on May 27, 1332, the descendant of a family that had for centuries served in high administrative posts in Spain and North Africa. He received a thorough education in the Koran—the holy book of Islam—and in Muslim law and the masterpieces of Arab literature.

From 1352 to 1375 he held various government posts in Spain and Africa. He then retired to a castle near Frenda, Algeria, and wrote his masterpiece, the ‘Muqaddimah’, an introduction to history. In 1382 he sailed to Egypt, where he spent most of the remainder of his life. He became a teacher at schools in Cairo and was made a chief judge and interpreter of Muslim law. In 1400 he spent several months at the court of Timur Leng, also known as Tamerlane, the Mongol conqueror who had just overrun Syria. He eventually returned to Cairo, where he died on March 17, 1406.

Ibn Khaldun’s chief works were the ‘Muqaddimah’ and the ‘Kitab al-‘ibar’, a definitive history of Muslim North Africa. The ‘Muqaddimah’, a theoretical introduction to the latter, presents a philosophy of history and of the rise and fall of cultures. Filled with brilliant observations on economics, politics, education, and historiography, it also contains wide-ranging sociological sketches in a variety of areas.

IBN SAUD (1880?–1953). The man who formed the modern nation of Saudi Arabia and who began petroleum exploration on the Arabian peninsula, Ibn Saud was a descendant of a dynasty that had ruled most of Arabia during the century prior to his birth. He was born about 1880 in the Saudi capital of Riyadh, and

during his early years his family was driven from power by a rival dynasty, the Rashids. He grew up in poverty-stricken exile in Kuwait.

In 1901, at age 21, Ibn Saud began a nearly 30-year struggle to conquer and consolidate a kingdom. A daring raid into Riyadh in January 1902 succeeded in rousing the former supporters of his dynasty, and within two years he had won over much of central Arabia. Turkish forces summoned by the Rashids opposed him until 1912 with little success and then withdrew for lack of supply bases.

Ibn Saud, himself a devout Muslim, supported Wahhabism, an extremist Muslim puritan revival. To further aid his cause, he founded a militantly religious brotherhood known as the Ikhwan to combat Arab rivals and bring more tribesmen under his control. By 1922 he had totally extinguished the rule of the House of Rashid. In 1924 he seized the territory of the Hejaz, including the city of Mecca, from Sharif Husayn. In the late 1920s the Ikhwan turned against him when he forbade further raiding on their part. He defeated them at the Battle of Sibilla in March 1929, and three years later all of his domains were united into the nation of Saudi Arabia.

Ibn Saud's 20 years as absolute monarch were, in many ways, less fortunate than his time of struggle. In 1933 he signed his first oil exploration lease. Oil was discovered five years later, but work on the wells halted during World War II, leaving the country and government in poverty. Once the oil money began coming in, the king was forced to watch the gradual encroachment of Western customs and irresponsible financial speculation. His puritan Muslim faith was offended by the great increase in corruption in government and society and by changing morals among his people. He spent his last years frustrated, unhappy, and plagued by ill health. He died on Nov. 9, 1953, at at-Ta'if and was succeeded by his son Saud.

IBSEN, Henrik (1828–1906). The first great modern playwright was Henrik Ibsen, a Norwegian. His plays show a wide variety of styles, ranging from the realism of 'Hedda Gabler' to the fantasy of 'Peer Gynt'. He is admired for his technical mastery, symbolism, and deep psychological insight.

Ibsen, born on March 20, 1828, in the small port town of Skien, Norway, was one of six children. When the boy was eight, his father went bankrupt. For the next eight years the family lived on a small farm near Skien. At 15 Ibsen was apprenticed to a druggist in the town of Grimstadt. It was a lonely life, and the boy soon turned to writing, especially poetry.

In 1849 Ibsen entered the university at Christiania (now Oslo), but he soon dropped out for lack of money. His life was hard for many years. He did routine writing for newspapers and managed a small theater. He traveled in Germany and Denmark to study scene design. He also wrote poetry and unsuccessful plays.

Finally in 1864, aided by a small government grant and the help of friends, Ibsen left Norway to live in Rome, Italy. His first successful play, 'Brand', was

originally written in 1865 as a narrative poem. Recast as a drama, it was first performed in 1885. It tells the grim story of a minister who renounces the compromises of his time in favor of a "true-to-onself" life. His next play was 'Peer Gynt' (1867), the tale of a world traveler involved in a variety of remarkable adventures. Wild as the story is, its point is clear—that a second-rate life has little meaning and purpose.

Then followed 'The League of Youth' (1868), about political corruption, and 'Emperor and Galilean' (1873), a plea for a new kind of Christianity. 'The Pillars of Society' (1877) and 'A Doll's House' (1879) deal with social reforms based on the principles of honesty and freedom. 'Ghosts' (1881), about the tragedy of disease that affects the mind, is perhaps Ibsen's greatest play.

Among his later plays are 'An Enemy of the People' (1882), a comedy with serious undertones; 'The Wild Duck' (1884), combining reality and poetry; and 'Rosmersholm' (1886), dealing with the conflict between conscience and desire for freedom. 'Hedda Gabler' (1890) is a powerful domestic tragedy ending in suicide. Among his last plays are 'The Master Builder' (1892) and 'When We Dead Awaken' (1899).

After years of living alternately in Rome and Dresden and Munich, Germany, Ibsen returned to Norway in 1892. He was rich, honored by the world, and loved by his own people. His plays were translated into many languages and staged in countries all over the world. He died in Christiania on May 23, 1906. (See also Drama.)

ICE. When liquid water or water vapor becomes cold enough, it changes into solid water, called ice. Ice is made up of crystals in various shapes. Liquid water freezes to six-sided needles; water vapor may form needles, plates, or hollow prisms, depending on the temperature. The separate crystals of freezing water, called frazil, grow and interlace until the whole body of water is one solid mass.

Most liquids contract as they freeze, but water expands. As ice forms on ponds, rivers, and lakes, it floats and forms a surface layer that helps keeps water below it from freezing. Under this layer some fishes and other water animals stay alive.

Water vapor usually crystallizes on tiny solid particles such as grains of dust. In absolutely clean air, even below the normal freezing point of 32° F (0° C), water vapor supercools, or does not freeze. At -40° F (-40° C) or lower, water vapor will freeze even if no dust particles are present. An airplane flying through supercooled air may help the vapor turn to ice. The cloudlike trails seen behind high-flying planes are not ice, but mainly the extra water vapor added to the air by the engine exhaust.

Cirrus clouds are made up of the microscopic particles formed when water vapor freezes (see Cloud). If there is enough water vapor in the air, these crystals will grow into the complicated shapes of snowflakes (see Snow). Hail is simply snow crystals partly melted and frozen again.

ICE AGE. The people who may have been living in central North America 20,000 years ago saw ice and snow the year round. The men hunted along the edge of a great wall of ice that extended across the continent from ocean to ocean. In summer the women fished in chill streams that flowed from the melting ice. Anyone who ventured to climb the wall saw ice extending northward without a break.

These people were living in the grip of the latest Ice Age, a period when all of Canada, much of the United States, and most of northwestern Europe lay buried beneath sheets of ice hundreds or even thousands of feet thick. But these people did not live in bitter cold. The average temperature was only 10 or 12 degrees lower than it is today along the border between the United States and Canada. Moreover, this cooler average and the very Ice Age itself were caused largely by cool summers rather than by bitter winters. There was not enough heat in the warm months to melt away the previous winter's snow and ice. So they piled up year after year, until they covered the northern country.

The biggest difference between the country near the edge of the ice sheet and the same country today was in the vegetation and animal life. The cold prevented the growth of trees, grasses, and most flowering plants. The ground was covered with mosses and lichens, and in the warmest weeks a few fast-blooming plants sprang up such as we find in the Arctic today (see Arctic Regions). The principal animals were wild reindeer, or caribou, musk-oxen, and mammoths, which could paw through snow to get food, and meat eaters, such as bears and wolves.

Today, some geologists say, this Ice Age is finally coming to an end. Inhabitants of Greenland live near the edge of a glacier that covers most of the island. The Antarctic is almost completely covered by a vast ice sheet. These enormous glacial areas are called *ice caps* (see Greenland; Antarctica). The slow-moving rivers of ice that fill valleys in the Alps and other high mountain ranges are called *valley glaciers*. (See also Glacier; Alps.)

Why Scientists Believe in an Ice Age

Why do scientists believe that ice once covered so much of North America? The answer begins with Louis Agassiz, who was born in 1807 in Switzerland (see Agassiz). Agassiz became a teacher of natural science, and he knew much about the glaciers of his native Alps. He observed how they rubbed the valley floors and sides, carried rocks, and left mounds of gravel as they melted. He noticed also that boulders of granite could be found hundreds of miles from any solid granite formations. Finally, bedrock far from the Alps showed grooves and scratches (called *striae*, from the Latin for "furrows"), such as would be made if glaciers had pushed small rocks over it. But if the glaciers had been big enough to do this, they must have covered most of northern Europe.



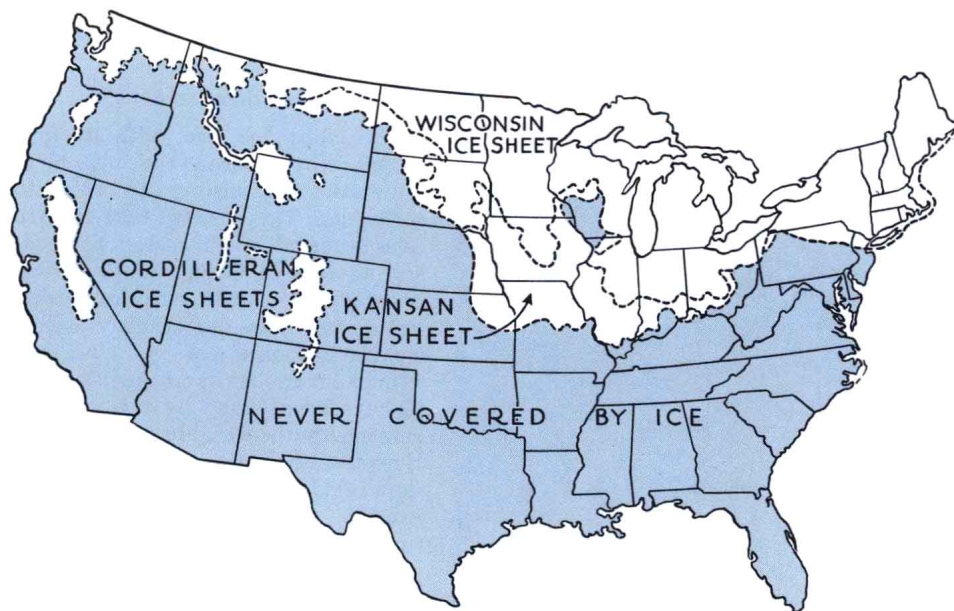
Johns Hopkins Glacier empties into Reid Inlet in Alaska's Glacier Bay National Monument. This active glacier and others in the park began to recede about 150 years ago.

Other Traces of the Ice Age

Geologists use modern glaciers as a guide in studying the old Ice Age. These show how the piled-up snow changed to sandlike grains near the surface and to ice below. When the ice became about 150 feet thick, it pushed out at the edges. The creeping ice rubbed away small hills and carried their gravel, sand, and clay into the valleys. These deposits are called *glacial till*. Streams from the melting edges of the glaciers scattered sand and gravel in long, crooked mounds called *eskers*. Drifts that piled up under the ice now appear as low hills called *drumlins*.

During this flow the ice carried boulders and soil southward until it reached a climate warm enough to melt it completely each summer. As it melted, it dropped its burden upon a sort of rubbish heap, called a *moraine*, along the line of melting. When warmer summers drove this line northward, the moraines were left. Today they are seen as broad, gently sloping mounds across the landscape.

Wherever the ice retreated, the water from the melting edge had to find new channels, for the old river valleys were filled with drift. Much of the flow was caught behind the moraines, and the waters spread out to form lakes. As the levels of these lakes rose, they overflowed at low places and often joined one another in long chains connected by small streams. A glance at any map of the northern United States and southern Canada will show this wealth of connected lakes and streams. The lakes range in size from small forest pools to the Great Lakes (see Great Lakes).



The white areas are those that were covered by ice sheets in the past. The Kansan and Nebraskan sheets overlapped almost the same areas, and the Wisconsin and Illinoian sheets covered approxi-

mately the same territory. In the high altitudes of the West are the Cordilleran ice sheets. An area at the junction of Wisconsin, Minnesota, Iowa, and Illinois was never entirely covered with ice.

As geologists studied this sort of evidence throughout the world, they decided that Agassiz's simple "Ice Age" really consisted of four periods; that is, the ice formed and advanced, then melted back toward the poles, four different times. They believe this because they find moraines and other deposits from each period, and in places these lie one over another, so that the younger can be distinguished from the older. In the United States, each of the four cold periods, called *glaciations*, is named for a state that was reached by its ice, as shown in the accompanying table. The intervening warm periods, called *interglacial* phases, are named for localities where relics from them were studied. In Europe, the glacial phases are named for the little Alpine river where they were studied and the interglacial periods are indicated by hyphenating the names of the glacial periods that preceded and followed.

	IN AMERICA	IN EUROPE
First Glaciation	Nebraskan	Günz
Warmer Period	Aftonian	Günz-Mindel
Second Glaciation	Kansan	Mindel
Warmer Period	Yarmouth	Mindel-Riss
Third Glaciation	Illinoian	Riss
Warmer Period	Sangamon	Riss-Würm
Fourth Glaciation	Wisconsin	Würm
Warmer Period	Modern or Post-glacial	Modern or Post-Würm

From the direction of the grooves or striae in the bedrock, it has been established that in North America the ice always spread out from the same three centers or ice caps. These were named after the regions they covered: Labrador, Keewatin, and Cor-

dilleran, as shown in the map on the next page. The thicknesses of the ice sheets in various places were measured by the height of the striae on mountain sides.

Many types of animals that formerly inhabited North America were driven out or destroyed by the successive invasions of ice. Among them were the huge elephant-like mastodon, the saber-toothed tiger, members of the camel and llama family, and several species of horses.

Patient study has helped geolo-

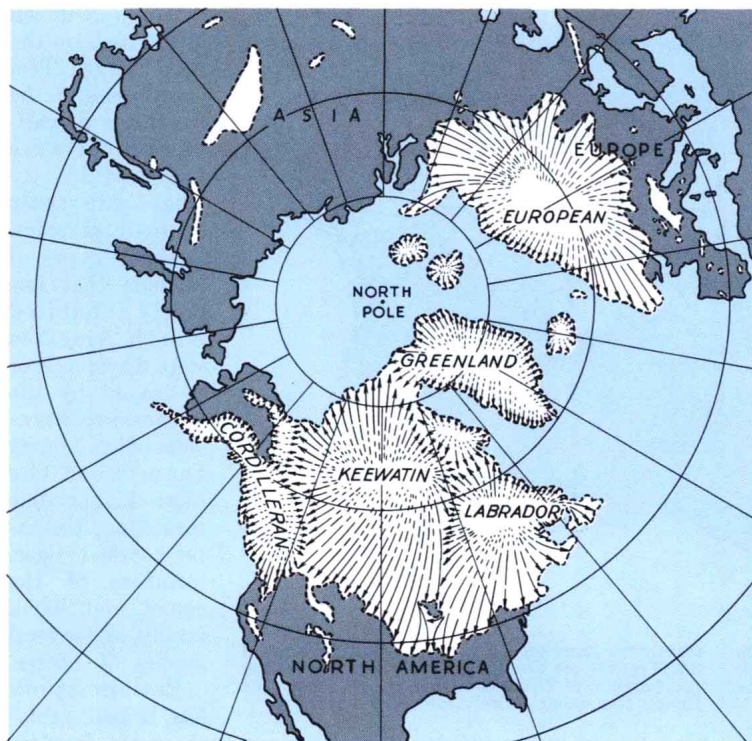
gists to estimate how long ago each of the four ice sheets covered North America and Europe. In general it seems that the Nebraskan ice sheet covered North America perhaps 2,000,000 years ago, the Kansan sheet 1,250,000 years ago, the Illinoian sheet 500,000 years ago, the Wisconsin sheet 100,000 years ago. The warm period called the *Yarmouth*, between the Kansan and the Illinoian glaciations, lasted much longer than any other period, warm or cold.

The latest, or Wisconsin, sheet probably began to melt at its edges about 40,000 years ago. The ice cap centered over Labrador drew back from the Niagara Falls region about 36,000 years ago and left New England clear about 28,000 years ago. The Keewatin ice cap, longer and thicker, did not leave Minnesota until about 15,000 years ago. Europe's ice blanket melted from central Germany 17,000 years ago, and from Sweden 13,000 years ago.

How the Ice Age Has Affected Modern Life

The immense amount of glacial drift inherited from the Ice Age has influenced the character of soil and the development of agriculture (*see Soil*).

Other changes were caused by the tremendous weight of the ice sheet. It was about two miles thick over much of North America. This placed 400 tons or more upon every square foot of surface. The earth's crust sank under this load—from 300 to 800 feet in areas like New England. Here the land has not yet risen to its former level, and many ancient valleys are now under the sea, forming bays and inlets. Chile and Norway present other "drowned coasts," with many fiords filling valleys which old glaciers gouged out.



The map shows five great ice caps from which the ice moved outward during the Ice Age and to which it retreated later. Three of these are in North America.

The estimated 12 million square miles of thick ice sheets were formed, of course, of water drawn from the oceans. This lowered the oceans several hundred feet below their present level, all around the world. Old, low shore lines have been found by sounding beneath the sea off the Hawaiian Islands, Bermuda, and elsewhere. A huge amount of water still remains locked in ice over Antarctica and Greenland. If this should melt, it would raise the oceans about 200 feet.

Scientists tell us men moved southward and northward, as the ice sheets advanced and melted back. In Colorado and near by, flint arrowheads have been found embedded in the bones of mammoths and other Ice Age animals, now extinct. During the last cold period in Europe, men lived in caves

where they left stone relics of many kinds (*see Man*).

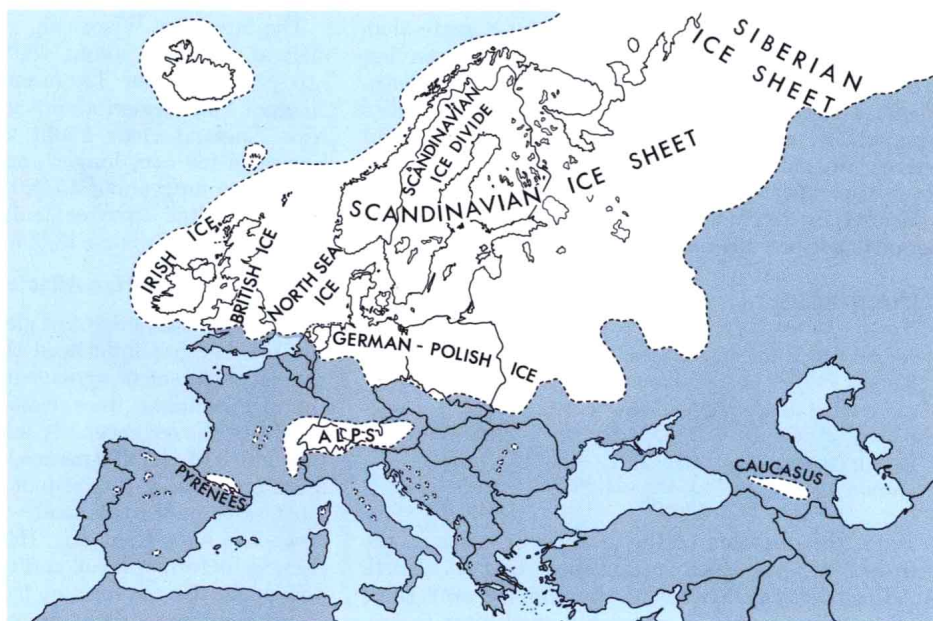
Evidence of Earlier Ice Ages

The latest Ice Age, with its four phases, is by no means the only one in the earth's long history, according to geologists. They believe that two Ice Ages occurred, one in eastern Canada, and another in China, South Africa, Norway, and North America during Proterozoic times (*see Geology*). During the Paleozoic era, the Coal Age with its luxurious swamp growth seems to have been closed by the most severe ice age the world has ever known. Even tropical lands in India and Africa show evidence of ice sheets. South America may have been ice-capped from the Brazilian jungles southward.

Causes Are Mysterious

Ice ages arrive, as we have seen, when the climate over a region becomes cooler. Summer heat fails to melt away winter ice and snow. Why did these events occur in the earth's history?

Some scientists have tried to explain this by variations in the movement of the earth around the sun. But no variation has ever been found which fits both the theories of astronomy and the record of what has happened on the earth. Others have guessed that blankets of dust or of carbon dioxide got into the air and cut off part of the sun's heat. The newest



Europe, like North America, had four periods of glaciation. Successive ice caps reached limits

which differed only slightly. The area covered by ice at any time is shown above (in white).