

GENERAL SCIENCE

# Explosions for Freedom

Every Fourth of July, America resounds with the noise of firecrackers, sky rockets, parades, speeches and picnics to celebrate the glory of being a free nation.

By BARBARA TUFTY

► FREEDOM comes with a bang, not a whimper.

For centuries man has expressed his exuberance of being independent with noise and bursts of light. From drums and bonfires to more elaborate explosions of firecrackers and streaks of colored fireworks—all are symbols of man's innate need to overcome tyranny and celebrate freedom.

This year Americans will see sights their forefathers never saw—jet planes streaking in formation across the skies, and televised orations emerging from a box. Yet smaller towns and sections of large cities will still continue their traditional parades, dancing, displays and speeches in the town square.

All these noises, lights, celebrations are enthusiastic tribute to celebrate the signing of the Declaration of Independence 187 years ago.

The United States actually became independent on July 2, 1776, when the Continental Congress adopted a resolution stating that the Colonies were free and independ-

ent. The signing of the Declaration took place on the 4th, and was celebrated on Monday, July 8, when the document was first read to the public from a platform in Independence Square, Philadelphia.

A cheering crowd, ringing bells and booming cannons welcomed the event. In those days news spread slowly by horseback, and it took two weeks for the Declaration to travel the 300 miles from Philadelphia to Williamsburg, Va., where independence was officially celebrated July 25.

The next year, 1777, July 4th celebrations were more elaborate. Bells rang out all day long, flags flew, bonfires were lit in the streets, and fireworks seared the tranquillity of the evening sky. As dusk fell, candles were placed in the windows of homes—and the more zealous patriots broke those windows which were not lit.

Thus began our independence celebration. Today scientific techniques have added so much more boost and bang to the bursts, bombardments, noise and color that some

cities, counties and states have passed laws prohibiting use of dangerous explosives. Civic groups have taken over organized displays of fireworks, and now many citizens watch in safety the fire splash into the sky in shapes of fountains, sky rockets, cascades, lattice poles, revolving suns, willow tree shells, comets, flags, Niagara Falls and all the other ingenious contraptions man has invented for the occasion.

No one knows the exact place and date where the first firework exploded on this world, but we do know it all started in China, perhaps more than 5,000 years ago. The T-hung-lian-kang-mu, the first authentic document in existence to describe fire-shooting, states that "rockets" were used in 1232 A.D., when the Mongols lay siege to the Chinese city of Kaifeng.

## Arrow of Flying Fire

Two new weapons were used by the Chinese during this siege, the report states. One was fei-i-ho-chien, or "the arrow of flying fire"—the rocket. The other new weapon was chen-t'ien-lei, a "heaven-shaking thunder"—or, as we call it, gunpowder.

In those days, the "rocket" was usually a bit of gunpowder or black powder wrapped in a piece of paper and tied to an arrow. Probably two men put this fire-arrow into action—one held the bow and arrow, the other lit the fuse. Later, warriors used a simple tube sealed solidly at one end and open at the other. A stick was tied on one side to direct the rocket, but still it would fly erratically in all directions, as the powder burned unevenly.

In an effort to keep their rockets from wobbling, the Chinese made the sticks longer and longer—until they found the optimum length for a pole is seven times as long as the rocket.

The new warfare innovations had startling psychological effect upon the enemy. The hissing flying fire terrified the horses, who shied and bolted, and frightened the men almost as badly. Often the weapons surprised and frightened the men launching them, as they would veer in other directions. Sometimes the stick would knock against an object with enough force to turn the rocket completely around and sent it roaring toward the sender!

Further experiments on the run-away gadget showed the Chinese that a point or cone on the front end of the rocket made it fly better, and that extra powder packed in this cone made the rocket explode all at once with a bigger bang. The Chinese also found that the rocket needed most power at the start, so they packed the powder in a hollowed-out V shape to create more surface of the powder to ignite at the beginning.

By the end of the 13th century, knowledge and interest in these fiery projectiles had spread from the Orient into Europe. Still unmanageable in warfare, they were used mainly in celebrations and for signals.



Mt. Wilson and Palomar Observatories

**CELESTIAL FOURTH OF JULY FIREWORKS**—Light from this exploding star had been traveling through space for 4,000 years before it reached earth on July 4, 1054. Named the Crab Nebula because of its outstretched limbs, this aftermath of a star is still expanding at a rate of about 800 miles per second.

Around 1760, rockets were spectacularly successful in a battle in India. An Indian raja constructed his rockets of iron tubes instead of pasteboard, and the 12-pound missiles traveled more than half a mile to rout the British troops.

An Englishman in London named William Congreve heard about this barrage and became intrigued with rocketry. By putting the stick in the center of the rocket fuse, he added new dimensions to the rocket, which became part of the equipment of the British Army.

The westward migration of rockets continued, as the British brought them to America, and in the War of 1812 bombarded Fort McHenry, guarding the city of Baltimore. The terrifying flares impressed many Americans—and one, Frances Scott Key, immortalized them in the “Star Spangled Banner.”

But still the brilliant, spitting flares could not be controlled for war. By 1900 every country had decided that rockets were not much use as weapons.

### Peaceful Uses

Their usefulness increased for peacetime activities. With different chemicals in their nose cones, they painted the night sky with colors—red from lithium, yellow from sodium, crimson from strontium, green from barium, and green or blue from copper. They were used more and more as signals at night—for distressed ships at sea, for damaged trains along the railroad tracks, or for lighting up the ground as aviators bailed out into the night. In World War I fireworks were used to light up the battlefields at night and as signals from the front lines. World War II saw tracer ammunition, ground flares and incendiary bombs.

Then liquid fuel took the place of the weak black powder, and gave spectacular impetus to rocket research in man's relentless urge to explore the universe.

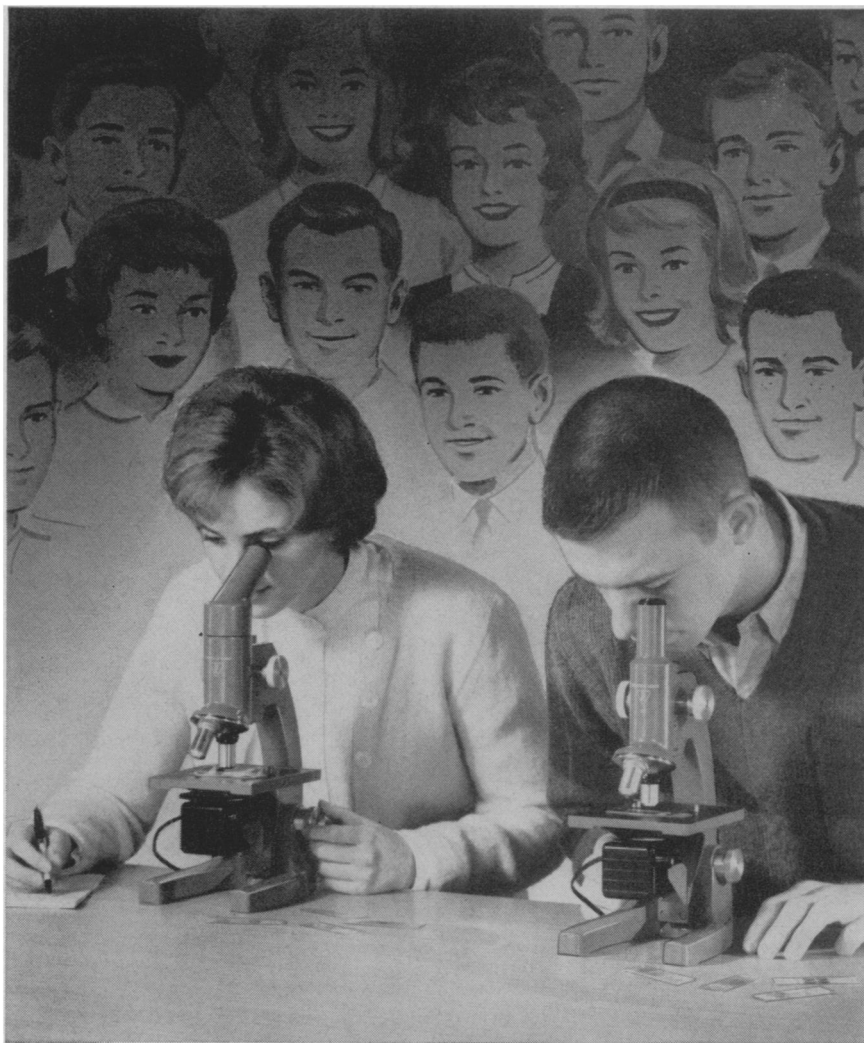
Yet still the powder rockets burst on earth, giving psychological impetus to another urge of man—to gain and retain freedom.

Today, with 111 independent nations as members in the United Nations, explosive celebrations can be heard around the world, around the clock. During our independence month of July, fireworks will be flung skyward from other nations celebrating their national or independence day—Argentina, Belgium, Canada, Colombia, Iraq, Liberia, Peru, Philippines, Poland, Somalia, Spain, United Arab Republic and Venezuela.

### Celestial Explosion

The most magnificent Fourth of July explosion ever seen took place on that day in 1054 A.D. The firework was the Crab Nebula, the luminous gaseous result of a powerful explosion of a star in our galaxy. Reports from ancient Chinese and Japanese records at that time state that the light was so bright the Crab Nebula was visible in daylight for 23 days, and was seen at night for nearly two years. Actually the star had exploded about 3,000 B.C., but the light had traveled through space for 4,000 years before reaching the earth.

• Science News Letter, 83:406 June 29, 1963



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