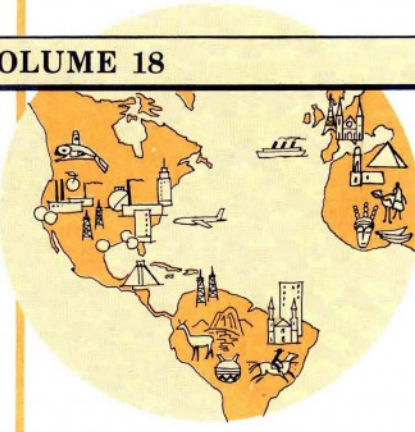
18

COMPTON'S ENCYCLOPEDIA

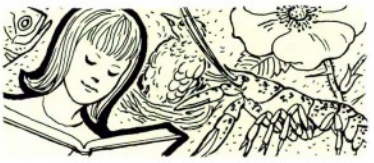
Niag
Ozark

HERE AND THERE IN VOLUME 18

AT ODD TIMES when you are just looking for "something interesting to read," without any special plan in mind, this list will help you. With this as a guide, you may visit faraway countries, watch people at their work and play, meet famous persons of ancient and modern times, review history's most brilliant incidents, explore the marvels of nature and science, play games—in short, find whatever suits your fancy of the moment. This list is not intended to serve as a table of contents, an index, or a study guide. For these purposes consult the Fact-Index and the Reference-Outlines.



HERE AND THERE IN VOLUME 18



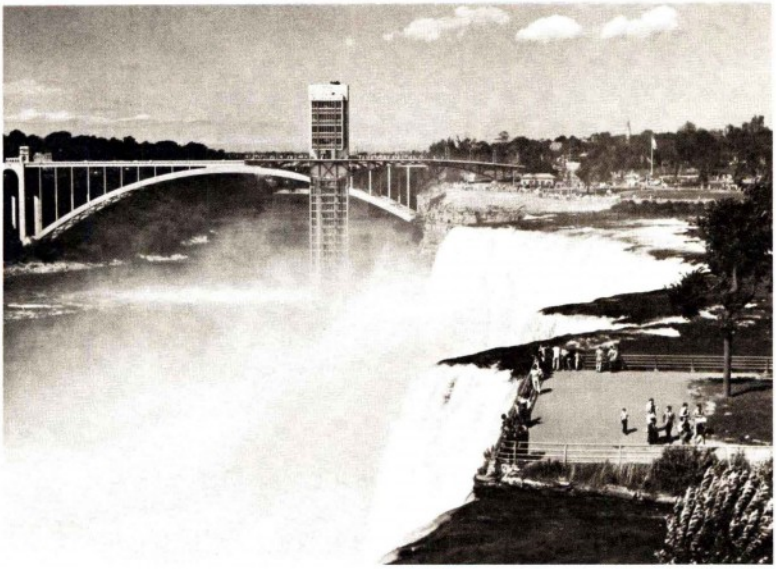
The Plant and Animal Kingdoms

The Wide World of Facts

Marvels of Science and Invention

The Arts

At Home and Abroad



One of the world's outstanding natural wonders is Niagara Falls. In the center, its base hidden in spray from the rushing water, is an observation tower near the American Falls section.

NIAGARA FALLS—One of the World's Greatest Waterfalls

NIAGARA FALLS. Father Louis Hennepin, the priest who accompanied La Salle, was the first white man to view the falls of the Niagara River, in 1678. In a recent year the falls had an estimated $3\frac{1}{2}$ million sight-seers. Among them were many honeymooning couples. The falls are about 17 miles northwest of Buffalo, N. Y., on the river that carries the waters of Lake Erie into Lake Ontario.

The Mighty Falls

Every minute about 12,000,000 cubic feet, or 379,000 tons, of water pour in torrents over the cliffs of the falls of Niagara. These torrents drop as much as 167 feet to the turbulent water below.

As the water plunges from the brink of the falls, it fills the air with a silvery mist which under the sunlight displays many rainbows. The plunging water also sends out a never-ending roar as it strikes the bottom. For this reason the Iroquois Indians called the cataract Niagara, meaning "thunder of waters." In winter the water near the edges of the falls may freeze into majestic masses of ice.

The falls are divided into two parts by Goat Island. The larger portion, on the southwest side, is the Canadian Falls, also called the Horseshoe Falls. It measures 3,000 feet along its curve and drops about 160 feet. The smaller American Falls is northeast of Goat Island. It is 1,000 feet straight across and drops about 167 feet. Between the American Falls and Goat Island are a small island, called Luna Island, and a small falls, named Luna, or Bridal Veil, Falls.

THE NIAGARA PENINSULA
This is the Niagara peninsula looking south from above Lake Ontario. Water flows in the Niagara River from Lake Erie and over the falls. In the foreground is the Niagara escarpment.

Just before flowing over the ledge, the American stream is only about $3\frac{1}{2}$ feet deep. The Canadian stream is about 20 feet deep and carries some 95 per cent of the Niagara River's water. Thus the Horseshoe is the larger and grander of the two falls.

The plunging water has worn the lower rocks away so that there are caves behind the sheets of water of both falls. Sight-seers may enter the Cave of the Winds, at the foot of the American Falls, and get an unusual view. The Canadian Falls has carved out a "plunge basin" 192 feet deep. The basin slows the flow below the falls, and two steamers, named *Maid of the Mist*, can go near the cataract here.

Putting Niagara Falls to Work

Almost all the drainage from four of the Great Lakes pours over the crest of Niagara Falls. This tremendous volume of falling water is used to generate power in hydroelectric plants. They develop a maximum of about $5\frac{3}{4}$ million horsepower, some 55 percent of this on the American side and about 45 percent on the Canadian side. The plants draw water from the river above the falls, through canals. Near each plant the water drops through penstocks to powerhouses below the falls. There it turns great turbine generators (*see* Turbine).

The Niagara Power Project, which includes the Lewiston and Robert Moses power plants, is among the largest in the Western world. The Schoellkopf plant, severely damaged by rockslides, was retired in 1961. One of the six power plants in Canada, the DeCew Falls, is on the Welland River; the other five are on the Niagara. They are the Sir Adam Beck stations No. 1 and No. 2, Ontario, Toronto, and Rankine.

International Co-operation at the Falls

The control of Niagara Falls between the United States and Canada has long offered the world a fine example of international co-operation. A treaty of 1910 and later agreements fixed the amounts of water that could be diverted. An international Niagara Control Board was set up in 1923.

In 1950 the two countries made a new treaty which specified the minimum flow to be maintained over the falls. This treaty made possible greater hydroelectric development. It provides that 100,000 cubic feet per second (c.f.s.) of water must flow over the falls during the tourist season in the daytime and 50,000 c.f.s. at night and during the off-tourist season in the daytime. The remainder is equally divided between Canada and the United States. An average of 202,300 c.f.s. flows over the falls.

Between 1954 and 1958 the United States and Canada completed the Niagara Remedial Works Project. This enormous operation checked erosion with a gated control structure, excavations, and fills.

The Hydro-Electric Power Commission of Ontario completed the Sir Adam Beck-Niagara Generating Station No. 1 in 1925 and No. 2 in 1958. The combined capacity of the plants is 1,443,000 kilowatts.

In 1957 Congress approved the construction of the Niagara Power Project by the Power Authority of the State of New York. It has a capacity of 2,190,000 kilowatts. The first electric current from the project was delivered in 1961.

How Niagara Came to Be

The falls of Niagara are about 25,000 years old. The hard rock (Lockport dolomite) at the brink of the falls is much older. It was made on the bed of an inland sea more than 300 million years ago, in Silurian times (*see* Geology). Gradually the limy sediment hardened to stone—either limestone or dolomite, a limestone with magnesium.

Later, the Niagara region raised in a widespread uplift centered in Michigan. Streams wore down the land. The layer of tough rock, however, resisted erosion. The edge of the deposit formed a great cliff—the Niagara escarpment. It runs west from Rochester, N. Y., between Lakes Erie and Ontario, then swings north through the Province of Ontario. It is capped by hard Niagara limestone or Lockport dolomite.

Many ages later, glaciers covered the Niagara region (*see* Ice Age). As the last glacier retreated it left Lake Erie at its southern edge. Water from the lake began to spill over the Niagara escarpment into the Ontario basin below, just south of where Queenston and Lewiston now stand.

The new falls did not wear away the dolomite cap rock as fast as they churned away the softer rock below. From time to time blocks of the undermined cap rock would break off. The falls worked back toward Lake Erie, forming a steep-walled gorge. (For a diagram of the undercutting process, *see* Earth.)

NIAGARA FALLS AND THE NIAGARA GORGE
This close-up view of the falls and the gorge shows places of interest. Tourist attractions include Rainbow Bridge, an aerial cableway, and the Whirlpool. On both the American and Canadian sides are hydroelectric plants.

Niagara's rate of cutting has changed many times. It started slowly, for at first the river drained Lake Erie only. Lakes Superior, Michigan, and Huron had a northerly outlet. The drainage changed as glaciers retreated. Water from all four lakes then poured over the falls. When the river spread to the point where the famous Whirlpool now is, it reached an ancient valley that had cut into the dolomite from the west. Later the valley filled with glacial debris. The river wore away the soft material, forming the 60-acre whirlpool basin.

From Stunts to Public Parks

The fascination of Niagara has prompted dangerous stunts. The French acrobat Charles Blondin walked across the gorge on a tightrope in 1859. Some persons have gone over the falls in barrels or other containers. Others have tried to swim the rapids. Hazardous stunts are now prohibited by law.

The American and Canadian governments have built parks, viewing platforms, paths, and highways. At night colored lights illuminate the falls. (For picture in color, *see* Waterfalls.)

NIAGARA FALLS, N. Y. One of the world's greatest waterpower sources and scenic attractions helped build the city of Niagara Falls.

This important industrial city and world-famous tourist center is in northwestern New York on the east bank of the Niagara River at the Niagara Falls (*see* Niagara Falls). The city is about 17 miles northwest of Buffalo, N. Y. Across the river is the city of Niagara Falls, Ont.

Waterpower for Industries

The plunging water at the falls provides a great and constant source of power for hydroelectric plants. The power generated supplies electricity for homes and industries in the city, in a large area in New York, Pennsylvania, and Ohio, and in Canada.

Abundant and cheap electric power has made the city of Niagara Falls one of the world's largest electrochemical and electrometallurgical centers. The city produces highly diversified manufactures. The most important of these are chemicals, abrasives, graphite products, aerospace equipment, and paper products. Another major source of income is tourism.

The main tourist attraction is Niagara Falls, with its gorge and upper and lower falls. In the city is Hyde Park, a 382-acre recreation area. Rainbow Bridge and the Whirlpool Rapids Bridges link the city with Niagara Falls, Ont.

A fort called Little Niagara was built about 1751 on the present site of Niagara Falls, N. Y. Here Augustus Porter founded the village of Manchester in 1806. It was burned by the British in 1813. The village remained small until a canal to supply water-power was built around the falls between 1852 and 1862. Electricity from the village's first hydroelectric plant was used for park lighting beginning in 1879 and for commercial purposes in 1881. In 1892 the villages of Manchester and Suspension Bridge were combined as the city of Niagara Falls, N. Y.

A city manager, appointed by a mayor and four councilmen, governs the city of Niagara Falls. Population (1970 census), 85,615.

THESE ARTICLES ARE IN THE FACT-INDEX

Niagara Falls, Ont.
Niagara University
Niamey, Niger
Niam-Niam, Azandeh
Niantic
Nias Island

NIBELUNGS (*nē'bĕ-lụngs*), **SONG OF THE.** One of the favorite themes of medieval storytellers was the long series of heroic deeds and tragic events centering around the treasure of the Nibelungs, a mythical race of Scandinavian dwarfs. These tales at last took written form in German as the 'Nibelungenlied', or Song of the Nibelungs, and in a Scandinavian version known as the 'Volsunga Saga'. From them Wagner took the stories of his Ring cycle of operas (*see* Opera; Wagner; Storytelling).

The story of the evil treasure began when three gods, Odin, Loki, and Hoenir, saw an otter devouring a salmon. They killed the otter and bearing the pelt with them sought shelter for the night in the abode of Rodmar, a greedy, heartless miser. Rodmar recognized the pelt as being that of one of his sons, who had the power of changing his shape. He demanded as pay (wergild) for the slaying of his son enough gold to completely cover the otter pelt. To get the gold the gods hastened to the river and seized a priceless treasure, but when all was heaped upon the pelt one hair remained uncovered. Loki placed on this a ring which bore this curse: "Evil shall come to him who wears it." This treasure passed after a time into the hands of the Nibelung kings.

In the Song of the Nibelungs this hoard is found in the possession of Siegfried, a daring warrior, who has slain the two kings of the Nibelungs to obtain it. The plot centers around Kriemhild, the sister of Gunther, king of the Burgundians, who holds his court at Worms, on the Rhine. Siegfried comes to woo Kriemhild, and in due course they are wedded.

Many characters are introduced into the story. One is Brunhild, an Icelandic princess of wonderful beauty and warlike strength. Only he who should overcome her in deeds of skill and strength might win her love and hand. King Gunther, attracted by the fame of her beauty, goes to woo her, and Siegfried accompanies him as his friend and ally. Wearing a cloak of darkness which makes him invisible, Siegfried aids Gunther in defeating Brunhild in three tests of prowess—hurling for him the spear, putting the weight, and jumping with Gunther in his arms far beyond the limit that Brunhild could reach.

Gunther weds Brunhild, and she goes to live in the court at Worms. Later she learns of the deception and that it was Siegfried and not Gunther who was worthy of her hand. Soon after, Siegfried is treacherously slain by one of Gunther's followers; and Brunhild slays herself with his sword. Kriemhild vows vengeance on her brother, for she knows that he is really responsible for her lord Siegfried's death. She marries Etzel (Attila), king of the Huns, and after many years invites Gunther to visit the kingdom. He comes bringing his followers but is met by a powerful army and overcome. Gunther is put to death and Siegfried is avenged.

The treasure again enters the story at this point. Kriemhild demands from Hagen, a vassal of Gunther and the slayer of Siegfried, the hiding place of the hoard. He refuses to impart it. Enraged, Kriemhild grasps Siegfried's sword and decapitates Hagen but is herself slain by a follower of Etzel.

The story is thus filled with tragedy. This perhaps is due to that element in the story which was known to the earlier versions but forgotten in the later—the curse of the Nibelung hoard which falls upon all who possess it.

THESE ARTICLES ARE IN THE FACT-INDEX

Nicaea, Asia Minor
Nicandra

NICARA'GUA. The largest of the Central American republics is Nicaragua (area, 57,143 square miles). It is shaped like a triangle. It adjoins Honduras on the north, the Caribbean Sea on the east, and the Pacific Ocean and Costa Rica on the southwest and south.

There are two ranges of volcanic mountains. One stretches along the northern border. The other separates the Pacific from Lakes Nicaragua and Managua. Lake Nicaragua is 100 miles long. In the Lake Managua region is the mile-high volcano Momotombo.

Nicaragua is divided into three natural regions—the western, the central, and the eastern. About three fourths of the people live in the high western region of lakes and mountains. The temperature ranges from 40°F. to 95°. There are two seasons—wet and dry. About 60 inches of rain falls in the wet

season from May to November. The volcanic soil is rich, and the region has the country's best farmland. Corn, rice, coffee, sugar, cotton, cacao, and beans grow on the mountain slopes and in the valleys.

East of the mountains is a sparsely populated plateau. About 120 inches of rain fall here each year. Forests of pine and oak cover the hills in the north. Forestry and mining are the chief occupations. Grasslands in the south support ranching.

The east coast region is low, hot, swampy, and densely forested. Many rivers cross it to the Caribbean. Rainfall varies from 120 to 240 inches a year.

Two major highways cross Nicaragua. The Road to Rama, a coast-to-coast highway, crosses the country from Managua in the west to Rama in the east. The Pan American Highway links Nicaragua to Honduras in the north and to Costa Rica in the south.

About one half of the people live in cities. The largest is the capital, Managua (population, 1974 estimate, 313,400). The city was devastated by earthquakes in 1931 and 1972 (*see* Managua).

Good roads, including the Pan American Highway, link the principal towns in the west. A railway runs from Managua through León to Corinto. At León is the National Autonomous University of Nicaragua. The chief exports are cotton, coffee, and beef.

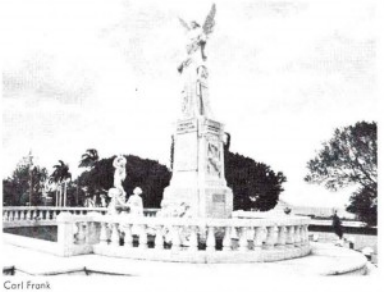
Spain ruled Nicaragua from early in the 16th century until the country became independent, in 1821. The United States Marines were sent there to protect American interests between 1912 and 1933. A treaty in force from 1916 to 1970 gave the United States the right to build a canal across Nicaragua.

From 1937 to 1979 the government of Nicaragua was controlled by the Somoza family and their supporters, backed by the National Guard. Gen. Anastasio Somoza was president from 1937 until his assassination in 1956 and was succeeded by his older son. Somoza's younger son, Gen. Anastasio Somoza Debayle, was president from 1967 to 1972 and, under a new constitution, was reelected in 1974. During the late 1970's opposition to Somoza's rule grew into a civil war led by the Sandinista guerrilla movement, named for Gen. Augusto Sandino who had been assassinated in 1934 by the National Guard. Under pressure from the United States Somoza resigned in 1979 and was replaced by a Sandinista junta. (*See also* Latin America; Central America.) Population (1978 estimate), 2,395,000.

THIS ARTICLE IS IN THE FACT-INDEX
Nicaragua, Lake

NICE (*nēs*), **France.** On the Mediterranean coast of France, at the western end of a crescent-shaped area called the Riviera, is the city of Nice. The Riviera lies between the Maritime Alps and the Gulf of Genoa. The mountains protect the coast from the north winds, and the climate is sunny and warm.

Many people come to Nice each year to rest in the sunshine, play in the Casino, and take part in the brilliant carnival held before Lent. Nice is divided into three parts: the New Town, the Old Town, and the Port. The medieval Old Town lies close to the seashore. To the north is the New Town, with modern theaters, hotels, casinos, and villas. East of the Old Town is the commercial center and port. Nice has a cathedral, a museum, a library, and a monument to Garibaldi, who was born there in 1807.



Carl Frank

A monument to Nicaraguan poet Rubén Darío stands near the shore of Lake Managua in Managua's Parque Darío.

Nice was settled about 2,000 years ago by Greeks from Marseilles. When the Greeks conquered a neighboring tribe, they named their city Nice (from the Greek *Nike*, meaning "victory"). Later the city fell under Roman and then Turkish rule. In the following centuries it was controlled at different times by Provence, Savoy, and Sardinia-Piedmont. Italy ceded Nice to France as a reward for aid in unifying Italy.

Nice's chief source of income is tourism. It manufactures perfumes and processes olive oil and foods. Population (1975 census), 331,002.

THESE ARTICLES ARE IN THE FACT-INDEX
Nicholas, Saint
Nicholas I (pope)
Nicholas II (pope)
Nicholas III
Nicholas IV
Nicholas V

NICHOLAS, Emperors (Czars) of Russia. Two of Russia's Romanov rulers were named Nicholas. Nicholas II was the last emperor.

NICHOLAS I (born 1796, ruled 1825–1855) was a grandson of Catherine the Great. His father was Paul I. Because he had two older brothers, Alexander and Constantine, it was thought he would never be emperor. Constantine abdicated his right to the throne in 1822. Then Alexander supposedly died in 1825. There is a legend that he was tired of ruling and went to live as a hermit monk in Siberia. He had no son to succeed him. (*See also* Alexander I.)

Nicholas thus succeeded Alexander and immediately trouble began. There was unrest in the army, and the St. Petersburg regiments revolted in what was called the Decembrist uprising. They demanded a constitu-

RUSSIA'S LAST IMPERIAL FAMILY
This picture of Nicholas II and his family was taken shortly before the revolution. The boy, Alexis, sits at his father's feet.

tion. Nicholas crushed the revolt. He then established an elaborate secret police system throughout the Russian empire.

The 30 years of Nicholas' reign saw three wars. In 1828–29 Russia fought against Turkey. Russian armies helped crush a Hungarian revolt against Austria in 1849. Nicholas died during the Crimean War (1854–56). He was succeeded by his son Alexander II. (*See* Russian History; Turkey; Crimean War; Alexander II.)

NICHOLAS II (born 1868, ruled 1894–1917) was a great-grandson of Nicholas I and the oldest son of Alexander III. His mother, a Danish princess, was a sister of Queen Alexandra of England, wife of Edward VII.

Nicholas had great charm but was hopelessly weak as the all-powerful head of the Russian state. He was greatly influenced by his wife Alexandra Feodorovna. She was the former Princess Alix of Hesse-Darmstadt, a granddaughter of Queen Victoria.

The imperial couple fell under the spell of an evil Siberian monk named Rasputin. Alexis, their only son and heir to the throne, had hemophilia, a blood disease. For some reason, when the boy began to bleed, only Rasputin seemed able to stop it. Nicholas and Alexandra thus came to believe that Alexis' life depended upon Rasputin. The monk gained great political power and offended many of the nobles.

Nicholas, trying to keep peace, called the Hague Conferences of 1899 and 1907 (*see* Hague Peace Conferences). In spite of his efforts, a powerful military bureaucracy managed to fling Russia into a disastrous war (1904–5) with Japan (*see* Russo-Japanese War). The war was followed by widespread revolutionary movements. Nicholas called for the election of a Duma (legislative assembly) as a step toward constitutional government (*see* Russian History). The Duma was not a success and public discontent grew, particularly in the cities. The discouraged emperor withdrew almost completely from public life. Rasputin continued to meddle with government affairs until he was assassinated by Russian nobles in 1916.

In the summer of 1914 Russia and the other great European powers became involved in World War I (*see* World War I). War again proved a disaster for the imperial government. There were corruption at home and defeat on the war fronts. The storm broke in 1917. Troops in St. Petersburg attacked and looted the Winter Palace. The emperor abdicated both for himself and the sickly Alexis, leaving the throne to his brother Michael, who disappeared during the uprisings and was never heard of again. The imperial family was kept under guard until they were finally sent to Siberia. There, on July 17, 1918, in the town of Ekaterinburg, Nicholas, Alexandra, and their five children were brutally murdered by the Soviets.

THESE ARTICLES ARE IN THE FACT-INDEX

Nicholas (hereditary prince of Montenegro)
Nicholas, Grand Duke
'Nicholas Nickleby'
Nichols, Charles A. (Kid)
Nichols, Edward Loring (Red)
Nichols, Robert Malise Bowyer
Nichols, Roy Franklin
Nichols Field
Nicholson, Sir Francis
Nicholson, Meredith
Nicholson, William
Nicias

NICKEL. This metal got its name from a German word for imp, because of the trouble it gave chemists in early times. Today nickel is one of our most useful metals. It is silvery, lustrous, hard, malleable, and magnetic. Pure nickel is seen only in coatings (nickel plate) on other metals, where it is used to embellish or protect them, or to give them a better wearing surface. The coat is applied by electroplating (*see* Electroplating). Alloyed with copper, nickel is widely used in coins. Copper, zinc, and nickel form a metal known as "German silver," used to make tableware and as a base for silver-plated ware.

These uses, however, are comparatively unimportant. Most nickel goes into the manufacture of nickel steel, an alloy adapted to withstand strains. It is used in armor plate, cannon, structural work, bridges,

PROPERTIES OF NICKEL

Symbol.....Ni	Density at 68° F.
Atomic Number.....28	.....8.9 grams per cc
Atomic Weight...58.71	Boiling Point..5,252°F.
Group in Periodic Table.....VIII	Melting Point .....2,651°F.

railroad rails, rivets, locomotive boilers, engine forgings, trailer frames, dipper teeth of steam shovels, and automobile gears, shafts, and axles.

A nickel steel called *Invar*, containing 36 percent nickel, is used for measuring implements and pendulums. It is practically nonexpansive within ordinary temperature variations. Another nickel steel called *platinite* expands at almost the same rate as glass. It is used for the connecting wires in electric light bulbs.

Nickel forms many other alloys. Copper-nickel alloys are used for bullet jackets and boiler tubes. Nickel-chromium steel is used for automobile forgings and gears and for armor plate. Electrical-resistance wire in electric appliances is usually an alloy of nickel with other metals—iron, chromium, or copper.

Monel metal is a "natural" alloy of nickel and copper, made by reducing certain ores which contain both these metals. This tough, lustrous, corrosion-resisting alloy is used for food-handling equipment, valves, turbine blades, propellers, wire filter cloth, and many other purposes. (*See* Alloys.)

Nickel oxide is used in Edison storage batteries, in glassmaking, and in pottery glazes. The salts are employed in electroplating and in hardening oils for making soap and oleomargarine. Nickel resists the action of most acids except nitric acid.

The Sudbury district of Ontario is the source of most of the world's nickel supply. The principal Sudbury ore is pentlandite, an iron-nickel sulfide. Other important nickel producers in addition to Canada are the Soviet Union, New Caledonia, Cuba, and the United States.

THESE ARTICLES ARE IN THE FACT-INDEX

Nickelodeon
Nicklaus, Jack (William)

NICKNAMES. "Nicknames and whippings," said Walter Savage Landor, "when they are once laid on, no one has discovered how to take off." Nations, like persons, have nicknames which grow up in curious ways and become fixed. The nickname Uncle Sam is applied to the United States. During the War of 1812, someone asked why "U. S." was stamped on government goods. He was told that the letters stood for Uncle Sam, the local title for Samuel Wilson, a government inspector in Troy, N. Y. This jest was repeated throughout the country. The name stuck, and Uncle Sam came to personify the United States government and the American people.

This nickname became even more popular than the earlier one, Brother Jonathan. The original of the name Brother Jonathan, according to the story, was Washington's friend, Gov. Jonathan Trumbull of Connecticut. When perplexed by the need of arms and war material, General Washington would say, "We must consult Brother Jonathan." This expression, being often repeated, came into common use and at last was extended to the American nation as a whole. Brother Jonathan, like Uncle Sam, is always portrayed as a tall thin man with long narrow beard, long-tailed coat, high hat, and a shrewd but humorous countenance—attributes which marked the typical American of the early days.

Very different is John Bull, the personification of the English nation, who is represented as a stout, ruddy-faced, matter-of-fact, blunt fellow attired in leather breeches and top boots, generally with a cudgel in his hand and a bulldog at his heels. The name John Bull was first used in a political satire published by Dr. Arbuthnot at the time of the War of the Spanish Succession, in Queen Anne's reign.

There are many nicknames, generally of an uncomplimentary character, applied by the people of one nation to those of another. Thus the American called the Mexican a "greaser," referring to his untidy appearance; while to the Mexican or Spanish-American an American or Englishman is a "gringo" (from the Spanish word for gibberish or unintelligible speech). (*See also* Yankee.)

Some think that the word nickname comes from *nick*, meaning "to cut," since a nickname is often a shortened name. Actually the word was originally *eke name* and it meant an "added name."

THESE ARTICLES ARE IN THE FACT-INDEX

Nicodemus
Nicolay, John George
Nicolet, Jean
Nicoll, Sir William Robertson
Nicolle, Charles Jean Henri
Nicollet, Joseph Nicholas
Nicolls, Sir Richard
Nicolson, Sir Harold (George)
Nicomedia, Bithynia
Nicopolis
Nicosia, Cyprus
Nicot, Jean
Niebuhr, Barthold Georg
Niebuhr, Reinhold
Niehaus, Charles Henry
Nielsen, Kay
Niemen River
Niemeyer (Soares Filho), Oscar
Niepce, Joseph Nicéphore
Nierembergia
Nietzsche, Friedrich Wilhelm
Nieuwland, Julius Arthur
Nigella

NIGER (*nī'jĕr*). Landlocked in the heart of the north African desert lies the republic of Niger. Its neighbors are Algeria and Libya on the north, Mali on the west, Upper Volta on the southwest, Nigeria and Benin on the south, and Chad on the east. (For map, *see* Africa.)

Although Niger's area of 458,993 square miles is greater than that of California and Texas combined, its population compares with Tennessee's. Three quarters of the country is desert. Only 8 percent gets as much as 21 inches of rain yearly; 48 percent receives less than 4 inches. The heat is intense.

Most of the people live along the southern border between the Niger River and Lake Chad. With 9 to 30 inches of annual rainfall, the inhabitants—Hausa and Djerma-Songhai—can practice farming. The chief towns are in this area—Niamey, the capital (population, 1975 estimate, 130,000), Zinder, Maradi, and Tahoua. In the Sahara to the north, the few farming settlements are in the Air Mountains. Elsewhere, nomadic tribes—the Tuareg, Fulani, and Borroros—roam about, seeking water and grass for their flocks. Islam is the chief religion. French is the official language.

In the past both farming and stock raising were primitive. Crops and animals were used for family subsistence. In the 1950's, however, irrigation systems were built in the eastern river basins, and peanuts and cotton were introduced as cash crops. Millet and sorghum are the basis of the people's diet. Other food crops are cassava, beans, rice, corn, and onions.

Efforts to establish ranching as an industry and to produce animals suitable for export have been hampered by the nomadic peoples, who look upon their animals as wealth and are slow to sell them. The stock tends to be of low quality due to poor pasturage and disease, so meat exports are low. Leather and goat hides are exported.

There is little manufacturing. The few plants process local products, such as peanut oil and cotton. Mining is unimportant, though tin and tungsten are found in the Air Mountains. The discovery of iron-ore deposits south of Niamey was announced in 1962. Trade is handicapped by poor transportation. Exports and imports must be hauled to and from ports in other lands. Roads are few and poor, and the Niger was not bridged until recent years.

History and Government

Roman expeditions entered this remote region in ancient times. The Songhai Empire arose on the Niger River in the 7th century. For a thousand years afterward, invasions and warfare among the tribes wracked the land. European explorers and traders came in the 19th century.

In 1904 Niger became a territory in French West Africa. Its status changed in 1958 to that of an autonomous republic within the French Community. A constitution was adopted in 1959, and on Aug. 3, 1960, the independence of Niger was proclaimed, and Niger withdrew from the French Community. In September it joined the United Nations. Until April 1974 the country was governed by a president and an elected National Assembly. A 12-man military council took over, charging the deposed officials with failure to cope with a six-year drought. Before achieving independence, Niger had joined with the Ivory Coast, Dahomey (now Benin), and Upper Volta to form the Council of the Entente. The council set up a customs union and coordinated certain legislation.

Progress has been slow in this arid, underdeveloped land. Since 1960 it has received credits and loans from France and the United States and the Common Market Development Fund, the World Bank, and other bodies. A large part of these funds was earmarked for the construction of transportation and telecommunications facilities. (*See also* Africa.) Population (1977 estimate), 4,850,000.

NIGERIA (*nī-jĭr'ē-ə*). The most populous of the independent nations that emerged in Africa after World War II was Nigeria. It had been governed by Great Britain for 100 years before it gained its freedom.

Nigeria is located on the Gulf of Guinea where Africa's west coast starts to bulge into the Atlantic Ocean (for map, *see* Africa). When it was a colony, Nigeria administered the British Cameroons, so the northern part of that colony joined Nigeria in 1961. The southern part is now in Cameroon, which borders Nigeria on the east and southeast. Chad lies on the northeast, Niger on the north, and Benin on the west. The area of the country is 356,669 square miles. Nigeria is more than twice as large as California. Lagos (population, 1970 estimate, 875,417) is the capital (for picture, *see* Africa).

Nigeria's coastal belt in the south is near the equator. It is wet and swampy, with heavy rainfall. The delta of the Niger River is a land of mangroves and tangled vines. Farther inland are tropical rain forests. Northward the rainfall decreases, the land gradually rises, and the forests give way to broad, rolling savannas (*see* Grasslands).

Nigeria's Peoples

With 76,600,000 inhabitants (1976 estimate), Nigeria is the most populous country in Africa. The people of Nigeria are mainly Negroes. In the extreme north, however, Nigerian Negroes have sometimes intermarried with Hamitic peoples (*see* Africa; Races of Mankind). The principal tribes are the Hausa and the Fulani of the north, the Yoruba of the southwest, and the Ibo of the southeast. The north is a land of mud-brick towns, trains of camels and other pack animals, and herds of goats. Most of the people of Nigeria are Moslems.

Unlike the Hausa, the Yoruba and the Ibo were not influenced by Moslem culture from the north. The main Christian churches are in the east and west. Animistic sects are scattered over the country. The Yoruba culture developed in ancient times. They had established organized kingdoms by the 12th century. Their cities of Benin and Ibadan flourished long before Europeans entered the area.

The Ibo were traditionally a village folk who had little contact with European peoples. Later a shortage of land in their thickly settled region led them to spread over the country.

Farming, Mining, and Trade

Agriculture is the leading industry. The chief products are cacao, peanuts, palm oil and palm kernels, rubber, and hides and skins. Other crops are cotton, rice, cassava, millet, bananas, corn, and yams.

Petroleum, discovered in 1956, has become the major source of national wealth and foreign exchange. Other mineral resources include columbite, tin, and coal.

By 1970 Nigeria had become one of the world's leading oil-exporting countries. Other exports include peanuts, cacao, palm kernels and oil, and rubber. Most manufactured products are imported, but plants have been built to produce cement, textiles, lumber and plywood, and petroleum products. The Kainji Dam and hydroelectric plant on the Niger River, about 180 miles northeast of Ibadan, was opened in 1969. In addition to supplying electricity, it opened a major section of the river to navigation.

The chief ports are Lagos and Port Harcourt. There are two main railroads. One runs from Lagos to Ibadan and on to Kano and Nguru. The other links Port Harcourt with inland trading centers. Although there are about 65,000 miles of roads, less than one half are hard surfaced. River transport is important. Lagos has international telecommunications facilities and radio and television broadcasting stations. International airports are at Lagos and Kano.

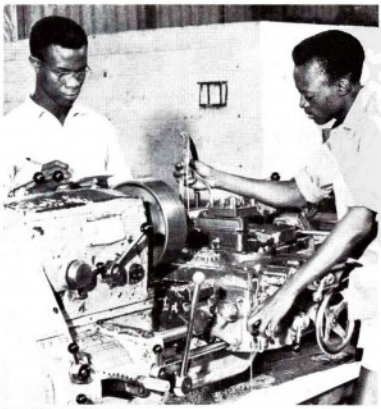
History and Government

Northern Nigeria was known to Moslem traders before Europeans discovered Nigeria's coast. Moslem caravans crossed the Sahara to obtain slaves, gold, and ivory. Portuguese mariners, who discovered the Gulf of Guinea in the 15th century, were followed by Dutch and English explorers. English slave-trading posts, subsequently established, operated in the Niger River delta until the British abolished slavery in 1833. Official British control of the area began with the annexation of Lagos in 1861. Nigeria became a separate colony in 1886, and in 1914 the region became the Colony and Protectorate of Nigeria.

After World War II self-government was demanded by the Nigerians. In 1960 Nigeria became an independent nation within the Commonwealth of Nations. It joined the United Nations the same year. In 1963 it became a federal republic comprising four regions and the federal capital.

In 1966 tribal hatreds led to revolts by army officers, political assassinations, and the killing of thousands of Ibo in the Northern Region. A federal military government was formed. Civil war broke out in 1967 when the Eastern Region, the tribal home of the Ibo, declared itself the Republic of Biafra. By 1969 federal forces, with Soviet and British military aid, had captured much of Biafra. International efforts were made to curtail mass starvation among refugees in combat areas. In January 1970 the Biafrans surrendered to federal forces.

Military government continued throughout the 1970's, but political instability led to a military coup in 1975 and an assassination in 1976. A national assembly was elected in 1977 to approve a new constitution, and in 1978 the 12-year ban on political activity was lifted. With the election of a president in 1979, Nigeria returned to civilian rule. Nigeria was the site of a World Black and African Festival of Arts and Culture in 1977. (*See also* Africa.)



Lintas W.A., Ltd. (Nigeria)

Skilled machinists turn a shaft on an engine lathe in a large cement plant at Ewekoro in southwest Nigeria. Increased industrial development is a national goal.

NIGER RIVER. Africa's third largest river is the Niger. Only the Congo and the Nile are longer. The Niger is 2,600 miles long. It rises on the Guinea-Sierra Leone border, 150 miles from the Atlantic Ocean. It flows northeast in a great arc and approaches the fringe of the Sahara. It then bends southeast, enters Nigeria, and empties into the Gulf of Guinea. Its delta is larger than that of the Nile.

As a navigable stream, the Niger is of great importance. Steamers of light draft can make their way over most of its length. Through its largest tributary, the Benue, it provides an 870-mile waterway eastward into central Africa. A railway connects the upper reaches of the Niger with the Senegal River, which empties on the extreme west coast. Thus, by boat and rail, travelers can reach the famous west African trading centers of Sansanding, Ségou, Timbuktu, and other river stations far in the interior toward the Sahara. The Kainji Dam and hydroelectric plant in Nigeria was completed in 1969.

Niger shipping is chiefly engaged in the transport of palm oil, peanuts, copal (a resin used for varnishes), tree gums, rubber, coffee, ivory, and other products of the vast and luxuriant Niger Basin.

The delta of the Niger is very complex. About 80 miles north of the Nigerian coast, the river starts

fanning out into a network of small streams. Small rivers enter it from either side. In some places it is almost impossible to find a navigable channel. Along the coast the delta is about 150 miles wide.

Large steamers enter from the sea through the Nun Mouth, the Forcados, the Brass Mouth, and the Bonny. Because of mosquitoes and the tsetse fly, the delta's climate is one of the most unhealthy in Africa.

The ancient Greeks and Romans knew that the Niger existed and where it was located, but they never explored it. Eighteenth- and 19th-century explorers were hampered by cannibal tribes living along its banks and by the almost impassable jungle. The Niger was not accurately mapped until late in the 19th century.

A LIVING INSECT TRAP
Notice how the nighthawk's plumage blends into the gravel on which it is lying. The huge mouth scoops in flying insects.

NIGHTHAWK. On summer evenings, the nighthawk can be seen swooping erratically through the sky, catching a meal of insects. From time to time it utters a loud nasal cry, "pee-eent," and follows this with several quick, fluttering wingbeats. Then suddenly it performs a thrilling high dive. From a height of a hundred or more feet it plunges straight down on half-closed wings, apparently determined to dash itself into the ground. Within a few feet of a house or treetop, it abruptly turns and mounts upward again. At the moment of the turn, the rush of air through the large (primary) wing feathers produces a loud booming sound. No satisfactory explanation of this spectacular dive has ever been given. The bird seems to dive for the sheer fun of it.

The nighthawk has a great froglike mouth that opens from ear to ear. During flight it holds its mouth open and uses it like a trap to catch flying insects. The beak is a tiny tip, less than a half inch in length.

A grown nighthawk is about ten inches long, as large as a robin. The large wings are quite out of proportion to the body. The plumage is a mixture of black, gray, brown, and buff, almost invisible against the bark of a tree limb. In flight, a patch of white in the primaries looks like a hole in the wing. This white patch distinguishes the nighthawk from its near relative, the whippoorwill. Otherwise the two birds look exactly alike.

The legs of the nighthawk are small and weak. In wooded country it rests lengthwise on a tree limb. The birds also roost on the open ground of plains or deserts or on flat roofs in the cities. They build no nest. The two eggs are laid on gravel ground or on graveled roofs, where their grayish-white, black-spotted coloration blends perfectly into the background. (For picture in color, *see* Birds.)

The nighthawks breed throughout North America from the Yukon Territory to the Gulf states. They are among the latest migrants to arrive in the spring. By the end of August they gather in large flocks to start the long journey to their winter home in South America. While flying they keep from 50 to 100 feet apart.

The nighthawk belongs to the goatsucker family, *Caprimulgidæ*, to which the whippoorwill also belongs. In the Southern states it is known as the bullbat. The names goatsucker and nightjar are more properly applied to a related bird found only in Europe. The scientific name of the nighthawk is *Chordeiles minor;* of the European goatsucker, or nightjar, *Caprimulgus europaeus.*

NIGHTINGALE, Florence (1820–1910). In 1854 a slim Englishwoman led a small band of volunteers to Turkey to nurse men wounded in the Crimean War. Florence Nightingale found filth, disease, and near-starvation among the wounded British soldiers. For two years she fought to wipe out these appalling conditions. She was hampered by official red tape and the army's prejudice against women. But in the end she won out. Wounded men were given real nursing care, perhaps for the first time in the history of war. Florence Nightingale became a famous authority on nursing and devoted her life to the improvement of hospitals.

Florence Nightingale was born May 12, 1820, in Florence, Italy, where her parents were spending a vacation. She was named for her birthplace. Her father, William Nightingale, was a well-to-do landowner of London and Derbyshire, England. Her

mother, Fanny, was a gay, charming woman, who loved society. William Nightingale taught Florence at home. She studied mathematics, music, and foreign languages.

Florence was a pretty girl and very popular. But she did not enjoy her mother's kind of social life. She liked to take care of the old and the sick people in the neighborhood. When she was 17 she wrote in her journal that God had called her to devote her life to nursing. She steadfastly continued to believe this. Later she refused to marry a man she liked because she felt that marriage would interfere with her work.

Over her parents' objections she visited hospitals in England and continental Europe. She studied the methods of the Catholic nursing orders in France and Egypt, and spent three months at the Institute for Protestant Deaconesses in Kaiserwerth, Germany. In 1853 she became superintendent of the Establishment for Gentlewomen During Illness, in London.

When war with Russia broke out, Miss Nightingale volunteered her services (*see* Crimean War). She was appointed head of the women nurses serving in Turkey. When she arrived, the death rate was 42 per cent. More men were dying from fever and infection than from battle wounds. She enforced sanitary regulations, introduced special diets, and reduced the death rate to 2 per cent. With her own money she bought linen, shirts, food, and even beds for the hospitals. Often she worked 14 hours a day without food or rest. Her health broke. She contracted Crimean fever (probably typhus), and nearly died. But she refused to return to England.

By 1856 Florence Nightingale was world famous. Longfellow wrote a poem, 'Santa Filomena', honoring her as the "Lady with a Lamp" (from her custom of walking through the wards at night, lamp in hand). England raised 50,000 pounds in her name to establish a nurses' home. Although invalided, Florence Nightingale was not done with her work. Back in England she campaigned by letter for hospital reforms. She enforced high professional standards in caring for the sick and made nursing a worthy career for women. She died Aug. 13, 1910, at the age of 90.

NIGHTINGALE. No bird is more celebrated in literature than the nightingale, but Americans have to go abroad to hear this famous bird, for it does not live west of the Atlantic. Its relatives, the thrushes, are the only American birds that approach the nightingale in beauty of song. It is found throughout Europe, most abundantly in southern France, Spain, and Portugal, and in parts of England. The bird called a nightingale by the ancient Persians, Greeks, and Romans was probably the Persian *bulbul*.

During the mating and nesting season, from the middle of April to the middle of June, the male sings day and night. His song is a melodious outpouring of glorious tone and is evidently an expression of devotion to his mate. The nest is a loosely built cup of dead leaves on or near the ground. The bird lays from four to six eggs, of a deep olive color.

This brilliant singer has drab plumage. The bird is about six inches long, with rusty brown and gray feathers. It is shy and perches in shrubs or low trees. Its favorite food is the larvae of insects.

The nightingale belongs to the family of thrushes, or *Turdidae*. The common European nightingale is *Luscinia megarhyncha;* the larger eastern species, *L. philomela;* the bulbul, *L. hafizi.*

THIS ARTICLE IS IN THE FACT-INDEX
Nightjar

NIGHTSHADE. Several weedlike relatives of the potato have mild or strong poisons in their leaves, berries, or roots. These plants are called the nightshades. The common or black nightshade grows about 12 inches high and has pointed, oval leaves, drooping clusters of white flowers, and small black berries. When animals chew the fresh leaves or people eat too many of the berries, they may be made sick. But in some regions, people boil the leaves and eat them as a kind of green.

Another plant of this nightshade group is the blue-blossomed bittersweet. Its scarlet berries taste both bitter and sweet and are mildly poisonous. Still another kind that is not very harmful is the horse nettle or apple of Sodom with its orange berry. This is a native of western North America.

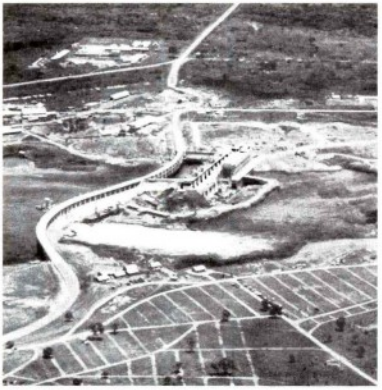
The deadly nightshade, or belladonna, found in various parts of Europe and Asia, is particularly valuable to medicine. Various preparations of the leaves and roots are called *belladonna.* They are used to relieve pain or spasm, and as an antidote to opium. The active agent in these preparations is the alkaloid *atropine.*

The deadly nightshade is a five-foot shrub with dull green leaves, purple bell-shaped flowers, and black cherrylike fruit. It has a disagreeable smell.

Nightshades belong to the family *Solanaceae.* The scientific name of the common nightshade is *Solanum nigrum;* of the bittersweet, *S. dulcamara;* of the horse nettle, *S. carolinense;* of the deadly nightshade, *Atropa belladonna.*

THESE ARTICLES ARE IN THE FACT-INDEX
Nightshade family
Niigata, Japan
Nijinska, Bronislava
Nijinsky, Vaslav
Nijmegen, Netherlands
Nike
Nikisch, Arthur
Nikko
Nikolayev, Andrian Grigorevich
Nikolayev, Russia
Nikolayevsk, Russia
Nikopol, Russia

NILE RIVER. The longest river in Africa and the third longest river in the world is the Nile. In one sense the main course of the river actually begins at Khartoum. Here the Blue Nile comes in from the mountains of Ethiopia. It flows clear and blue, except at floodtime, when it is reddish brown. It meets the gray-green White Nile coming from the lake



OWEN FALLS DAM, UGANDA

The Owen Falls Dam controls the flow of water from Lake Victoria through the Victoria Nile and into the White Nile. It supplies electric power for East African industry.

region of East Africa (*see* Africa, subhead "The Great Rift Valley"). From Khartoum to Aswan the combined Blue Nile and White Nile descend in six cataracts. As the greater Nile approaches the Mediterranean it fans out into the fertile region called the delta.

Except for the broad delta, the Nile Valley is a thin green ribbon of irrigated land confined on both sides by the great deserts of Egypt and the Sudan. For thousands of years these lands have depended for crops and life itself upon the Nile's yearly floods. These come from spring and early summer rains, particularly in the Ethiopian highlands. The flood waters reach Egypt in the middle of the summer.

Egyptians of the past let the water flood the land and deposit soil-renewing sediment. Today there is a series of dams between Lake Victoria and the Mediterranean Sea. These dams hold the water of the Nile in reserve until it is needed for irrigation. The Owen Falls Dam, near Jinja, Uganda, on the Victoria Nile, is one of the largest hydroelectric developments in Africa. It was opened in 1954.

In 1968 the gigantic Aswan High Dam, in southern Egypt, was completed (*see* Aswan High Dam). It was designed to reclaim a million acres of desert land. Archaeological treasures threatened by its waters were moved from the site at a cost of 36 million dollars. Egypt borrowed from other nations to finance construction of the dam; Russia provided technical aid.

From Lake Victoria to the Mediterranean Sea, the Nile is 3,473 miles long. Some geographers include the headwaters—about 150 miles across Lake Victoria to the mouth of the Kagera River, and the 430 miles up the Kagera into Burundi. (*See also* Egypt; Sudan; Uganda; Victoria, Lake.)

THESE ARTICLES ARE IN THE FACT-INDEX

Niles, Ill.
Niles, Mich.
Niles, Ohio
Nilgai
Nilgiri Hills
Nilson, Lars Fredrik
Nilsson, (Märta) Birgit
Nimble fly
Nimbus
Nimes, France
Nimitz, Chester William
Nimrod
Ninebark
Nineveh, Assyria
Nine Worthies, The
Ningpo, People's Republic of China
Ningsia Hui Autonomous Region, People's Republic of China
Ninon
Ninus
Nio
Niobe
Niobium
Niobrara River
Niort, France
Nipa palm
Nipissing, Lake
Nipkow, Paul Gottlieb
Nipmuc
Nippur, Mesopotamia
Nirenberg, Marshall Warren
Nis, Yugoslavia
Nisei
Nishapur, Iran
Niska
Niterói, Brazil

NITRATES. Most forms of plant and animal life could not exist without the chemical compounds called nitrates. Ammonium nitrate is an important commercial soil fertilizer. Potassium nitrate and sodium nitrate have value because of their use in fertilizers and explosives. Silver nitrate has many applications—as a caustic in medicine, as a light-sensitive substance in photographic film, and as silvering for the backs of mirrors. Iron nitrate is used in dyeing. Barium and strontium nitrates give vivid colors to flares and fireworks.

The molecule of every nitrate has within it a combination of atoms known as the *nitrate radical*. This consists of one nitrogen atom bound to three oxygen atoms. Its chemical formula is NO_3. The nitrate radical stays together and acts as a unit in most chemical reactions. It does not exist by itself, however, except in the ionized state (*see* Ions and Ionization).

The nitrate radical is somewhat unstable. Nitrogen does not enter into chemical combinations easily, and when it does it tends to go back to its normal free state. Nitrates also dissolve readily in water. These two facts make nitrate compounds very useful to plants, for all plants need a constant supply of nitrogen in order to form proteins for body building. Without an ample supply, which they must get from the soil, their growth is poor and stunted (*see* Plants, Physiology of). Decaying plants give up nitrates, and animal excrement also contains these compounds. But rain usually washes the nitrates away and the compounds break up.

Some nitrates are *salts* of nitric acid (*see* Nitric Acid). Plant life requires more nitrates than can be produced from nitric acid in nature (*see* Nitrogen). Thus, by a process called *nitrification*, certain soil bacteria oxidize ammonium salts in the ground into the nitrates needed by higher plants.

Nitrates are distinct from *nitrites*, another group of nitrogen compounds. These are salt of *nitrous acid* (HNO_2). Unlike nitrates, they are highly stable.

NITRIC ACID. Nitric acid (HNO_3) is a colorless and very corrosive liquid. It is a strong acid which ionizes completely to hydrogen ion and nitrate ion $(NO_3)^-$ in aqueous solution. Nitric acid can be prepared commercially by heating sodium nitrate with sulfuric acid. The equation for this reaction is as follows:

$$3NaNO_3 + 2H_2SO_4 \longrightarrow 3HNO_3 + Na_2SO_4 + NaHSO_4$$

An important method of manufacturing nitric acid is by the oxidation of ammonia (NH_3). The ammonia is first oxidized to nitric oxide which is further oxidized to nitrogen dioxide (NO_2). This gas is passed through a packed tower in which water is circulating. Nitric acid and nitrous acid (HNO_2) are produced according to the equation:

$$2NO_2 + H_2O \longrightarrow HNO_3 + HNO_2$$

Commercial nitric acid contains from 50 to 70 per cent acid and the rest is water.

The most important use for nitric acid is in the process known as nitration. When a hydrocarbon reacts with nitric acid, a nitro group ($-NO_2$) replaces one of the hydrogen atoms attached to the carbon atom. This process is vital in the manufacture of plastics, dyes, explosives, and some nitrates. Nearly all metals react with nitric acid to produce nitrates.

Nitric acid was first made by a distillation process about 850 years ago. Henry Cavendish determined the composition of nitric acid in 1785.

THESE ARTICLES ARE IN THE FACT-INDEX
Nitric oxide
Nitriles

NITROGEN—The Chemical Base for Living Structures

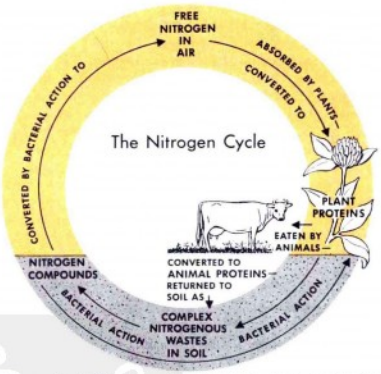
NITROGEN. About four fifths of the air we breathe is the gas called nitrogen. It dilutes the oxygen in the air and is exhaled from the lungs unchanged. Nitrogen slows down the chemical action of oxygen in the body. Most of the nitrogen in the world exists as a free element in the atmosphere. It is not chemically active and is slow to combine with other elements to form compounds. The compounds it forms, however, are essential for the existence of all living things.

Protoplasm, the complex substance in living cells, requires nitrogen for its formation. The essential food materials called proteins are composed of nitrogen compounds linked together. Although there is a great abundance of free nitrogen in the atmosphere, it must be combined in compounds to be used by living things. The process by which free nitrogen is joined to other elements is called *nitrogen fixation*.

Natural Methods of Nitrogen Fixation

Nitrogen fixation is produced in nature by the action of lightning and the action of bacteria. A flash of lightning causes nitrogen to unite with oxygen to form nitric oxide (NO). This is changed to nitrogen dioxide upon cooling. Nitrogen dioxide combines with water to form nitric acid (HNO_3). The dilute acid falls to the earth and reacts with minerals in the soil to produce nitrates. The nitrates form compounds necessary for cell growth. However, the amount of nitrogen fixed by lightning is less than the amount required by nature. A greater amount is fixed by the action of bacteria in the soil and in the roots of plants.

The soil bacteria that fix nitrogen include a type called *Clostridium pasteurianum* and several types of the genus *Azotobacter*. Other important nitrogen-fixing bacteria live in the roots of plants and belong to the genus *Rhizobium*. Plant-dwelling bacteria live



Nitrogen is fixed by the action of bacteria. It passes into the soil, into plant tissue or into plant and then animal tissue. It returns to the atmosphere and the cycle begins again.

only on the roots of leguminous plants such as alfalfa and beans (*see* Alfalfa). However, they fix more nitrogen than these plants require. The surplus is stored in the roots and escapes to the soil when the plant dies. Thus leguminous plants enrich the soil in which they grow. Both soil and plant-dwelling bacteria take nitrogen from the air and combine it with hydrogen to form compounds. These compounds then join together to form the structures of proteins.

The Circulation of Nitrogen

When nitrogen is present in living tissues, it can be used over and over again. If a plant or animal dies, bacteria of decay break up proteins, and nitrogen is released in the compound of ammonia (NH_3). Part of this escapes into the air. The remainder is acted upon by another type of bacteria to convert ammonia to nitrites. Still another type of bacteria