

SCIENCE NEWS of the Year

This is a review of important science news stories of 1989 as reported in the pages of SCIENCE NEWS. The references after each item refer to the volume and page number in which the main article on the subject appeared in SCIENCE NEWS (Vol. 135 is Jan.-June; Vol. 136 is July-Dec.). Where several references exist, the news developed and was reported in more than one issue. Back issues or, when out of stock, copies of articles are available for one dollar each by writing to SCIENCE NEWS, 1719 N Street, N.W., Washington, D.C. 20036.

1989

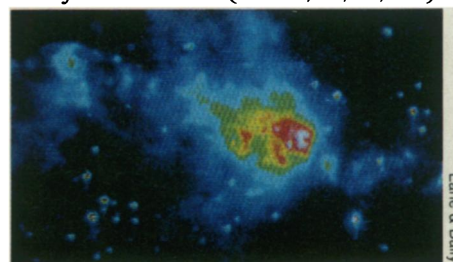
Anthropology

- Excavations of the Roman Forum indicated Rome was an urban center in the 7th century B.C., much earlier than many scholars had assumed (135: 20).
- A recently developed dating technique suggested anatomically modern humans inhabited the Near East 100,000 years ago, more than twice as long ago as many previous estimates (135: 263). The earliest known remains of modern humans in southern Asia, dating to 28,000 years ago, were identified on Sri Lanka (135: 388). And an analysis of human teeth from around the world suggested *Homo sapiens* arose in southeast Asia rather than in Africa (136: 100).
- Anatomically modern humans were estimated to have inhabited southwestern Europe 40,000 years ago, much earlier than previously thought (136: 388).
- Scientists presented evidence from fossil skulls that Neanderthals and anatomically modern humans developed side by side, and interbred, in the Near East beginning 145,000 years ago (135: 229).
- A small bone found in the neck of a Neanderthal skeleton was said to show that Neanderthals could talk much as modern humans do; the claim was immediately challenged (136: 24).
- Archaeologists discovered a 4,000-year-old Mesopotamian city in the Iraqi desert (135: 198).
- Scientists continued a debate over the Philippine tribe known as the Tasaday, with some anthropologists charging the group is a politically inspired hoax (135: 280), even as new studies supported its authenticity (136: 343).
- An island near Belize yielded evidence of shared cultural practices and trading among Maya settlements more than 200 years after Classic Maya civilization collapsed around A.D. 900 (136: 20). Other excavations indicated that warfare played a crucial role in the demise of Classic-era cities (136: 365).
- Researchers challenged the widespread view of modern hunter-gatherers as a window to humanity's past (135: 264).
- Further evidence emerged that the Sahara once harbored major waterways and attracted human occupation more than 200,000 years ago (136: 138).
- Microscopic analysis of stone blades from Israeli sites indicated small-scale cultivation of cereals began 12,000 years ago, 3,000 years before the appearance of full-scale agriculture in the region (135: 101).
- An archaeologist proposed that status competition leads to historical trends in the way people of diverse cultures are buried (136: 330).
- The director of a 15-year study of baboons in Kenya reported that friendship outweighs fierceness as a means for adult males to attract sexually receptive females (135: 251).
- Excavations revealed that Europe's first farmers, long thought to have existed in tranquil villages around 8,000 years ago, engaged in significant fighting either among themselves or with nearby hunter-gatherers (136: 165).
- Artifacts at one of Iron-Age Europe's first cities indicated trade with Rome led to intensified iron production in the 2nd century B.C. and stimulated important cultural changes (135: 170).
- One team of astronomers identified the most distant object now known in the universe (136: 340), while another found a nearby gas cloud that may represent a budding galaxy (136: 164).
- Astronomers for the first time detected gravitational microlensing (136: 375).
- The idea of a phase transition — a change in the fabric of space — following the Big Bang by a million or so years rather than only a nanosecond prompted a new look at how galaxies formed in the universe (135: 262).
- Additions to the catalog of known pulsars forced reevaluations of how pulsars form and evolve (135: 86, 303).
- Astronomers proposed that mergers play an important role in galaxy formation and evolution (135: 218; 136: 150).
- The detection of large-scale flows suggested the presence of large concentrations of matter in certain regions of the universe (135: 230).
- Astronomers detected a new, surprisingly strong source of X-rays, which appear to come from a pair of stars in the constellation Cygnus (136: 4).
- Radio-wave and infrared observations revealed complicated patterns of gas flow, stellar winds and jets shooting out of newly formed stars (136: 12, 20, 55, 102).

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Astronomy

- Astrophysicists mapping the location of galaxies discovered the largest structure known in the universe — a long, thin sheet of galaxies dubbed the "Great Wall" (136: 340).
- Astronomers caught a glimpse of a rapidly spinning pulsar at the center of supernova 1987A, then failed in subsequent attempts to confirm their discovery (135: 100). Other observers found additional light echoes (135: 155; 136: 12) and unusual characteristics in the supernova's gamma-ray spectrum (135: 303).



- The question of what constitutes dark matter in the universe prompted a wide variety of proposals, from dim, gas-rich galaxies and clouds (136: 60, 84) to charged, massive particles (136: 214).
- Data from Japan's Kamiokande II neutrino detector provided the first experimental confirmation that the sun generates neutrinos (136: 280).

Behavior

• Moderate drinking by pregnant women was linked to significantly lower intelligence test scores for their children at age 4 (135: 68).

• A study of Holocaust survivors surprised researchers by suggesting that repressing traumatic memories, rather than dredging them up, may enhance psychological adjustment (136: 4). Another investigation of Holocaust survivors yielded a contrasting conclusion: that talking candidly with others about past traumas is beneficial (136: 271).

• Two scientific teams found no evidence for a previously proposed gene on chromosome 5 predisposing its bearers to schizophrenia (135: 359). Further study of an Amish family also cast doubt on prior claims that a predisposition gene for manic depression lies on chromosome 11 (136: 327).

• Researchers observed that depression is often as physically disabling as high blood pressure, arthritis and other serious medical conditions (136: 132).

• A year-long stress reduction program for heart attack survivors produced a marked drop in the incidence of subsequent heart attacks (136: 261).

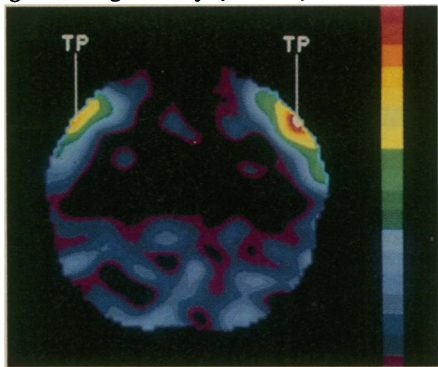
• Researchers gleaned clues to the generation of emotions during infancy from evidence of greater emotional intensity on the right side of babies' faces (135: 149). Others reported that children in the first few years of life can intentionally mask their facial expressions to deceive adults (135: 343).

• A long-term study of parental styles gave the nod to supportive control over permissiveness in the nurturing of psychologically healthy teenagers (136: 117).

• Researchers used bright lights to reset volunteers' biological clocks, hinting at a potential therapy for some types of sleep disorders (135: 374). Another study showed that night-shift workers are less attentive and have more accidents than their day-shift colleagues (135: 37), while a third investigation showed that young men improve their reaction time when they get an extra hour of sleep (136: 260). Insomnia and other persistent sleep problems were proposed as early warning signs of an impending depression or anxiety disorder (136: 180).

• Evidence emerged that specific speech sounds are recognized by infants as young as 6 months old and influence language abilities (136: 37).

• Positron emission tomography (PET) scans illuminated brain areas crucial in generating anxiety (135: 116).



• Challenging earlier conclusions, researchers reported that cigarette smokers who use "stop smoking" manuals are as successful at kicking the habit as those who quit on their own (136: 358).

• Encouraging signs indicated that behavior modification techniques relying on parents as co-therapists substantially help autistic preschoolers (136: 312).

• Some researchers and clinicians charged that an upcoming revision of the official manual of psychiatric diagnoses is misguided (135: 120).

• A study of an Indonesian tribe suggested the physiological changes accompanying basic emotions are determined genetically rather than culturally (135: 59).

• The ability of 4-year-old children to delay gratification was linked to their psychological health and school performance at age 14 (135: 325).

Biology

• Clearing numerous regulatory hurdles and a last-ditch legal challenge (135: 68), U.S. researchers performed the first injections of genetically engineered cells into human patients (135: 324).

• The prospects for gene therapy improved as scientists produced gene-altered blood vessels in animals (135: 373) and tinkered with "antisense" genetic technology (135: 360). The human genome project gradually overcame organizational and technical hurdles in its quest to map all 50,000 to 100,000 human genes (136: 230, 254).

• Providing new hope for people with serious nerve injury, scientists reported the first successful reestablishment of neuronal function in a regenerated, central nervous system nerve (136: 244).

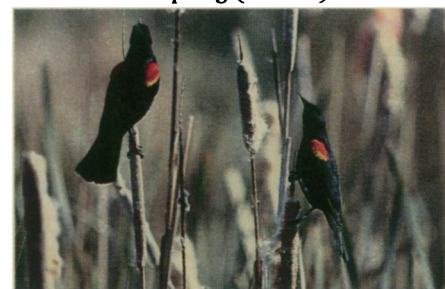
• U.S. government officials extended a ban on federal funding for most human fetal cell transplants (136: 310). Researchers put new emphasis on gene-altered alternatives to fetal cells (136: 378) as potential treatments for neurodegenerative diseases.

• The polymerase chain reaction continued to revolutionize molecular biology and genetics with applications ranging from criminal investigation (136: 74) to preservation of endangered species (135: 72).

• Norwegian scientists found that even pristine freshwater and marine environments harbor up to 10 million times as many viruses as previously believed (136: 100). Vaccine studies confirmed that canine distemper virus or a closely related virus caused the deaths of thousands of seals in the North and Baltic seas beginning in April 1988 (135: 39). Virologists expressed concern that deadly viral epidemics among humans are becoming more likely (136: 200).

• Biotechnology played an increasingly important role in agricultural research (135: 300; 136: 46, 120). The federal government tightened restrictions on releases of U.S.-developed genetically engineered organisms in foreign countries (135: 237).

• Ornithologists observed that African bee-eater birds sacrifice their own reproductive opportunities to help their kin raise offspring (135: 364) and that male red-winged blackbirds with familiar neighbors attract larger harems and thus have more offspring (136: 311).



Orlans

• A team of entomologists and engineers developed the first robot honeybee capable of using the waggle dance to communicate with other bees (136: 282).

• Scientists discovered the first known photosynthetic nitrogen-fixing bacteria capable of symbiosis with leguminous plants (135: 36).

• Settling a long-standing canine question, researchers found that dogs do see colors (136: 215).

• Scientists isolated and synthesized two reptilian pheromones critical to sexual behavior in some snakes (136: 55).

- Studies of the spectral properties of spider webs revealed that the silken threads lure prey by reflecting ultraviolet light (135: 330).

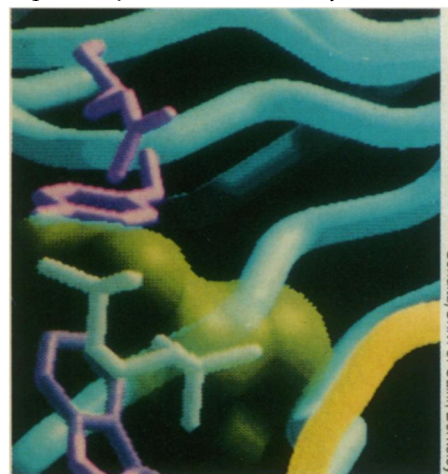
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Biomedicine

- In AIDS research, the most encouraging news was the report that zidovudine (AZT) slowed disease progression among HIV-infected people with no disease symptoms (136: 135) and among those in an early stage of AIDS known as ARC (136: 102). Several research teams also reported promising results with experimental AIDS vaccines tested in chimpanzees and rhesus monkeys (135: 375; 136: 116). A federal official outlined a proposal to give AIDS patients better access to experimental drugs (136: 6), and the Food and Drug Administration allowed broader use of the drug dideoxyinosine (136: 231) after successful early trials (136: 69). On the down side, scientists reported that some common viruses resist drug treatment in AIDS patients (135: 110). Other studies showed that some people who harbor HIV lack telltale antibodies in their blood (135: 340) and that a type of herpesvirus may accelerate the development of AIDS symptoms (135: 55). Pathologists identified a mysterious microbe found in the tissues of deceased AIDS patients and others (136: 356).
- Scientists identified a mutant gene causing most cases of cystic fibrosis (136: 149), but the ensuing rush to market a genetic screen to detect that gene was called premature (136: 325). Other researchers demonstrated the reliability of a nongenetic test to screen newborns for the disease (136: 233).
- Chemotherapy reduced the threat of breast cancer spread for certain women (135: 135) and made radical mastectomy unnecessary for others (135: 325). Marker molecules helped predict breast cancer spread (136: 164, 325), and an experimental test measuring breast density identified healthy women at increased risk of the disease (135: 213). In colon cancer patients, a double-drug treatment given soon after surgery reduced the risk of fatal recurrence by one-third (136: 228).
- A study suggested that coronary angioplasty is unnecessary in as many as 40 percent of the heart attack survivors who today undergo the costly procedure (135: 148). Several research teams reported a link between high blood insulin levels and the risk of heart disease (136: 184). Hostility was found to be the most significant factor in predicting the health risks of Type A behavior (135: 60), and researchers noted that aggressive children (136: 15) and people living in war zones (136: 284) run an increased risk of developing heart disease. Research suggested that lowering blood pressure too much can be dangerous for some people with hypertension (136: 116). Other research helped explain why blacks are prone to hypertension (136: 15, 214).
- Drug treatment slowed the progression to full-blown Parkinson's disease and may prolong lives (136: 84). Researchers found Alzheimer-related proteins in organs other than the brain (136: 197) and reported hints of a neuron-killing toxin in some brain-bound proteins associated with the disease (136: 68).
- For the first time in the United States, surgeons performed a liver transplant using tissue taken from a live donor (136: 358). An experimental preservation fluid extended the "shelf life" of livers from deceased donors (135: 69). Bone marrow transplants showed new promise as scientists used critical immune markers to screen unrelated marrow (135: 348), used recombinant growth factors (135: 380) and reconstituted marrow using umbilical stem cells (136: 293).
- Ophthalmologists reported that wearing soft contact lenses while sleeping increases the risk of serious eye infection, and some called on the FDA to initiate new label instructions cautioning against overnight lens use (136: 197).
- Researchers developed a genetic test to predict a person's risk of Type I diabetes (135: 357). A DNA-based test used in basic research showed promise in definitive diagnosis of Lyme disease (136: 374). Scientists refined genetic-disease screening tests to work on single embryonic cells (135: 132) and on unfertilized ova (136: 326).
- Researchers became increasingly convinced that genetic imprinting accounts for a variety of unusual inheritance patterns (135: 312) and identified the first genetic disease clearly linked to the phenomenon (136: 324).
- A fluoride-calcium treatment restored lost bone in a study of people with osteoporosis. Other scientists cautioned, however, that the new bone may be brittle (135: 36).
- Research suggested that children with sickle cell anemia suffer from previously unrecognized neuropsychologic impairments (136: 404), while new therapies for the disease appeared on the horizon (135: 349; 136: 360).
- Parasitologists and geneticists gained ground in their understanding of an amoeba that infects 10 percent of the world's population (136: 216).

Chemistry

- Two chemists made unconfirmed reports of a bench-top route to nuclear fusion, which became known as cold fusion (135: 196, 212, 229, 244). Their claims electrified scientists and the public with hopes that the world's energy needs could be met indefinitely. But frustrated attempts by other labs to reproduce the original results led to widespread skepticism that the proposed phenomenon was real (135: 276, 311, 341; 136: 78). Further work added little support, though rare observations of unusual happenings in cold fusion experiments kept the issue above water (136: 278, 406).
- Molecular biologists created a type of RNA capable of replicating parts of itself, clarifying the potential evolutionary role of this simple genetic molecule (135: 372). Researchers who discovered enzymatic properties of RNA won the chemistry Nobel (136: 262).
- The variety of catalytic antibodies, or "abzymes," grew as chemists developed clever techniques for making and improving them (135: 28, 252; 136: 152).



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- Researchers designed enzyme-like chemicals, or "chemzymes," and used them to catalyze reactions that produce far more of a desired product and far fewer unwanted by-products (135: 388).
- Hydrogen gas subjected to millions of atmospheres of pressure turned into a metal-like phase that some predict to be superconducting (135: 327).
- With rod-like, triangular and square molecular building blocks, researchers assembled new materials for electronic and optical uses (135: 166; 136: 86).
- Chemists inserted synthetic amino acids into laboratory-made enzymes (136: 246).

Earth Sciences

• Scientists calculated that 1988 was the warmest year on record for average worldwide temperatures – an announcement that sparked increased interest in issues of greenhouse warming and global climate change (135: 84). Despite the record-breaking temperatures, many researchers said they could not yet determine whether the greenhouse effect has started, in part because of inaccuracies that plague temperature measurements (135: 216).

• Vexing problems also hampered efforts to assess how quickly the climate will warm under greenhouse conditions and which areas will warm most. Clouds emerged as a key wild card in the climate equation (136: 106, 196), and one landmark study showed that, for now at least, clouds collectively help cool the climate rather than warm it (135: 6). Experts scaled down their previous predictions for future sea-level rise (136: 397). Other work revealed serious gaps in scientists' understanding of how different regions of the Earth absorb the greenhouse gas carbon dioxide (136: 132).

• While an independent panel of U.S. climate experts charged that the government is not conducting enough research on global change (135: 150), a number of agencies are drawing up broad battle plans for such research (135: 232). Emergency funding staved off the threatened March shutdown of two Landsat satellites, which scientists say are vital for monitoring large-scale changes on Earth (135: 172).

• Severe ozone depletions over Antarctica rivaled the record-breaking events of 1987 and confounded several theories about ozone loss (136: 246). New analysis of the 1987 data revealed that the Antarctic ozone loss that year affected a much larger area than previously suspected (136: 324). And in the Arctic, airborne instruments detected high levels of ozone-destroying chemicals in the stratosphere (135: 37, 116), while balloon measurements detected what appeared to be the birth of a small ozone hole there (136: 54).

• A magnitude 5.2 earthquake erupted in August along the San Andreas fault in California's Santa Cruz mountains (136: 119), followed by a magnitude 7.1 quake there in October – the worst to strike the area since 1906. The October jolt caused major damage but failed to relieve stress on other, more dangerous faults that continue to threaten the area (136: 261). Researchers later uncovered surprising details about movement along the fault

(136: 277) and possible precursory signs before the October quake (136: 374, 390).

• The Earth's strongest earthquake in 12 years struck a remote area southeast of Australia (135: 340), where ocean crust may be going through the initial phase of subduction (136: 396). And in Armenia, investigators sifting through the rubble of the deadly 1988 quake blamed poor construction practices as well as geologic bad luck for the high mortality rate (135: 43).

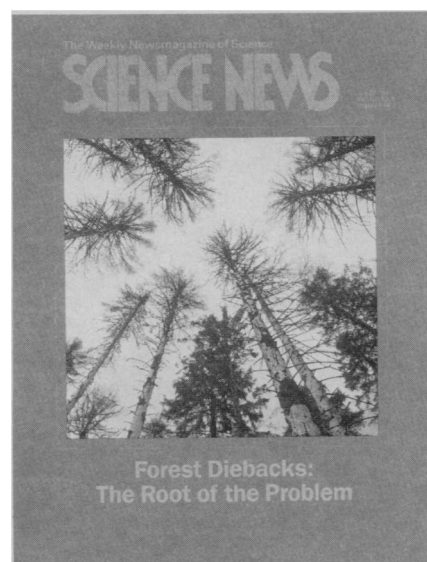
• Geologists reported finding the oldest known rocks, dated at 3.96 billion years old (136: 228), and the earliest evidence of plate tectonic activity, dated at 2.5 billion years ago (135: 159). Another geoscientist compiled several pieces of evidence suggesting all Earth's land masses have gathered together to form supercontinents on at least two occasions over the last 2.5 billion years (135: 344). Calculations of how plateaus affect climate led two researchers to propose that the rise of Tibet and the American Rockies set the stage for the recent ice ages (135: 309).

• Using seismic waves to probe the underwater mountain chain called the East Pacific Rise, oceanographers discovered that the melted pool of magma under this spreading center is much smaller than previously estimated (135: 326). A recent project that mapped 900 kilometers of the Mid-Atlantic Ridge provided new insight into the structure of the spreading centers on that mountain chain (135: 295). The shells of tiny marine animals from 40 million years ago suggested that the oceans were once turned upside-down, with cold water covering warm, salty water (136: 71).

• Probing the secrets of the continental crust, the Soviet Union and West Germany continued drilling to unprecedented depths (136: 266). The United States started a 6-kilometer-deep drill-hole designed to test the feasibility of extracting heat energy from molten rock beneath a volcano (136: 101).

Environment

• A series of new studies indicated that high-altitude forests may be suffering serious diebacks from nutritional imbalances initially induced by acid rain (136: 56). Ecologists found that geology and weather predispose high-elevation lakes in the northeastern United States to acid rain damage (135: 165). Other analyses indicated that many of these lakes may have already suffered severe and potentially unrecognized chemical and ecosystem damage (135: 311; 136: 151).



• The number of U.S. regions violating the ozone standard increased (135: 119; 136: 94). As one step toward reducing the problem, EPA tightened limits on the allowed volatility of U.S. gasoline (135: 191). Studies showed that ozone-laden summer smog could be unexpectedly high in rural areas and inside buildings (136: 22, 198), while new data indicated ozone can cause irreversible lung damage in test animals (136: 53).

• Researchers discovered that even low levels of lead in a child's bloodstream can cause serious difficulty in maintaining balance (135: 54). A new study suggested that measurements of lead stored in bone – rather than blood levels, the standard gauge of human lead exposure – may offer the only reliable indicator of toxic exposure to the metal (135: 111). Research showed that demineralization of bone can release potentially dangerous levels of stored lead to vulnerable tissues (135: 181), while other studies unveiled new clues to how lead impairs growth, vision and reproduction (136: 87, 373).

• A major new reassessment of the human health hazards posed by low-dose exposures to ionizing radiation elevated the cancer risk estimate for X-rays three- to four-fold (136: 404).

• A series of studies showed that trees, crops and polar plankton may be threatened by the increasing ultraviolet radiation penetrating Earth's stratosphere as the ozone layer thins (136: 134, 284).

• The largest spill of crude oil in U.S. history fouled Alaska's nearly pristine Prince William Sound. EPA tests showed that native microbes may help break down and detoxify the residues left on Alaskan beaches (135: 383; 136: 38). Earlier in the year, diesel fuel spilled by the grounding of an Argentine ship threatened research at an Antarctic station (135: 85).

- Two scientific teams established the first strong link between respiratory disease in industrial communities and concentrations of the smallest aerosol pollutants (135: 277).

- Challenging previous speculations, biologists suggested the higher carbon dioxide levels expected in the future may not benefit vegetation (136: 134, 143).

- Several studies revealed that chlorine bleaching of wood pulp leaves trace residues of dioxins and furans in a range of paper products — including cardboard milk cartons — where the toxicants can migrate into foods (135: 104; 136: 94, 165). Other data showed that skin is most permeable to these chemicals in young animals or when exposure involves only a small amount of toxicant (135: 141).

- EPA initiated new controls to cut industrial benzene emissions (136: 165). One month later, researchers reported that benzene's greatest cancer hazard stems from nonindustrial releases in and around the home (136: 245).

- Field studies demonstrated that clay liners fail to block the diffusion of many toxic chemicals out of landfills (135: 164).

- One of the world's leading chlorofluorocarbon (CFC) manufacturers announced the availability of three new substitutes for the most widely used CFC, maintaining that each substitute poses 97 percent less threat than the CFC to stratospheric ozone (135: 94).

- NASA researchers reported that a range of common houseplants can filter toxic organic pollutants from indoor air (136: 212).

- In an Italian study, saturated fats and animal proteins proved the most potent dietary risk factors associated with breast cancer (135: 102).

- Fish oil's ability to suppress blood clotting depends on its ratio to other types of polyunsaturated fats in the diet, researchers showed (135: 183). Diets high in this fat demonstrated promise not only in treating malaria (135: 237) but also in reducing blood pressure (136: 181) and slowing the development of some cancers (135: 390).

- While new data suggested how plant pigments called carotenoids help prevent cancer (136: 294), other research indicated these are not the only vegetable constituents that inhibit cancer formation (136: 102, 351).

- The sugar in yogurt and other dairy products was linked to ovarian cancer in some women (136: 52).

- For the first time in almost a decade, the National Research Council revised its recommended daily allowances for key dietary nutrients (136: 277).

- New calculations showed that children face an especially serious cancer risk from eating produce containing residues of agricultural chemicals, such as the daminozide used on apples (135: 133). Though many apple growers claimed to have halted daminozide use, a consumer group testing 32 apple juices from such sources found traces of the carcinogen in more than 70 percent of the samples (135: 155). Just weeks after EPA announced plans to ban daminozide use on food crops, the chemical's sole manufacturer suspended U.S. sales for those applications (135: 311, 358).

- A series of studies offered clues to how various dietary fibers reduce blood cholesterol and inhibit cancer (136: 344). High-fiber breakfasts also reduced lunchtime appetites (136: 412).

- Animal studies suggested chronic food restriction may lengthen life expectancy by boosting immunity (136: 46).

- Adding lactose (milk sugar) to the drinking water of broiler chickens allowed most birds to fend off infection by a bacterium that causes one-fourth of all U.S. *Salmonella* food poisonings (135: 349).

- In a study of adult men, nutritionists found that high-fat diets did not elevate cholesterol when saturated fats were strictly limited (136: 318).

- Low-salt diets restored dilating ability in the blood vessels of middle-aged and elderly subjects (136: 367).

- A food chemist developed a treatment to restore crispness to canned fruits and vegetables (136: 206).

- The National Research Council identified triticale, a wheat-rye hybrid, as the grain with the best potential for weathering climate change (136: 46).

- Biochemists reported that shriveled brown spots on commercially marketed potatoes may harbor potentially harmful levels of fungal toxins (135: 238).

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Math & Computers

- Newly discovered links between quantum physics and knot theory helped tie together a number of mathematical ideas (135: 174).

- A new algorithm for computing the digits of pi pushed the calculation to a record-breaking billion digits (135: 372; 136: 166).

- A team of six computer scientists set the record for the largest known prime number (136: 191).

- Mathematicians worked out several new ways of turning a sphere inside out without introducing any creases during the transformation (135: 299).

- A Hungarian mathematician proved it possible to cut up a circle in such a way that the pieces can be fitted together to create a square (136: 31).

- Researchers used IBM's experimental GF11 supercomputer, capable of performing the world's fastest scientific calculations, to compute how galaxies evolve (135: 24).

- World computer chess champion Deep Thought lost both games in a match against world champion Gary Kasparov (136: 276).

- A National Academy of Sciences report recommended a major overhaul of the way mathematics is taught in U.S. schools (135: 70).

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Paleobiology

- The discovery of extraterrestrial amino acids (135: 356) and the rare mineral stishovite (135: 132) in rocks from the Cretaceous-Tertiary Boundary provided further evidence that a large body collided with Earth 65 million years ago, causing

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Food Science

- Dietary supplements of two antioxidant vitamins — C and E — helped prevent cataract formation in a study of elderly Canadians (135: 308). Other researchers demonstrated that cells can recycle vitamin E, suggesting one reason why the body needs only small doses of this fat-soluble compound to fend off damaging oxidation reactions (135: 327). A third study identified the water-soluble vitamin C as the premier antioxidant in blood (136: 133).

- Cheeses and other dairy products inhibited the formation of several cancers in laboratory animals. Researchers attributed the effect to the reconfigured polyunsaturated fat contained in these products (135: 87).

the mass extinctions that occurred around that time. Complicating scientists' attempts to sort out the dramatic events that led to the extinctions, biologists reported that microorganisms may have tampered with the principal pieces of evidence from the boundary layer (136: 341).

- Paleontologists studying the fossils of the gargantuan dinosaur *Supersaurus* discovered unexpected hollow spaces in portions of its bones (135: 261). An extensive group of footprint tracks found in Virginia offered insights into the behavior of some of the first dinosaurs (136: 21). One researcher raised the controversial theory that ceratopsian dinosaurs used their horns less for combat and more for protecting their huge, radiator-like frill from accidental injury (136: 309).



- A puzzling bacterium living in Dutch ponds took center stage in the debate over how higher plants first acquired the ability to harvest energy from the sun (135: 71).

- Studies of ancient injuries suggested huge marine lizards from the dinosaur era were territorial animals that locked their snouts in combat (136: 318). Researchers debated the dietary habits of a strong-jawed, 7-foot-tall, flightless bird from 50 million years ago (136: 332).

- Two researchers suggested that the first microbes to colonize the continents paved the way for the evolution of more complex life by cooling the planet's surface (136: 376).

who pioneered some of these methods won the physics Nobel (136: 262). One such experiment demonstrated that making frequent measurements of the state of a quantum system inhibits transitions from one state to another (136: 292), and another high-precision experiment set stringent limits on nonlinear corrections to quantum mechanics (136: 181).

- Experiments demonstrated that certain high-temperature superconductors show significant resistance to the flow of electrical current in the presence of even small magnetic fields (135: 197). The discovery of ceramic superconductors in which electrons rather than "holes" carry the superconducting current provided important clues about how high-temperature superconductors work (135: 143, 207, 367).

- A number of experiments raised serious questions about how the proton is put together (135: 215).

- Congress approved funding for the start of construction of the Superconducting Super Collider (135: 303; 136: 199).

- A team of physicists demonstrated the postulated Aharonov-Casher quantum effect (136: 363).

- Several research teams prepared samples of quasicrystalline materials perfect enough to yield extremely sharp X-ray images (135: 149).

- Physicists proposed a number of novel schemes for sifting out, detecting or creating "strange" matter (135: 138).

- Researchers applied the concept of fractal time to the study of a phenomenon known as stretched exponential relaxation (135: 157) and suggested the concept of self-organized criticality as an explanation for phenomena that seem to have a fractal nature (136: 40).

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Science & Society

- The United States and the 12-nation European Community announced plans to halt all production and use of chlorofluorocarbons by the end of the century (135: 148). Three months later, another 68 nations joined them in backing a global phaseout of these ozone-destroying chemicals by 2000 (135: 367).

- EPA reported that "reasonable" policy options could go a long way toward reducing the threat of global warming (135: 183). In order to limit global warming to acceptable levels, a Dutch-sponsored study concluded, those options should

encourage industrial nations to halve their carbon dioxide releases from fossil-fuel combustion within 25 years (136: 359). By the end of the year, several U.S. states and foreign governments had announced plans to take the first steps toward such carbon limits (136: 394).

- Leaders from 105 nations drafted an international treaty to control exports of hazardous wastes (135: 197).

- In an unprecedented action, the National Academy of Sciences offered the President-elect a list of recommendations from leading researchers concerning space, AIDS, global environmental change and the role of the presidential science adviser (135: 23). Three months later, George Bush selected nuclear physicist D. Allan Bromley as his science adviser (135: 263).

- U.S. and Soviet leaders signed a unique five-year agreement to encourage cooperation in basic research, allowing scientists from the two nations to initiate joint studies (135: 62).

- George Bush introduced a bill to revise the Clean Air Act, ending an eight-year stalemate between Congress and the Office of the President over the need to strengthen air pollution regulations (135: 375).

- The National Institutes of Health cleared Nobel laureate David Baltimore and his colleagues of charges of science fraud (135: 85) but later reopened its investigation when a congressional inquiry found evidence of altered laboratory notebooks (135: 278, 294).

- New studies indicated that the cost of cleaning up the Energy Department's defense facilities may run \$80 billion (135: 60).

- Three U.S. environmental groups and a multilateral development bank created "environmental bonds" as a financial incentive to promote conservation programs in Africa (135: 62).

- The Energy Department again postponed opening the first U.S. underground nuclear-waste repository (136: 47).

- EPA released its first national inventory of toxic releases, which showed that chemical companies in 1987 not only represented the leading source of toxic air pollutants but also released 10 times as many tons of these chemicals as reported in 1985 (135: 204).

- In June, the National Academy of Sciences suspended collaborative programs with the Chinese government in protest against that nation's attacks on student demonstrators (135: 383).

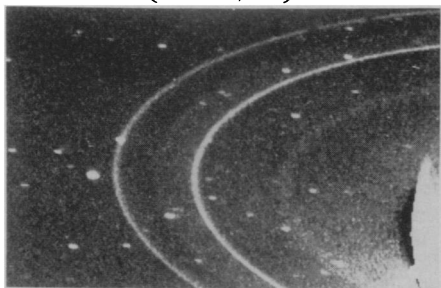
Physics

- Z^0 particles were produced, first at the Stanford Linear Collider, then at the Large Electron-Positron collider at CERN (135: 245; 136: 159). Researchers collected enough data to establish the particle's mass (136: 69) and to limit to three the number of families of fundamental particles (136: 260).

- Novel laser techniques permitted the measurement of important physical quantities to unprecedented precision (135: 38; 136: 103, 117), and researchers

Space Sciences

- Voyager 2 flew past Neptune, sending back a wealth of data that enabled scientists to observe the strangely varied density of one of the planet's rings, raise the number of its known satellites from two to eight, and discover geyser-like plumes rising from the surface of its big moon Triton (136: 148, 247).



- The sun produced one of the most active regions yet recorded as it approached the height of its 11-year cycle, setting records for flares, X-ray emissions, geomagnetic storms and more (135: 212). The high activity levels also raised the height of Earth's atmosphere enough to cause the Solar Maximum Mission satellite to reenter it earlier than expected, wrapping up a 10-year career that yielded about 250,000 photos of the sun, identified more than 12,500 solar flares, provided the first evidence to support the idea that only supernovas are suitable sites for the formation of elements heavier than iron, and discovered 10 "sun-grazing" comets (136: 357).

- The United States launched its first two interplanetary spacecraft in 11 years, the Venus-bound Magellan radar-mapper (135: 292) and the Galileo project to visit Jupiter (136: 325).

- The second of two Soviet spacecraft sent toward the Martian moon Phobos provided some early data (136: 286) but failed before it could deploy a landing craft to the moon's surface (135: 245). Scientists continued to wonder what caused the strange grooves on Phobos' surface, suggesting they might be strings of pits formed when surface material slid into surface cracks (136: 301) or the result of low-angle impacts by material orbiting Mars (136: 334).

- A research team concluded that life on Mars is not required to explain suggestive data from the Viking spacecraft that landed there in 1976 (135: 266). Other researchers continued to differ about whether Mars was once a warmer, wetter place than it is today (135: 21, 173, 351). Organic material was identified on a meteorite that may have come from Mars (136: 53).

- Radar studies of Saturn's moon Titan indicated it is not covered by a global ocean. The data did not rule out smaller seas in some areas of this atmosphere-shrouded moon, but they left Earth the only body in the solar system known to have liquid on its surface (136: 5).

- Astronomers finally found a tentative answer to the question of whether Chiron, an object discovered in 1977 between the orbits of Saturn and Uranus, was just a rocky asteroid or a comet too cold to be giving off a fuzzy coma. New observations showed Chiron to have a diffuse, possibly comet-like appearance, which researchers interpreted as sunlight reflected from an extended dust atmosphere (135: 247).

- Pluto's passage in front of a star provided the first good evidence that the planet's atmosphere contains a second gas — probably carbon dioxide — in addition to the previously detected methane (135: 326).

- Radar observations of a newly discovered asteroid revealed a double-lobed shape, perhaps representing two initially separate chunks that came together so slowly that neither of them shattered (136: 343).

- Spectral measurements strengthened the possibility that so-called C-type asteroids may be related to a class of meteorites called carbonaceous chondrites, suggesting that samples of such meteorites may be the first asteroid pieces found on Earth (136: 334).

- Some researchers concluded that Mercury's thin atmosphere of sodium and potassium may have formed from material that diffused up through fractures in the planet's crust rather than from meteorite impacts, judging from spectral measurements showing that more of these elements seemed to be present when a huge surface feature called Caloris Basin was in view (136: 311).

- Scientists reported that an Apollo moonrock seemed to have formed in an otherwise unsampled deep layer of the lunar crust nearly 50 kilometers below the surface and from which it probably was later disgorged by a large meteorite impact (135: 126). In addition, a 663-gram rock found in Antarctica turned out to be the largest lunar meteorite yet identified on Earth (136: 62).

- Eight chicken eggs fertilized two days before a five-day orbital trip aboard the space shuttle Discovery afterwards failed to hatch, while eight eggs fertilized nine days before the same trip hatched and developed normally, leaving researchers initially baffled about the reason for the difference and wondering what it might

- imply for future human spacefarers such as those living aboard a space station (135: 213).

- In other tests conducted during shuttle missions, the first crystals grown in that micro-gravity environment in an aqueous solution were purer and more symmetrical than ones from corresponding experiments on Earth (136: 206). Related studies produced larger, more uniform examples of three different kinds of protein crystals in orbit than did such tests on the ground (136: 349).

Technology

- Scanning tunneling microscopes (STMs) produced images of naked DNA (135: 53) and of many organic and inorganic molecules and surfaces (135: 200). Scientists made preliminary attempts to sequence DNA with an STM (136: 351) and created the first molecular-resolution "movie" of a biological process using multiple STM scans (135: 180). The scanning ion-conductance microscope, a closely related instrument, monitored charged particles flowing through tiny pores in membranes (135: 84).

- Following theoretical hints that diffraction-free radiation is possible, physicists constructed an acoustic source whose emissions remain localized (135: 38).

- Physicists used photons to optically bond particles — a process analogous to the chemical bonding mediated by electrons (136: 212).

- Genetic engineers altered tobacco plants to produce large amounts of antibodies (136: 334) and anticancer drugs (135: 238).

- Physicists slammed fast-moving clusters of heavy water molecules into deuterium-containing targets to achieve hot fusion (136: 196).

- Micromechanics added new items, including rotors and tweezers, to the inventory of supertiny moving parts made of silicon and other materials (136: 8).

- Solid-state physicists etched millions of gallium-arsenide-based lasers onto a dime-sized chip (136: 68).

- A gathering of nanotechnology researchers predicted that scientists will one day achieve thorough control over the structure of matter down to the level of individual atoms and molecules (136: 295).