SCIENCE NEWS OF THE YEAR

life sciences

In life science's bitter argument over whether research should aim directly at applicable results or follow the cult of serendipity, advocates of the former view advanced a few paces in 1967—vocally, if not in fact.

When President Johnson declared in 1965 that he wanted "pay-offs" from the Government's billion-dollar backing of fundamental biological research, the scientific community rose in righteous indignation to say discoveries aren't made on demand.

Obviously, rhetoric in both camps tends to exaggeration. Scientists and policy-makers recognize the necessity of having fundamental knowledge stand behind and stimulate medical advances, but because Vietnam commands so much of the Federal budget, research coffers are not as full as they used to be. 1967 was the first year that the National Institutes of Health—supporter of 40 to 60 percent of all U.S. biological research—took a budget cut on Capitol Hill. Until this year, Congress always gave the Institutes what they asked for, and then some. This year, NIH's $1.187 billion request was sliced to $1.178 billion.

Last spring White House adviser Dr. Ivan L. Bennett warned a gathering of 1,200 biologists to begin thinking about priorities in deciding which research projects to foster and which to let slide. "It is abundantly clear," he said, "that if we don't take the lead in jettisoning some of the excess baggage, others will—and the job may be done by those who can't tell a carpetbag from a treasure chest."

This year, in a special report to the President, NIH director Dr. James L. Shannon committed NIH to increased concern with priorities and applicability—a commitment that was followed by announcement of a $250,000 grant to the National Academy of Engineering for an intensified effort to apply engineering skills to problems in medicine.

The biological sciences record for 1967, however, is not just one of philosophical discussion. From Buffalo's Roswell Park Memorial Institute, Dr. David Harker reported success in elucidating the structure of ribonuclease after 16 years' and $2 million worth of work. Australian researchers developed an automatic sequenator that will cut the time of future work on protein structure in half. Ribonuclease is a protein that breaks down RNA, a message-carrying genetic unit in all cells. Dr. Harker, who used X-ray crystallography to decipher the precise anatomical architecture of this protein, believes alterations in its structure, and in that of other important proteins, may have a relationship to cancer.

The protein sequenator, the result of 20 years' work by Dr. Par Edman and co-workers at St. Vincent's School of Medical Research, Melbourne, does in days what Drs. Harker and Stanford Moore of Rockefeller University did in a decade. It identifies the primary structure of proteins by stringing a twisted molecule out into a long chain and then systematically pulling it apart, amino acid by amino acid, so scientists can learn what order they are in. Using hand chemical methods, researchers can separate two or three amino acid molecules a day; the protein machine, working around the clock, handles up to 60.

Pharmacologists also recorded major achievements in 1967. For the first time there is real hope of a drug that will give man broad-spectrum protection against viruses. A team of scientists headed by Dr. Maurice R. Hilleman of the Merck Institute for Therapeutic Research, Rahway, N.J., reports finding three substances that induce interferon production in mice. Interferon is a protein the body manufactures in response to virus invasion.

In the past year, pharmacologists and physiologists studying birth control worked their way through preliminary investigations for new and better contraceptives. Dr. Sheldon Segal of the Population Council, New York, reports initial success with the "minipill," an oral contraceptive that contains only one-tenth the progesterone and none of the estrogen of currently available combination pills. The minipill effectively prevents conception without disrupting a woman's normal cycle of ovulation and menstruation. Implantable time capsules, once-a-month pills and long-term injectables are also on the horizon, he says.

Although there is no such thing as a morning after contraceptive as such—it is still in limited clinical investigation—Dr. John MacLean Morris of Yale and others confirmed the fact that any estrogen taken in sufficient quantities soon after intercourse prevents pregnancy.

Expanding research in male reproductive physiology, scientists gathered in 1967 to evaluate possibilities of a pill for men. It's not likely to be available soon, they say, but chances are that within 10 years, some men will be taking contraceptives as regularly as women. Research is directed at finding a drug that will temporarily inhibit sperm production without reducing libido.

While investigators working on contraceptives made encouraging advances, scientists who had been perfecting a drug to induce rather than inhibit conception completed clinical trials on a compound called Clomid that received Food and Drug Administration approval for general marketing. Clomid works through the pituitary gland to synchronize production of the hormones that trigger ovulation and is effective in women whose barrenness is the result of a failure to ovulate.

medical sciences

Medical science in the year 1967, while mostly undramatic in terms of radical new cures, showed marked progress against the three top killers—heart disease, cancer and stroke.

For the first time a human heart was transplanted into the chest of a patient doomed to die if he retained his own damaged heart. The operation, in South Africa, appeared to be a success on a short-term basis, at least.

Massive efforts to understand fully the work of drugs and their side effects are still in their infancy, with more promise than progress reported. Similar slow forward motion is being made toward increasing the chance that organ transplants can be routinely and successfully retained; classes of drugs that prevent the rejection of kidney and other organ transplants as foreign bodies to be attacked by the host body's defense mechanisms are promising, but still experimental. So, at year's end, are efforts to produce cheap and easy artificial kidneys that can be widely afforded and used at home.

In one breakthrough, a new vaccine against the baby-killing Rh disease was being stockpiled in expectation of approval for use by the National Institutes of Health. RhoGAM, as it is called,

has been found effective in almost 100 percent of its test cases. The disease regularly killed 10,000 infants a year in the United States, 200,000 around the world.

Meanwhile, medicine's persistent fight against the major killers is apparently beginning to pay off.

During 1967 statistics were compiled that show heart disease deaths cut down by five percent during the decade ended in 1965. Most startling drop: a cut of 46 percent in the incidence of high blood pressure deaths, due to new drugs such as guanethidine and mecamylamine.

Rheumatic heart disease deaths were cut 33 percent and stroke deaths dropped 20 percent. While coronary heart disease deaths climbed 11 percent in the decade, they have since fallen by two percent.

And in the heart field, there are great advances in the offing.

Although plastic heart valves have been installed in humans for a dozen years, they often caused dangerous blood clotting. This year, researchers reported that using frozen natural valves from cadavers or animals overcomes the clotting problem. On the heels of their announcement, doctors working with plastic valves overcame the problem in another way—the use of Dacron or polypropylene coated with silicone and dipped in heparin, an anticlotting agent.

The 15,000 people who are wearing implantable pacemakers to back up their unreliable hearts can look forward to new devices that will dispense with the batteries—which now have to be replaced at intervals of three years or less. One of the new pacers sponsored by the Atomic Energy Commission will derive power from heat given off by the man-made radioisotope plutonium 238. Others take their power from the body itself, forming an electric cell in the bloodstream.

Researchers were making headway in their long struggle to identify some elusive virus as a cause of leukemia in humans. Dr. Robert J. Huebner of the National Cancer Institute predicts success may come within 1968. Pitting one type of virus against another, scientists developed new techniques permitting them to isolate leukemia-causing viruses from chickens and mice. Next, they're hoping these methods will uncover leukemia viruses in dogs and eventually in man.

A similar effort is being launched to find out whether another type of virus, called adenoviruse, causes human cancer. Certain types of these viruses which cause common respiratory diseases were shown to trigger cancer in rats. The initial study of what these viruses do to man will involve examination of blood serum and tissue extracts from 500 cancer patients.

The enzyme L-asparaginase showed promise against some types of leukemia. Its effect, in preliminary tests on humans, has been to kill cancerous cells and to leave healthy cells untouched.

Among the legislative changes during 1967 was liberalizing the abortion laws, especially in California, Colorado and North Carolina. The American Medical Association's House of Delegates accepted a Board of Trustee's report on therapeutic abortion recommending similar changes. These follow the Model Penal Code of the American Law Institute. This Code provides for the legal termination of pregnancy to preserve the life and health of the mother, or when there is a substantial risk of fetal abnormalities or when pregnancy is the result of rape or incest. Licensed physicians in accredited hospitals may perform therapeutic abortions after consultation with colleagues.

Research in the United States and England linked several human diseases, including multiple sclerosis, with a tiny subvirus that causes the sheep disease, scrapie. This agent appears to be neither viral nor genetic, but may be a protein that reproduces in a different way from the nucleic acids, DNA and RNA. Other linked human diseases are amyotrophic lateral sclerosis, which killed the famous baseball player Lou Gehrig; a type of shaking palsy called Parkinsonism dementia and a disease of the Fore tribe of New Guinea called kuru.

In spite of apparent success of Medicare, hospital costs have continued to climb, with predictions of $100 a day for a room in some cases because of increased costs of labor and equipment. Studies showed that poor planning in some areas had permitted excessive beds and whole hospitals that should never have been built.

behavioral sciences

For social scientists no news is good news. In 1967 there was plenty of news.

Early in the year, the President's Crime Commission published its 10-volume study on law enforcement and the administration of justice—a story of the inadequacies, inefficiencies and injustices of the entire $4 billion criminal justice system including police, courts and prisons.

This was followed later in the year by a similarly large study on the world food crisis in which the President's Science Advisory Committee gave the world 20 years to solve the problem. If steps are not taken immediately to reform agriculture in poor nations, said PSAC, the problem of supplying food to increasing millions may well become insoluable around 1985.

At the same time, evidence emerged to indicate strongly that a protein deficient diet retards a child's mind as well as his body. Some 60 percent of the world's children under school age have protein deficient diets.

Then came the reports on alcoholism in the United States. The country has about five million alcoholics, a good number of whom have been shuttling back and forth through streets, courts and jails.

But a Federal court broke new ground when it ruled that alcoholism can no longer be considered a crime, and should be treated as a mental illness.

The United States, however, doesn't begin to have the services and personnel for treating alcoholism. Nor does it have the facilities for treating juvenile delinquency although child delinquency has not been legally considered a crime in this country for 50 years. As the Crime Commission pointed out, most children who come in contact with the U.S. criminal justice system—whether because they have committed an offense or have simply been neglected by parents—end up in local jails for temporary storage. Better facilities are, for the most part, not available.

The same tale of unfulfilled promises was true of family planning. In September the Planned Parenthood-World Population Organization estimated that 85 percent of the 5.3 million impoverished women in the United States still do not have access to birth control clinics and modern contraceptives, despite the announced intentions of Federal agencies.

For social scientists, this array of miserable problems was in part a message indicating how far U.S. social troubles are rooted in the lack of a national network of medical-social services.

If the reports of 1967 revealed the extent of social problems, the riots of 1967 gave them concrete form.

Gaps of another kind showed between criminal laws and public practices, particularly in abortion and marijuana use.

The first major airing of the abortion situation in the United States came in a September conference sponsored by the Joseph P. Kennedy Jr. Foundation

and the Harvard Divinity School. Conferees struggled with the moral issues of more liberal abortion laws, but the fact remained that an estimated 200,000 to 1.2 million U.S. women get illegal abortions every year—no one can be sure of the statistics. Most of the illegal operations are obtained by white, married women who can afford them, authorities stated.

Marijuana use developed out of all proportion to the punitive narcotic laws that were designed to control the drug. As one sociologist and expert on campus drug use put it: Pot is no longer a special thing; it's accepted, like the cocktail, as a part of college life.

The strain between law and practice became great enough that the marijuana issue landed in court late last year. But medical experts were unable to give solid evidence on the drug, either on its effects or potential dangers. Too few studies have been done. Until very recently there has been no reliable way of measuring an accurate dose of the active marijuana chemicals, tetrahydrocannabinols (THC), for study. In the natural plant, the chemicals come in widely varying degrees of strength and are difficult to extract. But last year, scientists succeeded in synthesizing THC and planned a number of research projects.

One piece of work already done with natural, extracted THC established that the mental effects of marijuana are strongly tied to dose. With the amounts available in most U.S. pot, smokers experience euphoria and some sensory distortion, although an occasional few will react with psychotic-like episodes even at that level. But if the dosage is increased three to five times, the marijuana ride begins to resemble a bad trip on LSD.

LSD, for its part, seems to damage chromosomes. Damage was found in both test-tube studies and clinical tests on actual users. There were reports of deformed children being born to mothers who had taken LSD during pregnancy. The chromosomal evidence raised the risk of both disease in the user and defects in offspring, but it was not well enough established to discard research pointing to possible therapeutic uses of the drug. LSD appears to have some use in treating alcoholism and a group of people called sociopaths, including addicts and criminally prone individuals. It also seems to help prepare terminal patients for death.

Another drug made news last year as a possible remedy for manic-depressive psychosis, a major mental illness instrumental in many suicides.

Lithium carbonate, a simple salt used by the ton in manufacturing, acts on mania to reduce excitement and seems to forestall depressive attacks. It apparently does nothing to help people once they sink into serious depression.

Schizophrenia research remained as contradictory as ever. On one hand Tulane University researchers proposed a theory, backed with evidence, that acute schizophrenia is an autoimmune disease in which the body manufactures antibodies against its own brain cells. On the other hand, a Norwegian scientist, with one of the largest identical twin studies ever done on this mental illness, claimed environment to be far more important than heredity, and presumably any genetic biochemical defect, in causing schizophrenia. The search for a biochemical villain is probably foredoomed to failure, he declared.

In brain research, the emphasis on integrating diverse electrical-chemical reactions with actual behavior gathered strength. The new field is developing under the name "psychobiology." Along these lines, University of California work linked learning with the spaces between nerve cells. It appears that mucoproteins packed over and around nerve cells may have something to do with memory storage and that shifts in electrical conductivity arising from intercellular space activate a memory package—mucoprotein plus cells.

anthropology and archaeology

In 1967 the earth relinquished secrets enshrouded for thousands and millions of years.

The oldest known member of man's family tree—28-million-year-old Aegyptopithecus—was unearthed late in the year from the Fayum desert southwest of Cairo by Prof. Elwyn L. Simons of Yale's Peabody Museum. The discovery of that ancient skull, culmination of six years of search, was foretold in early spring by another noted anthropologist, British Louis S. B. Leakey, who announced his own finding of 20-million-year-old Kenyapithecus on Rusinga Island in Lake Victoria.

In the New World, bones and tools of earliest men yet discovered were unearthed in two sites. An old riverbed near Mexico City yielded 40,000-year-old stone tools to Harvard. Shortly afterwards, 40,000-year-old bones and artifacts were discovered in the Old Crow River of the Yukon, announced by the National Museum of Canada. Previously, scientists believed man did not exist on the American continents before 12,000 years ago.

Lost Atlantis was found—the long-sought, mysterious continent, believed sunk some 3,500 years ago in the Atlantic Ocean, was located last summer by scientists probing a city interred in volcanic ash on the tiny island of Thera in the eastern Mediterranean Sea. The 1500 B.C. eruption of Santorini volcano, scientists believe, not only "sank" Atlantis, but destroyed the extensive empire of the Minoans who may have fled to Greece and paved the way for the Golden Age. Perhaps it helped cause the collapse of prominent Indian and Turkish cities.

The long-lost tomb of Greek mathematician Archimedes may have been rediscovered late in the year by the Sicilian Archaeological Center. Killed by the Romans in 212 B.C. as they invaded Syracuse, Archimedes was given honorable burial by a sympathetic Roman general. In 75, the statesman Cicero refound the weed-covered tomb, then it was again forgotten. Recently builders came upon a part of what might have been a column of the tomb described by Cicero—thrown away among tons of earth and rubble, but possibly recoverable.

During the forthcoming year, scientists will continue to unearth fragments of the past, aided with new methods of detection and hustled by the bulldozers of an overcrowded world eager to dig up the ancient sites for building highways and dams.

natural sciences

The year 1967 saw a slight but significant escalation in the struggle of man versus nature—in man's fight to find clean sources of water, to lessen water and air pollution, to keep certain wild creatures alive, and special wooded, marshy and rocky areas of the natural world free from civilization.

One resource, essential to life itself—water—made news both in a hopeful and in a disappointing way. Late in May, nearly 5,000 delegates from some 90 nations met in Washington, D.C., at a Water for Peace Conference, bent on reassessing the amount of fresh water in the world, discussing methods of conserving it and abating water pollution. In the same month, U.S. support of the 95-nation, 10-year program, International Hydrological Decade, was slashed, first by the House of Representatives, then by the Senate.

Ultraviolet spectroscopy showed that Lake Ontario may be even more polluted than dying Lake Erie, and Lake Michigan is also becoming a murky cesspool. A $10 million program was proposed to study the Lake Michigan alewife which littered the water and shores with hundreds of tons of carcasses in late summer.

Good news broke that populations of the lamprey eel, once the ogre of the Great Lakes, were lessened by nearly 97 percent, thanks to chemical warfare.

Water pollution created unprecedented problems in the ocean when some 118,000 tons of raw petroleum washed upon British and French shores as the oil tanker Torrey Canyon broke over a submerged rock near Lands End. Soon after, a submerged oil tanker, sunk during World War II, began spewing up oil that threatened the U.S. eastern coast. An oil pollution study was ordered by President Johnson.

Several bright events helped the water situation—the five-year drought of the Northeast was broken by heavy rains, as was the five-year Everglades drought which, along with engineering projects, had gravely endangered many rare species of wildlife. The year saw sharp increases in studies of weather modification, in and out of the government. Although no national standards were set, 22 states adopted some form of regulation of weather modification activities.

Attempts were made to halt air pollution with experimental incinerators, conversion of coal to gas, and reassessment of electric cars, but the air remained murky and toxic—the major question being how much power the Federal Government should have to force urban and industrial polluters to spend their share of the estimated $3 billion per year needed to clean the American air.

A sea current more than twice the volume of the Gulf Stream was discovered flowing past the southern tip of South America. Strong new evidence from many studies favored the theory of continental drift—stating that ocean floors are slowly welling up in mid-ocean ridges and flowing east and west, forcing continents apart.

An eruption of Hawaii's Kilauea volcano, though not predicted exactly, occurred as expected, and closer tabs on earthquake tremors along the western U.S. coast have kept geologists alert for the next earthquake.

An absence of news made news, as the longest period of time elapsed without a major earthquake occurring in the United States—the last big quake struck Anchorage, Alaska, March 1964.

New frontiers continued to be opened in the world's icy regions—in the Arctic where U.S. icebreakers started the first circumnavigation of the Arctic Ocean and collected new data, in spite of having to turn back from wind-packed ice on the Soviet side. In the tenth consecutive year of Antarctic summer research, 150 American scientists began mapping the last unexplored region of that continent and drilling a core through thousands of feet of the ice cap.

One cause for celebration in man's attempt to conserve wildlife is the highest count yet taken of the one remaining flock of whooping cranes—now numbering 47 wild birds flying between Canada and Texas, and 12 in captivity —59 in all.

astronomy

Although space spectaculars such as the thousands of high quality photographs of the moon and a more definitive structure for the atmosphere of Venus stole most of the headlines from earth-based astronomers, there was, nevertheless, significant progress in astronomical fields. A fourth ring encircling Jupiter was discovered and a tenth satellite of Saturn.

Some of the discoveries made from earth's surface were based on two techniques with tongue-twisting names: long base line interferometry and multiplex interferometric Fourier spectroscopy.

Interferometry is a technique involving receiving signals—optical, radio or audio—from the same source, then comparing them when they are reunited after having traversed slightly different paths. It has long been a standard method optical astronomers use to determine the distances between double stars and the diameters of very large stars. With the advent of radio astronomy the technique was adapted to the very much longer radio wavelengths by separating the receiving antennas and recombining the signals electronically.

During 1967, scientists learned how to combine the signals from antennas too far apart to be linked electronically. They recorded the radio waves and the precise time they were received, compared them at a central point later.

The first results of this new technique were reported by Canadian scientists in early spring, using antennas separated by a 2,000-mile-long base line. They found that the diameter of the quasar 3C-273-B was one-fiftieth of a second of arc, or about 100 light years if the object is 1.5 billion light years away, smaller than had been suspected.

By fall, this measurement had been narrowed down to less than five-thousandths of a second of arc, making 3C-273-B one of the most compact and intense sources of radiation known in the universe. Plans are underway not only to span the Atlantic for a base line, but to use the earth itself as a giant radio antenna by using the full diameter as a base line.

The second new technique, also taking advantage of interferometry, involves the use of a computer to correlate observations of planets in the infrared. A key factor is incorporation of the mathematical theory known as Fourier analysis by which the two split beams of a planet's light are combined by the computer.

MIFS, as the method is abbreviated, gave the first indication that the atmosphere of Venus contains trace amounts of hydrogen chloride and hydrogen fluoride, as well as confirming carbon dioxide as a major constituent.

Four years after the discovery of a chemical other than hydrogen emitting radio waves in space—the hydroxyl ion, which is part of the water molecule—astronomers continued to be puzzled by the mystery of the OH radical and the mechanism by which it emits radio waves. They did find that the sources are about the size of the solar system. The hope is that during the coming year observations with long base line interferometers will provide a solution to these puzzles. They may, it was suggested, reveal a galactic maser.

On the other hand, the cryptic hydroxyl observations could be the result of attempts at interstellar communication by some advanced civilization. Besides the hydrogen line, where a fruitless search has been made, the radio frequencies of hydroxyl in the 1600 megacycle range could be prime candidates for interstellar signals.

The astrophysical problems concerning the bizarre quasars remained astronomical. No light was shed on what they are nor the source of their intense energy by the discovery that seven of them have an identical red shift. This would mean they were all receding from the solar system at the same rate, considered to be a coincidence of fantastically small probability.

Not until February will astronomers have confirmation of a report made in December that the distance to one quasar had been measured, locating 3C-287 as either 100,000 or one million light years away—either being very close astronomically.

In the realm of large telescopes, the

future looked brighter for optical astronomers than for radio astronomers, except that the latter have the long base line technique in their favor. That is reported to be one reason why some of the proposals for big antennas were turned down or postponed by the National Science Foundation. The report of its eight-member committee on large facilities for radio astronomy will hopefully serve as a blueprint for progress in that field during the next decade, unless budget cuts become even more drastic than anticipated.

The recommendations were to proceed with only two of the five proposals, at a cost of $20 million. These are the 130-foot array of eight antennas in the shape of a letter "T" to be built by the California Institute of Technology in Owens Valley; and the upgrading of the 1,000-foot sperical dish in Arecibo, Puerto Rico, to permit observations at wavelengths shorter than 10 centimeters.

As for optical telescopes, a vitreous ceramic not affected by temperature will be the material for the three 150-inch telescopes to be installed in Australia, southern France and Chile. The 98-inch Isaac Newton telescope went into operation in England.

What is expected to be even more of a boom next year occurred during 1967 in the interest in residual radiation still pervading the universe from the original "big bang" in which it was formed, otherwise known as the cosmic microwave background.

A group at Princeton University, for instance, in late fall reported measurements of the background intensity at wavelengths between eight millimeters and 10 centimeters, supporting the suggestion that the radiation extends over a sufficiently large region of the electromagnetic spectrum to correspond to that of a blackbody.

physics

In physics 1967 saw more promise than concrete discoveries.

As particle physicists struggled to bring order to the web of experimental data emanating from today's accelerators, a new-generation machine, the 200-400-Bev accelerator to be built at Weston, Illinois, took shape on the drawing board. In Russia, meanwhile, a 70-Bev machine, more than twice as energetic as the till-then most powerful Alternating Gradient Synchrotron at Brookhaven, reached full power.

With the more powerful machines, physicists hope to find the elusive quark, a mathematical sub-particle thought to make up the 200-some elementary particles so far discovered. If quarks do exist, they are presumably bound together so tightly that very great energies are needed to break them loose so they can be observed.

Perhaps the most controversial research of the year was contributed by Princeton physicist Dr. Robert H. Dicke, whose measurements of the sun's shape led him to challenge Einstein's general theory of relativity. One of the most precise tests of that theory was that it predicted the shift in Mercury's orbit around the sun. But according to Dr. Dicke's observations, the sun is flattened on its ends, and this should also help shift Mercury's orbit.

The sun's oblateness results from a strongly rotating core deep within it, hypothesized Dr. Dicke. This explanation was later challenged by two California physicists, Drs. Peter Goldreich of the California Institute of Technology and Gerald Schubert of the University of California at Los Angeles, who said that the sun would be unstable if its core spun as fast as Dr. Dicke believes.

While the general theory was being challenged, the special relativity theory received new support from experiments at the Brookhaven AGS. A cornerstone of the special theory, the assumption that signals do not travel faster than the speed of light in a vacuum, was verified within distances of 10^{-16} cm. by a team led by Dr. S. J. Lindenbaum, using on-line computer equipment to register and analyze the millions of events taking place each hour.

A new record in low temperature physics was achieved when Dr. Arthur Spohr of the Naval Research Laboratory cooled a bundle of copper wires to within less than a millionth of a degree of absolute zero. And a new high in low-temperature phenomena was set when Dr. B. T. Matthias of the Bell Telephone Laboratories found a material—a combination of niobium-aluminum and niobium-germanium—that became superconducting at 20 degrees K.

Meanwhile, the theoretical explanation of superconductivity—the flow of electric current without resistance at very low temperatures—remained indeterminate. Experiments carried out on uranium by Dr. Robert D. Fowler of Los Alamos Laboratories showed that U-235 became superconducting at a lower temperature than its heavier isotope U-238, contrary to the most popular theory of superconductivity.

The year saw final agreement on the name of element 102, widely called Nobelium. Named in 1957 shortly after its reported synthesis by an international group including scientists from the Nobel Institute for Physics in Stockholm, it was discovered in 1958 by scientists at the University of California, Berkeley, using another method. The Berkeley group challenged the validity of the original discovery claim and would not accept the name. After a decade of controversy, the Berkeley scientists acceded to usage by calling it Nobelium, while yielding nothing in their claim to be the original discoverers of the element.

Also from Berkeley came news of the creation of the heaviest atom yet: an isotope of mendelevium with an atomic weight of 258. The tiny sample of matter, consisting of atoms with 101 protons and 157 neutrons in its nucleus, was created by bombarding samples of einsteinium.

Nuclear chemists also continued to use high-energy accelerators to study what happens when heavier atoms are struck by protons. Among the results reported during the year were the creation of lithium 11 and helium 8, isotopes with such a disproportionate number of neutrons compared with protons that scientists had believed they could never hold together.

The lithium and helium experiments were carried out at the Berkeley Bevatron. Unhappily, the year saw the shutting down of the Brookhaven Cosmotron, a 3-Bev machine that was obsolete for high-energy particle physics but held much interest for nuclear chemists.

space sciences

Tragedy marred the space efforts of both the United States and the Soviet Union in 1967, but the two countries vigorously set about picking up the pieces and getting back on course—although the courses are now somewhat different.

The U.S. was dealt the first blow on Jan. 27 when a violent fire, made even hotter by a pure oxygen atmosphere, swept through an Apollo spacecraft being tested on the launch pad. Astronauts Virgil Grissom, Edward White and Roger Chaffee died in the holocaust, and the resulting investigation shook the National Aeronautics and Space Administration.

Layer upon layer of officials were shuffled around by NASA and its main Apollo contractors as a result of the conditions that permitted the tragedy. Congress, alerted by the accident and pressured by the Vietnam war, decided that the space program's headlong pace had to slow down, and chopped more than $500 million from NASA's budget request.

Almost 10 months after the fire,

however, Apollo got back on the track with the flawless flight of an unmanned spacecraft atop the huge Saturn 5 rocket. Among the hardware tested for the first time were the booster's first two stages and the heat shield that will protect three future Apollo astronauts from the 5,000 degree heat of reentry through earth's atmosphere.

The Soviet tragedy followed the American one by less than three months. Soviet cosmonaut Vladimir Komarov, returning from the only manned space flight of the year by anyone, lost his life when his Soyuz spacecraft's reentry parachute lines became snarled. During the rest of the year, Russia flew more than a dozen objects believed to be unmanned versions of Soyuz, in an effort to work out a variety of bugs.

The moon again was the most-photographed object in space, as it was in 1966, thanks entirely to the United States. The Soviet Union had sent nothing to the moon as late as December, but three U.S. lunar orbiters and three Surveyors collected tens of thousands of lunar photographs, while two Surveyors, in addition, made chemical analyses of its surface.

The other big target of the year was Venus. The Soviet Venus 4 probe and the U.S. Mariner 5 raced toward the planet only two days apart, climaxing their journey when the Russian craft landed on the surface and the American version flew by (as planned) slightly more than 2,400 miles out.

Together, the two probes painted a grim picture of earth's sister planet, with temperatures of more than 500 degrees and an atmosphere that is mainly unbreathable carbon dioxide. Strange optical effects caused by the dense atmosphere, scientists said, would include the impression of standing in a bowl, with the sides sloping up around the observer. In addition, a person on the surface—if he could see the wavelengths of light that could get through Venus' clouds—might even see the back of his own head, because light rays reflecting from it might be bounced around the entire planet.

Several countries besides the Big Two fared into space. France, Italy, Japan, England, Australia and the European Space Research Organization (ESRO) all launched satellites, though not all of them got into orbit.

In the future, space activity in the United States may well be less active, with the economic brakes on. As a result, a number of foreign countries, or groups of them, may achieve a bit more prominence. This could be counterbalanced, however, by a general slackening of far-out space projects if the U.S. slowdown reduces the pressure of competition.

It appears as though one big question facing policy planners will be, "Will it pay for itself?" Satellites and programs specifically aimed at the commercial utilization of space are already starting to meet with more favor than their pure-research counterparts.

The following are the principal satellites, spacecraft and probes launched in 1967 up to Nov. 10. When available, initial orbital distances closest to (perigee) and farthest from (apogee) earth are shown in miles. The times represent the periods of the orbits. Unsuccessful launches are not listed.

PACIFIC 1 (U.S.) Jan. 11—Also known as Intelsat 2B, it hovers in synchronous orbit over the Pacific and provides general communications between the U.S., Japan, Australia and the Philippines; Apollo tracking communications for NASA; and military communications for the Defense Communications Agency. 22,244-22,257 miles, 1,436.1 minutes.

IDCSP 8-15 (U.S.) Jan. 18—An eight-in-one launch brought to 15 the number of satellites in the Initial Defense Communication Satellite Program, which keeps the Pentagon in touch with Vietnam 24 hours a day. Approx. 20,885-21,153 miles, 1,336 minutes.

COSMOS 138 (U.S.S.R.) Jan. 19—The first of more than 50 launches this year in the Soviet Union's catch-all satellite series, an increase of more than 40 percent over last year's total. 120-182 miles, 89.2 minutes.

ESSA 4 (U.S.) Jan. 26—Lofted to replace ESSA 2, the Environmental Science Services Administration's fourth satellite got into orbit with only one of its two weather cameras working, but provides daily weather coverage to almost 200 worldwide Automatic Picture Transmission (APT) receivers. 822-894 miles, 113.4 minutes.

LUNAR ORBITER 3 (U.S.) Feb. 4—Took 182 pictures of potential Apollo landing sites on the moon, following its two successful predecessors of last year.

COSMOS 140 (U.S.S.R.) Feb. 7—Though its mission was, as usual, unannounced, this Russian probe was first of several believed precursors of the Soyuz manned spacecraft series. 106-150 miles, 88.5 minutes.

D1C (France) Feb. 8—The first of two D1 geodetic satellites intended to provide more accurate triangulation data, particularly in the Mediterranean area, via lasers and doppler measurements. 360-833 miles, 104.3 minutes.

D1D (France) Feb. 15—Successful comrade to D1C. 368-1,172 miles, 110.2 minutes.

COSMOS 144 (U.S.S.R.) Feb. 28—Equipped with two TV cameras for daytime cloud cover photos, infrared scanners for day and night observations and sensors to measure radiation emitted and reflected by the earth and its atmosphere, this satellite was the first in the U.S.S.R.'s proposed "Meteor" global weather-watching system. 388-388 miles, 96.9 minutes.

OSO 3 (U.S.) March 8—The third Orbiting Solar Observatory was successfully set to work with its nine experiments to replace OSO C, which failed to get into orbit in August 1965. 336-354 miles, 95.9 minutes.

ATLANTIC 2 (U.S.) March 22—Alias Intelsat 2C, this communications satellite is the Atlantic Ocean's version of Pacific 1 (Intelsat 2B). 22,246-22,254 miles. 1,436.1 minutes.

ATS 2 (U.S.) April 5—The second in the multipurpose Applications Technology Satellite series, it got into the wrong orbit for its primary goal of trying out a gravity gradient stabilization system, but carried out communications and meteorological experiments. 115-6,947 miles. 218.9 minutes.

SURVEYOR 3 (U.S.) April 17—It dug holes in the moon and photographed itself in action, as well as adding more than 6,300 photos to the Apollo landing-site search file.

ESSA 5 (U.S.) April 20—Replaced ESSA 3 in the Tiros Operational Satellite System (TOSS). 840-883 miles, 113.5 minutes.

SOYUZ 1 (U.S.S.R.) April 23—In the only manned flight of the year by any country, Cosmonaut Vladimir Komarov orbited the earth 17 times, but was killed during reentry when the spacecraft's parachute lines fouled. 125-139 miles. 88.6 minutes.

SAN MARCO 2 (Italy) April 26—Launched from a floating platform off the coast of Kenya, the weather satellite was successfully placed in an equatorial orbit. 135-498 miles, 94.9 minutes.

COSMOS 156 (U.S.S.R.) April 27—Joined Cosmos 144, but phased 95 degrees behind so that the two weather satellites would pass over the same areas six hours apart. 391-391 miles, 97 minutes.

VELA 7 and 8 (U.S.) April 28—These two nuclear-blast-detecting sky-spies were launched as part of a five-in-one shot which also included: ERS 18, to continue mapping the Van Allen radiation belts; OV5-1, to aid in solar flare prediction; and OV5-3, to investigate the effects of space on metals. Vela orbits approx. 67,521-70,332 miles, 6,696 minutes.

LUNAR ORBITER 4 (U.S.) May 4—The first Orbiter to be devoted more to scientific research than to Apollo site-picking, it sent 163 photos back to earth.

ARIEL 3 (U.K.) May 5—The third satellite in the U.S.-U.K. cooperative research program, it was the first British-built one and was placed in orbit with all five of its experiments operating. 306-373 miles, 95.6 minutes.

MOLNIYA 1E (U.S.S.R.) May 25—The fifth Soviet communications satellite, it could handle color and black-and-white TV, voice and telegraph transmissions. 286-24,737 miles, 319 minutes.

VENUS 4 (U.S.S.R.) June 12—Part of it flew by the planet Venus, the other part landed on the planet's surface on Oct. 17, concluding that Venus was every bit as inhospitable as expected, with temperatures of more than 500 degrees F.

MARINER 5 (U.S.) June 14—Launched toward Venus two days after the Russian vehicle, the third U.S. Venus probe got there two days later, found that Venus has an ionosphere and a glowing hydrogen corona as does earth, but that the mysterious planet lacks both a magnetic field and Van-Allen-style radiation belts.

DODGE (U.S.) July 1—This huge, spidery satellite was the Department of Defense's Gravity Experiment. 20,627-20,868 miles, 1,319.1 minutes.

EXPLORER 35 (U.S.) July 22—Now in orbit around the moon, it is measuring the solar wind and other interplanetary data as influenced by the moon's presence.

OGO 4 (U.S.) July 28—The fourth Orbiting Geophysical Observatory collects a wide range of data as part of one of the most complicated satellite series ever flown by the United States. 257-551 miles, 97.7 minutes.

LUNAR ORBITER 5 (U.S.) Aug. 1—The final Orbiter in the series worked just as well as its predecessors, adding even more photos to the lunar art gallery.

BIOSATELLITE 2 (U.S.) Sept. 7—After its identical predecessor was lost over Australia with its cargo of wasps, wildflowers, frogs' eggs, pepper plants and other living organisms, the second satellite successfully ejected its cargo of flora and fauna out of orbit, providing geneticists with samples exposed to three days of controlled radiation and weightlessness. 164-164 miles, 90.1 minutes.

SURVEYOR 5 (U.S.) Sept. 8—Besides cameras, the third success in the series (1 and 3 worked; 2 and 4 crashed) carried an automatic chemical laboratory that analyzed the moon directly beneath itself by observing the characteristic scattering of alpha particles bounced off the lunar elements. The spacecraft found that the lunar material was basaltic rock of which more than 75 percent was oxygen and silicon.

PACIFIC 2 (U.S.) Sept. 27—The latest addition to the U.S. communications satellite system, this one's other name is Intelsat 2D. 22,219-22,225 miles, 1,436.1 minutes.

OSO 4 (U.S.) Oct. 18—The 3,000th manmade object sent into space, the fourth Orbiting Solar Observatory carries nine experiments to monitor the sun for its effects on such phenomena as the communications blackout that plagues reentering spacecraft. 337-359 miles, 95.8 minutes.

COSMOS 186 (U.S.S.R.) Oct. 27—Another unmanned Soyuz spacecraft duplicate, it orbited three days until the launch of...

COSMOS 188 (U.S.S.R.) Oct. 30—When 188 got into orbit, it carried out an automatic docking procedure with 186, remaining coupled for several orbits, after which 186 came back to earth to a reported "soft landing in the pre-set area." Orbits for the two spacecraft while coupled: 124-171 miles, periods varying from 88 to 97 minutes.

ATS 3 (U.S.) Nov. 5—Packed with experimental meteorological and communications equioment, the third Applications Technology Satellite carried a new camera to take the first high-resolution color pictures of the earth's full disc. 22,229-22,255 miles, 1440 minutes.

APOLLO 4 (U.S.) Nov. 9—This unmanned flight marked the first launch of Apollo hardware since the Jan. 27 fire that killed three astronauts; in addition it was the first launch ever of the giant Saturn 5 booster, one of which will send a crew to the moon.

SURVEYOR 6 (U.S.) Nov. 7—Equipped with both cameras and robot chemistry laboratory, this next-to-last Surveyor was to enable scientists to make broader generalizations about the moon's makeup than could be drawn from Surveyor 5 alone. It also became the first spacecraft ever to take off from the moon, when it refired its engines to move over eight feet to enable lunar photos in stereo for the first pinpoint measurements of the surface.

ESSA 6 (U.S.) Nov. 10—The latest member of the Tiros Operational Satellite System, this weather-watcher is equipped with APT cameras to enable its use by low-cost, worldwide ground stations. 874-922 miles, 114.8 minutes.